DIGITAL COMMUNICATIONS ISSUE

QST

DEVOTED ENTIRELY TO AMATEUR RADIO

May 2013 WWW.ARRL.ORG

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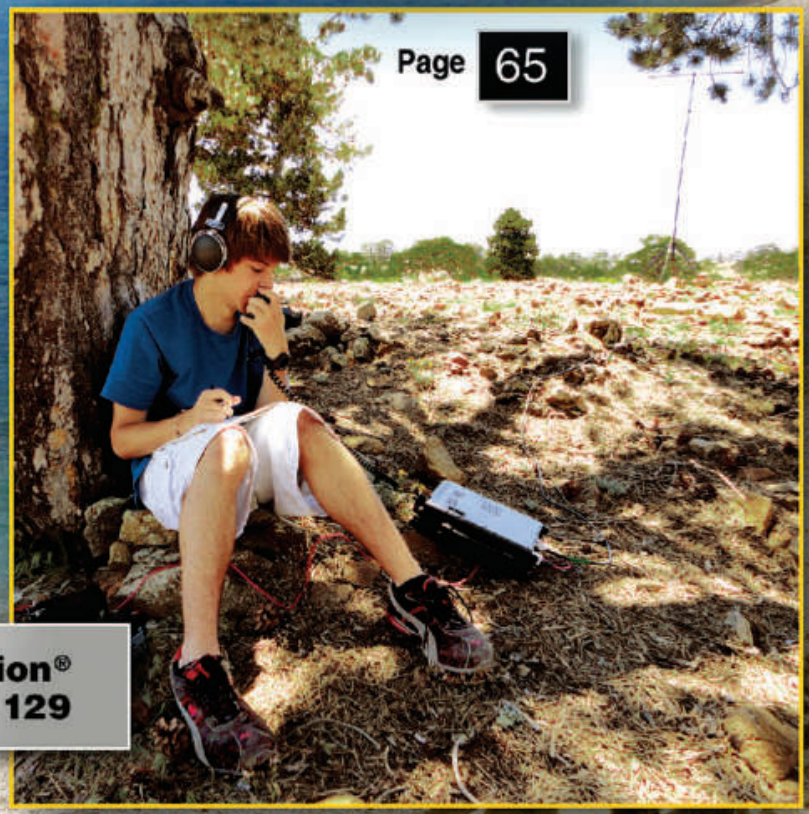
QST reviews:

Inside:



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The national association for AMATEUR RADIO

The radio...YAESU

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FT DX 3000

New Crystal Roofing Filters provide ultimate weak signal receiver performance in crowded, strong signal environments

The amazing Crystal Roofing Filter performance

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Outstanding receiver performance, the heritage of the FT DX 5000!

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AF SCOPE display and RTTY/PSK encoder/decoder

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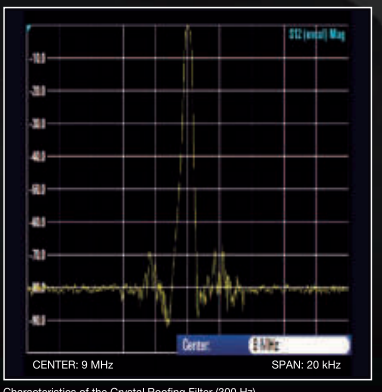
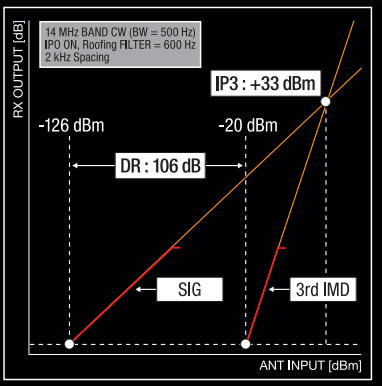
The specialized Receiver amplifier for 50 MHz is built in / Three antenna connectors are provided / The “ANT-3” terminal may be assigned to “RX-only” / Signal output for an external receiver and the 9 MHz IF output are furnished / High speed Automatic antenna tuner built in / Optional μ-tune unit available / USB interface equipped



Characteristics of the Crystal Roofing Filter (300 Hz)



3rd Order Dynamic Range / IP3 (2kHz Spaceing)

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Introducing the Yaesu FT-950 transceiver for DX enthusiasts
Superb receiver performance
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- Triple-conversion super-heterodyne receiver architecture, using 69.450 MHz 1st IF
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- Original YAESU IF DSP advanced design, provides comfortable and effective reception. IF SHIFT / IF WIDTH / CONTOUR / NOTCH / DNR
- DSP enhancement of Transmit SSB/AM signal quality with Parametric Microphone Equalizer and Speech Processor
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- Built-in automatic antenna tuner ATU, with 100 memories
- Powerful CW operating capabilities for CW enthusiasts
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- Optional Data Management Unit (DMU-2000) permits display of various operating conditions, transceiver status and station logging.
- Optional RF μ -Tune Units for 160 m, 80/40 m and 30/20 m Bands

COMPACT HF/50 MHz TRANSCEIVER WITH IF DSP

Compact size : 9" X 3.3" x 8.5" and Light weight : 7.9 lb

A superb, compact HF/50 MHz radio with state-of-the-art IF DSP technology configured to provide YAESU World-Class Performance in an easy to operate package.
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Cushcraft

R9

80-6 Meters!

No Radials!

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 and 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.

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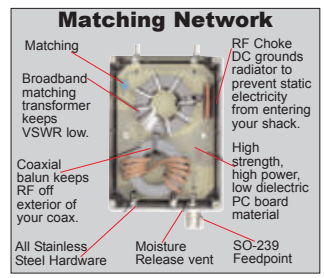
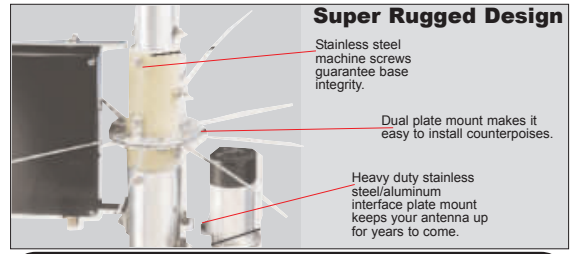
31.5 feet tall, 25 lbs. Mounting mast 1.25 to 2 inches. Wind surface area is 4 square feet.

R8, $539.95. Like R9 antenna but less 75/80 Meters.

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

R-8GK, $56.95. Three-point guy kit for high winds.





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Length: Approx 13 ft (assembled horizontally)

Weight: 5 lbs 14ozs (inc mounting plate and balun)

Max Power: 40/20M: 150W SSB 15/10/6M: 220W

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Our mission: To promote and advance the art, science and enjoyment of Amateur Radio.

In This Issue

May 2013 Volume 97 Number 5

Technical

News and Features

Our Cover
Last summer, 15-year-old Padraig Lysandrou, KC9UUS, led his ham family to Cyprus for the DXpedition adventure of a lifetime, where they enjoyed beaches, battled bugs and, of course, made contacts and new friends. First licensed in October 2011, Padraig's involvement with Amateur Radio is off to a brilliant start. Read about his Cyprus DXpedition starting on page 65. Cover photo by Padraig Lysandrou, KC9UUS. Inset photo by Plato Lysandrou, KC9VIL.

Radiosport


Page 84


Page 94


Page 86

Columns

Departments

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2 m MONO BAND

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Actual Size

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Bluetooth® for hands-free Operation with optional accessories
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Attached to the radio (microphone input) using the optional GPS Antenna Adapter CT-136

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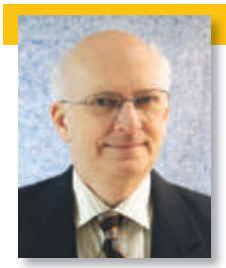


David Sumner, K1ZZ – dsumner@arrl.org
ARRL Chief Executive Officer

Restrictive Covenants: The Next Step

"The FCC report to Congress on impediments to enhanced Amateur Radio disaster and emergency communications was not everything we had hoped for, but it has laid the groundwork for us to make our own case on Capitol Hill for relief from restrictive covenants."

Last August this page was devoted to a recap of the ARRL's persistent efforts to persuade the FCC that the federal interest in Amateur Radio stations having effective antennas is as great in residential areas that are subject to restrictive covenants as in areas that are subject only to state and local land use regulation. In 1985 the Commission declared a policy of limited preemption of state and local regulation that requires reasonable accommodation of amateur station antenna structures. However, it declined to extend that policy to private land use restrictions (covenants, conditions and restrictions, or CC&Rs). Since that time such restrictions have become almost ubiquitous in new residential construction.

Early last year we achieved a breakthrough in the form of a provision in Public Law 112-96 that required the FCC to study and report to Congress on the uses and capabilities of Amateur Radio communications in emergencies and disaster relief. Congress directed that the report identify impediments to such communications and make recommendations regarding their removal and specifically mentioned "the effects of unreasonable or unnecessary private land use restrictions on residential antenna installations." In April 2012 the FCC opened a docket to collect public input and in August released a 15-page report with its summary and analysis of the responses.

The FCC's report amply documents the capabilities and value of the Amateur Radio community in emergency response situations. It identifies several ways in which the Department of Homeland Security, state, local and tribal emergency management authorities, and Amateur Radio emergency communications organizations might be able to enhance this value through mutual cooperation. It notes that some of the Commission's own rules might represent unnecessary impediments, but that these can be addressed through the normal rulemaking process without Congressional action. The report concludes:

> The amateur radio community and the emergency response and disaster communications communities all agree that amateur radio can be of great value in emergency response situations. Amateur radio carries with it a wide range of advantages that allow it to supplement other emergency communications activities during disasters. This has been demonstrated time and again in a wide variety of emergency and disaster situations. Amateur radio emergency communications require not only stations in a position to originate the emergency message, but also an alternative to the commercial communications infrastructure impacted by the emergency. This alternative infrastructure is the network of amateur radio operators and their stations that relay messages, build and maintain repeater stations and repeater networks, operate HF message networks to send messages greater distances than are practical with mobile or transportable transmitters, and develop new technologies to improve the reliability of these networks.

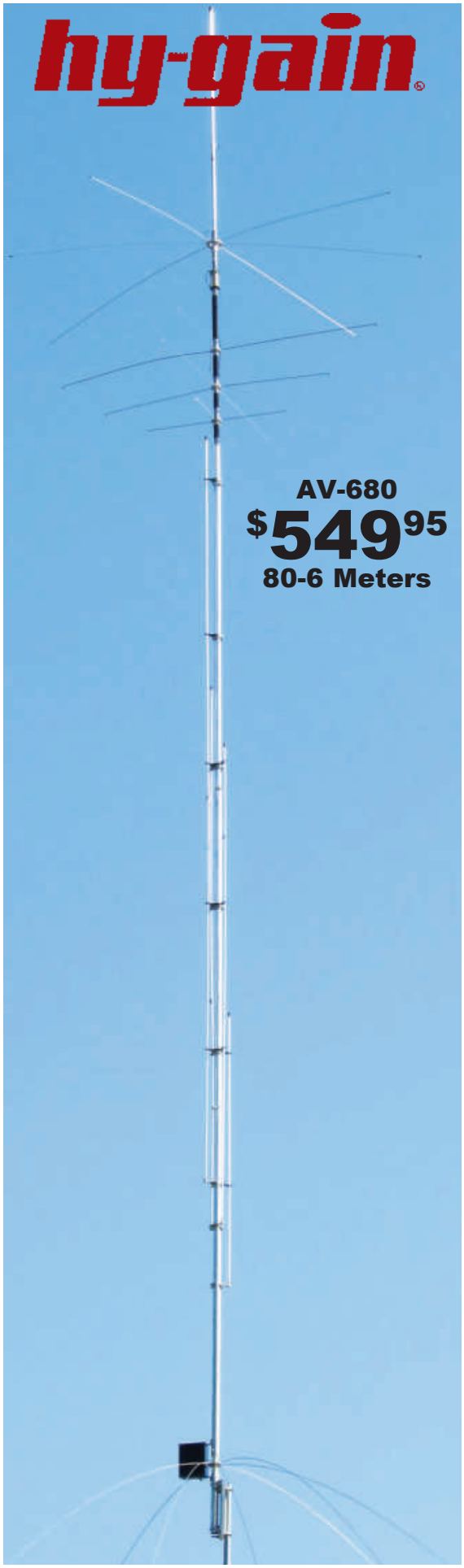
However, the report was disappointing in one major respect: In a single sentence it dismissed the evidence presented by the ARRL and others that clearly demonstrated restrictive covenants are a growing problem, leaving amateurs in large and growing areas of the country with no practical choice but to live under arbitrary, nonnegotiable restrictions on their antenna installations. Without citing any contrary evidence the Commission simply concluded, "…while commenters suggest that private land use restrictions have become more common, our review of the record does not indicate that amateur operators are unable to find homes that are not subject to such restrictions." With that, the Commission decided not to revisit its earlier decisions to not preempt CC&Rs.

While it would have been nice had the FCC reviewed the evidence and decided to act on its own initiative, we really didn't expect that to happen. As far back as 2001 the Commission signaled its desire to avoid making the decision by saying, "…should Congress see fit to enact a statutory directive mandating the expansion of our reasonable accommodation policy, the Commission would expeditiously act to fulfill its obligation thereunder." In the ensuing decade the ARRL repeatedly sought such an instruction from Congress. Bills were introduced in the 107th, 108th and 109th Congresses but failed to gain any traction. In 2008 the ARRL decided to tackle the issue in two steps, the first being to ask Congress simply to mandate a study of the issue. Such a bill made it through the Senate the following year but died without action in the House. Finally, early in 2012 our study bill made it into a larger and essential piece of legislation and was signed into law.

So, step one is completed. While the FCC's brief report to Congress concludes there is no compelling reason for the Commission to take matters into its own hands, it reiterates that it will "expeditiously act" to fulfill a Congressional directive. The evidence to support such a directive is now part of the public record in the form of the ARRL's 128-page filing and those of others. We now move to step two.

By the time this issue of *QST* reaches members an ARRL team will have begun the process of visiting key players on Capitol Hill. A briefing paper has been prepared that lays out the problem and argues, we hope persuasively, that Congressional action is both necessary and appropriate. One point in our favor is that Congress has already declared by Joint Resolution (Public Law 103-408) that "reasonable accommodation should be made for the effective operation of amateur radio from residences, private vehicles and public areas."

As our efforts on the Hill move forward we will be asking ARRL members who are constituents of key legislators to contact them and ask for their support. By working together, we can get this done.



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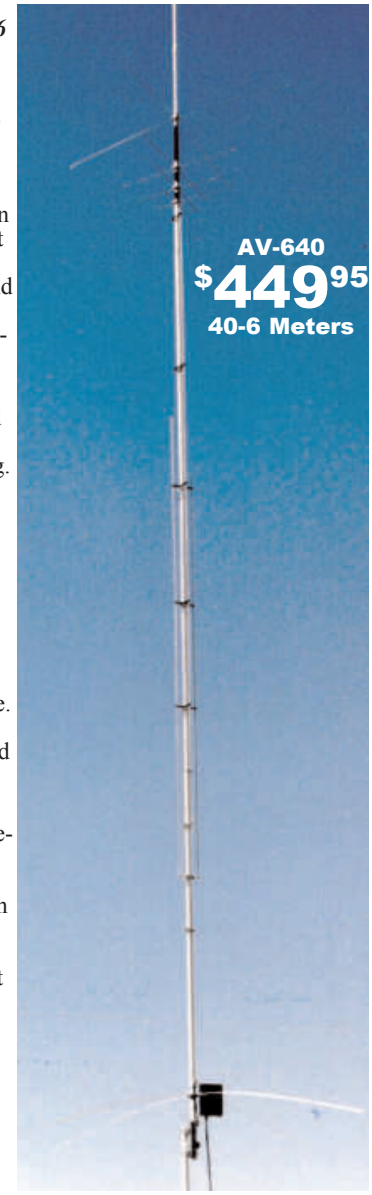

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Harold Kramer, WJ1B – hkramer@arrl.org, ARRL Chief Operating Officer/*QST* Publisher

Frequently Asked Questions

This February I had the pleasure of representing the ARRL at HamCation, the well organized and educational ARRL Southeastern Division Convention in Orlando, Florida. Standing in the ARRL booth, I spoke with hundreds of our members who had questions about the ARRL and Amateur Radio in general.

In this month's column I've gathered some of the most common questions I've encountered. I also consulted with some of my colleagues here at HQ and incorporated what they believe are the most frequently asked questions. Like most FAQs (Frequently Asked Questions), I've organized this one by area of interest.

■ **Licensing** questions are asked at any hamfest. Here are the most common ones. (Questions on this topic can also be addressed to **vec@arrl.org**.)

1. How far in advance of the expiration date can I renew my license?

You can renew your license 90 days before its 10 year expiration date, or any time during the two year grace period after expiration. You cannot operate once your license expires, however.

2. If the two year grace period has passed, can I still renew my license?

No, you will need to take the license exams again.

3. Will the ARRL remind me about my license renewal?

Yes, we will send you a notice in the mail about 120 days before your license expires. Although you can return the renewal form right away, we cannot process your renewal with the FCC until the 90 day point. More information at: **www.arrl.org/call-sign-renewals-or-changes**.

4. You mean the ARRL will renew my license for me?

Yes, and unless you have a vanity call sign, we'll do it free of charge as long as you are an ARRL member. If you have a vanity call sign, we charge a processing fee of $5 for members and $15 for non-members. In addition, the FCC charges a regulatory fee of $15 for vanity license renewals.

5. I'd like to have a vanity call sign. Will you file the application for me?

Sorry, you have to file that one yourself, but we can certainly help. There are two ways to apply for a vanity call sign. The FCC accepts the required forms by mail, or you can apply online using the FCC's website, **www.fcc.gov/uls**. The instructions and specific information are located here: **www.arrl.org/applying-for-a-vanity-call**. Our VEC department is available to help you with other special call signs such as Special Event and club calls.

■ **Membership registration** questions are common, too. For example…

1. How do I register on the website?

Go to the ARRL home page at **www.arrl.org** and select the "Register" link under the "Site Login" area at the top of the page. We recommend that you use your call sign as your Username. Registering on the website allows you to view digital *QST*, access the *QST* archive and take advantage of many other benefits that are only available to members.

2. How do I reset my password?

To reset your ARRL website password, select the "Forgot Password?" link at the Site Login and follow the instructions.

3. How do I reset my Username?

For security reasons, Username reset is not available online. Members need to call us if they cannot remember their Username. More information on Username and passwords is available at **www.arrl.org/member-support**.

4. Where can I access the digital edition of *QST*?

The digital edition of *QST* can be found on the *QST* page on our website, **www.arrl.org/qst**. You must be logged in to view the issues. You can also sign up to have us send you an e-mail notice whenever new editions are available, which usually happens around the 15th of the month. See **www.arrl.org/digital-qst-faq**.

5. How do I change my mailing address with the ARRL?

Just send an e-mail to **coa@arrl.org**, or call Member Services at 888-277-5289.

For other questions about membership, you can call us at 860-594-0200, or toll-free at 888-277-5289, or e-mail us at **membership@arrl.org**.

■ **Clubs and exam sessions** is the final topic in this FAQ.

1. How do I find a license exam session, club or a licensing class in my area?

The easiest way is to use the search pages on our website.

For licensing exams go to: **www.arrl.org/find-an-amateur-radio-license-exam-session**.

To find an ARRL affiliated club: **www.arrl.org/find-a-club**.

To locate a licensing class go to: **www.arrl.org/find-an-amateur-radio-license-class**.

Of course, if you do not have Internet access, just call Headquarters at 860-594-0200 and we'll put you in touch with someone who has the answer.

Next month, I'll be reviewing frequently asked questions about our award programs, such as the DX Century Club. In the meantime, let me know if you have any particular questions that you would like me to answer.

Bill Tynan, W3XO, Receives the Barry Goldwater Award

At the Radio Club of America banquet in New York City on November 16, 2012, Bill Tynan, W3XO, was presented with the Barry Goldwater Award for his service in expanding the public's interest in Amateur Radio. Tim Duffy, K3LR, presented the award. Bill has been a radio amateur for more than 60 years and was one of the founding members of the Radio Amateur Satellite Corporation, or AMSAT. He represented AMSAT on the Shuttle Amateur Radio Experiment committee.

Bill was also conductor of *QST*'s "The World Above 50 MHz" column from April 1975 through November 1992.

Tim Duffy, K3LR (left) presents the Barry Goldwater award to Bill Tynan, W3XO.

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Your ARRL membership includes ***QST*** magazine, plus dozens of other services and resources to help you **Get Started**, **Get Involved** and **Get On the Air**. ARRL members enjoy Amateur Radio to the fullest!

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- ***QST* Archive and Periodicals Search – www.arrl.org/qst**
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- **Product Review Archive – www.arrl.org/qst**
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- **E-Mail Forwarding Service**
  E-mail sent to your **arrl.net** address will be forwarded to any e-mail account you specify.
- **Customized ARRL.org home page**
  Customize your home page to see local ham radio events, clubs and news.
- **ARRL Member Directory**
  Connect with other ARRL members via a searchable online Member Directory. Share profiles, photos and more with members who have similar interests.

ARRL Technical Information Service — www.arrl.org/tis

Get answers on a variety of technical and operating topics through ARRL's Technical Information Service. ARRL Lab experts and technical volunteers can help you overcome hurdles and answer all your questions.

ARRL as an Advocate — www.arrl.org/regulatory-advocacy

ARRL supports legislation and regulatory measures that preserve and protect access to Amateur Radio Service frequencies. Members may contact the **ARRL Regulatory Information Branch** for information on FCC rules; problems with antenna, tower and zoning restrictions; and reciprocal licensing procedures for international travelers.

ARRL Group Benefit Programs* — www.arrl.org/benefits

- **ARRL "Special Risk" Ham Radio Equipment Insurance Plan**
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- **The ARRL Visa Signature® Card**
  Every purchase supports ARRL programs and services.
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  ARRL members may qualify for up to a 10% discount on home or auto insurance.

* ARRL Group Benefit Programs are offered by third parties through contractual arrangements with ARRL. The programs and coverage are available in the US only. Other restrictions may apply.

Programs

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Community

Radio Clubs (ARRL-affiliated clubs) – **www.arrl.org/clubs**
Hamfests and Conventions – **www.arrl.org/hamfests**
ARRL Field Organization – **www.arrl.org/field-organization**

Licensing, Education and Training

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Find a Licensing Class – **www.arrl.org/find-an-amateur-radio-license-class**
ARRL Continuing Education Program – **www.arrl.org/courses-training**
Books, Software and Operating Resources – **www.arrl.org/shop**

Quick Links and Resources

QST – ARRL members' journal – **www.arrl.org/qst**
QEX – *A Forum for Communications Experimenters* – **www.arrl.org/qex**
NCJ – *National Contest Journal* – **www.arrl.org/ncj**
Support for Instructors – **www.arrl.org/instructors**
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ARRL Volunteer Examiner Coordinator (ARRL VEC) – **www.arrl.org/vec**
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The American Radio Relay League, Inc. is a noncommercial association of radio amateurs, organized for the promotion of interest in Amateur Radio communication and experimentation, for the establishment of networks to provide communication in the event of disasters or other emergencies, for the advancement of the radio art and of the public welfare, for the representation of the radio amateur in legislative matters, and for the maintenance of fraternalism and a high standard of conduct.

ARRL is an incorporated association without capital stock chartered under the laws of the State of Connecticut, and is an exempt organization under Section 501(c)(3) of the Internal Revenue Code of 1986. Its affairs are governed by a Board of Directors, whose voting members are elected every three years by the general membership. The officers are elected or appointed by the directors. The League is noncommercial, and no one with a pervasive and continuing conflict of interest is eligible for membership on its Board.

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

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

Membership inquiries and general correspondence should be addressed to the administrative headquarters: ARRL, 225 Main Street, Newington, Connecticut 06111-1494.

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570 Brush Mountain Rd
Blacksburg, VA 24060
540-552-3903; **n3kn@arrl.org**

First Vice President
RICK RODERICK, K5UR*
PO Box 1463, Little Rock, AR 72203
501-988-2527; **k5ur@arrl.org**

Second Vice President
BRUCE FRAHM, KØBJ
1553 County Rd T, Colby, KS 67701
785-462-7388; **k0bj@arrl.org**

International Affairs Vice President
JAY BELLOWS, KØQB
1925 Bidwell St,
West St Paul, MN 55118
651-238-4444; **k0qb@arrl.org**

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Atlantic Division

Bill Edgar, N3LLR
22 Jackson Ave, Bradford, PA 16701
(814-362-1250); **n3llr@arrl.org**

Vice Director: **Tom Abernethy, W3TOM**
PO Box 73, Accokeek, MD 20607
(301-272-0629); **w3tom@arrl.org**

Central Division

George R. Isely, W9GIG*
736 Fellows St, St Charles, IL 60174
(630-584-3510); **w9gig@arrl.org**

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

Dakota Division

Gregory P. Widin, KØGW
13457 Sixth St N, Stillwater, MN 55082
(651-436-8811); **k0gw@arrl.org**

Vice Director: **Kent R. Olson, KAØLDG**
148 Ironwood Dr, Horace, ND 58047;
(701-298-0956); **ka0ldg@arrl.org**

Delta Division

David A. Norris, K5UZ
3040 Campground Rd, Cabot, AR 72023;
(870-613-1606); **k5uz@arrl.org**

Vice Director: **Glen Clayton, W4BDB**
238 Old Parksville Rd, NE, Cleveland, TN 37323
(423-400-9381); **w4bdb@arrl.org**

Great Lakes Division

Jim Weaver, K8JE
5065 Bethany Rd, Mason, OH 45040-8130
(513-459-1661); **k8je@arrl.org**

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

Hudson Division

Mike Lisenco, N2YBB
1635 East 46 St, Brooklyn, NY 11234
(917-865-3538); **n2ybb@arrl.org**

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

Midwest Division

Cliff Ahrens, KØCA
65 Pioneer Trail, Hannibal, MO 63401
(573-221-8618); **k0ca@arrl.org**

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

How to Find an ARRL HQ Staff Member

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New England Division

Tom Frenaye, K1KI
PO Box J, West Suffield, CT 06093
(860-668-5444); **k1ki@arrl.org**

Vice Director: **Mike Raisbeck, K1TWF**
85 High St, Chelmsford, MA 01824
(978-250-1235); **k1twf@arrl.org**

Northwestern Division

Jim Fenstermaker, K9JF*
10312 NE 161st Ave, Vancouver, WA 98682
(360-256-1716); **k9jf@arrl.org**

Vice Director: **Jim Pace, K7CEX**
PO Box 1602, Centralia, WA 98531
(360-508-8437); **k7cex@arrl.org**

Pacific Division

Bob Vallio, W6RGG*
18655 Sheffield Rd, Castro Valley, CA 94546
(510-537-6704); **w6rgg@arrl.org**

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

Roanoke Division

Dennis Bodson, W4PWF
233 N Columbus St, Arlington, VA 22203
(703-243-3743); **w4pwf@arrl.org**

Vice Director: **Dr James Boehner, N2ZZ**
525 Barnwell Ave NW, Aiken, SC 29801-3939
(803-641-9140); **n2zz@arrl.org**

Rocky Mountain Division

Brian Mileshosky, N5ZGT*
PO Box 20186, Albuquerque, NM 87154-0186
(505-463-9468); **n5zgt@arrl.org**

Vice Director: **Dwayne Allen, WY7FD**
PO Box 1482, Sundance, WY 82729-1482
(307-756-9439); **wy7fd@arrl.org**

Southeastern Division

Greg Sarratt, W4OZK
230 Latigo Loop, Huntsville, AL 35806;
(256-337-3636); **gsarratt@arrl.org**

Vice Director: **Jim Millsap, WB4NWS**
5127 Bramblewood Dr, Acworth, GA 30102
(770-928-8590); **wb4nws@arrl.org**

Southwestern Division

Richard J. Norton, N6AA
21290 West Hillside Dr, Topanga, CA 90290
(310-455-1138); **n6aa@arrl.org**

Vice Director: **Marty Woll, N6VI**
21301 Candice Pl, Chatsworth, CA 91311-1404
(818-773-9655); **n6vi@arrl.org**

West Gulf Division

Dr David Woolweaver, K5RAV*
PO Box 531605, Harlingen, TX 78553
(956-425-3128); **k5rav@arrl.org**

Vice Director: **John Robert Stratton, N5AUS**
PO Box 2232, Austin, TX 78768-2232
(512-282-7851); **n5aus@arrl.org**

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www.arrl.org/sections

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Eastern Pennsylvania: Robert B. Famiglio, K3RF, PO Box 9, Media, PA 19063-0009 (610-359-7300); **k3rf@arrl.org**
Maryland-DC: James E. Cross III, WI3N, 16013 Dorset Rd, Laurel, MD 20707-5314 (301-725-6829); **wi3n@arrl.org**
Northern New York: Thomas Dick, KF2GC, 11 Jenkins St, Saranac Lake, NY 12983 (518-891-0508); **kf2gc@arrl.org**
Southern New Jersey: George Strayline, W2GSS, 10 E Pacific Ave, Villas, NJ 08251-2630 (609-741-8322); **w2gss@arrl.org**
Western New York: John Mueller, K2BT, 2011 E Main St, Falconer, NY 14733 (716-489-7001); **k2bt@arrl.org**
Western Pennsylvania: John Rodgers, N3MSE, 803 S Main St, Butler, PA 16001 (724-287-0424); **n3mse@arrl.org**

Central Division (IL, IN, WI)

Illinois: Tom Ciciora, KA9QPN, 1887 Irene Rd, Sandwich, IL 60548 (815-498-4929); **ka9qpn@arrl.org**
Indiana: Lou Everett Sr, WA5LOU, 11909 Cardis Ct, Cumberland, IN 46229 (317-622-1130); **wa5lou@arrl.org**
Wisconsin: Donald Michalski, W9IXG, 4214 Mohawk Dr, Madison, WI 53711 (608-274-1886); **w9ixg@arrl.org**

Dakota Division (MN, ND, SD)

Minnesota: Richard H. "Skip" Jackson, KSØJ, 1835-63rd St E, Inver Grove Heights, MN 55077 (651-260-4330); **ks0j@arrl.org**
North Dakota: Lynn A. Nelson, WØND, 6940 4th St SW, Minot, ND 58701 (701-839-8200); **w0nd@arrl.org**
South Dakota: Chris Stallkamp, WØADZ, PO Box 271, Selby, SD 57472-0271 (605-870-1784); **w0adz@arrl.org**

Delta Division (AR, LA, MS, TN)

Arkansas: Dale Temple, W5RXU, 5200 Timber Creek Circle, North Little Rock, AR 72116 (501-771-1111); **w5rxu@arrl.org**
Louisiana: James M. Coleman, AI5B, 1530 Military Rd, Bogalusa, LA 70427-2901 (985-516-2632); **ai5b@arrl.org**
Mississippi: Malcolm Keown, W5XX, 64 Lake Circle Dr, Vicksburg, MS 39180 (601-636-0827); **w5xx@arrl.org**
Tennessee: Keith E. Miller Sr, N9DGK, 1635 Jarratt Dr, Rockvale, TN 37135 (615-631-9952); **n9dgk@arrl.org**

Great Lakes Division (KY, MI, OH)

Kentucky: Jim Brooks, KY4Z, 7099 Louisville Rd, Cox's Creek, KY 40013 (502-349-2099); **ky4z@arrl.org**
Michigan: Larry Camp, WB8R, 71 Oakdale Lane, Coldwater, MI 49036 (517-278-0406); **wb8r@arrl.org**
Ohio: Frank J. Piper, KI8GW, 496 Hillview St, Pickerington, OH 43147-1197 (614-589-4641); **ki8gw@arrl.org**

Hudson Division (ENY, NLI, NNJ)

Eastern New York: Pete Cecere, N2YJZ, 329 W Saugerties Rd, Woodstock, NY 12498 (845-246-4359); **n2yjz@arrl.org**
NYC-Long Island: Jim Mezey, W2KFV, 38 Appletree Ln, Carle Place, NY 11514-1336 (516-315-8608); **w2kfv@arrl.org**
Northern New Jersey: Richard Krohn, N2SMV, 23 Sweetmans Ln, Manalapan, NJ 07726; **n2smv@arrl.org**

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Iowa: Robert McCaffrey, KØCY, 1210 Noble Hills Pl, Boone, IA 50036 (515-432-2512); **k0cy@arrl.org**
Kansas: Ronald D. Cowan, KBØDTI, PO Box 36, LaCygne, KS 66040 (913-757-3758); **kb0dti@arrl.org**
Missouri: Dale C. Bagley, KØKY, PO Box 13, Macon, MO 63552-1822 (660-385-3629); **k0ky@arrl.org**
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New England Division (CT, EMA, ME, NH, RI, VT, WMA)

Connecticut: Betsey Doane, K1EIC, 92 Mohegan Rd, Shelton, CT 06484-2448 (203-929-7759); **k1eic@arrl.org**
Eastern Massachusetts: Phil Temples, K9HI, 125 Coolidge Ave, Apt 803, Watertown, MA 02472-2875 (617-331-0183); **k9hi@arrl.org**);
Maine: William Woodhead, N1KAT, 68 Madison St, Auburn, ME 04210 (207-782-4862); **n1kat@arrl.org**
New Hampshire: Alan K. Shuman, K1AKS, PO Box 681, New Boston, NH 03070-3520 (603-487-3333); **k1aks@arrl.org**
Rhode Island: Bob Beaudet, W1YRC, 30 Rocky Crest Rd, Cumberland, RI 02864 (401-333-2129); **w1yrc@arrl.org**
Vermont: Paul N. Gayet, AA1SU, 11 Cherry St, Essex Junction, VT 05452 (802-878-2215); **aa1su@arrl.org**
Western Massachusetts: Ed Emco, W1KT, 37 Bullard Ave, Worcester, MA 01605 (508-853-3333); **w1kt@arrl.org**

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

Alaska: Jim Larsen, AL7FS, 3445 Spinnaker Dr, Anchorage, AK 99516-3424 (907-345-3190); **al7fs@arrl.org**
Eastern Washington: Mark Tharp, KB7HDX, PO Box 2222, Yakima, WA 98907-2222 (509-965-3379); **kb7hdx@arrl.org**
Idaho: Edward Stuckey, AI7H, 2300 W Polo Green Ave, Post Falls, ID 83854-9680 (208-457-0354); **ai7h@arrl.org**
Montana: George Forsyth, AA7GS, 212 Skyline Dr NE, Great Falls, MT 59404 (406-868-2212); **aa7gs@arrl.org**
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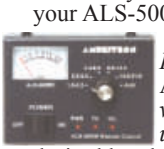

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SDC-102
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Suggested Retail

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Monitor motor current on LEDs for signs of trouble and to determine stall current.

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Compatible with single and dual magnetic turns sensors. Requires 12 VDC.

3½Wx3¼Hx1¼D inches.

SRS-100, $29.95. Magnetic sensor kit for High Sierra antennas to use SDC-102.

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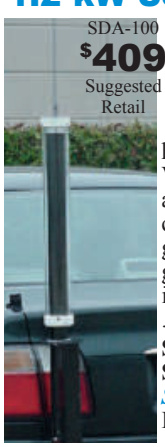
1.2 kW Screwdriver Antenna



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Steve Ford, WB8IMY, upfront@arrl.org

Amateur Radio in a Classic Corvette

By Dr Harvey Hutchison, NKØS
nk0s@arrl.net

I enjoyed cruising in my vintage 1981 Corvette, but I missed being able to chat with friends on the local 2 meter and 70 centimeter repeaters. Normally it's sacrilege to even consider modifying a Corvette to accommodate Amateur Radio or anything else not original to the car. However, since I had partially disassembled my Corvette for repainting I decided it would be the perfect time to carefully install a VHF/UHF transceiver.

I started by visiting the Raleigh, North Carolina RARS Fest where I netted a good buy on a Kenwood TM-700A transceiver with extender cables and an external speaker. I mounted the radio in the Corvette's package tray using four threaded inserts in the tray bottom. The package tray has two "finger holes" on each end that provide an opportunity to run the cables to the radio with no further modification of the tray.

The main body of the radio found a home in the Corvette's package tray.

The jack storage compartment is adjacent to the battery location, which allows a short run for the power cable. I had decided to use a flexible mount on the right side of the center console for the TM-700's control head and microphone. The extender cables for these components were run though the center console and an existing opening at the back of the console to the jack storage compartment.

I installed external speakers behind each door's kick panel. Wires from the external speakers were run under the door sills and through the existing opening at the back of the center console alongside the extender cables. The GPS unit (for APRS) was mounted on the hump between the jack and battery compartments just aft of the cockpit rear bulkhead.

A close-up view of the antenna mount where it attaches to the frame.

Here is one of the transceiver's external speakers being installed behind a kick panel.

The jack storage compartment had a drain hole with a rubber nipple that had an inside diameter just large enough to accommodate RG-8 Mini coaxial cable. From there the coax was routed behind the rear axle swing arm and through the frame from the wheel well to the rear of the car.

Underneath the rear of the car I found an unused hole in the frame cross member. Looking closer, I realized the hole would be the perfect attachment point for an antenna mount. Using a strip of cold-rolled steel, I fabricated a mount that could be easily removed if desired.

Now with warm weather finally arriving, it is time to do some mobile VHF/UHFing and beach cruising. Look for me on Google APRS maps (NKØS-8), or at a car show in the Carolinas!

A flexible mount near the center console holds the TM-700 control head. The microphone is nearby.

My newly repainted Corvette, with a stylish dual-band antenna at the rear.

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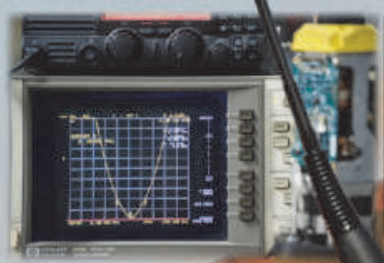

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Letters from Our Members

LED by the Light

After reading about low voltage halogen lamps ["Technical Correspondence: Noise Problems for Broadcast and MF/HF, Mar 2013, pages 59-60], I wondered if anyone else had experienced the RFI problem I had with LED incandescent light bulb replacements. After installing two 45 W equivalent bulbs made by a highly rated manufacturer, I had S9+ interference that blocked out the entire 2 meter band, as well as all but the strongest local stations on a nearby FM radio; 6 meter FM and lower frequency AM were not affected. I know the LED bulbs employ a switching power supply, but I was surprised that they could cause FM interference at relatively high frequency. I can only imagine the dilemma I'd face if I replaced all the incandescent and CFLs in the house with LED bulbs!

Gene Howell, AJ4GK
Boone, North Carolina

Manageable Barriers Between Interoperability and Technology

In his monthly column, ARRL Chief Executive Officer David Sumner, K1ZZ ["It Seems to Us: Going Digital," Mar 2013, page 9] said that as hams use and experiment with the wide range of radio communication technology available to us, the unintended consequences will be to create "barriers to interoperability." He also pointed out that interoperability "is essential to the functioning of any communications network." I believe that users and system design teams must agree that interoperability is the singular function or capability of any communications network. Barriers must be dealt with via sound engineering practices across a wide range of engineering disciplines.

Sumner stated that we have two objectives: avoid creating barriers to interoperability, and promote the use of, and experimentation with, the widest range of radio communications technologies. Even so, he acknowledged that these objectives "are somewhat in conflict." By way of historical examples, he illustrated how regulations, standards and a "leave it to the market place" mindset can influence interoperability. Regulations and standards won't go away, and under watchful eyes, they do have their place, but barriers are here to stay.

Sumner has opened our eyes to the importance of — as well as the vagaries, risks and barriers associated with — ensuring a high degree of interoperability. We must keep in mind that in today's economy of diminishing resources, the integration of existing systems into "new, more capable networks" (where the risks associated with interoperability are high) will receive far more resources than research and development efforts. It's up to us to take the reins alongside the integration and networking communities, become more informed and have a voice in that "market place," so that we are influencers in the march toward new, integrated communications networks that are as close as possible to 100% interoperable.

James Rodenkirch, K9JWV
Saint George, Utah

Chasing Good DX

I like to chase DX, both from my home in New York, as well as in St Martin. I have been a ham for more than 50 years and I am appalled at the bad operating practices hams exhibit when trying to work a DX station. It is very frustrating when trying to work DX from the US when a ham gets right on the frequency and starts tuning up, or a ham does not listen to the instructions from the DX station to "call up," and then they start calling the DX as if the DX station was operating simplex. When hams deliberately send a long series of dots or dashes on top of the DX station, it can make it almost impossible to work the DX station. I just do not understand this malicious behavior.

It seems to me as if many hams around the world have very poor general operating manners and do not follow the DX Code of Conduct (see **www.dx-code.org**). I have observed that when I operate from outside the US, American hams generally follow the DX Code of Conduct. If only other hams working DX did so, too.

Tom Metz, K2GSJ/PJ7TM
Sag Harbor, New York

Quality Beats Out Quantity

ARRL News Editor S. Khrystyne Keane, K1SFA, wrote that the number of radio amateurs in the US reached its highest point ever ["Happenings: 2012 Marks All-Time High for Amateur Radio Licenses," Mar 2013, pages 79-81.] While I can't argue with the numbers — as numbers don't lie — I question the quality of the new licensees. As I listen and operate on various bands, I am astounded by the lack of standard common sense, operational protocol and technical knowledge from my fellow hams. This has nothing to do with doing away with the CW requirement, but rather, the simplification of earning a license. Today, anyone can memorize the question pool, easily pass the test and obtain a license.

While I am not saying that all operators need to be RF engineers, I believe they need to have at least a basic knowledge of electronics, RF theory and operating procedures. Today, it's hard to distinguish a radio amateur from a CB operator, as I have heard many hams operate in a very similar fashion. I am personally disgusted with what I hear on the air and have made the decision to sell my equipment, stop operating and find a new hobby. In part, I blame the ARRL for supporting how simple and easy it is to obtain a license. While the ARRL may puff its chest that the numbers are at an all-time high, I feel that the quality of the licensee is at an all-time low!

Vince Cammarata, NT4I
Mechanicsville, Virginia

Old and New — Together

The 10 and 12 meter homebrew transceiver built by Gregory L. Charvat, N8ZRY ("Dual-Band Homebrew," Mar 2013, pages 39-42) made use of both an ancient rack cabinet and very modern components, creating a work of art. He mentioned that he plans to expand this to other HF bands, and I look forward to hearing more about his results. It's difficult for some amateurs to learn how to use and incorporate new components into homemade products. I hope the ARRL will continue to encourage such articles, as I plan to use some of Greg's ideas in projects of my own.

Charles Hooker, VE3CQH
East Garafraxa, Ontario, Canada

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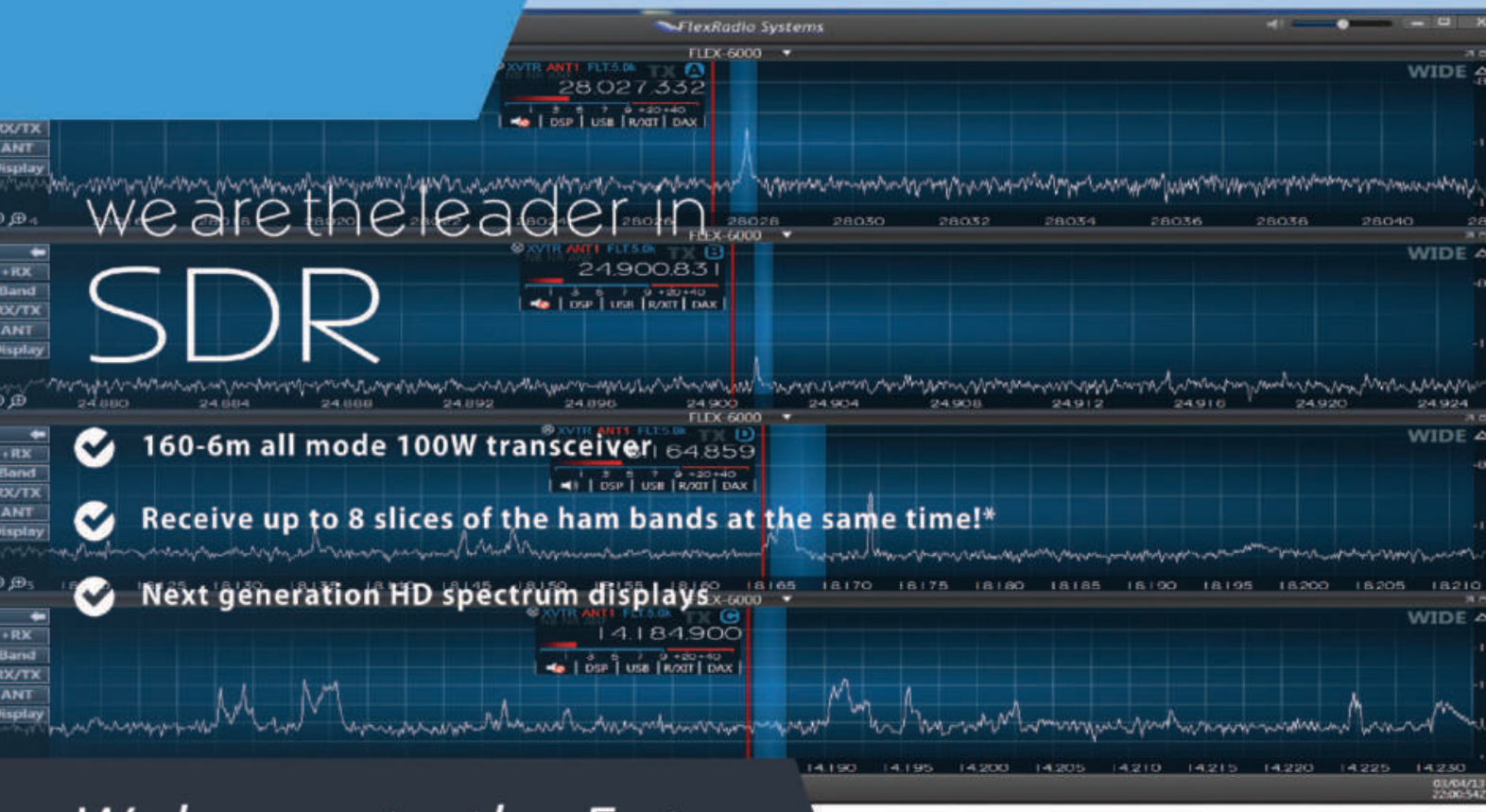

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Bob Fuller W7KWS Kapaa, HI in QSO with Mike (K7IR) and John (WA7IR) at SteppIR HQ.

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James Klitzing, W6PQL

There are many different 2 meter low power rigs in use, ranging from handheld transceivers for FM to older multimode transceivers and even the newer all purpose types such as the Yaesu FT-817 or the Elecraft 2 meter transverters. Low power (QRP) operation can be fun, but if you're like me, you have the occasional need for a bit more power.

If you have a couple of afternoons to spend on a project, you can build this 80 W multimode amplifier with ease. It's easy because it uses one of the newer Toshiba modules as the heart of the amplifier. The Toshiba S-AV36 provides direct 50 Ω input and output impedances with gain galore — so much gain that less than 50 mW can drive it to full output in any mode. This design will work with any exciter providing 1 to 10 W drive, through the use of a built in attenuator.

My original intent in making this was to have an amplifier capable of boosting an older 10 W multimode radio up to 80 or 100 W. I wanted to keep it low in cost and simple (no preamp or power meters), yet capable of fixed station or mobile operation in any mode and operation from the usual nominal 12 V dc power supply. In this way, the supply that powers a 100 W HF transceiver can likely power the amplifier as well.

After absorbing the specs in the data sheet, it was clear to me that this module could be driven by almost any low power rig; thinking about it a bit more, and keeping in mind the low cost and simplicity requirements, a few more useful features came to mind, such as:

- An output low-pass filter to comply with FCC regulations for harmonic and spurious suppression.
- A low loss antenna relay.
- An RF-sensing TR switch for remote operation, as well as a hard key option.
- TR sequencing to protect the S-AV36 module and prevent hot switching of the antenna relay.
- Indicator LEDs and control switches.
- Reverse polarity protection.

The inside of the final project is shown in Figure 1. Note the simplicity.

The devil is in the details for the designer, though, and it did take a little planning, but the end result was a small PC board made at home using common hobby tools. Add a few interconnecting wires, heat sink, connectors, switches, a couple of sheet metal parts for the enclosure, and that's about it. A schematic and parts list is provided in Figure 2. The input and output power of the amplifier with the built in attenuator for a 10 W exciter shown in Figure 2 is provided in Table 1. This also shows the current required at 13.8 V dc.

Designing the Amplifier

The S-AV36 module is pretty easy to use; aside from RF IN and RF OUT, there are two power connections; one is for BIAS (this turns the module on and off), and the other for main DC POWER, 13.5 V nominal at up to 15 A. Since the input power required to drive it is only about 50 mW, the first thing to do is design an input attenuator to match the output of the driver to the S-AV36. The resistive attenuator (R7, R8 and R9) can adapt the attenuator to drive levels ranging from 1 to 10 W as shown in Table 2. There are some strange values there, but these are not terribly critical,

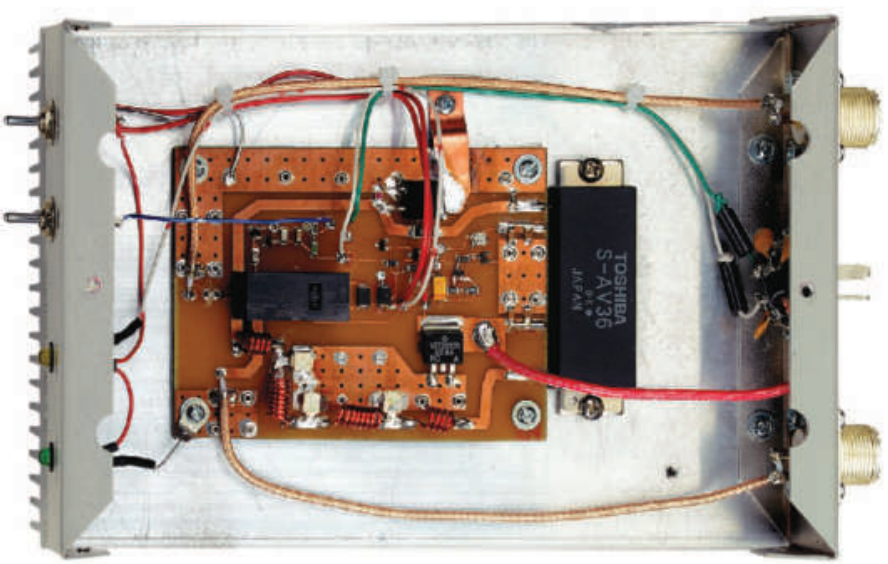


Figure 1 — Inside of the compact amplifier showing the simplicity of the final design. The amplifier module is the black rectangle connected to the right edge of the PC board.

you just have to get within a few ohms to get the job done. For example, a 23 dB attenuator is needed for a 10 W radio. The resistors chosen were those readily available from major distributors, so 58 Ω became 56, and 351 became 360 (close enough). L5 is not really necessary. Its purpose is to compensate for the stray capacitance of R7 at 2 meters (a 35 W tab-mounted resistor). The input SWR was acceptable without it, but it does make the input match almost perfect.

The Low-Pass Filter

Now that the input is taken care of, let's deal with the output. The data sheet says the second harmonic will only be down about 25 dB, and the third about 30. Not good enough for the FCC, so we need an output filter that will put us in good graces with at least 60 dB total suppression. For that 25 dB second harmonic, we need another 35 dB.

The filter shown (L1-L4, C12-C14 in Figure 2) is a standard pi type, Chebyshev filter of seven poles. The design provides the required suppression with very little insertion loss at the operating frequency.

The Antenna Relay and Switching Controls

In the spirit of keeping costs low, a PCB mount type of DPDT general purpose relay was chosen for TR and bypass switching. At less than $5 in cost, the contacts are rated at 8 A. At 2 meters, a bit of reactance is introduced by this part, but compensated for by a small capacitor (C15) in series with its input.

The best way to tell the amplifier to switch on is to use a control line back to the driving radio (PTT). If this is unavailable or inconvenient, the amplifier has an RF sensing circuit that samples a bit of drive from the input connector to provide the transmit trigger.

In another little twist; switching from receive to transmit should be sequenced for two reasons; first, the S-AV36 is tough, but no self-respecting amplifier module likes seeing an open circuit while those lazy relay contacts are moving, even if it only takes 20 ms to happen. It's not good for the module, and just plain rude. For this reason, the module has to be kept off while the relay contacts are settling. The other reason is to protect the relay contacts from that 80 to 100 W the amplifier will generate before they finally settle; it tends to shorten the life of the relay.

C4, D1 and D2 sample the input while C5, C6, R1 and R2 provide filtering and some timing, depending on the position of S1. In SSB mode, the circuit provides a delay on switching to RECEIVE similar to VOX, providing a second or so of delay. In FM mode, the switch back to RECEIVE is much quicker, as the delay is not necessary for FM operation. The circuit is sensitive, and will trigger with less than ½ W drive.

Q1 is the switch that operates the relay. When the relay is turned on by Q1, it also turns on Q2 (the bias switch) after a short delay. This delay is provided by C9 and R4, and is about 50 ms in duration, allowing those relay contacts to settle before the module becomes active.

When switching back to RECEIVE, the bias to the module is cut off before the relay contacts open. This fast cutoff is timed by C9 and R5, and is only about 5 ms in duration.

Another noteworthy component is D6, the reverse-polarity protection diode. This diode's purpose is to blow the in-line fuse in the power cord if you accidentally connect the power cord backwards (come on, we've all done it).

The extra contacts on power connector J3, Pins 3 and 4, provide a means to disable the RF sensing and connect PTT directly to the driver should the RF sensing be deemed unnecessary. If just Pin 4 of J3 is grounded by a PTT line, the amplifier will be switched by the PTT, but all the delays will apply. If Pin 3 is grounded the amplifier the will follow the PTT with only the delays designed to protect against hot switching, as described above.

Building the Amplifier

Here are the recommended steps, in sequence, for constructing the amplifier:

- Mark the heat sink for drilling by using the PC board as a template. You can also position the Toshiba module and mark its two mounting holes; leave a small gap of 2 to 3 mm between the module body and the board for strain relief.
- Drill and tap the module mounting holes for #6-32 screws, and the PCB holes for 4-40 screws.

Install all the PC board components except for the module. The relay should be installed last, and because the pins will protrude through the bottom of the board, they should be cut off flush with the board after soldering.

While I used a PC board and surface mount components, there is no reason leaded components could not be substituted. The PC board is still recommended because the etched transmission lines going in and out of the TR the relay will provide minimum loss on receive — important since any loss adds directly to the receive noise figure.

- Make the enclosure parts and two aluminum spacers as shown in the fabrication drawings available on the *QST* in Depth web page.[1]
- A PC board is available from the author, or can be made from the artwork on the *QST* in Depth web page. Mount the board to the heat sink with four 4-40 screws. The two aluminum spacers must be positioned under the board on either end to elevate the board to a convenient height for the module and keep the back side PCB connections at the relay pins from shorting against the heat sink.
- Some minor tuning of the low-pass filter coils can be made at this time. Connect a dummy load to the output of the board, and a transmitter and SWR meter to the trace at the input of the filter where the module will connect. Apply 12 V across the relay coil to close the relay, and spread or compress L1-L4 for lowest SWR reading. If this is inconvenient to do, the filter can be adjusted after the amplifier is fully constructed, adjusting for max power at about 50 W output. It's best to do it now, though, and you'll probably find that

[1]www.arrl.org/qst-in-depth

Table 1
Output Power and Current Required with Resting Current at 8 A

Drive Power (W)	Output Power (W)	Current (A) at 13.5 V
1	12	8.2
2	29	9.0
3	44	9.5
4	53	10.0
5	66	11.0
6	74	11.5
7	80	12.0
8	85	12.5
9	89	12.8
10	92	13.0

Table 2
Values of R7, R8 and R9 for Different Drive Levels

Drive Power (W)	Attenuation (dB)	R7, R9 (Ω)	R8 (Ω)
1	13.0	79	106
2	16.0	69	154
3	17.8	65	191
4	19.0	63	220
5	20.0	61	248
6	20.8	60	272
7	21.5	59	295
8	22.0	59	313
9	22.6	58	335
10	23.0	58	351

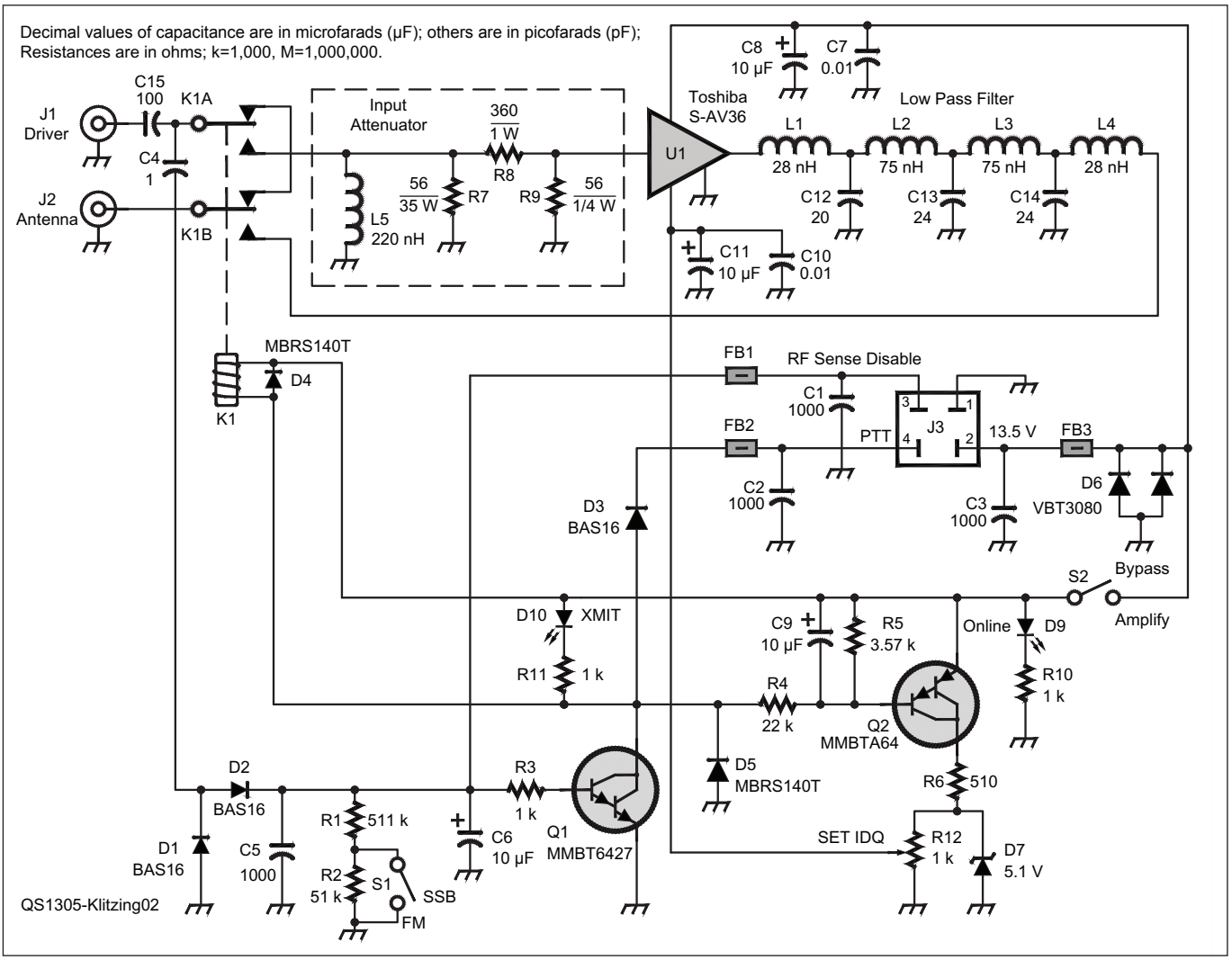


Figure 2 — Schematic diagram and parts list for the amplifier. For parts supplied by Mouser, you can order all of these by ordering the project list from their website, or order individual parts if your prefer. **www.mouser.com/tools/projectcartsharing.aspx**. The access ID code for the project is **c3ad150d1a**. RFPARTS (**www.rfparts.com**) is the supplier for the Toshiba module and coax connectors. Heat Sink USA parts are available at **www.heatsinkusa.com**. Artwork for the PC board is provided on the *QST* in Depth web page, along with fabrication drawings for sheet metal parts. For those not wishing to make their own board, commercially made boards are available from **www.w6pql.com**.

C1, C2, C3 — 1000 pF ceramic capacitor (Mouser S102K29Y5PN6TJ5R).
C4 — 1 pF SMT capacitor (Mouser 12061A1R0CAT2A).
C5 — 1000 pF 1206 (SMT) capacitor (Mouser 12065C102KAT2A).
C6, C8, C9, C11 — 10 μF 1206 (SMT) ceramic capacitor (Mouser 581-TAJA106M016R).
C7, C10 — 0.01 μF 1206 (SMT) capacitor (Mouser VJ1206Y103KXXCW1BC).
C12 — 20 pF metal mica capacitor (Mouser MIN02-20J-F).
C13, C14 — 24 pF metal mica capacitor (Mouser MIN02-24J-F).
C15 — 100 pF metal mica capacitor (Mouser MIN02-100J-F).
D1, D2, D3 — SMT switching diode (Mouser 512-BAS16).
D4, D5 — 1 A surface mount diode (Mouser MBRS140TRPBF).
D6 — SMT dual diode, 30 A (Mouser VBT3080S-E3/8W).
D7 — 5.1 V SMT Zener diode (Mouser MMBZ5231B-V-GS08).
D9 — 5 mm green LED (Mouser 941-C503BGCNCY0C0791).
D10 — 5 mm red LED (Mouser 941-C566CRFSCT0W0BB2).
F1 — 20 A fuse to fit the fuse holder in the power cable called out below.
FB1, FB2 — Small ferrite bead (Mouser 623-2643000701).
FB3 — Large ferrite bead (Mouser 623-2643000801).
J1, J2 — Panel mount SO-239 coax socket.
J3 — Power connector, 4 Pin cable mount (Mouser 38331-8004).
K1 (RL1) — Omron DPDT relay (Mouser G2RL-2-DC12).
L1, L4 — Inductor, 28 nH. 4 turns #18 AWG, 4 mm inside diameter, 8 mm long.
L2, L3 — Inductor, 75 nH. 7 turns #18 AWG, 4 mm inside diameter, 10 mm long.
L5 — Inductor, 220 nH. (Mouser 70-IMC10008ERR22J).
Q1 — NPN Darlington transistor (SMT) (Mouser MMBT6427).
Q2 — PNP Darlington transistor (SMT) (Mouser MMBTA64).
R1 — 511 kΩ 1206 (SMT) resistor (Mouser CR1206-FX-5118ELF).
R2 — 51 kΩ SMT resistor (Mouser CR1206-FX-5102ELF).
R3 — 1 kΩ 1206 SMT resistor (Mouser CR1206-FX-1001ELF).
R4 — 22 kΩ SMT resistor (Mouser CR1206-FX-2202ELF).
R5 — 3.57 kΩ SMT resistor (Mouser CR1206-FX-3571ELF).
R6 — 510 Ω SMT resistor (Mouser CR1206-FX-5100ELF).
R7 — 56 Ω, 35 W SMT resistor (Mouser PWR263S3556R0F).*
R8 — 360 Ω, 1 W SMT resistor (Mouser RK73B3ATTE361J).*
R9 — 56 Ω, ¼ W SMT resistor (Mouser CR1206-FX-56R0ELF).*
R10, R11 — 1 kΩ, ¼ W metal film resistor (Mouser 660-1/4DCT52R1001F).
R12 (VR1) — 1 kΩ potentiometer (Mouser TC33X-2-102E).
S1, S2 — SPST miniature toggle switch (Mouser A101SYZQ04).
U1 — Toshiba S-AV36 amplifier module (RF Parts)
Heat sink extrusion 5.375 × 8 × 1.376 inches (Heat Sink USA A009).
Heat sink extrusion 5.375 × 8 × 1.375 inches (Heat Sink USA A008).
In-line fuse holder (Mouser 441-R-332B-GR).
RG-316 50 Ω Teflon coax to go from J1 and J2 to K1.

*These parts provide the input attenuation required for a 10 W input. For other levels of driving power, see Table 2.

very little adjustment is necessary.

■ Using heat sink compound, mount the Toshiba module with #6-32 machine screws. Note that the mounting bar of the module is slightly concave; this is not a defect, the manufacturer makes them this way, as do other module makers. Do not attempt to sand this footing flat or otherwise fill with any material except for heat sink compound. There is still plenty of contact area for heat transfer. I'm just guessing, but I believe the manufacturer makes the footing this way for strain relief in order to protect the mechanical bonds inside. Solder the module wires to the appropriate traces on the PC board (cut off the excess wire length if necessary, see Figure 3).

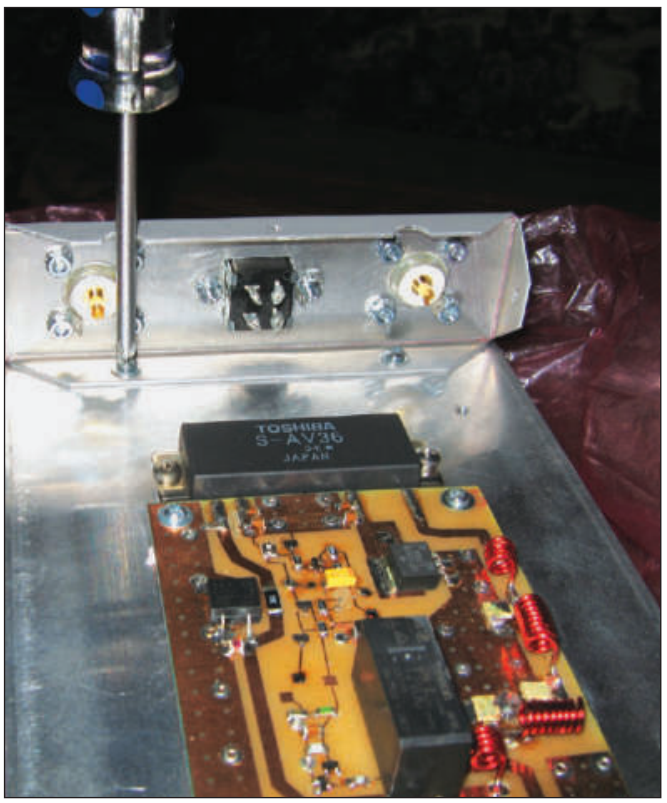


Figure 3 — The rear panel is attached using #6-32 machine screws. The module connections are soldered to the PC board as shown.

■ Mount the connectors, switches and LEDs, and complete the chassis wiring (see Figure 4). The LEDs have their 1 kΩ resistors soldered directly to their leads, with the wire connected to the other side of the resistor; heat shrink is used to cover the resistor and connections. Use solder lugs under the mounting screws for the connectors on the rear panel; these are for connecting coax shields, dc chassis ground, and bypass capacitors as shown in Figure 5.

■ Make the power cord from #14 AWG wire. Make certain to use an in-line fuse on the positive lead, and fuse it for no more than 20 A. If you will be hard keying your amplifier from your radio, jumper Pin 3 of the connector to ground, and carry Pin 4 back to your keying connection from the radio. The radio's PTT relay contacts or other switching must be capable of sinking 12 V at 50 mA to ground.

Testing the Amplifier

Once everything is wired and in place, you can test the amplifier using the following procedure:

■ Connect the output to a suitable wattmeter and dummy load, and the input to your driving radio.

■ Connect the power cord to a power supply

Figure 4 — View of the inside of the front panel before wiring.

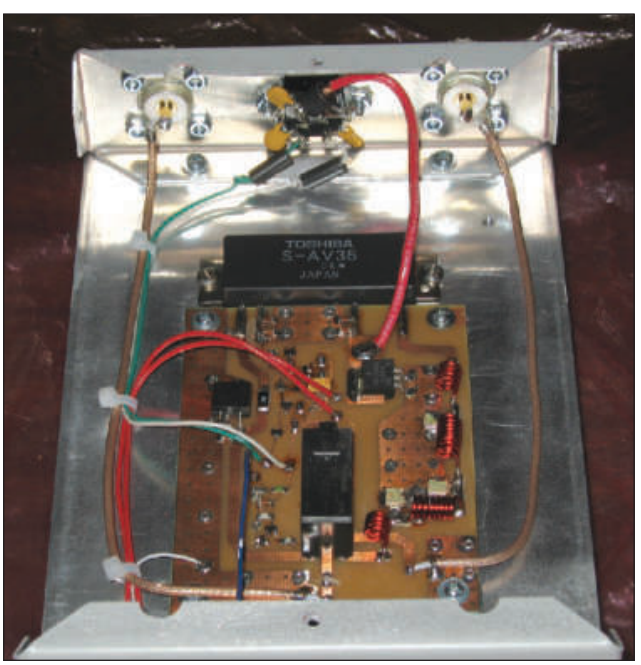


Figure 5 — Details of the rear panel wiring.

A Quest for a More Linear Amplifier

Your editor, in common with many casual VHF operators, uses a transverter with a power output of 10 W. In my case it is an Elecraft K3 HF and 6 meter transceiver with an internal 2 meter transverter. This unit has a very low noise receiver with the result that I can hear many more 2 meter stations than can hear me.

In an effort to put my station on an equal footing with stations with the frequently encountered 100 W multimode radios, I wanted to find an amplifier that could be added to my station to make up the difference. I tested a number of "brick" amplifiers in the hopes of finding one that would provide the needed power with appropriate intermod products for use on SSB.[1,2] While the tested units delivered the desired power, and indicated that they were suitable for SSB, the intermod levels were high enough that I thought they would cause trouble for other stations during contests. These amplifiers work fine on FM, their primary use design goal, as well as on CW. It is only using them in SSB operation that generates the spurious signals due to the multiple simultaneous frequency components.

There was an alternative, a much higher priced, higher powered, amplifier (now discontinued) that showed HF type IMD was indeed possible on VHF.[3] There was also the very nice 2 meter kilowatt amplifier described by Jim Klitzing in a recent *QST* article.[4] That inspired me to commission Jim to put his talents to work designing a lower powered amplifier that would meet my operational objectives, be easy to build and relatively inexpensive.

Jim has met my objectives in this very nice package. The IMD output, as measured in the ARRL Lab were as shown in Table A, and a plot of the input versus output power in Figure A. Note that it closely follows the straight line until 75 to 80 W, at which point the compression is evident.

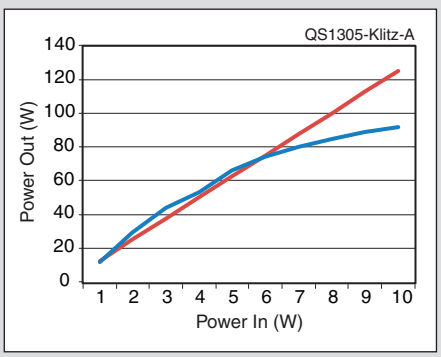


Figure A — Power output versus input, as measured in the ARRL Lab. A straight line (red) is shown for comparison.

Table A
Intermodulation Response as a Function of PEP Output

Power Output	Intermodulation Products (dBc)			
PEP (W)	3rd	5th	7th	9th
55	–27	–44	–46	–56
75	–24	–42	–49	–53
100	–19	–28	–36	–47

[1]J. Hallas, W1ZR, "Product Review —A Pair of Mirage 2 Meter Amplifiers" *QST*, Aug 2010, p 52.
[2]J. Hallas, W1ZR, "Product Review — TE Systems 1410G 2 Meter Linear Amplifier," *QST*, Jan 2012, p 54.
[3]J. Hallas, W1ZR, "Product Review — Tokyo Hy-Power Labs HL. 350VDX 2 Meter Linear Amplifier," *QST*, Mar 2012 p 48.
[4]J. Klitzing, W6PQL, "Solid State 1 kW Linear Amplifier for 2 Meters," *QST*, Oct 2012, p 32.

capable of delivering 13.5 V at up to 15 A.

Place the AMPLIFY/BYPASS switch in BYPASS mode. Transmit, and verify that bypass mode works (most of the driver's power should pass through the amplifier to the load). The bypass mode insertion loss is only about 0.1 dB.

Turn off the driving radio and put the amplifier in AMPLIFY mode. The READY LED should illuminate. Jumper PTT to ground, and the XMIT LED should also illuminate. Adjust the IDQ trimmer (VR1) for 8 A. Place the amplifier back in BYPASS mode and remove the PTT jumper.

Turn the radio back on, place the amplifier in AMPLIFY mode, and transmit. Performance should be similar to the data shown in Table 1.

I experimented some with various IDQ settings, and concluded that Toshiba must have designed the module to operate close to Class A. Setting IDQ too low tended to introduce lower overall gain and crossover distortion in SSB, while setting it too high resulted in higher gain and saturated output power. At 10 A IDQ, for example, the amplifier could be driven to over 100 W output with about half the drive required at 8 A IDQ. This current drawn at this level is close to the manufacturer's absolute maximum ratings for the device, and really doesn't make any difference on the air, so I resisted the temptation to leave it that way. For all mode versatility, leaving IDQ set at 8 A is best.

One last note. At a drive level of 10 W, I noticed R7 (the 35 W attenuator input resistor) ran hot. This was due to the inadequate heat transfer of the PC board I made for the original prototype, which has just a few rivets where there should have been multiple plated through holes surrounding this part. My solution was to use a piece of 0.040 inch copper strip soldered to the ground tab of the resistor. I used this to transfer the heat to the heat sink by fastening the other end to it with a #4 screw. Most of us making our own prototype boards at home don't have the ability to make plated through holes the way the commercial board houses do, so if you make your own board for this project, you'll probably need to implement a similar solution.

ARRL member and Advanced class licensee James Klitzing, W6PQL, was first licensed in 1964 as WB6MYC. He has been a precision measurement specialist for the US Air Force and Hewlett-Packard Company. He retired in 2006 as an engineering manager for Agilent Technologies after 34 years with HP/Agilent. Jim has always enjoyed building his own equipment and is active on HF through 3456 MHz.

You can reach him at 38105 Paseo Padre Ct, Fremont, CA 94536, or at **jim@w6pql.com**. Jim's website, **www.w6pql.com**, has all current updates to this and many other projects.

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

Digital Modes for Your SDR

Your PC can do double duty — serving as an SDR engine and receiving digital modes.

Robert Nickels, W9RAN

My "Cheap and Easy SDR" article featured in the January 2013 issue of *QST* showed how a low cost HF converter and a $20 digital TV dongle can open up the entire HF and VHF spectrums for hams, shortwave listeners (SWLs) and hobbyists in ways that have not been possible before.[1]

The first thing most people want to do is tune around the ham bands and international shortwave broadcast frequencies to sample the high quality AM and SSB reception made possible by software based digital signal processing. Before long, however, many hams and SWLs will be intrigued by the non voice signals that pop up across the HF bands. We're accustomed to using PC based multimode software to listen in on those CW, RTTY, BPSK or other digital signals. But what do you do when the PC is not only the host for decoding software, but is now an integral part of your receiver as well?

Thanks to the way *Windows* multitasking and sound cards work, I can show you several ways to allow a single PC and sound card to do both jobs at the same time.

Digital Decoding — The Traditional Approach

With the advent of sound card based digital decoding programs, interfacing receivers and transceivers with a PC has become pretty straightforward. The audio signal from the receiver is connected to the LINE INPUT of the PC sound card as shown in Figure 1.

VHF/UHF digital decoding is done the same way, except for digital modes, such as weather satellite reception, that require audio to be taken directly from the output of the FM discriminator. But in all cases, receiver audio is fed into the sound card of the PC at which point it is digitized and processed to extract the digital information that is then displayed for the operator.

Until recently, low cost SDRs used the PC sound card to digitize the stream of I/Q signals from the RF front end. Using the DVB-T dongle that sends high speed digital I/Q samples via USB to the PC eliminates that bottleneck, but poses a new question: How can the audio output of one program be used as input for another program running on the same PC at the same time?

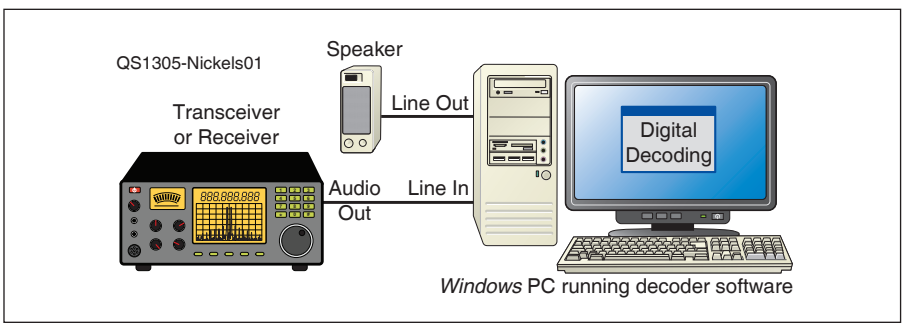


Figure 1 — The audio signal from the receiver is connected to the LINE INPUT of the PC sound card as shown.

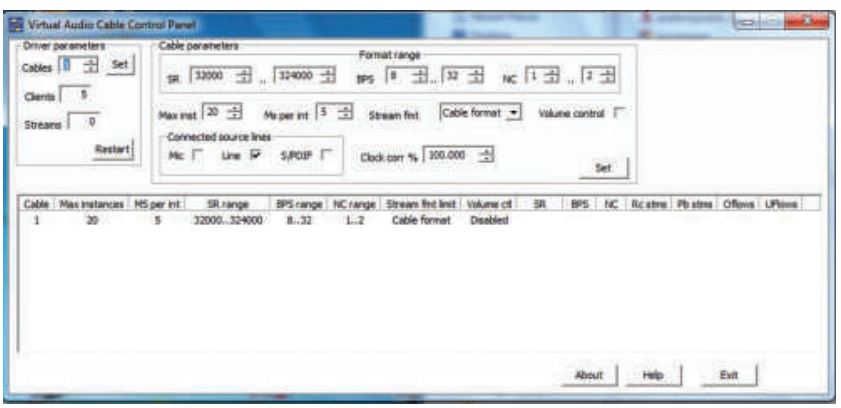


Figure 2 — The *Control Panel* application is used to configure a virtual audio cable.

A Virtual Solution

We have all become spoiled by the vast amount of work that our PCs do "behind the scenes" to make things work smoothly and effortlessly for the user. For example, we can open a web page that contains audio or video information and the multimedia content is automatically detected and played for us. Wouldn't it make sense if the digital output from our SDR could work the same

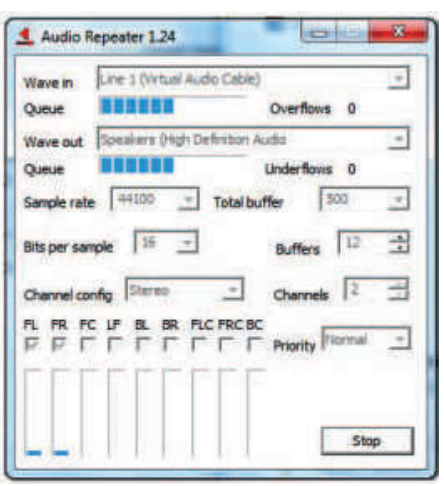


Figure 3 — The *Audio Repeater* application is used to route signals via a virtual audio cable.

[1]Notes appear on page 38.

way? In other words, if the digital audio signal from an SDR could be automatically transferred in digital form into our decoder application. For that to happen, we need some sort of "virtual" connection that could link two programs together using that "behind the scenes" software magic.

That is exactly what the program called *Virtual Audio Cable* (*VAC*), written by Eugene Muzychenko, can do. With *VAC*, any application can send an audio stream to a virtual cable and any other application can receive this stream without any loss of audio quality, merely by selecting the VIRTUAL AUDIO CABLE for its input. In fact, multiple cables can be running simultaneously to create a *virtual patch panel* that provides a great degree of flexibility for sophisticated audio processing needs. Figures 2 and 3 show the *Control Panel* and *Audio Repeater* applications that are used to configure and route virtual audio cables.

VAC is a fine product, but it is neither shareware nor freeware, and although a limited trial version is available for free download, there is a voice reminder superimposed on the audio. Its extensive features are more than most users need, especially those who just need a single link between two applications.

Software Alternatives

Some PC owners might have a similar capability already at hand. Certain *Windows 7* and *Vista* audio drivers include a feature called *Stereo Mix* that can be enabled by the user. Not all PCs and sound cards offer this option — a web search on "stereo mix" will provide information that allows you to see if it can be enabled on your PC (see Figure 4). If it's available, *Stereo Mix* works in a similar manner to *sound on sound* on an analog tape recorder (remember those?). In that example, some of the output is sent back into the input channel. That's just what is needed to feed SDR audio into the sound card input for a decoder application.

Another possibility for owners of certain Creative Labs sound card hardware is a feature called *What U Hear* or *wave out mix* that works in a similar way.

For those of us who don't have *Stereo Mix* and don't want to purchase *VAC*, there's a hardware based alternative that I call the AAC or *actual audio cable*.

The AAC — Actual Audio Cable

While it may seem obvious to some, many PC users don't realize that their audio systems are actually capable of *full duplex* operation. In other words, the *record* and *playback* capabilities are able to operate independently. This makes it is possible to feed the audio produced by the playback or output side of the sound card directly into the LINE INPUT or record side, where it can be used as the input source for a digital mode decoding program. Since SDRs using inexpensive DVB-T dongles receive I/Q samples via USB, everything can be done with just one sound card in the PC.

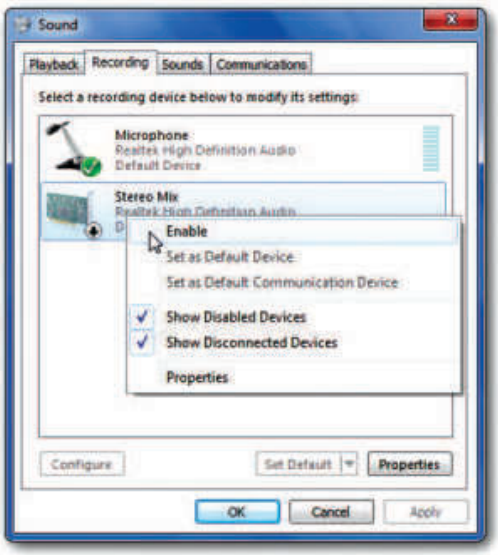


Figure 4 — Google "stereo mix" for instructions on how to check to see if your PC and sound card support this option.

How It Works

Basically, a sound card converts digital data into analog information for the speakers (called *playback* mode), and it also converts analog information from external sources such as a MIC or LINE input into digital data (typically the RECORD function). This is accomplished with either separate digital to analog and analog to digital converters or a coder/decoder (CODEC) chip that performs both functions.

Granted, there are many variations in how these functions are implemented, and all sorts of technical issues regarding sample rate, resolution, aliasing and others — but for our purposes, the simple solution shown in Figure 5 will do just what we need to couple the SDR audio into the digital decoder by creating an actual audio cable.

A stereo Y adapter (see Figure 6) is used to split the Line Out (blue connector on most PCs) from the PC sound card into two signals. One feeds audio to the amplified PC speakers as usual; the other is connected (by means of a short patch cable, also in Figure 6) to the LINE INPUT jack (green on most PCs). We can get by with making these parallel connections, because whatever impedance mismatch may occur doesn't noticeably affect sound quality.

Connected in this way, the normal audio output from the SDR goes to the speakers as usual, so there is no difference whether using the SDR for voice modes, or while running any other audio applications on the PC. The AAC also sends the LINE OUTPUT signal into the LINE INPUT of the sound card, at which point it can be made available as an input selection by the *digital decoder* program. This simple configuration allows the PC based SDR to be used with a PC based digital decoder program as easily as if a conventional receiver were used.

No drivers or special configurations are needed on the PC, and only two parts are needed:

- A stereo Y adapter with ⅛ inch or 3.5 millimeter connectors. The RadioShack 274-879 is one example. Many other suppliers carry them in either the molded or flexible Y cable style (see Figure 6).
- A stereo patch cable with a ⅛ inch or 3.5 millimeter plug on each end. The shorter the better — a length of 12 inches or less is ideal, but the 36 inch cable from RadioShack (42-962) will work fine (see Figure 6).

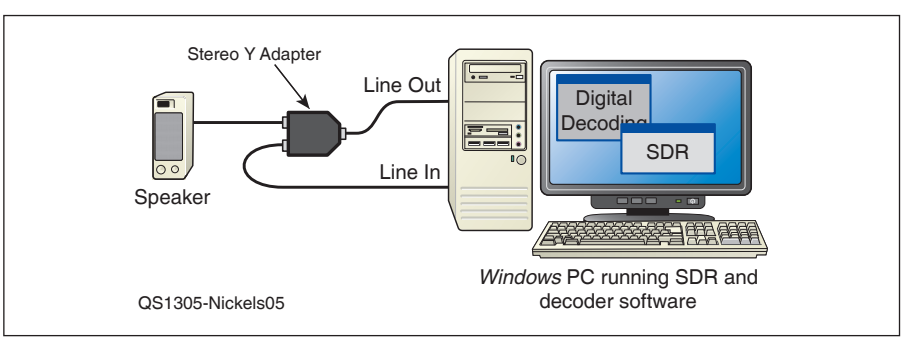


Figure 5 — Just what we need to couple the SDR audio into the digital decoder by creating an actual audio cable.

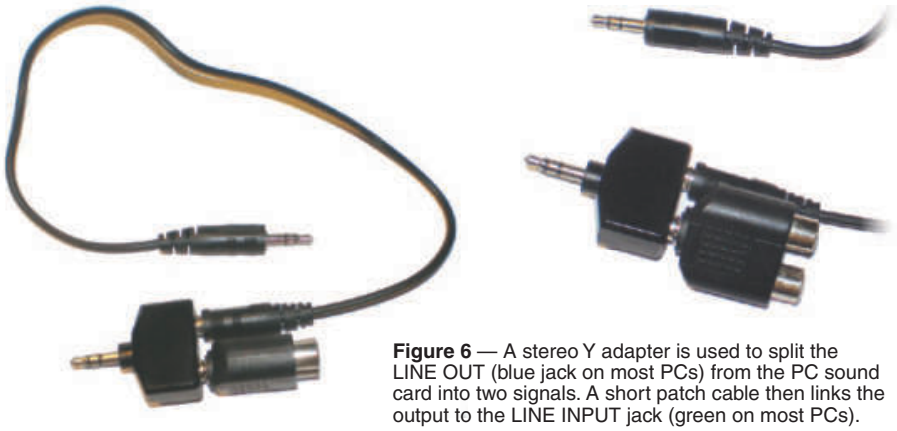


Figure 6 — A stereo Y adapter is used to split the LINE OUT (blue jack on most PCs) from the PC sound card into two signals. A short patch cable then links the output to the LINE INPUT jack (green on most PCs).

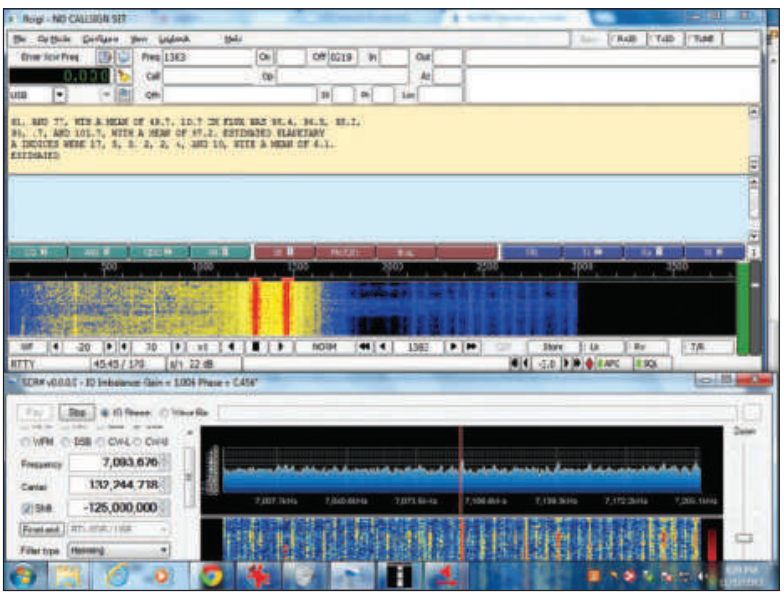


Figure 7 — A split screen with *Fldigi* decoding W1AW 40 meter bulletins on the top and the *SDR#* screen below.

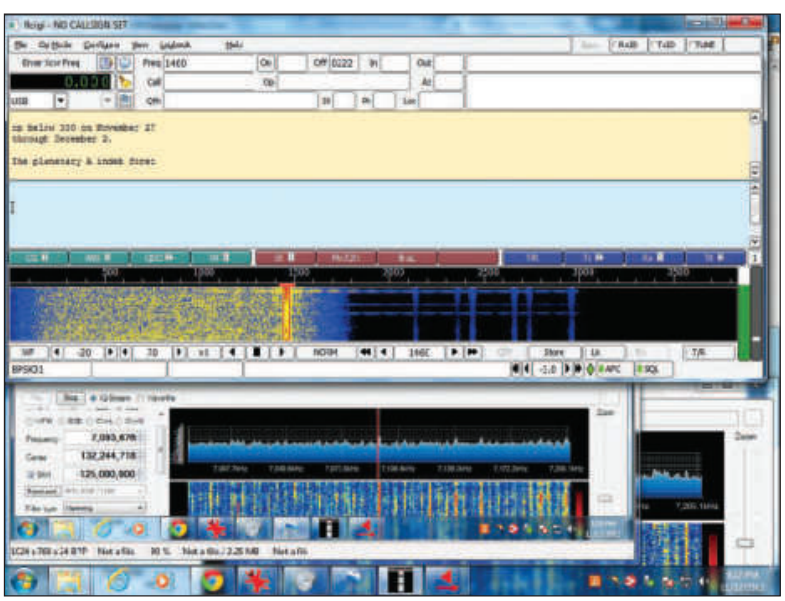


Figure 8 — A split screen with *PSK31* decoding W1AW 40 meter bulletins on the top and the *SDR#* screen below.

Pros and Cons

The simple AAC hardware based approach has its strengths:

- It's cheap — $5 or less if you shop around, or even free if you have the required audio stuff in your junk box.
- It's easy — plug and play in seconds — see Figures 7 and 8.
- It works just as well for normal amateur use as only one program needs to feed audio to one other program.
- No installation, no added drivers, and no CPU loading.

There are also a few limitations that users should keep in mind:

- In a conventional setup, the PC sound card is used to digitize an analog sign from the receiver's audio system. But with the AAC, we're redigitizing an audio signal that was produced by a digital to audio converter. Thus far I've not observed any problems because of this double conversion.
- The computer VOLUME control will also change the audio level that is fed to the digital decoder, just as if it were tapped across the speaker of a conventional receiver. So, if you adjust the volume slider in *Windows*, it will also affect the level being fed to the decoder application.
- The receiver audio will be heard in the speakers because it is wired directly (bypassing the *Windows* sound mixer) and thus can't be muted without also cutting off audio to the decoder program.

A solution to the previous two issues is simple — just use the VOLUME control located on the speaker or amplifier itself to control the local sound level, and leave the *Windows* VOLUME control in a set position while decoding digital signals.

The LINE IN mixer VOLUME control in *Windows* should be set to produce a signal level that does not overload the decoder or cause distortion (most decoders have AGC that will help with this).

Since the audio is being *looped* from output to input, any loose connections will result in noise or intermittent audio, and there is also the potential for RF to enter via the line input cable. Use of good quality connectors and fully shielded cables will help minimize problems, otherwise normal mitigation methods such as RF chokes and filtering may be required, especially if a transmitter is to be used nearby.

Some Software Notes

With *VAC* or *Stereo Mix*, the audio stream from the SDR program is transferred in digital form to the input of the decoder program without any modification. This eliminates

the possibility of noise or RFI, but it does require CPU resources. In my experience, one *VAC* cable driver adds less than 1% CPU loading.

VAC provides an *Audio Repeater* application that can be used, for example, to listen to what is being sent over a virtual cable. This application requires additional CPU resources (another 1% in my experience).

VAC offers lots of configuration flexibility that isn't needed for basic use. I've stuck with default settings for the most part, but the power is there if needed, and the price seems fair for what it is capable of doing. The documentation is comprehensive but assumes the user is sophisticated when it comes to digital audio. *VAC* isn't free but the price depends on the support level desired.

The *What U Hear* and *Stereo Mix* options are as simple to use as are other *Windows* sound applications, but are hardware and software dependent and don't seem to be present in new operating systems. According to the Internet, many users have found the *Stereo Mix* feature disappeared after doing updates, and some have not been able to restore this functionality.[2]

Test Results

I've evaluated several digital decoders with the AAC approach, including the popular *Fldigi* software. Figure 8 shows a split screen with Fldigi decoding W1AW 40 meter bulletins on the top, with the *SDR#* screen below.[3] The receiver is a DVB-T dongle along with the W9RAN HF converter in USB mode with 2.7 kHz filtering. I haven't been able to detect any difference in copy while switching the input source between virtual and actual audio cables.

Interestingly, both software applications are using sophisticated digital signal processing techniques, yet with the power of modern PC hardware and the multitasking capability of *Windows*, both tasks are easily performed in real time, moving us one step closer to a fully digital ham radio world.

The SDR approach is also a plus for those who like to decode wideband digital signals, such as APT weather fax pictures, trunking or other digital signals that require tapping the discriminator output (and sometimes even changing IF filters). With the infinitely variable DSP selectivity provided by an SDR, configuring for these modes is as simple as typing in the bandwidth desired. Recent versions of *SDR#*, a popular SDR application, also include the provision to automatically track and adjust for Doppler shift on satellite transmissions.

SDR and Digital Modes — A Combination for the Future

There's no doubt that digital communication modes and software defined radio will be a big part of the future of Amateur Radio. Today we are on the leading edge of these technologies, but each new application smooths off more rough corners, and integrates more functionality. As SDR continues to evolve, it is inevitable that digital mode decoders will simply become another plug in that can expand the power of the SDR just as we take for granted with our web browsers and other software tools.

In fact, one recent experimental package (*SDR J*) includes built in decoders for a number of digital modes that can be selected just as if they were AM or SSB. The "SDR wish list" includes smart decoders that will analyze the characteristics of a digital signal and choose the proper decoder automatically — this is surely a sign of interesting things to come!

Fast and inexpensive A/D converters that deliver high speed digital samples are giving SDR users a window into larger chunks of spectrum. Until those next generation SDR applications come along, the simple AAC makes it easy to link PC based decoding software with PC based software defined radios to explore the digital modes.

Notes

[1]R. Nickels, W9RAN, "Cheap and Easy SDR," *QST* Jan 2013, pp 30-35.

[2]See, for example: **superuser.com/questions/299082/whats-the-reason-behind-stereo-mix-becoming-a-missing-option** and **stream-recorder.com/forum/missing-sound-recording-option-stereo-mix-record-t4876.html?s=91322d7dd878a2104de253de50fc8361&amp**.

[3]*SDR#* (pronounced SDR Sharp) software is described in note 1.

ARRL member and Amateur Extra class licensee Robert Nickels, W9RAN, was first licensed at age 14 in 1965 as WN0OHO in Nebraska. He has a BS from Fort Hays State University in Kansas, and credits ham radio as a major influence during his 35 year career in the electronics manufacturing industry. A holder of three US patents, Bob recently retired from Honeywell, where he held positions as a principal engineer, engineering manager, and strategic marketing director. He currently heads up RAN Technology Inc, a business and technology consulting firm. An avid cyclist and cross country skier, he enjoys ham radio history and homebrewing, in addition to his main interest — collecting, restoring and operating a growing collection of vintage electronics and boat anchor radios from the last five decades.

You can reach Robert at 2645 East Dr, Freeport, IL 61032 or at **w9ran@arrl.net**.

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

New Products

MFJ Trunk Lip Antenna Mounts with NMO Adapters

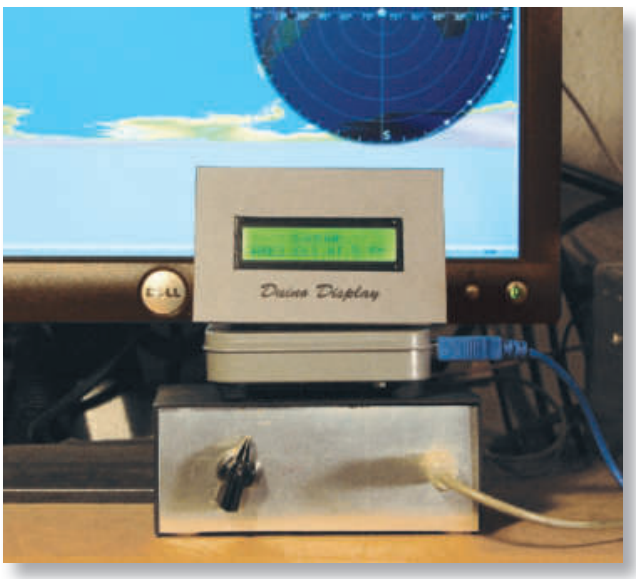
The MFJ-345M (left) and MFJ-348M (right) trunk/hatchback antenna mounts have 360° rotation and 180° left-to-right flexibility. A thumb/finger knob adjusts the antenna position to clear garage doors and low overhangs. The MFJ-348M has a 3.3 inch wide lip with reinforcing tabs on each side to distribute the antenna load. The MFJ-345M lip width is slightly less. Rubber guards help protect the vehicle's finish. Each mount has 17 feet of coaxial line terminated with a PL-259 connector. Either mount is rated to hold large VHF/UHF antennas and medium size HF antennas including HF antenna sticks. Allen wrenches are included. Price: MFJ-345M, $39.95; MFJ-348M, $42.95. For more information, to order or for your nearest dealer, call 800-647-1800 or see **www.mfjenterprises.com**.

Microcontrollers — No Experience Necessary

"Duino Display" is a simple Arduino project that will start you on your way.

Roger Shipley, KA9NAH

I recently decided to update my 30-year-old satellite station to include computer control. The last time I looked at this situation I saw two choices: one of the many PIC®s on the market (but little information on how to use them) or a Parallax Basic Stamp controller card. My first station warmed the room with the soft glow of vacuum tubes and, frankly, this new technology was all a bit scary.



While I was in the process of doing research this time, I happened across a magazine article describing an entry level robotics project that used an Arduino board as a controller. I visited the Arduino website and it didn't take me long to decide this was the right place for someone with no previous microcontroller experience — like me — to start.[1]

Introducing the Arduino

The Arduino offers a number of significant benefits compared to other possible approaches. First, the Arduino website had all the information I thought I might need to get started. On top of that, there were forums covering both the hardware and software side with easy-to-find links. Second, it all looked easy compared to a stand-alone PIC, and it was less expensive than a basic stamp.

The Arduino board has an onboard USB port and requires nothing more than the installation of a driver on your computer and downloading the *Integrated Development Environment* (IDE) to set up communication with your PC. The USB port powers the entire controller board, so, at least for programming purposes, no other power supply is necessary. In fact, when my board arrived, it took less than 5 minutes from the time I opened the package until I was programming the board. To be fair, stand-alone PICs have become easier to use since I first became aware of them, but they aren't this easy.

The Arduino and its programming environment are compatible with Mac, PC and *Linux*. Both the hardware and software aspects are completely open source. That means you have access to the complete design, schematics, board patterns, code — everything. You can incorporate them into anything you like and even put it on the market, as long as you don't use the name *Arduino* as part of your product.

Arduino clones are available from any number of vendors, including RadioShack. They are not very expensive. You can get an *authentic* (not a clone) Arduino UNO R3 board for about $22 and some of the clones are even cheaper.

The UNO has 14 digital input and output lines (in/outs) and six analog in/outs with an onboard analog to digital converter (ADC) (see Figure 1). Each line can handle up to 40 mA. There is also a 5 V regulator on the board that can be used to power your circuit. The analog in/outs can also be used as digital lines, and all lines can be changed from input to output lines and back again in microseconds through software. That offers a lot of connectivity to the rest of the world.

Other versions of the board have more in/outs if you need them. These lines are also available on standard 0.1 inch female headers that make breadboarding and prototyping a breeze — no soldering is required. Two of the digital lines on the UNO are used for the USB interface. If you need to keep the controller board connected to the computer after programming it, they are unavailable for other use.

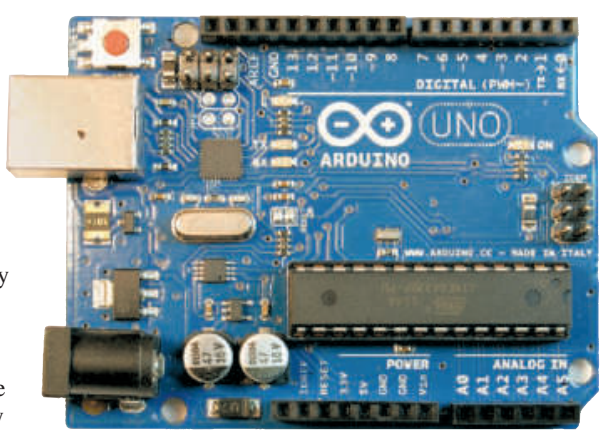


Figure 1 — The Arduino Prototyping Platform. D0-D13 can be used as digital inputs or outputs. A0 — A5 are analog lines but can be used as digital lines as well. There is a tiny green LED permanently connected to digital Pin 13 and just below it in the photo. (See text.)

Talking to Your New Friend

The UNO has 32 kB of memory with 0.5 kB taken up by the preprogrammed *bootloader* — think of it as a program that loads your program. The board runs at 16 MHz. Programming the Arduino board is accomplished through a language based on *Java* in the Arduino IDE and then compiled and uploaded into the ATmega328 controller chip on the board. The IDE checks — but doesn't correct — your code for errors, handles the upload and has a serial port monitor so you can get info back from the board while debugging your code.

The language and IDE used in programming the Arduino are based on *Processing* and *Wiring*, two other open source programs created to encourage students, artists and designers to enter the computer program-

[1]Notes appear on page 43.

ming world.[2] *Processing* is visually oriented (good for graphing and animation) and can be used to program in an Apple, *Windows* or *Linux* environment. Learn to program an Arduino and you are most of the way to writing programs you can run on your computer. *Processing* can create stand-alone *.exe* files.

Because *Processing* was developed for artists and designers, it has some interesting vocabulary. A program is called a *sketch (Processing* was seen as a software *sketchbook*). If you are familiar with *Java* or *C*, you will have no trouble adapting to the Arduino environment. If not, the place to start is the Arduino reference pages.[3]

Check out a Library

One of the great things you'll find as you look around the reference pages is the number of *libraries* available to make programming easier. A library is essentially a block of code written by someone else that makes doing something *you* want to do easier. For example, using an LCD display to read out information from a sensor can involve many lines of code if you have to create each character before you print it. By using a readily available library you can use a single line to include the library in your program and the IDE generates all the code for you. You can then use a few simple lines to set a cursor to a certain point in a certain line and print what you need. My sample project, the little *Duino Display* described here, uses the LCD library included in the Arduino IDE to display your call and scroll message reminders across the second line.

You Will Need to Be Able to Write Programs

There is no way to escape the fact that if you want to use an Arduino or any other microcontroller for your projects, you have to learn to program well enough to accomplish what you want to do or be stuck duplicating what someone else has written. Fortunately, it's not all that hard to learn, and with the popularity of the Arduino today, there is a vast network of information and support to fall back on.

You can use the *Duino Display* as a launching pad into the world of microcontroller programming with a minimum of effort and have a useful little device to show for your efforts. Because of the quasi breadboard construction of the project, you can continue to use the same Arduino board and LCD display to experiment with other projects. Or you can forgo the "packaging," and just breadboard the project as a starting point for your own experimentation and then strike out on your own.

Gathering all the Pieces

Once you have the Arduino board and LCD display ordered, download the IDE and drivers from the Arduino download page and install the appropriate versions on your computer. [4] While you are waiting for the hardware to arrive you can open the IDE and go to the examples menu from the file drop down (FILE->EXAMPLES).Open some of these programs and read through them. It won't take you long to get a sense of how the programming language works. Visit the Arduino reference page and look up the commands that you see.[5] You can also find numerous tutorials online. Pay special attention to information on "for loops" since the *Duino Display* program uses several of them.

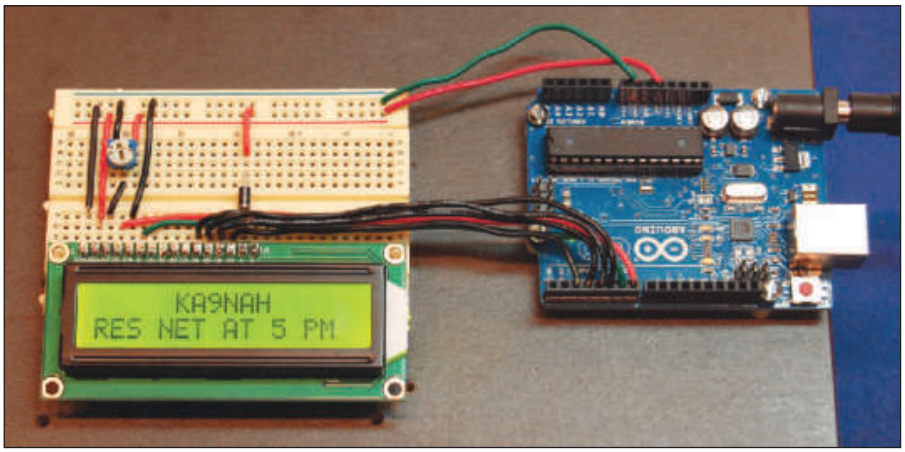


Figure 2 — The Duino Display breadboarded on a small RadioShack breadboard. The wire connecting Pins 1 and 16 on the LCD is hidden by the display in this photo.

Sometimes it Takes a Dictionary

If you are having trouble getting what you need from these sources, buy or borrow a book on programming the Arduino. There are now quite a few of them.[6] If you still can't find what you need, join a forum and ask.

Put the Pieces Together

Once you have the hardware, the fun begins. I suggest you breadboard the *Duino Display,* even if you plan to package it up later. That will allow you to experiment with some of the example programs, and that can be very helpful in learning to program.

The LCD display comes with a male header (perhaps a female header also), a 10K trimmer and a diode. Solder the male header to the display, plug it into a small breadboard as shown in Figure 2, add the diode and trimmer, and wire it all up with #22 solid wire as shown in Figure 3. That's it! You're done. If you decide to experiment with the example programs as well as the *Duino Display* program there will be plenty of room on the breadboard.

You can mount the Arduino and breadboard to another piece of wood for stability, or just let them sit on the desk. If you use just the breadboard, place a piece of cardboard under the Arduino board to prevent any possible shorts to a metal surface. Connect the Arduino board to a USB port on your computer with a Type A to Type B USB cable.

Bring It to Life

Go to the TOOLS menu and make sure that UNO is selected (TOOLS-> BOARD->UNO). The tiny LED on the Arduino (next to digital Pin 13, see Figure 1) should start to blink once the board powers up. That's because an example program, *Blink*, is already programmed into the Arduino's memory. It's used to test the board. You can start your programming adventure by opening the *Blink* program from the examples menu (FILE->EXAMPLES->BASICS ->BLINK) and changing the rate at which the LED blinks. Just change ***delay*** *(1000);* to ***delay*** *(2000)* everywhere in the program. That changes the time on and time off from 1000 to 2000 ms. Now upload the program to the board by clicking on the RIGHT ARROW at the top left of the IDE window. The LED should blink half as fast. You're already learning to program.

When you are ready, open a new IDE window (FILE->NEW) and type or copy in the *Duino Display* program from the *QST* in Depth web page and upload it to the Arduino.[7] If you type it in you can ignore all the comments (everything after "//"), but be sure to type it exactly as shown otherwise. All those semicolons and brackets are a part of the language, and if you miss one, the program won't compile. The comments explain a little about what is happening in the program on a line-by-line basis, so it might be worth your while to keep them. Be sure to keep any that have a SERIAL command after the "//." Adjust the 10 kΩ trimmer that controls the contrast of the display until you see clear letters. You should see my call letters on line one of the LCD display and the default messages marching from right to left across the bottom line. If not, or if the program would not upload, double check to see that you have reproduced the program exactly. Be sure to save the program (FILE ->SAVE AS).

Make It Yours

Look through the beginning of the program and find the line that declares the string "***myCall.***" Strings are simply a group of ASCII characters. Replace the call sign with your own and upload the program again. Be sure to keep the quotation marks around the call sign. You should see your own call on line one, once you upload the program.

Experiment with changing the messages to whatever your needs might be. Follow the guidelines in the comments. You can add messages if you like, just be sure to change the variable NUMBEROFMESSAGES to the total number you've included. Be sure to upload and save the program after any changes you like.

There are a number of ways to scroll text on a HD44780 based LCD display. There are actually 80 memory locations on the LCD controller, but the 16 × 2 display can only display 32 of them.

Memories Are Made of This

A good explanation of the memory location use on the HD44780 controller is available on the web.[8] Writing to memory on the controller that is not displayed can get confusing, so this program only writes to the 32 memory locations that *are* displayed.

It does that by using a series for "for loops" and "substrings" to choose the text to display and then printing it to a specific location in the display memory. All of the string commands used in this program are illustrated in the examples menu of the IDE (FILE ->EXAMPLES ->STRINGS). You can load them and run them one at a time to get more familiar with the commands used. It may all look like gibberish at first, but you'll quickly begin to see the logic behind it.

Test Drive the Software

You can get an even better idea of how this program works by experimenting. Open the *Duino Display* program in the IDE. "Uncomment" any line beginning "***Serial.***" by deleting the double slash (//). Save the program under a new name and upload it to the Arduino. Now open the serial monitor (TOOLS->SERIAL MONITOR). The serial monitor window will open and you'll see all the data that is flowing to the LCD in a scrolling fashion displayed line by line on the serial monitor. Notice how the function (subroutine) *printit1()* adds one character at a time from right to left until the display is full (16 characters).

Printit2() then creates a substring (a 16 character portion) of the message that drops the leftmost character and adds the next one to the right and prints that after a half second delay. On the serial monitor it looks like a series of 16 character lines in which the content keeps changing. On the LCD it looks as if it is scrolling text.

Printit3() simply continues dropping the leftmost character but adds a blank space at the right side until the display is empty.

The program then loops back and begins all over again with the next message. When the last message has been displayed, the loop begins again from the beginning.

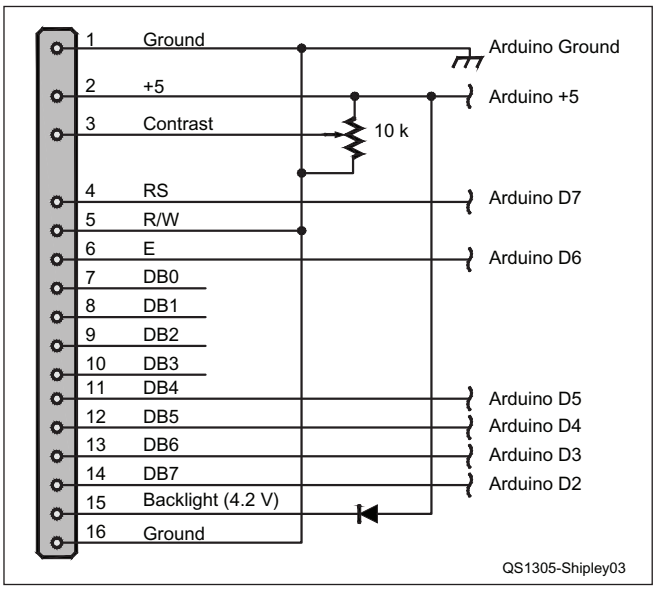


Figure 3 — The wiring diagram for the LCD display and its connections to the Arduino. The trimmer and diode should come with the display. As viewed from the front of the display, Pin 1 is on the left. The LCD display is an HD44780 based Microtivity IM162 LCD Module 1602 or equivalent (available at **www.amazon.com**). The Arduino Uno is also available from Amazon.

Packaging to Put It to Work

There are a number of ways to package this project. I used Altoids® tins. The Arduino board itself is housed in one tin and the display in another. They are connected in such a way that you can still use the Arduino board for experimentation or other projects.

Take the LCD display off the breadboard. Measure the size of the projecting front of the display you purchased and lay that out centered on the top of an Altoids tin. Mine measured 15⁄16 × 2¾ inches (see Figure 4). The best way to cut the square holes needed for this project is to use an abrasive cutoff wheel in a hand held rotary grinding tool. Be sure to wear eye protection if you adopt this method. With careful cutting you can make neat, square corners. If you need to trim them up or enlarge the cutout, a small triangular file works well.

After you have the opening cut, place the LCD module through it from the back side of the lid and mark the mounting holes with a small awl or a small nail. Use a 7⁄64 inch bit to drill the mounting holes for #4-40 machine bolts. You can use the file or a small piece of 150 grit sandpaper to clean up any burrs.

I found 5⁄16 inch ID × 7⁄16 inch OD vinyl grommets to protect the wires going from one tin to another. You'll need to drill a hole to accommodate whatever size you use. I used a step bit made for drilling metal after drilling a 1⁄8 inch starting hole. If you don't have access to one, you can use standard drill bits, but start with a small one and keep enlarging the hole with progressively larger bits. Back up the tin with a block of wood and clamp it down for safety. Larger bits tend to catch in the thin metal.

Place the Arduino in the other Altoids tin. You'll have to raise the board slightly to avoid shorting the bottom traces. I used 1⁄8 inch thick nylon washers from the local hardware store. If you use exactly the same materials I did, you can follow the dimensions in Figure 4. If not, put whatever you use as a spacer under the board mounting holes and then slide it to the right and mark the locations for the cutouts for the USB plug and the external power supply on the inside of the tin. Using a square, transfer those marks to the outside of the tin.

Cut the openings with the cut-off wheel. You'll have to cut through the rims of both the lid and the bottom to accommodate the USB socket. I chose to cut a square hole for the auxiliary power socket even though the power socket does not extend past the tin. It was easier than trying to drill a hole through the rim. I cut the top and bottom separately.

With those openings complete, put the Arduino back in the tin with the spacers under it and move it to the far right with the USB connector protruding through the Altoids tin wall and mark the locations for the #4-40 mounting bolts for the Arduino in the bottom of the tin. Drill four 7⁄64 inch holes in the bottom. Lastly, drill a hole in the lid as shown in Figure 5 for the grommet. If you are using feet that require bolts, locate the holes for those and drill them as well.

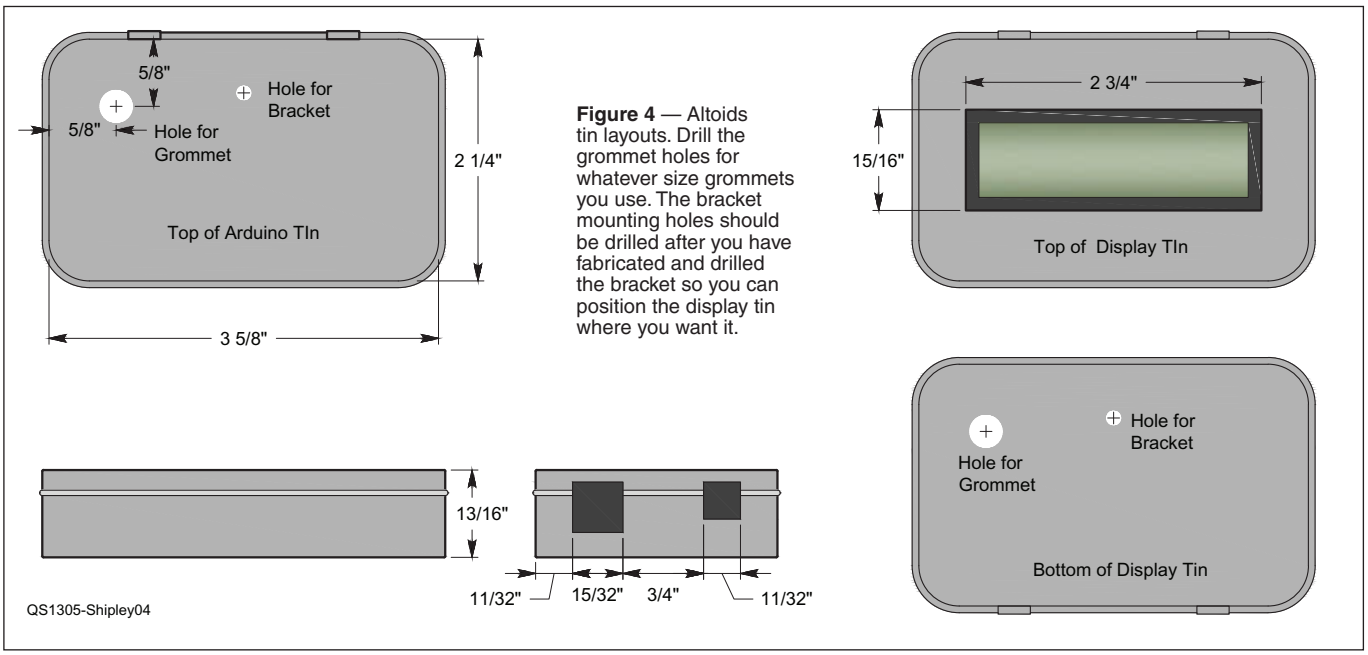


Figure 4 — Altoids tin layouts. Drill the grommet holes for whatever size grommets you use. The bracket mounting holes should be drilled after you have fabricated and drilled the bracket so you can position the display tin where you want it.

Figure 5 — Put the #4-40 mounting bolts for the bracket through from the inside to keep them from interfering with the Arduino headers.

Figure 6 — Inside the display tin: The small piece of vector board in the top left of the photo holds the diode and trimmer as well as ground and power bus wires.

I fastened the LCD tin to the Arduino tin with a piece of ¼ inch brass strip I had in the junk drawer. I cut it 2 inches long, bent it in half to a 75° angle, and drilled each leg for a #4-40 bolt (see Figure 5). You can drill the back of the LCD tin and the top of the Arduino tin with the 7⁄64 inch bit for those mounting holes after you have fashioned the bracket and drilled it. Drill your holes in the tins to match your bracket.

After all the cutting and drilling have been completed, spray the Altoids tins whatever color you like. I used a gray that was close to my radios' cabinets. After the paint dries, mount the display in the lid of its tin using #4-40 machine screws and nylon washers to space it away from the top.

I cut a small section of vector board (from the corner of an old RadioShack part 276-179) and soldered the trimmer pot and diode to it (see Figure 6). Follow the same wiring diagram as for the breadboard. I mounted it on a longer #4-40 bolt using an extra nut as a spacer.

You can use the same solid #22 AWG wire that you used on the breadboard for wiring inside the display tin. For the longer wires that have to be threaded through the grommets, I suggest using smaller stranded wire. It's much more flexible and easier to work with.

Cut eight pieces of wire, each 7 inches long, and solder them to the power bus and ground on the vector board and to the male header

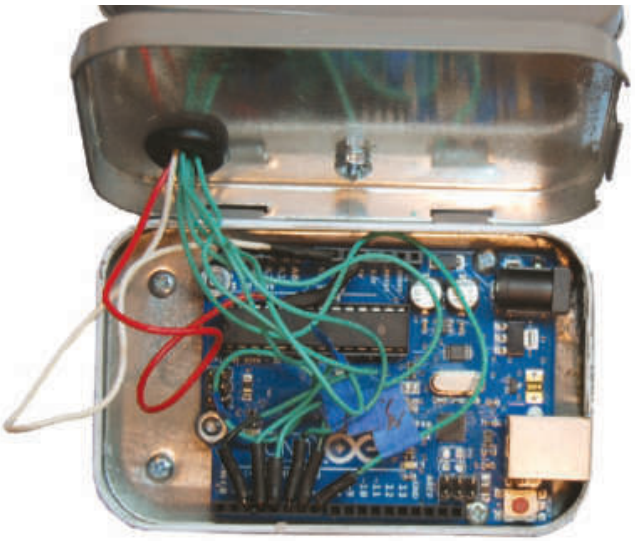


Figure 7 — Inside the Arduino tin: There is room on the left hand side to tuck away the extra length of the wires.

Figure 8 — The completed Duino Display. Decorate the front card stock to complement your shack.

pins on the display. Be sure to also connect the power from the diode to the backlight (Pin 15) and the wiper of the trimmer to the contrast Pin 3 and from the power bus and ground to the display. When finished, thread the wires out through the display tin and in through the Arduino tin grommets. It's a good idea to mark each wire with its display connection at the Arduino end as you do this.

Strip about ⅜ inch of insulation from the free ends of the stranded wire and solder each one to a short piece of #22 AWG solid wire. Cover the joint with a piece of small diameter shrink tubing. Bend the solid wire at 90° where it emerges from the tubing and cut it so that it seats completely into the Arduino header (about ⅜ inch).

Put the solid wire ends into their appropriate Arduino pin headers (see Figure 7). Join the two tins with the brass angle and #4-40 hardware. Carefully close both tins while working the excess wire neatly into the Arduino tin. There is room for the extra wire on the left side of the Arduino tin. The extra length will be useful if you decide to separate the two units during later experimentation.

To dress up the display I cut a piece of photo mat board with a hobby knife to fit around the LCD. Any heavy cardboard thicker than the bolt heads would work. You can be much more accurate with the mat board than with the Altoids tin and it masks earlier problems. I used a small punch to make relief holes for the #4-40 mounting screw heads. Attach the mat board to the lid with super glue or spray adhesive. As a final touch I printed *Duino Display* on a piece of heavy cardstock and glued it over the mat board to hide the relief holes (see Figure 8). Feel free to be creative.

Time for a Test Drive

If you have a computer with the newer always-powered USB ports, just plug the display into one of them and you're done. If the power goes out on your USB ports after you shut off the computer, or if you need the port for other things, you'll need a 9 or 12 V wall wart capable of supplying at least 400 mA attached to the power plug on the Arduino tin. The Arduino will automatically switch between the USB power and the auxiliary power, so you could leave both plugged in. If you reversed the 5 V and GROUND connections to the trimmer when you packaged the project, you may need to readjust the contrast.

If you want to experiment with other projects, just pop open the Arduino tin and you have full access to all the headers. You can temporarily disconnect the LCD or use it with your new project. If you want, you can separate the Arduino tin from the display tin while you are experimenting.

The *Duino Display* is a simple project that allows you to enter the world of microprocessor control and have both a useful device and a conveniently packaged development platform for further experimentation. As your programming skills improve you'll find endless possibilities for using this little board around the shack. I also used one to control my satellite station's azimuth-elevation rotator.

Notes

[1]**www.arduino.cc/**
[2]**processing.org; wiring.org.co**
[3]**arduino.cc/en/Reference/HomePage**
[4]**arduino.cc/en/Main/Software**
[5]See Note 3.
[6]L. Klotz (editor), WA5ZNU, *Ham Radio for Arduino and PICAXE*. Available from your ARRL dealer or the ARRL Bookstore, ARRL order no. 3244. Telephone 860-594-0355, or toll-free in the US 888-277-5289; **www.arrl.org/shop/**; **pubsales@arrl.org**.
[7]**www.arrl.org/qst-in-depth**
[8]**web.alfredstate.edu/weimandn/lcd/lcd_addressing/lcd_addressing_index.html**

ARRL member Roger Shipley, KA9NAH, has been licensed since 1982 and currently holds a General class license. He is a graduate of Oberlin College and has pursued careers as a teacher, theatrical designer, theatre manager, cabinet maker, furniture designer and in his retirement as a carver. When he gets on the air it is generally on the satellites or lurking on 20 meters. He can be reached at 4023 Willowbrook Ln, Bellingham, WA 98229 or at **roger.shipley@comcast.net**.

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

Adding Frequency Shift Keying to the TigerTronics SignaLink USB

Using audio tones for RTTY works for some, but there are radios that sound much better with true FSK.

Ronald C. Berry, WB3LHD

In this article I'll show you how to interface the TigerTronics SignaLink USB Interface with the FSKit designed by Doug Hall, K4DSP, to an ICOM IC-756 Pro II or many other transceivers.[1]

This idea came about from my desire to run frequency shift keyed (FSK) radioteletype (RTTY) rather than *audio* frequency shift keyed (AFSK), which the SignaLink provides. One of the benefits of being in RTTY mode with FSK rather than using AFSK in LSB-D mode is that you can take advantage of your transceiver's internal 250 Hz twin peak filters. It also makes it easier to find the correct RTTY frequency without having to add or subtract the 2.125 kHz that needs to be done if using LSB or USB mode. After building Doug's FSKit I wanted a way to interface it with my SignaLink that would allow me to switch between FSK RTTY and all the other SignaLink audio modes such as SSTV, PSK-31 or JT-65 by just switching my transceiver's mode and not having to change any cables around.

Making it Happen

Only two simple connections are needed between the SignaLink and the FSKit (see Figure 1). On the back of the SignaLink is a transmit audio output jack marked MON, make a connection between that and the J1 on the FSKit (AFSK IN) with an audio cable with 3.5 mm stereo phone plugs on each end. The other connection is from FSK KEYING, J4 on the FSKit-J4 back to the SignaLink with a small audio cable that has an RCA connector on one end and is open on the other end. This connection runs to Pin 1 on the ICOM's rear panel ACC(1) connector, the transceiver's input FSK keying line, via the 8 pin RJ-45 cable supplied with the SignaLink. To do this, drill a small hole in the back of the SignaLink in an open area (see Figure 2). Feed the open end of the small audio cable from the FSKit-J4 thru the hole and solder the center lead to the SignaLink Pin 1 on the internal jumper plug (JP-1). Connect the cable ground to one of the "G" ground pins on Jumper Plug (JP-1) (see Figure 3). Refer to your SignaLink manual for pin number location. You could install a 3.5 mm phone jack at the rear of the SignaLink to make a cleaner looking installation. On the FSKit board, I put a jumper on P1 between Pins 1 and 2, a jumper across P3 and left P2 open. You will have to jumper across SW1 to supply the power to the PCB or install an on/off switch. Your jumper positions may be different depending on your setup and RTTY mode. Refer to Doug's original article for reference.

What you are doing is taking the AFSK output from the SignaLink to the FSKit which demodulates the AFSK to an FSK output. That output is fed back to the SignaLink, which is then directed to the ICOM's FSK input line. This is all possible since the 8 pin RJ-45 cable supplied with the SignaLink that plugs into the

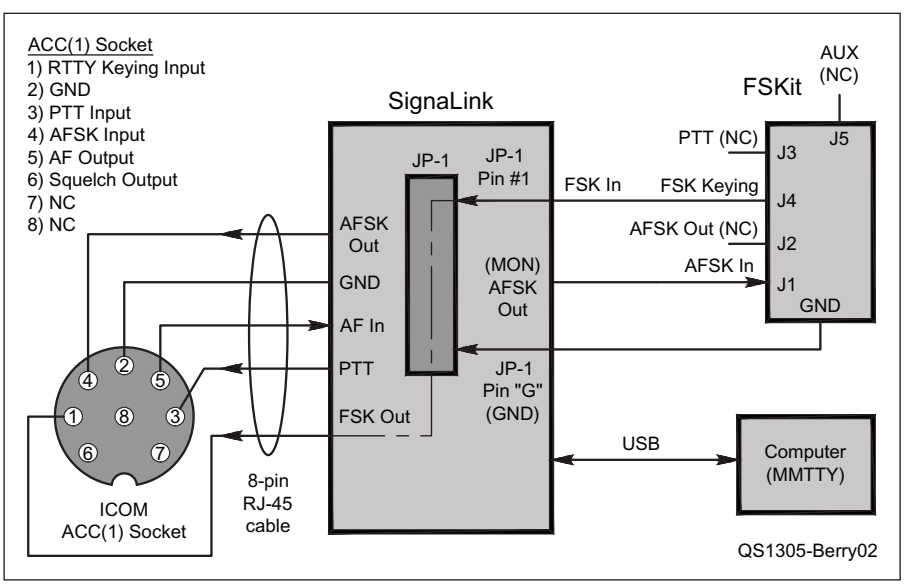


Figure 1 — Schematic diagram of the interconnections among the SignaLink USB, FSKit and an ICOM IC-756 PRO II.

[1]Notes appear on page 45.

FSK versus AFSK — What's the Story?

In the days before personal computers (PCs) and sound card modes, RTTY was the most popular of the few *digital modes* that existed at the time. In those days, the frequency of a transmitter was shifted slightly (850 or 170 Hz were the usual standards) between MARK and SPACE. Many transmitters had a pair of terminals that would cause this to happen, often by inserting a capacitor across the VFO tuning circuit. If the FSK terminals weren't there, many amateurs added the needed circuitry so they could send text with their military surplus teletype machines.

Progress Happens

The advent of PCs with sound cards made it possible to generate tones of any desired frequency in response to application software generating MARK and SPACE signals. If the resulting audio tones are applied to the MIC or AUDIO input of a perferct SSB transmitter, the result comes out as a pair of alternating single frequency signals that are virtually indistinguishable from FSK as sent by a CW transmitter with an FSK circuit.

So, What's the Rub

With a true FSK transmitter, each of the two frequencies sound just like a single frequency signal from a CW transmitter—as they would with an ideal SSB transmitter. Of course, as good as they are, a real SSB transmitter is not quite the same as an idea one. The key issues are:

- *Carrier and Sideband Suppression.* While the FSK transmitter generates signals at just the two frequencies, the SSB transmitter also generates a (suppressed) carrier signal and (suppressed) sideband components. While the suppressed signals may be 30 to 50 dB below the desired sideband, they are still there, and can be heard. The carrier comes through as a steady tone whenever the transmitter is on, while the suppressed sideband comes through as an RTTY signal with MARK and SPACE signals reversed — potentially confusing.
- *Other Spurious Signals.* If the audio system of the transmitter is overdriven by the sound card, the stages may generate spurious signals, often harmonics of the audio tones. These signals can pass through the transmitter all the way to the antenna and sound like RTTY signals with a multiple of the frequency shift. In addition any hum, or other spurious signals generated within the sound card, or the transmitter, will be translated to RF and sent, along with the desired signal.

Why Not FSK for All Digital Modes?

FSK works fine for RTTY and some other forms of signaling, but can't send everything. The only modes it can handle are those designed to be two-frequency FSK. Modes such as PSK31, that require phase shift keying, especially those with more states than binary, cannot be handled by binary FSK. So even if you go to FSK, you won't be able to toss out your sound card if you want to operate using other popular modes.

Figure 2 — Details of the additional cable attached to the rear of the SignalLink. A grommet would reduce abrasion of the cable jacket.

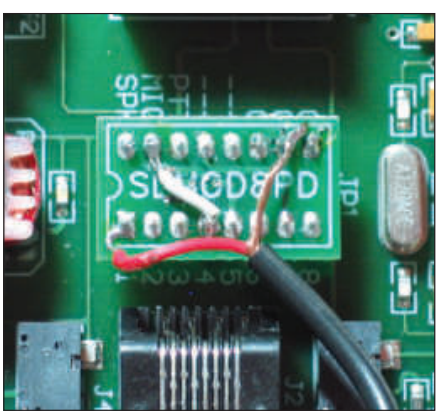


Figure 3 — Photo of the SignaLink (JP-1) connections from J4 of the FSKit.

ICOM's ACC(1) rear port, has all the pins connected, even though not all are being used by the SignaLink.

You can now run FSK RTTY and all the other audio modes the SignaLink can deliver by just switching your transceiver's mode and without having to change any cables around. While in RTTY mode, the SignaLink TX AUDIO can be kept at a minimum since the AFSK audio to the ICOM is not needed. When you want to run JT-65, SSTV, PSK-31 or even AFSK RTTY, just switch the transceiver's mode to the normal LSB-D/USB-D and turn up the SignaLink TX AUDIO knob to the appropriate level.

This hookup may work with many transceivers that are using a SignaLink USB. You just need to verify that your transceiver has an FSK/RTTY INPUT line that the SignaLink's RJ-45 cable plugs into. Then you would just need to solder the cable from the FSKit-J4 to the correct Jumper Plug (JP-1) pins in the SignaLink that will feed the FSK keying signal into your transceiver. Reference information can be found in the manual supplied with the SignaLink and your transceiver's operating manual. I have used this setup for more than a year without any problems.

While Doug no longer supports the FSKit, you can purchase the FSKit PCB from Far Circuits.[2] I can supply a preprogrammed Atmel AVR ATTiny45 microcontroller.

Notes

[1] D. Hall, K4DSP, "The FSKit — A Simple Sound Card Interface for Generating Radioteletype Frequency Shift Keying," *QST*, Aug 2011, pp 40-42.

[2] **www.farcircuits.net**

Ron Berry, WB3LHD, has been a ham and an ARRL member for 36 years and holds an Amateur Extra class license. He is also a member of INDEXA, a non-profit organization for the enhancement of Amateur Radio, worldwide peace and friendship. His operating mostly consists of chasing DX on 160 through 10 meters using CW, SSB and digital modes. He is an active DXCC Honor Roll member and only needs three entities to achieve DXCC #1.

Ron graduated from electronics school in 1969 and presently works as an RF engineering technician in the Engineering Department of GigaHertz LLC. He has built many homebrew projects and enjoys restoring vintage radios and building antennas. Ron's other interests are racing his Dodge SRT-4 at the Pittsburgh International Race Complex in Wampum, Pennsylvania and attending car shows.

You can reach Ron at 326 Sunset Dr, Bethel Park, PA 15102-1442 or at **wb3lhd@verizon.net**.

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

An Easy to Build High Impedance Choke Balun

This choke provides good common mode current suppression and doesn't cost much.

Jerry Campbell, K4ZHM

You can use this uniquely constructed choke balun to significantly reduce conducted current on the outside of coax going to a balanced antenna.

I had originally planned to use an air wound choke balun, as described in *The ARRL Antenna Book* to feed an 80 meter inverted V antenna.[1] I decided on a different tack after discussing the approach with Warren Pratt, NRØV. Warren pointed me toward *A Ham's Guide to RFI, Ferrites, Baluns and Audio Interfacing* by Jim Brown, K9YC.[2] Jim has written a very instructive paper that is worthwhile reading for anyone interested in learning about RFI and baluns.

After reading the article, I decided to use the choke baluns that Jim recommended. The balun is made from six turns of RG-8 on a stack of five FT-240, #31 mix toroids. The impedance is stated to be greater than 5000 Ω at 3.5 MHz. Jim states that, as suggested by Chuck Counselman, W1HIS, a value of 5000 Ω is a more suitable target than the typical 500 Ω to optimize noise suppression. This impedance value is also much greater then traditionally accepted as needed for eliminating RF on the coax feed line, but the higher impedance can't hurt.

Putting it Together

I originally had planned to put the entire coil assembly inside a length of 4 inch diameter PVC pipe. The completed balun assembly, approximately 9 inches in diameter, is about as small as the assembly can be made without damaging the coax (see Figure 1). I realized that the PVC pipe could be used as a support

[1]Notes appear on page 47.

Figure 1 — My six turn balun, too big to fit inside a 4 inch diameter PVC pipe.

Figure 2 — An end view of the toroid wound balun.

Figure 3 — A side view of the balun assembly.

Figure 4 — Balun before final assembly.

Figure 5 — Completed balun and antenna.

Figure 6 — Balun and antenna mounted on tower.

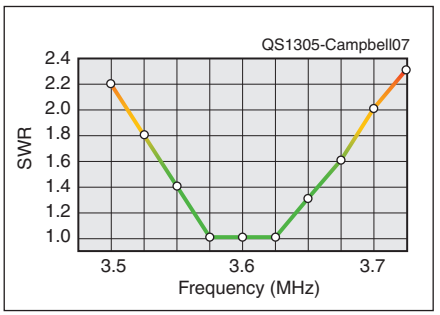


Figure 7 — SWR plot taken using *K3_EZ* software application and the author's Elecraft K3.

for the balun assembly by winding the coax through the stacked cores placed in the center of the PVC pipe and through side holes in the PVC pipe (see Figures 2 and 3). The 4 inch PVC pipe, end cap and eye bolt assembly provide support and protect the toroid stack from the weather (see Figures 4 and 5).

The rows of holes are about 5 inches apart along the pipe axis. A 2 inch center-to-center hole separation around the circumference will keep the turns spaced far enough apart. They should not be bunched together. Silicone sealant applied to any openings will seal them well enough to keep water from entering on the sides. Drilling six or eight 1/16 inch holes in the assembly bottom provides for drainage of condensation. Those holes are small enough to keep out most insects.

While it isn't difficult to wind the coax through the holes in PVC pipe and the stacked toroids in the center, a small amount of petroleum jelly helps in threading the coax through the toroid stack.

The completed balun and antenna mounted on the tower is shown in Figure 6. The balun looks neat, like something from Tesla's world. More importantly, it works! Figure 7 shows an SWR scan generated using the *K3_EZ* software application as verified by my Elecraft K3. As expected, the choke did not change the antenna system SWR. Your total cost for this balun, not including the coax, should be less than $50.

Notes

[1] *The ARRL Antenna Book,* 22nd Edition, pp 24-42. Available from your ARRL dealer or the ARRL Bookstore, ARRL order no. 6948. Telephone 860-594-0355, or toll-free in the US 888-277-5289; **www.arrl.org/shop**; **pubsales@arrl.org**.

[2] **audiosystemsgroup.com/RFI-Ham.pdf**

ARRL Life Member Jerry Campbell, K4ZHM, was first licensed in 1957 and has held an Amateur Extra class license since 1971. Jerry can be reached at 1417 Troy Rd, Wilmore, KY 40390 or at **k4zhm@arrl.net**.

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

New Products

Dual Polarized 2.4 GHz Flat Panel Antenna from L-com

The HG2414DP-3NF from L-com is a 2.4 GHz three element, dual polarized panel antenna said to provide high gain and combined vertical and horizontal polarization in a single enclosure. Compatible with IEEE 802.11 b/g/n standards, the HG2414DP-3NF combines three separate antennas in a single housing. The unit consists of multi-patch antennas, two vertically polarized and one horizontally polarized. It is designed primarily for point-to-multipoint and point-to-point applications. The triple feed system makes it ideal for use with routers with 1, 2 or 3 antenna ports. With features such as a UV-resistant plastic radome and an included tilt and swivel mast mount kit, this antenna can be mounted indoors or outdoors and aligned for maximum signal propagation. Price: $100. For more information, visit **www.l-com.com**.

Buckmaster HamCall on DVD with HamCall Archives

Published on CD-ROM since 1990, HamCall from Buckmaster Publishing has outgrown 700 MB CDs and is now published on DVD, which holds up to 4.7 GB of data. The Ham Call database includes 2,175,000 current call signs and now, with the extra DVD space, includes 590,000 archival call signs from 1960 and 1983, all integrated into one call sign lookup program. Search by name, city, county, state, country and more. HamCall is supported by more than 53 logging programs and ham-related programs. Price: $50 including 6 months of downloadable updates and 6 month HamCall.net Gold member website access, or $80 for 12 months of down-loadable updates and HamCall.net access. For more information, or to order, visit **http://hamcall.net**.

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

Hendricks BitX17A 17 Meter SSB Transceiver Kit

Ten watts on an exciting band — all with a rig you build yourself.

Reviewed by Bob Allison, WB1GCM
ARRL Senior Test Engineer
wb1gcm@arrl.org

I've enjoyed building kits lately. It's fun constructing something useful, and at the same time I learn how each section of a kit is supposed to work. Wishing for another challenge, I chose the BitX17A from Hendricks QRP Kits, a fully functional SSB transceiver that covers a band in which I rarely operate — 17 meters. The similar BitX20A kit for 20 meters is also available at the same price.

The BitX17A is related to the BitX20, the 20 meter version originally conceived by Ashhar Farhan, VU2ESE, who intended the design to be easily built from surplus and salvaged components using *ugly construction* (soldering the parts together over a ground plane). A Yahoo! Group of dedicated followers soon formed and the design was refined, making this fledgling transceiver quite popular with low power (QRP) enthusiasts.

In 2007, Doug Hendricks, KI6DS, decided the BitX would make a great kit for radio amateurs who didn't wish to spend the time hunting for the necessary parts. An experienced team created a PC board layout and resolved the inevitable issues with making any new design stable and reproducible. In 2008, the kit was offered to the amateur community. The Yahoo! Group is still very active today, helping builders of the 20 and 17 meter versions (more on this later).[1]

The BitX transceiver kit is not for beginners. I recommend that the novice builder attempt the assembly of smaller kits first, in order to gain the experience of following instructions, soldering and using small hand tools. Hendricks offers simpler kits such as the Scout Regen Receiver.[2]

[1] **groups.yahoo.com/group/BITX20/**
[2] S. Ford, WB8IMY, "Scout Regen Receiver by Hendricks QRP Kits," Short Takes, Oct 2012, p 59.

The BitX components are small, so the proper magnifying eyeware, good lighting and a pair of steady hands are needed. The builder must also have some basic test equipment, such as a signal generator, digital volt-ohm milliameter (VOM), dummy load and wattmeter. An oscilloscope with a diode probe is helpful as well.

The detailed and well illustrated manual guides the builder through one building block of the transceiver at a time, followed by basic tests and adjustments. Don't rush it. Enjoy the process and savor every solder joint. There's no race, but the builder will be a winner, with a trophy in hand, upon completion.

What You Get

The BitX17A kit includes a powder coated and punched case, a commercial quality PC board (plated through holes, silkscreened and solder masked), a digital readout, Polyvaricon tuning capacitor, hardware, knobs and rubber feet. It's everything needed to make this kit a complete SSB transceiver. Just add a power supply and push-to-talk microphone.

The completed BitX transceiver has a somewhat Spartan, yet handsome appearance. The professional looking panel labels are water soluble transfers the builder must apply. There are only three controls: the ON/OFF/VOLUME control, the 1⅛ inch diameter COARSE TUNING knob, and the FINE TUNING control (±7.5 kHz), that tunes both transmit and receive. Though the control knobs are nonmetallic, they do have a sturdy feel. The MIC jack accepts a three conductor, ⅛ inch mini phone plug.

The 1⅝ × ½ inch, four digit LED FREQUENCY dial is nicely proportioned to the front panel. A momentary pushbutton just below the lower right corner of the digital dial toggles the display to read kHz (100 Hz least significant digit) and MHz (0.01 MHz least significant digit). Pressing and holding the button will shut off the display, saving precious milliamps for battery operation.

A 2 inch speaker is mounted under the top of the blue cover. The rear panel has a coaxial jack for 13.8 V dc and a BNC antenna connector. A handy flip stand allows for comfortable viewing. The powder coated finish is thick and appears durable.

Under the hood is a single conversion receiver with a four pole crystal IF filter with an IF frequency of 12.96 MHz. There is *no* AGC circuitry. The venerable LM-386 audio amp IC provides plenty of power to the speaker. The BitX features a pair of IRF510 MOSFETs in a push-pull arrangement for 10 W RF output. You can use a dynamic or electret microphone.

The manual contains all the necessary construction, testing and alignment steps. There is a troubleshooting section with a schematic diagram of each circuit, a description of its

Bottom Line

The Hendricks BitX17A 17 meter SSB transceiver kit is challenging to build and rewarding to use. The finished radio sounds great on the air, although some operators will have to get used to having no AGC on receive.

function and what to look for in case of trouble.

Unpacking — A Lot of Parts!

My first step was to download and print the construction manual. The manual need only be printed in black and white, though I strongly recommend the color coded parts placement diagram be printed in color. The manual has a complete inventory of the included parts. In fact, the BitX17A kit is actually two kits: the transceiver kit and the KD1JV digital dial (Figure 1).

Usually, I place the various kit parts in empty cardboard egg cartons. Hendricks had a variation of sorting out parts I haven't thought of before — inserting parts into a two-tiered piece of packing Styrofoam (Figure 2). This turned out to be a great timesaver since each type of component was grouped together, making identification easier. In an hour's time, I had everything sorted, inventoried and was ready for construction. I decided to put aside the KD1JV digital dial until I completed the transceiver.

Construction

I must admit feeling a bit intimidated by the number of parts to be soldered to the 4½ × 5½ inch PC board. Would my eyes be up to the task of properly identifying and placing each part into the proper holes? To make sure, I borrowed my wife's 10X loupe magnifier from her pocket watch cleaning kit. I still had difficulty detecting some of the resistor color stripes. For example, violet looked like black to me. I ended up measuring each resistor with a VOM to ensure I had the proper value before soldering it to the circuit board.

Construction went smoothly, but at times, a practical decision had to be made in order to keep the work flowing. I used shielded cable from the microphone jack to the microphone input pads instead of a twisted pair of wires to avoid stray pickup. I also used miniature coax from the circuit board to the antenna jack. I decided to make tie points out of 2 W resistor leads for the major circuit board connections, such as the PTT line, the microphone input and the RF output connections. Using clip leads, the tie points made testing the circuitry and removal of the circuit board from the case a little easier.

I found it best to work on the kit in 2 to 3 hour intervals to avoid losing focus and making mistakes. As a Novice ham, I rushed to build my very first kit, a Heathkit DX-60B. After several "all nighters" of building, I eagerly turned on my newly completed transmitter for the first time, only to watch smoke billow out the top! After that painful lesson, I learned to take my time. Dear wife Kathy, KA1RWY, was most understanding, allowing me to commandeer the dining room table for several weeks. Total construction time was about 23 hours.

Figure 1 — Contents of the Hendricks BitX17A 17 meter SSB transceiver kit package. The material came well packed in thick, clear plastic envelopes.

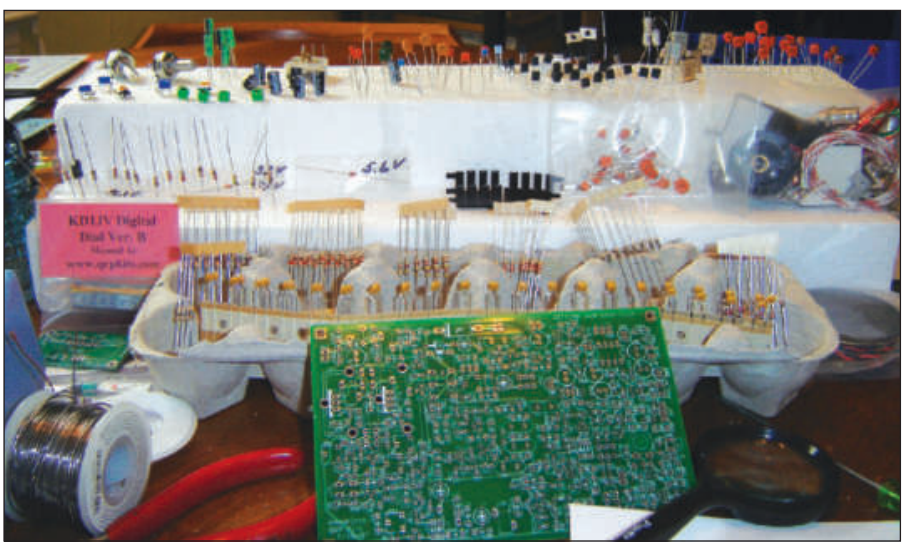


Figure 2 — My homemade parts holder, one of Hendricks' many helpful suggestions. I still needed a paper egg carton for the several strips of the same part.

I did have a bump or two in the road. I used the potentiometer without the on/off switch for the AF gain, only to discover this upon installing the control into the case. I had a good laugh and swapped it with other 10 kΩ potentiometer for the FINE TUNING control. Also, I had one resistor left over. Close inspection found two empty holes where it belonged — pilot error. Once I was certain all circuits were operating as they should, it was time to tackle the KD1JV digital dial.

Panic, then Resignation

The KD1JV digital dial is a kit by itself and is actually a mini frequency counter. Upon opening the plastic envelope containing all the parts, I was horrified to see itty bitty surface mount parts! My only experience with surface mount parts was with the installation of a

Table 1
Hendricks BitX17A, serial number BOB-0001

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: Receive & transmit, 17 meter band.	Receive & transmit, 18.028-18.217 MHz.
Power requirements: 12 V dc.	13.8 V dc ± 15% external power: Receive, max audio, no signal, LED display on, 170 mA, LED off, 158 mA; Transmit, 1.060 A (peak).
Mode: USB.	As specified.
Receiver	**Receiver Dynamic Testing (3 kHz IF filter)**
Sensitivity: Not specified.	18.150 MHz, 0.25 µV.
Noise figure: Not specified.	26 dB.
Blocking gain compression dynamic range: Not specified.	20 kHz spacing, 100 dB.
Second-order intercept point: Not specified.	18.150 MHz, +27 dBm.

ARRL Lab Two-Tone IMD Testing (3 kHz IF filter)*

Band	*Spacing*	*Input Level*	*Measured IMD Level*	*Measured IMD DR*	*Calculated IP3*
18 MHz	20 kHz	–21 dBm	–119 dBm	98 dB	+28 dBm
		–15 dBm	–97 dBm		+26 dBm

Receiver audio output: Not specified.	825 mW at 10% THD into 8 Ω. THD at 1 V RMS: 1%.
IF/audio response: Not specified.	Range at –6 dB points, (bandwidth): 860-3825 Hz (2965 Hz).
Spurious and image rejection: Not specified.	IF rejection, 81 dB; Image rejection, 107 dB.
Transmitter	**Transmitter Dynamic Testing**
Power output: 10 W PEP.	11 W PEP.
Spurious-signal and harmonic suppression: Not specified.	50 dB (3rd harmonic). Meets FCC requirements.
Unwanted sideband and carrier suppression: Not specified.	Unwanted sideband suppression, 50 dB; carrier suppression, 50 dB.
Third-order intermodulation distortion (IMD) products: Not specified.	At 10 W PEP, 3rd/5th/7th/9th order: –25/–38/–50/–59 dBc.
Receive-transmit turnaround time (tx delay): Not specified.	70 ms.
Transmit-receive turnaround time: Not specified.	64 ms.
Size (height, width, depth): 2.6 × 6.0 × 6.0 inches, including protrusions; weight: 1.25 lbs.	
Price: $180 including BitX transceiver, case, cover and KD1JV Digital Dial.	

*Due to filter bandwidth and the lack of AGC, the 5 and 2 kHz spacing tests could not be performed without receiver overload. No low noise test oscillator was available for the reciprocal mixing dynamic range tests. Second order intercept points were determined using an S5 reference.

roofing filter in a modern transceiver. I was ill-equipped and was lucky not to have damaged that radio. I nearly convinced myself I couldn't possibly do this part of the BitX, but soon decided to try something new. How hard could it be?

A quick search online found a YouTube video called "Surface Mount 101." The video made it look easy, once I understood the process and the tools needed. After obtaining a flux pen, the proper tweezers and a headband with magnifying lenses, I was ready to give it a try. At the ARRL Laboratory, I decided to try removing and re-soldering various surface mounted parts on a discarded sound card before attempting the digital dial kit. Soon I was comfortable enough with my newly found skill to start the last phase of the BitX kit construction.

Much to my surprise and relief, construction of the digital dial went well. Figure 3 shows one side of the completed PC board. Toward the end, I realized I could solder surface mount parts faster than through hole parts. I did have one unfortunate incident in which an accidental flick of the soldering iron sent a resistor flying in an unknown direction. Looking for a lost resistor the size of a pencil tip in our Lab was worse than looking for the proverbial needle in the haystack. I quickly realized my folly and asked fellow Lab Engineer Zack Lau, W1VT, for help. Zack has just about everything squirreled away, including a surface mount resistor kit. With a replacement resistor carefully in hand, I was able to complete construction.

With both kits complete, it was time for the final steps. Before mounting the hardware in the case, I applied the transfer labels to the front and rear panels and then spray coated them with clear-coat glossy paint to give the labels a long life. Figure 4 shows the finished PC boards, controls and speaker mounted in the case and ready for use.

Alignment and Lab Testing

The instructions for construction and alignment are good. It's important to carefully read each instruction, especially the setup of the PA idling current. This is accomplished by turning three potentiometers all the way down (counterclockwise) and sequentially adjusting each one while monitoring the current consumption with an ammeter. Not following the procedure carefully or simply adjusting for maximum power will quickly overheat the IRF510s. With a single audio tone input to the microphone jack, my BitX17A RF output measured 11 W. It also passed FCC emission standards.

Current consumption of only 170 mA maximum in receive mode and slightly over 1 A (peak) while transmitting makes the BitX a good candidate for battery powered portable operation. Power output starts to dip as the supplied dc supply falls below 11.5 V.

Transmit IMD 3rd order products levels fall into the "fair" category, while the 5th, 7th and 9th order products were comparable to many modern transceivers. Despite my rather outdated, generic hand microphone, transmitted audio sounded good. Carrier and unwanted sideband suppression are both 50 dB.

There is plenty of receive sensitivity, about 0.25 µV. That's just about at the noise level with a dipole antenna attached during daytime operation on 17 meters. Audio response favors the mid range, with –6 dB points at 860 and 3825 Hz nearly a width of 3 kHz and wider than the typical 2.4 or 2.7 kHz IF filter widths seen in modern transceivers. The manual gives tips on changing the filter shape; that requires some experimenting.

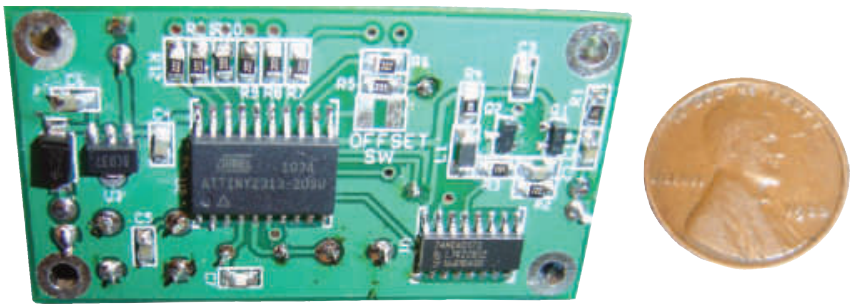


Figure 3 — One side of the completed KD1JV digital dial, showing the surface mount parts. The penny gives an indication of how tiny this PC board and components are.

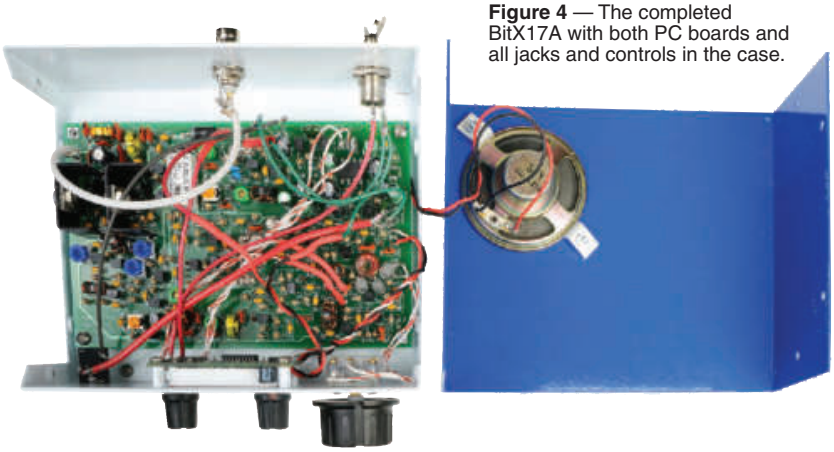


Figure 4 — The completed BitX17A with both PC boards and all jacks and controls in the case.

There is no external speaker jack but I tried hooking up an external speaker to the BitX17A. This helped increase the lower audio frequencies, indicating the filter skirts are not terribly sharp, but the audio is quite good this way. There is plenty of room on the rear panel for extra connectors, such as an external speaker jack.

Table 1 shows the test results from my building efforts. As with any kit, some tweaking may be needed. For example, the builder has option to choose from one of three tuning ranges — roughly 185, 377 or 448 kHz — by using a section or both sections of the Polyvaricon tuning capacitor. I opted for the smallest tuning range. That makes tuning the main dial easier since the phone band is a mere 58 kHz wide on 17 meters. Choosing the narrowest tuning range meant I had to find the correct number of turns for L7, an inductor made of many turns around a ferrite toroid. While the manual called for 36 turns of the provided #36 AWG enamel wire, I found 37 turns were needed to hit my tuning target. My actual tuning range ended up being 18.028 to 18.217 MHz. A drop of hot glue secured each of the 10 toroids to the circuit board.

Once completed, the owner of a BitX transceiver may choose to use it as is, or modify it to specific needs. There are plenty of articles and videos of modifications to be found on the Internet.

Support

The Hendricks website suggests that the builder join the Yahoo! Group that specializes in supporting and modifying the BitX transceiver. There are over 1000 entries, starting at the beginning in 2004 to present day, so there is plenty to read about!

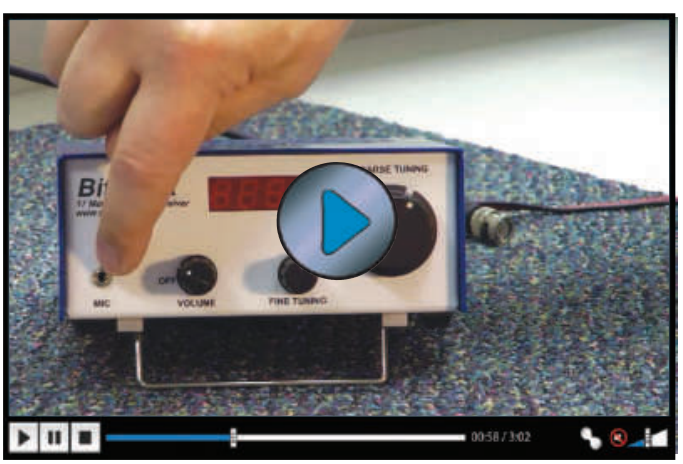
The Yahoo! Group was very helpful when I had trouble comprehending the digital dial hookup. The instructions and programming were not clear to me in either manual. Arv Evan, K7HKL, and others jumped in to get me on course. I soon figured out that I had to *first* have the digital dial (counter) read the BFO frequency (12.96 MHz), then put the counter in the Lo—A mode (IF + VFO frequency), disconnect the counter from the BFO and then couple it to the VFO, using a 22 pF capacitor to the top of R27, allowing the display of the actual operating frequency.

Kinks

There is a birdie at 18.1375 MHz that is present even when the antenna jack is disconnected. The birdie is not strong, but it does interfere with weak signals around that frequency. Arv Evan, from the Yahoo! Group, told me it was caused from the harmonics of the BFO mixing with the harmonics of the VFO. He hinted that the band-pass filter made up of C25 and L10 can be fine tuned to minimize the birdie.

I observed some frequency drift when the BitX17A is first powered up. Reasonable stability is achieved after about 10 to 15 minutes. This is most likely due the temperature variations of the mechanical (Polyvaricon) tuning capacitor and surrounding components. I searched the web and quickly learned there is a modification for converting the BitX mechanical tuning to varactor tuning, greatly improving ease of tuning and reducing drift. There is also a Zener diode modification to improve temperature stability.

See the Digital Edition of *QST* for a video overview of the Hendricks BitX17A 17 meter SSB transceiver kit.



On the Air

Listening to a receiver without AGC allows the user to hear the nuances of changing propagation with variations of speaker volume. While this effect is interesting, please keep in mind that a strong station popping up suddenly may startle the operator. The rapid change in volume is something to think about before considering installation of a headphone jack.

My first contact, as many of you would guess, was with W1AW across the ARRL Headquarters parking lot. Using attenuation, W1AW station manager Joe Carcia, NJ1Q, was able to critically listen to my transmitted audio. Joe gave the BitX17A a clean bill of health, so I brought it home where I could put it on the air using my 17 meter antenna attic dipole. Undeterred by my compromise antenna, I patiently tuned around a bit. Eventually, I heard a friendly fellow wrapping up a contact and decided to give him a call. To my surprise, KD4FNI, Glenn in Ozark, Alabama, came right back to me and gave a report of 53 with good audio. It wasn't big DX, but it was big DX for me considering the power output and antenna.

I spent more time tuning around the 17 meter phone band that Sunday afternoon in early February, listening to stations in Europe, South America and the US. I actually worked a few too until the band faded and closed a couple hours after sunset. That day will always be a memorable one for me. The day's fun inspired me enough to string up an outside 17 meter antenna and I vowed to make that band QRP only, *for the challenge of it.*

Conclusion

The BitX17A is a complete, single band, SSB transceiver kit that has reasonable performance and is affordable. A builder with moderate skill can build and modify the BitX.

Manufacturer: Hendricks QRP Kits, 862 Frank Ave, Dos Palos, CA 93620; tel 209-704-3522; **www.qrpkits.com**.

M² 2M-1K2 High Power 2 Meter Amplifier

Reviewed by Jeff Klein, K1TEO
QST Contributing Editor
wa2teo@aol.com

You can have a lot of fun on 2 meters with the 50 or 100 W available from a modern transceiver or transverter. That's plenty of power for local contacts and for DX when the band is open, but you'll eventually want more power if you start to get serious about working VHF contests, DX or some of the more challenging propagation modes such as scatter or EME (moonbounce).

VHF operators have a number of choices for power amplifiers up to the legal limit of 1500 W. Solid state "brick" amplifiers typically provide power up to about 300 to 400 W. Beyond that power level, tube type amplifiers have traditionally been required. High power solid state amplifiers are now practical with a new generation of MOSFET devices that run at higher voltage levels (about 50 V) instead of 12 or 28 V. This creates some interesting new choices.

Enter M², long known for a wide selection of antennas and accessories. M² has expanded into the solid state power amplifier arena as well with high power amplifiers for 6 and 2 meters. Both models are compact and light weight, offering substantial power in a package that fits comfortably in any home shack or portable station. This review takes a look at the 2M-1K2 for 2 meters, capable of running 1250 W output on SSB or CW and about 900 W on continuous modes such as FM voice or digital modes that you can operate using *WSJT*.

Options

The 2M-1K2 allows the option of using an integrated power supply from M² or supplying your own (48-50 V at 40-50 A). The review unit included the M² supply. One of the goals M² set for this amplifier was to make it small and lightweight. With the power supply, the package measures 7¼ × 15 × 14 inches (HWD) and weighs just over 20 pounds — small and lightweight indeed.

Setup

The M² amplifier package is ready to go and reminiscent of adding a linear amplifier to an HF station. Setup involved only a few steps, starting with a 240 V ac line for the power supply. It came with an ac power cord that I then mated with a plug to match the existing 240 V wall socket in my shack. If the optional M² power supply is not used, the amplifier comes with #10 AWG leads for connecting an external dc supply.

The 2M-1K2 has a built-in TR relay (ground to transmit), connected through a phono jack on the back panel. My station uses a TR sequencer that is operated with a footswitch. The TR sequencer makes sure that my transceiver, amplifier and preamplifier are all keyed in the correct order, with no "hot switching" of relays. Hooking up a connection between the sequencer and the amplifier for keying was straightforward. A direct connection between the transceiver and the amplifier can also be used, but for reasons discussed later it is advantageous to use a sequencer.

The rear panel has Type N female connectors for RF input and output. Be sure that you're using coaxial cable rated to handle 1200 W on 2 meters. The manual recommends using a wattmeter between the amplifier and antenna as no internal wattmeter or SWR meter is

Bottom Line

The M² 2M-1K2 is a quiet and convenient solution for high power operation on 2 meters. It puts out near legal limit power and is compatible with most modern transceivers or transverters.

included. Once these connections are made the amplifier is ready to go.

Front Panel

The straightforward front panel has all of the information needed to operate the amplifier except a wattmeter to show power output. The ON/OFF switch controls the integrated ac power supply, and the POWER switch places the amplifier inline or bypasses it as needed. The JT MODE switch moves the amplifier into more efficient class C operation to run continuous modes such as *WSJT* and FM that do not require linear operation. Amplifier output is slightly reduced when it is in JT MODE (see Table 2).

The +50V LED indicates that power is on, and READY lights if the amplifier is inline. There is also a VSWR/TEMP LED to indicate high SWR or amplifier overheating. The JT LED shows that the amp is in JT mode, and the TX indicator shows that the amplifier has been keyed and is in transmit mode.

Rear Panel Connections

The rear panel (Figure 5) includes jacks for the input from the transceiver and the output to the antenna. Neither jack is marked, though they are clearly shown in the instructions. This is not a major issue, but labels would be nice (and easy to add), especially for those who take the amplifier to a portable location and need to break down the station from time to time. Internally there is an RF coaxial relay on the input side and a high power vacuum relay on the output. No additional relays should be needed, a nice feature for added simplicity of operation.

The rest of the rear panel includes the phono jack to key the amp, as well as a terminal strip with a 13.6 V at 500 mA output and a switching contact that could be useful for external relays and preamps. Early versions of the amplifier had a 20 pin connector used for factory testing only. This connection has been moved inside on later versions. Other than the chassis ground, I did not need to use any of these connection points.

Table 2
M² 2M-1K2, serial number 201222

Manufacturer's Specifications	Measured in ARRL Lab
Frequency range: 144-148 MHz.	As specified.
Power requirements: 180-264 V ac, 47-63 Hz, 15 A maximum.	As specified.
Driving power required: 50 W (maximum).	As specified.
Power output: 1200 W PEP with 50 W drive.	As specified, typically: *RF Input (W)* / *RF Output* (W)* / *JT Mode* (W)* 5 / 335 / 335 10 / 580 / 580 15 / 760 / 760 20 / 920 / 840 25 / 1010 / 840 30 / 1090 / 850 35 / 1150 / 880 40 / 1200 / 920 45 / >1200 / 960 50 / >1200 / 1000
Spurious and harmonic suppression: Not specified.	65 dB; meets FCC requirements.
Transmit intermodulation distortion: Not specified.	3rd/5th/7th/9th order: –26/–43/–43/–52 dB.
Size (height, width, depth): 9 × 7 × 13 inches; weight, 20.6 lbs.	
Price: $2995 with power supply; $2425 without power supply.	

*RF Output using SSB and CW. JT Mode represents 100% duty cycle modes, such as JT65 and FSK441 digital modes or FM voice.

Using the Amplifier

After years of using tube type amplifiers requiring high voltage supplies and warm up periods, I found that operating the 2M-1K2 is

WSJT — Digital Modes on VHF

WSJT by Joe Taylor, K1JT, is a free software program for weak signal digital communication. Using a standard transceiver with a computer interface, the program allows communication with signal levels near or below the audible signal level. It allows operators to work more stations than they might ordinarily be able to work using SSB or CW.

WSJT offers several modes of operation. FSK441 is used for meteor scatter. JT65 is used for EME (Earth-Moon-Earth) and troposcatter, and JT6M is used for scatter mainly on 6 meters. Because it allows much greater ability to work weak signals, much of the EME and scatter work on the VHF bands is now done using *WSJT*. Stations with single Yagis and medium power can routinely work scatter, long haul troposcatter and EME by using the program.

To learn more about *WSJT* or download the program, you can go to the *WSJT* home page at **physics.princeton.edu/pulsar/K1JT/**. As discussed in the text, the 2M-1K2 has a JT MODE switch to be used for *WSJT* operation with its longer duty cycle. — *Jeff Klein, K1TEO*

Figure 5 — The 2M-1K2 rear panel.

about as simple and quick as it can get. After pushing the ON and POWER buttons, the amplifier is ready to go. That is a nice feature of solid state amplifiers and it made me think of all the times over the years that I have run into brief sporadic E openings on 2 meters and had to wait several agonizing minutes before I could run high power!

Two fans come on at startup to keep the built in power supply cool. There are also two fans on top of the amplifier that come on to cool the RF section as needed. They would usually come on for transmissions longer than a minute or so, or when I was doing some intense heavy duty cycle operating during a contest. Even with all fans going, the noise level in my shack was far lower than the normal level for my 8877 tube type amplifier that I use on 2 meters.

The LDMOSFET device at the heart of the 2M-1K2 needs only a few watts to drive it to maximum output. Recognizing that many typical transceivers run considerably more power, M^2 built in a 10 dB attenuator so that the amplifier will operate at maximum power with about 50 W drive. I set my TS-2000 drive level at 45 W and found this consistently created more than 1200 W of output power as measured with my Bird wattmeter. See Table 2 for the results of the ARRL Lab tests at various drive levels. While using the amplifier in JT Mode, the power output was around 900 W.

I did run into one issue along the way. When I first received the amplifier, every time I turned it on the noise floor rose in my receiver. Typically it would jump about two S units, more than enough to be problematic for serious 2 meter operators. Cycling the amplifier on and off confirmed the noise was coming from the new installation. I was able to use external relays to bypass the amplifier on receive, indicating the noise was coming from the amplifier. M^2 suggested returning the amplifier, and testing on their end indicated that the built in switching power supply was the source of the noise. It was not a problem they had heard about from others, so perhaps it was just a single bad supply. M^2 sent a new amplifier and supply and the problem was solved.

Amplifier Protection

The 2M-1K2 comes with two important protection features. If the SWR at the output reaches 2.5:1, the amplifier is deactivated and the VSWR/TEMP indicator will let the user know of the problem. The second feature is a temperature sensor. If the amplifier reaches 40° C, the fans come on to cool the RF deck heat sink. If the temperature reaches 90° C, the amplifier will shut down and the indicator light on the front panel will come on. The amplifier can be reset by cycling the READY switch.

I used the amplifier for a number of long *WSJT* attempts and also for the ARRL January VHF Contest. Under those intense operating conditions I never ran into any problems that tripped the protection circuitry. The manual indicates that it is unlikely for the amp to shut down in an over-temp condition, and that was my experience even running this amplifier flat out for extended periods.

TR Switching

As noted earlier, I keyed the amplifier through my existing sequencer, which itself is activated by a footswitch. As a result, I had no problems with my preamps, or with timing for keying the amplifier on CW. Testing in the ARRL Lab, however, did show that the TR relay is a bit slow to engage. The manual indicates that the there is a 15 to 20 ms delay built in before bias voltage is applied to the MOSFET device.

This is consistent with what was seen in the ARRL Lab. The TR switching circuitry in the 2M-1K2 is slow enough that the first character may be lost during semi break-in CW operation or the first syllable may be truncated if using VOX on SSB. For transceivers with adjustable delays, this problem can likely be solved with a delay to match the amplifier's engagement time. Better yet, use a sequencer to create the small delay before keying. There is no problem if you're using a mic with a manual PTT switch or a footswitch on CW, or for someone starting a digital transmission.

Documentation

The 21 page operating manual does a good job of describing setup and operation. It also provides helpful background on the amplifier's capabilities and on the protection circuitry. I found the troubleshooting section helpful as well. For those inclined to "open up the hood" there are clear schematics of all of the boards as well as pictures. M^2 has also added helpful information on *WSJT* operation, knowing that many who are interested in high power operation will also want to use that mode to work either scatter or EME.

On the Air

I was able to use the amplifier for several weeks with regular over the air contacts and to give it a real workout during *WSJT* skeds and during the ARRL January VHF Contest. I live in Connecticut where there are quite a few locals who know me well and have heard my signal at high power using my TS-2000 and 8877 amplifier for many years. A big concern in a relatively congested area for 2 meter operation is to be sure you have a clean signal. Living in a good location with four high gain antennas means I am pushing a lot of RF in the direction the array is pointed. I have always gotten good reports on my signal — how would that hold up with the 2M-1K2?

Bottom line is that after a good deal of testing, all reports came back with excellent audio quality. Testing showed that the TS-2000 barefoot and with the amplifier inline sounded the same, confirming the amplifier was "clean" over the air. I actually ran the amplifier at slightly higher power most times (around 1200 W) versus my tube amplifier (800 W).

Overall it was a fun experience to use a new piece of equipment and have it perform as it was supposed to. For me the appeal of the amplifier is the small size, broadband tuning, low voltage supply and lower noise level compared to my own tube amplifier. Solid state operation near the legal limit at 2 meters is now a reality, and M^2 offers an excellent candidate for those choosing to head in that direction.

Manufacturer: M^2 Antenna Systems, 4402 N. Selland Ave, Fresno, CA 93722; tel 559-432-8873; **www.m2inc.com**.

See the Digital Edition of *QST* for a video overview of the M^2 2M-1K2 high power 2 meter amplifier.

Larry D. Wolfgang, WR1B, tc@arrl.org

Contributing to Science

More on Electromagnetic Interference (EMI) Troubles

In this column in the March 2013 issue of *QST*, Jack Belrose, VE2CV/VE3CVV, mentioned some tests conducted by Norm Rashleigh, VE3LC, on the EuroFase lighting system that gave Larry Parker, VE3EDY, so much trouble. Jack mentioned a YouTube video that Norm has posted to demonstrate his tests. Unfortunately the URL for that video was printed incorrectly in *QST*. The URL is correct in the digital edition of *QST*, however. The correct link for Norm Rashleigh's video is **www.youtube.com/user/ve3lc**. You will find several Amateur Radio related videos there. Scroll down to the EuroFase Interference video. — *73, Larry Wolfgang, WR1B, ARRL HQ*; **lwolfgang@arrl.org**

Amateur Radio Science

Eric Nichols, KL7AJ, had a great article in the February 2013 issue of *QST*, titled "Amateur Radio Science." The thrust of Eric's article was to encourage Amateur Radio operators to get involved in the science of radio. He pointed to a couple of specific examples, and stated in his introduction that "…you don't need a PhD to enter, just some curiosity and a willingness to look beyond routine radio."

We've Done It Before

Our history has many instances of Amateur Radio contributing to radio science. It all stems from the Radio Act of 1912, which regulated us to wavelengths below 200 meters (frequencies higher than 1.5 MHz) that were considered to be useless for all but local contacts. We accepted the challenge, and set off into uncharted territory with a "can do" attitude. This attitude resulted in many new discoveries and worldwide radio communications.

For example, in the summer of 1920, fading tests by amateurs were run in conjunction with the Bureau of Standards. Bureau of Standards personnel met with the ARRL to come up with a joint proposal, as reported in the July 1920 issue of *QST*. The results of these extensive tests involving Amateur Radio operators were discussed in the November 1920 and December 1920 issues of *QST*. As an ARRL Member, you have access to these old issues of *QST* through the ARRL Periodicals Archive and Search (**www.arrl.org/arrl-periodicals-archive-search**).

Another great example is Amateur Radio's discovery of trans-equatorial propagation. In August 1947 Amateur Radio operators reported the first instance of unusual VHF propagation. During the International Geophysical Year (July 1, 1957 to December 31, 1958), the ARRL set up the Propagation Research Project (PRP) and collected reports from Amateur Radio operators of possible 50 MHz and 144 MHz ionospheric propagation. The 50 MHz reports were analyzed by the Radio Propagation Laboratory at Stanford University (notably Mason Southworth, W1VLH and Oswald G. Villard, Jr, W6QYT). Mason Southworth, W1VLH, published a summary of this work in the June 1959 issue of *QST*.

Two relatively recent examples are the eleven year study of mid latitude sporadic E by Pat Dyer, WA5IYX, (March 1992 *QST*) and Dave Olean, K1WHS, building a magnetometer to predict aurora to aid in his chasing of 144 MHz DX (his write-up of this project is at **www.directivesystems.com/PDF/MAGTALK.PDF**). There are many, many more examples, and me not mentioning them does not diminish their contribution.

What Can I Do?

I suggest you read Eric's article again, and then take a look at his references. If those don't suit you, there are other areas in which contributions can be made.

How about a study of noise at your QTH? The goal would be to understand how it varies throughout a solar cycle, throughout the seasons and throughout the day. It could be a specific study on a single band, or you could branch out and do the whole HF enchilada. Along the way you'd learn about antennas, about measuring noise, and about atmospheric/galactic/man-made noise.

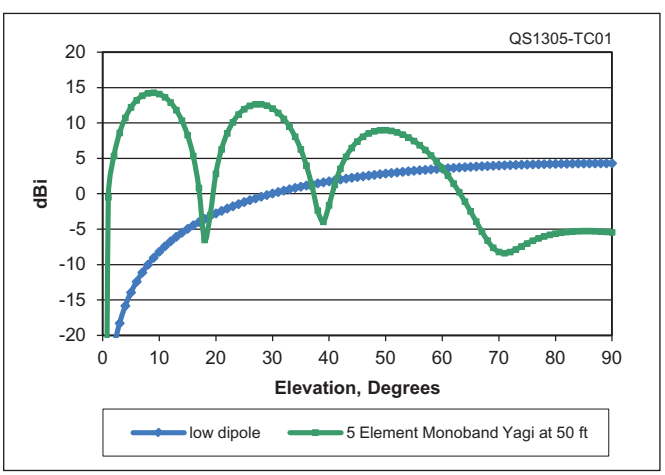


Figure 1 — Gain of 10 meter antennas versus elevation angle of arriving signals.

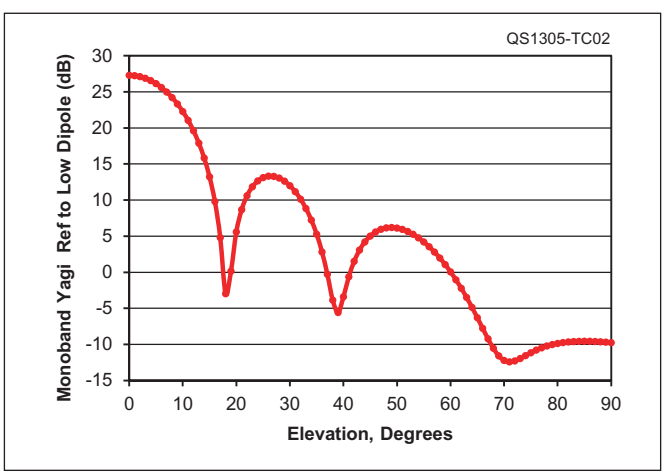


Figure 2 — Advantage of a 10 meter monoband Yagi at 50 feet over a 10 meter dipole at 4 feet.

Table 1
Sample of Initial Results Comparing a 10 Meter Monoband Yagi at 50 Feet with a 10 Meter Dipole at 4 Feet

Date	Time (UTC)	Call	Yagi Signal	Dipole Signal	Delta (dB)	Angle (degrees)	Comments
5-Jan-13	1548	VO1CAL	S9	S5	22	10	
6-Jan-13	1437	PA7MM	S7	S3	25	7	
12-Jan-13	1358	MWØYUK	S8	S3	21	11	
14-Jan-13	2250	VK2LAW	S5	S2	22	10	
17-Jan-13	1958	ZL1BYZ	S6	S3	20	12	
20-Jan-13	1511	OE2Ø13S	S6	S2	27	2.5	Band Just Opening

Something With Antennas

Another good study would be the elevation angle of arriving signals. We have predictions of these (see *The ARRL Antenna Book*), but not a lot of measured results. I have a 10 meter monoband Yagi at 50 feet, and at the end of 2012 I strung a 10 meter dipole (the wire runs northwest-southeast) at 4 feet high. When the monobander is pointed to Europe or to Australia/New Zealand, the dipole is off the tips of the monobander for minimal interaction. Figure 1 shows the gain of these two antennas using *EZNEC*.

Figure 2 shows the difference in gain between these two antennas. By noting the difference in signal level between the two antennas, you can surmise the arriving angle (within certain limitations, of course). Table 1 gives a sample of my initial results.

If you do something like this, along the way you'll learn about antennas, antenna modeling, calibration of your S meter, interaction between antennas, and taking readings under signal fading conditions. You might even answer some questions about high angles (the Pedersen ray) and sporadic E (in the summer). Most of you will likely restrict this study to frequencies of 14 MHz and higher due to antenna height considerations.

Summary

As KL7AJ suggests, get involved in more than just "routine radio." You may not contribute to an Earth-shattering discovery, but you'll gain a better personal understanding of your topic. And it may even be good fodder for a presentation at your local club meeting or a local hamfest. — *73, Carl Luetzelschwab, K9LA, 1227 Pion Rd, Fort Wayne, IN 46845*; **k9la@arrl.net**

Off Center Fed Dipoles

I live on the western edge of the Mojave Desert, where ambient seasonal winds can gust up to 100 mph. I try to keep the highest parts of my HF antennas behind the "shadow" of my house, somewhere around 20 to 22 feet above ground.

I purchased an off center fed dipole (OCFD) on the premise that by hanging its short end over my ham shack, I could economize on the coaxial cable that would be required to feed the antenna. What I learned shortly after receiving my new antenna kit was that it had to be suspended about 35 feet above ground, to attain the 50 Ω antenna resistance that a conventional OCFD requires.

The feed point of an OCFD (designed for 50 Ω systems) is 30° off center, or 60° in from one end of the antenna wire. The feed point resistance at that point is 200 Ω, so a 1:4 step-up transformer is used. My problem was that I would not be able to install the antenna high enough to attain the requisite 50 Ω. I was going to have to improvise.

The basic formula for an OCFD, when driven at 50 or 75 Ω impedance is given by Equation 1.

$$F_r = \frac{R_a}{\cos^2\left(L^o\right)} \qquad \text{[Eq 1]}$$

where F_r = feed point resistance (normally 200 Ω)

R_a = feed line characteristic impedance (normally 50 Ω)

$L°$ = electrical length of the antenna wire from one side of the dipole to the point at which the 1:4 transformer is attached. The standard value for $L°$ is 60°.

If the equation were rearranged, we could use known values for F_r and R_a to compute the value for $L°$.

$$\cos^2\left(L^o\right) = \frac{R_a}{F_r} \qquad \text{[Eq 2]}$$

$$\cos^2\left(L^o\right) = \frac{50}{200} = 0.25$$

From Equation 2, we only need to run potential $L°$ values to find a match for 0.25. That can be accomplished on a computer or simple inexpensive pocket calculator that includes trigonometry functions. For example, for the normal OCFD, $\cos^2(60°) = 0.25$.

Basic antenna theory tells us that a half wavelength dipole (180°) displays minimum impedance at its mid point (90°) position, and maximum impedance at its end (0° and 180°) positions. Along with Equation 2, we can formulate a couple of OCFD axioms:

1) If R_a is less than 50 Ω, $L°$ will be greater than 60°.
2) If R_a is greater than 50 Ω, $L°$ will be less than 60°.

Using these axioms, we can substitute alternate values for R_a, and by dividing by 200, we can come up with various numerics equivalent to "$\cos^2(L°)$."

In an imaginary situation, let's say that the available value for antenna resistance (R_a) is 40 Ω. Dividing 40 by 200, we arrive at the value for $\cos^2(L°) = 0.200$.

Using a scientific calculator, we can take the square root of 0.200, and find the value as 0.447. Then find the arc cos (or inverse cos) value to be 63.4°. Note that axiom 1 says that if R_a is less than 50 Ω, $L°$ will be greater than 60°. That gives us a check on our math, to indicate that our calculation is reasonable. You can perform similar calculations for other values of R_a, for your particular case.

Finally, we will translate the value of electrical length to feet and inches: 63.4° / 180° = 0.352 times the antenna length. So with my 40 meter antenna's total length of 64.5 ft, I will have 0.352 × 64.5 ft = 22.7 ft, or about 22 ft, 8½ inches. Measure in that distance from one end of the antenna wire, and the feed point resistance (F_r) should be 200 Ω, ±1%.

These calculations are based on my adaptations from an article by Frank Witt, AI1H, "How to Design Off-Center-Fed Multiband Wire Antennas Using that Invisible Transformer in the Sky," on page 66 of *The ARRL Antenna Compendium, Volume 3*. — *73, A. Mike McAlister, KD6SF, 7570 Dartmouth Ave, Rancho Cucamonga, CA 91730*

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

There's Always Room for Some Kind of Antenna

Q Jim, MØMAC, asks: I have only a small backyard and I am considering putting up a 40 meter dipole. I only have a span of 54 feet available so I can't fit a full size 66 foot antenna. My supports can be 25 feet high. Is it feasible to fold back wire at each end to make it fit?

A Your approach is viable; the only thing is that just folding back the ends of the wire doesn't quite maintain the resonance, so some more wire is needed. The closer the spacing, the more wire will be required. At this length you will have an antenna that will have virtually the same performance as full size, and will be able to cover the band with a reasonable SWR.

The good news is that the peak gain (per my *EZNEC* modeled antenna over typical Earth) is only down 0.15 dB from full size.[1] The shortened antenna has a lower impedance than the full size version at this height, and that works to your advantage, resulting in a 2:1 SWR bandwidth that covers the whole band.

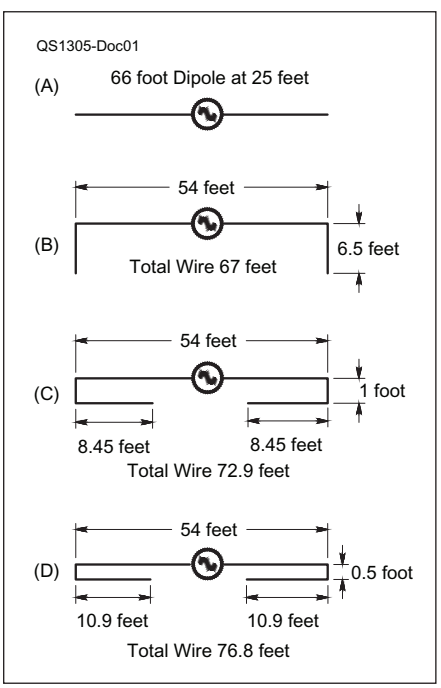


Figure 1 — The *EZNEC* modeled wire lengths required for various folding strategies. Note that the perpendicular bends (case 2) don't have to be parallel.

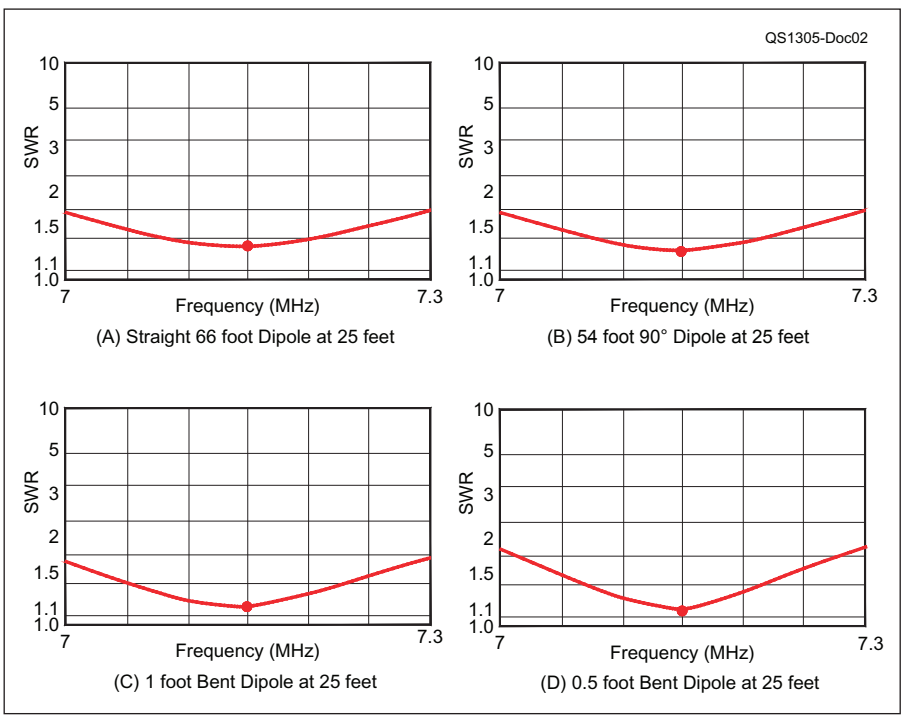


Figure 2 — SWR of each of the four dipole versions of Figure 1 at 25 feet above typical ground (conductivity 0.005 S/m, dielectric constant 13).

Figure 1 shows the modeled determination of required wire lengths for the various shortening strategies that will fit in your space. As indicated, the closer the spacing, the more wire will be needed to achieve resonance. The SWR for each configuration is shown in Figure 2. Note while the bandwidth of each case covers the band with a 2:1 SWR, the full size dipole would have an even wider bandwidth if it were matched to 50 Ω.

[1]Several versions of *EZNEC* antenna modeling software are available from developer Roy Lewallen, W7EL, at **www.eznec.com**.

The extreme case may be a dipole folded back on itself made of 450 Ω window line. Such an antenna resonant at 7.15 MHz can be made as short as about 42 feet long, with 83 total feet of wire required. The impedance drops to 30 Ω at resonance and the 2:1 bandwidth is less than half the band if matched at the center. It will still work just fine within its limits.

Q Richard, KD6UNR, asks: How can I find out what the difference is between the signals required for S meter readings of S-7, S-8 and S-9 on my SSB transceiver? I would like to use the readings to verify the performance of a Yagi antenna I am building.

A Some recent transceivers actually are set up so that the S meter is calibrated. That means that a reading of S-9 happens only if the voltage at the an-

tenna terminals is exactly 50 µV (–73 dBm at 50 Ω). Each S unit represents a change of 6 dB from that. So an S-8 is 25 µV (–79 dBm), an S-7 is 12.5 µV (–85 dBm) and so forth.

Unfortunately, most other transceivers and receivers are not only uncalibrated, but the difference in level required for a change of 1 S unit is not the same across the scale. In addition, they often differ on different bands and change with the RF GAIN control, as well as with different filter selections.

The best way to actually determine the meaning of S meter readings is to use a calibrated signal generator to inject a known signal into the receiver (be sure to disable the transmit function — few signal generators last long as dummy loads) and record the meter readings corresponding to the values you are interested in. As noted above, you should do this on each band of interest and take note of all control positions, since that will be the conditions under which the calibration is accurate.

That does take a pretty expensive signal generator with a calibrated attenuator to get all the data. Another possibility is to borrow a receiver with a calibrated S meter and compare and log the meter readings. A relatively inexpensive Elecraft XG3 RF Signal Source will provide calibrated signals from 1.5 to 200 MHz at levels of 107 dBm or 1 µV (slightly above S-3), –73 dBm or 50 µV (S-9), –33 dBm (S-9 + 40 dB) and 0 dBm.[2] By constructing a pair of 6 dB attenuators, it is easy to go from S-9 to S-8 (with one attenuator) and then to S-7 (with two in cascade). Making shielded attenuators for a fixed change is pretty easy — one metal box, two coax connectors and three resistors, see Figure 3. If you find an inexpensive step attenuator at a hamfest, that will be even handier. An attenuator can also be used directly (without the need for a calibrated meter) to determine Yagi front-to-back ratio, or other signal differences.

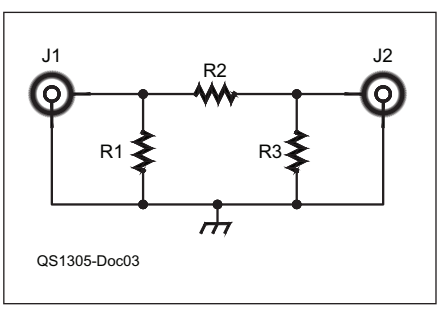


Figure 3 — Schematic diagram of a 6 dB, 50 Ω attenuator. Use non-inductive carbon composition resistors and keep leads short. To avoid coupling, build in a shielded box. One such attenuator will reduce a signal by 1 S unit. J1 and J2 are coax connectors of your choice, I like the size and easy on and off of BNC type connectors in this application. R1 and R3 are 150 Ω, the R2 target is 37.4 Ω. While 150 Ω is a standard 5% value, the closest to 37.4 Ω are 36 Ω (6.2 dB) or 39 Ω (5.8 dB). You can either accept the small difference, or buy 10 or so and select the closest using an accurate ohmmeter. Note that if you build two and use 36 Ω in one and 39 Ω in the other, the two in cascade will provide 12 dB attenuation, right on for 2 S units.

Q Carl, KB3YUV, asks: I have a question about the recent *QST* Product Review of the Elecraft KX3 QRP transceiver.[3] I am trying to understand the description of image rejection in direct conversion receivers a little better. The article states: "In the direct conversion architecture with an IF of dc (0 Hz), the image is just twice the beat note away." Please help me understand this. What is the "beat note?" What are the other issues?

A To listen to a CW signal on the usual superhet, it is necessary to mix the incoming signal with a signal at about 1 kHz from the intermediate frequency (IF). This signal is generated in the receiver by the *beat frequency oscillator*. The mixing of the two signals results in an audio tone of 1 kHz whenever the transmitter is keyed. This is called the beat note, and without it we couldn't hear Morse code in our receiver (switch your receiver to AM mode to observe this effect).

A direct conversion receiver works essentially the same way, except it all happens at the signal frequency — there is no conversion to an IF. A local oscillator is mixed directly with the incoming signal. For example to listen to a CW signal at 14,020 kHz, the local oscillator could be set to 14,021 (or 14,019) kHz and the resulting 1 kHz beat note would be audible. The problem is that with this arrangement you can actually hear two signals at every setting of the tuning knob. For example, if the local oscillator is set to 14,021, you can hear the desired signal at 14,020 but you will also hear any signal on 14,022 kHz just as well. This is referred to as the *audio image*.

In the more common superheterodyne receiver, this signal can be removed before it gets to this point in the receiver by the use of selective filtering in the IF stages. Fortunately, there is a way to remove the audio image in a direct conversion receiver by the use of old radar receiver technology — the image canceling mixer. This is the same idea as a phasing type of SSB exciter that uses two 90° phase shift networks and two balanced mixers to cause the image to be cancelled, resulting in single signal reception. This is described in detail in my book *Basic Radio*.[4]

Q Al, W4ZSC, asks: I have always been oriented toward looking at receiver sensitivity as a function of bandwidth; hence CW reception in a narrow filter provides greater receiver sensitivity than wider bandwidth modes. In the usual software defined radio (SDR) display, one of the benefits is being able to see a displayed spectrum covering an entire amateur band or even more. The SDR advocates and advertisers proclaim this is a great advantage for SDR with which I would heartily agree; however, does this result in the loss of sensitivity we would expect in a receiver with perhaps a 300 kHz bandwidth as opposed to perhaps 1 kHz or less for CW?

A That is a very good question, and one that does not have the same kind of immediate answer we expect from our experience in the analog world! While the SDR is indeed scanning across a very wide bandwidth, the digital signal processor (DSP) at its heart is effectively processing a small chunk or slice of bandwidth at a time. That slice is the effective bandwidth that determines the sensitivity. The amount that can be displayed on the screen (apparently, but not in reality all at the same time) is some multiple of that effective bandwidth depending on the processing power of the DSP engine. More insight into the operation of SDRs can be found in a new ARRL book, *The ABCs of Software Defined Radio*, by Martin Ewing, AA6E.[5]

[2]R. Allison, WB1GCM, "Product Review — Elecraft XG3 RF Signal Source," *QST*, Nov 2011, pp 58-60.
[3]J. Hallas, W1ZR, "Product Review — Elecraft KX3 HF and 6 Meter QRP Transceiver," *QST*, Dec 2012, pp 39-44.
[4]J. Hallas, W1ZR, *Basic Radio,* p 6-5. Available from your ARRL dealer or the ARRL Bookstore, ARRL order no. 9558. Telephone 860-594-0355, or toll-free in the US 888-277-5289; **www.arrl.org/shop**; **pubsales@arrl.org**.
[5]M. Ewing, AA6E, *The ABCs of Software Defined Radio*, Available from your ARRL dealer or the ARRL Bookstore, ARRL order no. 6320. Telephone 860-594-0355, or toll-free in the US 888-277-5289; **www.arrl.org/shop**; **pubsales@arrl.org**.

Do you have a question or a problem? Ask the Doctor! Send your questions (no telephone calls, please) to "The Doctor," ARRL, 225 Main St, Newington, CT 06111; **doctor@arrl.org**.

Steve Ford, WB8IMY, wb8imy@arrl.org

RemoteHamRadio Station Network

Imagine your dream station, the one you'll never own because…

- You can't afford it (most dream stations come with price tags north of $50,000).
- You don't own a house, much less the acres of property needed to support several towers, a four-square vertical antenna array on 80 and 160 meters, etc.
- It will generate RF fields the likes of which God has never seen and cause your neighbor's electronic devices to respond accordingly.
- Your spouse says, "No way."

The DIY solution is to build your dream station at your buddy's abode and control it via the Internet. (Surely you have a friend with dozens of acres available to satisfy your every whim, right?) You'll need to have a few tons of hardware delivered and installed. When that task is complete, you will need to interface all that gear to your generous friend's Internet connection. Then, you'll need to set up the other end of the Internet control circuit at your home.

RemoteHamRadio takes a far less painful approach to the remote dream station dilemma. For an annual subscription fee, they provide easy Internet access to not just one but *several* superbly equipped stations.

How Does It Work?

You need only two things to qualify for access to the RemoteHamRadio network: a computer (even a tablet computer will do) and a broadband Internet connection with a minimum downstream data rate of 1 Mbps. The RemoteHamRadio people take care of everything else.

Your membership begins when a package shows up at your door. Inside you'll find an Elecraft K3/0 transceiver and a RemoteRig transceiver/network interface. The K3/0 contains no RF components whatsoever; it is a transceiver designed strictly for remote control functionality.

The next step begins when your telephone rings. That will be the support person at RemoteHamRadio calling to walk you through the process of connecting various cables and testing your setup.

The RemoteHamRadio K3/0 with the Remote Rig interface and the Apple iPad I was using at the time.

The RemoteHamRadio console screen. You select your stations and control their antennas and amplifiers here. There is also a "chat" window so that you can exchange messages with other operators.

You're on the air in less than 30 minutes and the experience is nothing short of astonishing. The RemoteHamRadio implementation is so seamless, no one visiting your station can tell that your transceiver isn't a real radio connected to a massive array of antennas that just happen to be hiding in your back yard. Spin the K3/0 VFO and listen to the signals zip by. Adjust the K3 filter bandwidths and hear the effects instantaneously. Plug a set of paddles into the RemoteRig and bang out Morse as powerfully as anyone else — especially when you activate the remote power amplifiers.

In addition to working voice and CW, you can also operate any digital mode supported by the K3. During this review, for example, I used my iPad tablet to operate PSK31.

You'll have access to a wide array of antennas at one of five station locations in the eastern United States (more are on the way). Some of the antenna selections include stacked, rotatable Yagis with phenomenal performance. While I was test driving the RemoteHam Radio system I heard signals that were completely undetectable with my 43 foot vertical antenna. Busting a pileup with a single call was a unique pleasure as well!

Is all this luxury legal? Absolutely. As far as the FCC is concerned, these are simply ham stations with extremely long microphone cords, so to speak.

Do your contacts count for ARRL DX Century Club awards? Under the current rules, yes. You operate these remote stations using your own call sign, so you take credit for the contacts you make. The rules of other award programs may differ.

Cost Considerations

Accessing the RemoteHamRadio network isn't inexpensive. Annual subscription costs range from $2999 to $4999 and you are also charged by the minute for access, depending on the package you purchase. (This helps discourage those who might monopolize a station for hours at a time.)

However, for those who are unable to get on the air at all — much less from a dream station — the costs are reasonable when spread over the course of an entire year. It is a particularly attractive option for groups of amateurs in retirement communities where the costs can be shared.

As for me...well...having access to Remote HamRadio was similar to being given the keys to a high performance sports car for an entire week. It was quite a ride!

Manufacturer: RemoteHamRadio, tel 888-528-6937; **www.remotehamradio.com**.

H. Ward Silver, NØAX, n0ax@arrl.org

Experiment #124

The Beta Match

This month's column will show you four different types of antenna feed-point impedance matching that all work in the same way even though they look quite different. In addition, I'll introduce a new friend for your computer toolbox — *SimSmith* by Ward Harrington, AE6TY.

The basic problem — impedance matching using inductance across an antenna's feed-point — is the same, but the solution goes by several names. This makes it more difficult to understand because giving the same things a different name (or giving different things the same name) is confusing. Nevertheless, as you read the column, keep in mind that all of the techniques presented here accomplish the same task.

The Essential Problem and its Solution

While discussing impedance matching of antennas, it's natural for most hams to imagine impedances *greater* than 50 Ω. The examples we use in learning about SWR primarily use higher impedance values for the calculation Z_{LOAD} / Z_0: 100 / 50 = 2:1, for example. In actuality, it's common for Z_{LOAD} to be *less* than 50 Ω. A Yagi's driven element feed-point impedance is often in the range of 20 to 30 Ω and the natural impedance for a quarter-wave monopole (the common ground plane) is around 35 Ω.

Transforming this lower impedance to 50 Ω doesn't lend itself well to the most common techniques. The impedance ratio of 1.4 - 2:1 doesn't fall into the usual 1:2:4:9-type ratio of "easy" transformer impedance ratios, nor are there coaxial cables with a characteristic impedance of 35 to 40 Ω that would enable simple quarter-wave "Q sections" to do the job.[1] [A pair of 75 Ω cables in parallel will get in range, though they are a bit clunky. — *Ed.*]

Nevertheless, the clever approach illustrated in Figure 1 gives the electrical schematic view of how this problem is solved. First, we have to give up the usual assumption that the feed-point impedance is resonant — that is, R + *j*0 Ω. It's part of our "ham DNA" that makes us think antennas need to be resonant to work, but in this case resonance actually makes the problem harder.

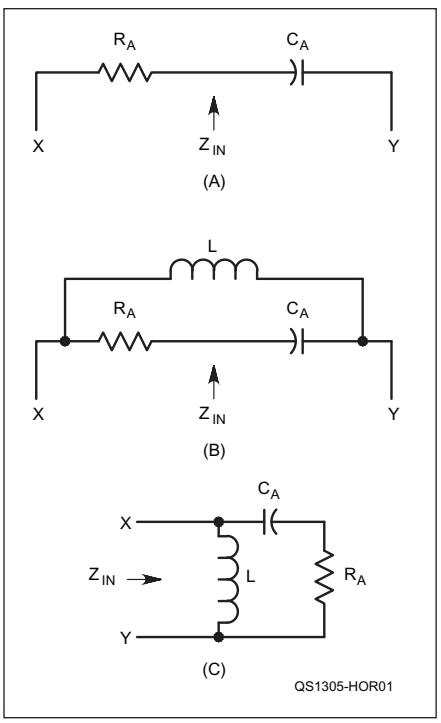


Figure 1 — A Yagi driven element or a monopole's feed-point impedance is made capacitive by shortening it below its resonant length. Adding inductance in parallel with the resulting impedance creates an L network as in (C), transforming the impedance to 50 Ω.

By making the antenna a little shorter than its resonant length, the feed-point impedance becomes slightly capacitive (A). That capacitive reactance can then be used as part of an L network by adding an inductor across the feed point as shown in (B). Redrawing the circuit (C) results in the L network's more familiar form. (See Experiment #21 for more about L networks.)

There is a bit of a trick involved. You can't have just *any* amount of resistance and capacitive reactance. The combination has to be in the right range so that adding the inductance transforms the impedance to 50 + *j*0 Ω. How do you figure that out?

SimSmith

The standard way of visualizing transmission line and impedance matching mechanics is by using a Smith chart. (If you are unfamiliar with the Smith chart, read the introduction in Hands-On Radio experiments #59-61. Recent editions of the *ARRL Antenna Book* include a detailed tutorial on the Smith chart, either in print or on the CD-ROM.[2]) Yesterday's compass and straightedge have been replaced by interactive computer software such as the easy-to-use *SimSmith* (**www.ae6ty.com/Smith_Charts.html**). Written in Java, AE6TY's free tool is available for a wide variety of computers. Furthermore, he has created videos and guides to explain how to use the software and the Smith chart, so there is no reason not to have a copy and begin learning the power of "seeing inside" transmission lines and matching networks. Before taking a look at our current problem using *SimSmith*, allow me to point out a few of its features that I will use here.

First, as you can see in Figure 2, the program shows the usual *constant-resistance circles* and *constant-reactance arcs* in light red. Less usual are the *constant-conductance circles* and *constant-susceptance arcs* shown in light blue. (Susceptance, B, is the reciprocal of reactance, X.) The normalized 1.0 + *j*0 point is at the center. (In our 50 Ω world, that represents an impedance of 50 + *j*0 Ω or an admittance of 0.02 + *j*0 S, where S is the symbol for siemens, the unit of conductance.) From any impedance or admittance point on the chart, adding resistance or reactance in series "moves" along the red circles

[1] See Hands-On Radio experiment #81, "Synchronous Transformers." All previous Hands-On Radio experiments are available to ARRL members at **www.arrl.org/hands-on-radio**.

[2] *The ARRL Antenna Book,* 22nd Edition. Available from your ARRL dealer or the ARRL Bookstore, ARRL order no. 6948. Telephone 860-594-0355, or toll-free in the US 888-277-5289; **www.arrl.org/shop**; **pubsales@arrl.org**.

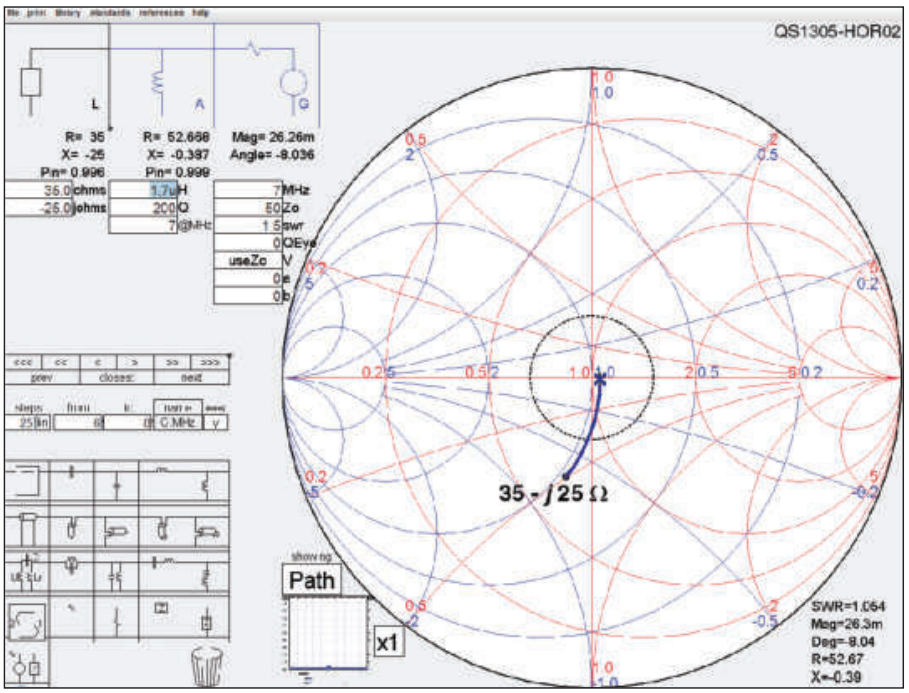


Figure 2 — *SimSmith* screen showing the shunt inductance sub-circuit matching a load of 35 – *j*25 Ω.

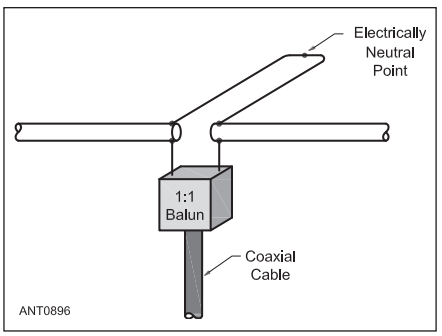


Figure 3 — The hairpin match across a balanced, insulated driven element. Hy-Gain antennas attach the electrically neutral center of the hairpin to the antenna boom, creating a beta match.

and arcs. Adding resistance or reactance in parallel or *shunt* "moves" along the blue circles and arcs. (Instead of move, I'll use the correct term *transform* from here on.)

At the upper left, *SimSmith* shows the transmission line circuit you've constructed, including a load at the left and the source (*generator* in Smith chart speak) at the right. A collection of subcircuits is available at the lower left — there is everything from series and shunt components, to stubs, to tuned circuits, to general-purpose blocks that perform specific math functions. Add a subcircuit by drag-and-dropping it onto the transmission line circuit at the desired point. Then fill in the values (too small to reproduce in the figure) underneath the subcircuit. *SimSmith* does the rest. Let's try it.

Using a Coil

Figure 2 is a screen shot from *SimSmith* showing the equivalent of Figure 1C. An easier to read version is on the Hands-On Radio web page. By entering 1.5 in the generator's SWR value window, *SimSmith* drew a *constant-SWR circle* around the center — all points within this circle represent SWR values of 1.5:1 or less — for reference. I selected a frequency of 7 MHz because I use a quarter-wave vertical on 40 meters at my station. Game on!

While designing an antenna, achieving the goal of being able to use a single shunt inductor as your matching network requires the right feed-point impedance, shown as the load on *SimSmith*. Adding the shunt inductor will transform the impedance counter-clockwise parallel to one of the light blue constant-conductance circles as shown by a heavy blue line. (The inductor adds susceptance but does not affect the conductance. Parallel capacitance transforms clockwise.) The feed-point impedance should be designed such that adding inductive susceptance can transform the impedance to within the desired constant-SWR circle.

Starting with the antenna's feed-point impedance at the left, I've entered a value of 35 – *j*25 Ω. This is a reasonable value for an aluminum tubing vertical over a good ground system, adjusted to a bit less than its natural resonant length. By "fiddling with" (technical term) the value of inductance, I found that a value of 1.7 µH presented a resulting impedance of 52.3 – *j* 0.4 Ω to the feed line for an SWR value of 1.05:1. I'd say that works. In fact, this is quite close to the size of inductor I use to match my vertical antenna on 40 meters.

Try a Shorted Stub

Assuming you've downloaded *SimSmith* and are running it, enter the same values for load impedance but replace the parallel inductor with a shorted stub — the sub-circuit directly below the parallel inductor. Drag-and-drop the parallel inductor sub-circuit into the trash can symbol. Then drag the shorted-stub subcircuit to the transmission line circuit.

From the values *SimSmith* assumes about the stub (such as it being made of 50 Ω coax), adjust the length until you get about the same match as with the inductor (≈55°). For fun, increase stub length to 90° — the stub now presents an open circuit so that it does nothing. (See Experiment #22 for more about stubs.)

Can you use a longer length to create an inductive feed-point impedance and match it with a parallel capacitance? Change the feed-point impedance to 35 + *j*25 Ω and find out. (300 pF should get you close.)

Using a Hairpin

Along with shunt inductance and shorted stubs, the third name and fourth idea covered here is the *hairpin* or *beta match* shown in Figure 3. You should recognize the matching device as a shorted stub of open-wire transmission line. Typical hairpins are made of heavy wire with wide spacing that results in a high characteristic impedance. What length of hairpin is required to match our original load if its characteristic impedance is 300 Ω? (Roughly15° or 2.8 feet at 7 MHz for a 95% velocity factor.)

If the driven element is insulated and electrically balanced, the very center of the feed-point and the matching hairpin are electrically neutral. Hy-Gain antennas add mechanical stability to the design by attaching that point of the hairpin to the antenna boom — also electrically neutral with respect to the feed line — creating the *beta match*.

A Common Theme

You should now see the common theme of all four matching designs. By creating capacitive reactance in the feed-point impedance and applying a shunt inductance across the feed point, the ratio and phase of voltage and current can be altered to create a purely resistive impedance of the desired value.

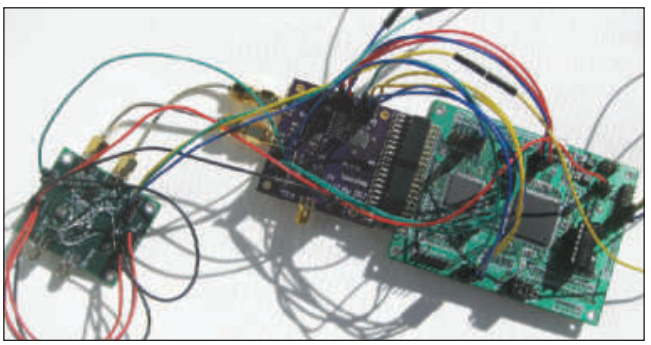
Steve Ford, WB8IMY, wb8imy@arrl.org

SDR Marches On

These are exciting times in the world of software defined radio (SDR). The atmosphere reminds me of the late '60s and early '70s when inexpensive integrated circuits became widely available to the Amateur Radio community. There were hams building HF receivers with handfuls of chips and the possibilities seemed almost endless.

The chips are still with us, but now they are orders of magnitude more powerful than anything I could have imagined back in the day. The idea of taking an RF signal directly from an antenna and converting it to data for software processing would have been pure science fiction in 1973. I remember thinking that such a thing might *someday* be possible, but I assumed that was a milestone for the distant future; it would be something I'd never live to see.

Recently I heard from a professor of electrical engineering at a prominent university who said, "When it comes to RF these days, it seems to be all about software defined radio. Even my freshman students come to their first classes having at least heard of SDR. They're eager to get their hands on analog to digital converters, field programmable gate arrays and, of course, software. When I was their age, it was discrete transistors and ICs. Today it's SDR."



The HackerRF transceiver prototype under development.

A number of amateurs have been among those on the cutting edge of SDR and interest in the ham community is strong. If you doubt this, you should take a look at the huge positive reaction we've received in response to the article "Cheap and Easy SDR" by Robert Nickels, W9RAN, in the January issue of *QST*. Ditto for the strong sales of our book for beginners, *The ABCs of Software Defined Radio* by Martin Ewing, AA6E.

For more advanced enthusiasts, Scott Cowling, WA2DFI, sent a tip about the SDR seminars Arrow Electronics is holding around the country. The seminars are free and you get a BeRadio development kit in the bargain. Although these classes are intended for engineers, they are attracting plenty of serious hobbyists as well — so many that when this column was written back in February, they were completely sold out. The word is that Arrow is planning to continue the seminars, so it's best to check their website at **www.arrownac.com/solutions/beradio/**.

The BeRadio SDR development kit.

Les Rayburn, N1LF, sent a link to a new SDR project whose goal is to produce a single transceiver capable of operation from 100 MHz to 6 GHz. Best of all, the price point the developer is shooting for is in the range of $300.

The product is intended for use in commercial and military applications, and just received a $200,000 development grant from the Department of Defense, but it has obvious Amateur Radio potential as well. You can follow the project on the HackerRF blog at **http://ossmann.blogspot.com/2012/06/introducing-hackrf.html**.

A New Smartphone/Tablet Interface

If you follow this column you know that I occasionally mention new ham-centric apps for smartphones and tablets. The only issue with using these devices on the air is finding a reliable interface to link the device and the transceiver. Skip Teller, KH6TY, designed a neat VOX-activated interface and described it in his March 2011 *QST* article "Digital VOX Sound Card Interface." It uses transmit audio from the smartphone or tablet to key the Push-To-Talk (PTT) line of your transceiver. This is the interface I've been using and it does a pretty good job on PSK31 and RTTY with my Apple iPad tablet.

Josh Mesilane, VK3XJM, has taken this idea a step further for those who don't want to build their own hardware. His *817iPad* interface is intended for use with the Yaesu FT-817 transceiver, but I don't see why you couldn't adapt it to a different radio. It offers calibrated transmit and receive audio with full signal isolation.

The VK3XJM iPad interface.

Building these interfaces is strictly a cottage industry for Josh. Demand has been high, so he occasionally has difficulty keeping the interfaces in stock. They sell for about $48 US at the time of this writing, not including shipping from Australia. Go to: **www.zindello.com.au/wordpress/shop/817ipad-interface-complete/**.

Steve Sant Andrea, AG1YK, hk@arrl.org

Magnifying SMTs, Battery B+ and a Field Day Dipole

Inexpensive SMT Microscope

In the March 2012 issue of *QST* Wayne Smith, WA4WZP, wrote an excellent article on using a USB webcam as a digital microscope for surface mount work.[1] That got me thinking about possible alternatives. In the period between the use of overhead projectors and the transition to laptops/tablets, a device called the document presenter (aka document camera) was sold widely. Its purpose was to digitize written documents and overheads and transfer them to a projector. These devices often had a high resolution camera with excellent optics, autofocus, lighting and other great features. Although still sold for classroom use, their popularity waned so they are currently available, used, for drastically reduced prices. I have found them to be an excellent magnifier for SMT work.

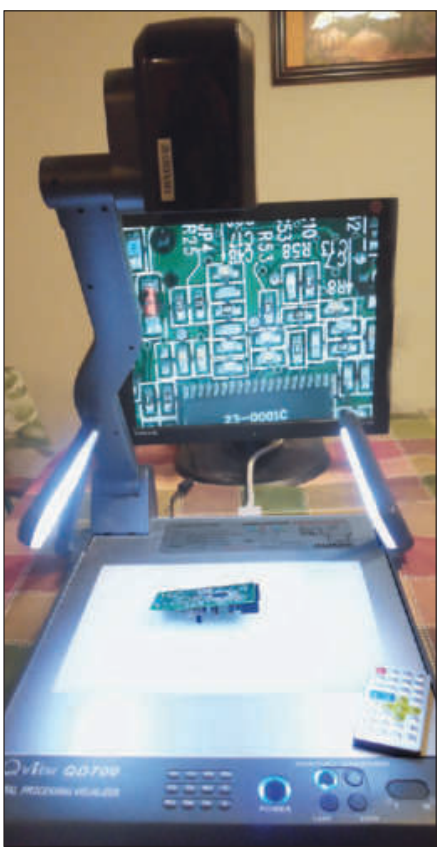


Figure 1 — Document cameras are available, inexpensive on the surplus market and make excellent magnifiers for SMT or other fine work. [Mat Breton, AB8VJ, photo]

When shopping for a unit the important characteristics are:

- Camera resolution; the higher the better
- The optics; generally the higher the zoom the better for SMT work
- The type of video output; In general, an XGA output is best, followed by VGA with NTSC video having the lowest quality. [SXGA outputs are also available as are some other high resolution video outputs but the aspect ratios of these vary and they may not display correctly on a standard monitor. — *Ed.*]
- Refresh rate; the higher the frames per second, the better for soldering

Other great features that are sometimes available are the ability to fold up into a small space, backlighting and the ability to control and capture images through a USB interface.

Because the surfaces are non-conductive plastic, it is important to use a ground mat or other anti-static procedures when working with sensitive electronics. A sheet of glass may suffice if using the backlight. Either will protect the soft plastic surface from stray solder drippings or scratches.

I was able to pick up an excellent unit for less than $1 on eBay [not including shipping — *Ed.*]. It has LED lighting, XGA resolution, a 22X optical zoom, both XGA and USB outputs as well as other great features (see Figure 1). I added an old flat panel monitor and now have an excellent digital microscope for next to nothing in terms of both effort and cash. — *73, Mat Breton, AB8VJ, 35229 Rosslyn St, Westland, MI 48185*, **ab8vj@arrl.net**

B+ From a Battery

Lately there seems to be a renewed interest in using vacuum tubes in small CW transmitters. The main problem in working with tubes in this SMT era is how to obtain the high plate voltage (B+) needed to operate them. Depending on the operating power level, tubes require from 100 V for low power operation, up to perhaps 200-300 V for a power-house like the old 6L6 tubes, which are still readily available.

Figure 2 — Inexpensive 12 V to 120 V inverters can make an effective substitute for a high voltage transformer, allowing the operation of small tube transmitters from 12 V batteries. [Robert Richardson, K4AMN, photo]

B+ plate transformers are not an everyday shelf item these days. Wiring a B+ power supply directly from the ac mains (without a transformer) is *very dangerous* and also makes portable operation impossible. The trendy, and more elegant, option is to provide for operation from a 12 V battery source, which might, in turn, be charged by a solar panel. Recent weather events have certainly born out the need for portable, self-sufficient readiness.

I have thought up a simple solution. The small 12 V dc to 120 V ac inverters that are available can substitute for the B+ transformer in a power supply circuit. If you don't have one already, you can purchase one very inexpensively. The Model 66944 inverter shown in Figure 2 is available at Harbor Freight for $17 and is good for 80 W.

You can use the inverter like a transformer to feed a simple power supply circuit and convert the inverter's 120 V ac to a higher level dc voltage. In the "Power Supplies" chapter of the *ARRL® Handbook* are half- and full-wave rectifier and voltage multiplier designs that will supply B+ range voltages.[2] Using an inverter in place of the usual high voltage transformer is inherently safer and well suited to portable emergency operation especially considering that tube equipment is much

[1] W. Smith, WA4WZP, "Webcam Microscope for the Radio Amateur," *QST*, Mar 2012, pp 38-39.

[2] Available from your ARRL dealer or from the ARRL Store, ARRL order no. 4197 or 4050. Telephone toll-free in the US 888-277-5289 or 860-594-0355, fax 860-594-0303. **www.arrl.org/shop/**; **pubsales@arrl.org**.

more resistant to EMP effects. — *73, Robert Richardson, K4AMN, 12418 Colby Dr, Woodbridge, VA 22192-2105*, **inoue@att.net**

Just Add Wire

Every ham needs at least one dipole antenna and every dipole needs a center insulator, two end insulators and a feed line support. You can make these items in many ways, for example, by sawing some Plexiglas as shown in Figure 21.15 of the 2013 *ARRL Handbook*.[3]

What if you don't have the Plexiglas? Another alternative is to cut and drill a plumbing PVC 1 inch Tee fitting to the dimensions shown in Figure 3. The top half of the lateral tube is cut away. Cut this hemispheric section into three parts. Cut two end insulators, each 10⁄16 inch wide, from the sides of the section and drill holes in each end. This leaves a 1 inch wide top section, which can then be drilled as needed to support either coax or twinlead. You get all the parts needed for just a small effort (see Figure 4).

The three holes in the center tube allow for either halyard mounting or pole mounting. If using coax, use Nylon clamps of proper diameter for support. You might find Tees whose lateral tube is either 3⅝ or 3⅛ inches long. If so, opt for the longer length because the shorter length requires rasping out the radius material between tube and the Tee as indicated.

[3]See note 2.

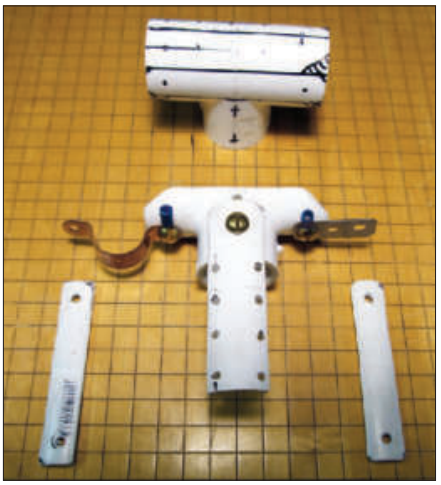


Figure 4 — In a portable or emergency situation, a PVC Tee can be cut into center and end insulators for a makeshift dipole. Just add wire. [Steve Sant Andrea, AG1YK, photo]

For hardware, brass bolts rather than steel will give you longevity without corrosion. Solder lugs should be heavy duty to withstand both pulling and flexing. Three possible choices, all using material available at major hardware stores are:

- Gardner-Bender P/N 15-105 Ring Terminals, come in a package of 15. They have a ¼ inch hole, which accepts up to 14 AWG wire. These are plated steel, not copper, normally used for interior wiring.
- Plumber's Tape, also called Hanger Strap, is ⅝ inch wide, predrilled, plated steel strap used for hanging galvanized pipes.
- Conduit or Tube Strap is a ½ inch wide metal, omega-shaped support used for hanging ¾ inch copper pipe. When flattened, cut in half, and drilled, it will make two pieces. — *73, Spud Monahan, K6KH, 817 Pacific Ave, Manhattan Beach, CA 90266*, **k6kh@aol.com**

Separating Aluminum Tubing

I have found a method for separating telescoping lengths of aluminum tubing that may be stuck firmly together due to minor corrosion. First, I use a screwdriver to lift, very slightly, the segments of the slotted ends. I do this one segment at a time, to prevent permanent bending. Then I cup my hand closely under the joint and dribble a little rubbing alcohol on it (see Figure 5). I repeat this 3 or 4 times over the course of a minute, then wait for a minute.

After allowing the alcohol to soak in, I use two pliers and/or locking grips to separate the two pieces. I find that the alcohol has penetrated to the very end of the joint, softening the corrosion products, allowing the tubes to be separated, at which point I can wipe off the soft residue before it dries. — *73, Bob Wilkinson, W7VN, 19048 Woodton Ln, Brookings, OR 97415*, **w7vn@arrl.net**

Figure 5 — A little rubbing alcohol applied to the junction of two stuck antenna elements can soften whatever impurities have become lodged between the sections, allowing them to be more easily separated. [Lorraine Wilkinson, W7RFC, photo]

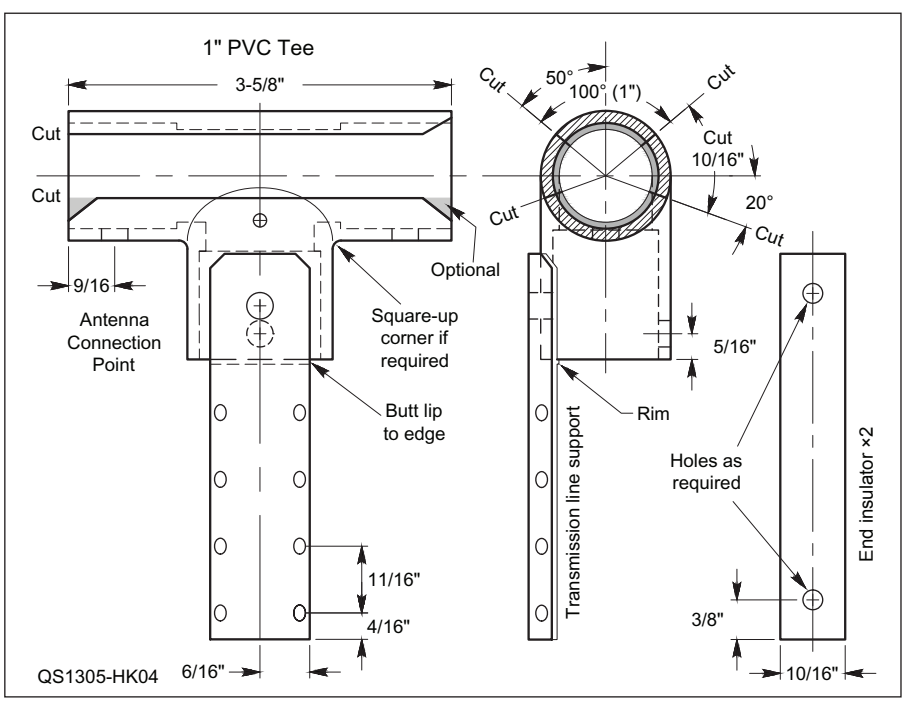


Figure 3 — This layout drawing shows how to cut the PVC Tee to create a complete dipole insulator set.

"Hints and Kinks" items have not been tested by *QST* or the 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 Kinks" at ARRL Headquarters, 225 Main St, Newington, CT 06111, or via e-mail to **hk@arrl.org**. Please include your name, call sign, complete mailing address, daytime telephone number and e-mail address on all correspondence. Whether you are praising or criticizing an item, please send the author(s) a copy of your comments.

A Crazy Idea: DXpedition to Cyprus

A teenager ignites his ham family's enthusiasm for a holiday DXpedition to Cyprus.

Padraig Lysandrou, KC9UUS

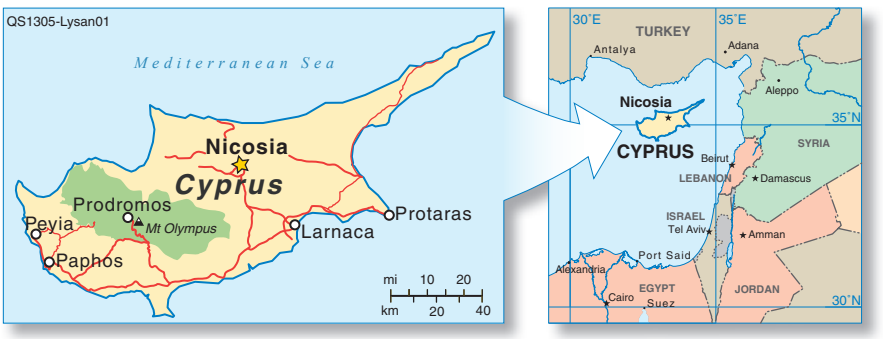
Many of us have tried to contact a DXpedition that's activating a rare entity. Many of us have also dreamed of being on a DXpedition to an exotic locale with plenty of hours to enjoy making contacts. Few of us have thought of leading a DXpedition, with all the details, difficulties and expense that entails, often traveling halfway across the world. Well, I can tell you that inexperience can be bliss, because leading such a DXpedition is exactly what I did. I am 15 years old and live in Bloomington, Indiana. From June 2-18, 2012, I led a very small DXpedition to the Greek part of the divided island of Cyprus. This is the story of that experience.

It started in the fall of 2011 when I decided to join the Bloomington High School South Amateur Radio Club, K9SOU, which is led by my chemistry teacher, Mr Neil Rapp, WB9VPG. This was my first exposure to Amateur Radio, having only experienced shortwave monitoring before then. Mr Rapp presented us with materials to study for the Technician test, which I passed in October. Wanting to get on HF, I studied for the General exam and passed it in December, in January 2012, I took the Amateur Extra class exam and passed that.

My interest spread to my family members, who also became licensed. We purchased a Kenwood TS-590 transceiver for the home and I assembled a Gap Titan DX for the backyard. Chasing DX, QSO parties and special event stations absorbed my free time. Then Mr Rapp showed us the *Peter Island DXpedition 3YØX Antarctica 2006* DVD, which sparked my interest in going on a DXpedition. I realized I could take my rig with me wherever I went. The option to be portable captured my imagination.

DX Details

To operate abroad, a ham must contact authorities and fully research the laws regarding Amateur Radio use in whatever country you visit. Cyprus is divided in half; the western part is Greek and the eastern part is Turkish. The Greek side is a full member of the European Union and abides by the European Conference of Postal and Telecommunications Administrations (CEPT) agreement.



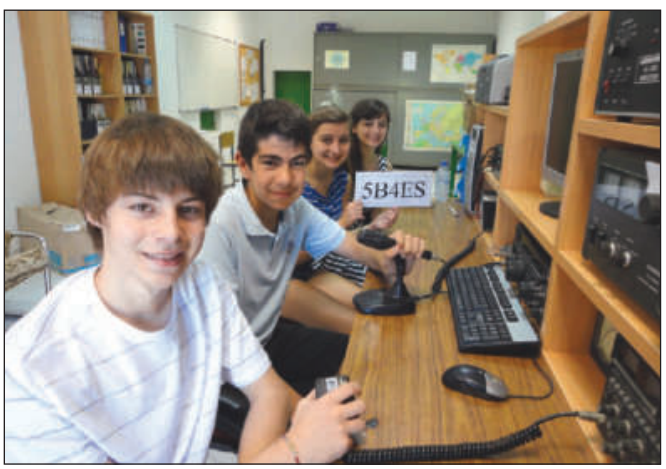


Figure 1 — Here we are visiting the English School Amateur Radio Club, 5B4ES, in Nicosia. From the front: Padraig Lysandrou, KC9UUS; Nicholas Yiakoumi, 5B4AKK; Helena Lysandrou, KC9VIM; Maria Sarah Lysandrou. [Carolyn Lysandrou, KC9URR, photo]

Figure 2 — From the third floor balcony of our hotel room in Protaras we had a beautiful view of the Mediterranean Sea. It was a great location for a Buddipole. [Padraig Lysandrou, KC9UUS, photo]

Figure 3 — Padraig, KC9UUS, holding tight to his rig for the paddle-boat ride to Fig Tree Island. [Carolyn Lysandrou, KC9URR, photo]

Figure 4 — A flat rock and a sunny day makes for a great afternoon of operating from Fig Tree Island. [Carolyn Lysandrou, KC9URR, photo]

Information on the CEPT agreement can be found on the ARRL® website.[1] Essentially it allows members of many countries to use their ham radios with certain limitations.

Checking in with the host country's national Amateur Radio association is a great way to make new friends and educate oneself on the local regulations. I contacted Mr Nestor Jacovides, 5B4AHZ, of the Cyprus Amateur Radio Society, who informed me that only Amateur Extra class operators can operate on Cyprus. He told me that each of the licensed hams in my family must carry a copy of our FCC license, passport, a printout of the CEPT agreement and his name and number at all times. No extra paperwork was required. Nestor also warned us to avoid all military bases, the Turkish side and any area that could be considered politically or militarily sensitive.

Cyprus itself is a politically sensitive zone due to its location in the eastern Mediterranean Sea, a mere 67 miles off the coast of Syria and 47 miles from Turkey. It is a small island only 62 miles wide and 240 miles long. Geopolitically, Cyprus is divided into two parts; the Republic of Cyprus (Greek) comprises the western half of the island and the Turkish Republic of Northern Cyprus the eastern half.

Considering the political climate of Cyprus, if you're a minor thinking of making a trip yourself, it's necessary to have an adult with you, particularly an adult who agrees that a DXpedition is a great idea. I had my mother, Carolyn Lysandrou, KC9URR, who also holds a new Amateur Extra class license, and my father, Plato Lysandrou, KC9VIL, who holds a new General class license and speaks fluent Greek. My sisters, Helena Lysandrou, KC9VIM, and Maria Sarah Lysandrou (studying for her Technician), were a great help during the trip.

The Journey

The logistics of a DXpedition can be a nightmare and since I am a new ham, I challenged myself to conduct this operation as simply as I could. Airlines these days have reduced weight limits for carry-on luggage. To reach Cyprus we had to take three different flights. Keeping the weight manageable and not putting any of our valuable gear in the checked baggage became a priority. To make this easier on all of us, I limited the gear to what was absolutely necessary and could be carried by one person if need be. This amounted to the following equipment:

- Yaesu FT-897 transceiver and microphone
- 20 feet of RG-8X
- Two rechargeable gel cell batteries, 6 lbs each
- One transformer
- MFJ power supply
- Buddipole
- A few adapter plugs for connecting the transformer to the variously shaped outlets found abroad.
- A camera, pens and paper and official paperwork.

Most of the airlines limit the carry-on luggage to one bag of no more than 45 pounds for each person. In order to comply with this limit, I divided my gear into three bags; my mother carried one of them. I placed the rig, power supply and all official paperwork in one bag with wheels. The Buddipole antenna had its own bag, which I slung over my shoulder and thus it went uncounted. I packed the coax, batteries, transformer and other items in another bag, which my father carried.

Carrying radio equipment through airport security and through international customs repeatedly can be a vexing experience. I worried that I would have to explain myself repeatedly and that the batteries might be flagged. Not so on the way there. The bag went through the X-ray machine without so much as an eyebrow raised. Security did not bat an eye for the Buddipole. No one asked a single question and not a red flag was raised. After many exhausting hours in transit, departing from Louisville, Kentucky, and changing planes in Philadelphia and Athens, we found ourselves in the beautiful new airport in Larnaca, Cyprus.

Awards, Contests and Finals

After arrival the jet lag hit us hard. In 2 days' time I felt better and was off to meet with a local school Amateur Radio club. The importance of high school clubs cannot be overemphasized — they have changed my life. Since it was my high school club that cemented my interest in Amateur Radio, it seemed appropriate to try to meet with a Cypriot club.

Much to my disappointment, the members of the English School Radio Club, 5B4ES, were in the midst of their final exams at the time; a large group photo of all the members was just not to be. In true Greek hospitality fashion, the incoming president, Nicholas Yiakoumi, 5B4AKK, agreed to meet with me between his final exams and show me around their shack.

The English School is located in Nicosia, the capital of Cyprus, and is the only school with an Amateur Radio club on the island. The shack is located on the large grounds of this private high school in the middle of the city. It took my breath away. Certificates and awards dating back to 1969 covered the walls, including multiple awards for the All Asian DX Contest, HA DX Contest, Black Sea Cup, WAS, Worked All Europe DX, CQ World Wide WPX. This was clearly no ordinary high school club. It had a library consisting of ARRL handbooks and publications, and books on radio theory.

The rigs included a Yaesu FT-1000MP as a main workhorse; the antennas included a Cushcraft 40 meter Skywalker, Hy-Gain TH5/MK2 5 element tribander on a tower and a homemade inverted dipole for 80 meters.

[1]Information on operating outside North America is available at **www.arrl.org/cept**.

These were isolated by trees and located on the grounds a considerable distance from the shack and headmaster's office. We thoroughly enjoyed our visit, posing for photos and exchanging QSL cards and presents. There we were, three Bloomington High School South Amateur Radio Club members meeting English School Amateur Radio Club members (see Figure 1).

A Dream Location

The party had just begun. We were invited to visit and set up my station on a large third floor veranda overlooking the coast, outside the town of Protaras (see Figure 2), which is located in the southeastern portion of the island. The location was beautiful, from the view of the sea to the lack of obstructions in all directions.

For 5 days I operated on 20 meters using 100 W. My power supply plugged into the transformer, since Cyprus uses 240 V mains. Every day from afternoon into the evening, I enjoyed excellent propagation and pileups. I was able to communicate with operators from all over the Middle East, Russia, Ukraine, England and even the United States.

When I needed a break, my mom was eager to take over and fully took advantage of the YL factor. Many of the same operators I had worked were anxious to contact my mom as well. We ended up having longer conversations than we could otherwise have had from our home in Indiana and we enjoyed every minute of it.

When we worked the pileups, it wasn't as a DXpedition trying to make as many contacts as possible. We wanted to enjoy our contacts and speak to people from all over the region. Propagation was often excellent until 1 AM local time. There were times when we experienced heavy interference. We didn't know why it was happening, but as on any other occasion, we looked for a clear frequency to move to and keep operating.

Cyprus is an island, designated as RSGB IOTA AS-004, with several small islands off its coast. IOTA lists the Cyprus coastal islands as AS-120, with no further specification. My friend Nicholas', 5B4AKK, father suggested I visit a small island located in Fig Tree Bay, near Protaras. This small island is directly offshore from a major beach and resort area, accessible by a short paddleboat ride, which is exactly how my parents and I got there. I spent the trip deathly afraid my rig would get wet or fall overboard (see Figure 3).

Once there, I set up in a frenzy using the gel cell 12 V, 9 Ah rechargeable battery I had just purchased a few weeks ago at my first Dayton Hamvention. I operated using well under 100 W, which was enough to reach the Ukraine for my first contact (see Figure 4).

Soon the winds came blowing and took the unguyed Buddipole down (see Figure 5). Damage was done, a lesson was learned and backup repair was completed. I continued operating for a while until a Greek fellow swam up and announced to my dad "So, I must have given you the license to operate here!" He was George Christodoulidis from the Cyprus Ministry of Communication and Works, who was on holiday. He and my dad got to talking; the next thing I knew they were fast friends and he was giving restaurant recommendations and talking about where he and his wife had studied in the US and about their families. I got back to making contacts. I never once had to pull out my paperwork.

Figure 5 — Padraig, KC9UUS, setting up the Buddipole on Fig Tree Island with Fig Tree Bay in the background ready to help launch his signal to the world. [Carolyn Lysandrou, KC9URR, photo]

Operating in paradise cannot last forever; there were other challenges for us and a lot of island to explore with my rig. We headed off to the Troodos mountain range, where Mt Olympus is the highest mountain, at 6404 feet. I thought I could do well operating from there.

The Attack

The Troodos Mountains run through the center of the island and are a cool break from the heat in the summer. The mountains are home to many military and communication antennas. The region is also loaded with tourists and parks. We had previously sought an activation designation from Rob Harwood, GØHRT, of the Summits on the Air (SOTA) program, but he told us that Cyprus is not yet part of the program. The radio amateurs in Cyprus are currently developing a list of potential summits that meet the height requirement of 150 meters or more.

Nevertheless, we thought it would be a nice place to try to set up the station so off we went, driving on the left side of the street, like in England, traveling up thin curvy roads, windy and wavy with the occasional rockslide evident on the roadside.

At the top, we were away from the military and communication antennas. We found a somewhat secluded park near Prodromos and away from other tourists. Under the pine trees, with a view of half the island and the sea beyond, I set up the antenna, this time securing it well. I made contact after contact. First Ukraine again, then Poland — one after another, fast and furious (see Figure 6).

Figure 6 — With his Buddipole out in the open, Padraig, KC9UUS, finds a shady spot to operate from while visiting the Troodos Mountains. [Plato Lysandrou, KC9VIL, photo]

Then I noticed something: bugs — *big bugs*. They got into my clothes, in my hair, on my shoulders, down my shirt and on the Yaesu. An immense swarm of bugs descended upon our group. It seemed like the plague of locusts that attacked Cyprus in 2004. Arthropod taxonomy was not my main interest at the time. These insects did not bite but they were large, and they flew down in vast numbers, preventing me from concentrating on my operating. Very soon enough was enough. We

had to say "uncle" and pack up. We piled into the car and drove down the wavy and windy hill returning to the heat of the city. It was not a fitting end to the day!

Paphos and Akamas

If operating near the beach is good, wouldn't *on the beach* be better? With this idea firmly in mind, off to Paphos we went. Paphos is located on the southwest part of the island and is home to many British expatriates, some of whom are hams. They have a club that meets regularly in a local restaurant. Unfortunately, it was not the week of their meeting, so I could not stop by and say hello.

Instead, I went to an area called St George Beach. It was an uncrowded beach with rocky sand and a gentle breeze, a perfect place to set up and operate 20 meters. I put up my antenna securely and set my rig up in the back of our SUV. Although there was a wonderful breeze, it was still Cyprus in the summer, which means it was *hot* — shade was necessary.

Using the battery for power, I was able to contact many Italian stations, one after another. My greatest surprise was my ability to contact Greek stations located on other Greek islands. I was very happy they were located far enough away to be in the skip zone. "From one Greek island to another" I told them. I was not sure if they understood my joy in being able to make these contacts; it could very well be an everyday thing for them. For me, nothing about ham radio is routine.

The view down along the beach was stunning. The light was bright, the water clear blue. That, combined with the ability to contact Russian, Serbian, Ukrainian and Polish stations, made for a perfect day. I was even able to make a Malta contact, not a typical experience for me. This day proved the best beach day. Others followed but with a lower contact rate, which is to be expected when you operate holiday style.

Holiday style are the key words here. There are times when a DXpedition must morph a little into holiday style operation. That may not be what an obsessive ham wants to hear, but it might be necessary to keep the peace and maintain the support from family members. A little rest and swimming in the hotel pool when propagation is not the best never hurt anyone either.

We were located at the far southwest corner of the island, near the Akamas peninsula and as we traveled farther southwest we encountered fewer tourists. There is a lesser mountain (or hill range) in the Akamas region that was just begging to be explored. We drove up toward the towns of Peyia and Kathikas looking for a remote area with a stunning overlook to operate from. It was not difficult as driving up the small mountains kilometer after kilometer presented view after unobstructed view of the sea below. We pulled off the road near Peyia at one of the highest possible points and set up (see Figure 7) the station. From there we could see Paphos, Peyia and Kissonerga below in the distance. We operated on 20 meters till after sunset. Propagation was not as good that day, but we made many Italian contacts.

Figure 7 — We drove up into the hills near Peyia and found this great overlook to operate from. During our DXpedition, my mom, Carolyn Lysandrou, KC9URR, often benefited from the "YL factor" in piling up contacts. [Padraig Lysandrou, KC9UUS, photo]

Bittersweet Departure

We went back to the hotel for a night of great food and Greek dance. Opa! Before we knew it, it was time to pack to return home. We packed our gear as before. Exiting the country was easy but bittersweet. The people were so hospitable and the DX was so good, it was hard to leave. Our flight to Athens went smoothly, but we hit a bump going through security in Athens. They asked to look at the radio very quickly but asked no questions. The official picked our carry-on bag apart and went through our souvenirs with a fine-toothed comb. What did it hold? A few papers, tourist brochures, a few assigned reading books for high school English class and some Cyprus stamps.

Everything else followed as smooth as silk, the entire DXpedition took place without my knowledge of the arrest of tourist and Amateur Radio operator Baldur Drobnica, DJ6SI, in Greece. Had we known of his arrest we may not have considered such a journey at all or we would have been too frightened to pull out the rig.

A DXpedition can be easy and relatively stress free. It can be accomplished on all levels from huge operations to the most exotic locations to small and simple but satisfying. It was certainly a learning experience, but for me, it was much more than that: it has firmly established ham radio as a lifelong hobby.

Acknowledgments

It took the support of many people to make this Cyprus DXpedition possible. I would like to thank Mr Neil Rapp of the Bloomington High School South Amateur Radio Club, K9SOU, for his generous advice. Thanks also go to my parents Plato, KC9VIL, and Carolyn, KC9URR, Lysandrou, who provided their financial support and the encouragement essential to the trip's success. A special thank you to my mom for her unusual request for a Mother's Day present — the Yaesu FT-897 — which just happened to be the perfect rig for our adventure.

I also want to thank my sisters Helena, KC9VIM, and Maria Sarah; Nicholas Yiakoumi, 5B4AKK, and his family for their exceptional hospitality, and Nestor Jacovides, 5B4AHZ, of the Cyprus Amateur Radio Society for his advice about Cyprus. Finally, I would like to thank the Bloomington Indiana Amateur Radio VEC team: AB9WW, K9FIC, K9FK, K9MEW, K9ZRL, KB9LGS, KB9RVB, KC9ACL, N9MEW and N9PDC, who were always there to encourage my family to *study and test, study and test*.

Padraig Lysandrou, KC9UUS, is a 15 year old junior at Bloomington High School South in Bloomington, Indiana. He is president of his high school Amateur Radio club, a member of the ARRL, president of the Monroe County 4-H Aerospace Club, and member of the Science Olympiad Team, Robotics Team and Solar Bike/Car Team. Padraig plays the cello in his school orchestra — which has performed at Carnegie Hall — and classical guitar. Padraig holds an Amateur Extra class ticket and is working on improving his Morse code. In his spare time, he target shoots at the family farm, restores antique radios and invents things. Padraig can be reached at 3087 Chase Ln, Bloomington, IN 47401, **clysandrou@comcast.net**

SDR at the Summit

A laptop, a loop and a low power software defined radio bring high tech to a North Carolina mountaintop.

Dennis Lazar, W4DNN

The uphill trek was a bit more taxing than we had expected. The June sun was warm, even though the temperature hovered around 68°. The sweat was breaking out and the backpack was feeling heavier with each 100 feet of elevation. My spouse, Ruthie, K4KLQ, and I paused many times to take a swig of water and admire the last of the withering rhododendron blooms adorning the high country while waiting for our panting to subside. The vista, visible through breaks in the trees, was breathtaking; row upon row of misty blue tinged mountains marching out toward the stark blue horizon.

We finally reached the summit at 6500 feet. We set our radio gear and antenna on some large flat rocks (see Figure 1) and soon I was scanning the panadapter displayed on my computer screen for 20 meter CW signals. While clicking the mouse on a particularly strong station calling CQ, I prepared to give him a quick call, but another station popped up right next door. I narrowed my bandwidth and adjusted the tracking notch filter to clear the frequency. "Turn the loop a little to the right" I told Ruthie. In a flash I logged a 579 contact from Minnesota and entered it into the computer log. Wow, high tech low power operating *al fresco* is the greatest!

How It All Began

My love affair with low power began in 1967 when, with a homebrew one tube transmitter, I activated Biorka Island, Alaska (AK144S) for the US Islands (USi) program (**www.usislands.org**).[1] I don't think anyone has been back there since, because my old call sign, KL7FSX, is still listed as the activator in the USi directory.

In 2012 and a much warmer location — my backyard in Port Charlotte, Florida — I was experimenting with a homebrew small magnetic loop antenna on 20 meter CW, radiating 5 W from a Yaesu FT-817 transceiver. The first station I worked was Alan, NM5S, operating from the summit of SOTA W5N/PW-027 in the Pecos Wilderness of New Mexico. So I wondered, what the heck is SOTA? Once I found out, I was hooked.

SOTA is the acronym for Summits on the Air, a worldwide award program similar to Islands on the Air (IOTA). The objective is to activate or work the highest summits in each state or country. Stations can be "activators" or "chasers" and points are awarded based on the elevations of the summits and the difficulty getting to them.

Activators range from weekend strollers to seasoned mountain goats. Activating a summit can be as easy as driving to a mountaintop park and setting up the rig on a picnic table (it can't be attached to your vehicle). At the other end of the spectrum, you can hike to a remote peak in the dead of winter and risk frostbite while erecting an antenna on a rocky escarpment to activate a summit for the first time. Activators can be spotted on the SOTA website or they can be self-spotted if cell phones work up on the summit. For information on the program go to **www.sota.org.uk**.

Figure 1 — On the summit of Craggy Knob, Dennis tunes the loop antenna on a convenient flat rock.

Figure 2 — This first attempt at a small loop theoretically should not have worked but stations in New Mexico and North Dakota didn't know this.

It's a Plan

Casual contest operating and DX are great fun for me, especially with a 5 W rig in the great outdoors, but there are sacrifices. Most low power rigs lack the sophisticated features of their larger base station cousins. I thought "Why not try backpacking an SDR to activate a mountain peak?"

The idea led to a bit of experimentation, culminating in three main components: a Flex-1500 SDR, a compact laptop computer and a small magnetic loop antenna. As RVers and avid hikers, Ruthie and I wanted to make sure this combination could be "trail friendly" for casual picnic table operation as well as for my planned trek to the clouds.

One of our favorite hikes has been from the Blue Ridge Parkway in North Carolina to the top of Craggy Knob, a

[1]Notes appear on page 71.

5600 foot summit in the Great Craggy Mountains. The climb is about ¾ mile uphill from the Craggy Gardens picnic area and ends at a mountaintop location that is ideal for snagging some great DX activity. Because we had hiked this summit before, we chose it as our "test climb."

The Super Looper Is a Winner

On a rock strewn, barren mountaintop, shooting a wire into a tree is usually not possible. Nor is this always an option in an upscale RV campground. I wanted something very compact, easy to set up and effective. A small loop antenna sounded intriguing. My first experiment involved a 7 foot length of #12 copper wire formed into a loop and supported by a cross shaped mount constructed of ¼ inch wooden arms. Not knowing any better, I connected it to a tiny random wire tuner — and it worked (see Figure 2)!

With the loop sitting in front of my sea level home only 3 feet off the ground, I quickly worked stations in New Mexico and North Dakota running 5 W from a Yaesu FT-817 transceiver. Unlike most low power operations, this was not CW but 15 meter SSB. Loops are amazing antennas with performance that can rival and surpass dipoles or verticals. I soon learned a lot more about them.

Small loops, those with a circumference of less than ⅓ wavelength, are great low noise antennas. For frequencies above 14 MHz, they work nearly as well sitting on a ground level picnic table as in a third floor hotel room. At 40 meters, however, ground losses increase so the height of that third floor location would be very beneficial. Loops are very directional and great for beaming out of an apartment window (or the veranda on a cruise ship — another future adventure for us, I think).

One thing I hadn't considered was that the loop attaches directly to the tuner and therefore the tuner is an integral part of the loop circuit. Current flowing through a small loop is very high and anything more than low power levels would have fried the little wire tuner despite its 150 W rating. This is because of the very high Q of the tuned circuit formed by the loop and its tuner. A 100 W transmitter would have resulted in currents in the tens of amperes and voltages across the tuning capacitor in the thousands of volts.

An answer to this problem is a welded, low-loss butterfly tuning capacitor, rated at 4200 V_{RMS}, that has no rotating contacts. This is placed in series with the loop. MFJ Enterprises (**www.mfjenterprises.com**) sells them alone or as part of its Small Loop Tuner.

Figure 3 — The SDR transceiver teamed with a lightweight laptop computer and enclosed in a cardboard box light shield brings high tech to the mountain summits.

Rather than build a tuner from scratch, I bought one of those.

For a low power HF operation, tuning is easy and straightforward. At higher power levels, however, because the loop connects directly to the tuner, RF exposure and loop voltages can be safety issues. You can find everything you need to know about small loops in the June 1986 issue of *QST* or the *ARRL® Antenna Handbook*.[2, 3] Also, there are a number of websites with this information, such as Steve Yates's, AA5TB, website (**www.aa5tb.com**) and his article "Small Transmitting Loops."

The Rig: Weight Versus Performance

Once I settled on the antenna, my attention turned to the rig. Using a low power SDR radio as the basis of a trail friendly station gives you some advantages, especially the panadapter display. When CW contesting with low power, my strategy begins with looking over the whole band segment, picking out the biggest signals, clicking on them and slipping in my call. Because I can see where the other stations are calling, I can easily position my signal just to one side and sound a little different from the crowd. I usually get a contact on the first few calls — with 5 W. After bagging the big ones, I click on the weaker ones and so on. Also, having an infinite choice of filter settings really helps in a pileup.

The Flex-1500 weighs in at 2 lbs and feeds on 13.8 V plus or minus 10%. Current drain, according to the ARRL test bench, is 358 mA on receive and 1.9 A while transmitting 5 W output.[4] If battery power is limited, you can transmit at 50 mW with as little as 940 mA. I found a 7 Ah gel cell battery, a good compromise between weight and capacity. The laptop computer can operate from its own internal battery for up to 6 hours.

The whole rig, which includes the loop antenna, tuner, SWR bridge and two coax jumpers, fits in a backpack and weighs about 18 lbs, not featherweight but manageable (see Figure 3).

One special problem when operating a computer in the great outdoors is the sunshine. To be able to see the screen in bright daylight, I needed a large cardboard box for a sun shield. Folded up, it was easy and light to pack.

The Countdown Is On

A few weeks before hitting the road in our 35 foot fifth wheel RV trailer, we spent a few days packing. I read somewhere that the best way to be assured that you won't wind up on the summit or on your DX island with a missing key, plug or antenna connector is to completely assemble your radio setup and make a few contacts. Then immediately pack it all up and put it aside. That way you'll know that everything is there.

My plan was to set up in the yard and make a few contacts (see Figure 4). The first station I heard near the 20 meter low power frequency (14.060 MHz) was Dennis, WA2USA, who was operating SOTA on the 5540 foot summit of Whitetop Mountain in Virginia. Over the next hour or so, I was able to work some great 5 W contacts including Puerto Rico, Washington state and Utah.

I broke down the setup, fit all the gear into the backpack and was ready to roll (see Figure 5). Because of the battery's weight, I saved it for last. Ruthie volunteered to lug it and a loop made of ¼ inch copper tubing (which dramatically increases loop efficiency) up the mountain.

On the Trail to the Clouds

"Trail to the Clouds" is not just a catchy title when you are in the Blue Ridge Mountains. Beginning just north of the Great Smoky Mountains National Park, the mountains along the Blue Ridge Parkway are often just as smoky, with low hanging clouds intermingling with the pine covered slopes and rocky peaks. Although many summits that are accessible from the parkway are popular with tourists, we have never found Craggy Knob to be crowded.

Figure 4 — Setting up in the backyard ensures that everything works and gets packed in the knapsack.

The main attraction of the Craggy Mountains is the rhododendrons that grow wild on its slopes. Since they bloom in June, fewer people climb this peak in other months. So on a weekday in mid-August we had it all to ourselves.

We parked in the picnic area part way up the mountain and had a nice lunch before assembling our gear and beginning our ascent to 5526 feet. Okay, I know for those of you out West, that's flatlands. But here in the East it's a big deal. The highest peak in the Appalachian Mountains is nearby Mount Mitchell, which at 6684 feet is the highest point in the eastern US. For us Easterners, we were way up there.

After about 40 minutes of strenuous hiking, we broke through into the clear of the summit. Once there we found a summit that was not rock strewn like those in Colorado, but adorned by a crown of grass and wildflowers. We set up our little folding table for the rig and placed the antenna on a large flat rock. I aimed the loop to the north northwest and within 15 minutes we were on the air. We began on 14.061 MHz, a popular SOTA frequency, and soon had a few good contacts in the log. Then we did some hunt and pounce, snagging our best DX for the day, Stan, AEØSL, in Hugo, Minnesota. He gave us a 559. With our experiment a great success, we packed up and trekked back down the mountain.

Over the next 2 weeks, we were able to activate two SOTA summits. Max Patch Mountain — 4629 feet, W4C/CM-36, accessed after driving a 6 mile nail-biter of a single lane gravel road to the trailhead — and Richland Balsam — 6410 feet, W4C/WM-003, following a steep hike and a yellow jacket nest that resulted in four stings on two legs.

One memorable contact was with Paul Signorelli, WØRW, famous for his *Pedestrian Mobile Handbook*.[5] Paul was strolling around Flat Lake, Montana backpacking with a 25 lb World War II military transceiver.

Two meters is also a great performer from a mountain summit. With our tiny Kenwood TH-F6A, we worked many stations on 145.52 MHz simplex with the best DX being N4GMU mobile in Knoxville, Tennessee and N5CSA in Anderson, South Carolina.

Also impressive was an answer to my 2 meter CQ by W4KTL, KE4ZWD, and Dale, W4OP, from the summit of Crabtree Bald, where they were setting up a temporary repeater for a benefit bicycle race that weekend. We were able to reduce power to 50 mW and still had full quieting FM signals.

It Worked!

After 2 weeks in the cool mountains of North Carolina, we packed up and headed south, back to Florida and right into Hurricane Isaac, which was heading in a northerly direction, threatening our west coast Florida home. Eventually it moved farther out into the Gulf so in Florida we dodged the bullet. The experiment had worked. SDR is not just for your desktop anymore.

Ruthie and I have already made our reservations to escape the hot days of August 2013 and activate the many North Carolina SOTA summits, running low power SDR from the clouds.

Notes

[1]D. Lazar, W4DNN, "Proving the QRP Equation: 1W+RI=1000 W+FL," *QST*, Apr 2003, pp 55-56.
[2]T. Hart, W5QJR, "Small, High-Efficiency Loop Antennas," *QST*, Jun 1986, pp 33-36.
[3]Available from your ARRL dealer or from the ARRL Store, ARRL order no 6948. Telephone toll-free in the US 888-277-5289 or 860-594-0355, fax 860-594-0303; **www.arrl.org/shop**; **pubsales@arrl.org**.
[4]W. Silver, NØAX, "FlexRadio Systems FLEX-1500 Software Defined HF+6 Meter QRP Transceiver," *QST*, Dec 2011, pp 45-50.
[5]See Paul Signorelli's, WØRW, **QRZ.com** page for more information.

Figure 5 — Laying out and packing all the pieces right after on the air operation ensures nothing is forgotten.

All photos by the author.

Dennis Lazar, W4DNN, an ARRL member, is a semiretired doctor of naturopathy and certified registered nurse therapist in a drug-free pain management practice in southwest Florida. His interests are ham radio (he holds an Amateur Extra class license) and RV travel across America. Dennis loves low power operating and CW as well as a good SSB ragchew. His rigs include the vintage Hammarlund HQ129X, Heathkit DX-40, National NC-98 and Johnson Viking Adventurer. For low power operating Dennis uses the Yaesu FT-817ND, Heathkit HW-8 and now the Flex-1500. For transceivers Dennis has a Yaesu FT-100D and FT-707. Lastly, he has a Heathkit SB-200 amplifier for when conditions are tough. He enjoys some wonderful ham radio harmony since his spouse, Ruthie, is K4KLQ. A former professional writer and editor, Dennis's work has been published in *QST*, *CQ* and *73*. Dennis can be reached at 227 Stebbins Terr, Port Charlotte, FL 33952, **w4dnn@arrl.net**

Winter Break at the ARRL Puerto Rico Convention

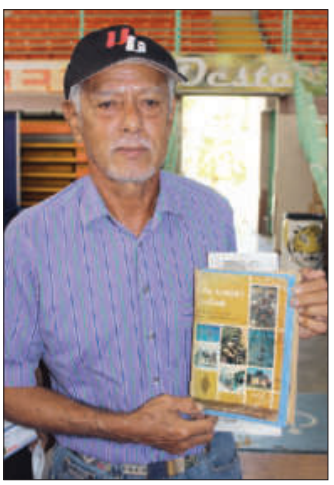
An ARRL-sanctioned convention was held in Hatillo, Puerto Rico in January and the event drew over 1100 attendees. The formula for success? Invite everyone!

Ángel Santana, WP3GW and Bob Inderbitzen, NQ1R

There are a handful of hamfests held in Puerto Rico throughout the year, but during one of the island's biggest annual hamfests, the Gran Hamfest del Norte in February 2012, an idea was born to host a large Amateur Radio convention that would draw interest from across all of Puerto Rico, the Caribbean and the US mainland. The convention was held January 26-27, 2013, and was organized by the Caribbean Amateur Radio Group (CARG) and the Puerto Rico Amateur Radio League (PRARL), two ARRL affiliated clubs. Even with such a large gathering, convention organizers worked hard to give the event plenty of local flavor: a ham radio convention "¡a lo Boricua!" (Boricua: someone from Borinquen or Borikén, which means the Land of the Valiant Lord, as the indigenous Taínos called the island of Puerto Rico before Columbus' arrival in 1493). Here's a photo recap from the event. (All photos by Bob Inderbitzen, NQ1R.)

ARRL Section Managers Rene Fonseca, NP3O (left, from Puerto Rico) and Fred Kleber, K9VV (right, from the Virgin Islands). Kleber gave a presentation on HSMM-MESH™, one of the many forums that were offered throughout the convention.

Over 950 contacts were made from the special event station, W1AW/KP4. The signals emanated from two beam antennas perched atop the Coliseum Francisco "Pancho" Deida, the site of the convention. Each operator was presented with a certificate *por la operacion del la estacion official de la ARRL*. Pictured is Rafael Ortiz, KP4ROS.



Julio Santiago Rivera, WP4EWE, shows off a well-worn copy of *The ARRL Radio Amateur's Handbook*, 1977 edition.

A group visiting Arecibo Observatory included (left to right) ARRL Marketing Manager Bob Inderbitzen, NQ1R; Dennis Perez, KP3CB; John Kalotai, N1OLO; Angel Garcia-Almeida, WP3W; Robert S. Sambolin, WP4WS; Robert M. Sambolin, KP4CI; Lisa Kleber, W4LIS; ARRL Virgin Islands Section Manager Fred Kleber, K9VV; Lou Dietrich, N2TU; ARRL Southeastern Division Director Greg Sarratt, W4OZK; ARRL Puerto Rico Section Manager Rene Fonseca, NP3O; ARRL President Kay Craigie, N3KN; Ethel Noris Delerme-Velez; Holly Kollenbaum, WH7YL; Bill Kollenbaum, K4XS; ARRL Puerto Rico Convention Chairman José "Otis" Vicens, NP4G; John Bigley, N7UR; Elizabeth Bigley, KD7RIN; Carlos Roman, WP4ZF; IARU Region 2 Secretary Ramón Santoyo, XE1KK; Juan Montijo, WP4OV, and Wilfredo Aviles, KP4ARN.

ARRL President Kay Craigie, N3KN (left), and ARRL Southeastern Division Director Greg Sarratt, W4OZK, made a special presentation to ARRL Volunteer Examiner Victor Madera, KP4PQ (right). Madera was recognized for having administered 340 Amateur Radio FCC license examination sessions in Puerto Rico.

Norberto Perez Rivera, KP4WK, gave a successful FM satellite demonstration using the special event call sign W1AW/KP4 via Saudi-OSCAR 50.

The ARRL Puerto Rico Section Team stands along with ARRL President Kay Craigie, N3KN, as she accepts a plaque from José "Otis" Vicens, NP4G (right), on behalf of the Convention Organizing Committee. Much to the surprise and delight of attendees, Craigie shared her remarks in the Spanish language.

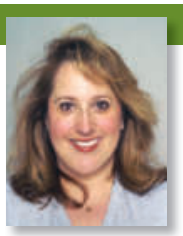
Facts about Puerto Rico

*[Source: **Answers.USA.gov**]*

- Official Name: Estado Libre Asociado de Puerto Rico (Commonwealth of Puerto Rico)
- Nickname: La isla del encanto (The Island of Enchantment)
- Capital: San Juan
- Population: 3,667,084 (US Census, July 2012)
- Puerto Rico is a self-governing, unincorporated territory of the United States located in the Caribbean, approximately 1280 miles southeast of Florida. The island is roughly the size of Connecticut. Its territory is an archipelago composed of the main island and a number of lesser islands and cays. Puerto Rican citizens became US citizens in 1917. Puerto Rico became a commonwealth in 1952.
- The unofficial mascot of Puerto Rico is a tiny tree frog called the coquí, which is found only in Puerto Rico. Its unique "ko-kee" melody is heard all around the island.

ARRL Member John Bigley, N7UR, and his wife Elizabeth, KD7RIN, live in Nevada, but travel to Puerto Rico often to keep up with many friends they've made through Amateur Radio over the years. Bigley recalled his first trip to Puerto Rico, and making friends with a local ham by knocking on the door of a home to inquire about the large antennas on the property. He was recognized with this award given by the Caribbean Amateur Radio Group for his commitment to promoting the convention.

ARRL Member Ángel Santana, WP3GW, is the Public Information Coordinator for the ARRL Puerto Rico Section; **santanaamt@aol.com**. ARRL Life Member Bob Inderbitzen, NQ1R, is the ARRL Marketing Manager. You can view Bob's photo blog from the convention on the ARRL Facebook page. He can be reached at **nq1r@arrl.org**.



S. Khrystyne Keane, K1SFA, k1sfa@arrl.org

FCC Issues $10,000 Fine to Missouri Man for Unlicensed Operation on 14.312 MHz

The FCC has received numerous complaints from the amateur community regarding alleged violations on this frequency, and it is dedicating resources (when available) to tracking down those who violate its rules.

On February 25, the FCC issued a *Notice of Apparent Liability for Forfeiture* (*NAL*) in the amount of $10,000 to Jared A. Bruegman, ex-KCØIQN, of Bolivar, Missouri. The FCC said that Bruegman "apparently and willfully violated Section 301 of the Communications Act of 1934, as amended by operating an unlicensed radio transmitter on the frequency 14.312 MHz." Bruegman — who does not currently hold an Amateur Radio license — was operating in the phone portion of the 20 meter band that is assigned to the Amateur Radio Service on a primary basis; his Amateur Radio license expired in 2010. As a former Technician class licensee, he did not have privileges to operate in that portion of the 20 meter band when he held an Amateur Radio license.

In December 2012, the FCC's office in Kansas City received a complaint from an Amateur Radio operator, reporting interference on 14.312 MHz. Upon investigation, agents from that office heard a male voice transmitting on the frequency 14.312 MHz. Using direction finding equipment, the agents located the source of the radio frequency transmissions to a transmitting antenna mounted on a pole next to Bruegman's residence. The agents determined that the signals on 14.312 MHz exceeded the limits for operation under Part 15 of the Commission's rules and therefore a license was required to transmit. The agents further discovered that Bruegman did not hold a license to operate a radio transmitter on 14.312 MHz at or near that location.

The agents determined that the source of the transmissions was an unlicensed radio transmitter in a bedroom at Bruegman's residence. "Mr Bruegman was the only person present in the bedroom and the only male in the residence during the inspection," the *NAL* stated. "Mr Bruegman admitted to the agents that he owned the radio transmitter. The agents observed that the transmitter was turned on and tuned to 14.311 MHz. Mr Bruegman told the agents that he had no current Commission licenses, but that he previously held an Amateur Radio license, call sign KCØIQN. Mr Bruegman told the agents he would remove the microphone from his transmitter and only use it as a receiver."

Section 503(b) of the Communications Act provides that "any person who willfully or repeatedly fails to comply substantially with the terms and conditions of any license, or willfully or repeatedly fails to comply with any of the provisions of the Act or of any rule, regulation, or order issued by the Commission thereunder, shall be liable for a forfeiture penalty." In addition, Bruegman was found to be in violation of Section 301 of the Communications Act, stating that "no person shall use or operate any apparatus for the transmission of energy or communications or signals by radio within the United States, except under and in accordance with the Act and with a license granted under the provisions of the Act."

Alleged Deliberate Interference Leads to $25,000 Fine for Florida Ham

On March 1, the FCC issued a *Notice of Apparent Liability for Forfeiture* (*NAL*) in the amount of $25,000 to Terry VanVolkenburg, KC5RF, of Cocoa, Florida. The FCC alleged that VanVolkenburg "apparently willfully and repeatedly violated Sections 301 and 333 of the Communications Act of 1934, as amended…, by operating a radio transmitter without a license on…465.300 MHz and for interfering with licensed communications." As an Advanced class licensee, VanVolkenburg does not hold privileges to operate in this portion of the spectrum.

In September 2012, FCC agents in the Tampa Office received a complaint of radio interference from the Brevard County Sheriff's Department. The Sheriff's Department — licensee of call sign WQCW384 — utilizes a wireless radio communications system in the county jail in Sharpes, Florida. According to the complaint, the Sheriff's Department experienced intermittent interference to its radio communications in the jail on at least 14 days during September and October 2012. According to the *NAL*, audio recordings taken by the Sheriff's Department suggest "that a male individual interfered with the prison's communications by transmitting vulgar language, sound effects, previously recorded prison communications and threats to prison officials over the prison's communications system."

On October 28, the agents used direction finding techniques and traced the source of the interfering radio frequency transmissions on 465.300 MHz to VanVolkenburg's residence.

According to the *NAL*, VanVolkenburg "did not specifically admit that he had interfered with the prison's communications system, but he told the agents that he chose 465.300 MHz because the prison's transmissions on that frequency were strong; that he was only using 300 mW and did not think that he 'could talk over anyone and therefore wasn't interfering with anyone;' and that the interference would not happen again."

"The totality of the evidence convinces us that

it was Mr VanVolkenburg who was operating the unlicensed transmitter from his residence that was causing interference to the prison communications systems over at least a two-month period," the FCC stated in the *NAL*.

According to the Commission's *Forfeiture Policy Statement* and Section 1.80 of its rules, the base forfeiture amount for operation without an instrument of authorization is $10,000, and the base forfeiture amount for interference is $7000. In assessing the monetary forfeiture amount, the FCC also takes into account statutory factors that include the nature, circumstances, extent and gravity of the violations, and with respect to the violator, the degree of culpability, any history of prior offenses, ability to pay and other such matters. "We find Mr VanVolkenburg's misconduct particularly egregious because his unlicensed operation involved willful and malicious interference to the communications of the Brevard County Sheriff's Department, which included threats against the officers, after being told (multiple times) to cease his interfering communications," the FCC stated in the *NAL*. "Thus, we find that an upward adjustment of $8000 to the combined base forfeiture of $17,000 is warranted."

American Red Cross to Phase Out Emergency Communication Response Vehicles

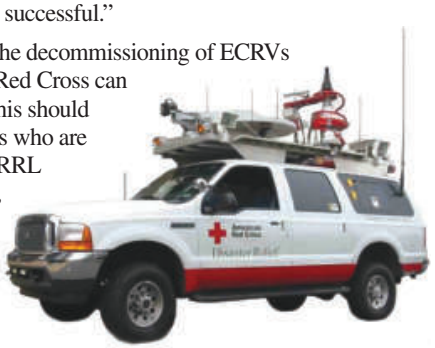
The American Red Cross will phase out and decommission its Emergency Communication Response Vehicles (ECRVs), due to changes in technology, as well as a new satellite system and other factors regarding the vehicle fleet. "Retrofitting the decade-old vehicles with new equipment is not a good use of donated funds, as the long-term strategy is to move to more portable systems," American Red Cross Disaster Services Technology Manager Keith Robertory, KG4UIR, told the ARRL. "This is consistent with the trends in the telecom and technology industries."

The American Red Cross will be removing the Amateur Radios from the ECRVs as part of the decommissioning process. These radios will either become part of the deployable inventory or provided to the local American Red Cross chapter to build local capacity. Equipment that can be used by the American Red Cross will not be phased out with the vehicle. According to Robertory, every communication capability of the ECRV already exists — or will soon exist — as a rapidly deployable kit that can be loaded on *any* vehicle that is owned or rented by the American Red Cross, providing more flexibility in shaping its response to match the disaster.

"From a radio perspective, the American Red Cross has a variety of different kits for amateur, business and public safety bands covering HF, VHF and UHF with portable radios, mobile units and base stations," he explained. "Two-way radio remains a valuable tool, providing communications in the initial days or weeks of a disaster, until normal communications is restored. Each American Red Cross chapter should continue with — and improve — the relationship with their local Amateur Radio operators. In a disaster, Amateur Radio will be the fastest deployed radio network because operators already live in the impacted communities."

Robertory called the ECRV operators "the key to the success of the ECRV program through the years," saying their skills, dedication and flexibility have made the ECRV one of the most visible aspects of the American Red Cross Disaster Technology team. The ability to establish connectivity and communications remains vital to the American Red Cross, and their skills will continue to be needed as the American Red Cross implements new technology strategy and tactics. The commitment and flexibility of technologists — including radio operators — is what makes technology on a disaster successful. Building our future path based on the lessons we have learned is important to keep us all successful."

Radio amateurs who are concerned about how the decommissioning of ECRVs will affect opportunities to serve the American Red Cross can be assured that such opportunities still exist. "This should not be seen as a setback for those radio amateurs who are working with the American Red Cross," said ARRL Emergency Preparedness Manager Mike Corey, KI1U. "In disaster response, adaptability is critical and keeping up with new technology is essential. This all must be done with a mind toward an effective and efficient response. Amateurs have played an important role in assisting the American Red Cross with their mission and I know we will continue to do so in the future."



Due in part to new and emerging technology, the American Red Cross will be phasing out its Emergency Communication Response Vehicles (ECRVs).

Montana Governor Signs Legislation to Limit Antenna Restrictions, Protect Hams from Distracted Driving Regulations

On February 28, Montana Governor Steve Bullock (D) signed House Bill 148 into law. Montana State Representative Pat Connell, WA7PDC, had submitted the bill — *Clarifying Local Government Authority to Regulate Amateur Radio Operations* — on the 2013 Montana legislative docket in order to protect Amateur Radio operators in Montana from distracted driving laws. The new law prohibits local governments from regulating licensed Amateur Radio operations from a motor vehicle and also establishes a 100-foot by-right height below which local jurisdictions may not regulate Amateur Radio towers.

Montana Governor Steve Bullock (seated, right) signs Montana House Bill 148 into law on February 28 as bill sponsor Pat Connell, WA7PDC (seated, left) and ARRL Montana Section Manager-elect George Forsyth, AA7GS (standing) look on. [William Erhardt, K7MT, photo]

"Over the past few years, many of the larger Montana cities have enacted laws to prohibit the use of mobile telecommunication devices while a motor vehicle is in motion," explained Rod Jackson, AE7JJ, Public Affairs Officer for the Great Falls [Montana] Area Amateur Radio Club. "These actions were taken to stem what was perceived as a safety concern from the distractions of trying to carry on a mobile phone call or send a text message while trying to drive the vehicle. Each time these new regulatory actions were under consideration, the drafters always tried to include mobile Amateur Radio operators into the same group as the typical cell phone user."

Jackson told the ARRL that many radio amateurs from across the state came to the capital to testify in support of HB 148 in both the House and Senate committees: "The bill received wide support during the process, including an official endorsement from the Montana Association of Counties. Their representative cited the numerous benefits that Amateur Radio operators bring to their

communities, in particular Amateur Radio's critical role in providing emergency communications support during times of disaster."

ARRL Montana Section Manager-elect George Forsyth, AA7GS, testified in front of both committees in support of the bill. "House Bill 148 is a great step forward in settling issues that have kept Montana Amateur Radio operators on the defensive for the last several years," he said. "This bill provides reasonable protections for Amateur Radio operators who are considerate, caring and involved members of their communities."

While HB 148 does not affect antenna installations in those areas designated as historic districts or those areas covered by agreed-upon covenants, Jackson explained that it does provide the vast majority of Montana hams "a good measure of protection from overzealous local government actions."

FCC News

FCC Proposes More Spectrum at 5 GHz for Unlicensed Broadband

On February 20, the FCC released a *Notice of Proposed Rulemaking* (*NPRM*) in ET Docket No. 13-49, seeking to revise the Part 15 rules governing unlicensed national information infrastructure (U-NII) devices in the 5 GHz band. These devices presently operate in the frequency bands 5.15- 5.35 GHz and 5.47-5.825 GHz. They use wideband digital modulation techniques to provide a wide array of high data rate mobile and fixed communications for individuals, businesses and institutions. Slightly different rules apply to 5.825-5.85 GHz. Among the changes being proposed are two additional bands totaling 195 MHz for unlicensed operation: 5.35-5.47 GHz and 5.85-5.925 GHz. The Amateur Radio Service has a secondary allocation at 5.65-5.925 GHz, including an Amateur Satellite Service uplink allocation of 5.65-5.67 GHz and a downlink allocation of 5.83-5.85 GHz.

The FCC notes in the *NPRM* that since it first made available spectrum in the 5 GHz band for U-NII in 1997, it has gained "much experience" with these devices: "We believe that the time is now right for us to revisit our rules, and, in this *NPRM*, we propose to modify certain technical requirements for U-NII devices to ensure that these devices do not cause harmful interference and thus can continue to operate in the 5 GHz band and make broadband technologies available for consumers and businesses."

The *NPRM* also satisfies Section 6406 (a) of the *Middle Class Tax Relief and Job Creation Act of 2012* that required the FCC to begin a proceeding to modify the Part 15 rules to allow unlicensed U-NII devices to operate in the 5.35-5.47 GHz band, subject to consultation with the National Telecommunications and Information Administration (NTIA). In response to the same legislation, the NTIA recently released an evaluation of the 5.35-5.47 GHz and 5.85-5.925 GHz bands that details the existing occupancy of these bands by federal and non-federal users and the potential risks of expanded unlicensed use.

"The Amateur Radio Service has a good record as a spectrum partner with the other licensed services in the 5 GHz band," observed ARRL Chief Executive Officer David Sumner, K1ZZ. "The ARRL plans to respond to the *NPRM* by pointing out that meaningful access to the 5 GHz band for amateur and amateur satellite operations continues to be in the public interest."

Pat Hawker, G3VA (SK)

RadCom columnist and RSGB Life Vice President Pat Hawker, G3VA, of London, England, passed away February 21. He was 90. For 50 years — 1958-2008 — Hawker penned the bimonthly "Technical Topics" column in *RadCom*, the member journal of the Radio Society of Great Britain (RSGB), focusing on many new techniques and devices that came into being and were enjoyed by radio amateurs in the second half of the 20th century.

In June 2006, Queen Elizabeth II awarded Hawker the Member of the Order of the British Empire (MBE) for "Services to Radio Communications." In 2006, he was inducted into the CQ Amateur Radio Hall of Fame. Hawker was named a Life Vice President of the RSGB in 2008 for his contributions to Amateur Radio and for his writing across a whole spectrum of publications over many years.

Section Manager Election Notice

To all ARRL members in the Colorado, Eastern Washington, Georgia, Los Angeles, Sacramento Valley, San Francisco, South Texas, West Virginia, and Western Washington Sections: You are hereby solicited for nominating petitions pursuant to an election for Section Manager (SM). Incumbents are listed on page 16 of this issue.

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

We suggest the following format:

(Place and Date)

Membership and Volunteer Programs Manager, ARRL
225 Main St
Newington, CT 06111

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

(Signature___ Call Sign____ City__ ZIP __)

Any candidate for the office of Section Manager must be a resident of the Section, an Amateur Radio licensee of Technician class or higher and a full member of the League for a continuous term of at least two years immediately preceding receipt of a nominating petition. Petitions must be received at Headquarters by 4 PM Eastern Time on June 7, 2013. If more than one member is nominated in a single section, ballots will be mailed from Headquarters on or before July 1, 2013, to full members of record as June 7, 2013, which is the closing date for nominations. Returns will be counted August 20, 2013. Section Managers elected as a result of the above procedure will take office October 1, 2013.

If only one valid petition is received from a Section, that nominee shall be declared elected without opposition for a two-year term beginning October 1, 2013. If no petitions are received from a section by the specified closing date, such section will be resolicited in the October 2013 *QST*. A Section Manager elected through the resolicitation will serve a term of 18 months. Vacancies in any Section Manager's office between elections are filled by the Membership and Volunteer Programs Manager. — *David Patton, NN1N, Membership and Volunteer Programs Manager*

Rick Palm, K1CE, k1ce@arrl.org

Operation RADAR II

ARES® steps up to the plate in Florida's statewide interoperability exercise.

It's not news that Florida is vulnerable to natural and man-made disasters, most frequently hurricanes, but also tornadoes, tsunamis, earthquakes and oil spills. The major theme parks dotted around the state could be top targets for terrorism. Fortunately the state boasts a robust disaster management infrastructure with an existing plan; this starts with the fortress-like emergency operations center (EOC) and its dedicated staff, situated near Tallahassee in the panhandle.

No infrastructure or plan can be effective if it is not tested and exercised periodically. That fact was not lost on Florida's Division of Emergency Management (FDEM) when it conducted a massive statewide interoperable communications exercise earlier this year, entitled "Operation RADAR II."

Held February 4-8, 2013, the exercise tested teams of various disciplines from state, county and city agencies that rolled mobile communications vans to the National Guard's Camp Blanding in northeast Florida and/or activated their home base EOCs to participate. The plan was to establish communications networks and pass messages, testing connectivity among one another and with county EOCs and Public Safety Access Points (PSAPs) located throughout the state. The goal was to fully integrate multiple communications systems into an effective emergency communications network.

The scenario involved two hurricanes directly impacting Florida within 10 days of each other. The effects were catastrophic, with numerous lives lost and populations displaced. All critical infrastructure was severely damaged, with much of the state without power, major transportation concerns and widespread communications failures. Regions 3, 4 and 5 in the north central portion of peninsular Florida were the hardest hit and needed interoperable communications support from the other four regions, as well as from state and federal resources. The budget for the exercise was $400,000, according to FDEM's Communications Grant Manager Bob Little, KK4OAI (see Figure 1).

ARES Becomes a Major Player

For the first time ever, ARES played a major role in this exercise. Its involvement was due largely to the efforts of the dynamic Northern Florida Section Manager Paul Eakin, KJ4G (see Figure 2). Paul worked with other Florida ARRL® and ARES officials to bring Amateur Radio into the action.

These officials and Paul joined forces with ardent supporters of Amateur Radio on the EOC staff at Tallahassee and in the various county and emergency management agencies where radio amateurs are embedded. FDEM's Amateur Radio Unit, which is managed by Paul, served as the Command Post/Auxiliary State Warning Point (CP/ASWP) and as the hub for message and request routing and tracking via the state's Internet-based Constellation system, the successor to its former Tracker system. Kimo Montague, K4IMO, a veteran state EOC emergency communications technician, ran this function from a position within the Amateur Radio Unit (ARU) tent (see Figure 3).

The interoperability aspect provided by Amateur Radio was manifested by hams deployed with the various other teams and mobile units situated at distant locations throughout Camp Blanding and the state. Estimates of 50%-75% of the field teams/units had active radio amateurs handling traffic with the CP/ASWP.

A message that originated at a county emergency management unit would be sent by one of the agency's radio amateurs to the

Figure 1 — K1CE (l) with FDEM staffer Bob Little, KK4OAI, in front of the State Emergency Response Team van.

Figure 2 — Northern Florida Section Manager Paul Eakin, KJ4G, left, managed the CP/ASWP and Amateur Radio Unit tent during Operation RADAR II. ASM Donna Barker, WQ4M, at right, ran the D-STAR and Mesh applications inside the Amateur Radio tent.

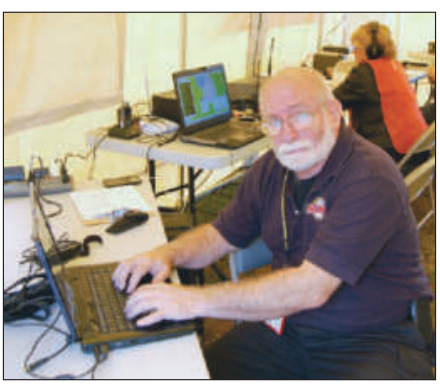


Figure 3 — Kimo Montague, K4IMO, longtime communications technician for the state EOC in the Amateur Radio Unit tent.

CP/ASWP tent via any one of several frequencies and modes. Once the message was received, the radio amateur there would process it, log it and send it to its destination unit via the appropriate frequency and mode or, if necessary, walk the message to a destination! Thus, having been routed via Amateur Radio, the message crossed jurisdictional and functional lines in a flash — and the goal of interoperability was achieved!

The exercise was run under the Incident Command System (ICS). Each region's All-Hazards Communications Unit Leader (COML) was in charge and all ICS log, message and other forms were used. Several radio amateurs participated as new graduates of the US Department of Homeland Security's Emergency Communications Course.

Players who needed to communicate with the State Warning Point contacted the ARU serving as the CP/ASWP. (The State Warning Point serves as the primary contact point for emergencies. It provides notification to the affected counties, emergency support functions and other affected members of the State Emergency Response Team). FDEM communications officers were in the Amateur Radio tent for this purpose. The same method was used to handle other interagency and/or interfunction messages.

Primary platforms were two HF stations, one on 3950 kHz and the other on 7242 kHz, using NVIS dipoles. For point to point coverage an array of 2 meter FM simplex frequencies was used. The goals were flexibility and redundancy, so several other bands and modes were tested as well. A portable UHF FM repeater (KJ4G) provided intra-site tactical communications for Amateur Radio Unit team members. Five different 2 meter FM simplex frequencies were available for inter-site communications.

For digital modes, several positions in the tent were dedicated to different systems, including the Southeastern Emergency Digital Associations Network (SEDAN), an extensive net on 145.77 MHz of traditional packet radio nodes heavily invested in Florida (**www.fla-sedan.com**). An Automatic Packet Reporting System (APRS) node (N2DB) was active on 144.39 MHz, tracking the movement and locations of most of the players on the exercise field (**www.aprs.org**). A separate tent housed two Winlink (a global radio e-mail system, **www.winlink.org**) stations, one on a VHF (145.63 MHz) network and the other on an HF (3593 kHz) net, for sending and receiving e-mail-formatted messages. The SEDAN and APRS modes were managed by Barry Isbelle, N2DB, (see Figure 4) and the Winlink stations were run by Jim Winfrey, KJ4SBG, and Ray Cook, WD4SEN, the assistant emergency coordinator (EC) for Clay County, Florida (see Figure 5).

Figure 4 —Barry Isbelle, N2DB, managed the SEDAN and APRS positions in the Amateur Radio Unit tent.

Figure 5 — Ray Cook, WD4SEN, operating the Winlink 2000 HF e-mail position from the FDEM's Amateur Radio Unit tent, Operation RADAR II. Cook is the Assistant EC for Clay County, Florida.

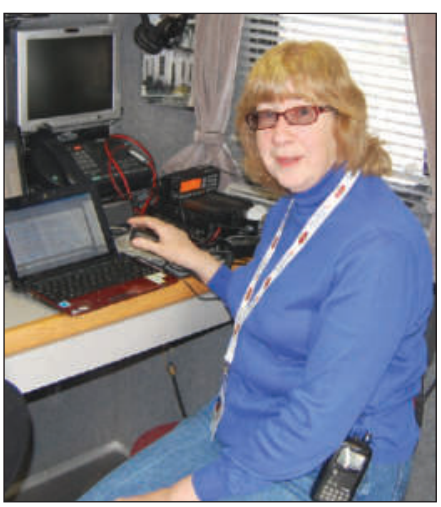


Figure 6 — Assistant SM Donna Barker, WQ4M, managed the D-STAR, D-RATS and Mesh network functions. She also served as network analyst/expert. Barker was responsible for communications connectivity with the state's rolling back-up EOC van.

Assistant Section Manager Donna Barker, WQ4M, a communications and network analyst/expert (see Figure 6), operated and managed D-STAR reflector 46C, a D-STAR "ratflector" [a *D-RATS* (**www.d-rats.com**) platform for D-STAR emergency text messaging] and a Mesh (**www.hsmm-mesh.org**) node. All players used these communication systems, but they were primarily used to communicate with the state EOC at Tallahassee and the mobile back-up EOC deployed to the exercise field.

Another ARU station was reserved for Red Cross communications. John Reynolds, W4IJJ, Communications Officer for the Florida Red Cross, monitored and received messages via the tent's 2 meter call channel on 147.585 MHz and then relayed the messages via KGB-223 on the Red Cross frequency 47.42 MHz, which was also used to communicate with rolling Red Cross vans out of Jacksonville and Gainesville.

The content of exercise messages was not as important as the connectivity, since the stated goal was to create a nearly instantaneous communications system that was reliable, effective and efficient. This system had to work across an incredibly diverse universe of public safety entities — those in towns, cities, counties, as well as those at the state and federal levels (FEMA) — for every conceivable function.

The entities included were not limited to the traditional ones, but others that aren't normally considered for disaster management: mapping units, radio shops, civil air patrol, Florida Department of Health — IT Security, Florida Fish and Wildlife Conservation Commission, Seminole Tribe of Florida and mortuary services, to name a few.

Hotwash: What Went Right, What Needs Work

Paul, KJ4G, reported that a common denominator was that each operator had ICS certifications (four were COML trainees), most held ARRL posts and all were familiar with the ICS standard forms. Thus, all operators were "on the same page from the start." Many had experience in major disasters, which obviously was an asset. The participants owned and operated all the Amateur Radio equipment and the operators were all personally self-sufficient — there was little or no reliance on outside parties for logistical support.

Through good leadership and prompt action, the operators set up the ARU arranging its positions for maximum efficiency. Equipment

worked and operating went well, with ample equipment redundancy to cover any failures. All operators worked together toward a common goal and stayed on task until it was completed, reported Paul. At the start the chief exercise COML was given a completed ICS 217, *Radio Frequency Assignment Worksheet*, which is a kind of communications "Yellow Pages." The IC 217s set the stage for the regional COMLs to quickly provide access for the radio amateurs, in their individual mobile units, to the CP/ASWP.

ARU operators said the exercise was a "good proving ground" and "showcase" for Amateur Radio, citing the presence of the new FDEM Director of Communications, Bill Stoye, K2WHS, "in the tent" during much of the event. Stoye said "When all else fails, Amateur Radio works" — where have we heard that before?

On the other side of the balance sheet, Murphy's Law was still in force with token failures of the UHF FM repeater and the large crank-up tower that seized. There were workarounds for both of those problems and others. The lesson learned was the critical need for the equipment to be maintained both while in storage and when deployed. Paul reported that one disadvantage to the CP/ASWP team was the vagueness in the task assignment system, which was solved to a degree with greater access to the state's Constellation system, granted by Stoye.

Notes from the Observation Post

The total count of participating entities was 102, nine of which had ARES, RACES, MARS or Amateur Radio in their names! Of course many more had radio amateurs in their units providing services directly, but to see so many with the name ARES was impressive. One in particular I really enjoyed seeing was the Florida Division of Emergency Management Amateur Radio Field Unit. It was a privilege to observe the elite team of operators who successfully managed the CP/ASWP and ARU tent. To witness Amateur Radio having such a prime seat at the table at this level was simply amazing.

A pitfall of being a columnist is that one usually ends up relying on the reports of others who are actually in the field. For me, it was good to "get out there."

All photos courtesy Rick Palm, K1CE.

West Central Florida Connection

"Several of the county ARES organizations represented the ARRL West Central Florida Section, including the Pasco County and Hillsborough County ARES/RACES, and Pinellas County Auxiliary Communications Service. We accomplished all objectives and worked well with our professional colleagues (sheriffs), increasing their awareness of our capabilities. We practiced our mutual aid protocols and discovered that our region as a whole had good, redundant capabilities. We conducted an excellent demonstration of the ability of each ARES/ACS group to provide communications. We did find that in a disaster requiring mobilization of the region, we will have to work together to share resources to maintain round-the-clock operations. With practice we will meet that future challenge." — *David Reed, K3DER; Kevin Poorman, KV4CT, West Central Florida Section Public Information Coordinator*

The BEARS Go to Camp Blanding

From Southern Florida, the Brevard Emergency Amateur Radio Services (BEARS), located on Florida's Space Coast, took its state of the art mobile command vehicle, BEARS-I, to the event (see photo). BEARS works in close partnership with the Brevard County EOC and BEARS greatly assisted the EOC on this occasion.

One of the tasks assigned during the exercise was to send a fax message to the state EOC in Tallahassee. Since the BEARS vehicle didn't have fax capability, an alternative method had to be devised. Robert Osband, N4SCY, had the telephone number for someone involved with the EOC. A phone patch was set up via the Military Auxiliary Radio System (MARS) and from that contact Osband found the appropriate e-mail address. He successfully sent the message via *WinMail*.

"I was an exercise participant/attendee with the Palm Bay Police Department. I am the trustee of the Amateur Radio equipment installed in the police department's mobile Unified Command Center. The UCC participated, to a degree, under my call sign, AI4GK. The Palm Bay contingent was impressed with Amateur Radio's capabilities. Another officer who participated in Operation RADAR II told me afterward, 'I always thought that Amateur Radio was just like CB. I never realized that it can do all these things!' That impression, spread to other instances, was one of the most important results of Operation RADAR II." — *Dan Fisher, AI4GK, ARRL Public Information Coordinator, Southern Florida Section; Public Information Officer, Platinum Coast Amateur Radio Society*

"In addition to the Brevard County operations reported above, ARES in the Southern Florida Section was also represented by members working with Broward, Indian River and Palm Beach counties as well as state agencies, all of which were deployed to Camp Blanding in support of Operation RADAR II. Our ARES members welcomed the opportunity to practice and network with our partners in the other two Florida ARRL Sections and with our representatives at the state EOC." — *Jeff Beals, WA4AW, ARRL Southern Florida Assistant Section Manager and Assistant Section Emergency Coordinator*

Contest Corral – May 2013

Check for updates and a downloadable PDF version online at www.arrl.org/contests

Refer to the contest websites for full rules, scoring information, operating periods or time limits and log submission information.

Start - Finish Date-Time		Date-Time		Bands HF / VHF+	Contest Title	Mode	Exchange	Sponsor's Website
3	0230Z	3	0300Z	1.8-14 / -	NS Weekly Sprint	CW	Serial, name and S/P/C	www.ncccsprint.com
4	6 AM	5	8 PM	- / 2.3G+	2 GHz and Up World Wide Contest	Ph CW Dig	6-character grid locator	www.ham-radio.com/sbms
4	6 AM	4	1 PM	- / 902+	Microwave Spring Sprint	Ph CW Dig	Grid square (6-character preferred)	sites.google.com/site/springvhfupsprints
4	0001Z	5	2359Z	28 / -	Ten-Ten Spring CW Contest	CW	Call sign, name, 10-10 number, state	www.ten-ten.org
4	1200Z	5	1159Z	1.8-28 / -	ARI International DX Contest	Ph CW Dig	RS(T), serial or Italian province	www.ari.it
4	1300Z	5	0700Z	1.8-28 / 50,144	7th Area QSO Party	Ph CW Dig	RS(T)+S/P or 7th-area county code	7qp.org
4	1600Z	5	0400Z	1.8-28 / -	Indiana QSO Party	Ph CW	RS(T) + S/P or IN county, DX RS(T) only	www.hdxcc.org/inqp
4	1700Z	5	0459Z	3.5-21 / -	Radio Club of America QSO Party	Ph	RS, QTH, name, equipment	www.radio-club-of-america.org
4	2000Z	5	See web	3.5-28 / -	New England QSO Party	Ph CW Dig	RS(T) and S/P or New England county	www.neqp.org
5	1000Z	5	1400Z	1.8-7 / -	Worked All Britain - LF Phone	Ph	RS, serial, and WAB nr or DXCC entity	www.worked-all-britain.co.uk
7	0200Z	7	0400Z	3.5-28 / -	ARS Spartan Sprint	CW	RST, S/P/C and power	www.arsqrp.blogspot.com
7	1600Z	7	See web	3.5 / 50, 144	OK1WC Memorial Contest	Ph CW	RS(T) and serial	www.hamradio.cz/ok1wc
8	1300Z	9	See web	1.8-28 / -	CWops Monthly Mini-CWT Test	CW	Name, member number or S/P/C	www.cwops.org/onair.html
9	0030Z	9	0230Z	3.5-14 / -	NAQCC Monthly QRP Sprint	CW	RST, S/P/C, and NAQCC mbr nr or power	naqcc.info
11	0000Z	12	2400Z	- / 1.2G	Worldwide EME Contest	Ph CW	TMO/RS(T) and "R"	www.dubus.org
11	1000Z	11	See web	3.5-28 / -	EUCW Fraternizing CW QSO Party	CW	RST, name, club, member number	www.eucw.org
11	1200Z	12	1200Z	3.5-28 / -	Alessandro Volta RTTY DX Contest	Dig	RST, serial, CQ zone	www.contestvolta.com
11	1200Z	12	2400Z	1.8-28 / -	Armed Forces Comm'ns Test	Ph Dig	RS(T)	www.netcom.army.mil/mars
11	1200Z	12	1200Z	1.8-28 / -	CQ-M International DX Contest	Ph CW	RS(T) and serial	www.cq-m.andys.ru
11	1500Z	12	1500Z	3.5-28 / -	Portuguese Navy Day	Ph CW	RS(T), serial, CQ zone	www.nra.pt
11	1700Z	12	1700Z	1.8-28 / 50	Nevada Mustang Roundup	Ph CW Dig	RS(T) and S/P/C or NV county	www.nvqsoparty.info
11	1700Z	11	2100Z	3.5-28 / -	FISTS Spring Sprint	CW	RS(T), S/P/C, name, FISTS nr or power	www.fists.org/operating.html#sprints
11	2300Z	12	0300Z	- / 50	50 MHz Spring Sprint	Ph CW Dig	Grid square (6-character preferred)	sites.google.com/site/springvhfupsprints
18	0000Z	19	2400Z	- / 5.7G	Worldwide EME Contest	Ph CW	TMO/RS(T) and "R"	www.dubus.org
18	0800Z	18	1500Z	3.5-28 / -	Portuguese Navy Day	Dig	RST, serial, CQ zone	www.nra.pt
18	1200Z	19	1200Z	3.5-28 / -	EU PSK DX Contest	Dig	RST and EU area code or serial	www.eu.srars.org
18	1200Z	19	1200Z	1.8-28 / -	His Majesty King of Spain Contest	CW	RST and serial or EA province	www.ure.es
18	1500Z	18	See web	1.8-28 / -	Feld-Hell Hamvention Sprint	Dig	RST, S/P/C, Feld-Hell member nr	www.feldhellclub.org
18	2100Z	19	0200Z	3.5 / -	Baltic Contest	Ph CW	RS(T) and serial	www.lrsf.lt/bcontest/english/rules_html.htm
20	0200Z	20	0400Z	1.8-28 / -	Run For the Bacon	CW	RST, S/P/C, Flying Pig nr or power	www.fpqrp.org
25	0000Z	26	2400Z	1.8-28 / -	CQ WW WPX Contest	CW	RST and serial	www.cqwpx.com
26	8 PM	26	Mid-night	3.5-28 / -	QRP ARCI Hootowl Sprint	CW	RST, S/P/C QRP number or power	www.qrparci.org/contests
27	2300Z	28	0300Z	1.8-28 / -	MI QRP Memorial Day CW Sprint	CW	RST, S/P/C, MI QRP number or power	www.miqrp.org

All dates refer to UTC and may be different from calendar date in North America. Times given as AM or PM are local times and dates. No contest activity occurs on the 60, 30, 17 and 12 meter bands. Serial = Sequential number of the contact. S/P/C = State, Province, DXCC Entity. XE = Mexican state. Publication deadline for Contest Corral listings is the first day of the second month prior to publication date (April 1 for June *QST*) — send information to **contests@arrl.org**. 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.

2012 ARRL November CW Sweepstakes Results

This year your broom had to sweep up four new sections.

by Kelly Taylor, VE4XT, ve4xt@mymts.net

The year 2012 was supposed to be the end of the world for a number of reasons, not the least of which was a misunderstanding of the Mayan calendar. 2012 was supposed to be cataclysmic for Sweepstakes, as well. The section Ontario ceased to exist, replaced by four new sections, Ontario North, Ontario South, Ontario East and Greater Toronto Area. A sweep would require 83 sections. Anarchy would surely result!

It didn't. Stations posting a sweep came in at a healthy 258. Ontario North (ONN) became the new rarest multiplier, but interestingly, many stations who missed a sweep did so by more than just ONN, and some who missed a sweep did so despite snagging ONN. The section was reported in 790 QSOs among logs submitted, but close on its heels was, perhaps oddly, Northern New York (NNY), in 803 QSOs. Even perennial sweep-busters Manitoba (1,190 QSOs), North Dakota (967) and Northern Territories (811) showed more QSOs than ONN.

Single Operator, High Power (SOHP)

Steve, N2IC, continues his mastery of this contest, edging out Gator, N5RZ, for the top spot with 1,424 QSOs and a sweep for a score of 236,384. Steve reports that 15 was his money band in daylight and 40 was hot after dark: "Thanks to CCO (Contesting Club Ontario) for encouraging activity from the new Ontario sections." Gator, N5RZ, beat Number 3 W7RN (N6TV, op) by only eight QSOs.

Single Operator, Low Power (SOLP)

The seesaw continues between Randy, KØEU, and Matt, K7BG. It swung back Randy's way this year (194,220 points), as he beat Matt (186,252) by 48 QSOs and Felipe, NP4Z, (182,932) by 68 QSOs. But it appears Puerto Rico is back. "NP4Z would have won the thing if he hadn't been pulled away from the chair by family matters," Randy wrote in an e-mail.

Randy, KØEU, has had great success over the past 10 years from his impressive Colorado SO2R (Single Operator, Two Radio) station. [Randy Martin, KØEU, photo]

Felipe, NP4Z, is thrilled with his finish. "Low Power is almost impossible to win from here and that's why I like the LP class. Even if you make it to Top 5 you feel like a winner!" he wrote.

Multioperator, High Power (MOHP)

When you have a good thing going, why mess with success? So it is with the crew at W6YI (W6YI, N6AN, N6KI, N6MJ, K6AM, ops), who took the Multioperator title once again, beating Number 2 WØDLE (WØDLE, WØUA, and WBØGAZ, ops) by 89 QSOs, or 222,108 points to 207,334. The U.S. Virgin Islands section was well represented, with KP2M (K1ZE, N3XF, W1EQ, ops) in third spot, just 11 QSOs behind WØDLE.

Multioperator, Low Power (MOLP)

It turns out Ward, NØAX, is proficient with more than just a soldering iron and hands-on radio experiments: he and Sterling, NØSSC, teamed up as WØEEE to win MOLP, beating out a small but capable field, including Number 2 W1HQ, piloted by ARRL staffers Sean, KX9X, and Mike, KI1U. [*It is rumored that a dinner wager was at stake — Ed.*] NX6T (N6KI, WB6NBU, K4RB, N7VM, ops), took third, giving the left coast something to cheer about.

QRP (SOQRP)

You have to sweep to win, right? Not exactly. You just need to make enough QSOs — more than anyone who does sweep. And that's the story atop QRP, where Dean, NW2K, missed a sweep by one but did lead his nearest rival by six QSOs and one section, and beat sweep artists Steve, KØOU, NN7SS (K6UFO, op) and Gary, N7IR, by at least 38 QSOs.

School Club (S)

Congratulations to Bob, WØBH, who again has KØHC on top of School Club with a respectable 1,051 QSOs and a sweep for 174,466 points. It seems Sweepstakes wouldn't be the same without his big Kansas signal.

N9GTC didn't win School Club. Indeed, the station's 177 QSOs and 59 sections were but a fraction of the 500,739 QSOs reported. But in a category small enough you'd have to add two

Top Ten by Category

Single Operator, High Power

N2IC	236,384
N5RZ	225,096
W7RN (N6TV, op)	223,768
NØNI (AG9A, op)	219,618
K5GN	212,480
W6NL (N5KO, op)	210,986
WDØT	210,820
K5TR (N2NC, op)	210,488
K6LA	207,998
W9RE	201,856

Single Operator, Low Power

KØEU	194,220
K7BG	186,252
NP4Z	182,932
K4RO	180,276
NØAT (NØKK, op)	177,620
N4OGW	177,454
VA7RR	175,972
N9CK	173,470
K7GK	169,818
NAØN	169,248

Single Operator, QRP

NW2K	111,684
NØUR	109,350
N7IV	107,568
KØOU	106,738
NN7SS (K6UFO, op)	104,580
N7IR	102,588
K9ZO	100,860
W6JTI	100,440
KØPC	99,996
W7IY	94,770

Single Operator, Unlimited, High Power

K6LL	208,496
K7RL	200,030
W4MR (AA4NC, op)	195,216
KY7M	194,884
N4BP	193,888
KB7Q	193,556
NY3A	192,726
VO1XX (K5KG, op)	184,758
N4ZZ	183,098
N4GG	182,102

Single Operator, Unlimited, Low Power

KE7X	171,644
N7XU (K4XU, op)	168,158
KK7S	163,344
K8BL	159,526
W2CS	153,550
K3AU (K2YWE, op)	147,574
N5DO	145,250
VE3KI	141,598
K7XC	141,532
W9CA (N9CO, op)	141,204

Multioperator, High Power

W6YI	222,108
WØDLE	207,334
KP2M	205,508
K1LZ	202,188
KH7X	194,054
W5RU	191,564
W4RM	173,636
KØS	172,806
W6TK	168,158
KØHB	157,036

Multioperator, Low Power

WØEEE	159,028
W1HQ	153,052
NX6T	144,320
N6WIN	142,096
N4UW	127,654
K4FT	98,496
VE4DR	74,240
WA6KYR	54,112
WDØGTY	52,812
KØUK	44,822

School Club

KØHC (WØBH, op)	174,466
W4UAL	48,924
N5XU (AA5BT, op)	42,312
W3YI (AB3LS, op)	38,776
N9GTC (WW9R, op)	20,886
W8SH	9,752
W1AF (W1PL, op)	9,682
W2DSC (WB2NVR,	6,364

Sponsored Plaque Winners

ICOM PRINCIPAL AWARDS SPONSOR

ARRL is pleased to award a Sweepstakes plaque to the Overall and Division Leaders in each entry category, thanks to Icom America and numerous clubs and individuals who sponsor these awards. For more information on plaque sponsorship or to order a duplicate plaque, contact ARRL Contest Branch Manager Sean Kutzko, KX9X, at (860)594-0232 or **kx9x@arrl.org**. Plaques cost $75, which includes all shipping charges.

Division/Plaque Category	*Winner*	*Plaque Sponsor*
Overall Winners		
Single Operator High Power CW	N2IC	Trey Garlough, N5KO
Single Operator Low Power CW	KØEU	Sean Kutzko, KX9X
Single Operator QRP CW	NW2K	QRP Amateur Radio Club International
Single Operator Unlimited High Power CW	K6LL	Joe KH6GA & Victoria N4WV
Single Operator Unlimited Low Power CW	KE7X (@ KØPP)	Icom America
Multioperator High Power CW	W6YI	In Memory of Jerry Grokowsky, WA9HCZ
Multioperator Low Power CW	WØEEE	Icom America
School Club CW	KØHC (WØBH, op)	Straight Key Contest Club
Atlantic		
Single Operator High Power CW	AA3B	Icom America
Single Operator Low Power CW	NO3M	Potomac Valley Radio Club
Single Operator QRP CW	NW2K	Milt Coleman, K4OSO
Single Operator Unlimited High Power CW	NY3A	Icom America
Single Operator Unlimited Low Power CW	K3AU (K2YWE, op)	Icom America
Multioperator High Power CW	W3LJ	Icom America
Multioperator Low Power CW	K2CDJ	Icom America
School Club CW	W3YI (AB3LS, op)	Icom America
Central		
Single Operator High Power CW	W9RE	Society Of Midwest Contesters
Single Operator Low Power CW	N9CK	Society Of Midwest Contesters
Single Operator QRP CW	K9ZO	Sean Kutzko, KX9X
Single Operator Unlimited High Power CW	NE9U	Straight Key Century Club
Single Operator Unlimited Low Power CW	W9CA (N9CO, op)	Icom America
Multioperator High Power CW	No Entrant	Icom America
Multioperator Low Power CW	N9MT	Icom America
School Club CW	N9GTC (WW9R, op)	Icom America
Dakota		
Single Operator High Power CW	WDØT	Minnesota Wireless Association
Single Operator Low Power CW	NØAT (NØKK, op)	Minnesota Wireless Association
Single Operator QRP CW	NØUR	Tod Olson, KØTO
Single Operator Unlimited High Power CW	K1KD	Minnesota Wireless Association
Single Operator Unlimited Low Power CW	KØMPH	Icom America
Multioperator High Power CW	KØHB	Minnesota Wireless Association
Multioperator Low Power CW	KEØL	Icom America
School Club CW	No Entrant	Tod Olson, KØTO
Delta		
Single Operator High Power CW	N8OO	Icom America
Single Operator Low Power CW	K4RO	Icom America
Single Operator QRP CW	N5EE	Icom America
Single Operator Unlimited High Power CW	N4ZZ	Icom America
Single Operator Unlimited Low Power CW	N4DW	Icom America
Multioperator High Power CW	W5RU	Icom America
Multioperator Low Power CW	N4UW	Icom America
School Club CW	No Entrant	Icom America
Great Lakes		
Single Operator High Power CW	AC8E (K8MR, op)	Mad River Radio Club
Single Operator Low Power CW	W1NN	Mad River Radio Club
Single Operator QRP CW	KT8K	Mad River Radio Club
Single Operator Unlimited High Power CW	N4QS	KD8LL & K4EQ — N8CVH Memorial
Single Operator Unlimited Low Power CW	K8BL	John S. Comella N8AA
Multioperator High Power CW	W8EDU	Icom America
Multioperator Low Power CW	K4FT	Icom America
School Club CW	W8SH	In memory of Raleigh Wert, W8QOI
Hudson		
Single Operator High Power CW	K2UF	Icom America
Single Operator Low Power CW	W2ID	Icom America
Single Operator QRP CW	KR2Q	Icom America
Single Operator Unlimited High Power CW	K2ONP	Icom America
Single Operator Unlimited Low Power CW	W2CS	Icom America
Multioperator High Power CW	KA2D	Stuart Silverstein, K3UEI, Memorial
Multioperator Low Power CW	AB2DE	Icom America
School Club CW	W2DSC (WB2NVR, op)	Icom America
Midwest		
Single Operator High Power CW	NØNI (AG9A, op)	Icom America
Single Operator Low Power CW	KØVBU	Society Of Midwest Contesters
Single Operator QRP CW	KØOU	Icom America
Single Operator Unlimited High Power CW	NØXR	Icom America
Single Operator Unlimited Low Power CW	KØNE	Icom America
Multioperator High Power CW	KØS	Icom America
Multioperator Low Power CW	WØEEE	Icom America
School Club CW	KØHC (WØBH, op)	Icom America
New England		
Single Operator High Power CW	K5ZD	Mark Olsen, KF1V
Single Operator Low Power CW	K1XM	Michael McKaughan, K1DM
Single Operator QRP CW	W1QK	Mark Olsen, KF1V
Single Operator Unlimited High Power CW	W1UJ	Mark Olsen, KF1V
Single Operator Unlimited Low Power CW	AE1T	Icom America
Multioperator High Power CW	K1LZ	Mark Olsen, KF1V
Multioperator Low Power CW	W1HQ	Icom America
School Club CW	W1AF (W1PL, op)	Icom America
Northwestern		
Single Operator High Power CW	N9RV	Icom America
Single Operator Low Power CW	K7BG	
Single Operator QRP CW	NN7SS (K6UFO, op)	Phil Yasson, AB7RW
Single Operator Unlimited High Power CW	K7RL	Icom America
Single Operator Unlimited Low Power CW	KE7X (@ KØPP)	Icom America
Multioperator High Power CW	KL2R	Icom America
Multioperator Low Power CW	No Entrant	Icom America
School Club CW	No Entrant	Icom America
Pacific		
Single Operator High Power CW	W7RN (N6TV, op)	The Carroll Dean Jensen Memorial (K6CDJ)
Single Operator Low Power CW	K7GK	Robert A. Wilson, N6TV
Single Operator QRP CW	W6JTI	Jim Davis, NN6EE
Single Operator Unlimited High Power CW	KM6I	Icom America
Single Operator Unlimited Low Power CW	K7XC	Icom America
Multioperator High Power CW	KH7X	Straight Key Century Club
Multioperator Low Power CW	No Entrant	Icom America
School Club CW	No Entrant	Icom America
Roanoke		
Single Operator High Power CW	N4AF	Potomac Valley Radio Club
Single Operator Low Power CW	N4UA	Icom America
Single Operator QRP CW	W7IY	Icom America
Single Operator Unlimited High Power CW	W4MR (AA4NC, op)	Icom America
Single Operator Unlimited Low Power CW	N3JT	Icom America
Multioperator High Power CW	W4RM	Icom America
Multioperator Low Power CW	K3MZ	Icom America
School Club CW	No Entrant	Icom America
Rocky Mountain		
Single Operator High Power CW	N2IC	Grand Mesa Contesters of Colorado
Single Operator Low Power CW	KØEU	Icom America
Single Operator QRP CW	WC7S	Colorado QRP Club
Single Operator Unlimited High Power CW	AA5B	Icom America
Single Operator Unlimited Low Power CW	KK6MC	Icom America
Multioperator High Power CW	WØDLE	Icom America
Multioperator Low Power CW	KØUK	Icom America
School Club CW	No Entrant	Icom America
Southeastern		
Single Operator High Power CW	AD4Z	Tom Alderman, W4BQF
Single Operator Low Power CW	NP4Z	David Brandenburg, K5RQ
Single Operator QRP CW	K3TW	Straight Key Contest Club
Single Operator Unlimited High Power CW	N4BP	Charlie Wooten, NF4A
Single Operator Unlimited Low Power CW	KY4F	Icom America
Multioperator High Power CW	KP2M	Icom America
Multioperator Low Power CW	K4FO	Icom America
School Club CW	W4UAL	David Brandenburg, K5RQ
Southwestern		
Single Operator High Power CW	K6LA	Icom America
Single Operator Low Power CW	AA6PW	Larry Serra, N6NC
Single Operator QRP CW	N7IR	N6HE and W6DLD
Single Operator Unlimited High Power CW	K6LL	Icom America
Single Operator Unlimited Low Power CW	KE7DX	Icom America
Multioperator High Power CW	W6YI	Icom America
Multioperator Low Power CW	NX6T	Icom America
School Club CW	No Entrant	Icom America
West Gulf		
Single Operator High Power CW	N5RZ	David Brandenburg, K5RQ
Single Operator Low Power CW	N5WR	David Brandenburg, K5RQ
Single Operator QRP CW	WA8ZBT	In Memory of Mick Lange, WB5RSS
Single Operator Unlimited High Power CW	K5RT	Icom America
Single Operator Unlimited Low Power CW	N5DO	Icom America
Multioperator High Power CW	No Entrant	Icom America
Multioperator Low Power CW	WDØGTY	Icom America
School Club CW	N5XU (AA5BT, op)	David Brandenburg, K5RQ
Canada		
Single Operator High Power CW	VE7CC	Icom America
Single Operator Low Power CW	VA7RR	Icom America
Single Operator QRP CW	VA3DF	QRP Amateur Radio Club International
Single Operator Unlimited High Power CW	VO1XX (K5KG, op)	Icom America
Single Operator Unlimited Low Power CW	VE3KI	Icom America
Multioperator High Power CW	VY1EI	Straight Key Contest Club
Multioperator Low Power CW	VE4DR	Icom America
School Club CW	No Entrant	Icom America

Regional Winners

Boxes list call sign, score and class (Q = QRP, A = Low Power, B = High Power, U = Single Operator Unlimited, High Power; UL = Single Operator Unlimited, Low Power; M = Multioperator, High Power; ML = Multioperator, Low Power; S = School Club)

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

AA3B	190,402	B
K2TJ	187,580	B
KD4D	183,098	B
K5ZD	170,150	B
K4O (K1RX, op)	169,154	B
NO3M	155,210	A
W2ID	153,384	A
W2LK	149,234	A
W2EG	146,780	A
K3AJ	136,120	A
NW2K	111,684	Q
WB2ABD	88,724	Q
W1QK	71,442	Q
K2ZR	64,452	Q
AA1CA	60,214	Q
NY3A	192,726	U
VO1XX (K5KG, op)	184,758	U
WR3Z	176,790	U
WX3B	173,304	U
N2MM	167,162	U
W2CS	153,550	UL
K3AU (K2YWE, op)	147,574	UL
AB3CX	126,492	UL
N3SD	111,618	UL
K3MD	108,232	UL
K1LZ	202,188	M
KA2D	122,674	M
W3LJ	56,880	M
W1HQ	153,052	ML
WO1N	34,304	ML
K2CDJ	30,668	ML
AB2DE	1,972	ML
W3YI (AB3LS, op)	38,776	S
W1AF (W1PL, op)	9,682	S
W2DSC (WB2NVR, op)	6,364	S

Southeast Region
(Delta, Roanoke and Southeastern Divisions)

N4AF	197,374	B
AD4Z	194,386	B
N8OO	179,944	B
K4BAI	178,284	B
KØEJ	149,566	B
NP4Z	182,932	A
K4RO	180,276	A
N4OGW	177,454	A
N4PN	154,712	A
N4OO	147,076	A
W7IY	94,770	Q
K4QPL	89,424	Q
K3TW	86,240	Q
N5EE	85,162	Q
WF7T	71,832	Q
W4MR (AA4NC, op)	195,216	U
N4BP	193,888	U
N4ZZ	183,098	U
N4GG	182,102	U
K4TD	182,102	U
N3JT	127,156	UL
N4DW	118,080	UL
KY4F	97,110	UL
N4KH	94,288	UL
W4MPS	86,560	UL
KP2M	205,508	M
W5RU	191,564	M
W4RM	173,636	M
N4GI	151,060	M
N4FX	121,524	M
N4UW	127,654	ML
W4UAL	48,924	ML
K3MZ	26,700	ML
K4FO	8,232	ML
W4UAL	48,924	S

Central Region
(Central and Great Lakes Divisions; Ontario Section)

W9RE	201,856	B
K9CT	184,094	B
AC8E (K8MR, op)	173,304	B
KE9I	158,364	B
K1LT	155,874	B
N9CK	173,470	A
W1NN	168,656	A
AJ9C	158,530	A
K9KM	138,942	A
WT9U	125,952	A
K9UIY	125,952	A
K9ZO	100,860	Q
N9NE	92,960	Q
VA3DF	92,904	Q
VA3SB	82,984	Q
KT8K	82,782	Q
NE9U	168,490	U
N4QS	165,336	U
K3WA	162,680	U
N8BJQ	156,040	U
K9NR	137,282	U
K8BL	159,526	UL
VE3KI	141,598	UL
W9CA (N9CO, op)	141,204	UL
K4FXN	125,496	UL
KB9OWD	120,184	UL
W8EDU	151,392	M
NT8V	91,798	M
KA3MTT	15,680	M
W8SH	9,752	M
K4FT	98,496	ML
N9MT	4,472	ML
N9GTC (WW9R, op)	20,886	S
W8SH	9,752	S

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

N2IC	236,384	B
N5RZ	225,096	B
N0NI (AG9A, op)	219,618	B
K5GN	212,480	B
WDØT	210,820	B
KØEU	194,220	A
NØAT (NØKK, op)	177,620	A
NAØN	169,248	A
N5WR	166,332	A
KØAD	156,620	A
NØUR	109,350	Q
N7IV	107,568	Q
KØOU	106,738	Q
KØPC	99,996	Q
WA8ZBT	65,450	Q
AA5B	176,956	U
KØHC (WØBH, op)	174,466	U
WØZA	164,672	U
K1KD	160,556	U
NØXR	155,472	U
N5DO	145,250	UL
KØMPH	139,938	UL
KTØA	125,132	UL
KTØR (KØOB, op)	119,852	UL
WØPI	107,236	UL
WØDLE	207,334	M
KØS	172,806	M
KØHB	157,036	M
NØMA	89,216	M
KØJA	49,896	M
WØEEE	159,028	ML
VE4DR	74,240	ML
WØGTY	52,812	ML
KØUK	44,822	ML
KEØL	25,200	ML
KØHC (WØBH, op)	174,466	S
N5XU (AA5BT, op)	42,312	S

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

W7RN (N6TV, op)	223,768	B
W6NL (N5KO, op)	210,986	B
K6LA	207,998	B
W6YX (N7MH, op)	201,524	B
K6XX	200,860	B
K7BG	186,252	A
VA7RR	175,972	A
K7GK	169,818	A
VE6EX	161,186	A
W7YAQ	152,720	A
NN7SS (K6UFO, op)	104,580	Q
N7IR	102,588	Q
W6JTI	100,440	Q
N6KV	75,036	Q
W7QDM	62,370	Q
K6LL	208,496	U
K7RL	200,030	U
KY7M	194,884	U
KB7Q	193,556	U
KO7AA	179,280	U
KE7X	171,644	UL
N7XU (K4XU, op)	168,158	UL
KK7S	163,344	UL
K7XC	141,532	UL
W7RM (N6TR, op)	140,934	UL
W6YI	222,108	M
KH7X	194,054	M
W6TK	168,158	M
VY1EI	153,340	M
K6MMM	144,342	M
NX6T	144,320	ML
N6WIN	142,096	ML
WA6KYR	54,112	ML

stations to even have a Top 10, that's hardly the point.

N9GTC is the club station located at Gateway Technical College in Sturtevant, Wisconsin. Pat, WW9R, is one of the instructors at the Johnson Integrated Engineering and Manufacturing Technology Center. When he asked the student club members what they wanted to focus on, they said they wanted to learn Morse code. So, he made them a deal: learn enough Morse and they would play in Sweepstakes CW. "It was an amazing thing to see," he wrote. "With every contact, their excitement grew. It caused me to relive those first contacts as a Novice so many years ago."

The students were thrilled. "Memories were made that will never be forgotten," he wrote. Students rotated in the chair each hour, making an average of 10 QSOs per hour. "But that didn't matter: They were grinning from ear to ear."

Single Operator Unlimited, High Power (SOUHP)

Dave, K6LL, continues to make the most of his Arizona QTH and his operating prowess. His 1,256 QSOs and a sweep (208,496 points) combined for a nearly 8,000-point victory over Mitch, K7RL.

Will, AA4NC (at W4MR), took third place.

Single Operator Unlimited, Low Power (SOULP)

Congratulations to Fred, KE7X (at KØPP), who is now the Unlimited, Low Power record holder with 1,035 QSOs and a sweep for 171,644 points.

Accidentally unlimited, Dick, K4XU, operating as N7XU, was hot on Fred's heels at 1,013 QSOs and a sweep.

Chad, KK7S, earned the bronze medal from his QTH in WWA. Nice to see him active and doing well after a 25-year absence from the airwaves.

Disqualification: K1FWE was disqualified for operating beyond the privilege of his license class.

Sweepstakes by the Numbers Facts and Figures

Number of logs	1,290
Number of QSOs claimed	500,739

Clean Sweeps

Number of Clean Sweeps	258
Number of stations missing a Clean Sweep by one section	118
Most QSOs without a Clean Sweep	1,120
Rarest section	ONN (790 QSOs reported)
Most-worked section	VA (22,650 QSOs reported)

Get Ready

Mark your calendars! The 2013 CW Sweepstakes runs Nov. 2-4. This will be the 80th running of the oldest domestic radio contest, so stay tuned for special ways to celebrate!

Sweepstakes Online

Don't miss the full line scores, additional photos, and Division leader tables in the online version at **www.arrl.org/contests**!

2012 ARRL International EME Contest Results

Have you been touched by a moonbeam?

by Rick Rosen, K1DS, rick1ds@hotmail.com

As many who are successful moonbounce neophytes can attest, there is a great thrill and sense of satisfaction in completing a VHF QSO via reflection off of the Moon. Three weekends of moonbounce make this contest an opportunity for all those capable of EME (Earth-Moon-Earth). The activities were held on the weekends of October 6-7 for bands 2.3 GHz and up, and on November 3-4 and December 1-2 for 50 MHz-1.2 GHz.

There were 107 logs submitted, down from the 130 entries last year but equal to the number of logs for 2010. Eighty-nine (83%) of the entries were single-operator and the other 18 (17%) were multioperator.

Zdenek Samek, OK1DFC homebrewed this 10 meter dish and feed. Zdenek made the top score on 1.2 GHz with 111 QSOs and 45 multipliers. [Zdenek Samek, OK1DFC, photo]

Of all the logs reviewed, 43 of the entrants were CW only and 38 were digital only. The remaining 26 logs showed use of both modes. With the first weekend devoted to 2.3 GHz and up, it was a challenge for participants with several bands available to decide which bands to operate and when. Unless you had multiple dishes, feeds and band scopes, you had to balance band and feed changes with operating time, Moon position and any pre-arranged schedules.

The table lists category winners while the expanded results (available at **www.arrl.org/contest-results-articles**) show who won the top three places.

Stresses and Successes

There were many comments about the conditions and the troublesome effects of Moon libration. Jimmy, SV1BTR, had the problems of a damaged elevation encoder and PA flashover (both repaired). Gerald, K5GW, had his 2 meter amplifier fail on the last day of the contest but that gave him more time to operate on 432 MHz. Wolfgang, DL5MAE, reported an outdoor temperature of –10° C and everything full of ice. Cowles, K4EME, was busy rebuilding his station after a storm in July. Simon, ZL4PLM, lost his complete system and came home to twisted metal on the last contest weekend. Herb, K2LNS, was readying the station at WA2FGK when Hurricane Sandy came along and broke the newly mounted dish right off its setting. At LU1C, Adrian reported that a tree fell and much to their advantage opened a greater Moon visibility window. Several European stations experienced problems with interference from the terrestrial VHF/UHF contest that was scheduled for the same weekend.

Despite these difficulties, we had some outstanding results. In first place Single op, Multiband, CW Only, operator Jimmy, SV1BTR, repeated his success of top score for the past several years. Using five bands he scored 2.352 million points. He also made the top CW Only scores for a single op entry on four bands. The top honors for a Single op, Multiband, All Mode entry goes to Gerald, K5GW, who posted a super score of 4.536 million points on six bands.

In the Multioperator, Multiband, CW Only category, the top honors go to Krzysztof, SP7DCS, who with his son Maciek, SP7MC, scored 638K points on three bands. In first place in the Multioperator, Multiband, All Mode category with 6.045 million points was the K1JT team. They used six bands to keep up their winning streak of the past few years in this category.

If you have ever considered making a moonbounce contact, there is useful information on the web, a chapter in the *ARRL Handbook*, and web-based EME newsletters for both 144 MHz[1] and for 432 MHz and up[2]. There is also an EME net each Saturday and Sunday morning on 14.345 MHz at 1500Z.

The three weekends scheduled for the ARRL EME contest in 2013 are September 28-29 (2.3 GHz and up), October 26-27 (50-1296 MHz) and November 16-17 (50-1296 MHz). Personally, I am waiting for warmer weather in order to get my portable EME gear on the air. I hope to be able to work you off the Moon soon!

[1]**www.df2zc.de/newsletter**
[2]**www.nitehawk.com/rasmit/em70cm.html**

Top Scores by Category

B=144 MHz, D=432 MHz, E=1296 MHz, F=2.3 GHz, G=3.4 GHz, H=5.7 GHz

Single Operator	Station	Bands	QSOs	Mults	Score
All Mode	K5GW	BDEFGH	274	159	4,356,600
CW Only	SV1BTR	BDEFH	196	120	2,352,000
Multioperator					
All Mode	K1JT	BDEFGH	362	167	6,045,400
CW Only	SP7DCS	BDE	103	62	638,600

Single Operator	Station	QSOs	Mults	Score
All Mode 144 MHz	KB8RQ	213	76	1,618,800
CW only 144 MHz	SV1BTR	29	18	28,500
All Mode 432 MHz	LZ1DX	63	40	252,000
CW only 432 MHz	SV1BTR	36	23	82,800
All Mode 1.2 GHz	OK1DFC	111	45	499,500
CW only 1.2 GHz	I1NDP	99	42	415,800
All Mode 2.3 GHz	SV1BTR	39	30	117,000
All Mode 3.4 GHz	PY1KK	6	5	3,000
All Mode 5.7 GHz	SV1BTR	19	13	24,700
All Mode 10.3 GHz	OK1CA	2	2	400
Multioperator				
All Mode 144 MHz	RX1AS	231	76	1,755,600
CW only 144 MHz	SP7DCS	19	15	28,500
All Mode 432 MHz	OH2PO	86	34	2,924,000
CW only 432 MHz	SP7DCS	18	16	28,800
All Mode 1.2 GHz	K1JT	82	37	303,400
CW only 1.2 GHz	S59DCD	80	45	360,000
All Mode 2.3 GHz	SP6OPN	32	28	89,600
All Mode 3.4 GHz	K1JT	4	4	1,600
All Mode 5.7 GHz	OK1KIR	17	12	20,400

2013 Field Day Announcement

■ The largest on-air Amateur Radio event in the world is returning June 22 and 23! If you haven't already started planning your effort, now is the time to do so! Complete details and the official 2013 Field Day Kit can be downloaded at **www.arrl.org/fieldday**.

■ **New For 2013: Changes to Field Day setup time.** A rules change for 2013 now allows groups to start setting up at 0000 UTC on Friday (8:00 PM EDT, 7:00 PM CDT, 6:00 PM MDT, 5:00 PDT Thursday). Groups may begin setup, stop for the night, and return the next day. However, remember that you only have a cumulative total of 24 hours within the 42-hour "setup window" to finish your setup.

Members of the Ski Country ARC of Carbondale, CO had a great time on the Western Slope during Field Day 2012. [Peter Buckley, N0ECT, photo]

Basic Info

When: 1800 UTC Saturday June 22 through 1759 UTC Sunday, June 23.

Setup: **NEW FOR 2013**: Stations have a maximum of 24 hours total time to use as setup between 0000 UTC Friday and 1800 UTC Saturday. If you wait until 1800 UTC Saturday to begin setup, you may operate until 2100 UTC Sunday.

Reporting Your Score: All scores must be received at ARRL HQ no later than July 31, 2013. **No late entries will be accepted.** Participants are *strongly encouraged* to use the online Field Day score reporting system at **www.b4h.net/cabforms**. You get the instant satisfaction of your score summary being accepted, with a confirmation receipt e-mailed to you for verification — and you earn 50 bonus points!

NOTE: Submitting only a Cabrillo formatted electronic log is not sufficient for entry; please be sure to fill out the online score reporting form mentioned above.

Use the Field Day Locator! Want to tell the world where your Field Day effort will be? Going out of town and want to find a Field Day site to visit? You can do both at the ARRL Field Day Locator page. Visit **www.arrl.org/field-day-locator** and get started.

Don't Forget the VHF Gear! All Class A stations receive a free VHF+ station. Don't leave free points on the table! For ideas on VHF station implementation and operation, download the Field Day VHF Operating Tips PDF at **www.arrl.org/fieldday**.

Questions? We're here to help! E-mail us at **fdinfo@arrl.org**.

Scan this QR code with your smartphone to go directly to the Field Day rules page.

Complete rules and forms can also be found at www.arrl.org/fieldday.

Don't Forget The Public Relations Bonuses!

A major purpose of Field Day is to give hams an opportunity to tell Amateur Radio's story to our friends, our neighbors, our communities and the leaders in our communities. As you prepare for Field Day, plan to spread information about Amateur Radio. You can earn points for doing so!

■ Instead of heading to a mountaintop, how about a supermarket parking lot? Being in a conspicuous public place is good for 100 points!

■ Instead of just telling your fellow hams and club members, tell the newspapers and local radio and TV stations, too! Press release samples are available at **www.arrl.org/pio**. Having a media release or link is good for 100 points!

■ In addition to manning the radios, man a public information table with brochures, signs and a smile. Having a public information table/center is good for 100 points!

■ Instead of just glad-handing the mike, how about shaking hands with your area's elected officials and politicians? A sample invitation is in your Field Day packet. If an invited, elected local official visits you earn 100 points!

■ Instead of talking to a served agency, invite one of their leaders to come down and visit you, and perhaps even get him or her to talk on your radio. If an invitee from an official served agency visits, you earn 100 points!

That's 500 free points for your Field Day effort! Go for it in 2013!

The 2013 ARRL June VHF Contest

1800 UTC Saturday, June 8 - 0259 UTC Monday, June 10

■ During the heart of sporadic E season, the ARRL June VHF Contest takes full advantage of great propagation on the "ultra-highs." With simple antennas and modest gear, you can work stations hundreds of miles away — if the propagation gods smile! Can you earn your VUCC award by working 100 different grid squares in a single weekend? Many VHF'ers have!

■ The exchange is simple: just the Maidenhead grid square you're operating from. For more info on grid squares, visit **www.arrl.org/grid-squares**.

■ Operate from home, a hilltop, or make QSOs from more than one grid square as a Rover. Pack up your gear and go on a DXpedition to a rare grid square! This contest is a terrific match for adventure in the great outdoors.

■ E-mail Cabrillo formatted electronic logs to **junevhf@arrl.org**; mail paper logs to ARRL June VHF Contest, 225 Main Street, Newington, CT 06111. All logs must be postmarked no later than 0300 UTC Wednesday, June 10.

Complete rules and entry forms can be found at

www.arrl.org/june-vhf

Robert Wade, KI6TQT, operated from Garnet Peak in the Cleveland National Forest outside San Diego in grid square DM12 during the 2012 ARRL June VHF Contest. He earned 3rd place in the Southwestern Division in the Single Operator, Portable category. Not bad for his very first contest! [Robert Wade, KI6TQT, photo]

New Categories In 2013!

Starting in 2013, the ARRL January, June and September VHF contests have two new entry categories designed to encourage activity among newcomers to VHF contesting:

Single Operator, 3-Band: Make QSOs on 50, 144 and 432 MHz only, 100 W power limit on 50/144 MHz, 50 W on 432 MHz.

Single Operator, FM Only: Make QSOs on the 50-440 MHz bands with 100 W power limit.

Scan this QR code with your smartphone to go directly to the June VHF Contest rules page.

Sean's Picks

Sean Kutzko, KX9X, kx9x@arrl.org, ARRL Contest Branch Manager

■ **State QSO Parties this month:** The first weekend in May is *the* time to be on the air for State QSO parties. The New England QSO Party, the 7-Land QSO Party and the Indiana QSO Party all have a huge draw and are great fun. Try one of these events as a mobile and activate more than one county for an extra thrill! On May 12, check out Nevada's Mustang Roundup, too!

■ **QRP Contests this month:** ARS Spartan Sprint (May 7), NAQCC Monthly QRP Sprint (May 16), Flying Pigs Run for the Bacon (May 20),QRP-ARCI Hootowl Sprint (May 26) MI QRP Memorial Day CW Sprint (May 26)

■ **Volta WW RTTY Contest (May 11-12):** Another great RTTY contest. If you haven't tried RTTY, you're missing out on serious fun! Exchange is RST, QSO number and CW Zone.

■ **His Majesty the King Of Spain Contest, CW (May 18-19):** If you're not going to Dayton, work España! How many Spanish provinces can you work? Non-Spanish stations send RST and a serial QSO number.

■ **CQ WPX Contest CW (May 25-26):** Prefixes are the name of the game in this 48-hour CW extravaganza. The more prefixes you work, the higher your score in this great event.

May 2013 W1AW Qualifying Runs

W1AW Qualifying Runs are held at 7 PM EDST (2300Z) Tuesday, May 7 and at 9 AM EDST (1300Z) Friday, May 24. The West Coast Qualifying Runs will be transmitted by station K9JM at 3590 and 7047.5 kHz at 9 PM PDST on Wednesday, May 15 (0400Z May 16). Unless indicated otherwise, sending speeds are from 10 to 35 WPM.

Bernie McClenny, W3UR, w3ur@arrl.org

Amateur Radio's Top DXers

The best of the best, these DXers top the rest.

Amateur Radio's Top DXer John Dack, W7KH, passed away this past January leaving the top notch position on the all-time ARRL® DXCC list vacant.[1] Let's take a look at the three men who have taken his place at the top of the ARRL DXCC Mixed standings (in call sign order). Each has worked and confirmed 394 countries, including all 340 of the current countries and all are missing seven deleted entities from the past.

Ami Shami — 4X4DK

Shortly after Israeli independence, Ami Shami began his Amateur Radio career. Before being licensed, he was involved at a club station where he first learned electronics. In 1950, at age 13, he became one of Israel's first licensed Amateur Radio operators, receiving the call sign 4X4DK.

A neighbor introduced Ami to electronics and radio around 1947. This sparked his interest and got him involved with his local club. At that time Israelis were not able to operate Amateur Radio due to the British mandate [a 1922 international agreement that placed what is now Israel under British control until the partition of Israel in 1948. — *Ed.*]. After obtaining his license Ami's interest in DXing began as a competition with a friend, to see who could get DXCC first.

His most memorable DX contact was in 1954, when he contacted Chak, AC4NC, in Lhasa, Tibet. Ami would get up early every morning and listen for Chak. Finally, one morning he heard Chak and worked him using a homemade 25 W AM transceiver and a dipole. Chak QSLed direct and sent a card with a Tibetan stamp.

Ami was the first Israeli station to operate on SSB, beginning in 1956. There are only seven countries Ami didn't work: C9 — Manchuria, CR8 — Damao and Diu, FN — French India, PK1-3 — Java, PK5 — Netherlands Borneo, PK6 — Celebe and Molucca Islands and VO — Newfoundland and Labrador. One of these seven, VO, was deleted before Ami was licensed. Ami thought he worked FN8AD in French India, however, FN8AD couldn't confirm the contact. Eventually Ami was able to verify this for himself. He had the opportunity to view the FN8AD log and saw with his own eyes that he was not there.

While waiting for new countries Ami continues to chase DX in the ARRL DXCC Challenge. As of early March 4X4DK had 3112 confirmed at the ARRL DXCC Desk. [Photo courtesy Ami Shami, 4X4DK]

That tall equipment on Ami's right is the 4X4DK transmitter circa 1954. [Photo courtesy Ami Shami, 4X4DK]

Ami has been on the other side of the pileup twice. First as part of the August 1965 4X1DK operation from Palestine, which was later deleted in June 1968 (and returned to the list in 1999). In 1995 he was a member of the JY74X and JY74Z joint operations by Jordanian and Israeli Amateur Radio operators in Amman and Mount Nebo, Jordan. This included the then King of Jordan — His Majesty Hussein Bin Talal, JY1.

At 77 years old, Ami is a member of First Class CW Operators Club (**www.g4foc.org**). He has worked all 340 current DXCC countries and keeps busy with the ARRL DXCC Challenge, for which he has 3112 band-countries confirmed.[2] Like many DXers his most difficult challenge is the local noise on 160 meters. He has a modest station in the middle of Rehovot city. His four story building has a very small roof for holding his 40-6 meter log periodic and an 88 foot tall vertical, as well as some receiving antennas.

For those just starting out in DXing, Ami advises having patience and listening carefully for the DX.

Robert N. Boulle — W2OKM

Bob became an Amateur Radio operator in September 1941 at the age of 17 with his first and only call sign, W2OKM. His first station, at his boyhood home in City Island, New York, featured a homemade 01A triode tube receiver that his father built and that Bob still has. He graduated from high school right into the beginning of World War II and was drafted in November 1942. He was in the Army Air Corps and flew some 250 flights in and around Papua New Guinea, thankfully without harm!

After World War II, he obtained his commercial license and worked for the next 31 years at Fort Monmouth, New Jersey. He joined the North Jersey DX Association the year after it first began. At the time he had a W3DZZ triband beam on a 40 foot tower. In the mid '60s Bob took over as the W2 QSL Bureau Manager.

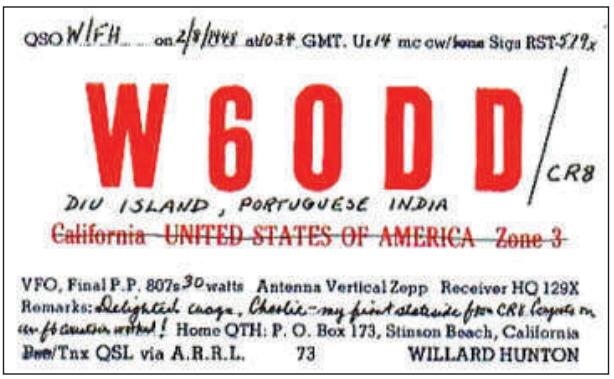
Over the years Bob worked every country except PK6 — Celebe and Molucca, CR8 — Damao and Diu, FI8 — French Indo-China, CR8 — Goa, PK1-3 — Java, PK5 — Netherlands Borneo and PK4 — Sumatra. His most exciting DX contact was with North Korea.

[1]B. McClenny, W3UR, "Amateur Radio's Top DXer," *QST*, Sep 2011, p 88

[2]Find more information about the DXCC Challenge Award at: **www.arrl.org/dxcc-challenge**

He currently runs an IC-7600 transceiver and TEN-TEC Titan amplifier driving an A3S Yagi and a vertical. You will often hear W2OKM in contests operating CW, his preferred mode. He's also worked and confirmed at the ARRL DXCC Desk 275 countries on Topband.

To all the new DXers, Bob recommends starting out on CW only — no need for fancy equipment — and to listen carefully. When asked about the future Bob, who is now 88 years old, just hopes there are no more new countries!



This is one of the rarest QSL cards. It confirms contact with the W6ODD Diu Island DXpediton in 1948. Deleted from the DXCC list in 1962, it's one all three of our master DXers missed.

Joseph J. Schroeder, Jr — W9JUV

If you have been to the W9DXCC Convention (your editor's favorite) you have seen Joe. He's always the last man standing in the DXCC countdown! Joe's interest in Amateur Radio began in World War II. Upon entering high school in 1944, a neighbor who was a radio operator in the Merchant Marine advised him: "Take the school's course in radio code and you'll never carry a rifle!" He did, and after seeing all the fascinating equipment and the QSLs on the wall in the New Trier High School radio club shack (W9EDC) Joe was convinced. Joe passed the code class and took his Amateur Radio exam, receiving W9JUV on May 2, 1946 at the age of 16.

Ten meters was the only HF band available at the time and it wasn't long before Joe worked his first DX, W3JMH/KH6 in Pearl Harbor, Hawaii "with 20 W input crystal controlled AM to a Taylor T21 tetrode and a folded dipole at about 30 feet above the ground." This was followed by working FM8AC (Martinique) on CW. Paddy, EI9J, was his first European DX.

Joe had great DX Elmers like W9ABA, W9FJB, W9FKC and W9GRV — all serious pre-war DXers. By the fall of 1946 he had logged some 50 countries and had upgraded to an 807 final running 50 W into a homemade 2 element 10 meter Yagi made of copper tubing.

By August 1947, he'd upgraded to a home built 250 W pre-war open rack panel rig, a pretty potent signal for that time. At this point W9JUV got involved in running phone patches for GI friends like J2ACS (Japan), J9AAS (Okinawa) and others overseas who had families in the Chicago area. Running patches for lonely GIs and their families probably cost him a few rare ones, but he says it was well worth it.

Like Ami and Bob, Joe has worked all of the current DXCC countries having missed only seven entities, all on the deleted list: AC4 — Tibet, CR8 — Damao and Diu, FI8 — French Indo-China, FN — French India, PK1-3 — Java, PK5 — Netherlands Borneo and PK6 — Celebe and Molucca.

In 1952 Joe became the youngest W9 to receive the Mixed DXCC Award. Joe has primarily lived and operated in the Chicago area, except for 4 years in college in Wisconsin and stint in New Hampshire working on *Ham Radio Magazine* in 1973 (where he held WA1SXB).

For the new and upcoming DXers Joe recommends listening before jumping into the DX pileup. "Listen and analyze what you are hearing and act accordingly," says Joe. Too many people hear the DX station and simply start calling. His advice is to first listen to the pileup and find the stations the DX station is working. Then determine the DX station's method. "Is he moving up a little bit after each contact, sticking on a frequency until too many people catch on to it, moving down or just jumping around?"

Joe is currently 83 years old and is using a TH2 Mark III (two element tribander), a Cushcraft vertical for the 12, 17 and 30 meter bands, a HyTower for 80 and 160, and a 3 element beam and HB9CV 2 element Yagi for 6 meters where he also has DXCC and WAS.

Joe, W9JUV, is a member of the CCC and operates PJ2T at Signal Point, Curacao. [photo courtesy Joseph Schroeder, W9JUV]

He uses IC-756 Pro and IC756 Pro II transceivers with a PW-1 amplifier. He's a contester who is active on 1.8-432 MHz and a member of the Northern Illinois DX Association, Caribbean Contesting Consortium (PJ2T), Old Old Timers Club, Radio Club of America and a life member of ARRL, AMSAT and Quarter Century Wireless Association.

The Rarest of Them All

So there you have it, Amateur Radio's top three DXers. It's interesting that all three missed CR8 — Damao and Diu, PK6 — Celebe and Molucca, PK1-3 — Java and PK5 — Netherlands Borneo.

Damao and Diu is no surprise, as it is without question the rarest ever DXCC entity on the list. These were two Portuguese enclaves on the western coast of India. Damao, now called Daman, is located on mainland of India while Diu is an island separated by a small channel between it and India's mainland. Their addition to the ARRL DXCC list was first announced in the August 1961 issue of *QST* and then corrected in the September 1961 issue. Credit was given effective October 1, 1961 for contacts from day one of DXCC, November 15, 1945. The first and only known operation was that of Bill Hunton, W6ODD/CR8, on February 8, 1948. It's thought that only 22 people have worked this one. On December 18th Portugal surrendered Damao, Diu and Goa (the other CR8), to India. It was deleted from the ARRL DXCC list effective January 1, 1962.

Wrap Up

That's it for this month. I want to add a special thanks to ARRL Awards Branch Manager Bill Moore, NC1L, for doing some background research for this article. Keep sending your DX news, DX Club newsletter and photos to **w3ur@arrl.org**. Until next month see you in the pileups!

Jon Jones, NØJK, n0jk@arrl.org

A Meteor That Made Everyone Scatter

A meteor streaking over Russia was a major lost opportunity for VHF meteor scatter DX.

A huge meteor flared through the skies over Russia's Chelyabinsk region on Friday, February 15 at 9:20 AM local time (0320 UTC), triggering a powerful shock wave that injured nearly a thousand people, blew out windows and reportedly caused the roof of a factory to collapse.

Multiple amateur videos posted online showed the meteor's flaring arc (called a *bolide*) crossing the western Siberian sky. Other videos from the scene included a loud boom, followed by a cacophony of car alarms. The meteor exploded in the air high above the ground. The Russian Academy of Sciences reported that "The meteorite was several meters in diameter and weighed around 10 metric tons. The object entered the atmosphere at a speed of 15-20 kilometers per second and disintegrated at a height of 30-50 kilometers. The movement of fragments at high speed caused a powerful emission of light and a strong shock wave."

This meteor created a massive swath of ionization in the lower ionosphere and a large visible smoke trail. A huge record setting meteor scatter opening followed on the VHF and UHF bands for stations within a few thousand kilometers.

Lost Opportunity

Scanning the DX clusters, I saw no VHF amateur meteor scatter contacts reported from this meteor. This may be in part due to where the meteor exploded over the ground — Chelyabinsk — which is in western Siberia. There are not many VHF Amateur Radio stations in the region and it is likely that even fewer were on the air as the meteor streaked across the sky at 9:20 AM local time on a work day. Had the meteor plunged to Earth over western Europe or North America during a meteor shower when many VHF stations were already active, it would be interesting to speculate what sort of radio conditions might have occurred.

I think all VHF operators dream of the "big opening." Whether 6 meter F2 to the Far East, a huge all day E_s opening to Europe, a 2 meter E_s cross-country opening, a week-long tropo opening, a long lasting "blue whizzer" meteor burst or an EME weekend with no ionospheric loss, many share these daydreams. A few may have actually worked such openings.

Meteor scatter radio propagation normally occurs when tiny grains of dust enter the Earth's atmosphere and burn up as they descend. When they begin to burn up, they leave a trail of ionized particles in the E layer of the ionosphere. These trails may persist from a few seconds to even a minute or more if a large grain ionizes.

The maximum frequency that can be reflected depends on the intensity of the ionization from the meteor. The optimum frequency seems to be around 40 MHz, so meteor scatter from random meteors is heard often on the 10 and 6 meter bands, less so on 2 meters. The range is typically 1000-2000 km and is based on the height above the Earth where the meteors ionize. Special digital techniques such as *WSJT* (a digital protocol created by Joe Taylor, W1JT) allow communication via meteor scatter using the short, weak bursts of ionization.

A Little Reverie

During meteor showers, stronger, longer bursts may allow communication occasionally via SSB and CW. A meteor the size of the February 15 Chelyabinsk meteor would create a massive trail of ionization in the E layer lasting a long time. It is a snowy winter night as I write this and, as I watch the snow fall, I imagine what it might be like if a meteor that size fell over North America when activity was high...

August 12, 2013 is the peak of the annual Perseid meteor shower. Many stations across North America are making digital *WSJT* contacts and a few SSB contacts on 144 and 222 MHz. There is a tropo opening in progress across the Midwest this humid summer morning, with some stations working several hundred miles on the UHF and microwave bands. At 0920 EDST (1320 UTC) a brilliant bright white trail is spotted over eastern Indiana, followed by a loud sonic boom. Larry, NØLL, in Smith Center, Kansas has just finished calling "CQ Scatter" on 144.200 MHz SSB. He takes a sip of coffee as he lets off the PTT button expecting to hear hiss, but instead his speaker shakes "Larry, NØLL, this is WB2AMU. You're 20 over in New York!" Larry drops his coffee cup, then collects himself, gives Ken a report and moves up 25 kHz to have a go at the pileup.

Loud stations call in as fast as Larry can log them. Signals pin his meter, there is no fading, but many have an odd Doppler shift. There seems to be no end to the frantic pileup. 144.200 is an absolute zoo. Larry then goes to 222 MHz and the pileup there is just as big, snarling and loud. At the same time JD, NØIRS, in Kansas City is calling CQ on

The Earth's North Magnetic Pole Is On the Move

In Dave Bernhardt's, N7DB, and Dave Lofgren's, K7RWT, excellent article in the March 2013 issue of *QST* "Pole Vaulting on Six Meters" there was some discussion about whether the movement of the Earth's north magnetic pole (NMP) may influence northern latitude sporadic E.[1] The magnetic pole has moved approximately 840 km north over the last 50 years. The farther north the NMP migrates, the farther north the zone of "mid-latitude" E_s could be, potentially leading to more E_s openings along the great circle path from W6, W7 and WØ to Europe. The pole migration may also move the geomagnetic equator farther north in the western hemisphere, extending the TEP zone northward and allowing more North American stations to make TEP contacts to Africa, South America and the South Pacific.

[1]D. Bernhardt, N7DB; D. Lofgren, K7RWT; "Pole Vaulting On Six Meters," *QST*, Mar 2013, pp 73-75.

432.100 MHz beaming northeast looking for tropo to 9 land. K1WHS in Maine calls JD with a 60 dB over S9 signal, with VE1SKY tail-ending Dave. It begins to dawn on some of the operators that this is not a typical blue whizzer meteor but something else. Something much bigger. Signals are not fading out. If anything, they are getting louder. JD has the presence of mind to ask 'WHS to move to 1296.1 MHz. Reports are exchanged, now to 2304 MHz. Dave, K1WHS, tunes his radio to 2304.1 and hears...

Six and 2 meters could sound like an E_s opening during a Chelyabinsk type meteor event. Strong, loud signals would fill the bands. It would be easy to make conventional SSB or CW contacts. Given the strong steady signals, these would be the best modes to use since contacts can be completed faster on these modes than with *WSJT*. The 222 and 432 MHz bands could be open for many minutes, allowing strong SSB contacts. During the peak of the 1998 Leonid meteor shower, a blue whizzer allowed Arliss, W7XU, in South Dakota to work Patrick, N6RMJ, in southern California on 432 MHz SSB. It's possible that 1296 MHz might briefly support meteor scatter communication for alert stations. Perhaps even a 2304 MHz meteor scatter contact is possible, particularly for those stations equipped with *WSJT*.

To catch such an event would be a daunting challenge, but meteors this size may occur more frequently than previously thought. Perhaps the way to catch one is through consistent daily activity such as promoted by the *205MorningReport*. Those who are at the radio at the right time would be in the "catbird seat" to work such an opening. Thanks to Bob, WA3YGQ, for background information on this spectacular event.

On the Bands

50 MHz

There were a number of good E_s openings during February. On the 12th, there was an E_s opening between Florida and the Midwest (see Figure 1). NØJK (EM28) worked KD4ESV (EL87) at 0045 UTC and WB7BBI (DM93) logged K4RX (EM70). K5GZR (EL29) worked W4ID (FM04) at 0106 UTC, probably cross path off the same E_s cloud. Chip, K7JA (DM03) logged a rare winter double hop E_s contact with K4RX. "I had a pleasant surprise tonight when I worked Terry, K4RX in EM70 at 0145 UTC 12 February. He peaked 59 with QSB down to 53. I'm running 200 W (IC-7800) to a 7 element LFA Yagi at 72 feet."

On Valentine's Day the West Coast had an

Figure 1 — A map of a more limited 6 meter E_s opening February 11-12 from the Midwest to Florida and California. Note the spot by N6EV of the WBØRMO/b. About an hour later K7JA worked K4RX on double hop E_s. [**DXMAPS.COM**]

E_s opening to the Pacific Northwest. AI6O (DM12) worked KA7BGR (CN82) at 0420 UTC the 14th. There were a number of spots for the XE2K/b (DM22) from Oregon. Tim, NWØW (EM47) worked KB3WL (FN02) at 0105 UTC on the 15th via E_s. Bill, WØWFH (EM48) worked NY2NY (FN30) and K5LA (DM61) via *WSJT* meteor scatter, also on the 15th.

An opening to New Zealand occurred on the 17th (see Figure 2). KD5PBR (EM04) worked ZL1RS (RF64) at 0233 UTC. Earlier Julian, XE2JS (DL68) had a strong steady opening for hours to the Midwest states. NØLL (EM09) first heard XE2JS at 0109 UTC. NØJK/m (EM28) chatted with Julian at 0137 UTC with 58-59 signals. His mobile antenna is a simple 2 meter ⅝ wave magnet mount vertical whip that is ¼ wavelength long on 6 meters. NØLL said he heard XE2JS a total of 3 hours. Julian worked hard to hand out DL68 and I heard him call many unanswered CQs. Tim, NWØW, also worked ZL1RS. "At 0207 UTC I had XE TV carriers all off sets about S7-9, at 0211 UTC had XE2JS (DL68) and XE2O (EL05) in here.

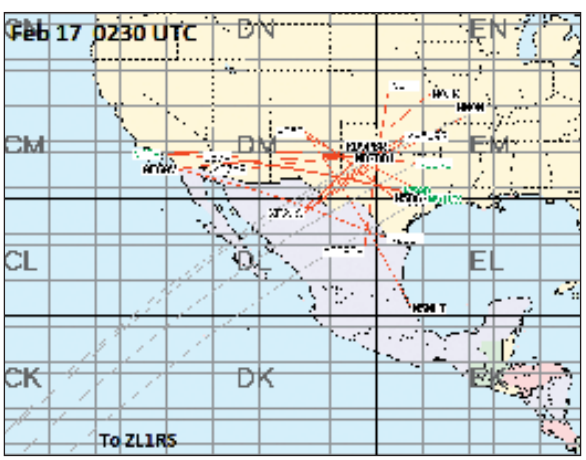


Figure 2 — On February 17 a 6 meter opening at 0230 UTC connected NØJK and XE2JS off the same E_s cloud of the NØLL — XE2PEA contact, which in turn may have created an E_s link for NWØW to ZL1RS. [**DXMAPS.COM**]

At 0212 UTC I checked ZL video and 45.260 MHz was in about S1-3 and at 0236 UTC I worked ZL1RS. Bob was really weak at 319-41."

Bob, W4GCB (EM73) had an unusual opening to Mexico all to himself on February 18. "I was about to shut down the 6 meter rig when I heard a strong CW station calling CQ at 0118 UTC. It was XE2YWH, in DL92. Not an unusual contact but *he was the only signal on the entire band*. No beacons, etc, to be heard. My beam was pointed northeast but I had no problem reaching him 579 both ways. He called CQ for at least half an hour and I did not hear him get any response. I also called CQ several times on CW, then moved to 50.125 and called on SSB, with no response. Nothing but silence."

Also on the 18th, Fred, KH7Y (BK29) on the "Big Island" of Hawaii worked FK8CP via TEP around 0630 UTC. He reports Remi was "very loud" when he turned his antennas toward Hawaii. Later that day CT8/KØRUI (HM68) heard KP4EIT via F2 backscatter at 2003 UTC. February 19 the 6W/HAØNAR DXpedition made many European contacts, mostly with Spain and Portugal. On the 20th KG6DX Guam heard the KH9/WA2YUN/b at 0745 UTC.

An extensive and long lasting E_s-TEP opening between North America and New Zealand took place February 20-21 (see Figure 3). It started abruptly at 2245 UTC February 20 taking many by surprise. Tim, NWØW (EM47) heard ZL TV video carriers from 2245 UTC to 0200 UTC on the 21st. The E_s opening started for Tim when he heard the WR7NV/b (DM25) on E_s at 2215 UTC, followed by a spot by KS7S (DM41) for Tim at 2232 UTC. Tim worked ZL1RS at 2245 UTC. NØJK (EM28) heard WR7NV/b 599 at 2300 UTC and copied ZL1RS working K3PA at 2303 UTC.

Steve, W5KI, in Arkansas logged ZL1RS at 2335 UTC. "Worked him at 2334 UTC on CW. Heard him for about 30 minutes, up and down, from 2330 to 0000 UTC (approximate)." ZL1RS was heard as far east as K2MUB at 2333 UTC. John, W9RPM, was surprised and pleased to work ZL1RS. "My friend KA9FOX called me and said he had just worked Bob, ZL1RS, on 6 meter CW. He was hesitant to even listen when he saw a post of ZL video, but turned the rig on.

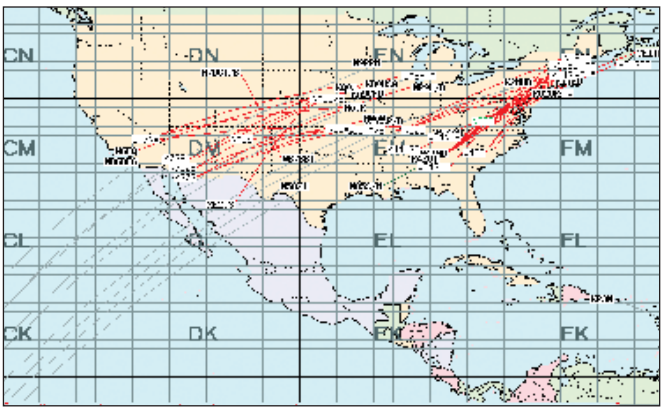


Figure 3 — On February 20 a strong 6 meter opening occurred at 2300 UTC connecting ZL1RS to the Midwest with multiple E_s clouds creating paths. [**DXMAPS.COM**]

I worked Bob about 15 minutes after KA9FOX. He was weak, but in and out for about 20 minutes here. I logged him at 2313 UTC. I heard many stations calling but most were calling when ZL1RS was also calling."

The K7NX/NQ7R meteor scatter Grid Expedition to DM32 logged NJ7A (DN30), NØLWF (EN10), N7NW (CN87) and W7OUU (DN22) via *WSJT* on 6 meters.

VKØRTM/b (MC12kj) located at Mawson Station, Antarctica (see Figure 4) began operating on 50.300 MHz on the 24th. The antenna is two stacked M^2 loops. The beacon was donated by Dave, N3DB.

144 MHz

Sam, K5SW (EM25) had 28 check-ins across 6 states on 2 meters to the Monday WSVHF net on February 4. Best DX was K5AND (EM00) 653 km and KE5JXC (EL39) at 703 km. These nets are a great way to build regional activity and for you to work new grids. Jim, W8SOL (EN71) worked Peter, VA3ELE (FN03) on February 15. Jim says Peter was mobile with 50 W to a halo on a lunch break from work and "a solid" 519 at nearly 480 km. Lloyd, K7NX, and Tom, NQ7R, were on a winter meteor scatter grid expedition to DM32 February 19-21. They worked WA7GSK (DN13), KI7JA (CN85), KS7S (DM41), K7MAC (DN13), WS5N (DM54), NØLWF (EN10), NJ7A (DN30), KF7CQ (DN13), N5TM (EL29), W7OUU (DN22) and XE2AT (DL81) all on 2 meters via *WSJT*. Larry, W5LDA (EM16) received his first 2 meter EME QSL from DK3WG for a contact on February 3 at 0747 UTC. (Thanks *205MorningReport*)

222 MHz

Brian, N5BA (EL29) worked Bill, W3XO (EM00) on February 13.

432 MHz

Rick, WØRT (EM27) chatted with several EM27 stations including KCØSNN Carl Junction, Missouri on February 14 at 0245 UTC on 432 MHz SSB. Vic, WB4SLM (EM82) logged KD4ESV, WP4O (EL87) and N4TUT (EL98) in Florida on the 21st.

Some new beacons to watch for this spring are N8PUM/b (EN57) on 432.311 MHz with 3 W to a turnstile antenna and the 432.372 MHz K4UHF/b (EM85cg).

902, 1296 MHz and Up

N4PZ (EN52gb) is now running a 10 W "split direction" beacon on 1296.274 MHz beaming toward MN and MO (one Yagi with 5 W each direction) from 6-9 AM and 5-11 PM CST. The beacons operate by wind/solar power. The K4UHF/b is on 902.310, 1296.310 and 2304.310 MHz from (EM85cg) per WB4SLM. K5TRA (EM10) has put together an impressive attic antenna farm on 144 through 1296 MHz including two 22 element home built Yagis on 23 centimeters. See **k5tra.net**. WA8RJF has a new beacon on 10,368.300 MHz from the campus of Case Western University in EN91em. The call is WA8RJF/b.

Figure 4 — The president of the local CC&R committee gives his approval to the VKØRTM 6 meter beacon's antennas — 2 × M^2 HO loops. [Craig Hayhow, VKØJJJ, photo]

Here and There

- The 18th VHF Weak Signal Group dinner will be held on Friday evening May 17, 2013 at the Dayton Grand Hotel (formerly the Doubletree Dayton Downtown Hotel) at 11 South Ludlow Street, Dayton, Ohio 45402.

The cash bar opens at 6:15 PM with plenty of room to mix and mingle with VHFers from all over the country and around the world. Dinner will be served at approximately 7:15 PM. The guest speaker is Jeff Klein, K1TEO — VHF Contester Extraordinaire. The prize drawing is at 9 PM.

Reservations are required. Cost per person is $40. This includes dinner and a prize ticket. Seating is limited to 125, spouses are welcome to join us and are eligible for the prize drawing. For tickets please send $40 per person and an SASE to: Tony Emanuele, WA8RJF, 7156 Kory Ct, Concord Township, Ohio 44077-2221.

- The *WSJT* 2012 Meteor Scatter "Winter Rally" contest results are posted at **www.meteorscatter.org/2012contest.html**. This contest took place during the December 2012 Geminid meteor shower.

NØLWF posted the high power top score and VE1SKY achieved the low power winning score. AA9MY has the first "5K" award for 222 MHz and NDØB for the first to achieve 10,000 miles of total contact DX on the 222 MHz band. There are many resources on this website for *WSJT* VHF and UHF meteor scatter.

- Dave, W9DR, will be active as VP2V/W9DR from the north shore of the island of Anegada (NA-023) in the British Virgin Islands June 14-28, 2013. Activity will be on 50.115 MHz (SSB) and 50.115.6 MHz (CW). He will also be running a beacon on 50.115.6 when the band is not open. QSL to his home call. Dave did a great job from Antigua as V25DR in June of 2011.

- Stan, KA1ZE, has "come out of retirement" to help his son with a business and thus is curtailing daily publication of the *205MorningReport*. Stan hopes to continue a weekend edition as time allows. The *205MorningReport* has become very popular and many look forward to seeing it in their e-mail inboxes each morning.

Special Events

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

Contact these stations and help commemorate history. Many provide a special QSL card or certificate!

May 1-May 31, 0000Z-2359Z, G75FOC, Various in UK and elsewhere. First Class CW Operators' Club. 75th Anniversary. .025 on 75/40/20/15/10 m, .020 on 30 m, .080 on 17 m, .905 on 12 m. Certificate & QSL. G3SWH, 21 Dickensons Grove, (QSL via OQRS is preferred via **g3swh.org.uk**), Congresbury, Bristol BS49 5HQ, England. **g4foc.org**

May 3-May 5, 1200Z-1800Z, W1ACT, Chilmark, MA. Team HAMCOW and the Fall River Amateur Radio Club. Martha's Vineyard 20th Annual DXpedition. 14.270 14.040 7.280 7.035. QSL. Roland Daignault, N1JOY, 19 Davis Rd, Westport, MA 02790. *IOTA NA-046, Dukes County, MA, US Islands MA005S, ARLHS USA-319 Gay Head Lighthouse, NEQP. QSL via N1JOY with SASE only. Watch our website for updates from our site, online log checking, and a webcam of our operation.* **hamcow.net**

May 3-May 5, 1400Z-2200Z, W8FO, Toledo, OH. Northwest Ohio Chapter 142 QCWA Toledo OH. 200th Anniversary of the Battles of Fort Meigs in 1813. 14.225 7.245 3.965. QSL. Kurt Meyers, W8IQ, 3680 Schneider Rd, Toledo, OH 43614.

May 4, 1300Z-2200Z, K5SRC, Stillwater, OK. Stillwater Amateur Radio Club. Oklahoma Gas & Steam Engine Show. 14.270 7.260 3.885. QSL. Nelson Ehrlich, 1716 Summit Ridge Dr, Stillwater, OK 74074. **www.stillwaterarc.org**

May 4, 1400Z-2200Z, W8VP, Cambridge, OH. Cambridge Amateur Radio Association Hopalong Cassidy. 14.260 7.235. Certificate & QSL. Cambridge Amateur Radio Association, PO Box 1804, Cambridge, OH 43725. *William Boyd aka Hopalong Cassidy, local hero. 5th Special Event in CARA's year-long 100th Birthday Celebration. QSL. Certificate available for anyone who works ALL 12 of CARA's monthly Special Events of 2013.* **www.w8vp.org**

May 4, 1500Z-2100Z, N4C, Leighton, AL. Bankhead Amateur Radio Club, Inc. Sesquicentennial Commemoration of the Burning of LaGrange College. 21.310 14.260 7.205 3.840. Certificate. Josh Hatton, 990 J. McGee Rd, Leighton, AL 35646. **n4idx.com**

May 4, 1500Z-2100Z, W8H, Maumee, OH. Toledo Mobile Radio Association. 200th Anniversary of Dudley's Massacre during the War of 1812. 14.270 7.270; 7.075 PSK 31. QSL. Toledo Mobile Radio Association, PO Box 9673, Toledo, OH 43697. *On the Site of Dudley's Massacre (War of 1812).* **www.tmrahamradio.org**

May 4, 1600Z-2100Z, WE7GV, Sahuarita, AZ. Green Valley Amateur Radio Club. Titan Missile Museum. 14.246 14.245. Certificate & QSL. Green Valley Amateur Radio Club, 601 N La Canada Dr (SAV), Green Valley, AZ 85614. *This event is from the Titan Missile Museum using the Collins Discage Antenna.* **gvarc.us**

May 4-May 5, 1219Z-1219Z, K1R, Northfield, MA. 72 Rag Chew Organization. 9th Anniversary. 7.272. Certificate. Robert W. Lobenstein, WA2AXZ, 1958 E 36th St, Brooklyn, NY 11234. *Join us on May 4 and 5 to help celebrate the 9th Anniversary of the 72 Rag Chew Organization. Work 2 NCS Stations and you will qualify for a special Rag Chew Certificate.* **www.72chew.net**

May 8-May 11, 1300Z-2200Z, W5KS, Lawton, OK. Lawton-Ft Sill Amateur Radio Club. Comanche Code Talkers of WWI & WWII. 50.125 21.295 14.295 7.295. Certificate & QSL. Lawton-Ft Sill Amateur Radio Club, PO Box 892, Lawton, OK 73502. *Lawton-Ft Sill Amateur Radio Club and the Comanche Nation of Oklahoma are proud to tell the story of the Comanche Code Talkers of both World Wars. For more info check website.* **www.w5ks.org**

May 9-May 20, 1700Z-2200Z, K6BBQ, San Rafael, CA. Rem O'Donnelley. National BBQ Month Celebration. 18.140 14.330 14.270 14.050. QSL. Rem O'Donnelley, 101 Woodland Ave #4, San Rafael, CA 94901. **www.qrz.com/db/k6bbq**

May 9-May 11, 1500Z-2300Z daily, W7SU, Ogden, UT. Ogden Amateur Radio Club. 1869 Transcontinental Rail Road Golden Spike Commemorative. 21.285 14.255 14.040 7.235. QSL. Ogden Amateur Radio Club, PO Box 3353, Ogden, UT 84409. **www.w7g.org**

May 11, 1600Z-2300Z, NI6IW, San Diego, CA. USS *Midway* (CV-41) Museum. Armed Forces Day, National Maritime Day. SSB 14.320 7.250 PSK 31 14.070 D-STAR 012C. QSL. USS *Midway* Museum Radio Room, 910 N Harbor Dr, San Diego, CA 92101.

May 11-May 12, 0800Z-0800Z, N7Q, Warrenton, OR. Mouth of the Columbia Amateur Radio Club. Mouth of the Columbia Day. 146.500 52.200 28.305 7.200 3.950; RTTY 14.120 10.125. Certificate & QSL. MOTCARC QSL Manager, 41155 School House Rd, Astoria, OR 97103. *Operating from Grid Square CN76xf.* **mouthofthecolumbiaarc.org/motcday**

May 11-May 12, 1000Z-2359Z, W1S, Waltham, MA. Waltham Amateur Radio Association. Watch City Festival. 28.360 14.250. Certificate & QSL. Bill McInnch Jr, 26 Margo Rd, Brighton, MA 02135. *Depending on operator availability, may also operate CW on 14.120.*

May 11-May 12, 1117Z-1316Z, N4USA, Floyd, VA. Foundation for Amateur International Radio Service. Floyd Auto Fair. 21.450 14.250 14.300 7.300. Certificate. FAIRS, PO Box 179, Floyd, VA 24091. **www.fairs.org**

May 18, 1400Z-2000Z, W9DUP, Wheaton, IL. DuPage Amateur Radio Club. Armed Forces Day. 145.430-600 28.400 14.290 7.250. Certificate. Brian Eder, PO Box 71, Clarendon Hills, Il 60514-00. **www.w9dup.org**

May 18-May 19, 0920Z-0420Z, W2GSB, Farmingdale, NY. Great South Bay Amateur Radio Club. Air Power Museum Armed Forces Day. 14.325 14.070 7.255 3.975. QSL. W2GSB/APM, PO Box 1356, West Babylon, NY 11704. **www.gsbarc.org**

May 20-May 26, 2300Z-2200Z, W9IMS, Indianapolis, IN. Indianapolis Motor Speedway Amateur Radio Club. W9IMS Indy 500 Special Event. 21.350 14.245 7.240 3.840. Certificate & QSL. IMS ARC, PO Box 30954, Indianapolis, IN 46230. **w9ims.org**

May 20-May 21, 1152Z-2122Z, K2CAM, Garden City, NY. Cradle of Aviation Museum and Long Island Mobile Amateur Radio Club. Lindbergh Crosses the Atlantic. 14.245 7.245 3.745 1.945. QSL. LIMARC, Attn: Cradle of Aviation Event, PO Box 392, Levittown, NY 11756**. www.cradleofaviation.org**

May 24-May 28, 1800Z-0200Z, W4M, Bishop, CA. Bishop Amateur Radio Club. Mule Days. 21.335 14.235 7.235 146.94. Certificate & QSL. Bishop Amateur Radio Club, PO Box 1024, Bishop, CA 93515. *"We're 4 Mules" celebrates everything mules!* **www.n6ov.com**

May 25, 1100Z-1800Z, N4USA, Floyd, VA. Foundation for Amateur International Radio Service. 3rd Annual Bluegrass & BBQ Festival. 21.440 14.290 14.250 7.295. Certificate. Foundation for Amateur International Radio Service, N4USA, PO Box 179, Floyd, VA 24091. **www.fairs.org**

May 25-May 26, 0000Z-2359Z, W4K, Palm Beach, FL. Jupiter Tequesta Repeater Group. Peanut Island DXpedition. 28.285 14.285 7.225 3.914. QSL. Jupiter Tequesta Repeater Group, PO Box 7751, Jupiter, FL 33468. **www.jtrg.org**

May 25-Jun 1, 1703Z-1703Z, W7OTV, Beaverton, OR. Oregon Tualatin Valley Amateur Radio Club. 35th Anniversary Special Event. 14.285 21.385 28.485. QSL. Oregon Tualatin Valley Amateur Radio Club, PO Box

Certificates and QSL cards: To obtain a certificate from any of the special event stations offering them, send your QSO information along with a 9 ×12 inch self-addressed, stamped envelope to the address listed in the announcement. To receive a special event QSL card (when offered), be sure to include a self-addressed, stamped business envelope along with your QSL card and QSO information. *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 e-mail. Offline completed forms can be mailed, faxed (Attn: Special Events) or e-mailed.

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 **Jul** *QST* would have to be received by **May 1**. In addition to being listed in *QST*, your event will be listed on the ARRL Web Special Event page. Note: All received events are acknowledged. If you do not receive an acknowledgment within a few days, please contact us.

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

5471, Beaverton, OR 97006. *Celebrating the Club's 35th Anniversary and the 31st NW Division Sea-Pac Convention in Seaside, OR.* **www.otvarc.org**

May 25-Jun 2, 0000Z-2359Z, W4B, Helen, GA. Gateway Amateur Radio Club. Helen to the Atlantic Hot Air Balloon Race. 21.355 18.145 14.260 7.265. Certificate & QSL. Gateway Amateur Radio Club, PO Box 691, Cleveland, GA 30528. *Operating from home stations on various frequencies; club will operate Sat Jun 1 from downtown Helen near race hq, 1500Z to 2100Z.* **wc4x@arrl.org** *or* **www.qrz.com/db/w4b**

May 31-Jun 1, 1800Z-0700Z, W4L, Lake Ozark, MO. North Side Amateur Radio Club. Relay For Life. 7.175.00 3.895.00 14.295.00. Certificate* & QSL. Northside Amateur Radio Club, c/o David Meye, KL7QW, PO Box 224, Lake Ozark, MO 65049. **www.aa0nc.com**

Life Members

Elected March 9, 2013

Edward Alspaugh, N3QL
Howard W. Bassham, K6RYA
Bronislav Batkilin, KB1WBL
Brian J. Battles, WS1O
Andrew Baze, AB8L
Emily M. Bishop, WE4MB
Michael R. Bishop, WM4RB
Curt W. Black, WR5J
Robert Blazewicz, KB1UBI
Kenneth W. Botterbrodt, K2WB
Daniel E. Cahoon, WD4AJI
John J. Caron, K1JJC
Jeffrey S. Cofsky, W5JSC
Steven Cohan, KFØRW
Joseph F. Connolly, KG4CWS
Paul D. Cooper, KB1USQ
Andrew B. Cornwall, KF7CCC
Larry D. Crichton, K4LDC
Roy E. Crosthwaite, KBØRFF
Thomas A. Dick, KF2GC
John E. Dimsdale, KD4FOX
Apostolos Doxiadis, K6DOX
Adam J. Due, KC9QMF
Steve Dyer, W1SRD
David M. Espenshade, AD7XU
Kevin J. Flanagan, KB7MAD
Charles F. Frost, K5LBU
Michael S. Fry, WØFRY
Nicholas W. Garner, N3WG
Michael A. Gavaller, AB9VP
Robert W. Germershausen, W2KNU
Arlo Gittings, KCØMNN
David W. Glenn, N6TEB
Scott G. Haacker, W9SGH
Tom Haavisto, VE3CX
J. Handley, K3WWT
K. Hensen, KCØZYW
James S. Holloway, KF4QQV
Howard Hoyt, WA4PSC
Brandon K. Hunt, KB7ZDM
Leoroy Huntington, N5KES
Mitchell S. Hutchins, W9MSH
Sean A. Hutchins, KI6JET
David W. Ivory, N6WLI
Jean Jacob, KD2DDA
Edward A. James, KA8JMW
Bryan K. Johns, K4GDW
Juan Kedzierski, LU3DSU
David J. Kennedy, K4HZF
Yoshimitsu Kikuchi, WJ1I
David A. Kindred, K3PO
Heather C. Kirby, KK4MMX
Jeffrey Kitzler, KA8YSW
Joseph C. Kuriger, WB5ZET
Peter W. Lashock, KB9JQT
Joseph W. Leary, N7PCS
Benjamin Liberatore, N2WCL
Guy E. Mallery, W6MSU
Connie T. Marshall, K5CM
Pamela Marshall, N5KW
Erik Martin, N5WR
Gregory L. Matthaey, KA2MKM
Joseph P. McAllister, N1JL
Christopher J. McGraw, KB2SKP
John N. Mercer, N4JNM
Caleb T. Miller, KE5SHR
James V. Minor, W2DSX
Joseph C. Moran, WC3K
John W. Moyers, N4QEA
Kenneth C. Nicely, KE3C
Sandra L. O'Leary, K7SLW
Bernard T. O'Neill, KB1VNS
Robert Obenchain, W9NWN
Donald P. Osmond, W4SKT
Peter H. Ozimek, K7RR
Jack W. Parker, W4JJ
Brian M. Patten, WV4Q
W. L. Pat Patterson, WL1PP
John Penney, AA6JN
John C. Peterman, W9VG
Doug Rehman, K4AC
Mark F. Reinen, NJ2MR
Charles Rinebold, N1CRR
William Ronay, KM4LS
Jerry W. Rosalius, WB9Z
Steven Ruman, KC8YDS
Alan L. Russ, AEØAR
Christina C. Sand, WO1NDR
Duane B. Sand, KG6OQZ
Joseph J. Sanders, WS4R
Vincent Sbordone, KI4AWJ
Nathan S. Schaan, KI3S
Robert Schaff, KF7VIH
Andrew Schmidt, W2BOS
Stephen J. Schrack, N3MX
Wayne D. Scott, N4RAP
M. J. Shannon, WA7BDK
Jeffrey C. Shivers, N3MQS
Robert J. Siemborski, KC2EOK
Michael J. Silvers, KB6WFC
Kevin Simmons, K6OW
Lisa S. Skittone, K2LSS
Brian Smith, WB4ES
Matthew R. Smith, KK4DUU
Joseph E. St Aubin, K7EQ
Kent A. Stein, KB1HNO
Michael A. Sterba, KG7HQ
Marcel Stieber, AI6MS
Mark A. Sweitzer, KD8MIV
Bruce Takenaka, KJ6DXJ
Daniel Tasch, N8OBB
Frank J. Taylor, AAØZP
Mike Vanderlip, KC5BQE
Carl Wallace, AD5XS
Billy Walter, KJ4NLR
Ralph M. Ward, KY2N
William A. Watt, K4BLL
Philip O. Weber, KH2EI
Alan D. Wedige, WDØBGZ
Dennis C. Wertz, W3DCW
Richard W. Wright, KCØHUY
Lucas Ziobro, KC9IFF

New Products

Enigma

If you like Morse code, you'll like Enigma code, too. You can use a free website and an award-winning German WWII Enigma code simulator to send and receive social networking messages with old friends and new ones worldwide. Check the website at **www.EnigmaWorldCodeGroup.com**.

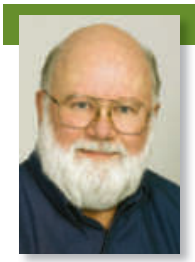
Radio Programming Software from RT Systems

RT Systems has released new programming software for the Wouxun KG-UV920 dual band mobile transceiver, ICOM ID-51 dual band D-STAR handheld, and Yaesu FT-950 and FTDX3000 HF/6 meter transceivers. In addition to memory management, the RT Systems software handles all radio memory settings. It allows import of data in CSV (comma separated value) format and sharing of files among radios. An appropriate programming cable for each radio is included. Price: $49 per kit (software and cable). For more information, visit your favorite dealer or **www.rtsystemsinc.com**.

Strays

QST congratulates...

Southcars, the directed communications net, which announced the enrollment of its 10,000th member. The South Coast Amateur Radio Service, SCARS, familiarly known as Southcars, is a volunteer network, meeting on air 365 days a year between the hours of 8 AM and 1 PM Eastern Time on 7.251 MHz. Members checking in provide their membership number, weather and travel conditions specific to their location. A member who wishes to contact another mobile, fixed or portable station may arrange a QSO off frequency. More information is available on the web at **http://southcars.com/**.



John Dilks, K2TQN, k2tqn@arrl.org

The Reluctant Rescue

ARRL® Test Engineer Bob Allison, WB1GCM, joins us again with the story of a dirty old "signal generator" that cleaned up very well indeed.

I've known my friend Scott since first grade. When his grandfather, Cecil, passed away in 1993 after living a long, adventurous life, my friend had the difficult task of cleaning out his house. He asked me to salvage anything possible from Cecil's workbench. Soon afterward, my wife Kathy, KA1RWY, and I traveled down to Darien, in Connecticut's southwestern "panhandle." Kathy and I didn't know it at that time, but we were about to visit the lair of an old, old "Sparks."

The directions lead us to a plain Cape Cod style house in a pleasant neighborhood. Scott greeted us at the front door. He soon herded us down the cellar stairway, toward a dingy workbench with lots of little bits scattered about; some tools here, a large soldering iron there, cobwebs galore and what looked like an old General Radio signal generator.

A small stack of technical books caught my eye, perched on a shelf above the workbench. I vowed to keep them out of the trash. After some coaxing from Scott, I reluctantly acquiesced to saving the signal generator also and lugged the filthy box to the car, all the while wondering why I had agreed to save this grimy piece of plain-vanilla test equipment.

On our way home, one of the signal generator's knobs, labeled TICKLER, kept nagging at me. I had plenty of experience with all types of radio and test equipment, vintage and new, but what was a Tickler?

The Ugly Duckling

At home, I began to remove years of grime and spider carcasses from the relic. Closer inspection revealed panel controls marked ANT, COUPLING and BUZZER. I realized I wasn't looking at a signal generator but a receiver. It was very old and very well built. It used a single vacuum tube and was powered by batteries. I set off to clean and polish the front panel, knobs and cabinet (see Figure 1). The inside of the copper lined mahogany case was nearly spotless. I cleaned and lubricated every switch contact I could see. After several nights of effort, I was ready for the big moment — applying the power.

Figure 1 — This is the IP-501 receiver and matching two stage audio amplifier I discovered in Cecil's basement and restored. It was used aboard the United Fruit Company ship S. S. *San Jose*.

Figure 2 — Cecil Williams at "the mill" copying traffic. The receiver is the later model IP-501A. The calendar in the background suggests this photo was taken in July 1928 aboard the S. S. *Santa Marta*.

Fortunately, I had some experience operating single 201 tube radios, which require 4-5 V on the filament and 22-27 V on the plate. With batteries and my vintage Baldwin headphones attached, I turned up the filament and started to twiddle knobs. The first sound I heard was WCBS, 880 kHz, in New York. It was 2 AM and the first news story was a report of a ship sinking off of the coast of Newfoundland, Canada.

Two days later, I dusted off the books from Cecil's basement. In one was a photo identifying my newly acquired receiver as the RCA IP-501, a Hazeltine design introduced after the First World War. It uses a single 200 type tube in a three circuit regenerative detector. My unit was found with a brass based "tipped" 200 tube, commonly used as the detector in the early 1920s.

Receiving That Newfangled CW

The TICKLER adjustment is essentially a feedback control that increases the receiver's RF gain up to and past the point of oscillation. Past the oscillation threshold, the receiver detects continuous wave (CW), a new mode (for most) in the early 1920s. Copper lines the interior of the cabinet and is used extensively for shielding between circuit stages, allowing for excellent selectivity. The dial's calibration is in wavelengths, which was common at the time. When converted to frequency, I found that the receiver covers the range of about 40-1100 kHz.

There are some other curious functions. The receiver can use a Galena crystal detector if the tube fails. A buzzer connected to a front panel pushbutton is used as a small spark transmitter. Pressing the buzzer allows the radio operator to "hunt" around the Galena crystal to find the most sensitive spot for best detection. It's also interesting to note that this receiver has a five position selectivity control that narrows the audio bandwidth.[1]

After informing Scott of my efforts and newly acquired knowledge, he invited us back to Darien, where we excitedly pored over a book of photos found in a closet. The photos showed that Cecil was once a radio operator aboard ships of the United Fruit Company (see Figure 2), which sailed from New York to various ports in the Caribbean and Central America, hauling bananas and other tropical produce to markets in New Orleans and New York but, at the same time, offering passengers an affordable and enjoyable trip to exotic ports. Best of all, there were some photos of the radio equipment used aboard the fleet (see Figure 3).

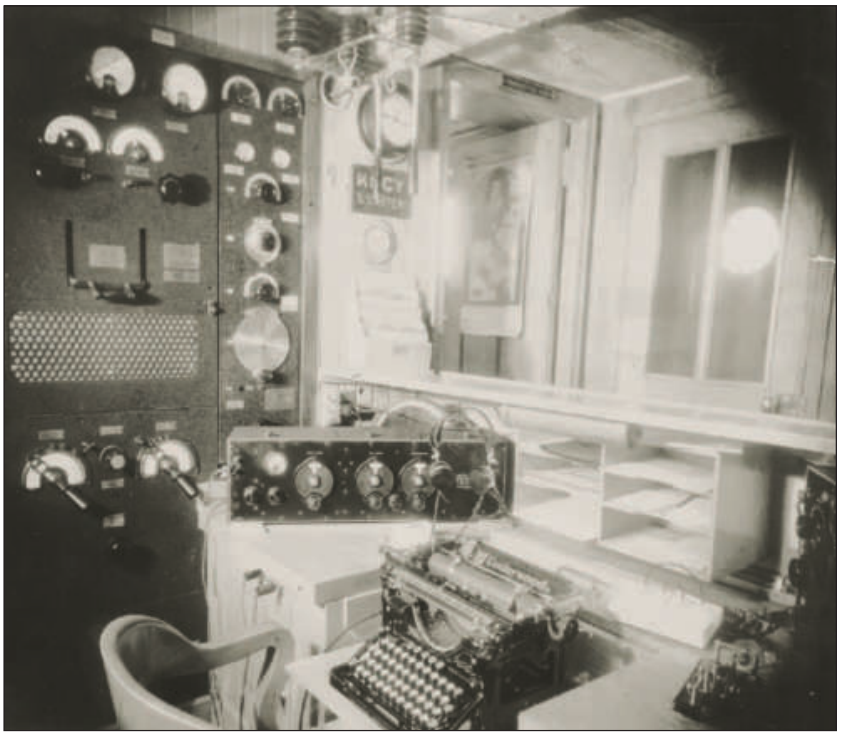


Figure 3 — Radio Cabin of the United Fruit Ship, S. S. *Peten*. The receiver to the left of the "mill" is a shortwave receiver. The RCA medium wave transmitter dominates the background.

More Pieces of the Puzzle

The second visit allowed me another look in Cecil's basement for other hints of the past. Tucked away in a dark corner was the matching audio amplifier to the IP-501. This two stage amplifier employs two 201 type tubes and produces enough audio output to drive a horn speaker. With careful cleaning and two used audio transformers, I was also able to restore it to working order.

How did Cecil acquire his IP-501? I got a hint from a crayon scribble on the copper lining inside the case: "San Jose." As it turns out, the S. S. *San Jose* (call sign KDAJ) was part of the United Fruit Company's shipping fleet. Built in 1904, the *San Jose* was a 3358 gross tonnage banana freighter, 330 feet long with a 44.5 foot beam and a draft of 31.5 feet full. With a typical crew of 35, the *San Jose* plied the Atlantic coastline, the Caribbean and Central America.

Cecil must have acquired the IP-501 in the late '30s or early '40s, when the United Fruit Company updated their communications equipment; the same time he retired from sea duty to work ashore as a radio engineer.

While I have been able to preserve the IP-501 from the *San Jose*, the *San Jose* itself did not fare so well. On January 17, 1942, off of Atlantic City, New Jersey, the *San Jose* was involved in a collision with the much larger armed freighter, S. S. *Santa Elisa*. There were no casualties but the damaged ship was sunk by German U-boat U-123.[2]

Low Band Radio

For the past 20 years, I've occasionally used the IP-501 to listen to the AM broadcast band and below. Twenty years ago, I was still able to copy some of the marine traffic from shore stations, such as WCC on Cape Cod, Massachusetts and ships at sea. Most of this traffic was centered at 500 kHz, which was the call and distress frequency. Omnidirectional Aerobeacons were commonplace from 190 to about 400 kHz and occasionally, especially during the winter months, I could copy longwave broadcast stations clearly.

Today, it's fairly quiet below the AM broadcast band. Loran C at 100 kHz has been deactivated, most Nondirectional Aerobeacons are silent; aircraft navigation is left to GPS these days. Evenings during the winter months, broadcasters on longwave in ITU Region 1 can still be heard on the East Coast but there's not much else to listen to. Perhaps that is why I don't tune below the AM band as much as I used to. That may be about to change, however.

200 Meters and Up

At this time, US radio amateurs are waiting for access to the two new proposed amateur bands of 136-138 and 472-479 kHz. Once prime real estate for commercial marine traffic, there are a few experimental stations centered around 137 kHz in the US. The ARRL 600 Meter Experimental Group, WD2XSH, has demonstrated effective communications in the 500 kHz region even at low power levels.[3]

I hope to soon use my IP-501 on a new ham band. Designed for CW or spark reception, it's certainly stable enough for digital communications, such as PSK-31 or JT-65. Perhaps someone will come out with a stand-alone PSK transmitter for our new LW/MF bands?

All photos by Bob Allison, WB1GCM

Bob Allison, WB1GCM, works in the ARRL laboratory as a test engineer and enjoys restoring vintage radios. He can be reached at **wb1gcm@arrl.org**.

[1]More information on the IP-501 can be found at **www.radioblvd.com/ip501.htm**

[2]More information on the S. S. *San Jose* is at **www.wrecksite.eu/wreck.aspx?16243** **njscuba.net/sites/site_san_jose.html**

[3]The ARRL 600 Meter Experimental Group is at **www.500kc.com**

Convention and Hamfest Calendar

Gail Iannone, giannone@arrl.org

Abbreviations
Spr = Sponsor
Tl = Talk-in frequency
Adm = Admission

Arizona (Show Low) — Jun 1 F H R S T V
8 AM-noon. *Spr:* Kachina ARC. Show Low City Hall, 180 N 9th St. *Tl:* 145.31 (110.9 Hz). *Adm:* Free. Tables: $5 per space. Lori Gurk, KF7DGU, 1020 N 22nd Ave, Show Low, AZ 85901; 928-242-1179; **ding55@cableone.net**; **www.kachina-arc.org**.

DELTA DIVISION CONVENTION

June 8, Rogers, AR
D F H Q R S T V

8 AM-1 PM. *Spr:* Benton County Radio Operators. Rogers First Church of the Nazarene, 4911 W Pleasant Grove Rd. *Tl:* 145.29 (110.9 Hz). *Adm:* advance $10, door $12. Tables: $7. Jay Harrison, KCØCNB, 1519 W Magnolia St, Rogers, AR 72758; 479-631-7727; **texgun19@cox.net**; **www.BCRO.org**.

Arizona (Sierra Vista) — May 4 D H R T V
7 AM-noon. *Spr:* Cochise ARA. Green Acres, 2756 Moson Rd. *Tl:* 146.76 (162.2 Hz). *Adm:* Free. Tables: $10. Pat Thies, KD7HAB, 102 E Via Corta, Huachuca City, AZ 85616; 520-227-0142; **kd7hab@gmail.com**; **www.k7rdg.org**.

California (Sacramento) — May 19 D F H R
7 AM-noon. *Spr:* North Hills RC. Natomas High School, 3301 Fong Ranch Rd. *Tl:* 145.19, 224.4 (both 162.2 Hz). *Adm:* Free. Tables: $20 (2 car spaces). Doug Emerson, N6NFF, 3530 Morse Ave, #2, Sacramento, CA 95821; 916-488-5717; **k6is@arrl.net**; **www.k6is.org**.

Colorado (Delta) — Jun 1 H T
9 AM-noon. *Spr:* Montrose ARC. Lions Club Pavilion at Confluence Park, 530 Gunnison River Dr. *Tl:* 147.195. *Adm:* Free. Tables: $5. Steve Schroder, KIØKY, 29848 Stingley Gulch Rd, Hotchkiss, CO 81419; 970-201-5997; **ki0ky@tds.net**; **montrosehamradio.org**.

ROCKY MOUNTAIN DIVISION CONVENTION

June 28-30, Estes Park, CO
D H Q R S V

Friday 4 PM-Sunday 1 PM. *Spr:* HamCon Colorado Committee. Rocky Mountain Park Inn & Convention Center, 101 S Saint Vrain Ave. *Amateur Radio — Adventure, Service, Knowledge.* W1AW/Ø Special Event Station, contests, Saturday eve banquet (7-9 PM, $40). Wouff Hong Ceremony. *Tl:* Estes Park area 146.685, 449.8 (both 123 Hz); Denver area 449.225 (141.3 Hz). *Adm:* advance $21 (by June 15), door $25. Steve Williams, KØSRW, 8310 Ashford Ct, Colorado Springs, CO 80920; 719-337-8103; **k0srw@arrl.net**; **www.hamconcolorado.org**.

Connecticut (Goshen) — Jun 1
D F H R T V

Setup 6 AM; public 8 AM-1 PM. *Spr:* Southern Berkshire ARC. Goshen Fairgrounds, 116 Old Middle St. *Tl:* 147.285 (77 Hz). *Adm:* $5 (public); $7 (vendors, tailgaters). Tables: $10. Doc Simont, K1CTT, 78 Pierce Ln, W Cornwall, CT 06796; 860-672-2659; **k1ctt@arrl.net**; **w1baa.org**.

Florida (Pinellas Park) — May 25 F H R T
7 AM-noon. *Spr:* The Glorious Society of the Wormhole. Freedom Lake Park, 9990 46th St. *Tl:* 146.85 (146.2 Hz). *Adm:* Free. Tables: Free. Bill Williams, AG4QX, 3215 W Tambay Ave, Tampa, FL 33611; 813-837-3833; **ag4qx@arrl.net**; **www.thewormholesociety.org**.

Georgia (Byron) — May 11 D F H R S T V
8 AM-3 PM. *Sprs:* Central Georgia ARC, Middle Georgia Radio Assn, Byron Middle School ARC. Byron Middle School, 201 Linda Dr. *Tl:* 146.85. *Adm:* $5. Tables: 8-ft $5 (inside). Bill Atkins, WR4BA, 106 Knob Hill Dr, Warner Robins, GA 31088; 478-542-1620; **wr4ba@yahoo.com**; **heartofgeorgiahamfest.com**.

GEORGIA STATE CONVENTION

June 1, Marietta, GA
D F H Q R S T V

8 AM-3 PM. *Spr:* Atlanta Radio Club. Jim Miller Park, 2245 Callaway Rd. *Tl:* 146.82 (146.2 Hz). *Adm:* $5. Tables: $20. John Talipsky, N3ACK, 385 Madison Chase Dr, Lawrenceville, GA 30045; 770-995-6446; **n3ack@atlantaradioclub.com**; **www.atlantahamfest.com**.

Idaho (Post Falls) — Jun 8 F Q R V
7 AM-1 PM. *Spr:* Kootenai ARS. American Legion Hall, 1138 E Poleline Ave. *Tl:* 146.98 (100 Hz). *Adm:* $5. Tables: $10. Bonnie Patterson, KG6QQM, 8959 E Howard Rd, Athol, ID 83801; 208-683-2939; **kg6qqm@arrl.net**; **k7id.org**.

Illinois (Godfrey) — Apr 20 D F H R V
7 AM-noon. *Spr:* Lewis & Clark RC. River Bend Arena, 5800 Godfrey Rd. *Tl:* 145.23 (79.7 Hz). *Adm:* advance $2, door $3. Tables: $10. Chuck Richie II, KB9TSX, Box 5187, Godfrey, IL 62035; 618-467-2997; **hamfest@k9ham.org**; **www.k9ham.org**.

Illinois (Granite City) — Jun 9 D H R T V
7 AM-2 PM. *Spr:* Egyptian RC. Moose Lodge, 2521 Maryville Rd. *Tl:* 146.76 (141.3 Hz). *Adm:* advance $5 each or 2 for $9, door $7. Tables: $10. Dennis Harris, KC9UER, 123 S Main St, New Douglas, IL 62074; 217-456-1242; **kc9uer@yahoo.com**; **www.w9aiu.org**.

Illinois (Princeton) — Jun 2 D F H R T V
8 AM-3 PM. *Spr:* Starved Rock RC. Bureau County Fairgrounds, 811 W Peru St. *Tl:* 146.955 (103.5 Hz). *Adm:* advance $7, door $8. Tables: advance $13, door $15 (tailgate fee $2). Matthew Weaver, KB9VZH, 319 Desoto St, Ottawa, IL 61350; 815-313-5924; **kb9vzh@mchsi.com**; **www.w9mks.org**.

Kentucky (Louisa) — May 11 F H R T
8 AM-2 PM. *Spr:* Big Sandy ARC. First Baptist Church Family Life Center, 301 W Pike St. *Tl:* 147.39 (127.3 Hz). *Adm:* $5. Tables: $5. Tom Lykins, K4LID, 106 W Maple St, Louisa, KY 41230; 606-638-4735; **k4lid@panix.com**; **www.bsarc.org**.

Kentucky (Princeton) — June 1
D F H R T V

8 AM-1 PM. *Spr:* Princeton Ham Radio Club. Princeton Fire Training Center, 2001 Hwy 62 W. *Tl:* 145.23 (179.9 Hz). *Adm:* $5. Tables: Free. Mike Taylor, N4MHT, 402 S Seminary St, Princeton, KY 42445; 270-365-7777; **n4mht@mchsi.com**; **w4kbl.org**.

Louisiana (Benton) — May 11 F H R T
8 AM-2 PM. *Spr:* ARC of Shreveport. Cypress Black Bayou Recreation Park, 135 Cypress Park Dr. *Tl:* 146.67 (186.2 Hz). *Adm:* $1 (park entrance fee). Tables: Free. John Beck, KB5LE, 3457 Harbor Ln, Shreveport, LA 71107; 318-636-5845; fax 318-221-3922; **kb5le@arrl.net**; **www.qsl.net/nwlarn/arcos.htm**.

Maine (Hermon) — Jun 1 D F H Q R T V
Setup 6:30 AM; public 8 AM-1 PM. *Spr:* Pine State ARC. Hermon High School, 2415 Rte 2. 26th Bangor Hamfest, balloon launch, R/C aircraft demos. *Tl:* 146.94 (100 Hz). *Adm:* $5 (under 12 free). Jerry Burns, K1GUP, Box 61, Carmel, ME 04419; 207-848-3400; **k1gup@roadrunner.com**; **n1me.com**.

Massachusetts (Cambridge) — May 19. Nick Altenbernd, KA1MQX, 617-253-3776 (9 AM-5 PM); **w1gsl@mit.edu**; **www.swapfest.us**.

Massachusetts (Dartmouth) — May 11
D F H

9 AM-2 PM. *Spr:* Southeastern Massachusetts ARA. SEMARA Clubhouse, 54 Donald St. *Tl:* 147.0, 224.8 (both 67 Hz). *Adm:* $2 (club members and under 12 free). Eric Pierce, N1WCO, 8 Bodfish Ave, Wareham, MA 02571; 508-295-2468; **n1wco@aol.com**; **www.semara.org**.

Michigan (Chelsea) — Jun 2 D F H R T
8 AM. *Spr:* Chelsea ARC. Chelsea Fair-

Coming ARRL Conventions

April 13-14
Communications Academy, Seattle, WA*

April 19-20
Southeastern VHF Society Conference, Cocoa Beach, FL*

April 19-21
International DX Convention, Visalia, CA*

April 20
Louisiana State Convention, Monroe, LA*

April 26-28
Eastern VHF/UHF Conference, Manchester, CT*
Idaho State Convention, Boise, ID*

May 4
South Carolina Section Convention, Spartanburg, SC*

May 17-19
Dayton Hamvention®, Dayton (Trotwood), OH

May 31-June 2
Northwestern Division Convention, Seaside, OR

June 1
Georgia State Convention, Marietta, GA

June 7-8
West Gulf Division Convention, Plano, TX

June 8
Delta Division Convention, Rogers, AR
Tennessee State Convention, Knoxville, TN

June 28-30
Rocky Mountain Division Convention, Estes Park, CO

July 6
Eastern Pennsylvania Section Convention, Harrisburg, PA

*See April *QST* for details.

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

grounds, 20501 Old US Hwy 12. *Tl:* 145.45 (100 Hz). *Adm:* advance $4, door $5. Tables: $10. Frank Pohs, KD8ABW, 636 W Main St, Manchester, MI 48158; 734-945-1915; **frank.pohs@gmail.com**; **wd8iel.net**.

Michigan (Hudsonville) — Jun 1
D F H Q R S T V
8 AM-1 PM. *Spr:* Independent Repeater Assn. Hudsonville Fairgrounds, 5235 Park Ave. Foxhunt. *Tl:* 147.16 (94.8 Hz). *Adm:* advance $5, door $6. Tables: $10. Kathy Werkema, KA8YSM, Attn: Hamfest, Box 8122, Kentwood, MI 49518; 616-262-8119; **hamfest@w8ira.org**; **www.w8ira.org**.

Michigan (Newberry) — Jun 8 D F H R V
9 AM-1 PM. *Spr:* Luce ARS. Pentland Township Hall, Hwy M-28. *Tl:* 146.61. *Adm:* $5. Tables: $5. Dave Hopper, KA8K, 22926 Maple Dr, McMillan, MI 49853; 906-586-3928; **hopperd@michigan.gov**; **www.w8nby.com**.

Minnesota (Maplewood) — Jun 1 F H R T
7 AM-1 PM. *Sprs:* TwinsLAN and Mining ARCs. 3M Center, 5th St. *Tl:* 147.12. *Adm:* buyers $8, sellers $18 per vehicle (includes 1 admission); under 16 free with paying adult. Anders Johansson, KBØPJV, 8201 32nd Ave N, Crystal, MN 55427; 763-208-7493; **kb0pjv@arrl.net**; **www.twinslan.net**.

Missouri (Adrian) — May 11 D F H R
8 AM-2 PM. *Spr:* Bates County ARC. Adrian Optimist Community Building, S Bus Hwy 71. *Tl:* 147.225 (91.5 Hz). *Adm:* $5. Tables: $15 (regular), $25 (commercial). Dennis Jacobs, NXØIA, 107 W Ohio St, Butler, MO 64730; 660-424-0620; **NX0IA.DJ@gmail.com**; **www.bc-arc.com**.

Nevada (Reno) — May 4 D F H R S T V
6 AM-1 PM. *Sprs:* Wide Area Data Group, Sierra Nevada ARS, & University Nevada Reno Radio Pack. Sandy's Electronics Parts Parking Lot, 9744 S Virginia St. BBQ. *Tl:* 147.3 (123 Hz). *Adm:* Free. Tables: $10. Anthony Marcin, N7ACM, Box 17444, Reno, NV 89511; 775-230-7226; **info@renohamswap.com**; **renohamswap.com**.

New Jersey (Clinton Township) — May 11
D F H R V
8 AM-2 PM. *Spr:* Cherryville Repeater Assn II. North Hunterdon Regional High School, 1445 Rte 31 S. SKYWARN Class. *Tl:* 147.375 (151.4 Hz). *Adm:* $7. Tables: $25. Bob Grear, KA2OEE, 133 Eastern Ave, Somerville, NJ 08876; 908-231-0746; **ka2oee@yahoo.com**; **www.qsl.net/w2cra**.

New Jersey (Wall Township) — May 18
D F H R T V
Sellers 6 AM; buyers 7 AM. *Spr:* Ocean-Monmouth ARC. InfoAge Learning Ctr, Project Diana Site, 2300 Marconi Rd. *Tl:* 145.11 (127.3 Hz). *Adm:* $5. Tables: $10 outdoors, $15 indoors. Jeff Harshman, N2LXM, 5 The Arborway, Ocean, NJ 07712; 732-996-0637; **n2lxm@juno.com**; **www.n2mo.org**.

New York (Bethpage) — Jun 2 D F H Q R
9 AM-2 PM. *Spr:* Long Island Mobile ARC. Briarcliffe College, 1055 Stewart Ave. Tune-up. *Tl:* 146.85. *Adm:* $6. Tables: $10 space. Richard Cetron, K2KNB, 198 Haypath Rd, Old Bethpage, NY 11804; 516-694-4937; **k2knb@arrl.net**; **www.limarc.org**.

New York (Cortland) — Jun 1 F H R T V
7 AM-1 PM. *Spr:* Skyline ARC. Cortland County Fairgrounds, Carroll St. *Tl:* 147.18 (71.9 Hz). *Adm:* $5. Tables: $10. Andrew Slaugh, KB2LUV, 922 Milton Ave, Syracuse, NY 13204; 315-395-7640; fax 315-425-9072; **k2iwr@arrl.net**; **www.skylineradioclub.org**.

New York (East Greenbush) — May 11
F H R T
8 AM-1 PM. *Spr:* East Greenbush ARA. East Greenbush Fire Company, 68 Phillips Rd. *Tl:* 147.27 (94.8 Hz). *Adm:* $6. Tables: 8-ft $6. Thomas Scorsone, KC2FCP, 1310 10th Ave, Watervliet, NY 12189; 518-272-1494; **kc2fcp@nycap.rr.com**; **www.w2egb.org**.

North Carolina (Bahama) — May 25
D F H R T V
8 AM-2 PM. *Spr:* Durham FM Assn. Little River Community Complex, 8307 N Roxboro Rd. *Tl:* 147.225. *Adm:* $5. Tables: $10. Paul Van Doren, KE4OXN, 5309 Falkirk Dr, Durham, NC 27712; 919-309-2457; **elivand@aol.com**; **dfma.org**.

North Carolina (Reidsville) — May 11
D F R T
8 AM-noon. *Spr:* Rockingham County ARC. Reidsville Christian Church, 2020 S Park Dr. *Tl:* 147.345 (103.5 Hz). *Adm:* advance $4, door $5. Tables: $5 (tailgate space). George Brewer, WN4LTY, 5190 NC Hwy 700, Eden, NC 27288; 336-635-1261; **wn4lty@rcarc.com**; **www.rcarc.com**.

North Carolina (Winston-Salem) — Jun 8
D F H R T
7 AM-noon. *Spr:* Forsyth ARC. Summit School, 2100 Reynolda Rd. *Tl:* 146.64 (100 Hz). *Adm:* $5. Tables: $5. Henry Heidtmann, W2DZO, 8812 Merry Hill Ct, Lewisville, NC 27023; 336-464-5402; **hgheidtmann@gmail.com**; **w4nc.com**.

DAYTON HAMVENTION®

May 17-19, Dayton (Trotwood), OH
D F H Q R S T V
Friday 8 AM-6 PM, Saturday 8 AM-5 PM, Sunday 8 AM-1 PM. *Spr:* Dayton ARA. Hara Arena, 1001 Shiloh Springs Rd. *Every amateur should go at least once.* Awards, operating station, "ARRL Expo" area (**www.arrl.org/arrl-expo**), bookstore, project building booth, ARRL Youth activities. *Tl:* 146.94, 442.1. *Adm:* advance $20, door $25 (good all 3 days). Charles Kaiser, KD8JZR, c/o Dayton Hamvention®, Box 964, Dayton, OH 45401; 937-276-6930, fax 937-276-6934; **info@hamvention.org**; **www.hamvention.org**.

Ohio (Tedrow) — Jun 1 F T V
8 AM-1 PM. *Spr:* Fulton County ARC. Roth Family Park, 101 Hill Ave. *Tl:* 147.195. *Adm:* $3. Lindsay Infante, K8LI, 7649 County Rd L, Delta, OH 43515; 419-346-8261; **lindsayinf@yahoo.com**; **k8bxq.org**.

NORTHWESTERN DIVISION CONVENTION

May 31-June 2, Seaside, OR
D F H Q R S V
Friday 1-4 PM, Saturday 9 AM-4 PM, Sunday 9 AM-1 PM. *Spr:* Oregon Tualatin Valley ARC. Seaside Convention Center, 415 First Ave. 31st Annual SeaPac Event. W7OTV Special Event Station; RAGS Country Store; SeaPac Collector's Pins ($5); DX and YLRL luncheons; Saturday eve banquet featuring special guest speaker Jack Crabtree, W7JLC (Amateur Radio Ballooning). *Tl:* 145.45 (118.8 Hz). *Adm:* advance $8, door $10. Tables: 1 day $15, 2 days $25. Wayne Schuler, AI9Q, 16414 NE 21st St, Vancouver, WA 98684; 360-892-5580; **ai9q@arrl.net**; **www.seapac.org**.

Pennsylvania (Butler) — Jun 2
D F H Q R S T V
8 AM. *Spr:* Breezeshooters ARC. Butler Farm Showgrounds, 627 Evans City Rd. *Tl:* 147.3. *Adm:* $5. Tables: $20. Robert Benna, N3LWP, 1010 Willow Dr, Pittsburgh, PA 15237; 412-366-0488; fax 412-366-0486; **n3lwp@verizon.net**; **www.breezeshooters.org**.

Pennsylvania (Lime Ridge) — Jun 8
D F H R T V
7 AM-1 PM. *Spr:* Columbia-Montour ARC. Lime Ridge Community Ctr, 6405 4th St. *Tl:* 147.225 (85.4 Hz). *Adm:* $5. Tables: $10. Randy Kishbaugh, N3JPV, 2508 Heights Rd, Berwick, PA 18603; 570-759-2306; **n3jpv@verizon.net**; **www.qsl.net/cm-arc/hamfest.htm**.

TENNESSEE STATE CONVENTION

June 8, Knoxville, TN
D F H Q R S T V
8:30 AM-4 PM. *Spr:* Radio Amateur Club of Knoxville. Kerbela Temple, 315 Mimosa Ave. *Tl:* 147.3 (100 Hz). *Adm:* $7. Tables: $20. Dave Garner, K4YRK, 10917 Sonja Dr, Farragut, TN 37934; 865-966-9811; **dgarner@usit.net**; **www.w4bbb.org**.

Texas (Amarillo) — May 11 H R T
9 AM-2 PM. *Spr:* Panhandle ARC. Thompson Park (Area 17), NE 24th and Dumas Hwy. *Tl:* 146.94 (88.5 Hz). *Adm:* Free. Tables: Free (limited). Henry Janhsen, N5HPJ, 8801 Red Wing Rd, Amarillo, TX 79119; 806-353-3747; **henryj_tx@yahoo.com**; **www.w5wx.org**.

WEST GULF DIVISION CONVENTION

June 7-8, Plano, TX
D F H Q R S T V
Friday and Saturday 8 AM-6 PM. *Sprs:* Ham-Com, Inc. and other clubs. Plano Centre, 2000 W Spring Creek Pkwy. Ham-Com 2013 (35th Anniversary West Gulf Division), Boy Scouts of America Radio Merit Badge Program, Lone Star DX Dinner (Friday, 6 PM, $40). *Tl:* 147.18 (107.2 Hz). *Adm:* advance $8, door $10. Tables: flea market $30; commercial $300. Bill Nelson, AB5QZ, 1915 Centenary Dr, Richardson, TX 75081; 469-964-2814; fax 972-231-7951; **ab5qz@swbell.net**; **www.hamcom.org**.

Utah (Ogden) — Apr 20 D F R S V
8 AM-3 PM. *Sprs:* Ogden ARC & Weber County ARES. Ogden Applied Technology Center, 200 N Washington Blvd. Antenna Building Class ($5), ICS-100 (30 seat limit), foxhunt. *Tl:* 146.9 (123 Hz). *Adm:* $5. Tables: $5. Sal Salazar, KD7JRX, 1531 Liberty Ave, Ogden, UT 84404; 801-540-9079; **elias.r.salazar@irs.gov**; **www.ogdenarc.org**.

Virginia (Manassas) — Jun 9
D F H Q R S T V
6 AM (tailgating), 7 AM (general). *Spr:* Ole Virginia Hams ARC. Prince William County Fairgrounds, 10624 Dumfries Rd. *Tl:* 146.97, 442.2, D-STAR 442.5125. *Adm:* advance $9 (by May 1), door $10. Tables: advance $25 (by May 1), door $30; tailgate space $9 (plus admission). Terry Erlacher, KC4DV, 10855 Felicia Ct, Manassas, VA 20110; 703-731-6629; **terry.erlacher@verizon.net**; **manassashamfest.org**.

Washington (Dryden) — Jun 7-9 F H R T V
Friday noon-Sunday morning. *Spr:* Apple City ARC. Dryden Gun Club, 7653 Saunders Rd. *Tl:* 146.68 (156.7 Hz). *Adm:* $7. Rich Cole, N7PZT, 4141 Luebber Ln, Malaga, WA 98828; 509-662-0215 (phone and fax); **rich8102@gmail.com**; **www.qsl.net/w7td**.

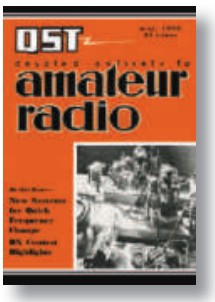
Washington (Stanwood) — May 11
D F H R V
9 AM-3 PM. *Spr:* Stanwood-Camano ARC. Stanwood Middle School, 9405 271st St NW. *Tl:* 145.19 (127.3 Hz). *Adm:* $5. Tables: $15 (before Apr 30), $20 (after Apr 30). Jim Ruble, KE7MHF, Box 941, Stanwood, WA 98292; 360-629-4713; **ke7mhf@arrl.net**; **scarcwa.org**.

West Virginia (Beckley) — Jun 9
D H R S T V
6 AM. *Spr:* Black Diamond ARC. Commission on Aging, 1614 S Kanawha St. *Tl:* 145.37 (100 Hz). *Adm:* $5. Tables: $10 (standard), $15 (with power). Zandle Cline, AC8DU, Box 909, Sophia, WV 25921; 304-683-3395; **ac8du@yahoo.com**; **wv8bd.multiply.com**.

75, 50 and 25 Years Ago

Al Brogdon, W1AB

May 1938

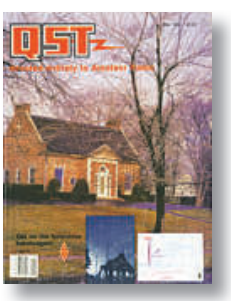


- The cover photo shows a ham's workbench, with a new project under way.
- The editorial discusses the fact that the age of the average ham is increasing. It comes to the conclusion that the increased cost and complexity of modern equipment might discourage younger hams, because of their low budgets.
- By Goodman, W1JPE, presents "Highlights of the 1938 DX Contest," in which many hams throughout the world participated.
- Clinton B. DeSoto, W1CBD, tells us about "Applying Band-Pass Couplers to Amateur Transmitters."
- "Intra-Band Quick Frequency Change for Transmitters," by By Goodman, W1JPE, expands on W1CBD's band-pass coupler idea, describing an exciter that will enable us to change frequency without retuning.
- "Simple Directional Arrays Using Half-Wave Elements," by Nick Stavrou, W2DFN, gives us information on how gain of an array varies with spacing.
- T. M. Ferrill, W5CJB, tells us how to build "A 5-, 10-, and 20-Meter Converter," using only two tubes.
- "A Desk-Type Push-Button Frequency-Control Unit," by Clark Rodimon, W1SZ, will give us finger-tip selection of crystals or electron-coupled oscillator at the operating table.
- Louis Padberg, W9FPA, describes "A Portable-Mobile Crystal-Controlled U.H.F. Transmitter" that can be built for either 28 or 56 Mc.
- Carl Drumeller, W9EHC, reports on his new project, "A Simplified Exciter Circuit."

May 1963

- The cover photo shows the transistorized dip meter described in this issue.
- The editorial discusses the League's building fund, "a new challenge."
- Lew Bergren, WØAIW, reports on his latest antenna project, "The Multielement Quad."
- Laird Campbell, W1CUT, tells us about "Modernizing a Transistorized Dip Meter" for 2 to 230 Mc.
- Ellen White, W1YYM, gives us the "1962 ARRL Sweepstakes" results.
- George Grammer, W1DF, presents Part III of "A.C. in Radio Circuits."
- "Grounded-Grid Nuvistor Preamplifiers," by Raymond Bohmer, W1REZ, reports on his compact and easily adjusted preamps for 50 through 450 Mc.
- Frank Noble, W3QLV, describes "A Crystal V.F.O.," a much-simplified version of W1RF's "Ultimate Exciter," which appeared in *QST* the previous year.
- Bruce Montgomery, W4BFR, adds a crystal filter, thus "Improving the C.W. Selectivity of the Collins 75A-4."
- In Part IV of "Pulse: A Practical Technique for Amateur Microwave Work," Robert Guba, W1QMN, and John Zimmer, W2BVU, discuss receiving equipment for 2300 Mc.

May 1988



- K1CE's cover photo of the W1AW building brings attention to the renovation fund that is growing at a brisk pace, but which still needs our help.
- The editorial reports on the milestone of "Five Years of Volunteer Examining," with good results.
- Corby Pratt, K4WV, and Virgil Yarbrough, K4IEK, tell us how easy it is to send "Pictures by Packet."
- Doug DeMaw, W1FB, helps us by discussing "How to Deal with Audio RFI Problems."
- Michael Owen, W9IP, reports on "The Great Sporadic-E Opening of June 14, 1987." His exhaustive analysis of contacts in the various parts of the USA is quite interesting.
- The discussion of "RX Noise Bridges," by John Belrose, VE2CV, helps us decide whether to buy or build.
- Rod Newkirk, W9BRD, tells the true and heart-warming story of "Bill: The Pirate Who Touched Our Hearts."
- "Hams and Public Service: NWS Wants You!" tells us how hams help the National Weather Service, and how you can join the effort.
- "Delaware: The First State Signs '200'," by Robert Pegritz, KC3TI, Delaware Section Manager, tells about the operation of special event station K200QBD.
- In "The World above 50 MHz," Bill Tynan, W3XO, discusses the new plan for a DX window on 50 MHz.

Field Organization Reports

February 2013

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**.

376 KØIBS
370 KT2D
358 KJ4G
353 WM2C
312 KB1UAU
300 KB2ETO
290 N1UMJ
253 KC5ZGG
245 WB8R
227 W4SEE
222 N8OSL
212 W2MTA
210 K2HAT
207 KA2ZNZ
204 WB9FHP
200 WB8RCR
193 WA2BSS
190 WE2G
187 KB2KOJ
185 K8RDN
180 AG9G KB8VXE
176 KØLQB
175 K2ABX
170 KT5SR WB4ZIQ
166 KC8YVF
165 KC8QKC KE5HYW

160 WS6P KGØGG W5DY
150 KB5SDU K6HTN N8FVM
145 K7EAJ W4DNA KE4CB
142 W7JSW
140 N9VC KA8ZGY KB2BAA KC2QVT W9BGJ N8IO K7BFL N5TMC N7CM WK4P NM1K KK3F
138 KK5NU KD7THV
137 WD8USA
135 WA3EZN W8DJG W3YVQ
130 K9LGU WV8CH W7EKB WB2FTX K6JT WI2G K7OAH K4IWW KW1U N1IQI
125 WB9WKO N2JBA KD8CYK
120 NX9K NN7H K4GK KF7PDV K4JUU KS4PG NA7G KA4FZI WB8WKQ
118 KB2RTZ

117 K4BEH
116 KK4BVR
115 N7EIE K1PJS N2GJ WB6UZX WØLAW WB6UZX KJ4JPE W4TTO
111 W3CB
110 N5NVP K4BG WA5LOU W7GB KC5OZT N2WKT N7XG N7YSS AK4RJ KJ4RUD W2EAG K1YCQ N7IE KJ7NO KB3MXM KA1G N9MN KB8RCR
107 W9EEU W9WXN AE5VY
105 W5CU KD2AXP N8CJS KF7GC N1TF
103 KJ6IJJ KC2SFU
102 KK4LSL NA9L
100 KØVTT N3SW WA1STU N9VT KB5KKT W8CPG WA2NDA K2UHF KC2PDO N2RAI K6FRG N1JX K4SCL

WØCLS NØMEA WAØVKC WB8HHZ WB8SIQ WG8Z WD8Q N8SY KF5IOU K1HEJ KB1RGQ W7YV WB4FDT KB3LNM K3IN NU8K WB8TQZ
97 K4VWK N3RB WAØCGZ WB8YYS KK7TN
96 K2GW
95 NØYR N5MBQ KB1NMO
94 W2CC
93 KD8DNE KK7DEB AA3SB
90 N3KB WB4BIK KB8HJJ W8MAL K5AXW N5RL KA5AZK N2RTF WB4Y WA4BAM N3ZOC W3GQJ W8IM KC8BW
89 WJ3P
88 KC2EMW
87 WØRJA WDØGUF KB5PGY KD7OED N1LKJ
86 K7FLI KJ4HGH

85 AB9ZA KE5YTA
84 N2VC KB1YNE
83 KB9KEG KJ6PCC N2DW
81 KD2DEJ NC3F
80 WA9QIB KØDEU NIØI NØMHJ KFØXO KCØZDA NC8V KB7RVF KZ8Q K8KV WB4RJW
79 KJ6GYL
78 N2GS
77 KD8RPP
76 W5XX N9WLW KC5MMH
75 N9EXM KC4PZA WB3FTQ
74 KD8TCH
73 KJ6CNO
72 K4MSG
71 KC2UMX
70 N2YJZ KDØAYN NØDLK NØDUW NØDUX WØFUI KDØNJH N3NTV KØPTK KØRXC KD7ZUP

The following stations qualified for PSHR in previous months, but were not recognized in this column yet. (Dec 2012) WØLAW, KØPTK 120, WDØGUF 92, WA1STU, WB6UZX 90. (Jan) N1UMJ 140, KW1U, N9VC, WB9WKO 130, K9LGU, AG9G 125, N1IQI 115, NX9K, K1YCQ, KØPTK 110, N1TF 105, KAØDBK 91, WA9QIB 80.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AK, AL, AR, AZ, CO, EB, EMA, ENY, EPA, EWA, GA, ID, IL, IN, LA, LAX, ME, MI, MN, MS, NC, NNJ, NTX, OH, OK, OR, SD, SNJ, SJV, STX, VA, WCF, WI, WMA, WNY, WPA, WV, WY.

Section Emergency Coordinator Reports

The following ARRL Section Emergency Coordinators reported: AZ, ENY, EWA, IA, ID, IN, GA, KS, KY, MDC, MI, MN, MO, MT, NFL, NLI, NM, OK, SFL, SJV, STX, SV, TN, UT, WTX, WV.

Brass Pounders League

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

NX9K 4319, WB9FHP 2602, KK3F 2291, K6HTN 1448, WØRJA 931, KW1U 889, K6FRG 794, N1IQI 702, K6JT 544, W7ARC 509.

The following station qualified for BPL with Originations plus Deliveries: NM1K 120.

The following stations qualified for BPL in previous months, but were not recognized in this column yet. (Jan) NX9K 3524, N1IQI 1063, KW1U 835, N9VC 802.

Silent Keys

Silent Keys Administrator, sk@arrl.org

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

W1ABM **Jones**, Harold T., Weymouth, MA
WA1AKC **De Lorenzo**, Joseph F., Rowayton, CT
♦W1ALE **Everett**, Edward F., Pembroke, NH
KB1APN **Cooper**, Julie, Rutland, VT
K1EEQ **Fortin**, Arthur, New Bedford, MA
♦K1IK **Johnson**, Albert E., West Dover, VT
N1JQR **Turner**, Elwood B., Hanover, MA
KB1KGV **Axiak**, Frank J., Manchester, CT
KB1KMW **Soderberg**, Emil F., Oakdale, CT
W1LX **Sunderland**, Everett S., East Greenwich, RI
W1MRD **Simons**, Robert L., Hampton, NH
WA1OZE **Farley**, Roger D., South Burlington, VT
KB1PRV **Rust**, Kenneth S., Derry, NH
K1SS **Shore**, Sidney X., Sharon, CT
K1SZ **Chamberland**, Roger R., Oakdale, CT
KB1TA **Mitchell**, Anita R., Sterling, UT
WA1ZGB **Zovich**, Amedeo "Dino," Kensington, CT
K2BUF **Delaney**, Robert L., Ballston Lake, NY
KB2DLY **Kotansky**, Stephen, Watervliet, NY
WA2DXS **Heffner**, Eleanor E., Albany, NY
N2ENX **Corrigan**, Thomas V., Delmar, NY
N2FP **Rosenzweig**, Jay P., Wantagh, NY
KC2FSK **Kubliski**, Edmund A., Garland, TX
W2GFP **Barrett**, James R., East Greenbush, NY
KA2GJQ **Pease**, Leon E. Jr, Manlius, NY
WA2GUK **Pryor**, Robert E. Sr, Troy, NY
KA2HRP **Kosarovich**, Eugene W., Cohoes, NY
KC2HUD **Pisani**, Yvonne G., Endicott, NY
KC2IFQ **Pitcher**, William H., Green Island, NY
W2IJL **Matthews**, Allan H., Waverly, NY
W2JEB **Hoffman**, James E., Troy, NY
K2JLU **Reith**, John F. Sr, Albany, NY
KA2JMY **Golden**, William F., Schenectady, NY
KB2JWP **Williamson**, Helen D., Cohoes, NY
K2JXQ **Hochman**, Stanley H., Monmouth Junction, NJ
K2JYR **Tremblay**, Edmond F., Cohoes, NY
W2KLZ **Henry**, Robert S., Brunswick, NY
KB2LNK **Smith**, Harold E. II, Westerlo, NY
W2LPT **Levine**, Seymour, Lake Worth, FL
N2LTZ **Paul**, David F., Albany, NY
WA2LWS **Anthenelli**, Victor A., Piscataway, NJ
KF2MJ **Rowley**, Vernon, Newfane, NY
W2MTG **Tully**, William P., Syracuse, NY
N2MUX **Anderson**, Robert, Poestenkill, NY
W2MXA **Denio**, Albert F., Troy, NY
N2PAT **Siefert**, Richard T., Oxford, NY
N2POW **Griffiths**, Douglas J., Schenectady, NY
N2PZS **Hynds**, Given S., Delmar, NY
N2QWJ **Polisse**, Lawrence F., Syracuse, NY
KA2RTY **Whitham**, Clifford Jr, Latham, NY
KB2SI **Lirtzman**, Solomon J., Lake Peekskill, NY
KB2SPL **King**, Charles F., Latham, NY
N2SQQ **Toomey**, James G., Lake Luzerne, NY
WA2TAY **La Rocca**, John A., Holmdel, NJ
KC2TMX **Henes**, David C., Liverpool, NY
W2TT **Werner**, Walter C., Tinton Falls, NJ
KB2UPV **Killings**, John C., Albany, NY
K2VCQ **Warenchak**, Richard A., Troy, NY
K2VDT **Stroh**, William III, Short Hills, NJ
WB2WAU **De Socio**, Frank, Camillus, NY
KC2WEL **Smith**, Marshall R., Millville, NJ
KA2WNA **Mac Dougal-Spross**, Linda L., Macedon, NY
N2WUC **Kiernozek**, John J., Albany, NY
W2WVG **Cruise**, James J., East Shodack, NY
W2YAV **Kafka**, William C., Chandler, AZ
WA2YAZ **Muller**, William F., Edgewater, FL
KA2YBM **Collier**, Robert H., Watervliet, NY
WA2YZQ **Crayer**, Joseph S., Troy, NY
KO2Z **Welter**, Joseph J., Albany, NY
WA3AHO **Gordon**, Harry W., Harrisville, PA
K3BZH **Baran**, Anthony S., Randolph, IA
W3GI **Green**, David E., Bel Air, MD
KB3GIR **Saxmann**, Milton D., Seagrove, NC
WB3IFE **Austin**, Willaim R., Erie, PA
W3JAA **Spandorfer**, L. M., Cheltenham, PA
N3JAE **Kissinger**, Earl D. Sr, Spring City, PA
ex-N3JZW **Fisher**, Theodore A., Clarks Summit, PA
K3MI **Lape**, Ronald D., Perryopolis, PA
W3MWV **Lange**, Erwin, Sharon, PA
KA3QVZ **Balos**, Thomas W., Erie, PA
W3RWZ **Carr**, Walter F. Jr, Palm Harbor, FL
W3TRC **Zehner**, William A., Wilmington, DE
K3VUT **Olenak**, Richard A., Munhall, PA
KA3ZAR **Hillard**, Donald L. Sr, Mehoopany, PA
KA3ZIR **Luckenbach**, Helen R., Reading, PA
KI4AAN **Blasingame**, William G., Port Orange, FL
KN4AO **Manning**, John F., Maryville, TN
KI4AT **Thompson**, Scotty, Rush, KY
K4BNE **Rutan**, Richard J., Saint Petersburg, FL
KC4BZO **Dolan**, James L., Woodbury, NJ
W4DLJ **James**, Daniel Lee, Staunton, VA
N4DOM **Turk**, Richard T. Sr, Rutledge, GA
♦K4EUX **Jones**, Elmer D. Jr, Arlington, VA
KN4FV **Gable**, Robert L., Florence, AL
WO4G **Rice**, Thomas A., Cullman, AL
WA4GEU **Norman**, Fletcher G., Eden, NC
W4GJA **Hatley**, Marvin T. Jr, Charlotte, NC
KG4GXM **Bell**, Geraldine M., Saint Petersburg, FL
KJ4HEO **Earwood**, William C., Morganton, NC
K4IOW **Lane**, William F., Monroeville, AL
N4IPJ **Fineman**, Michael A., Palm Bay, FL
K4IVD **Sims**, Louis R., Pensacola, FL
NA4J **Watson**, Johnie R., Lexington, KY
W4JOM **Murray**, John O., Charleston, SC
W4JVG **Puel**, Andrew F., Pensacola, FL
K4KCO **Kelly**, James R., Newberry, SC
KB4LPR **Fulmer**, William "Kenneth," Pell City, AL
KD4LSB **Johnsen**, Robert, Aiken, SC
KI4LTC **Sommerville**, James L., Palm Bay, FL
KF4LUB **Boyan**, Thomas A., Southport, NC
KK4MG **Juras**, Stanley J., Augusta, GA
W4NNE **Edwards**, Ralph N., Tifton, GA
W4PLL **Thompson**, Doyle D. Sr, Punta Gorda, FL
WD4RGV **Hampton**, Allen L., Cedar Bluff, AL
N4SSU **Breeden**, Edward V. III, Raleigh, NC
KA4TEU **Benet**, Keith S., Louisville, KY
WA4THX **Davis**, Roscoe C. P. Sr, Louisville, KY
KA4UMW **Kunda**, Joseph J. Jr, Woodbridge, VA
KE4UVZ **Maggard**, Wilkie, Asheville, NC
N4VIJ **Fraser**, Marian T., Norfolk, VA
K4VIQ **Gourley**, Martin B., Rogersville, TN
KJ4WME **Raymer**, Robert L., Beverly Hills, FL
KI4WSW **Arnold**, Richard M., Lake City, FL
KD4YOL **Anderson**, Robert J., Amelia, VA
AA4YW **Whatley**, Marvin E., Houston, TX
AK4ZL **Vanselow**, Neal R., Summerville, SC
K4ZVM **Moseley**, Zeb V. III, Elizabeth City, NC
WW4ZZ **McVicker**, Donald J., Boynton Beach, FL
WD5CGR **Roberts**, Stewart H., Houston, TX
W5ECU **Cecil**, Gowan L., Savannah, GA
W5EWA **Rife**, Stanford E., Pearland, TX
KC5FR **Goldsberry**, Jim E., Nacogdoches, TX
♦WD5GJB **Bodensteiner**, Cornell C., Lafayette, LA
W5HRJ **Bass**, Guy W., Traskwood, AR
K5HYD **Perkins**, Edward D. Jr, Hillsboro, TX
AE5IT **Lemons**, Walter J., McKinney, TX
WA5IXN **Means**, Larry L., Nacogdoches, TX
N5LXF **Barnes**, Donald J., Poteau, OK
KF5MTA **Morris**, Jonathan D., Austin, TX
♦W5NXS **Gray**, Jon H., Dothan, AL
KB5PN **Neal**, Gerald R., Pollock, LA
W5RCW **Robinson**, Alvin E., Powell, WY
ex-K5REN **Betar**, Richard G., New Iberia, LA
KA5RML **Coleman**, Joseph E. Sr, Lafayette, LA
K5ROV **Parsons**, James, San Angelo, TX
N5SVE **Howell**, Samuel W., Odessa, TX
K5TXQ **Ewing**, Evalyn M., Tyler, TX
KZ5WH **Huffman**, Wade Jr, Hickory, NC
N5XYF **Morewitz**, Louise R., Houston, TX
KB5ZNO **Turner**, Rickey L., Russellville, AR
KB6ALD **Deskey-Wegg**, Louise T., Anacortes, WA
WD6BAJ **Besocke**, Forrest R., Arcadia, CA
K6BVL **Fregly**, Bert F., El Cajon, CA
KF6GK **Vidmar**, Richard W., El Segundo, CA
♦KK6JI **Patterson**, Donald M., San Jose, CA
KO6LP **O'Donnell**, Henry E., Butte, MT
N6MGY **Dale**, Wilbur G., Santa Rosa, CA
W6MZ **Quinn**, John R., Los Altos, CA
K6PWF **Mollberg**, Richard D., Lafayette, CA
KE6TIY **Fraser**, Robert A., Santa Rosa, CA
AC6TO **Babcock**, Stanley R., Fresno, CA
W6UMP **Zentner**, Robert P., Berkeley, CA
KF6VXM **Sandstrom**, Rev Mark R., Glendora, CA
W6WAS **Underberger**, George M., Palm Desert, CA
♦K6YYR **Brooks**, Michael D., Silverdale, WA
KB6ZNR **Gardner**, Gladys M., New Carlisle, OH
♦WS7A **Garrison**, Evelyn, Sammamish, WA
WB7AIV **Sparlin**, Raymond R., Everett, WA
KE7BBN **Rowell**, Mickey D., Hortense, GA
KC7DJY **Wade**, Martin G. Jr, Kent, WA
WB7ECH **Sparlin**, Joyce A., Everett, WA
W7GR **Egerer**, Barney E., Shoreline, WA
W7ILN **Rollins**, David F., Las Vegas, NV
K7JML **La Ferla**, J. "Mike," Newport, WA
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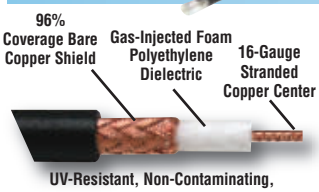

DXE-8X Low-Loss Foam Dielectric Cable (also known as RG-8X or Mini-8)

- Very flexible; ideal for short, in-shack jumper cables
- .242" Type II jacket is non-contaminating and UV-resistant
- Direct-bury

Attenuation/ 100 ft.	Power Rating	Efficiency %
0.6 dB @ 5 MHz	3.0 kW	86%
0.9 dB @ 10 MHz	2.2 kW	81%
1.4 dB @ 30 MHz	1.2 kW	69%
2.0 dB @ 50 MHz	0.9 kW	62%
3.8 dB @ 150 MHz	0.4 kW	42%

Cable Only		
DXE-8X	By the foot	**$.31/ft.**
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Part Number	Length/Ft.	Price
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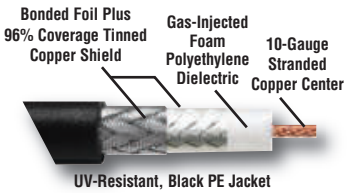

DXE-400MAX Low-Loss Cable

- Low-loss, gas-injected foam polyethylene dielectric bonded tape foil covered by a braided copper shield
- .405" low-density polyethylene jacket is UV resistant, ideal for outdoor use
- Direct-bury

Attenuation/ 100 ft.	Power Rating	Efficiency %
0.3 dB @ 5 MHz	6.9 kW	93%
0.5 dB @ 10 MHz	4.8 kW	90%
0.8 dB @ 30 MHZ	2.8 kW	83%
1.1 dB @ 50 MHz	2.1 kW	79%
1.8 dB @ 150 MHz	1.2 kW	65%
3.3 dB @ 450 MHz	0.7 kW	47%

Cable Only		
DXE-400MAX	By the foot	**$.82/ft.**
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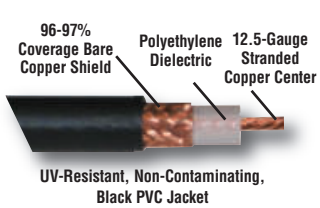

DXE-213U MIL-Spec Cable

- .405" Type II jacket is non-contaminating and UV-resistant, suitable for outdoor use
- Direct-bury

Attenuation/ 100 ft.	Power Rating	Efficiency %
0.4 dB @ 5 MHz	4.9 kW	90%
0.6 dB @ 10 MHz	3.4 kW	87%
1.0 dB @ 30 MHz	2.0 kW	79%
1.3 dB @ 50 MHz	1.5 kW	73%
2.4 dB @ 150 MHz	0.9 kW	57%

Cable Only		
DXE-213U	By the foot	**$.89/ft.**
DXE-213U-500	500 ft.	**$409.99**

Pre-cut Cable with Connectors		
Part Number	Length/Ft.	Price
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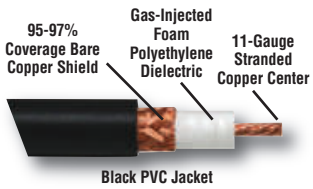

Gas-Injected Foam Won't Absorb Water.

DXE-8U Low-Loss Foam Dielectric Cable

- .405" high-flex PVC jacket
- Low-loss foam dielectric

Attenuation/ 100 ft.	Power Rating	Efficiency %
0.3 dB @ 5 MHz	5.4 kW	93%
0.5 dB @ 10 MHz	4.1 kW	90%
0.9 dB @ 30 MHZ	2.2 kW	81%
1.2 dB @ 50 MHz	1.8 kW	77%
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DXE-SAD-100A	1.00	1/4-20	**$6.05**
DXE-SAD-125A	1.25	1/4-20	**$6.85**
DXE-SAD-150A	1.50	1/4-20	**$7.75**
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V-Bolt Style, sized to accommodate ranges of tubing sizes

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DXE-CAVS-3P	2.00 to 3.00	3/8-16	**$15.25**

Dimensions in Inches.

Clamps with black powdercoated saddles are also available in U-Bolt and V-Bolt styles, designed and sized to fit ½" to 2" tubing.

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Available in either fiberglass or aluminum, these kits contain several tapered sections of DX Engineering tubing and stainless steel band camps, allowing you to build your own vertical antenna. You can design, experiment and create an adjustable setup tailored specifically to your specs. These kits contain almost everything you'll need, eliminating extra trips to the hardware store.

Part number		Price
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DXE-ATK65	Aluminum Antenna Tubing Kit, 65 Foot Max. Length	**$194.50**

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1K2 Amplifiers are designed for EME (CW and JT65), SSB, CW or the very popular JT6M for meteor scatter. The amps constantly monitor device temperature, current, VSWR, drive and mode to adjust output. Full power output is possible for hours using 50 second transmissions for JT65A.

MSQ-6M-1K2	6 Meter 1,200 Watt Amplifier with Power Supply
MSQ-6M-1K2-NOPS	6 Meter 1,200 Watt Amplifier without Power Supply
MSQ-2M-1K2	2 Meter 1,200 Watt Amplifier with Power Supply
MSQ-2M-1K2-NOPS	2 Meter 1,200 Watt Amplifier without Power Supply

The MSQ- amplifiers have not yet been approved by the Federal Communications Commission. These devices may not be sold or leased, or be offered for sale or lease, until approval of the FCC has been obtained.

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Super Duty Saddle Clamps are designed for maximum clamping strength to control large or unbalanced loads.

- A356-T6 cast aluminum saddle, with rough, as-cast finish for high-torque grip on masts, etc
- Cast stainless reinforcement plate included
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ICO-IC-V8000 2 Meter FM Transceiver **$229.95**

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If you've got a 2 meter base or mobile station, then this amplifier can boost your 50 watt signal up to 160 watts. That includes all modes, too: FM, Digital, SSB and CW. Plus, it features a low-noise receive preamplifier and automatic, RF-sensing T/R switching. You can also use external direct keying with a rear panel RCA phono connector. Mirage offers more VHF and UHF amplifiers; the entire list is at DXEngineering.com.

MIR-B-5018-G 160 Watt 2 Meter Amplifier..... **$409.95**

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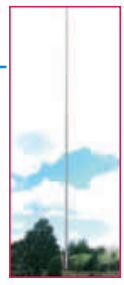
Samlex's SEC-1235M Desktop Switching Power Supply provides a well-regulated 13.8 Vdc output at any current demand up to 35 amps peak—plenty of power for your whole station. It gives your reliable power that is well-filtered to suppress unwanted noise and RFI. The entire Samlex line of power supplies can be found at DXEngineering.com.

SXA-3435 Samlex SEC-1235M DC Power Supply **$125.95**

See website for all available configurations

Full Size 75/80 Meter Quarter-Wave Vertical Antennas



These 68 foot tall, high-performance, full size antennas have rugged base sections (2, 3 or 4 inch diameter) made from aircraft-grade aluminum tubing.

See video on how these four UNGUYED DX Engineering 80M Verticals easily withstood SuperStorm Sandy at DXEngineering.com!

The VA-1 requires simple guying. The VA-2 and VA-3 models are very stout and don't require guying. The VA-2 and VA-3 antennas are supplied with a Heavy Duty Plus Stainless Pivot Base and can be lowered easily with the optional, DXE-VRW one-man, manual winch.

- 2:1 bandwidth up to 500 kHz
- DX Engineering structural design + high strength tubing custom manufactured to our rigid specifications **= Highest Wind Ratings**
- High strength, UV-protected Extren® insulator **= High Power Handling Capacity**
- Specially manufactured stainless steel and aluminum saddle clamps, stainless steel bolts, and precision machining **= Reliability Second to None**
- Specially manufactured Pivot Base supplied with VA-2 and VA-3 antennas **= Easy Tilt Up and Down**

DXE-7580FS-VA-1	Vertical Antenna, standard HD, 2 inch O.D. base section	**$379.50**
DXE-7580FS-VA-2	Vertical Antenna, Heavy Duty, 3 inch O.D. base section	**$825.00**
DXE-7580FS-VA-3	Vertical Antenna, Super Duty, 4 inch O.D. base section	**$1,775.50**

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DXE-VRW-1 Manual Winch

A great option, this winch allows one person to easily raise or lower a VA-2 or VA-3 vertical antenna.

DXE-VRW-1 Manual Winch..... **$169.99**

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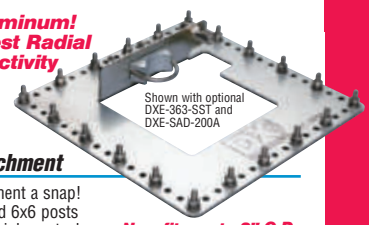
Stainless Radial Plate with Coax Attachment



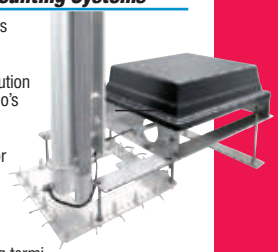
Makes radial attachment a snap!

- Fits 3" pipe, 4x4 and 6x6 posts
- 0.125" thick 304 stainless steel
- Accommodates up to 120 radials
- Patented high current coax connection to radials

Now fits up to 3" O.D. mount

DXE-RADP-3	Complete with 20 stainless bolt sets	**$54.50**
DXE-RADP-1HWK	20 sets of 1/4" stainless hardware	**$7.50**
DXE-SSVC-2P	Stainless Saddle Clamp for attachment to steel tube 1" to 2" O.D.	**$11.95**

MFJ-998RT Remote Tuner Mounting Systems

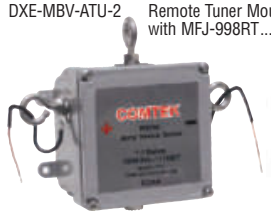


These Remote Tuner Mounting Systems provide an easy way to mount your MFJ-998RT tuner to any quarter-wave vertical antenna. They're the perfect solution for the Full Legal Limit Power DX'er who's using MFJ-998RT's great auto-tuning features. The ATU-2 mounts to the DX Engineering RADP-3 Radial Plate for a secure connection.

The DXE-ATU-2 has custom laser-cut stainless steel brackets, a right angle PL-259/SO-239 adapter, an insulated stranded copper feedline cable with ring terminal and other specialized hardware that facilitates the correct RF connections for maximum power transfer to antenna without arcing. Stainless steel hardware and instructions are included.

The DXE-MBV-ATU-2 has everything that the DXE-ATU-2 features, plus it includes a bias tee power injector and the MFJ-998RT remote IntelliTuner, making it a complete setup!

DXE-ATU2	Remote Tuner Mounting System	**$64.50**
DXE-MBV-ATU-2	Remote Tuner Mounting System with MFJ-998RT	**$824.45**



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FREE! RBA-1:1 Balun or RU-4:1 Unun
When You Buy A S9V 43', 31' or 18' Multiband Antenna

Purchase an S9v 43', 31' or 18' antenna and fill out the included form. Mail it to LDG Electronics, and we will send you either a 200 watt balun or unun, your choice!

S9v43 $199.99
80-6 meters *Fixed Operation*

The S9v 43' is a high-performance lightweight telescoping fiberglass vertical. The best value in high-performance 'tall' verticals!

S9v31 $99.99
40-6 meters *Fixed or Portable Operation*

S9v18 $49.99
20-6 meters *Fixed or Portable Operation*

The S9v 31' and 18' are tapered, ultra-lightweight fiberglass vertical antennas. Friction-locking sections and high-tech polymer tube rings allow the antenna to be quickly and safely deployed in practically any environment without tools!

S9rp $39.99
Aluminum Radial Plate
Includes 20 sets of stainless steel nuts & bolts

Designed to handle the higher power of the Tokyo Hi Power HL-45B.

NEW! Z-817H
The ultimate autotuner for QRP radios including the Yaesu FT-817(D) with addition of the Tokyo High Power HL-45B. Interfaces to the CAT port (ACC) on the back of the radio with the provided cable. One button push on the tuner and the Z-817H takes care of the rest. Will also function as a general purpose antenna tuner with other QRP radios or QRP radios with up to 75 watt HF amps. Powered by four AA internal Alkaline batteries (not included). 2000 memories cover 160 through 6 meters.
Suggested Price $159.99

- RF Sensing
- Tunes Automatically
- No Interface Cables Needed

AT-200ProII
The AT-200ProII now includes LEDs to show antenna position and if the tuner is in bypass. A two position antenna switch stores 2000 memories per switch. Handles up to 250 watts SSB or CW on 1.8 to 30 MHz and 100 watts on 54 MHz. Rugged and easy to read LED bar graphs simultaneously show RF power and SWR. Includes a six foot DC power cable. **Suggested Price $259.99**

AT-1000ProII
LDG Electronics' new flagship 1KW tuner features: 5 to 1,000Watts PEP; RF Sensing; Auto and Semi Tuning Modes; 1.8 to 54 MHz range; 6 to 800 ohm range (15 to 150 on 6M); simplified operation; and an optional external 4.5" analog meter. With the two position antenna switch, there are 2,000 memories that store tuning parameters for almost instantaneous memory recall whenever you transmit on or near a frequency you've used before. Includes six foot DC power cable. **Suggested Price $539.99**
Optional M-1000 external analog meter $129.99

IT-100
Matched in size to the IC-7000 and IC-706, for either manual or automatic tunes, and status LEDs. Control the IT-100 and its 2000 memories from either its own button or the Tune button on your IC-7000 or other Icom rigs. For your Icom radio that is AH3 or AH-4 compatible.
Suggested Price $179.99

YT-100
For Yaesu FT-857, FT-897 and FT-100 (and all D models) an integrated tuner, powered by the interface. Press the tune button on the tuner, and everything else happens automatically.
Suggested Price $199.99

KT-100
For AT-300 compatible Kenwood transceivers (except TS-480HX). The KT-100 actually allows you to use the Tune button on the radio. 2,000 memories for instant recall of the tuning parameters for your favorite bands and frequencies.
Suggested Price $199.99

YT-450
Designed for Yaesu's newest 100 watt radios. Interfaces directly with the Yaesu FT-450 and FT-950 radios. Press the tune button on the tuner and the rest happens automatically. It will quickly match nearly any kind of coax fed antenna with an SWR of up to 10:1. 2000 memories recall settings in an instant! Seamless connection to a PC. **Suggested Price $249.99**

YT-847
YT-847 Autotuner is an integrated tuner for the Yaesu FT-847. An included CAT/Power cable interfaces with your FT-847. Just press the tune button on the tuner and everything else happens automatically! **Suggested Price $249.99**

LDG ELECTRONICS

Your Favorite Dealer has these tuners in stock NOW!

1445 Parran Road, St. Leonard, MD 20685 **Phone 410-586-2177 • Fax 410-586-8475**

We have a tuner that will work for you!

We make tuners that will work with any transceiver. Don't know which one is right for you? Give us a call or see the ***Tuner Comparison Chart*** *on our web site for more selection help!*

LDG ELECTRONICS

radio not included

AT-897Plus
for the Yaesu FT-897

If you own a Yaesu FT-897 and want a broad range automatic antenna tuner, look no further! The AT-897Plus Autotuner mounts on the side of your FT-897 just like the original equipment and takes power directly from the CAT port of the FT-897 and provides a second CAT port on the back of the tuner so hooking up another CAT device couldn't be easier. ***Suggested Price $199.99***

NEW! AT-600ProII

Building on the success of the AT-600Pro, we refined and expanded the model with an optional external 4.5" analog meter. The new AT-600ProII keeps many of the same features of the previous model, but simplifies the operation. With the two-position antenna switch, there are 2,000 memories that store tuning parameters for almost instantaneous memory recall whenever you transmit on or near a frequency you've used before. Includes six-foot DC power cable.

Suggested Price $369.99

Optional M-600 external analog meter $129.99

Z-100Plus

Small and simple to use, the Z-100Plus sports 2000 memories that store both frequency and tuning parameters. It will run on any voltage source from 7 to 18 volts; six AA batteries will run it for a year of normal use. Current draw while tuning is less than 100ma. The Z-100Plus now includes an internal frequency counter so the operating frequency is stored with tuning parameters to make memory tunes a blazingly fast 0.1 seconds; full tunes take an average of only 6 seconds. Includes six foot DC power cable. ***Suggested Price $159.99***

AT-100ProII

- ***RF Sensing***
- ***Tunes Automatically***
- ***No Interface Cables Needed***

This desktop tuner covers all frequencies from 1.8 – 54 MHz (including 6 meters), and will automatically match your antenna in no time. It features a two-position antenna switch with LEDs, allowing you to switch instantly between two antennas. The AT-100ProII requires just 1 watt for operation, but will handle up to 125 watts. Includes six foot DC power cable.

Suggested Price $229.99

Z-11ProII

Meet the Z-11ProII, everything you always wanted in a small, portable tuner. Designed from the ground up for battery operation. Only 5" x 7.7" x 1.5", and weighing only 1.5 pounds, it handles 0.1 to 125 watts, making it ideal for both QRP and standard 100 watt transceivers from 160 - 6 meters. The Z-11ProII uses LDG's state-of-the-art processor-controlled Switched-L tuning network. It will match dipoles, verticals, inverted-Vs or virtually any coax-fed antenna. With an optional LDG balun, it will also match longwires or antennas fed with ladder-line. Includes six foot DC power cable. ***Suggested Price $179.99***

radio not included

Z-817

The ultimate autotuner for QRP radios including the Yaesu FT-817(D). Tuning is simple; one button push on the tuner is all that is needed - the Z-817 takes care of the rest. It will switch to PKT mode, transmit a carrier, tune the tuner, then restore the radio to the previous mode! 2000 memories cover 160 through 6 meters. The Z-817 will also function as a general purpose antenna tuner with other QRP radios. Just transmit a carrier and press the tune button on the tuner. Powered by four AA internal Alkaline batteries (not included), so there are no additional cables required.

Suggested Price $129.99

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hy-gain® Rotators

. . . the first choice of hams around the world!

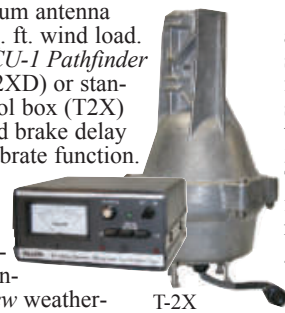
HAM-IV

HAM-IV
$649.95

The most popular rotator in the world! For medium communications arrays up to 15 square feet wind load area. *New* 5-second brake delay! *New* Test/Calibrate function. *New* low temperature grease permits normal operation down to -30 degrees F. *New* alloy ring gear gives extra strength up to 100,000 PSI for maximum reliability. *New* indicator potentiometer. *New* ferrite beads reduce RF susceptibility. *New* Cinch plug plus 8-pin plug at control box. Dual 98 ball bearing race for load bearing strength and electric locking steel wedge brake prevents wind induced antenna movement. North or South center of rotation scale on meter, low voltage control, max mast size of $2^{1}/_{16}$ inches.

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

TAILTWISTER SERIES II



For large medium antenna arrays up to 20 sq. ft. wind load. Available with *DCU-1 Pathfinder* digital control (T2XD) or standard analog control box (T2X) with *new* 5-second brake delay and *new* Test/Calibrate function. Low temperature grease, alloy ring gear, indicator potentiometer, ferrite beads on potentiometer wires, *new* weatherproof AMP connectors plus 8-pin plug at control box, triple bearing race with 138 ball bearings for large load bearing strength, electric locking steel wedge brake, North or South center of rotation scale on meter, low voltage control, $2^{1}/_{16}$ inch max. mast.

T-2X
$799.95

T-2XD
$1229.95
with DCU-1

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

CD-45II
$449.95

For antenna arrays up to 8.5 sq. feet mounted inside tower or 5 sq. ft. with mast adapter. Low temperature grease good to -30 F degrees. *New* Test/Calibrate function. Bell rotator design gives total weather protection, dual 58 ball bearing race gives proven support. Die-cast ring gear, stamped steel gear drive, heavy duty, trouble free gear train, North center scale, lighted directional indicator, 8-pin plug/socket on control unit, snap-action control switches, low voltage control, safe operation, takes maximum mast size to $2^{1}/_{16}$ inches. MSLD light duty lower mast support included.

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

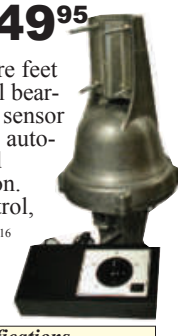
HAM-V

HAM-V
$1099.95
with DCU-1

For medium antenna arrays up to 15 square feet wind load area. Similar to the HAM IV, but includes *DCU-1 Pathfinder* digital control unit with gas plasma display. Provides automatic operation of brake and rotor, compatible with many logging/contest programs, 6 presets for beam headings, 1 degree accuracy, auto 8-second brake delay, 360 degree choice for center location, *more!*

AR-40

AR-40
$349.95



For compact antenna arrays and large FM/TV up to 3.0 square feet wind load area. Dual 12 ball bearing race. Automatic position sensor never needs resetting. Fully automatic control -- just dial and touch for any desired location. Solid state, low voltage control, safe and silent operation. $2^{1}/_{16}$ inch maximum mast size. MSLD light duty lower mast support included.

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

HDR-300A

HDR-300A
$1499.95

King-sized antenna arrays up to 25 sq.ft. wind load area. Control cable connector, *new* hardened stainless steel output shaft, *new* North or South centered calibration, *new* ferrite beads on potentiometer wires reduce RF susceptibility, *new* longer output shaft keyway adds reliability. Heavy-duty self-centering steel clamp and hardware. Display accurate to 1°. Machined steel output.

HDR-300A Rotator Specifications	
Wind load capacity (inside tower)	25 square feet
Wind Load (w/ mast adapter)	**not applicable**
Turning Power	5000 in.-lbs.
Brake Power	**7500 in.-lbs.**
Brake Construction	solenoid operated locking
Bearing Assembly	**bronze sleeve w/rollers**
Mounting Hardware	stainless steel bolts
Control Cable Conductors	**7**
Shipping Weight	61 lbs.
Effective Moment (in tower)	**5000 ft.-lbs.**

ROTATOR OPTIONS

MSHD, $109.95. Heavy duty mast support for T2X, HAM-IV and HAM-V.
MSLD, $49.95. Light duty mast support for CD-45II and AR-40.
TSP-1, $34.95. Lower spacer plate for HAM-IV and HAM-V.

Digital Automatic Controller

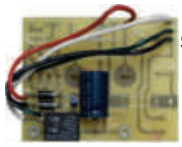
DCU-1
$749.95

Automatically controls T2X, HAM-IV, V rotators. 6 presets for favorite headings, 1° accuracy, 8-sec. brake delay, choice for center of rotation, crisp *plasma* display. Computer controlled with many logging/contest programs.

AR-303 Rotator/Controller

AR-303
$89.95

For UHF, VHF, 6-Meter, TV/FM antennas. Includes automatic controller, rotator, mounting clamps, mounting hardware. 110 VAC. One Year Warranty.



RBD-5
$29.95

NEW! **Automatic Rotator Brake Delay**
Provides automatic 5-second brake delay -- insures your rotator is fully stopped before brake is engaged. Prevents accidentally engaging brake while rotator is moving. Use with HAM II, III, IV, V, T2Xs. Easy-to-install. Includes pre-assembled PCB, hardware.

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2M FM Handheld

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2M/440 FM Mobile with TNC

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2M/220/440 FM Handheld

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KENWOOD TS-480SAT
100W HF/6M Mobile with Antenna Tuner

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KENWOOD TH-D72A
2M/440 FM Handheld with GPS

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100W HF/VHF/UHF Transceiver

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KENWOOD TS-590S
100W HF/6M Transceiver

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KENWOOD TM-V71A
2M/440 FM Mobile

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KENWOOD TS-990S
200W HF/6M Flagship Transceiver

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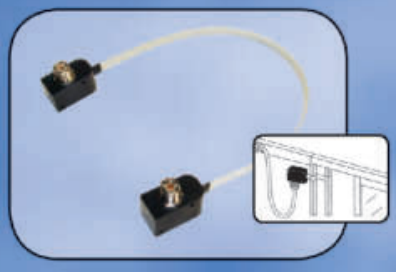


NEW! COMET CTC-50M
Window Gap Adapter!

Max Power: HF 100W PEP
VHF: 60W FM
UHF: 40W FM
900MHz - 1.3GHz: 10W
VSWR: <500MHz 1.3:1
>500MHz 1.5:1
Impedance: 50Ohm
Length: 15.75"
Conn: 24k Gold Plated SO-239s

MALDOL HVU-8
Ultra-Compact 8 Band Antenna!

Unique ground radial system rotates 180 degrees around the base if building side mounting is required.

Max Power: HF 200W SSB/100W FM
6M - 70cm: 150W FM
TX: 80/40/20/15/10/6/2M/70cm
Impedance: 50 Ohm
Length: 8'6" approx
Weight: 5lbs 7oz
Conn: SO-239
Max Wind Speed: 92MPH

Each band tunes independently.
Approx 2:1 band-width:
80M 22kHz
40M 52kHz
20M 52kHz
15M 134kHz
10M 260kHz

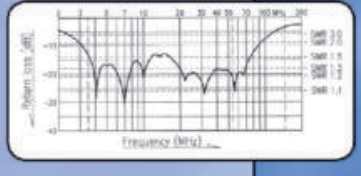
COMET CHA-250B
Broadband HF Vertical!

3.5 - 57MHz with SWR of 1.6:1 or less!

- *NO ANTENNA TUNER NEEDED*
- *NO RADIALS*
- *NO TRAPS*
- *NO COILS*

If you suffer in an antenna restricted area, must manage with space restrictions or you simply want to operate incognito you will be forced to make significant antenna compromises. The CHA-250B makes the most of the situation, making operating HF easy!!

Max Power: 250W SSB/125W FM
TX: 3.5– 57MHz
RX: 2.0– 90MHz
Impedance: 50Ohm
Length: 23'5"
Weight: 7lbs 1 oz
Conn: SO-239
Max Wind Speed: 67MPH



NEW! COMET H-422
40/20/15/10M compact, broadband, rotatable dipole!

Assemble in either a "V or horizontal ("H") configuration.
CBL-2500 2.5kW balun and heavy duty hardware included.

Max Power: 1000W SSB / 500W FM
SWR: Less than 1.5:1 at center frequency
Rotation Radius: "V" 12' 6" "H" 17' 5"
Length: "V" 24' 5" "H" 33' 10"
Weight: 11 lbs 14 ozs
Wind load: 3.01 sq feet
Max Wind Speed: 67 MPH

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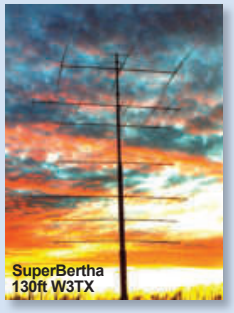
SuperBertha 130ft W3TX

LittleBertha: 35ft high...45ft high...55ft high...65ft high

- Coastal Zone Ready: Engineered to TIA-G 120 MPH Basic Wind Speed (Upgrades for Higher Wind Speed Zones Available) • No Guy Wires
- Entire Pole Rotates • Ground Level Rotor • Small Yard Footprint • Perfect for HF Monoband Christmas Tree • Perfect for Stacked Multibanders
- Perfect for VHF/UHF Stacks • Perfect for EME.

SuperBertha: 75ft high to 200ft+ high

- Ultimate Antenna Tower…Custom Designed to Your Specified Height from 75ft to 200ft+ High • Individually Engineered to TIA-G For Your Exact Location and Your Custom, Stacked Antenna Load • No Guy Wires
- Entire Pole Rotates • Ground Level Rotor • Small Yard Footprint
- Stack and Rotate All Your Antennas at Optimum Heights on One Pole!


SuperBertha 130ft N2NY

"OWA" Optimized Wideband Array Yagis... The Ultimate Monoband Yagi

- Sustained Optimal Gain, F/B, and Clean Pattern Across Entire Monoband
- SWR Better Than 1.4 to 1 Across the ENTIRE SSB, CW, RTTY, and DIGITAL Passbands.

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Christmas Tree VE3TA

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- 6MOWA-36, 6M13OWA-65
- 10MOWA-24, 10MOWA-36, 10M8OWA-48, 10M9OWA-60
- 12MOWA-36, Inquire for other custom boom lengths
- 15MOWA-36, 15M7OWA-48, 15M8OWA-72
- 17MOWA-36, Inquire for other custom boom lengths
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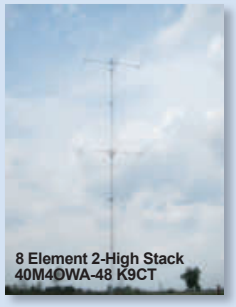
- 30M1, 30M2-Moxon, 30M3V-Yagi, 30M3-36, 30M4OWA-36
- 40M1, 40M2-Moxon, 40M3V-Yagi, 40M4OWA-48, 40M5OWA-72
- 80M1-Tornado, 80M2-Moxon, 80M3V-Yagi, 80m4OWA-96

Coming Soon – Log Periodics, Quads, Multibanders


10M9OWA-60 HK1R

K3LR/WA3FET OWA Yagis Propelled Team K3LR's Awesome Operators to Seven Consecutive Years as #1 USA Multi-Multi in CQWW SSB and #1 World Multi-Multi in 2008!!!

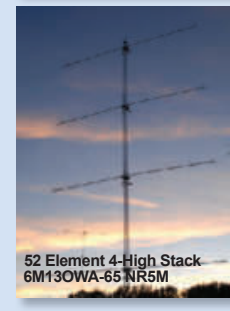

8 Element 2-High Stack 40M4OWA-48 K9CT


K3LR Team 2012 ARRL DX CW


10M8OWA-48 and 15M7OWA-48 K5KC

With awesome operators at K3LR, SuperBertha OWA Yagi's powered excellent scores during the 2012/2013 DX Contest Season.


12 Element 3-High Stack 40M4OWA-48 K3LR


52 Element 4-High Stack 6M13OWA-65 NR5M


SuperBertha 160ft


SuperBertha 130ft 40M4OWA-48 W3TX


18 Element 3-High Stack 20M6OWA-48 K9CT

Specifications subject to change without notice.

MFJ-259B *World's* most popular Antenna Analyzer is super easy-to-use!

MFJ-259B
$289.95

The MFJ-259B is the world's most popular Antenna Analyzer and the easiest to use! Just select a band and mode. Set frequency. Your measurements are instantly displayed!

Handheld Antenna Lab

Owning the MFJ-259B is like having an entire antenna lab in the palm of your hand!

Measure SWR quickly or make sophisticated measurements such as Return Loss, Reflection Coefficient, Resonance, Complex Impedance (R+jX), Impedance Magnitude (Z) plus Phase in degrees. Covers 1.8 to 170 MHz -- no gaps.

Coax Analyzer

Determine coax cable velocity factor (Vf), loss in dB, coax length, distance to open or short plus detect wrong coax impedance.

Frequency Counter

Measure frequency of external signals using the separate BNC counter input.

Signal Generator

Use as a signal source 1.8-170 MHz with digital dial accuracy for testing and alignment.

Inductance and Capacitance

Measure Inductance (uH) and Capacitance (pF) at RF frequencies not at audio frequencies used by most L/C meters.

Digital and *Analog* Meters

A high-contrast backlit LCD gives precision readings and *two* side-by-side *analog meters* make antenna adjustments intuitive.

Smooth, Stable Tuning

Velvet-smooth reduction drive tuning and precision *air-variable capacitor* makes setting frequency easy and stable.

Battery Saver & More

Battery-saver, low-battery warning, battery voltage meter and charger are all built in. Use ten Alkaline, NiCad or NiMH AA batteries (not included) or 110 VAC with MFJ-1312D, $15.95. 4Wx6¾Hx2D inches.

Here's What You Can Do

Find true antenna resonant frequency
Tune *antenna quickly for minimum SWR*
Match complex loads to your feedline
Adjust *mobile whips without stressing finals*
Determine safe 2:1-SWR operating windows
Adjust *tuners without generating QRM*
Find exact location of shorts and opens
Cut *stubs and phasing lines accurately*
Check cable for loss and contamination
Find *value of unknown coils and caps*
Test RF transformers and baluns
Troubleshoot *filters and networks*
Find self-resonance and relative Q
Check *patterns and compare gain*
MFJ-259B does all this and more!

MFJ Analyzer Accessories

MFJ-29C, $24.95. Tote your MFJ-259B anywhere with this *genuine* MFJ custom carrying case. Special foam-filled fabric cushions blows, deflects scrapes and protects knobs and meters from harm. **MFJ-39C, $24.95.** Like MFJ-29C, but for MFJ-269.

MFJ-66, $24.95. Plug-in coils turns any MFJ Antenna Analyzer into a sensitive and accurate *band switched* dip meter. 2 coils.

MFJ-92AA10, $29.95. Ten MFJ *SuperCell*™ Ni-MH AA rechargeable batteries.

MFJ-99B, $88.90. ***Save $7!*** MFJ-259B Deluxe Accessory Pack: MFJ-29C Pouch, 10 Ni-MH batteries, dip coils, AC adapter. **MFJ-98B, $88.90.** Like MFJ-99B but for MFJ-269.

MFJ-99, $60.85. ***Save $5!*** Like MFJ-99B, less batteries, for MFJ-259B. **MFJ-98, $60.85.** Like MFJ-99 but for MFJ-269.

MFJ-99C, $40.90. ***Save $5!*** AC Adapter and 10 Ni-MH batteries for MFJ-259B/269.

MFJ-917, $29.95. Current balun lets you make balanced line antenna measurements on HF with your MFJ Analyzer. **MFJ-7702, $3.95.** MFJ-917 to MFJ Analyzer adapter.

MFJ-731, $99.95. Tunable RF filter allows accurate Antenna Analyzer measurements in presence of strong RF fields. 1.8-30 MHz.

MFJ-5510, $9.95. Cigarette lighter cord.

MFJ-269 ...1.8-170 MHz and 415-470 MHz plus 12-bit A/D!

The MFJ-269 does everything the MFJ-259B does - and much more!

Expanded Frequency Coverage

MFJ-269 adds UHF coverage from 415 to 470 MHz -- right up into the commercial band. With it, you can adjust UHF dipoles, verticals, Yagis, quads and repeater collinear arrays with ease -- plus construct accurate phasing harnesses and timed cables. Also use it as a signal source to check UHF duplexers, diplexers, IMD filters and antenna patterns.

Much Better Accuracy

New *12-bit* A/D converter gives much better accuracy and resolution than common 8-bit A/D converters -- *an MFJ-269 exclusive!*

Complex Impedance Analyzer

Read Complex Impedance (1.8 to 170 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) -- *an MFJ-269 exclusive!*

MFJ-269
$389.95

CoxCalculator™

Lets you calculate coax line length in feet given electrical degrees and vice versa for any frequency and any velocity factor -- *an MFJ-269 exclusive!*

Use any Characteristic Impedance

You can measure SWR and coax loss with *any* characteristic impedance (1.8 to 170 MHz) from 10 to over 600 Ohms, including 50, 51, 52, 53, 73, 75, 93, 95, 300, 450 Ohms -- *an MFJ-269 exclusive!*

Logarithmic Bar Graph

Has easy-to-read LCD *logarithmic* SWR bargraph and SWR meter for quick tuning.

Uses instrumentation grade N-connector to ensure minimum mismatch on all frequencies. Includes N to SO-239 adapter.

MFJ-269*PRO*™ Analyzer

MFJ-269PRO
$419.95

Like MFJ-269, but has extended commercial frequency coverage in UHF range ***(430 to 520 MHz)*** and *ruggedized* cabinet that protects LCD display, knobs, meters and connectors from damage in the field/lab.

MFJ-266 ...Wide range 1.5-185 MHz and 300-490 MHz!

New!

MFJ-266
$349.95

The compact MFJ-266 covers HF (1.5-65 MHz) in 6 bands, plus VHF (85-185 MHz) and UHF (300-490 MHz).

In *Antenna Analyzer* mode, you get Frequency, SWR, Complex Impedance (R+jX), and Impedance Magnitude (Z) *all displayed simultaneously* on a high-contrast backlighted LCD (SWR only on UHF).

In *Frequency-Counter* mode, the MFJ-266 functions as a 500-MHz counter with up to 100 Hz resolution and measures relative field strength of a signal and its frequency and can be used for tracking measurement interference.

MFJ-266 also functions as a 10 dBm signal source with digital-frequency readout. It can also measure inductance and capacitance at RF frequencies.

Features include solid-state band switching and electronic varicap tuning with a smooth 10:1 lockable vernier tuning drive.

Use eight AA *alkaline* batteries or 110 VAC with MFJ-1312D, $15.95. Includes N-to-SO-239 adapter. 3¾Wx6½Hx2¾D inches. 1.3 lbs.

Free MFJ Catalog

Visit: http://www.mfjenterprises.com or call toll-free 800-647-1800

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MFJ . . . The World Leader in Amateur Radio!

MFJ TUNERS

New, Improved MFJ-989D 1500 Watt *legal limit* Antenna Tuner

World's most popular 1500 Watt Legal Limit Tuner just got better -- much better -- gives you more for your money!

New, improved MFJ-989D *legal limit* antenna tuner gives you better efficiency, lower losses and a new *true* peak reading meter. It easily handles *full* 1500 Watts SSB/CW, 1.8 to 30 MHz, including MARS/WARC bands.

New dual 500 pF *air variable capacitors* give you twice the capacitance for more efficient operation on 160 and 80 Meters.

New, improved *AirCore*™ *Roller Inductor* gives you lower losses, higher Q and handles more power more efficiently.

New *TrueActive*™ peak reading Cross-Needle *SWR/Wattmeter* lets you read *true* peak power on all modes.

MFJ-989D **$389.95**

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. $12^{7}/_{8}$Wx6Hx$11^{5}/_{8}$D 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.

More hams use MFJ tuners than all other tuners in the world!

MFJ-986 Two knob *Differential-T*™

MFJ-986 **$349.95**

Two knob tuning (differential capacitor and *AirCore*™ roller inductor) makes tuning foolproof and easier than ever. Gives minimum SWR at only one setting. Handles 3 KW PEP SSB amplifier input power (1.5 KW output). Gear-driven turns counter, lighted peak/average Cross-Needle SWR/Wattmeter, antenna switch, balun. 1.8 to 30 MHz. $10^{3}/_{4}$Wx$4^{1}/_{2}$Hx15 in.

MFJ-962D *compact* kW Tuner

MFJ-962D **$299.95**

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

MFJ-969 300W *Roller Inductor* Tuner

MFJ-969 **$219.95**

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

MFJ-949E *deluxe* 300 Watt Tuner

MFJ-949E **$179.95**

More *hams use MFJ-949s than any other antenna tuner in the world!* Handles 300 Watts. Full 1.8 to 30 MHz coverage, custom inductor switch, 1000 Volt tuning capacitors, *full size* peak/average lighted Cross-Needle SWR/Wattmeter, 8 position antenna switch, dummy load, *QRM-Free PreTune*™, scratch proof Lexan front panel. $3^{1}/_{2}$Hx$10^{5}/_{8}$Wx7D inches. **MFJ-948, $139.95.** Economy version of MFJ-949E, less dummy load, Lexan front panel.

MFJ-941E *super value* Tuner

MFJ-941E **$139.95**

The *most for your money!* Handles 300 Watts PEP, covers 1.8-30 MHz, *lighted* Cross-Needle SWR/Wattmeter, 8 position antenna switch, 4:1 balun, 1000 volt capacitors, Lexan front panel. Sleek $10^{1}/_{2}$Wx$2^{1}/_{2}$Hx7D in.

MFJ-945E HF/6M *mobile* Tuner

MFJ-945E **$129.95**

Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 8x2x6 in. *Lighted* Cross-Needle SWR/Wattmeter. Lamp and bypass switches. Covers 1.8-30 MHz *and* 6 Meters. 300 Watts PEP. **MFJ-20, $6.95,** mobile mount.

MFJ-971 *portable/QRP* Tuner

MFJ-971 **$119.95**

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

MFJ-901B *smallest* Versa Tuner

MFJ-901B **$99.95**

MFJ's smallest (5x2x6 in.) and most affordable wide range 200 Watt PEP Versa tuner. Covers 1.8 to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-902 *Tiny Travel* Tuner

MFJ-902 **$99.95**

Tiny $4^{1}/_{2}$x$2^{1}/_{4}$x3 inches, full 150 Watts, 80-10 Meters, has tuner bypass switch, for coax/random wire.

MFJ-904H, $149.95. Same but adds Cross-needle SWR/Wattmeter and 4:1 balun for balanced lines. $7^{1}/_{4}$x$2^{1}/_{4}$x$2^{3}/_{4}$ inches.

MFJ-16010 *random wire* Tuner

MFJ-16010 **$69.95**

Operate all bands anywhere with MFJ's reversible L-network. Turns random wire into powerful transmitting antenna. 1.8-30 MHz. 200 Watts PEP. Tiny 2x3x4 in.

MFJ-906/903 *6 Meter* Tuners

MFJ-906 **$99.95**

MFJ-906 has lighted Cross-Needle SWR/Wattmeter, bypass switch. Handles 100 W FM, 200W SSB. **MFJ-903, $69.95**, Like MFJ-906, less SWR/Wattmeter, bypass switch.

MFJ-921/924 *VHF/UHF* Tuners

MFJ-921/924 **$89.95**

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8x$2^{1}/_{2}$x3 in.

MFJ-931 *artificial* RF Ground

MFJ-931 **$109.95**

Eliminates RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding. Creates artificial RF ground or electrically places far away RF ground directly at rig. **MFJ-934, $209.95**, Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

Dealer/Catalog/Manuals

Visit: http://www.mfjenterprises.com or call toll-free 800-647-1800

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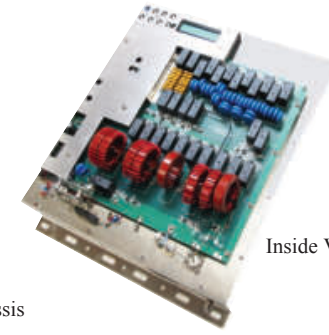
MFJ 1500 Watt *Remote* Auto Tuner

Place this MFJ-998RT remote tuner at your antenna to match high SWR antennas/long coaxes -- greatly reduce losses for high efficiency

. . . Match 12-1600 Ohms, 1.5 kW, SSB/CW, 1.8-30 MHz . . . Match coax/wire antennas . . . Weather-sealed . . . Remotely powered thru coax . . . Amplifier, radio, tuner protection . . . Output static/lightning protection . . . StickyTune™ always tunes when power folds back . . . DC power jack . . .

MFJ-998RT
$769.95

Bottom Chassis



Inside View

Tune your antenna AT your antenna!

Get greatly reduced losses and high efficiencies with long coax runs and high SWR antennas with this new MFJ-998RT 1.5 kW Remote Antenna Tuner.

Weather-Sealed

A tough, durable weather-sealed ABS cabinet with over-lapping lips, sealing gasket and stainless steel chassis protects the MFJ-998RT from all kinds of weather.

No Power Cable Needed!

No power cable needed -- remotely powered through coax. Includes MFJ-4117 Bias-Tee with on/off switch for station end of coax. Has 12 VDC jack for power cable, if desired.

Fully Protected

MFJ exclusive algorithms protect your tuner, radio and RF power amplifier from damage.

Automatic inductor and capacitor limiting prevents tuning extreme loads which can destroy your tuner.

Your tuner will not tune if more than 75 Watts with SWR greater than 3:1 is applied or if more than 125 Watts is applied.

Tuner output is static electricity and lightning induced surge protected.

MFJ exclusive StickyTune™

Very high SWR can fold back transmitter power and *prevent tuning* caused by extreme differences in loads (example: changing bands and other conditions).

But MFJ exclusive *StickyTune™ always* tunes with a simple on/off power cycle and re-transmit.

Tunes Coax fed and Wire Antennas

Tunes both coax fed and wire antennas. Has *ceramic* feed-through insulator for wire antennas. 2 kV *Teflon*® insulated SO-239 -- prevents arcing from high SWR.

High Power, Highly Efficient

A highly efficient L-network matches 6-1600 Ohms at *full* 1500 Watts legal limit SSB/CW 1.8 to 30 MHz with Hi-Q Ls, Cs.

MFJ-998RT Learns as you Operate

As you operate, the MFJ-998RT automatically tunes for minimum SWR and remembers your frequency and tuner settings. The next time you operate on that frequency and antenna, its tuner solution is restored in milliseconds and you're ready to operate!

Highly Intelligent, Ultra-fast Tuning

MFJ *InstantRecall*™ recalls stored tuning solutions from 10,000 memories. For new frequencies, MFJ *Intelli-Tune*™ measures your antenna impedance and instantly determines the correct matching components. If antenna impedances cannot be measured, MFJ *AdaptiveSearch*™ searches *only* the relevant components that can match your antenna giving you ultra-fast tuning.

Field upgradeable firmware. Requires 12-15 VDC at 1.4 Amps maximum or 110 VAC with optional MFJ-1316, $21.95. Weighs 9.5 lbs. 13¼Wx6¾Hx17½D inches.

600W *Remote IntelliTuner™*

MFJ-994BRT
$399.95

MFJ-994BRT -- perfect for 600 Watt SSB/CW amplifiers like Ameritron's AL-811/ALS-600/ALS-500M. Matches 12-800 Ohms. Coax/wire antennas, 1.8-30 MHz. Fully *weather-sealed* for outdoor use. Remotely powered through coax. Tough, durable, *built-to-last* cabinet, 9¼Wx3Hx 14¼D inches, 4 lbs. Includes MFJ-4117 BiasTee Power Injector.

300W *Remote IntelliTuner™*

MFJ-993BRT
$299.95

MFJ-993BRT handles 300 Watts SSB/CW and matches an *extra-wide* 6-1600 Ohm impedances. Coax/wire antennas, 1.8-30 MHz. Fully *weather-sealed* for remote outdoor or marine use. Remotely powered through coax. Tough, durable, *built-to-last* cabinet measures 9¼Wx3Hx14¼D inches. Weighs just 4 pounds. Includes MFJ-4117 BiasTee Power Injector.

200W *Remote IntelliTuner™*

MFJ-926B
$279.95

MFJ-926B, 200 Watts SSB/CW, matches 6-1600 Ohms, Coax/wire antennas, 1.8-30 MHz. Includes BiasTee.

200W *Remote Econo Tuner™*

MFJ-927
$259.95

MFJ-927, 200 Watts SSB/CW, 6-1600 Ohms, Coax/Wire antennas, 1.8-30 MHz. Weather-sealed, BiasTee. 7½Wx5¼Hx8½D in.

MFJ-2990
$359.95

160-6 Meters 43 foot Vertical Antenna

Operate all bands 160-6 Meters at full 1500 Watts with this self-supporting, 43 foot high performance vertical! Assembles in less than an hour. Low profile blends in with sky and trees -- barely see it. Entire length radiates. Exceptional low angle DX performance on 160-20 Meters and very good performance on 17-6 Meters. Telescope it shorter for more effective low angle radiation on 17-6 M if desired. One of these wide-range *MFJ automatic tuners* at the antenna easily matches all bands 160-6 Meters. There's no physical tuning adjustments on the antenna -- you *simply put it up!* Requires ground system, at least one radial, more the better. Includes balun and base mount. **MFJ-1932, $34.95.** All band ground radial system.

Free MFJ Catalog

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MFJ *Switching* Power Supplies

Power your HF transceiver, 2 meter/440 MHz mobile/base and accessories with these highly reliable 15, 22, 30, 40 or 75 Amp MFJ Switching Power Supplies!

No RF hash . . . Super lightweight . . . Super small . . . Volt/Amp Meters . . .

MFJ's adjustable voltage switching power supplies do it all! Power your HF or 2M/440 MHz radio and accessories.

MFJ's *MightyLites*™ are so light and small you can carry them with one hand! Take them with you anywhere.

No more picking up and hauling around heavy, bulky supplies that can give you a painful backache, pulled muscle or hernia.

These babies are clean . . . Your buddies won't hear *any* RF hash on your signal! *None* in your receiver either! These super clean *MightyLites*™ meet all FCC Class B regulations.

Less than 35 mV peak-to-peak ripple under 25 or 45 amp full load. Load regulation is better than 1.5% under full load.

You won't burn up our power supplies!

MFJ Power supplies are *fully protected* with Over Voltage, Over-temperature and Over Current protection circuits.

MFJ *MightyLites*™ can be used anywhere in the world! They have switchable AC input voltage and work from 85 to 135 VAC or 170 to 260 VAC. Replaceable fuse.

A whisper quiet internal fan efficiently cools your power supply for long life.

22 Amp Continuous

Ham Radio's smallest and lightest 22 Amp continuous power supply is also its best selling!

MFJ-4125 **$84.95**

22 Amps continuous/25 Amps max at 13.8VDC. 5-way binding posts on front, 5A quick connects on back. 85-135/170-260 VAC input. 2.9 lbs. 5¾Wx3Hx5¾D".

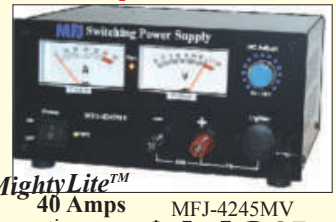
MFJ-4125P, $94.95. Adds 2-pairs *Anderson PowerPoles*™.

22 Amp Continuous

22 Amps continuous, 25 Amps maximum. Like MFJ-4125 but adds Volt/Amp meters, cigarette lighter plug. Adjustable 9-15 VDC Output. 5¼Wx 4½Hx6D in. Weighs 3.7 lbs. Use 85-135 VAC or 170-260 VAC input. Replaceable fuse.

MFJ-4225MV **$99.95**

40 Amp Continuous



MightyLite™

40 Amps continuous, 45 Amps max. Adjustable 9-15 VDC output. Volt/Amp meters, cigarette lighter plug, front 5-way binding posts, two rear quick connects. 5.5 lbs. 7½Wx 4¾Hx9D inches. Use 85-135 VAC or 170-260 VAC input. Replaceable fuse.

MFJ-4245MV **$149.95**

70 Amp Continuous

75 Amps maximum and 70 Amps continuously. Adjustable voltage 4.0-16 VDC. Short circuit, overload and over-temperature protection, 10.5 lbs. 9¾Wx5½Hx9½D". Great for Ameritron's ALS-500M mobile amplifier!

MFJ-4275MV **$249.95**

High Current Multiple DC Power Outlets

Power multiple Transceivers/accessories from a* single *DC power supply . . . Keeps you neat, organized and safe . . .Prevents fire hazard . . . Keeps wires from tangling up and shorting . . . Fused and RF bypassed . . . 6 foot, 8 gauge color coded cable . . .

Versatile 5-Way Binding Posts

MFJ-1118, $84.95. Power two HF and/or VHF rigs and six accessories from your main 12 VDC supply. *Built-in 0-25 VDC voltmeter.* Two pairs 35 amp 5-way binding posts, fused and RF bypassed for transceivers. Six pairs RF bypassed binding posts provide 15 Amps for accessories. Master fuse, ON/OFF switch,"ON" LED. 12½x2¾x2½ in.

MFJ-1118 **$84.95**

MFJ-1116, $59.95. 8 pairs binding posts, 15A total.Voltmeter, on/off switch.

MFJ-1116 **$59.95**

MFJ-1112, $44.95. 6 pairs binding posts, 15 Amps total.

MFJ-1112 **$44.95**

MFJ-1117, $64.95. Powers *four* transceivers simultaneously (two at 35 Amps each and two at 35 Amps combined). 8x2x3 inches.

MFJ-1117 **$64.95**

***All PowerPoles*™**

MFJ-1128, $104.95. 3 high-current outlets for transceivers. 9 *switched* outlets for accessories. Mix & match included fuses as needed (one-40A, one-25A, four-10A, four-5A, three-1A fuses installed). 0-25 VDC *Voltmeter*. *Extra* contacts, fuses. 12Wx1¼Hx2¾D".

MFJ-1128 **$104.95**

MFJ-1126, $84.95. 8 outlets, each fused, 40 Amps total. Factory installed fuses: two 1A, three 5A, two 10A, one 25A, one 40A. *0-25 VDC Voltmeter*. Includes *extra PowerPoles*®, *extra* fuses -- *no extra cost*. 9Wx1¼Hx2¾ inches.

MFJ-1126 **$84.95**

PowerPoles*™ *AND 5-Way Binding Posts

MFJ-1129, $114.95. 10 outlets each fused, 40 Amp total. 3 high-current outlets for rigs -- 2 *PowerPoles*® and one 5-way binding post. 7 *switched* outlets for accessories (20A max) -- 5 *PowerPoles*® and 2 binding posts. Fuses include (1- 40A, 2-25A, 3-10A, 3-5A, 2-1A installed). *0-25 VDC Voltmeter*. Includes extra *PowerPoles*® and fuses, 12½Wx1¼Hx2¾D inches.

MFJ-1129 **$114.95**

MFJ-1124, $64.95. 6 outlets each fused, 40 Amps total. 4 *PowerPoles*®, 2 high-current binding posts, Installed fuses: 1-40A, 2-25A, 2-10A, 1-5A, 1-1A. Includes extra *PowerPoles*® & fuses -- *no extra cost.*

MFJ-1124 **$64.95**

15 Amp Continuous

15 Amps continuous, 17 Amps max at 13.8 VDC. Over-voltage, over-current protection. 5-way binding posts. Load fault indicator and automatic shutdown. 90-130 VAC input. 1½ lbs. Tiny 3¾Wx2¼Hx3¾D inches fits easily in an overnight bag.

MFJ-4115 **$59.95**

30 Amps Continuous

Linear with 19.2 lb.Transformer

This heavy-duty linearly regulated MFJ-4035MV has *abolutely no RF Hash*. It delivers 30 Amps continuous, 35 Amps maximum from its massive 19.2 lb. transformer. Front panel adjustable 1-14 VDC output with convenient detent at 13.8 VDC. Volt/Amp Meters. 1% load regulation, 30 mV ripple. Over-voltage/current/temperature protection, 5-way binding posts, 2 pairs of quick-connects and a covered cigarette lighter socket for mobile accessories. Front panel replaceable fuse. 110 VAC input. 9½Wx6Hx9¾D in.

No RF Hash!

MFJ-4035MV **$149.95**

Free MFJ Catalog

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Tech Help: (662) 323-0549
FAX:(662)323-6551 8-4:30 CST, Mon.-Fri. ***Add shipping.***

MFJ 160-6 Meter Antenna

Self-supporting 43 foot vertical -- no guy wires required . . . 1500 Watts . . . exceptional performance . . . low-profile . . . includes base mount and legal limit balun . . . assembles in an hour . . .

MFJ-2990
$359.95

New!

Operate all bands 160 through 6 Meters at full 1500 Watt with this self-supporting, 43 feet high performance vertical! It assembles in less than an hour and its low-profile blends in with the sky and trees -- you can barely see it from across the street.

Exceptional Performance

The entire length radiates to provide exceptional low angle DX performance on 160 through 20 meters and very good performance on 17 through 6 Meters. You can shorten it by telescoping it down for more effective low angle radiation on higher bands if desired.

With an automatic antenna tuner there's no fuss -- just talk!

A wide-range automatic or manual antenna tuner *at your rig* easily matches this antenna for all bands 160-6 Meters. There's no physical tuning adjustments on the antenna -- you simply put it up!

An optimized balun design allows *direct coax feed* with negligible coax loss (typically less than ½ dB 60-6 Meters and less than 1 dB 160-80 M with good quality, low-loss coax).

Fully self-supporting, Extremely low wind loading, Very low visibility . . .

With just 2 square feet wind load, the fully self-supporting MFJ-2990 -- *no guy wires needed* -- has the lowest wind-loading and lowest visibility of any vertical antenna! The key is a six foot section of tapering diameter *stainless steel* whip that flexes in strong wind instead of stressing the bottom sections. Its 2-inch O.D. and .120 inch thick walled tubing bottom section makes it incredibly strong -- it'll stay up!

Weighs just 20 pounds -- you can easily put it up by yourself because its corrosion resistant *6063 aircraft aluminum* tubing and stainless steel construction make it light *and* super-strong.

Assembles in an hour

You can easily assemble it in an hour! Ground mounting lets you completely hide its antenna base in shrubbery. Includes ATB-65 high-strength antenna mount. Requires ground system -- at least one radial. More extensive ground system will give much better performance.

Great for Stealth Operation in antenna restricted areas

This very low-profile antenna is perfect for stealth operation in antenna restricted areas. Hide it behind trees, fences, buildings, bushes. Use it as a flagpole. Telescope it down during the day. Put it up at night and take it down in the morning before the neighbors even notice!

Quick and easy installation makes it great for DXpeditions, field day and other portable and temporary operations.

MFJ *Automatic* Tuners

MFJ-998
$699.95

For legal limit 1500 Watt SSB/CW amplifiers. Auto-ranging LCD and Cross-Needle SWR/Wattmeter, antenna switch, amp bypass, matches 12-1600 Ohms, 1.8-30 MHz.

MFJ-993B
$259.95

Dual power range -- 300 Watt range matches 6-1600 Ohms. 150 Watt/6-3200 Ohms. Auto-ranging LCD and Cross-Needle SWR/Wattmeter, antenna switch, 1.8-30 MHz.

MFJ *Manual* Tuners

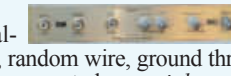
MFJ-989D
$389.95

1500 Watts SSB/CW, 1.8-30 MHz. Active peak-reading Cross-Needle SWR/Wattmeter, balun, dummy load, antenna switch, aircore roller inductor.

MFJ-949E
$179.95

World's most popular tuner! 300 Watts, 1.8-30 MHz. Peak/Average Cross-Needle SWR/Wattmeter, 8 pos. antenna switch, dummy load, 1kV capacitors.

Window Feedthru



MFJ-4602
$69.95

Bring 3 coaxes, balanced line, random wire, ground thru window. Connectors mounted on *stainless steel* panel. ¾" thick *pressure-treated* weather-proof wood.

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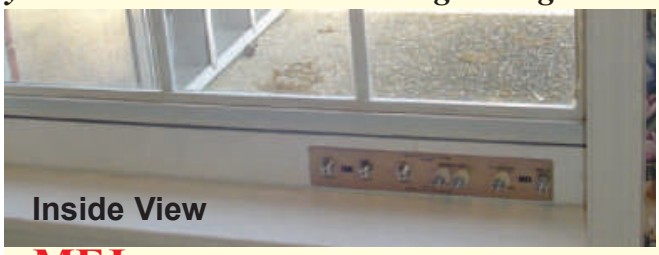
MFJ Weather-Proof *Window Feedthrough Panels*

Weather-proof window feedthrough panels bring coax, balanced lines, HF/VHF/UHF antennas, random wire antennas, ground, rotator/antenna switch cables and DC/AC power into your hamshack without drilling through walls!



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 horizontally or vertically. Connectors are mounted on inside/outside stainless steel plates and attached to a 4 foot long, 3½ inch high, ¾ inch thick *pressure-treated* wood panel. Has excellent insulating properties. Weather-sealed with a heavy coat of long-lasting white outdoor enamel paint. 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 Universal Window Feedthru Panel

MFJ-4603 **$89.95**

Four 50 Ohm *Teflon*(R) SO-239 coax connectors lets 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 television, Satellite, HD, cable TV and FM radio signals.

A pair of high-voltage *ceramic feedthru insulators* lets you bring in 450/300 Ohm balanced lines directly to your antenna tuner.

Has random/longwire antenna *ceramic feedthru insulator*.

***5-way** binding posts* lets 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 1¼X1⅝ 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 longwire/random wire, Stainless steel ground post.

MFJ-4602 **$69.95**

6 Coax

6 high quality *Teflon*(R) coax connectors for HF/VHF/UHF antennas. Stainless steel ground post. Full 1500 Watt legal limit.

MFJ-4601 **$59.95**

4 Balanced Line, 2 Coax

4 pairs of high-voltage *ceramic* feed-thru insulators for balanced lines and 2 coax connectors.

New! MFJ-4600 **$79.95**

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.

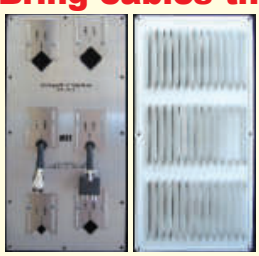
MFJ-4604 **$99.95**

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 **$159.95** **New!**

Bring cables thru eave of your house



MFJ-4616
shown with standard full-size vent (not included) it replaces. For *6 Cables*
$26.95

MFJ-4613
shown with standard half-size vent (not included) it replaces. For *3 Cables*
$14.95

Replace your standard air vents on the eave/sofitt of your house with these *MFJ AdaptiveCable*™ *Air Vent Plates* and…

Bring in coax, rotator, antenna switch, power cables, etc. *with connectors* up to 1¼x1⅝ inches!

Sliding plates and 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.

AdaptiveCable™ Wall Plates

MFJ-4614 *For 4 Cables* **$34.95**

Bring nearly any cable -- rotator, antenna switch, coax, DC/ AC power, etc. -- through walls *without removing connectors* (up to 1¼x1⅝ inches). Sliding plates and rubber grommets adjust hole size to weather-seal virtually any size cable.

Includes *stainless steel* plates for each side of wall, sliding plates, rubber grommets, weather stripping and screws.

MFJ-4612 *For 2 Cables* **$24.95**

MFJ-4611 *For 1 Cable* **$14.95**

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MFJ All-Band G5RV Antennas

Operate all bands through 10 Meters, even 160 Meters, with a single wire antenna!

MFJ-1778
$44.95

***The** famous G5RV antenna is the most popular ham radio antenna in the world!* You hear strong signals from G5RVs day and night, 24/7.

And it's no wonder . . . it's an efficient, *all band* antenna that's only 102 feet long -- shorter than an 80 Meter dipole. Has 32.5 foot ladder line matching section ending in SO-239 connector for your coax feedline.

Use as Inverted Vee or Sloper, and it's even more compact and needs just one support.

With an antenna tuner, you can operate all bands 80 Meters through 10 Meters and even 160 Meters with an antenna tuner and a ground.

MFJ's fully assembled G5RV handles 1500 Watts. *Hang and Play™* -- add coax, some rope to hang and you're on the air!

MFJ-1778M, $39.95. *Half-size*, 52 foot *G5RV JUNIOR* covers 40-10 Meters with tuner. Handles full 1500 Watts.

MFJ All Band Doublet

MFJ-1777
$59.95

MFJ-1777 is a 102 foot *all band* doublet antenna that covers 160 through 6 Meters with a balanced line tuner. Super strong custom fiberglass center insulator provides stress relief for ladder line (100 ft. included). Authentic *glazed ceramic* end insulators. Handles full 1500 Watts.

MFJ *Dual Band* 80/40 *or* 40/20M Dipoles

MFJ-17758
$89.95
80/40 Meters

MFJ-17758 is a short 85 foot long *dual band* 80/40 Meter dipole antenna. It's *full-size* on 40 Meters and has ultra-efficient end-loading on 80 Meters. Handles full 1500 Watts. Super-strong injection-molded center insulator with built-in SO-239 connector and hang hole. Solderless, crimped construction. 7-strand, #14 gauge hard copper wire. Connect your coax feedline directly, no tuner needed.

MFJ-17754, $59.95. Short coax fed 42 foot long *dual band* 40/20 Meter dipole antenna. *Full-size* on 20 Meters, ultra-efficient end-loading on 40 Meters. Same construction as MFJ-17758.

MFJ *Single Band* Dipole Antennas

Ultra high quality center fed dipoles will give you trouble-free operation for years. Custom injection-molded UV-resistant center insulator has built-in coax connector and hanging hole. Heavy duty 7-strand, 14-gauge hard copper antenna wire. Extremely strong solderless crimped construction. Authentic *glazed ceramic* end insulators. Use as horizontal or sloping dipole or inverted vee. Handles full 1500 Watts. Simply cut to length for your favorite frequency with cutting chart provided.

MFJ-1779A **$69.95** 160M, 265 ft.
MFJ-1779B **$49.95** 80-40M, 135 ft.
MFJ-1779C **$29.95** 20-6M, 35 ft.

True 1:1 Current *Balun & Center Insulator*

MFJ-918
$24.95

True *1:1 Current Balun/ Center Insulator* forces equal antenna currents in dipoles for superior performance. Reduces coax feedline radiation and field pattern distortion -- your signal goes where *you* want it. Reduces TVI, RFI and RF hot spots in your shack. *Don't build a dipole without one!* 50 hi-permeability ferrite beads on high quality RG-303 *Teflon*® coax and *Teflon*® coax connector. Handles full 1.5kW 1.8-30 MHz. Stainless steel hardware with *direct* 14 gauge stranded copper wire connection to antenna. 5x2 inches. Heavy duty weather housing.

RF Isolator

MFJ-915
$29.95

MFJ-915 *RF Isolator* prevents unwanted RF from traveling on the outside of your coax shield into your transceiver. This unwanted stray 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. 5x2 in. Handles full 1500 Watts. Covers 1.8-30 MHz. **MFJ-919, $59.95.** 4:1 current balun,1.5 kW. **MFJ-913, $29.95.** 4:1 balun, 300 Watts.

Antenna Switches

MFJ-1704
$79.95
4-Positions

MFJ-1704 heavy duty *antenna switch* lets you select 4 antennas or ground them for static and lightning protection. Unused antennas automatically grounded. Replaceable lightning surge protection. Good to 500 MHz. 60 dB isolation at 30 MHz. 2.5 kW PEP. Less than .2 dB insertion loss, SWR below 1.2:1. SO-239 connectors. Handy mounting holes. 6¼Wx4¼Hx1¼D in.

MFJ-1702C
$39.95
2-Positions

MFJ-1702C Like MFJ-1704, but for 2 antennas. 3Wx2Hx2D"

MFJ-1700C
$99.95

MFJ-1700C *Antenna/ Transceiver Switch* lets you select one of six antennas and one of six transceivers in any combination. Plug in an antenna tuner or SWR wattmeter and it's always in-line for any antenna/transceiver combination. Has lightning surge protection. Handles 2 kW PEP SSB, 1 kW CW, 50-75 Ohm loads. Unused terminals are automatically grounded. 1.8 to 30 MHz. SO-239 connectors. 4¾W6½Hx3D inches.

MFJ-1701
$69.95

MFJ-1701 *Antenna Switch* like MFJ-1700C but lets you select one of six antennas only. 10Wx3Hx1½D inches.

33 ft. Telescoping fiberglass Mast

3.8 feet collapsed, 3.3 lbs.

MFJ-1910
$79.95

Super strong fiberglass mast has huge 1¾ inch bottom section. Flexes to resist breaking. Resists UV. Put up *full size* inverted Vee dipole/vertical antenna in minutes and get *full size performance!*

Make your own antennas

Dipoles, G5RV, Random Wire, Doublets, Beverage Antennas, etc.

MFJ-16C06, $4.56. 6-pack authentic *glazed ceramic* end/center antenna insulators. **MFJ-16B01, $19.95.** Custom injection-molded UV-resistant center insulator has built-in coax connector and hanging hole. **MFJ-18G100, $24.95.** 100 ft. of flexible, 7-strand, 14-gauge solid copper antenna wire. **MFJ-58100X, $49.95.** 100 ft. 50-Ohm RG-8X with PL-259s on each end. **MFJ-18H100, $34.95.** 100 feet, 450 Ohm ladder line, 18 gauge copper covered steel.

Lightning Surge Protectors

Ultra-fast gas discharge tube shunts 5000 amps peak. Less than 0.1 dB loss. Up to 1000 MHz. SO-239s. **MFJ-270, $29.95.** 400W PEP. **MFJ-272, $39.95.** 1500W PEP.

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DSP-599zx Audio Signal Processor*

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Noise Reduction, precision highpass, lowpass, bandpass & notch filtering for audio, CW & data.

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Sweep and analyze antennas in seconds. Zoom, Compare & Store Data. Sunlight-visible color graphics, handheld, rechargable batteries, no computer required.

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ACCESSORIES

Plug & Play Cables

RBC-XX, $69.95. *Includes all the cables you need to get you on the air in minutes!*

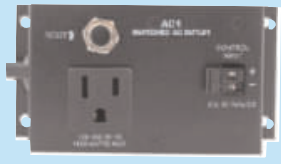
Has Microphone/speaker cables, data (CAT) cable, telephone cable, power supply.

For Kenwood, Icom, Yaesu, Flex, Elecraft and more. See *www.mfjenterprises.com* for model number for your rig.

Rotator Cable

RBC-RCC, $36.95. Required to control a rotator (rotator controller must have an RS-232 port).

Remote Switched AC Outlet



RBC-120REL, $149.95. Use this to turn your radio (or other 120 Volt/15 Amp device such as a power supply) on or off remotely. For *all* Icom radios and some later model Yaesu radios without remote on/off capability.

Microphone/headphone Interface

Microphone/Headphone Interface

RBC-CMI1, $249.95. Plug this noise cancelling microphone into your cellphone and get real PTT with many other bells and whistles. Provides receive audio for your car or headphones. Superb audio. Cellphone, headphones not included.

Cordless Phone Interface

RBC-CPI1, $179.95. Lets you use your cordless phone to control your station.

RBC-212
$499.95

Send DTMF commands from your cell phone or your laptop computer.

CONTROL YOUR RIG

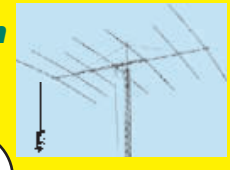
- TX, RX, Set/Speak VFO's
- Scan the bands
- Set and recall memories
- Fine tune stations
- Apply filters

ROTATE YOUR BEAM

- Set heading
- Stop rotation

Receive high quality voice confirmation responses.

SWITCH ANTENNAS



- Control rig antenna tuner
- Set auxiliary relays

HAM-VI Rotator & Digital Controller

New hy-gain HAM-VI, $749.95, like HAM-IV but with DCU-2 *digital controller*. Gives you fully automatic or manual control of medium antennas up to 15 square feet wind load. ***www.hy-gain.com***

HAM-VI
$749.95
with DCU-2

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MFJ-392B, $24.95. Superb padded headband/ear cushioned headphones. High-performance driver for enhanced audio.

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- Receives 2 frequencies simultaneously even on the same band
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- FM/FM-W/FM-N/AM plus SSB/CW receive
- Bar antenna for receiving AM broadcasts
- Special weather channel RX mode
- 435 memory channels, multiple scan functions
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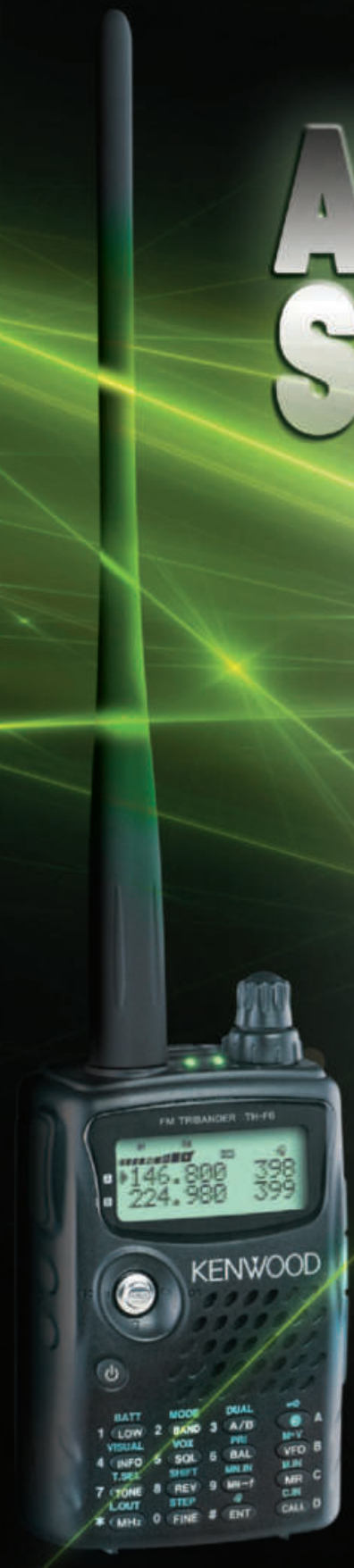
- 16-key pad plus multi-scroll key for easy operation
- Built-in charging circuitry for battery recharge while the unit operates from a DC supply
- Tough construction: meets MIL-STD 810 C/D/E standards for resistance to vibration, shock, humidity and light rain
- Large frequency display for single-band use
- Automatic simplex checker
- Wireless remote control function
- Battery indicator • Internal VOX • MCP software

[1]Note that certain frequencies are unavailable. [2]5W output



TH-F6A
TRIBANDER

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Fax: (310) 537-8235

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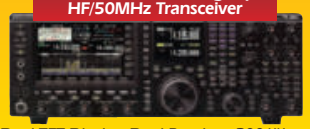
Kenwood TS-990S
Kenwood's NEW Flagship HF/50MHz Transceiver



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HF/6M 100W
USB, LSB, CW, RTTY, AM, FM

$200 Coupon TS-2000S
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High performance true IF/stage DSP on main band

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HF/6/2/440 all mode, Electronic Keyer
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YAESU FT-950
100 Watts of power output on SSB, CW, and FM (25 Watts AM carrier), exceptional performance both on transmit and receive

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200/400 watts, dual meters & LCD, VRF installed in main receiver, extra key & headphone jacks, internal power supply

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160-6 meters, Noise Reduction, Keypad Entry, Roofing Filters, HF and 6M Antenna Jacks

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Selectable roofing filters at 3kHz, 6kHz and 15kHz, IF-DSP technology

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HF/6 100W easy-to-use controls, DSP filtering with 51 passband widths, digital twin passband tuning

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Base Mobile, HF/6M, Electronic Memory Keyer, Audio D.S.P., Digital NL

YAESU FT-2000/D
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Premium HF/50MHz Transceiver, Full color TFT display

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all mode
5W QRP all bands

KENWOOD Coupons good until June 30, 2013. YAESU Rebates expire on June 30, 2013. ICOM expiration date on Rebates and Coupons is June 30, 2013.
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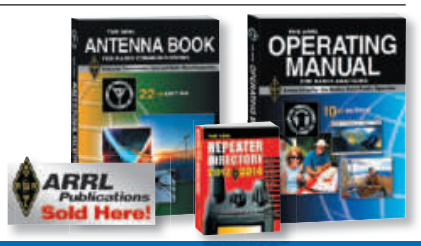

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55 Watts
200 Memories

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Large Display

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FM, 50/35 Watts

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144/440MHz
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YAESU FTM-350AR
2M/440 50W
220MHz 1W

NEW!

ICOM IC-2300H
144MHz FM
65 Watts - 4 pwr settings
207 Memories

D-STAR Compatible
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144/440MHz
50W D-Star
Optional(UT-123)

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ICOM ID-880H
144/440MHz 50W FM
D-STAR ready

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2M, FM Mobile
Transceiver, 200 memory channels

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VHF/UHF 50/40 watts

Wouxun KG-UV920P-A

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50 Watts - Dual Display
1000 Memories

HamPROS NS-508 Microphone
Will fit a wide array of radios including FM Mobiles. Optional Cable required.

Nissei LP-350 Lightning arrester
Frequency: DC-500 MHz
Power: 300 W Max

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144MHz 5 Watts
209 Memories
Backlit Keypad

YAESU FT-270R
144MHz 5 Watts
200 Memories
Ultra Rugged

TYT TH-UVF1A
TX: 144-148/430-450MHz
RX: 136-174/400-470MHz
Broadcast(RX)

ICOM IC-T70A
2M/440MHz
Wide/Narrow
channel spacing

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144/220/440MHz
5 Watts
144/440MHz
1.5 Watts on
222MHz

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5W HT/GPS/TNC,
LCD Dot Matrix
Display

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D-STAR ready

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144/440MHz
D-Star Built-in,
5 Watts
1052 Memories

YAESU FT-60R
144/440MHz
5 Watts NOAA
WX Alert
ARTS System

Wouxun KG-UVD1P
TX: 144-148/430-450MHz
RX: 136-174/400-480MHz
FM Broadcast

YAESU VX-3R
2M/440MHz
Micro-mini 1.5W
2M 1.0W

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YAESU VX-8GR
144/440MHz
5 Watts
Integrated GPS
Dot Matrix LCD

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5W, 435 Memories
Compact Design

D-STAR ready
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1304 Memories

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144MHz, 5.5 Watts
207 Memories
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Surmen Max-1 Antenna Black
SO-239
Now in Black and Natural
Frequency (MHz): 144/430
Max. Power(W): 60
V.S.W.R: <1.5
Length (M): 0.92
Weight(g): 135
Connector: PL-259

PRESENTING the Surmen NEW Max-1 NMO in Black!
Frequency (MHz): 144/430
Max. Power(W): 60
V.S.W.R: <1.5
Length (M): 0.92
Weight(g): 135
Connector: PL-259

S-850B Antenna
Frequency (MHz): 144/430
Max. Power(W): 150
V.S.W.R: <1.5
Length (M): 1.04
Connector: PL-259

WP-115
Frequency (MHz): 144/430 MHz
Z (ohms): 50
Max Power: 10W
Length (mm): 400
Weight: 42g
Connector: SMA or BNC

KY-66 Trunk Lid/Hatch Back Door Mount
Color: Chrome
Weight: 168g

P-800 External Speaker Speaker
Max Power: 5 Watts
Cord: 4M
Plug: 3.5mm mono
Size: 90x85x35MM

Magnetic mount
2 in diameter, accepts a SMA antenna either K-800 SMA F(female) or a K-800 SMA M (male) with matching cable.

Princeton Antenna
80M Windom 131' overall length, black jacketed wire, 200 watts

Princeton Antenna
40/80D-Black, 109' overall length, black jacketed wire, 1500 watts

Princeton Antenna
G5RV, 102' overall length, 34' of 450 ladderline, 1500 watts

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DC 13.8V
Output: (9-15V adjustable)

QJE PS50SWIII Switching Power Supply
13.8 VDC at 40 amps continuous

QJE PS30SWI DC Power Supply
Output voltage: DC13.8+0. 3V

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30 amps Max (10% duty cycle), 20 amps continuous 110/220 VAC.

QJE PS30SWIII DC Power Supply
Output DC 13.8V (9-15V adjustable)

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We were not ready to go at press time, but we have some very exciting new products that will be announced in Dayton!

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Tom, DF2BO, the president of OptiBeam will once again be with us in Dayton.

Stop by for your personal OptiBeam multi-monobander system consultation.

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See the full Rig Expert line including the new AA-170 in Dayton!

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NEW!

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- New Larger, Sharp & Fast LCD Display
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- New - Both 3kW and 10kW couplers on one display - switched
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Introducing the

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En route...

On location...

HF

VHF

UHF

USB Control Audio

IC-7410 HF + 6m

100 Watt Output (40W AM)

RX: 0.030–60.000MHz*

32 Bit Floating Point DSP Unit

+30 dBm 3rd Order Intercept Point*

Double Conversion Superheterodyne System

Built-in 15kHz 1st IF Filter (Optional 3kHz/6kHz)

USB Port for PC Control and Audio In/Out

USB Control Audio

IC-7200 HF + 6m

100 Watt Output (25W AM)

RX: 0.030–60.000MHz*

32 Bit IF-DSP + 24 Bit AD/DA Converter

Digital Twin Passband Tuning

USB Port for PC Control and Audio In/Out

Flexible Selectable Filter Width and Shape

USB Port for PC Control and Audio In/Out

IC-7000 HF/6m/2m/70cm

100W (40W AM),
50W on 2M (20W AM),
35W on 70CM (14W AM)

RX: 0.03–199.999,
400–470MHz*

Digital IF Filters

Digital Voice Recorder

Front Panel Separation
with Optional 3.5m
or 5m Cable (As Shown)

USB Control Audio

IC-9100 HF + 6m + 2m + 70cm + 23cm[1]

100/100/100/75/10[1] Watt Output[3]

RX: 0.030–60.000[2], 136.000–174.000[2],
420.000–480.000[2], 1240.000–1320.000[2,3]MHz

AM[3], FM, SSB, RTTY, CW, & DV[1]

Satellite (Mode B/J/L[1])

+30dBm TOI[2]

Two Independent 32-bit DSP Systems

3kHz/6kHz 1st IF "Roofing" Filters[1] (HF/6m)

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with Image Rejection Mixer

USB Port for PC Control and Audio In/Out

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Electronic advertisements feature active links for each radio.

*Frequency coverage may vary. Refer to owner's manual for exact specifications. [1]Optional UX-9100 required. [2]HF (14MHz) [3]See manual for AM output power.

On the go!

VHF

IC–2300H 2m

65/25/10/5 Watt Output
RX: 136–174MHz*
207 Alphanumeric Memory Channels
4.5W Audio Output
Built-in CTCSS/DTCS Encode/Decode
MIL-STD 810 G Specifications

IC–V8000 2m

75 Watt Output
RX: 136–174MHz*
207 Alphanumeric Memory Channels
Icom's DMS Scanning
CTCSS Encode/Decode with Tone Scan
Weather Channel Scan with Alert

UHF

IC–2820H 2m + 70cm

50/15/5 Watt Output
RX: 118–549.995, 118–173.995,
375–549.999, 810–999.990MHz*
522 Alphanumeric Memory Channels
One Touch Reply Function
Digital Voice/GPS (Opt. UT-123 Required)
Low Speed Data (Opt. OPC-1529R Required)

D-STAR optional

ID–880H 2m + 70cm

50/15/5 Watt Output
RX: 118–999.99MHz*
FM, AM (Receive only), DV
1052 Alphanumeric Memory Channels
Free Programming Software![†]

[†]*www.icomamerica.com/amateur/DSTAR for details about free software*

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28 amp max,
25 amp continuous power supply.

JTPS28M 28 amps max, 25 amps continuous, adjustable 9-15 VDC, Volt and current meters, Light weight, only 4 lbs!, Compact, only 5.75" x 4.5" x 7", Five way binding post for high current radios, Quick connectors for low current accessories, Over voltage protection, Over current protection, Quiet internal cooling fan with "fan on" LED, Switchable AC input voltage, 110 or 220 VAC, AC line fuse.

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YAESU
The radio

FTDX3000D

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DVS6 Digital Voice Memory Unit..... 65.95
FC40 Auto Tuner for Long Wires..... 304.95
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MD200A8X Desk Top Mic..... 389.95
SP2000 Ext Spkr w/Audio Filters..... 198.95
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FT950

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The ruggedly built yet compact new FT1900R 2m transceiver brings you Yaesu's legendary mechanical toughness along with outstanding receiver performance and 55 watts with crisp, clean audio that will get your message through!

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FT8800R

If you're ready for the best in a Dual-Band FM Mobile Transceiver, the FT-8800R is ready for you! With easy operation, outstanding receiver performance, and crossband repeat capability, the FT-8800R is the new standard of comparison!!

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FT7900R

Yaesu's economically priced One-Touch Operation FT-7900R Dual band FM mobile. Back-lit push button controls ensure extraordinarily easy and safe operation while driving at night. The exceptionally wide receiver coverage provides all sorts of additional uses!

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JTPS14M Jetstream Power Supply..... 49.95
MLS100 External Speaker..... 47.95
MMB60 Quick Release Mobile Bracket..... 37.95
YSK7800 Separation Kit..... 39.95

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Great Price
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Dayton Sale price
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Yes!
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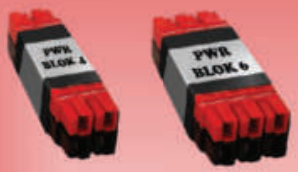

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15-30-45-50-75 Amp Powerpoles
***And* Many Other Connectors**

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Many Types Available

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Get your feedline outside the easy way

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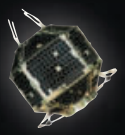

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2. The Ham-Ad rate for commercial firms offering products or services for sale is $2.25 per word. Individuals selling or buying personal equipment: ARRL member 1.00 per word. Non-ARRL member $1.50 per word. **Bolding** is available for $2.50 a word. Prices subject to change without notice. You may pay by check payable to the ARRL and sent to: Ham-Ads, ARRL, 225 Main St., Newington, CT 06111. Or, you may pay by credit card sending the information by fax to 860-594-4285 or via e-mail to hamads@arrl.org. The credit card information we need is: the type of credit card, the exact name that appears on the credit card, the credit card number, the expiration date and the credit card billing address.

3. Remittance in full must accompany copy since Ham-Ads are not carried on our books. Each word, abbreviation, model number and group of numbers counts as one word. Entire telephone numbers count as one word. No charge for postal Zip code. No cash or contract discounts or agency commission will be allowed. Tear sheets or proofs of Ham-Ads cannot be supplied. Ads submitted in writing should be typed or printed clearly on an 8 1/2" X 11" sheet of paper.

4. Closing date for Ham-Ads is the 15th of the second month preceding publication date. No cancellations or changes will be accepted after this closing date. Example: Ads received March 16th through April 15th will appear in June *QST*. If the 15th falls on a weekend or holiday, the Ham-Ad deadline is the previous working day. Please contact the Advertising Department at 860-594-0209 or hamads@arrl.org for further information or to submit your ad.

5. No Ham-Ad may use more than 200 words. No advertiser may use more than two ads in one issue. A last name or call must appear in each ad. Mention of lotteries, prize drawings, games of chance etc is not permitted in *QST* advertising.

6. New firms or individuals offering products or services for sale must check with us to determine if a production sample (which will be returned) should be submitted for examination. Dealers are exempted, unless the product is unknown to us. Check with us if you are in doubt. You must stand by and support all claims and specifications mentioned in your advertising.

The publisher of *QST* will vouch for the integrity of advertisers who are obviously commercial in character and for the grade or character of their products and services. Individual advertisers are not subject to scrutiny.

The American Radio Relay League does not discriminate in its advertising on the basis of race, color, religion, age, sex, sexual orientation, marital status or national origin. The League reserves the right to decline or discontinue advertising for any other reason.

7. AN IMPORTANT NOTICE TO ALL HAM AD POSTERS AND RESPONDERS, FROM THE ARRL ADVERTISING DEPARTMENT Greetings from ARRL HQ! Please note that we have received reports from many ARRL members who have placed classified ads in these listings, and have received responses from individuals proposing "creative" payment schemes. These particular instances involved offers of overpayments for goods by bank check, followed by instructions to deduct the cost of your item from the overpayment, and to transfer the overage back or to another individual. This is a well-known scam. Unfortunately, we have no control over this and other scams of this type. Once your email address is posted, you are vulnerable to those individuals seeking to provide you with questionable information.

QST Ham Ads on the Web Updated Monthly!

www.arrl.org/ham-ad-listing

Club/Hamfests/Nets

ARMS-Amateur Radio Missionary Service Net Christian Fellowship Net - Everyone Welcome 14.307.5 Daily xcpt Sunday 1500-1700Z Website: www.qsl.net/arms

FRIEND OF BILL W-Join HAAM net daily 12:30 East (09:30 Pac) time on 14.316 Mon-Sat and 14.340 Sun w/290 or 340 as the alt freq's. www.qsl.net/haam

Ham Radio Club Websites & Newsletters Domain names, websites, email, newsletters, logo's and club marketing aids. Newsletters customized for your club. So affordable any size club can now have a professional newsletter. http://www.HamRadioWebsites.Net 503-717-3484

MARCO The Medical Amateur Radio Council Ltd is a charitable non-profit group of health care professionals who meet weekly at 11:00am Eastern time Sundays for the "Grand Rounds of the Air" net on 14.307 MHz. All interested are welcome. Request info & free newsletter to Danny@w4dan.com or write MARCO, 2712 Bryant Dr, Cleveland, TN 37311. Ph 423-665-2621. Web site www.marco-ltd.org

Dayton Booth 568-569
WWW.THESIGNMAN.COM
Ham-com Plano, TX

RAINBOW AMATEUR RADIO ASSOCIATION Serving the gay/lesbian/GLBT community since 1995. ARRL affiliated. Privacy respected. Active HF/VoIP nets, newsletter, chat room, message forums, cruises, Dxpeditions. Web Site: WWW.RARA.ORG. Information: 214-810-0285 PO Box 18541, Rochester NY 14618-0541.

Property/Vacation/Rentals

Aruba Radio Rental www.p49v.com

Beautiful Maine Home 2800 sq ft on 23 acres on a small mountain 860 ft of elevation unobstructed easterly views for 160 degress. nearest neighbor 1500 ft. 3rd story tower room all glass perfect for radio room. Incredible views $265,000. 207-938-3434 For more information.

Caribbean DX! KL7JR@Yahoo.com

COLORADO CHALET with ham gear for weekly rental, www.lostcreekcabin.com. WØLSD, Buena Vista, CO.

Ham Cruise 2013 N5DSR info mypinmoneytravel@yahoo.com

Beautiful Maine Home 2800 sq ft on 23 acres on a small mountain 860 ft of elevation unobstructed easterly views for 160 degress. nearest neighbor 1500 ft. 3rd story tower room all glass perfect for radio room. Incredible views $265,000. **207-938-3434** For more information.

HAWAII DX VACATION RENTAL STEPP-IR Antennas KH6RC. 808-929-7101 www.leilanibedandbreakfast.com

Pacific Ocean Front QTH in SW Washington very fine three bedroom 2.5 bathhouse No HOA. Tower, Beam, Vertical, Wire antennas in place. For more information see www.lemkestudios.com/beach or ad7af@yahoo.com

Paradise Antenna Farm. 40 acres. **Southern Arizona**, $360K, Large tall towers, many antennas, living area and ham shack. Remote control station via internet. Call for details 520-398-2722 **w7uo@hotmail.com**

VY2TT www.peidxlodge.com

Antique/Vintage/Classic

ANTIQUE WIRELESS ASSOCIATION. The organization for all enthusiasts of antique and historical radio! Publishes THE AWA JOURNAL, covering vintage ham gear, keys, telegraphy, contests, broadcast receivers, vacuum tubes, historical, technical articles, restoration, and much more. AWA produces the famous annual Rochester, NY meet. Maintains world-famous historical radio-electronics communications museum. Membership only $25/year USA, $30 elsewhere. Antique Wireless Association, PO Box 421, Dept. 1, Bloomfield, NY 14469. Check our Website: http://www.antiquewireless.org

BUY-SELL-TRADE-ESTATE SALE HENRY RADIO SALES Henry Fehrmann-N4EDQ 708 N. Dixie Freeway (HWY US1) New Smyrna Beach, Florida 386.527.5159

CLASSIC REPAIR - Specializing in Collins, Drake and other fine tube radios. Steve, 661-822-6850. n6hk@hotmail.com

CODE PRACTICE OSCILLATOR MUSEUM: http://www.n4mw.com

Visit THE SOUTHERN APPALACHIAN RADIO MUSEUM! - www.saradiomuseum.org 828-299-1276. Asheville, NC.

W4QCF MANUALS - 828-298-1847 http://www.w4qcfmanuals.com

QSLCards/Call Sign Novelties

CALL SIGN DECAL 1-1/4 white vinyl characters. Interior or exterior window mount. $6.00. Gary Hengstenberger 6880 Rolling Ridge Rd NE Canton, OH 44721 330-354-1755

DCALLKD8PER@HOTMAIL.COM for info. WOUNDEDWARRIORPROJECT.ORG contributor

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DISPLAY YOUR AMATEUR LICENSE on the wall in your shack with this beautiful holder. Visit www.fan--nanenterprises.com

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Engraving, **QSL's** since 1962, Full Service Printing. Samples. WA2WAO@CornerPress.com [425] 286-5952

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HANDCRAFTED OAK CALL SIGNS www.oakcallsigns.com 314-605-4971, KCØSDV

NAME CARD with "Amateur Radio Active" logo in the middle. Go to http://wwwhamradioid.com

NEED A RELIABLE QSL MANAGER details contact James E. Mackey k3fn@aol.com

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QSLKIT – CardBoxes – Dividers – MORE www.HamStuff.com by W7NN

"WANTED" Used QSL'S Thanks, K4CLA 562 Oak Dr Lexington, SC 29073-9536 standup4.american@yahoo.com

www.airmailpostage.com

WWW.THESIGNMAN.COM 877-SIGNMAN (744-6626)

General

#1 AMATEUR CALLSIGN DVD! HamCall contains over 2,175,000 world-wide callsigns. Supported by most logging programs. Six FREE monthly Internet updates and HamCall.net online access included. Check/Visa/MC/Discover. $50 + $5 S/H Buckmaster, 6196 Jefferson Hwy., Mineral VA 23117 800-282-5628, http://hamcall.net

73s: Join our hamradio social network! http://www.73s.com

ANTENNA COMPARISON REPORT: TRIBANDERS K7LXC & NØAX test Hy-Gain, KLM, CC, Bencher, Force 12, Mosley and others. $17 + $4 s/h. More info at www.championradio.com 206-890-4188

www./arduinowatch.com

ANTENNA COMPARISON REPORT: VERTICALS. K7LXC & NØAX test CC, Butternut, MFJ, Force 12, Diamond, Hustler, GAP and other. $17 + $4 s/h. More info at www.championradio.com 206-890-4188

Antennas and accessories for portable operating: vacations, hiking etc. Check out our WireWinders for tangle-free antennas! We ship to the US and Worldwide. www.sotabeams.co.uk The Portable Radio Specialists.

APRS Link Cables - for Garmin/Kenwood products - http://stores.ebay.com/Jabber-Electronics WE6G 480-905-8484

BIGGEST on-line ham classifieds: http://swap.QTH.com

CALL SIGN DECAL 1-1/4 white vinyl characters. Interior or exterior window mount. $6.00. Gary Hengstenberger 6880 Rolling Ridge Rd NE Canton, OH 44721 330-354-1755

DCALLKD8PER@HOTMAIL.COM for info. WOUNDEDWARRIORPROJECT.ORG contributor

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Custom Ham Maps by N1XFS!!! Customized azimuthal equidistant projection maps with beam headings and distances based on your QTH. Adds that special "wow" factor to your shack. Makes a great gift! Go to: **CustomHamMaps.com**

ELECTRIC RADIO MAGAZINE: America's popular monthly publication devoted entirely to vintage amateur radio, military equipment, restorations, and radio history. Samples $1. Electric Radio, P O Box 242, Bailey CO 80421, www.ERmag.com

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FAR CIRCUITS CD is available for $5.00 with orders or $8.50 including First Class shipping CD contains over 350 articles and additional project information.

www./arduinowatch.com **Please come visit**

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HEATHKIT AMATEUR RADIO REPAIR by RTO Electronics, 601 E. 1st Street Calexico, CA 92231 269-468-7780. E-mail: hamtech@rtoham.com. www.rtoham.com

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PRINTED CIRCUIT BOARDS for projects shown in QST, QEX, HR, ARRL HB, 73 and more. Custom boards available. FAR Circuits, 18N640 Field Ct, Dundee, IL 60118; fax/phone 847-836-9148; www.farcircuits.net; mail@farcircuits.net

Put the FUN back into ham radio! http://HamRadioFun.com

QRP KITS: Easy to build. Fun to use. www.breadboardradio.com

Rohn Tower, telescoping poles, tripods and antenna parts. www.antennapartsoutlet.com

St Petersburg FL has a store, Ralph's Hobbies and Amateur Radio Supply - 5208 66th St. N, Call 727-547-8607 - for directions.

TELETYPE machines wanted, Model 15 and 28-ASR. kolchak1@yahoo.com

TELEVISION TRANSMITTERS Digital Analog www.kh6htv.com

TELEVISION'S PIRATES -a HAM "novel" by "Coop" (K6EDX/ZL4AAA) at www.bobcooper.tv
C-BAND REMEMBERED ("A joy to read"; K9EID) at www.bobcooper.tv Archived
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TOWER ACCESSORIES Gin Pole Kits - stand off brackets - antenna mounts - vehicle radio mounts for 30 years. IIX Equipment Ltd. 708-337-8172 www.w9iix.com

TXRX System ATV duplexer TX421.250 receive on 439.25 paid $1300.00 sell for $750 or BO W5DLH@ 501-835-2501

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AMSAT – WHO DECIDES THE FUTURE OF AMATEUR RADIO IN SPACE? YOU DO! Your membership in AMSAT will support exciting projects planned for launch in the years to come. In addition, you'll receive the bimonthly *AMSAT Journal* and substantial discounts on software distributed by AMSAT. Join now! Call 301-589-6062 or visit the AMSAT Web site at www.amsat.org. AMSAT®, 850 Sligo Avenue, Suite 600, Silver Spring, MD 20910-4703.

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ARRL invites your gift to one or more of the organizations permanent funds

In addition to the Spectrum Defense Fund and the Education & Technology Fund, ARRL has a collection of permanent funds that support ARRL's mission to promote, protect and enhance Amateur Radio. Contributions may be made at any time on the web, by phone or mail. Visit us at **www.arrl.org/arrl-donation-form**

Advertising Department Staff:

Debra Jahnke, K1DAJ, Sales Manager, Business Services
Janet Rocco, W1JLR, Account Executive
Lisa Tardette, KB1MOI, Account Executive
Diane Szlachetka, KB1OKV, Advertising Graphic Design
Zoe Belliveau, W1ZOE, Business Services Coordinator

QST Index of

Contact Information:

Toll Free: 800-243-7768
Direct Line: 860-594-0207
Fax: 860-594-4285
E-mail: ads@arrl.org
Web: www.arrl.org/ads

Additional advertising information is available on the web at:
www.arrl.org/ads

Advertisers

QST Advertising Deadlines:

Issue	Reservation Date	Materials Due Date
June 2013	Wednesday, April 17, 2013	Friday, April 19, 2013
July 2013	Wednesday, May 15, 2013	Friday, May 17, 2013

For links to the Web sites of all ARRL advertisers, visit www.arrl.org/ads/adlinks.html

QST QuickStats

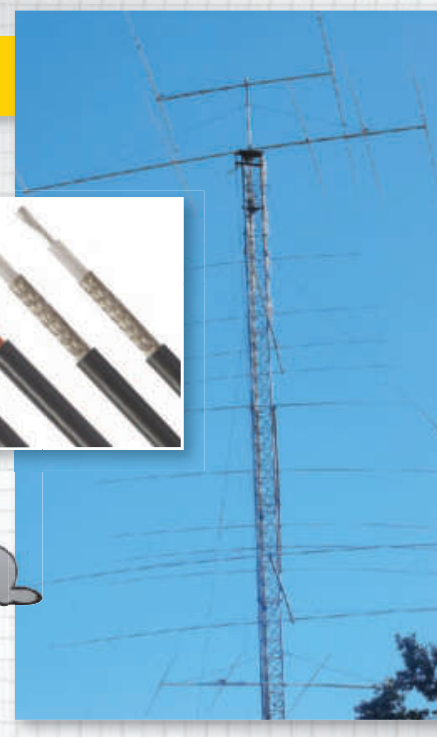
sta·tis·tics (st-tstks) n.
1. (used with a sing. verb) The mathematics of the collection, organization, and interpretation of numerical data, especially the analysis of population characteristics by inference from sampling.
2. (used with a pl. verb) Numerical data.

www.arrl.org/QuickStats

Online QuickStats Poll Results for February 4 through March 4, 2013.

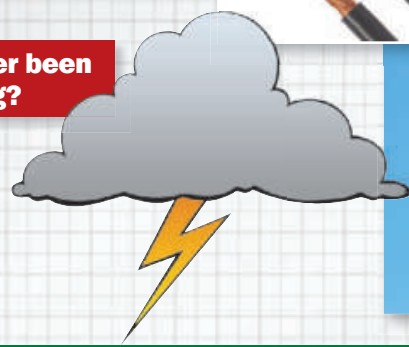
Get on the web and vote today at **www.arrl.org/quickstats**!

Is your primary HF antenna fed with open wire/ladder line or coaxial cable?



- Open wire/ladder line **12%**
- Coaxial cable **73%**
- A combination of both **12%**
- I don't operate HF **3%**

Has your station ever been damaged by lighting?



- Yes **18%**
- No **82%**

When operating voice, do you mostly use a hand microphone, desk microphone, a microphone on a boom or a headset microphone?

- Hand microphone **38%**
- Desk microphone **25%**
- Microphone attached to a boom **12%**
- Headset microphone **21%**
- I don't operate voice **4%**

Do you use a difficult to see "stealth" antenna at your home station?

- Yes **24%**
- No **76%**
- I don't have a home station **2%**

Photo courtesy of DX Engineering

powerwerx.com

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Affordable Radios for Every Market

Amateur Radio

KG-UV3D

- VHF/UHF Dual Band
- Available in 2m/440 or 2m/220
- Wide Receive Range 136-174/420-520 MHz RX
- 144-148/420-450 MHz TX
- 128 Memory Channels
- Dual Display w/ Full Keypad
- 3 Hour Desktop Rapid Charger
- Built-in Flashlight

SRP: $119.99

Recreation Radio

GU-16 GMRS

- UHF 16 Channel Single Band
- Preprogrammed GMRS Channels
- Built-in Voice Announcement
- No Display / Simple Operation
- FCC Part 95 Approved
- 3 Hour Desktop Rapid Charger

Target Markets:

Sports, Recreation, Hunting, Fishing, Hiking

SRP: $99.99

Commercial Land Mobile

KG-UV6X

- VHF/UHF Dual Band
- 200 Channels
- Dual Display w/ Full Keypad
- 136-174/406-512 MHz TX
- Dual Slot 2 Hour Rapid Charger
- 2013 Narrowband Compliant

Target Markets:

Fire, Police, Rescue, CAP, MARS, Government

SRP: $174.99

Commercial Land Mobile

KG-UV3X Pro

- VHF/UHF Dual Band
- 125 Channels
- Dual Disp. w/ 4-Key Operation
- 136-174/406-512 MHz TX
- 3 Hour Desktop Rapid Charger
- 2013 Narrowband Compliant

Target Markets:

Fire, Police, Rescue, CAP, EMS, Schools, Business, Hotels, Construction

SRP: $149.99

Commercial Land Mobile

KG-UVA1X

- VHF/UHF Dual Band
- 16 Memory Channels
- No Display / Simple Operation
- 136-174/406-512 MHz TX
- 3 Hour Desktop Rapid Charger
- 2013 Narrowband Compliant

Target Markets:

EMS, Schools, CERT, Business, Hotels, Hospitals, Construction

SRP: $139.99

Economy Business Radio

GU-16

- UHF 16 Channel Single Band
- Preprogrammed Business Channels
- Built-in Voice Announcement
- No Display / Simple Operation
- 3 Hour Desktop Rapid Charger
- 2013 Narrowband Compliant

Target Markets:

Schools, Business, Manufacturing, Hotels, Restaurants, Construction

SRP: $104.99

See our complete 2013 Wouxun accessory line online at www.powerwerx.com/wouxun

YAESU

FT-DX5000 Series
HF/6m XCVR with automatic antenna tuner, 32-bit IF-Level DSP, built-in power supply, built-in TCXO and more ..... Please Call

FT-DX3000
HF/6m XCVR with 3.5" color display, auto tuner, 32-bit DSP, 3 kHz & 600Hz roofing filters, bandscope display and more ..... Please Call

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HF/6m XCVR with 32-bit DSP, built-in automatic antenna tuner, built-in computer interface and more ..... Please Call

FT-450D
HF/6m all mode XCVR with DSP, built-in automatic antenna tuner and more ..... NEW!

FT-857D
HF/6m/2m/70cm all mode mobile XCVR with DSP, wide band RX and more ..... NEW!

FTM-400D
2m/70cm Mobile FM XCVR. Large display, dual RX, built-in TNC for APRS ..... NEW!

KENWOOD

TS-990S
HF/6m XCVR, true dual RX, automatic antenna tuner, color TFT display and more. Top-of-the-line performance ..... NEW!

TS-590S
HF/6m all mode XCVR with 32-bit DSP, automatic tuner, CW keyer, built-in computer interface via USB and more ..... Call

TS-2000/TS-2000X
HF/6m/2m/70cm all mode XCVR with built in auto tuner, built-in TNC , CW keyer, built-in computer interface and more ..... Call

AMERITRON

AL-1500/AL-1200	$3679/3319
AL-800/AL-800H	$2459/3739
AL-80B/AL-572	$1339/1589
AL-811/AL-811H	$739/869
AL-811HD/AL-82	$1129/2419
ALS500M/ALS500MR	$749/779
ALS600/ALS600S	$1259/1319
RCS4/RCS4L	$149/199
RCS-8V/RCS8-VL	$159/209
RCS-10/RCS-10L	$179/219
RCS-12/RCS-12L	$299/339

CUSHCRAFT

A3S/A4S	$599/699
MA-5B/MA-6VA	$479/329
R6000/R8	$419/519
X7/XM240	$979/939
A50-3S/A50-5S	$139/199
A50-6S	$369
A627013S	$269
A270-6S/A270-10S	$119/159
A13B2/A17B2	$239/349
A148-3S/A148-10S	$65/129
AR-270/AR-270B	$129/179

LDG ELECTRONICS

AT-1000PROII/M1000	$489/129
AT-600PROII/M600	$339/129
AT-200PROII	$229
AT-100PROII	$209
AT-897 PLUS	$189
IT-100/KT-100	$169/189
YT-100/YT-450	$189/239
Z-100 PLUS/Z11PROII	$149/169
Z-817/Z-817H	$119/159
FT METER/FTL METER	$49/79
RBA1:1/RBA4:1	$29/29

COMET

CH-250B 80-6m Vertical	$399
CH-V5X 40-6m Rot. Dipole	$319
GP-3/GP-6	$99/149
GP-9/GP-9N	$189/189
GP-15/GP-98	$169/189
H422 40-10m Rot. Dipole	$369

DIAMOND

CP-725H 40-6m Vertical	$359
CP-5H 40-6m Vertical	$379
X-510HDMA/HDNA	$199/199
X-6000A/X3200A	$179/179
X-300A/X-300NA	$139/139
X-50A/X-50NA	$99/99

HYGAIN

TH-11DX, 5-BAND	$1039
TH-7DX, 10/15/20m	$779
TH-5MK2S, 10/15/20m	$689
TH-3MK4, 10/15/20m	$419
TH-3JRS, 10/15/20m	$339
TH2MK3, 10/15/20m	$319

M2

6M3/6M3SS	$175/159
6M5XHP/6M7JHV	$359/379
2M3SS/2M4	$89/115
2M7/2M9FMSSB	$145/219
2M12/2M5WL	$239/349
2MCP14/2MCP22	$259/359
2MXP20/28	$285/429
222-5SS/222-10EZ	$89/155
440-6SS/420-50-11	$75/135
432-12EME/440-18	$145/159
432-9WL/13WLA	$229/335
436CP30/42UG	$289/349
902-9/902-17	$115/139
23CM-22EZA/23CM35	$184/239
KT34M2, 10/15/20m	$1499
KT36XA, 10/15/20m	$1999

MFJ

259B/269	$249/359
826B/828	$179/229
867/868	$159/149
870/872	$79/79
873/874	$79/109
891/892	$109/109
893/894	$109/129
941E/945E	$129/119
948/949E	$149/159
962D/969	$279/199
986/989D	$319/359
991B/993B	$199/249
1702C/1704	$39/79
1778/1778M	$45/39
1796/1798	$$229/339
4225MV/4245MV	$99/149

ROTATORS

Hygain AR-40	$319
Hygain AR-303	$89
Hygain AR-500	$119
Hygain CD-45II	$419
Hygain Ham-IV	$599
Hygain Ham-V	$939
Hygain T2X	$699
Hygain T2X Digital	$1159
M2 OR-2800PDX	$1879
Yaesu G-450A	$329
Yaesu G-550	$409
Yaesu G-800SA	$399
Yaesu G-800DXA	$499
Yaesu, G-1000DXA	$599
Yaesu, G-2800DXA	$1399
Yaesu G-5500	$789

US TOWER

We Ain't Braggin'
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TX Series

TX-438	$1829
TX-455	$2549
TX-472	$4199
TX-472MDP	$6779
TX-489MDPL	$10959

HDX Series

HDX-538	$2179
HDX-555	$3819
HDX-572MDPL	$9969
HDX-589MDPL	$12969
HDX-689MDPL	$38199

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4-30	$419

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7-40/9-30	$839/549

B22 Series

3-70/4-60	$1739/1349
5-50/6-60	$1069/1619
7-50/9-40	$1199/939
9-50/12-40	$1329/1079
15-40/21-30	$1209/819

B26 Series

4-70/4-80	$2199/2739
6-70/7-60	$2219/1749
7-70/9-60	$2309/1889
15-50/21-40	$1759/1369
23-40/35-30	$1629/1239

B30 Series

HD8-70/HD8-80	$2379/3059
HD8-90/HD8-100	$3709/4409
HD9-60/HD9-80	$2109/3129
HD11-80/HD11-90	$3559/4189
HD12-70/HD12-80	$2899/3579
HD16-60/HD16-80	$2569/3799
HD21-50/HD21-60	$1989/2619
HD21-70/HD35-40	$3239/1859

GUY HARDWARE

3/16"EHS, 500 / 1000'	$139/259
1/4"EHS, 500' / 1000'	$159/329
3/16" / 1/4" Big Grip™	$7/8
5/16" Thimble	$1.35
3/8" Thimble	$1.45
3/8x6" EE Turnbuckle	$16
3/8" x6" EJ Turnbuckle	$19
1/2"x9" EE Turnbickle	$25
1/2"x9" EJ Turnbuckle	$28
1/2x12" EE Turnbuckle	$29
1/2"x12" EJ Turnbuckle	$32
#502 Strain Insulator	$8
#504 Strain Insulator	$10

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HPTG-1200I	$.49/ft.
HPTG-2100I	$.75/ft.
HPTG-4000I	$1.05/ft.
HPTG-6700I	$1.45/ft.
PLP-2738 Big Grip™	$9
PLP-2739 Big Grip™	$12
PLP-2755 Big Grip™	$18

ALUMINUM

O.D.	WALL	$/FT.
6063-T832 DRAWN TUBING		
.375"	.058"	$.65
.500"	.058"	$.70
.625"	.058"	$.80
.750"	.058"	$.90
.875"	.058"	$.95
1.000"	.058"	$1.00
1.125"	.058"	$1.10
1.250"	.058"	$1.30
1.375"	.058"	$1.40
1.500"	.058"	$1.50
1.625"	.058"	$1.65
1.750"	.058"	$1.80
1.875"	.058"	$1.95
2.000"	.058"	$2.10
2.125"	.058"	$2.25

GLEN MARTIN

H2 Hazer (12 sq. ft.)	$609
H3 Hazer (8 sq. ft.)	$459
H4 Hazer (16 sq. ft.)	$589
RT-424, 4.5' (6 sq. ft.)	$319
RT-832, 8' (8 sq. ft.)	$469
RT-936, 9' (18 sq. ft.)	$779
RT-1832, 17.5' (12 sq. ft.)	$1029
RT-2632, 26' (9 sq. ft.)	$1709

ROHN

25G, Middle Section	$119
25AG2, Sleeve Top	$189
25AG4, Flat Top	$239
AS25G, Rotor Shelf	$65
BPC25G, Base Plate	$69
BPH25G, Hinged Base	$279
HB-25AG/BG/CG	$119/129/149
GA25GD, Guy Assembly	$179
SB25G, Short Base	$79
SB25G5, Short Base (5')	$109
SBH25G, Hinged Short Base	$249
TB3, Thrust Bearing	$159

ROTOR CABLE

R62, 6-C (6#18)	$.59/ft.
R81, 8-C (2#18/6#22)	$.49/ft.
R82, 8-C (2#16/6#18)	$.79/ft.
R83, 8-C (2#14/6#18)	$.89/ft.

COAX

9913F7	$1.39/ft.
BuryFLEX	$.89/ft.
LMR-100	$.59/ft.
LMR-200	$.65/ft.
LMR-200 Ultraflex	$.85/ft.
LMR-240	$.69/ft.
LMR-240 Ultraflex	$.89/ft.
LMR-400	$.89/ft.
LMR-400 Ultraflex	$1.39/ft.
LMR-600	$1.59/ft.
LMR-600 Ultraflex	$2.49/ft.
RG-8X Mini	$.29/ft.
RG-213/U	$.79/ft.

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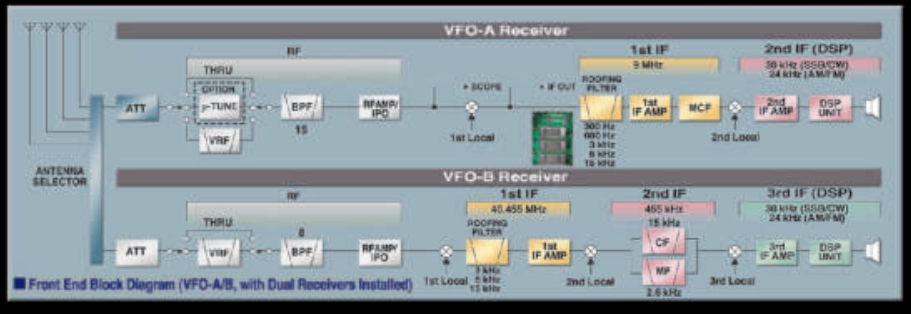

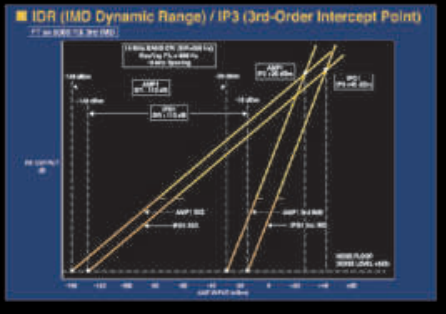

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