MARCH 2013 QST Vol 97 No 3

SPECIAL ANTENNA ISSUE

QST

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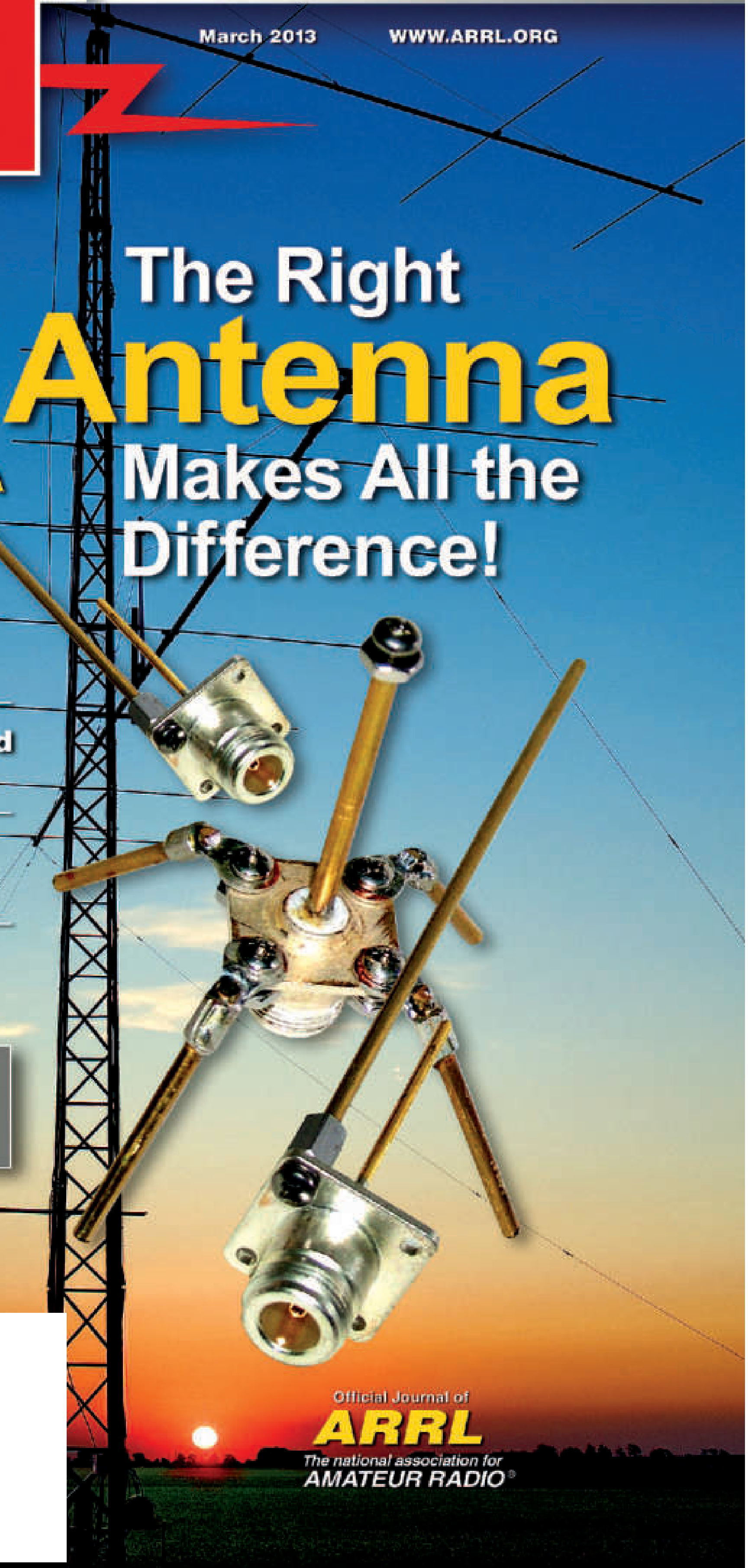

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QST reviews:

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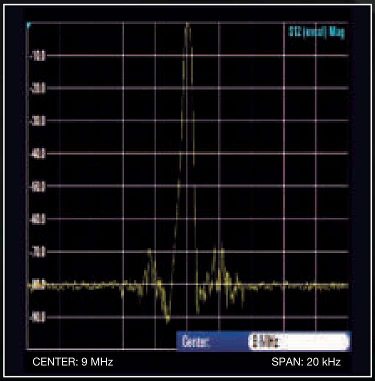
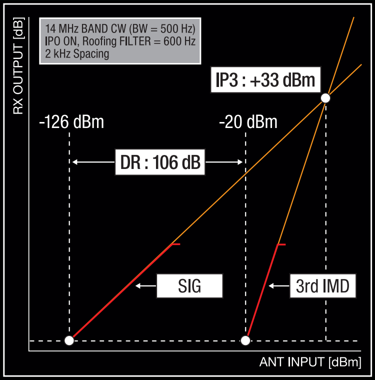


Characteristics of the Crystal Roofing Filter (300 Hz)



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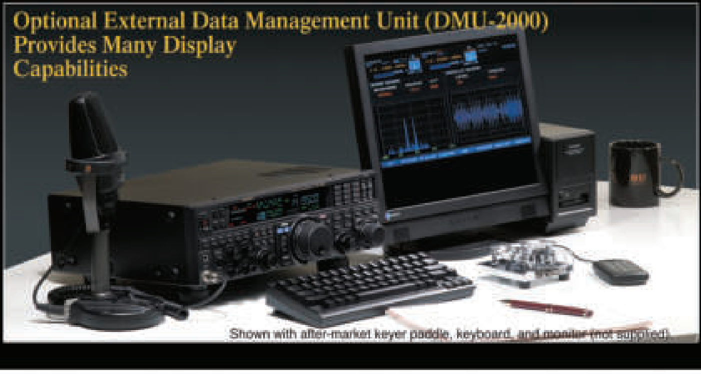

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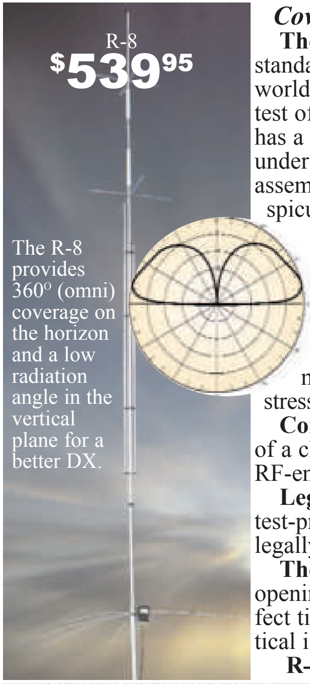
Cushcraft R8 *8-Band Vertical*



The R-8 provides 360° (omni) coverage on the horizon and a low radiation angle in the vertical plane for a better DX.

Covers 6, 10, 12, 15, 17, 20, 30, and 40 Meters!

The Cushcraft R8 is recognized as the industry gold standard for multi-band verticals, with thousands in use worldwide. Efficient, rugged, and built to withstand the test of time, the R8's unique ground-independent design has a well-earned reputation for delivering top DX results under tough conditions. Best of all, the R8 is easy to assemble, installs just about anywhere, and blends inconspicuously with urban and country settings alike.

Automatic Band Switching: The R8's famous "black box" matching network combines with traps and parallel resonators to cover 8 bands. You QSY instantly, without a tuner!

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

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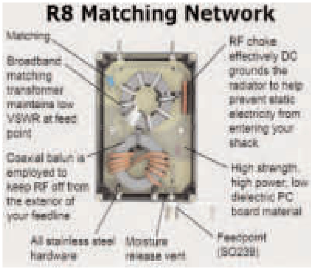
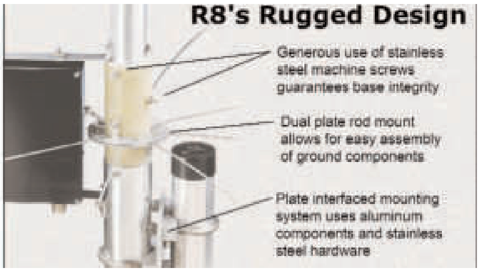
R-8GK, $56.95. R-8 three-point guy kit for high winds.


R8 Matching Network


R8's Rugged Design

MA-5B *5-Band* Beam
Small Footprint -- Big Signal

The MA-5B is one of Cushcraft's most popular HF antennas, delivering solid *signal-boosting directivity* in a bantam-weight package. Mounts on roof using standard TV hardware. Perfect for exploring exciting DX without the high cost and heavy lifting of installing a large tower and full-sized array. Its 7 foot 3-inch boom has less than 9 feet of turning radius. Contest tough -- handles 1500 Watts.

The unique MA-5B gives you 5-bands, automatic band switching and easy installation in a compact 26-pound package. On 10, 15 and 20 Meters the end elements become a two-element Yagi that delivers solid power-multiplying gain over a dipole on all three bands. On 12 and 17 Meters, the middle element is a highly efficient trap dipole. When working DX, what really matters are the interfering signals and noise you *don't hear*. That's where the MA-5B's impressive side rejection and front-to-back ratio really shines. *See **cushcraftamateur.com** for gain figures.*

Cushcraft 10, 15 & 20 Meter Tribander Beams

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

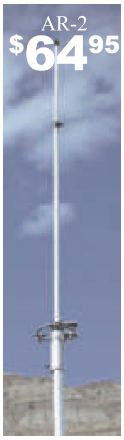
It goes without saying that the World-Ranger lineup is also famous for its rugged construction. In fact, the majority of these antennas sold years ago are still in service today! Conservative mechanical design, rugged over-sized components, stainless-steel hardware, and aircraft-grade 6063 make all the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

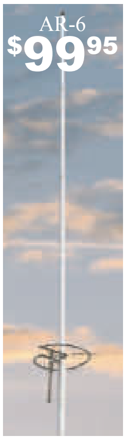
The 3-element A3S/A3WS and 4-element A4S are world-famous for powerhouse gain and super performance. **A-3WS, $499.95,** 12/17 M. **30/40 Meter** *add-on kits* available.

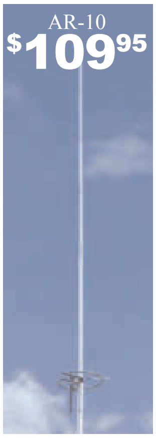
Cushcraft Dual Band Yagis
One Yagi for Dual-Band FM Radios

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

Cushcraft Famous *Ringos* Compact FM Verticals







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

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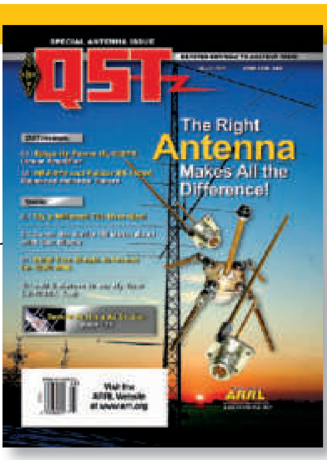
Our Cover
In springtime, hams take stock of their antennas and ponder enhancements and upgrades. We celebrate that spirit in this, our annual antenna issue. *Main photo*: Designed and built by Jurek Smoczyk, SP3GEM, of Jarocin, Poland, the bottom antenna is a 10 meter semi-fixed Yagi that is usually pointed toward the US or Japan. The middle antenna is a fully rotatable 10 meter Yagi, while a Yagi for 12 and 17 meters is on top [photo by Henryk Kotowski, SM0JHF]. *Inset photo*: Don Dorward, VA3DDN, presents two simple antennas for 1200 MHz (23 centimeters). Find out more beginning on page 37.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The Right Antenna Makes All the Difference!

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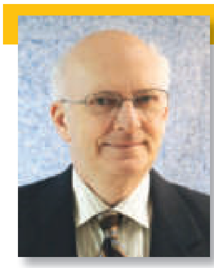

It Seems to Us

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

Going Digital

> *“Welcome to cyberspace, I’m lost in the fog — everything’s digital, I’m still analog.”*

Last year’s hit song “Analog Man” by rock musician and ARRL Life Member Joe Walsh, WB6ACU, captured the angst of many in his generation. “When something goes wrong,” Joe laments, “some 10-year-old” has to show him what to do. Yet there is no denying the positive impact of digital technology, particularly in the field of communications.

Those of us who grew up using vacuum tubes weathered the transition to solid state, but that change — revolutionary as it was — did not have much effect on how the amateur bands sounded. The shift from AM to single sideband (SSB) was much more dramatic in that regard, even though the basic emission is the same: SSB is simply an analog AM signal stripped of its nonessential elements.

Radio amateurs have been using digital modes since the dawn of the radio art. Morse code itself is digital, being made up of a string of equal blocks of time in which a signal is either present or absent. Amateurs have used radioteletype for more than 60 years and packet radio for more than 30. In each of these three cases, as well as in the case of analog telephony, the equipment you buy or build today permits you to communicate with amateurs who are using gear from yesteryear.

Interoperability is essential to the functioning of any communications network. We radio amateurs want to be able to communicate with one another to the greatest extent possible. Not only is this consistent with the principle that Amateur Radio is a single global community, it is also one of our great strengths as public service and emergency communicators.

It logically follows that we want to avoid creating barriers to interoperability. At the same time we want to be able to use and experiment with the widest possible range of radio communications technologies. These two objectives are somewhat in conflict.

One way to encourage or ensure interoperability is by regulation, although this would be a poor choice for Amateur Radio. Regulations of this kind tend to freeze technology, hamper innovation and impose unnecessary costs. Regulations are difficult to change; for example, in the late 1970s it took years for the FCC to amend its rules to permit amateurs to use the American National Standard Code for Information Interchange (ASCII).

Another is through the adoption of voluntary standards. An example of this approach is the AX.25 packet radio protocol. This adaptation of the pre-existing X.25 international standard protocol was developed by a team of volunteer experts and approved by the ARRL Board of Directors in October 1984, and is still in use today. While standards also tend to freeze technology, they can be of great benefit as long as there is a mechanism for reviewing and updating them that is accessible to stakeholders. Even the venerable Morse code can benefit from updating from time to time. In 2004, at the urging of the International Amateur Radio Union, the International Telecommunication Union (ITU) added the “@” symbol, universally used in e-mail addresses, to the international definition of the International Morse code contained in Recommendation ITU-R M.1677. The same ITU process currently is being followed to add the amateur-created Varicode, used for PSK-31 and other purposes, as a new ITU-R Recommendation.

A third approach is to leave it to the marketplace — what amateurs choose to buy or to adopt. If we value interoperability, as we should, then we will make our choices accordingly. Varicode might be regarded as an example of the marketplace approach since it was in use for more than a decade before being proposed for ITU recognition.

Amateurs who are active using HF RTTY and data modes know there is a mind-boggling array of digital communications options, with new ones being introduced all the time. The main limitation on HF data modes has been the FCC rules, which specify a symbol rate of not more than 300 bauds below 28 MHz. So far, interoperability is not a major concern. Most HF digital stations consist of an SSB transceiver, interface, sound card, and computer. The major variable is software, which can be updated or supplemented readily. Even if you have one favorite digital mode it’s likely that you’re also equipped to use a number of others.

The situation with regard to digital voice is a bit different. Thus far, while there has been some pioneering work done at HF, most of the adoption of digital voice modes has occurred at VHF and UHF and has involved commercial products using protocols such as APCO-25, D-STAR, and Motorola’s MOTOTRBO. Amateurs using a digital voice mode on VHF/UHF generally retain analog FM capability but are unlikely to be equipped for any other digital voice mode. At this stage an amateur who is interested in digital voice is at risk of having no one to talk to unless he or she finds out what is in use locally before acquiring a rig, and would still face the same risk when traveling.

The opportunity for amateur digital voice to progress more along the lines of digital data is offered by the Codec2 Project, an unincorporated international Open Source project to produce a low-bandwidth digital voice codec. In awarding the 2012 ARRL Technical Innovation Award to David Rowe, VK5DGR, one of the principal developers engaged in the Codec2 Project, the ARRL Board of Directors observed that “the open-source nature of this work is a major step forward in the development of digital voice communications.”

Further advancements in Amateur Radio digital communications are as welcome as they are inevitable. They are deserving of our continued support. But, let’s make sure we will still be able to talk to one another.

David Sumner, K1ZZ

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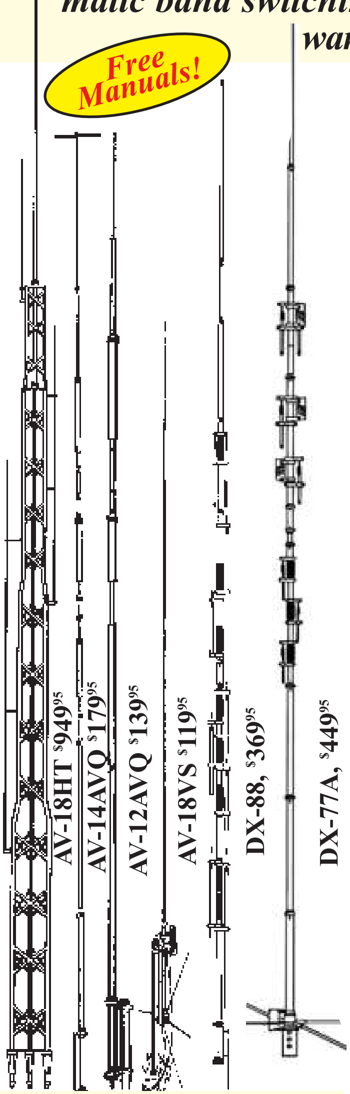

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AV-18VS, $119.95 (10,12,15,17,20,30,40,80 Meters). 18 ft., 4 lbs. High quality construction and low cost make the AV-18VS an exceptional value. Easily tuned to any band by adjusting feed point at the base loading coil. Roof mount with Hy-Gain AV-14RMQ kit, $89.95.

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AV-12AVQ	$139.95	10/15/20 M	1500 W PEP	13 feet	9 pounds	80 MPH	1.5-1.625”
AV-18VS	**$119.95**	**10 - 80 M**	**1500 W PEP**	**18 feet**	**4 pounds**	**80 MPH**	**1.5-1.625”**
DX-88	$369.95	10 - 80 M	1500 W PEP	25 feet	18 pounds	75 mph no guy	1.5-1.625”
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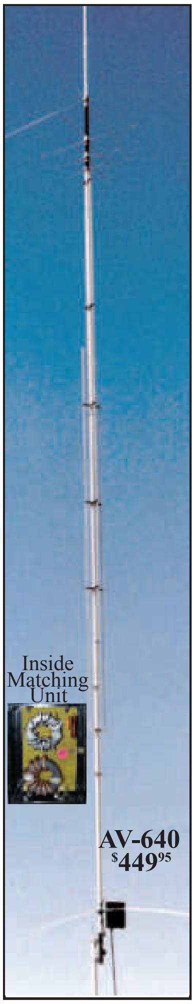

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Harold Kramer, WJ1B – hkramer@arrl.org, ARRL Chief Operating Officer/*QST* Publisher

The Governance Structure of Your ARRL – *Part 1*

I am writing this in January, which is ARRL Board meeting time. If you are not familiar with how the ARRL Board and governance structure works, here's a brief explanation.

The ARRL is a membership association whose governance structure is a representative democracy comprised of 15 geographical Divisions. Each Division covers multiple States and some include US Territories, such as the US Virgin Islands. Each Division has a Director and a Vice Director who are elected to three-year terms of office. Five Director and Vice Director positions, one third of the Board, are elected every three years so that the entire Board does not change at once. You can find a list of all Directors and Vice Directors on page 15 of *QST* every month and also on our website at **www.arrl.org/divisions**. Until this year, members voted in Division elections only by paper ballot, but in the 2012 elections we began using a web-based electronic voting system along with the traditional paper ballots.

ARRL Board Meetings are normally held twice a year on the third full weekend of January and July, and usually in the Hartford area. However, this year the January meeting was in New Orleans. This provided Board members the opportunity to meet with ARRL leadership and members outside of New England. The Board can hold special meetings at other times, but rarely finds it necessary. Board Committee meetings are also held throughout the year.

Along with the Directors and Vice Directors, there are also Officers, Honorary Officers and Staff Officers on the Board. Other dignitaries, often from our sister IARU societies, may attend the meeting as guests; however, only the 15 elected Directors can vote. Vice Directors stand in for Directors in the event that a Director, for whatever reason, is unable to fulfill his or her duty.

Each Director, therefore, represents 1⁄15 of the group that determines ARRL policy, which is then implemented by the ARRL staff. Except for staff officers, Board Members are volunteers. Being a Director, Vice Director or Officer requires commitment and dedication. These people spend a lot of time on ARRL matters and working on behalf of Amateur Radio overall and they receive no compensation except for expense reimbursements for ARRL business.

Every two years the Directors nominate and elect a President, a First Vice President, a Second Vice President, an International Affairs Vice President, a Secretary, a Treasurer and a Chief Executive Officer as Officers who also serve on the Board of Directors. Our current President is Kay Craigie, N3KN. The President presides over all Board meetings and is the official spokesperson of the Board regarding ARRL policy.

I'll be discussing more about our governance structure and Board of Directors next month, including the important work done by our Board Committees. In the meantime, if you would like to learn more about our governance structure, our By-Laws can be found at **www.arrl.org/arrl-by-laws.**

Awards All Around!

Last November the Radio Club of America (RCA) held its 103rd Awards Banquet with ARRL Chief Executive Officer David Sumner, K1ZZ, as the keynote speaker. During the banquet Gordon West, WB6NOA, received the RCA Special Service award for his work with the RCA Youth Activities program. Carole Perry, WB2MGP, earned the RCA President's award for her initiatives to introduce young people to wireless communications. Erin King, AK4JG, was presented with the RCA Young Achiever's award. Ms King was also the first place winner of the 2012 *QST* Video Contest.

Erin King, AK4JG (right), received her RCA Young Achiever's award from Carole Perry, WB2MGP.

Award winners Carol Perry, WB2MGP, and Gordon West, WB6NOA.

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- **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.

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Hamfests and Conventions – **www.arrl.org/hamfests**
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ARRL Continuing Education Program – **www.arrl.org/courses-training**
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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**
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The American Radio Relay League, Inc.

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.

Officers, Division Directors and Staff

As an ARRL member, you elect the director and vice director who represent your division on ARRL policy matters. If you have a question or comment about ARRL policies, contact your representatives at the addresses shown.

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Four rugged MRF-150 FETs at 50 Volts give high efficiency . . . No deterioration with use

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Ameritron ALS-600 *Solid State FET* compact desktop station amplifier is only 4 dB below 1500 Watts -- less than an S-unit!

There are no tubes, no tube heat, no tuning, no worry rugged -- just turn on, select band and operate. 600 Watts PEP/500W CW -- lets you talk to anyone you can hear!

Covers 1.5-22 MHz, (10/12 Meters with \$29.95 kit, requires FCC license), instant bandswitching, SWR/thermal protected, extremely quiet, lighted peak reading Cross-Needle SWR/Wattmeter, front panel ALC control, operate/standby switch. 12.5 lbs., $9^{1}/_{2}$Wx$7^{1}/_{8}$Hx12D in.

Includes ALS-600PS transformer AC power supply for 120/220 VAC, inrush current protected. 32 lbs., $9^{1}/_{2}$Wx6Hx12D inches.

ALS-600 Amp with Switching Power Supply

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Switching Power Supply

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Works with all ALS-600 amplifiers. Extremely lightweight, just 10 lbs. Superb regulation, very low radiated noise. 9Wx6Hx$14^{1}/_{2}$D in.

From QST Magazine, March, 2005

". . . the ampifier faulted only when it was supposed to. It protected itself from our boneheaded, sleep-deprived band changing manuevers . . ."

"I found myself not worrying about damaging this amplifier. It seems quite capable of looking out for itself. . . . Kudos to Ameritron."

"I couldn't hear any noise at all from the SPS (*switching power supply*) on the vertical or quad . . ."

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"The ALS-600S makes it possible to pack a transceiver and a 600 Watt amplifier, that together weigh less than 30 pounds."

AMERITRON *mobile* 500 Watt *no tune* Solid State Amp

Instant bandswitching, no tuning, no warm-up, SWR protected, 1.5-22 MHz, quiet, compact

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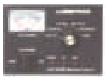
Ameritron's ALS-500M solid state *mobile* amp gives you 500 Watts PEP SSB or 400 Watts CW output! Just turn on and operate -- no warm-up, no tuning, instant bandswitching. Fits in very small spaces.



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ALS-500MR, \$929, ALS-500M/Remote Head

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Protects rig from damage by keying line transients and makes hook-up to your rig easy!

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Use 1 coax for **4** antennas. No control cable needed. SWR <1.25, 1.5 - 60 MHz. Useable to 100 MHz.

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Replace **5** coax with 1! 1.2 SWR at 250 MHz. Useable to 450 MHz.<.1 dB loss, 1kW@ 150MHz.

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Band data from transceiver auto selects antennas. Antenna memories. No hotswitching. Rig-to-amp interface. For 3/4 BCD, 1 of 8 relay boxes. **RCS-12, \$309.95**, auto controller with 8 coax relay box, to 60 MHz. **RCS-12L, \$349.95**, with lightning arrestors.

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Active circuit gives *true* peak/average readings on lighted cross-needle meter.3000/ 300 Watt ranges, Remote sensor.

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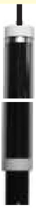

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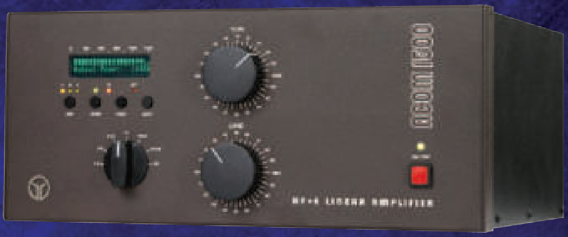

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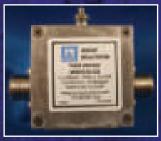

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Steve Ford, WB8IMY, upfront@arrl.org

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Rocky Mountain High

Jim Adams, KØBAM, of Delta, Colorado didn't let antenna restrictions keep him from enjoying Amateur Radio satellites. With a dual-band handheld transceiver and an Arrow portable antenna, Jim has logged more than 2600 satellite contacts during the last three years. He has received his VHF/UHF Century Club satellite award with more than 100 grid squares confirmed, along with the AMSAT W4AMI Achievement award for 2000 confirmed contacts. [Jim Adams, KØBAM, photo]

Oldest Female Amateur?

Ann Brummer, N2FER (second from left) may be among the oldest active female Amateur Radio operators in the United States. She recently celebrated her 98th birthday in Mahopac, New York with her daughter-in-law Pat Brummer, KD2JQ (left), longtime friend Fran Carr, N8HJW (second from right) and son Dick Brummer, K2JQ (right). Ann's granddaughter Cheryl Brummer-Katz is also licensed as KB2KIV.

No Anchovies, Please!

In fine Amateur Radio tradition, several members of the Mt. Airy VHF Radio Club in Southampton, Pennsylvania went to a pizza parlor for dinner. While there, Rick Rosen, K1DS, noticed that the delivery boxes included a choice of "CB" or "HAM" toppings. [Rick Rosen, K1DS, photo]

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Letters from Our Members

Texas Seniors Get Radio-Active

We were most interested in the story by Grant Bagley, W3GB [Radio in Retirement — One Ham's Tale," Jan 2013, pages 70-72]. There is a similar story here in Allen, Texas.

We live in an active senior's retirement community, The Aspens at Twin Creeks. Thanks to ham radio license plates on their cars, new residents Robert Bryer, NB5D, and Eugene Chenette, N5YJ, met and shared ham radio memories. Along the way, they began to talk about forming a local radio club. They spoke with the community's Activities Director and Manager and received great feedback. A first meeting was announced and publicized to all residents. Eight people showed up.

So the Aspens Amateur Radio Club was formed. We asked the Manager for permission to have a ham shack on the premises. The manager not only found a room for our shack, he also let us put antennas on the roof. The club station — boasting two HF rigs — is on the air as K5ASP. The antennas are mounted on the sturdy rail of a rooftop mechanical balcony about 45 feet above the ground, only visible from the ground from inside the atrium of the largest building. We operate SSB, CW, PSK31, RTTY and other data modes using HRD and DM780 software.

These modest stations serve us well. Over the past two months, one of our experienced hams has made contacts with stations in 150 countries. We are also committed to being prepared for emergencies, supporting the Amateur Radio Emergency Service in the Dallas-Fort Worth Metroplex.

K5ASP now has five licensed members. Two of them are newly licensed hams who were encouraged by our senior ham members to get their licenses and participate in club activities. The youngest member of our group is 68 and the oldest is 84. We are all once again having fun through Amateur Radio.

Eugene R. Chenette, N5YJ,
and Joan Parent, KF5SQY
Allen, Texas

DIY Excitement

The January 2013 issue tweaked my memory of what Amateur Radio was like when I first started back in the late 1950s; I waited for the delivery of *QST* every month, especially for the construction articles by the late Lew McCoy, W1ICP. Like most hams these days, I build very little, but the January *QST* that focused on DIY rekindled my desire. Keep up the good work! Please pass my appreciation on to Robert Nickels, W9RAN, for his article "Cheap and Easy SDR." I procured a DVD-T dongle and had no trouble getting it to work per his instructions. My next project is to build a HF converter.

Don Chambers, AE6WH
Menlo Park, California

Not CERTain

The column by Rick Palm, K1CE ["Public Service: The Future of ARES is CERTain," Jan 2013, pages 85-86] causes me some concern. Amateur Radio is not an emergency service. As amateurs we can, should and do assist others in emergencies, but our reason for being is to learn about communications electronics, experiment with and develop new technologies and also just enjoy chatting with new and old friends while growing our skills as radio operators. In an emergency, we help others when their normal communications systems fail or become overloaded. Look at the federal goals of CERTs. The teams learn, teach and assist with public health issues, fires and search-and-rescue. Nothing in their mandate has to do with furthering, or even mastering, the art and science of radio. For a CERT, the radio is a mere tool, just as it is for professional police, fire and other public servants.

Rick points out in the article that many CERTs depend on Family Radio Service (FRS), Multi-Use Radio Service (MURS) and General Mobile Radio Service (GMRS) equipment. Allow me to point out that FCC rules (Part 97.113(a)(5)) specifically prohibit Amateur Radio from being used to regularly provide communications that could be provided by another radio service. I believe this provision is there to prevent Amateur Radio from being taken over by other services looking for back-door entry to additional spectrum and relatively low-cost equipment.

Should we amateurs help our local CERT operations? Of course! The CERTs can provide a positive public service. We can assist by training CERT members in how to use their radios, educate them about propagation, antennas and other basics to optimize their system, and perhaps even join the team. Should the CERTs plan on using Amateur Radio as their primary communications? I think not.

Growth is essential to our continued existence; however, as radio amateurs, we need to recruit people who love radio and who want to learn all about it and try all sorts of modes and technologies. Amateurs who view their radio as merely a cell phone that works "when all else fails" and have no interest in advancing the art and science — or even pursuing the hobby aspects of ham radio — are not likely to master even the basic radio skills that could be needed in an emergency. Amateur Radio's proud history of providing communications in emergencies was made possible by having a body of amateurs who knew their equipment and how to use it and could improvise as needed. People who look at a handheld transceiver or mobile radio as a mere tool to be used only when needed will seldom approach that level of skill and knowledge. Is this really in the best interest of Amateur Radio's future? I, for one, am not CERTain.

Ken Downs, W1KRT, Sullivan County ARES
Assistant Emergency Coordinator
Springfield, New Hampshire

Defining Terms

I read with some dismay the letter from Nunzio Addabbo, W4VYD, who took offense at the use of the word "amateur" to describe our Service — and yes, it *is* a Service ["Correspondence: Amateur Actions," Feb 2013, page 24]. His dictionary must be somewhat short on defining words that have many meanings, because mine also says an amateur is "one who pursues some endeavor for his/her own enjoyment, without regard to compensation." In this case, competence and experience are not in question.

Many important discoveries have been made by "amateurs" who were not working for pay or even fame — they just enjoyed what they were doing. For example, William Herschel discovered the planet Uranus (and some of its moons) while enjoying his hobby of grinding lenses and building the telescopes that he used to observe the heavens. His later appointment in 1782 as The King's Astronomer to George III underlines his competence, but it doesn't change the fact that he made his living in another field while making those discoveries.

It's the same with Amateur Radio operators, many of whom are highly competent in many fields, including electronics and engineering. Simply reading the first part of Part 97 of the FCC Rules will emphasize this point.

Bill Carrigan, K3DC, ARRL Life Member
Malabar, Florida

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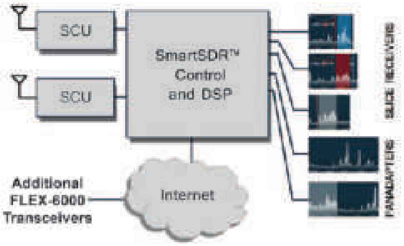

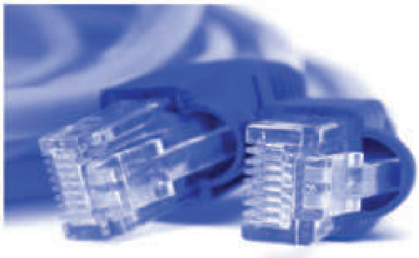

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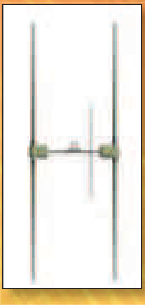
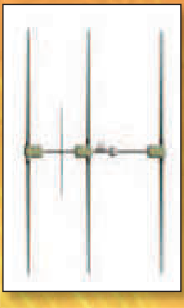


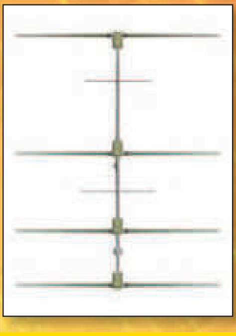
2 Element 20m-6m Yagi

2 element Yagi, 20m-6m continuous coverage; 57" boom, 36 ft longest element, 18.2 ft turning radius, 6 sq ft wind load, 30 lb; SDA 100 controller included. 40/30 dipole option is available.



3 Element Yagi 20m-6m

3 element Yagi, 20m-6m continuous coverage; 16 foot boom, 36 ft longest element, 19.7 ft turning radius, 6.1 sq ft wind load, 51 lb; SDA 100 controller included. 40/30 dipole option is available.



4 Element Yagi 20m-6m

4 element Yagi, 20m-6m continuous coverage; 36 ft longest element, 24.1 ft turning radius, 9.7 sq ft wind load, 99 lb; SDA 100 controller included. 40/30 dipole option is available.

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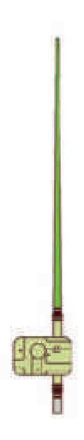
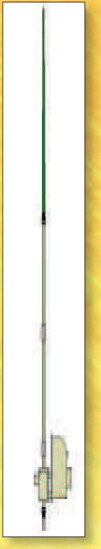
BigIR vertical antenna, 40m-6m continuous coverage, 32 ft length, 15 lb total weight, 2 sq ft wind load; EIA 222C wind rating when guyed; Comes with SDA 100 controller and 1.5"mounting pole; Does not include optional 80m coil.

SmallIR Vertical Antenna 20m-6m
20m-6m continuous coverage, 18 ft total length, 12 lb weight, 1 sq ft wind load; EIA-222C wind rating without guys.

20m-6m Dipole
20m-6m continuous coverage dipole; 36 ft element length; Comes with SDA 100 controller.





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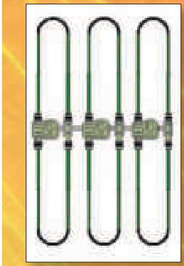
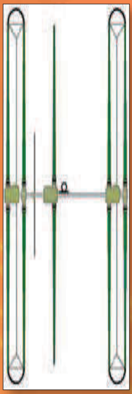
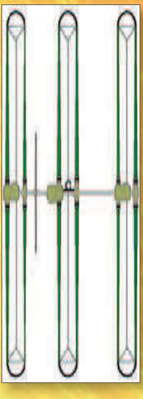


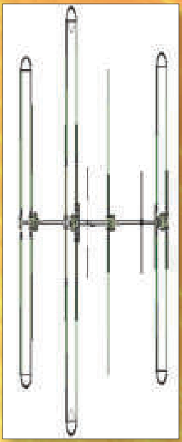
DB11 Yagi Antenna
DB11 Yagi, 18.5 ft element length, 11 ft boom, 10.8 ft turning radius, 61 lb, 5.9 sq ft wind load; 2 active elements on 20m; 3 active elements on 17, 15, 12, 10, 6m.

DB18 YAGI
Dreambeam DB18 yagi, 3 el on 20m-6m, 2 el on 40/30m, 18 ft boom; Does not include optional 6m passive element kit; Includes SDA100 controller.

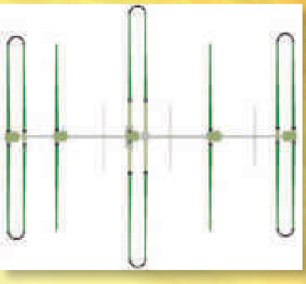




DB18E YAGI
Dreambeam DB18E, 3 el 30m-6m, 2 el 40m, three looped elements, does not include optional 6m passive element kit, 18 foot boom; Includes SDA 100 controller.



DB36 DreamBeam Yagi, 40m-6m
DreamBeam DB36 4 element Yagi, 40m-6m continuous coverage; single feed line, no relays, 36ft boom, 49 ft longest element, 26 ft turning radius, 17.5 sq ft wind load, 160 lb; SDA 100 controller included.



DB42 MonstIR PRO Yagi
5 elements on 20m-6m and 3 elements on 40/30. DB42 provides coverage from 80m through 6m (with optional 80m dipole kit). The DB42 has a 49 ft looped driven element. End loop elements only 39 feet long, yet the performance is as if all 3 of the loop elements are 49 feet long. 29 ft turning radius, 19.9 ft wind load. Includes basic SDA100 electronic controller, connector junction box and Astron.

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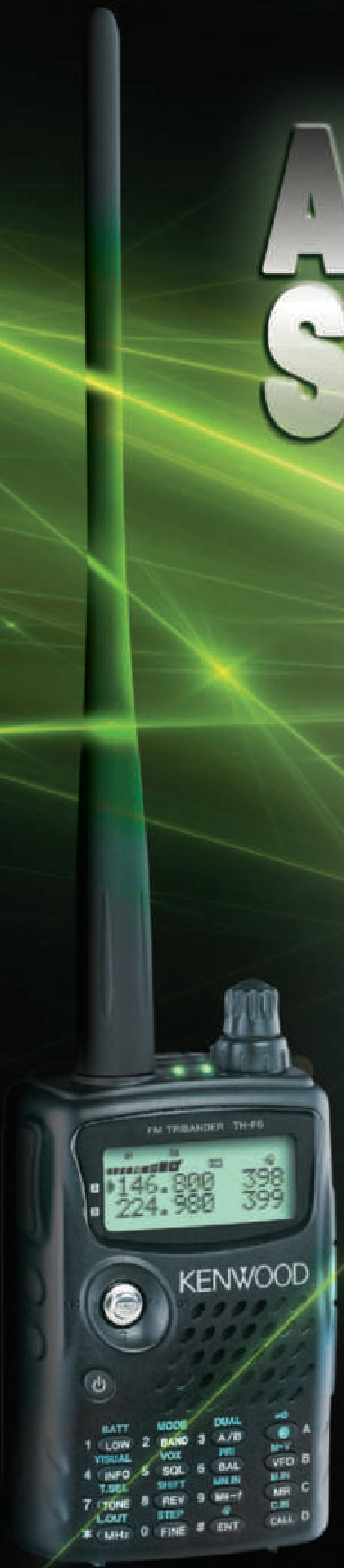
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A Different Way to Make a Tilt-Over Mount and Mast

Tilting makes raising antennas easy, and this scheme works on the road as well.

Geoff Haines, N1GY

I'm always trying to make the deployment of my portable Amateur Radio operations easier. One of the more difficult tasks has been the erection of my antenna mast. I have used a tilt-over type mount for several of my base station antennas in the past with great success, so I figured I could do it again for use while away from home.

Commercial tilt mounts tend to be pricey and are generally not designed to attach easily to the "under the tire" mount that I built several years ago. My son and I were discussing the options available when I noticed one of his boating catalogs on the table. A tilt-over boat trailer jack seemed to be just the ticket.

The Plan Comes Together

Within a few days I had occasion to go to the Northern Tool store in Tampa. They had just the jack I was looking for (see Figure 1) and it was even on sale.[1] The disassembly of the telescoping portion of the jack took less than an hour. The U shaped metal cap on the top of the jack is held on by a spring clip. With that removed, access to the mechanism was easy. I simply drove the retaining pin out of the crank handle and removed the gears. This was the messy part of the job since they were covered in grease, but a can of brake cleaner and some rags helped a lot.

With the inner tube (the one with the caster wheel attached) gone, I measured the inside diameter of the outer tube. I thought it would be a slip fit for 1⅞ inch tubing. The outer diameter of the tube is a nominal 2 inches. Unfortunately, the jack manufacturer's claim that the inner tube was 1⅞ inch turned out to be a hair off — more about that later.

First Dismantle

I do not have any pictures of the disassembly process but it was relatively simple. The drift pin I removed from the crank allowed the crank and its associated gears and washers to be removed easily. If the tube holding the caster is rotated down a few turns and then pushed up, the cylindrical pin that holds the other gear in place falls out easily and the entire sub assembly can be pulled out the bottom of the outer tube. The outer tube is then rotated so that the top (where the gears were) is now the bottom. Since the rotating plate that holds the tube to the mounting bracket has an extra hole (one in each lower corner) and the bracket itself has one in each corner to match, an extra bolt with a captured nut can be used to provide a safety lock so that if someone accidentally pulls the spring loaded lock handle the mast will stay vertical.

Figure 1 — This is what we started with — a stock trailer jack that I got on sale for $18.

Then Install

The mount for the jack is normally clamped around the tongue of a boat trailer but the base has several sets of holes predrilled to accommodate various sizes of fittings. I chose to use 2 inch muffler clamps (short U-bolts) to attach the base of the jack to the 12 inch long 1½ inch ID pipe nipple that is the vertical portion of my portable mount (see Figure 2). I originally planned to use stainless steel U-bolts but they were too long and the muffler clamps turned out to be exactly the right length and are a more robust thickness to boot.

I call my portable mount "Bigfoot," but it's just an 18 × 10 × 2 inch oak plank with a floor

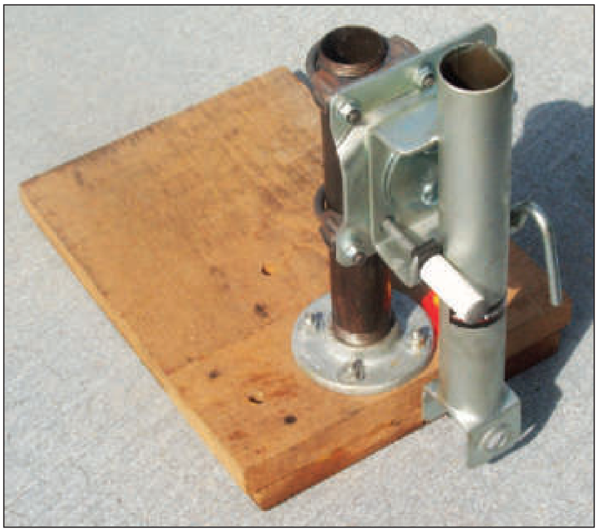

Figure 2 — Mounting the jack to a preexisting "under car mount" I built several years ago was simply a matter of using 2 inch muffler clamps available at any auto parts store.

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[1] Notes appear on page 33.

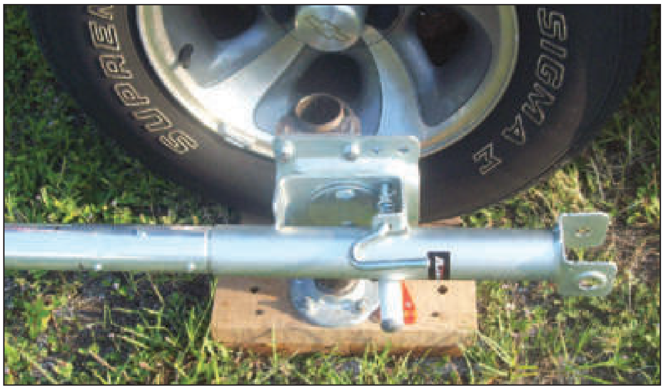

Figure 3 — The completed mount is in place under the wheel of my Blazer. You can see the safety bolt that we added to ensure that a snagged rope cannot drop the antenna mast accidentally.

Figure 6 — Securing these stainless steel hose clamps does not require the use of a screwdriver or nut driver. The key is operable without tools.

Figure 4 — The mast is in place ready to be elevated with the help of the jack.

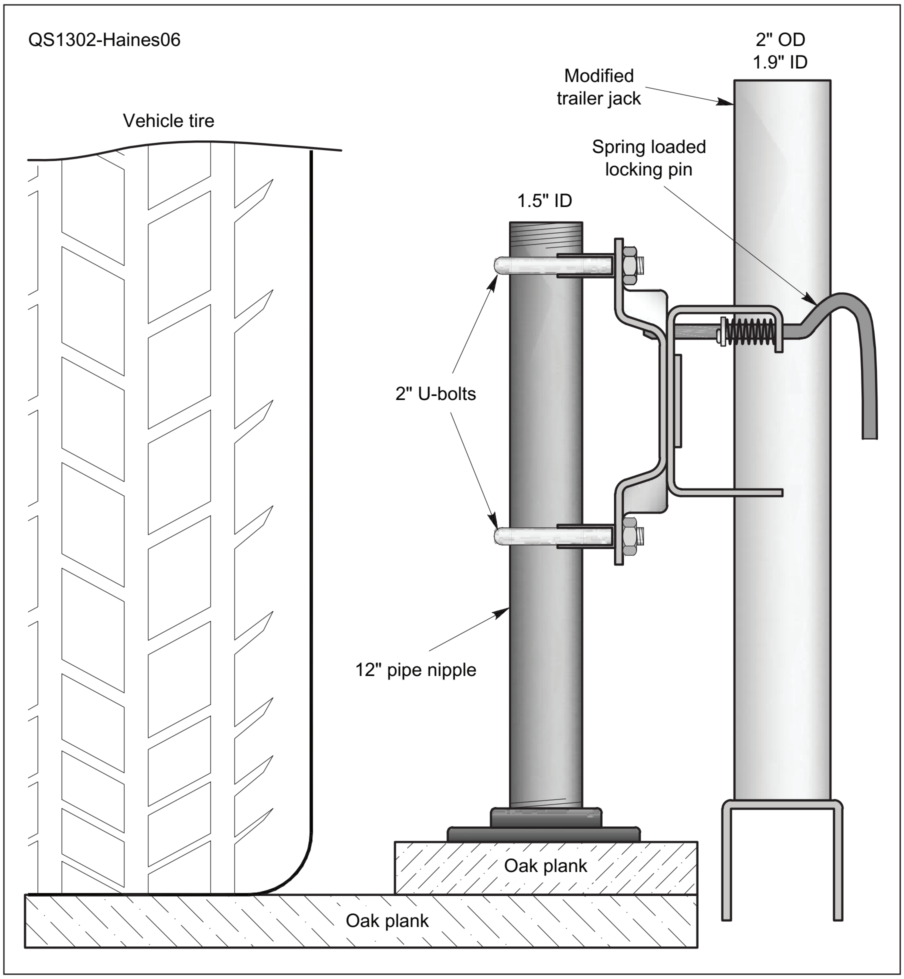

Figure 5 — This drawing shows the major elements of the jack, with the mount in place under a front tire.

flange and pipe bolted to the outer portion. The inner portion is placed under a front tire by driving the car up onto it so that the weight of the car keeps the portable mount solidly in place (see Figure 3 and 4). The nipple and flange are insulated from the ground so that they can be part of the antenna system without grounding it. With the boat jack in place, the bottom of the jack clears the ground by about 1½ inches when vertical and the tilt mechanism is similarly isolated from ground (see Figure 5).

It just so happened that one of my suppliers of aluminum telescopic tubing, DX Engineering (**www.dxengineering.com**), had that size in stock, along with all the other sizes to make a telescopic mast of almost any height. With the arrival of the tubing, the construction of the mast began. Since I already had a telescopic aluminum mast, I simply had to add the larger diameter sections to the bottom of that mast to get it from 1.5 to 1.875 inches. This required three lengths of tubing, 1.875, 1.750 and 1.625 inches in outside diameter. I mentioned earlier that the inside diameter of the trailer jack main tube was a bit off. When the new tubes arrived, I found that the largest one (1.875 inch) would not fit into the jack tube.

The solution was easy. I had ordered 6 foot lengths of tubing knowing I would be cutting them down to 4 feet to match the existing sections of the mast. I simply slid a 2 foot section of the 1.75 inch diameter tubing into the bottom of the larger section and joined the two pieces securely using six sheet metal screws. This did make the mast a little taller but the beauty of a telescopic mast is that it can be any height you want below its maximum length.

Together with the 1.500, 1.375, 1.250 and 1.125 inch sections from the old mast, I had a mast that could run to a maximum height of 23 feet and could be lowered to NVIS height as needed. It was considerably more rugged than the previous mast, which would bend precariously if a relatively heavy antenna

Figure 7 — In December 2007 *QST*, I wrote an article about the "Octopus Antenna." This adaptor fits it to the new mast, which is somewhat larger in diameter.

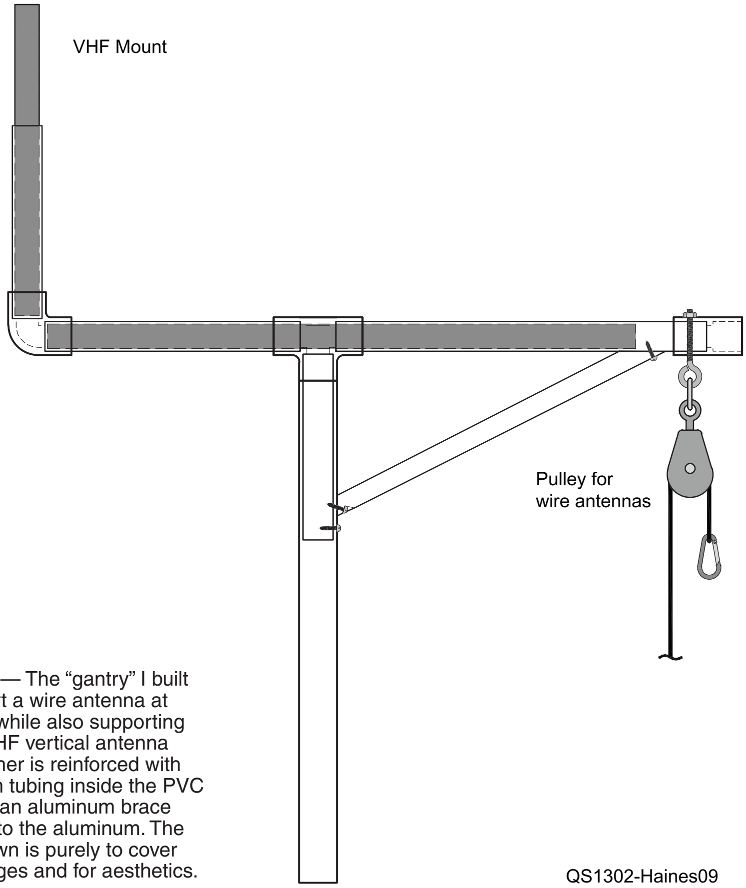

Figure 8 — The "gantry" I built to support a wire antenna at one end while also supporting a VHF/UHF vertical antenna on the other is reinforced with aluminum tubing inside the PVC pipe and an aluminum brace screwed to the aluminum. The tape shown is purely to cover sharp edges and for aesthetics.

were mounted. To secure each length of tubing to its neighbor, the usual method is to use hose clamps. As with the previous telescopic mast, I chose to use a particular clamp that, so far, I have only found at one source. MSC Industrial Supply Company (**www1.mscdirect.com**) has stainless steel hose clamps with a hand operated key permanently attached to the bolt that adjusts the clamp (see Figure 6). This makes it a "no tools needed" affair to set up the mast in the field. There are other clamps that also appear able to be hand tightened but they use plastic keys or knobs. The MSC clamps are the only ones I have found that are all metal.

Putting the Antenna in Place

I was concerned that the various antenna setups that I used with my original mast were all designed to use a length of ¾ inch inside diameter PVC pipe as the mounting arrangement. This would slip over the top of the mast that was also ¾ inches in diameter. Luckily, I discovered that the outside diameter of that same ¾ inch PVC pipe is an easy fit to slip *inside* some thin wall PVC pipe that I had on hand. A few turns of vinyl tape made the fit just right and a few self tapping stainless sheet metal screws made the adaptation permanent. The thin wall PVC then fits over the 1⅛ inch aluminum tubing that is the top section of the new mast. Each thin wall section is secured to the mast with the same type of hose clamps that I use to connect the sections of the mast. With a little fabrication I was able to make an adapter to fit my Octopus array to the 1⅛ inch aluminum tube (see Figure 7).[2]

I also fabricated a new adapter to enable the use of wire antennas fed with ladder line (see Figure 8). I had to make the attachment point at least 12 inches away from the aluminum mast to avoid affecting the ladder line. This was accomplished by building a PVC T out of ¾ inch PVC pipe, reinforced with ¾ inch aluminum slipped inside the PVC. I also added an aluminum brace to triangulate the gantry so that hoisting the antenna would not stress the mast too much. The braced end of the T is fitted with a pulley and rope to allow raising a wire antenna independently from the raising of the mast. This mounting adaptor also has provision for a VHF/UHF antenna mounting on the opposite end of the T. With that completed, any of my original antenna systems will fit the newly upsized mast.

I plan on using my Octopus antenna array but I can also use my homebrewed Carolina Windom (the "heavy" antenna that caused the previous mast to bend) as well as my G5RV Junior antennas in place of the Octopus if necessary. The mast itself can also be used as a vertical antenna with the appropriate automatic or manual tuner in place. Radials would be needed to make the vertical perform adequately. Wire is cheap and it would not be hard to make 12 or 16 wires, each 25 feet long, to attach to the tuner at the base and spread them out on the ground around the mast. Other writers have noted the use of inexpensive metal tape measures as radials, which have the advantage of being self storing.

Keeping it Up

Since the mast I built is only 23 feet tall, one set of guys is sufficient even if I use a relatively heavy antenna like the Octopus. In order to make setting the guys easier for me, I chose to go with a package of four 14 foot long, 1 inch wide tie down straps with ratchet handles. Their extra weight would have been too much for a light duty mast, but with the mast now starting at 1⅞ inches and the guys attached at the 1.5 inch diameter point on the mast, the heavy duty guy straps are appropriate. They attach to the mast at the 10 or 11 foot level.

Figure 9 — A close up of what must be the most unusual guy ring I have ever seen. Made from an aluminum candy dish my spouse donated, it is very heavy gauge aluminum and has a floral design stamped into it.

I have tried the three guy line setup in the past and I like the extra security of four. The military has standardized four guy lines per level and they generally don't do anything without testing it thoroughly first. The ratchet handles on the guy straps are placed near the ground anchors so the extra weight is minimized and the ratchets are accessible that way. Speaking of the ground anchors, several companies make excellent screw type ground anchors.

I chose, based on past experience, to go a different route. Many years ago I picked up metal stakes that were originally used for tying down helicopters in Vietnam. I have used them for years and not one has ever pulled out until desired. They have a short metal cable with a spring loaded hook on the end of the cable. They are very strong and have a W shape similar to a miniature metal highway barrier. A metal cap ensures that they can be driven all the way into the ground. To remove them simply pull up parallel to the stakes' orientation. Pulling in any other direction does nothing. Since I have no idea if they are still available or even where one could find them, you will have to choose an available ground anchor that works for you.

Figure 10 — This "stinger" uses a 10 foot MFJ telescopic whip to extend the mast to 33 feet for use as a vertical antenna. A radial field of many 35 foot radial wires is necessary to make it effective, but the option is there.

To attach the guy straps to the mast, some kind of guy ring was necessary. All the commercially available guy rings that I saw had a maximum mast diameter of 1.25 inches. I needed one for a mast diameter of 1.5 inch. I checked with a couple of fabricating companies in my area and they wanted more for the ring than I had invested in the whole project. I figured I had to go back to homebrewing to get what I wanted. While discussing the problem with my wife Audrey, KJ4YMX, she reached into the dark recesses of a cabinet and pulled out an aluminum candy dish we had gotten as a wedding present many years ago. With the drilling of five holes, four at 7⁄16 inches for the guy hooks and one in the center to fit the 1½ inch mast (see Figure 9), the deed was done. The material of the dish is very heavy gauge aluminum, easily capable of taking the strains expected. Given that it also has a floral design stamped into the aluminum, it must be the most elegant guy ring in all of Amateur Radio.

Putting it Up

The first test of the new mount and mast combination was elementary. I placed the drive-on mount under a wheel of my car and installed the 23 foot mast into the jack tube in a horizontal position (see Figure 4). I then pulled the spring loaded pin on the jack and proceeded to walk the mast up to a vertical position. As it reached the upright position the spring loaded pin clicked neatly into the matching hole in the base. I added the safety bolt on the other side of the jack tube and the mast was now secure.

My wife and I have repeated the testing with each of the antenna mounting adaptors with and without the guy straps in place. All tests were successful. Obviously, the guy straps will be used at all times, but it was nice to know that the mast is strong enough that they are an added safety measure, not a critical part of just keeping the mast upright. With the guys in place and the base suitably secured to the ground with three 12 inch landscaping spikes, the car can be driven off the base and used elsewhere.

Wrapping it Up

I will not bother you with the testing of the performance of the various antenna systems that we can deploy with this mast and mount. Each one that I tried worked up to its potential. Suffice to say that one can mount any antenna system that will perform at around 25 feet altitude, whether it be of vertical or horizontal persuasion. With the appropriate number of radials and the 10 foot stinger extension in place, it can also operate as a multi-band vertical antenna itself if an antenna coupler or tuner is used.

This project is adaptable to many different types of antennas and many different situations. It can be set up as high as 33 feet (with the 10 foot "stinger adaptor," see Figure 10), or as low as 8 to 10 feet for NVIS use. It can be used for HF or V/UHF antennas. It can also be used for park or beach DX when the need arises. With the increased risk of weather emergencies here in Florida, and the frequent opportunities for beachside DX in calmer times, I expect to be using this system frequently in the future.

Notes

[1] **www.northerntool.com/shop/tools/product_200414698_200414698**

[2] G. Haines, N1GY, "The Octopus — Four Band HF Antenna for Portable Use," *QST*, Dec 2007, pp 36-38.

Geoff Haines, N1GY, was first licensed in 1992 as a Technician Plus with the call sign N1LGI. He received his current call upon upgrading to Amateur Extra in 2005. Geoff is retired after a career in intensive respiratory care.

Geoff currently holds several ARRL appointments in the West Central Florida Section including Assistant Section Manager, Technical Coordinator, Net Manager and Official Emergency Station. He is a past president of the Manatee Amateur Radio Club, a past president of the West Central Florida Group, (operators of the NI4CE linked repeater system) and a member of several ham radio clubs both in Florida and Connecticut. In his spare time, Geoff researches, designs and builds projects such as antennas and station accessories for Amateur Radio. He also finds time to update his website **www.n1gy.com** on a regular basis.

His wife, Audrey, KJ4YMX, is also an active ham. Both participate in ARES, Skywarn and other club activities. Geoff can be reached at 904 52nd Ave Boulevard West, Bradenton, FL 34207 or at **n1gy@arrl.net**

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

A Wideband Dipole for 75 and 80 Meters

Covering all the way from 3.5 to 4 MHz with one antenna takes some tricks.

Ted Armstrong, WA6RNC

On most of our MF and HF bands, a single dipole is the most basic antenna. With one exception, it can be used to cover all the usual CW, data and SSB frequencies without any tuning, if adjusted for minimum SWR at or near mid band. The exception, and the antenna designer's challenge, has always been the band from 3.5 to 4.0 MHz, which is so wide, in terms of percentage bandwidth, that many have a separate name for each end — 80 meters for the low end and 75 for the high end!

Why Not a Dipole

There have been a few designs proposed to meet the objective of a single 75/80 meter dipole in the past, but most have been proven flawed or difficult to implement.[1] The challenge is clear if we look at the SWR of a typical wire dipole tuned to mid band as shown in Figure 1. Note that with the antenna tuned to an exact match at the center of the band, we can achieve less than a 2:1 SWR over (at most) about 200 kHz. For full band coverage we would need three separate thin dipoles.

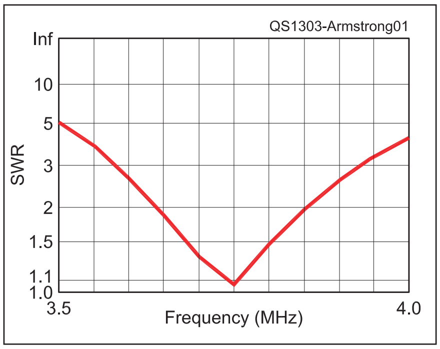

Figure 1 — Modeled 72 Ω SWR of a thin 80 meter dipole. Note the high SWR at the band edges.

The fraction of bandwidth to center frequency on 75/80 meters tells the story. If expressed as a percentage it is 13.3%, while for the full 10 meter band, for example, it is 5.8%, which would also be a challenge for a single antenna. My caveat about modes saves us here — on 10 meters, CW, data and SSB usage is generally in the bottom 0.5 MHz (1.8%), while FM is near the top. The two segments usually use different antenna types, often horizontal polarization for the low end and vertical for the high segment.

Similarly, 160 and 6 meters are 10 and 7.7% respectively, but they are not HF bands and also have usage divided among segments. Table 1 shows the percentage bandwidth of amateur bands from 160 meters through 70 centimeters. As indicated, 80/75 is the bandwidth challenge champ, even through our VHF and UHF bands. The other HF bands, with the caveat about 10 meters can usually fit onto a dipole, with 40 meters usually just making it to 2:1 on the edges.

Making it Work

Most of us are familiar with using over-coupled tuned transformers to make wideband RF coupling transformers or filters. The same approach can be applied to antennas, with similar results. I investigated this approach using *EZNEC* antenna modeling software and have modeled a number of broadband antennas that work as designed over their frequency range with the SWR not

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[1] Notes appear on page 36.

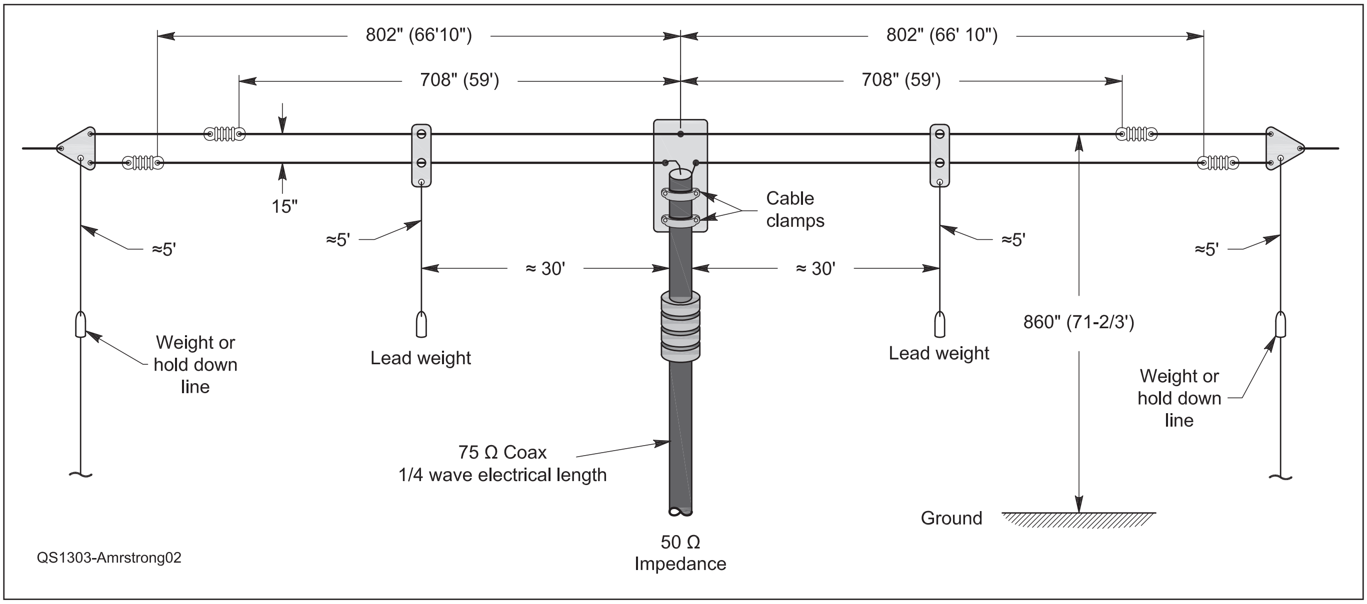

Figure 2 — Construction details and dimensions of the coupled resonator 75/80 meter antenna including ¼ wave impedance transformer of 75 Ω coax. The ¼ wave transformer should be an electrical quarter wave long, 65.6 feet in free space, 43.3 feet in standard (0.66 V_R) solid polyethylene dielectric coax. For RG-9 coaxial cable use type 43 shield beads (Fair-Rite part # 2643102402), for RG-59 use type 43 (Part # 2643540402). For Fair-Rite Products see **www.fair-rite.com**. If you have surplus 75 Ω coax and want to use it for the transmission line transformer, first measure its velocity factor and trim to a ¼ wave at 3.74 MHz. A support at the center will reduce sag.

Table 1
Percentage Bandwidth of Amateur Bands

Band (meters)	Frequency Range (kHz)	Bandwidth (kHz)	Bandwidth (%)
160	1800 – 2000	200	10.5
75/80	3500 – 4000	500	13.3
60	5330.5 – 5405	74.5	1.4
40	7000 – 7300	300	4.2
30	10,100 – 10,150	150	1.5
17	18,068 – 18,168	100	0.6
15	21,000 – 21,450	450	2.1
12	24,890 – 24,990	100	0.4
10	28,000 – 29,700	1700	5.9
6	54,000 – 58,000	4000	7.7
2	144,000 – 148,000	4000	2.7
1.25	222,000 – 225,000	3000	1.3
70 cm	420,000 – 450,000	30,000	6.9

exceeding 1.5:1 across the band.[2, 3] [Note that successful *NEC* modeling of closely coupled antenna elements requires that the segment size of the coupled segments be the same and that they need to be in alignment. — *Ed.*]

There are a number of interacting parameters in the design of such an antenna. Unlike the two-band coupled resonator dipoles described in other articles, this antenna requires greater spacing than can be provided by window line. This results in a higher resonant impedance than the usual transmission line — 112 Ω in my design. Fortuitously, 112 Ω can be transformed through a ¼ wave section of 75 Ω coax to provide a good match to our usual 50 Ω systems. The resultant antenna is shown in Figure 2, while the 112 Ω SWR of the antenna itself is shown in Figure 3 and the transformed 50 Ω SWR is in Figure 4.

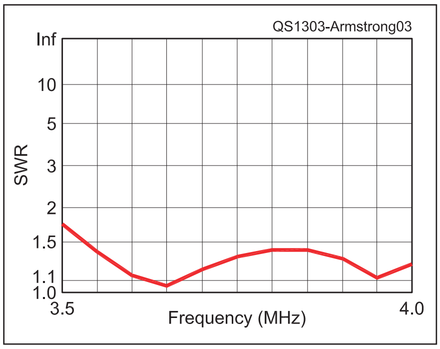

Figure 3 — Modeled 112 Ω SWR of the coupled resonator dipole of Figure 2 without quarter wave matching section.

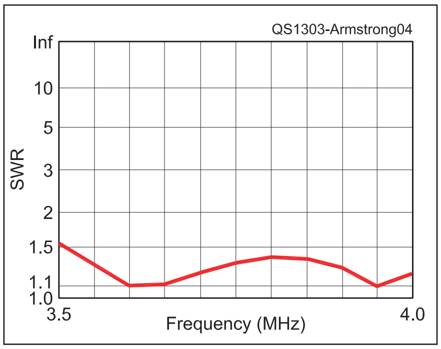

Figure 4 — Modeled 50 Ω SWR of the coupled resonator dipole of Figure 2 with the quarter wave matching section of 75 Ω Coax.

Validating the EZNEC Results

This horizontal antenna will not fit on a small city lot such as mine, so I needed to scale the frequency up to where it will fit and then verify that the antenna would work as predicted. The antenna would have the identical percentage band width except now it would be at a higher frequency. I scaled the frequency up to 60.5 MHz model in the built the antenna and obtained similar results to those of my larger modeled antenna. I also modeled and constructed some vertical "half antennas" fed against ground (see Figure 5) and duplicated the model results.

Putting Up the Antenna

This construction project requires lots of open space to work properly, but you will no longer have to use a tuner or multiple dipoles to cover the entire 75/80 meter band from one antenna. You can jump from the low end to the high end or anywhere in between without a tuner and still have low SWR.

The design height of this antenna is 72 feet; a bit more then ¼ wavelength. At its design height and perhaps 10 feet above and below it will be less than a 1.7:1 SWR, rising to 2:1 at a height of 40 or 100 feet, all based on typical soil (conductivity of 0.005 S/m, dielectric constant of 13). Dry, sandy soil makes it look like the antenna is higher; wet soil makes it seem lower.

Figure 5 — View of the 10-12 meter coupled resonator monopole, one of the smaller antennas used to validate the design process. It had a bandwidth of 17.7%

This broadband antenna uses two #14 AWG uninsulated antenna wires separated by 15 inches for the entire antenna length. A single spreader on each side (B in Figure 2) and the antenna end supports (C) help to maintain that separation. Don't let the wires get twisted, as that will kill the antenna's performance.

To keep the wires from getting twisted, attach a hold down nonconductive line or weights on a five foot nonconductive line to the bottom of B and C. The minimum weight of each lead weight should be

1 pound. In areas subject to heavy winds, it might be a good idea to use more weight. The center feed point is kept vertical by the weight of the transmission line transformer. That line should run as close to vertical as possible to reduce antenna currents coupled to the coax shield.

The feed point of the antenna is balanced, but the coax is unbalanced. The four ferrite shield beads on the coaxial cable help make the coax at the feed point appear more balanced and reduce the coax shield currents below the ferrites as detailed in Figure 2. Sketches of my implementation of the various support pieces are provided on the QST in Depth web page (**www.arrl.org/qst-in-depth**).

Notes

[1] One successful implementation is the four wire cage in use at W1AW. The solution presented here requires two rather than four wires, is more compact and needs a simpler support structure.

[2] J. Hallas, W1ZR, "A Folded Skeleton Sleeve Dipole for 40 and 20 Meters," *QST*, May 2011, pp 58-59; J. Hallas, W1ZR, "The Folded Skeleton Sleeve on Other Ham Bands," *QST*, Oct 2011, p 48.

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

Amateur Extra class operator and ARRL member Ted Armstrong, WA6RNC, is a member of MARES, the Milpitas, California ARES®/RACES group and enjoys antenna modeling and experimenting. He can be reached at 721 Calero St, Milpitas, CA, 95035-4308 or at **theo_a@att.net**.

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

New Products

DXtreme *Station Log* — Multimedia Edition Version 9.0

DXtreme *Station Log* Version 9.0 offers multimedia and advanced functions. The *Station Log* window includes the expected logging functions and also retrieves the frequency and mode from supported rigs through integration with Afreet's *Omni-Rig*. This window displays ARRL DXCC and grid/VUCC status information for logged stations and tracks QSLs sent and received. If the computer is connected to the DX spotting network, the DX Spot Checker queries the *Station Log* database and alerts the operator to spots needed for DXCC or VUCC awards. Multimedia functions let users listen to previous contacts and view QSLs whenever they browse their logs. The software can also be used to create QSL and address labels for physical QSLs; create signed TQ8 files automatically for uploading to ARRL's Logbook of The World (LoTW) server; produce ADIF-based electronic QSLs for uploading to eQSL.cc; and produce a variety of reports. New features in Version 9 include a grid at the bottom of the window that shows up to 500 of the most recent log entries (providing the look and feel of a paper logbook); integration with the Afreet *Band Master* lists to indicate the DXCC entities and IOTAs needed for all bands or individual bands; advanced searches filtered by user selected criteria; and IOTA updates directly from the RSGB website. DXtreme *Station Log* runs in 32- and 64-bit versions of Microsoft *Windows 8, 7, Vista* and XP. Price: $89.95 (North America) for new users; special upgrade pricing is available for current users. For more information or to order, visit **www.dxtreme.com**.

ARRL VEC Volunteer Examiner Honor Roll

The ARRL VEC Honor Roll recognizes the top 25 Volunteer Examiners according to the total number of ARRL exam sessions in which they have participated since their accreditations. Considering each session requires an average time commitment of 2 to 4 hours or more, the thousands of hours these VEs have invested represents extraordinary dedication! Whether you are one of our VE Teams that test once a week, once a month or once a year, we want to express our warmest appreciation to all volunteers for their generous contribution to the ARRL VEC program.

If you are an ARRL VE, you can see your session stats online at **www.arrl.org/ve-session-counts**.

If you're not a VE, become one! See **www.arrl.org/become-an-arrl-ve**.

Examiner	*Sessions*	*Accreditation Date*
Harry Nordman, AB0SX	547	09-Jan-02
Sammy Neal, N5AF	519	20-Nov-84
David Bartholomew, AB0TO	446	22-Mar-02
Franz Laugermann, K3FL	423	01-Dec-91
Kevin Naumann, N0WDG	421	17-Nov-02
Bill Martin,AI0D	398	01-Nov-84
John Moore III, KK5NU	391	21-May-95
Karen Schultz, KA0CDN	383	06-Sep-84
Paul Maytan, AC2T	370	06-Sep-84
Royal Metzger, K6VIP	368	29-Apr-85
Jeanette Nordman, AB0YX	360	21-Aug-03
John Mackey Jr, KS0F	353	01-Oct-90
Richard Morgan, KD7GIE	339	11-Aug-00
Gerald Grant, WB5R	338	04-Jan-85
Victor Madera, KP4PQ	337	01-Mar-92
John Hauner, K0IH	323	11-Jan-85
David Fanelli, KB5PGY	319	01-Oct-91
Adolph Koehler, K5VCR	305	29-Sep-95
Daniel Calabrese, AA2HX	302	01-Nov-91
E. Drew Moore, W2OU	301	01-Aug-90
Robert Hamilton, N0RN	295	19-May-87
Loren Hole, KK7M	292	06-Sep-84
Michael Faucheaux, N5KBW	291	15-Jul-96
Morris Jones, AD6ZH	290	27-Nov-01
Roland Kramer, W0RL	288	21-Jun-01

Two Simple Antennas for 1200 MHz

Get started on this interesting band by building these antennas.

Don Dorward, VA3DDN

Not long after getting interested in the 1200 MHz (23 centimeter) amateur band I realized there were not a lot of commercial antennas available for the band and few plans if you wanted to build your own.

In my area just outside of Toronto, Ontario, Canada, there is only one repeater within range (1286 MHz) and it was obvious that using the flexible antenna that came with my 1 W handheld was not good enough, particularly while operating mobile. I also needed some kind of reasonable but simple outside antenna even while using my 10 W transceiver from the home base.

The Designs

So I experimented with several straightforward antenna designs for 1200 MHz, two of which I will describe here. They are shown in the lead photo above, and as may be evident, both are constructed on a chassis mount female Type N connector using brass rod for the elements. Brass rod is a handy material for V/UHF antenna experimenters and it is readily available from most hobby shops and online. One source is K&S Precision Metals (**www.ksmetals.com**).

The one shown on the left is the classic ¼ wave ground plane with drooping radials. The one shown on the right is a mini J pole. Either of these antennas can be easily mounted on top of a length of 1 inch diameter PVC electrical conduit, with a male Type N plug on top and the coax, RG-213, LMR-400 or equivalent running down the center. Figures 1 and 2 show examples of this technique. If used outside, the top of the PVC conduit and the shell of the male Type N plug should be moisture sealed with a silicone sealant. For mobile use, a magnetic mount with a Type N socket and a male-to-male Type N adapter works well.

Construction Details

I made the ¼ wave ground plane antenna first. I used a ⅛ inch outside diameter brass tube, tapped with female #6-32 threads on the top end. This allows some change to the physical length through adjustment of a ½ inch #6-32 screw and a nut to lock it in place. In this case the inside diameter of this tube fits nicely over the center pin of the Type N socket making soldering easy. An alternative is to use 3⁄32 inch outside diameter solid brass rod, which fits *inside* the center pin of the Type N socket, again making soldering easy. In this case you should make it a bit longer than needed, and then trim for tuning with wire cutters. Shortening the antenna will increase the resonant frequency. Figure 3 shows some of the construction details.

Figure 1 — Close up of the ¼ wave drooping ground plane for the 1200 MHz band.

Some Construction Tips

At 1200 MHz, ¼ wavelength is only about 2.2 inches, or 56 mm long. For improved accuracy in measuring and cutting elements, I prefer to use the metric values. Even so, a change of only 1 mm (0.04 inch) in element length can change the resonant frequency by as much as 20 MHz, so care must be taken in the measuring and trimming steps. At this frequency other factors that may affect resonance come into play, such as type of hardware, proximity to nearby conductors, and the diameter of the radiating elements.

Construction Notes

I recommend using only good quality Type N connectors and low loss coax

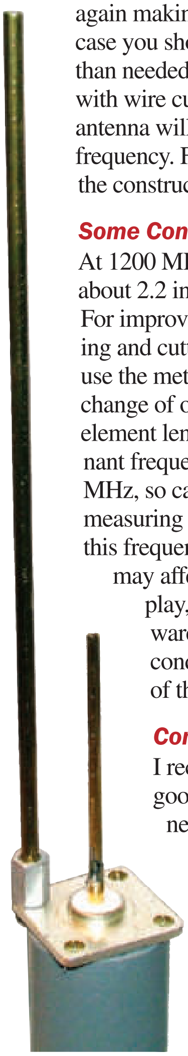

Figure 2 — Close up of the simple J pole for the 1200 MHz band.

such as LMR-400 or RG-213. LMR-240 is a good choice for short runs. I suggest cutting the elements 1 or 2 mm longer than calculated and then trim for the lowest SWR. I was able to get a flat match with the ¼ wave antenna and less than 1.8:1 on the J pole.

I used #6-32 stainless-steel hardware, which meant having to drill out the socket mounting holes slightly. One could use #4-40 instead, to avoid drilling, but the #6-32 seems to give either structure somewhat more rigidity.

Note that in the construction of the ¼ wavelength version, the radial length is measured from the center conductor of the Type N connector.

If you choose to use the ⅛ inch brass tube in place of the 0.093 inch brass rod, the effect of the lower *L/d* ratio will be to further shorten the radiator resonant length.

Effect of Element Diameter on Resonant Frequency

At lower frequencies, such as at HF, the old standby equation of L(feet) = 468/f for a ½ wave or L = 234/f for ¼ wave is usually pretty accurate. These formulations include a correction factor for typical wire diameters, a "K" assumed 0.95 — appropriate for HF antennas. For example a ½ wave 40 meter dipole at 65.5 feet is more than 12,281 times as long as #14 AWG wire (0.064 inch diameter).

In these designs, we are using a radiator of either 0.093 or 0.125 inch in diameter. The ratio of the half wave length to conductor diameter in these — and most V/UHF antennas — is considerably smaller. The ratio is about 50 for the 0.093 inch radiator and 36 for the 0.125 inch diameter radiator. This means that the K factor will become smaller too, making the antenna elements shorter as well.

In these designs I have estimated K values from data in *The ARRL Antenna Book*, as approximately 0.925, for the *L/d* ratio of 50.[1] This section in the *Antenna Book* has a good discussion of the effects of conductor diameter on resonant length.

The equation I used to calculate the ¼ wavelength elements is L(mm) = (2952 × 25.4 × 0.925)/f, where f is my repeater input frequency, 1274 MHz. For the ¾ wave section of the J pole, "B" in Figure 3, the equation is L(mm) = (8858 × 25.4 × 0.925)/f, with my f again at 1274 MHz.

Using these formulas for 1274 MHz, I have calculated the "A" lengths as 54.4 mm, and the "B" length as 163.3 mm.

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[1] *The ARRL Antenna Book,* 22nd Edition, Figure 2-8. 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**.

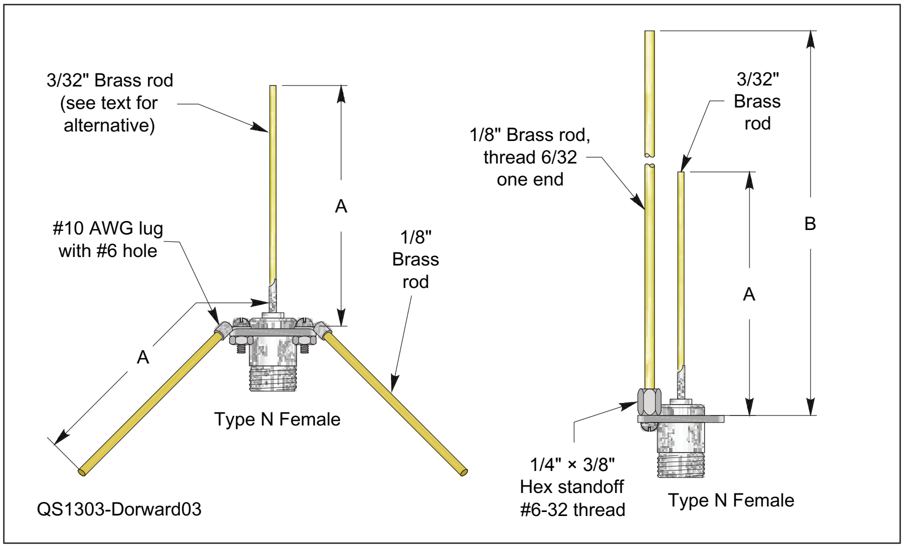

Figure 3 — Dimensioned drawing of the two antennas. For author's 1274 MHz repeater, A is 54.4 mm, B is 163.3 mm. For other frequencies, use formulas as shown in the sidebar.

ARRL International Member Don Dorward, VA3DDN, is an electronics technology graduate licensed since 2002 with basic and advanced certification. He retired in 2006 following a career in engineering management in multiple fields including the development of passive motion machines for orthopedic rehabilitation. He shares in two patent awards, is a Life Member of the IEEE and a member of the Radio Amateurs of Canada as well as the ARRL. You can reach Don at 1363 Brands Ct, Pickering, Ontario, Canada L1V 2T2 or at **ddorward@sympatico.ca**.

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

New Products

DC Power Panels from WF5Y

The model IMPP-7 OLDU dc power distribution panel from Grumpy Shop (WF5Y) includes seven sets of fused Anderson Powerpole connectors, digital voltage readout, USB charging port, low battery alarm and overvoltage protection from spikes and transients. Using a heavy duty plastic base and rubber cover for the circuit board and electronic components, the panels are protected from liquid splashes and from contact with metal objects. Other models feature 3, 4, 7, 11 and 15 outputs with different combinations of binding post and Anderson Powerpole outputs. Any or all of the above features are available on each model at the customer's request. Available either in 45 or 90 A versions, these panels are intended for mobile and field usage, and for cleaning up wires inside a home station. Price: IMPP 7 OLDU (pictured), $79.95. Other models start at $29.95. For more information, or to order, visit **www.wf5y.com**.

Dual-Band Homebrew

This 6 and 10 meter SSB/CW transceiver is scalable to all bands.

Gregory L. Charvat, N8ZRY

[This transceiver was submitted as an entry in the most recent Homebrew Challenge competition and received an Honorable Mention. It exceeded all technical requirements, but also exceeded the cost requirement.[1] — Ed.]

In designing and building from scratch, I believe hams should leverage modern technologies for optimal performance, while also acknowledging our heritage and what we personally like about Amateur Radio. This is why the radio described in this article has the appearance of a traditional ’50s era system.

In this article I will show my approach to a modern homebrew SSB/CW transceiver that covers the 6 and 10 meter bands and is scalable to almost all of the heavily used bands between 80 and possibly up to 2 meters. This radio is to be used as a framework of which pieces can be borrowed to make other equipment, additional filter banks can be added to cover additional bands or higher performing components can be substituted into its modular architecture.

Technical Description

I used some new design techniques not commonly found in the amateur homebrew community, including the use of current feedback op-amps for RF and IF amplifiers, the Si570 PLL IC for the VFO and high performance audio-derived AGC.[2] A documentary of the end-to-end development is shown in my YouTube video series.[3]

A block diagram of this radio, as well as photos, are shown in Figures 1 through 4. Complete schematics, bills of material and additional construction details and notes are presented on the *QST* in Depth web page.[4]

Transmit Signal Flow

The antenna is connected to the front panel of the radio and fed into the harmonic filter assembly containing the system low pass filter (LPF), a seventh order 6 meter LPF and a selectable 10 meter fifth order LPF. The harmonic filter assembly is connected to the power amplifier (PA) assembly on transmit and the low noise amplifier (LNA) assembly on receive.

The PA assembly contains a 50 W power amplifier based on the Toshiba 2SK1310A transistor. The 2SK1310A was chosen because it is capable of handling high impedance mismatch, which often occurs while tuning up antennas, or if something breaks in an antenna system. This power amplifier was made without etching a circuit board. Instead, a blank single-sided FR4 board was cut manually using a utility knife. Vias (electrical paths through the board) were made by drilling #4-40 threaded screws through the top layer, down through the aluminum enclosure and into the heat sink. Modern power transistors such as the 2SK1310A require many vias for circuit stability and shielding because they are capable of providing a large amount of gain up to microwave frequencies. This via technique helped to provide amplifier stability (see Figure 4).

The PA assembly is driven by the driver assembly that provides 1.5 W PEP to the PA input. The driver assembly is driven by –10 dBm PEP excitation from the front end mixer assembly. The –10 dBm is first amplified by an AD8009a current feedback op-amp. The output of the AD8009a feeds into a Mitsubishi RD06HVF1 N-channel RF power MOSFET biased into Class A mode and providing 1.5 W PEP output to the PA.

Receive Signal Flow

Weak signal RF is fed into the LNA assembly, which contains selectable second order band-pass filters for the 6 and 10 meter bands and a LNA and driver. The LNA is based on the 2N5109 NPN VHF transistor, a small-signal RF transistor providing a noise figure of about 2 dB. LNA gain was measured at about 10 dB. The output of the LNA is fed into an ERA-2+ MMIC amplifier providing a total gain of about 20 dB in the front end, thereby setting the system noise floor to that of the LNA, plus losses out to the antenna. Amplified weak signals from the LNA assembly are fed into the front end mixer assembly.

The front end mixer assembly contains two selectable third order band-pass filters for both 6 and 10 meter bands, a Mini-Circuits ADE-1 double balanced mixer, and a local oscillator (LO) filter and amplification signal chain. The double balanced mixer works by the principle of reciprocal mixing so it can both transmit and receive without rearranging its inputs and output ports, thus making transmit and receive switch easier. The VFO output is filtered by a fifth order 65 MHz low-pass filter and amplified by a Mini-Circuits MAR-4 MMIC.

The K5CBQ Si570 LO assembly is a kit manufactured by Kees Talen, K5CBQ.[5] This kit controls an Si570 PLL chip, displays the frequency (including calculation for IF offset), and provides a rotary encoder for tuning, a means for storing memory stations and automatically changing bands. High-side mixing is

Table 1
Measured Performance of 6 and 10 Meter Transceiver

Transmitter
Output power: 10 meters, 47 W; 6 meters, 50 W. Spurious emissions: 10 meters –53.8 dBc; 6 meters –63.15 dBc.
Receiver
MDS: 10 meters; SSB –135.7 dBm, CW –140.4 dBm; 6 meters; SSB –136.7 dBm, CW –140.6 dBm. Blocking dynamic range: 10 meters, 117.8 dB; 6 meters, 114 dB. IMD dynamic range: 10 meters, 81.8 dB; 6 meters, 82.4 dB. Third Order Intercept: 10 meters, –13 dBm; 6 meters –13.1 dBm.

[1] Notes appear on page 42.

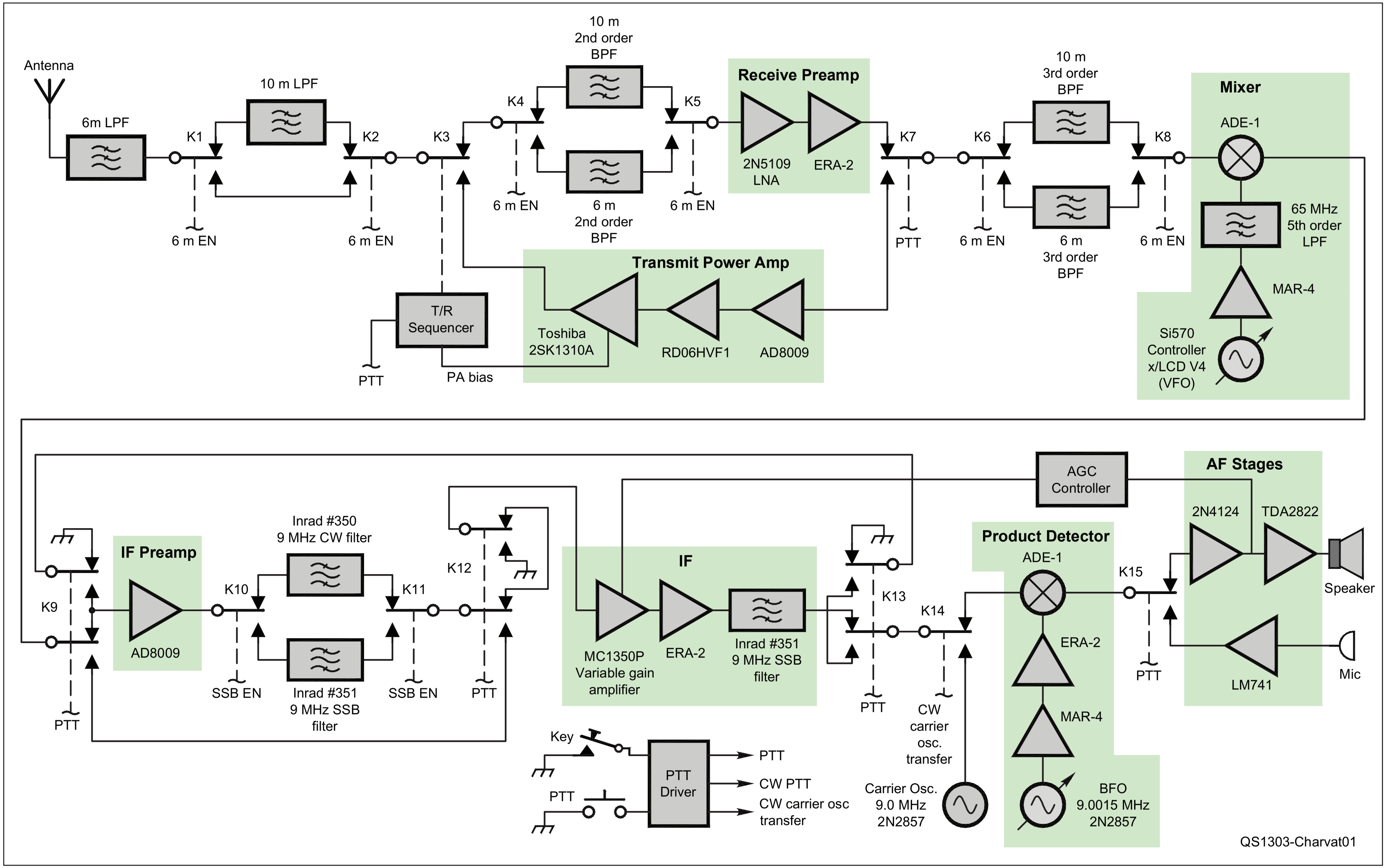

Figure 1 — Block diagram of the 6 and 10 meter transceiver. The green blocks are major active subassemblies. Details of each block are provided in the schematic package on the *QST* in Depth web page at **www.arrl.org/qst-in-depth**.

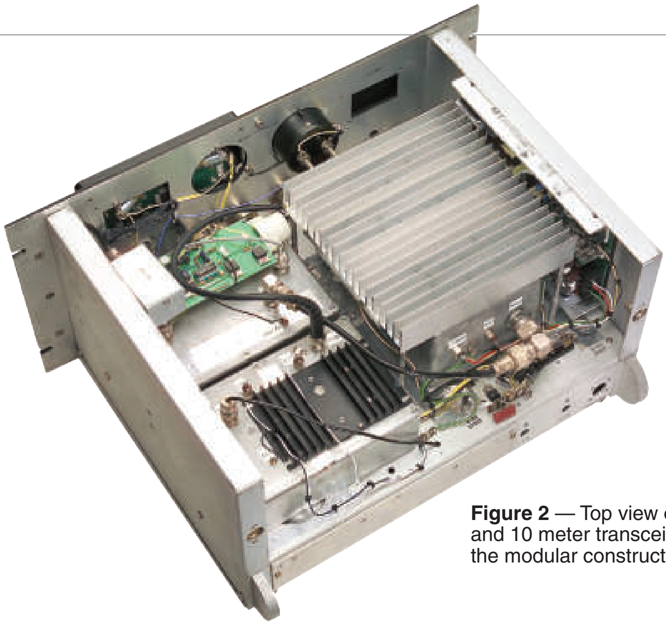

Figure 2 — Top view of the 6 and 10 meter transceiver. Note the modular construction.

Figure 3 — Rear view of the 6 and 10 meter transceiver.

chosen for this radio such that the local oscillator (LO) frequency equals 9 MHz (the IF frequency) plus desired frequency. By using high-side mixing, the receiver's high-side image is additionally rejected by the transmitter harmonic filters thus improving the image rejection performance of the receiver.

The IF port of the front end mixer is fed into the bidirectional IF amplifier assembly, which provides about 70 dB of IF gain, 60 dB of IF gain control and selectable SSB and CW crystal filters. On receive, all IF amplifiers are used. On transmit only one IF amplifier is used. A second SSB crystal filter is used on receive to prevent the high frequency noise produced by the IF amplifiers from folding over into baseband after the product detector, thereby improving the receiver's minimum detectable signal (MDS) performance. The first IF amplifier is an AD8009a current-feedback op-amp. The second IF amplifier is the venerable MC1350P because it is an easy to use voltage controlled amplifier. The final IF amplifier is a Mini-Circuits ERA-2+ MMIC (monolithic microwave integrated circuit). Relays are used to control and isolate the receive and transmit modes and amplifier configurations.

The bi-directional IF amplifier assembly is connected to the beat frequency oscillator (BFO), carrier oscillator and product detector assembly. While transmitting, we can select between the RF port of the ADE-1 double balanced mixer or the CW carrier oscillator at 9.0007 MHz. While receiving, the IF is fed into the RF port of a double balanced mixer. The LO port of this mixer is fed by a low phase noise crystal oscillator at 9.0015 MHz; the IF port of this mixer is fed to the AF, PTT and AGC assembly.

The AF, PTT and AGC assembly amplifies receive audio, transmit audio, contains the audio derived AGC circuit and controls the keying of the radio. While transmitting in SSB mode, small signal audio from the microphone is amplified by the LM741, setup in a single-supply configuration, which is fed directly into the product detector mixer's IF port. When receiving, small signal audio is amplified by a NPN transistor then up to 1.2 W by a TDA2822M power amplifier for easy reception. Audio is coupled off of the NPN transistor and fed into the audio derived AGC circuit, which limits the maximum audio output of the radio by controlling the IF gain. The CW key controls the CW delayed keying circuitry, which consists of the LM311 comparator operating as a time delay. The signal strength meter displays antenna voltage at 50 Ω.

To protect the power amplifier, a T/R sequencer energizes the relays in the harmonic filter assembly first, then biases the PA transistor by using an LM339 comparator, a simple R-C circuit and potentiometers to set time delays. Diodes force the reverse sequence when switching from transmit to receive.

The power supply is a switching mode 28 V, 9 A supply. The 28 V is used directly to power the PA. Linear regulators drop the voltage down to 8 and 12 V for the RF and analog circuitry and a separate 12 V for the driver. This switching mode power supply is low cost and is approximately 90% efficient, providing a green solution to efficiently powering the radio.

Vintage indicator lamps using light bulbs (not LEDs) are used in this radio, therefore simple lamp drivers were used to drive 28 V military surplus lamps from TTL level control signals.

Scalability

It has always been my intention to build out this radio into an all-band transceiver. For this reason the radio supports wide band operation. It is capable of providing high output power and excellent sensitivity down to 80 meters and up to 2 meters. There are three front end filter banks that house only two filters each, one for 10 and one for 6 meters. These banks include the harmonic filter assembly, the LNA assembly and the front end mixer assembly. To add bands to this radio one has to simply add the necessary low-pass and band-pass filters for each band desired, along with a simple means of switching. Filter designs are readily available in *The ARRL Handbook* or pre-made filters can be purchased from various distributors.[6]

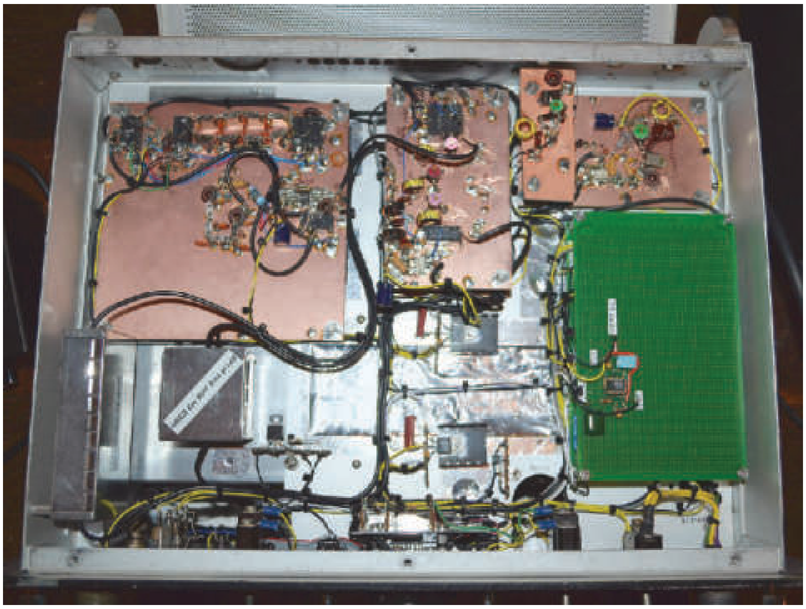

Figure 4 — Bottom view of the 6 and 10 meter transceiver.

A Modern Transceiver from the Late '50s

Seeking out the best surplus chassis for your project is a great way to get yourself involved in the local radio community. I found an old rack mount chassis at a local hamfest. These chassis are readily available in various large sizes and are often sold inexpensively or given away free because they are too heavy for the seller to carry home (I've sold my share of old rack mount chassis at hamfests; it is always a one-way trip).

My chassis was from an old Nemes Clarke wideband VHF FM telemetry receiver. All internal parts including tube sockets and transformers were stripped out. Additional surplus military lamp indicators, toggle switches, connectors and other parts were salvaged off of other chassis as needed. To determine the best mounting positions, these parts were placed on top of the salvaged front panel and their locations eyeballed.

Once the layout was finalized with firm measurements, the front panel was machined out with a drill press using my eighth grade metal shop skills. There were many extra holes left over from the original Nemes Clarke receiver. These were either reused or covered with auto body putty. All controls were mounted into the front panel resulting in a stunning "old school" appearance.

On the Air

I had neither a 10 meter radio nor a 6 meter station before building this transceiver, so I set up 10 and 6 meter dipoles in my backyard to try it out. My first 10 meter SSB contact was into England, my second was Poland and my third was Italy. Not bad for my first-ever 10 meter contacts. An on-air demo is shown on a referenced link.[7] Measured performance is outlined in Table 1.

Learn Something New

It is now up to you to challenge yourself by building a custom transceiver. There is no better feeling than making DX contacts with a radio that you designed and built yourself. Borrow ideas and schematics from this radio to make yours even better. Send me photos once it is complete. I look forward to talking to you on the air soon!

Notes

[1] J. Hallas, W1ZR, "Homebrew Challenge III — And the Winner Is," *QST*, Apr 2012, pp 32-33.

[2] Lecture on AGC, IIT Madras is available at **www.youtube.com/watch?v=Xqiyvv2Maf0**.

[3] A video documentary is available at **www.youtube.com/playlist?list=PL0B78D8A3B74F467E&feature=plcp**.

[4] Additional documentation, complete bill of materials, additional photos and notes are posted on **www.arrl.org/qst-in-depth**.

[5] **www.cliftonlaboratories.com/si570_kit_from_k5bcq.htm**.

[6] *The ARRL Handbook for Radio Communications,* 2013 Edition. Available from your ARRL dealer or the ARRL Bookstore, ARRL order no. 4050 (Hardcover 4197). Telephone 860-594-0355, or toll-free in the US 888-277-5289; **www.arrl.org/shop**; **pubsales@arrl.org**.

[7] On-air demo available at **www.youtube.com/watch?v=Cdos7dlmod8**.

Greg Charvat, N8ZRY, is an ARRL member and has been a licensed Amateur Radio operator since 1993, currently holding a General class license. He enjoys restoring antique radio equipment including consumer broadcast band, amateur and military equipment. He also enjoys designing radio equipment from scratch using classic texts such as *Solid State Design for Amateur Radio* as a reference.

Greg earned his PhD in electrical engineering in 2007, his MSEE in 2003 and BSEE in 2002 from Michigan State University. He was a technical staff member at MIT Lincoln Laboratory from September of 2007 to November 2011, has taught short radar courses at the Massachusetts Institute of Technology, and is cofounder of Butterfly Network. He authored or coauthored many journals, proceedings, magazine articles and seminars on various topics including applied electromagnetics, synthetic aperture radar (SAR), phased array radar systems and RF and analog design. Greg is a Senior Member of the IEEE. You can reach Greg at 630 Old Clinton Rd, Westbrook CT, 06498 or at **charvatg@gmail.com**.

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Feedback

- In the "Power Supply Options" sidebar to "Have Fun Building the Simplest Transmitter" [Nov 2012, p 48] C1 and C2 are 8 μF, 450 V electrolytic capacitors. They are available from Antique Electronics Supply (**www.tubesandmore.com**), part numbeC-SA8-450.

- In "PSK-31 Operation on 2 Meter FM" [Dec 2012, pp 37-38] in Figure 1, the word "Ring" should be further to the right to line up with the contact for the right channel. The portion of the connector on the far left is the "sleeve." In addition, the tip should be shown to the right of the ring.

- In "Down Periscope!" [Jan 2013, pp 36-38] The galvanized steel pipe identified in the "Mounting Arrangement" section should be 1¼ inch, not 1½ inch diameter.

- In "A Sampling Down Converter for Low Frequency Oscilloscopes" [Jan 2013, pp 39-45] the description of L1 in Figure 2 is incorrect. Please use the description in the parts list instead. In Figure 3, the INPUT and OUTPUT terminals of U7 are shown reversed.

A Tilt-Over Antenna Mast Born of Necessity

A ham's physical limitations lead him to design a convenient mast.

Bruce Belling, N1BCB

While I have a capable 55 W home transceiver for 2 meters, it just wasn't enough to reach the repeaters in my area while using an indoor antenna. I live in the woods and in a slight hollow, which necessitated getting my antenna up high enough for line of sight coverage. Because of surgeries I am not allowed on ladders or roofs, so I had to devise a way to construct and raise a mast at least 25 feet high and be able to get it down quickly for service or impending hurricane strength weather.

The antenna I devised will also serve as a termination point for a horizontal loop HF antenna that is strung from tree to tree around my back yard. This antenna is pulled up to about 15 feet using a pulley and small line system. Releasing the line at the mast point allows me to lower the mast without disturbing the loop antenna. A neighbor performed the ladder part of this pulley installation. This horizontal loop plus a dipole antenna gives me two HF antennas that are attached to an antenna switch at my desk. This gives me plenty of HF flexibility.

Mast Construction Plan

To make the tower, I blocked two 8 foot 2 × 4s together with a enough space between them to clear a 2 × 4. The space was maintained by four 2 × 4 blocks and shims. Then I bolted a third 8 foot 2 × 4 between the two and at the top, so the single 2 × 4 fit 2 feet 8 inches between the two. Then I drilled a ⅜ inch hole 4 inches below the top of the joint and through all three boards. I inserted a ⅜ inch bolt to act as a pivot point (see Figures 1 and 2).

I drilled another ⅜ inch hole 2 feet below the first and inserted another ⅜ inch bolt. This served as the locking pin to keep the assembly together while the mast is raised. At the top of the single board, I fastened two 8 inch pieces of 2 × 4 lumber side by side and perpendicular to the single board. I used this as a backing plate to fasten two pipe brackets that hold the 14 foot long 1½ inch PVC pipe antenna mast. The bottom of the pipe was secured with two 2 × 4 blocks and another pipe clamp (see Figures 3 and 4).

Pipe Mast

I inserted a 10 foot long piece of wooden dowel up into the PVC pipe and fastened the bottom of it to the single board about 2 feet below the PVC pipe. This was to stiffen the PVC pipe and keep it in line with the 2 × 4 part of the mast when the mast is lowered. You may attach your antennas to the mast in a number of ways, depending on your requirements.

For my application, I put a 90° elbow at the top of the PVC pipe, then a 5 inch piece of PVC, another 90° elbow pointing up and added an 8 inch piece of PVC. The top 8 inch piece of PVC is used to attach my 2 meter J pole antenna. This gets the height up to just over 25 feet. I used the 5 inch piece of pipe to attach the guy lines for stability. Two guy lines ran to the building and one to a tree, giving me a three way triangle pattern and a stable mast in high winds.

In the middle of the main piece of PVC I put a four way fitting so I could add two spreaders. I put a T at the end of each spreader and a 5 foot piece of pipe in each. The reason for this is to provide a base for any vertical antennas I may want to put up in the future. I am in the market for a vertical that will cover 80 and 20 meters, but haven't yet selected one. Figure 4 and the lead photo show how this looks and works.

Raising and Lowering

To lower my antenna support, I only need to release one line to the building, one line to the tree and the line to the HF loop so that the mast will pivot down without having to take apart anything else. I left enough slack in the cable to allow for this movement. At first I had to raise and lower the mast by hand, which was a little tricky.

I installed a boat trailer winch just above the

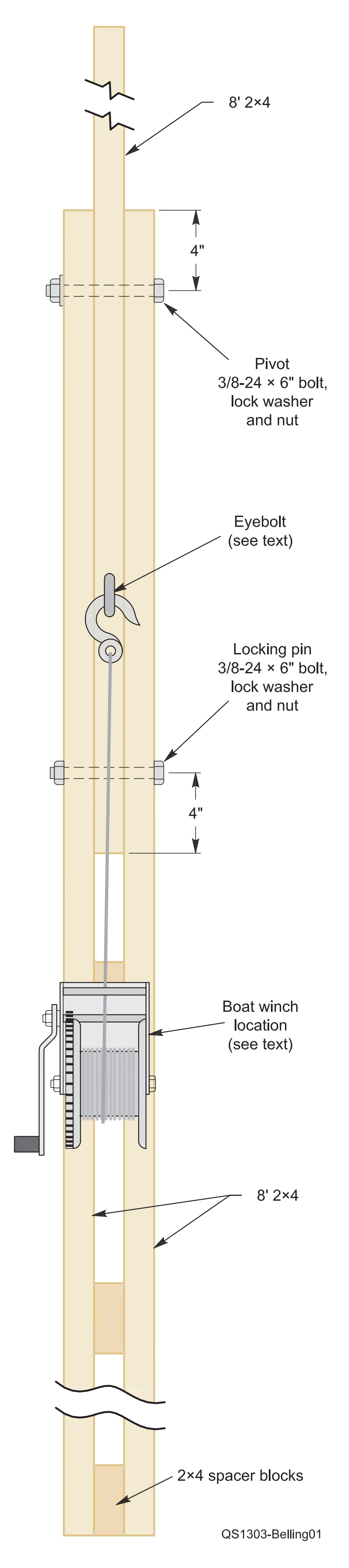

Figure 1 — Construction details of the lower mast section. The pair of 2 × 4s making the base are secured to the house.

Figure 2 — Close up of the lower mast section. Note the boat winch, winch cable and snap hook used to safely raise and lower the mast.

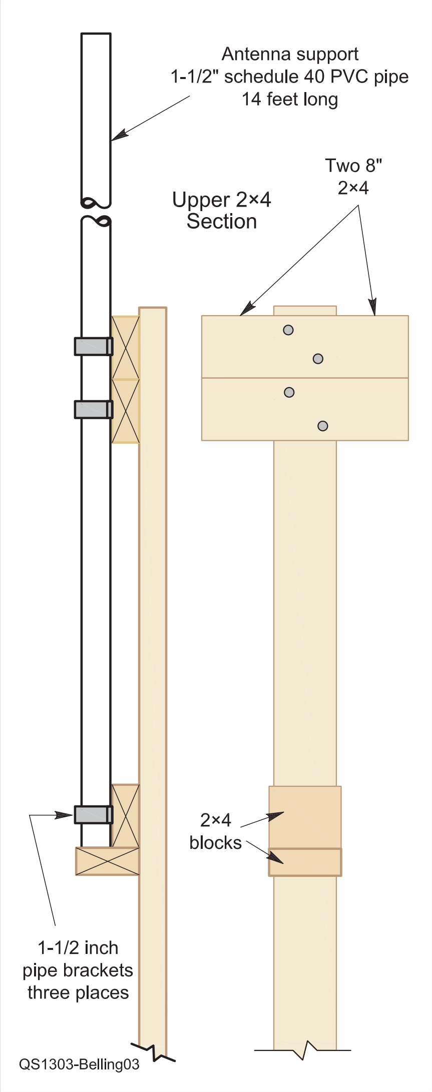

Figure 3 — Construction details of the upper mast section. The PVC pipe can be adapted to support your antenna systems.

Figure 4 — Close up of the upper mast section showing the antenna attachment methods employed.

hand rail (see Figure 2) and attached the cable to the butt end of the upper 2 × 4. Now all I have to do is loosen the cable a small amount, lock the winch, remove the locking pin and push the mast over enough to offset the balance. Then I unlock the winch and lower the mast. I find that this takes 10 minutes or less, and about the same to raise and tie and lock everything in place.

If there are any storm warnings indicating high winds, I drop the mast which, when in horizontal position, is only about 6 feet off the ground and 3 feet from the house. So far, the mast has been fine in winds up to 40 mph. I wouldn't worry too much about higher wind velocities but I would lower the mast if hurricane warnings came in.

Perhaps there are others out there with physical limitations such as mine who could use a plan like this, or would appreciate the convenience.

ARRL member and General class licensee Bruce Belling, N1BCB, has been licensed since 1995, but considers himself new to Amateur Radio, since he didn't buy his first radio until 2008. You can reach Bruce at 113 Brayton Point Rd, Westport, MA 02790 or at **jabrwest@charter.net**.

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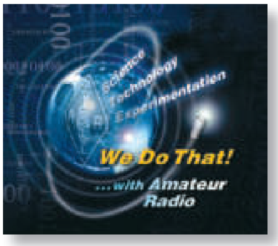
Strays

An Odd Coincidence

On January 4, 1972 Doug Bowles, VE4QZ, worked Dale Drake, WA7GMY, on 75 meters. Forty one years later — *to the day* — they randomly made contact again, this time on 10 meters. Dale is now W7GMY, which is a call sign once held by a Silent Key whom Dale knew and who used to live nearby — an amateur that VE4QZ also worked in April 1972!



The Case for Stacking Yagi Antennas

Stacking can provide additional gain and directivity in a small footprint, but also has other advantages.

Joel R. Hallas, W1ZR

Directional antennas such as Yagis are used to provide gain and directivity — to *focus* radio signals both to and from particular portions of the world. Antennas don't have gain in the same way that amplifiers do, they just rearrange the available power such that in some directions the signals are stronger. To receivers in the antenna's beam, the signals sound the same as if they did have an amplifier. Of course, that means in other directions the signals will be weaker — but sometimes that is a good thing too.

If Antenna Gain is Good, is More Better?

To make an antenna with more gain usually requires a bigger antenna structure. It also results in narrower beams of radiation. Again this can be a mixed blessing — yes, we're stronger in a particular direction, but we need to aim our antenna more and more carefully to get the energy where we want it.

We do have some choices, however. There are basically two ways to increase the gain of a Yagi array. First, we can increase the boom length and add more director elements (adding elements to an already properly designed Yagi without making the boom longer doesn't usually help), or we can use multiple Yagis spaced and fed properly to provide the desired gain. As with all design choices, there are tradeoffs involved — let's take a look. In this discussion, we will consider horizontally polarized antennas — the most frequently encountered at HF and for SSB and CW on V/UHF. For vertically polarized antennas, everything just flips by 90°.

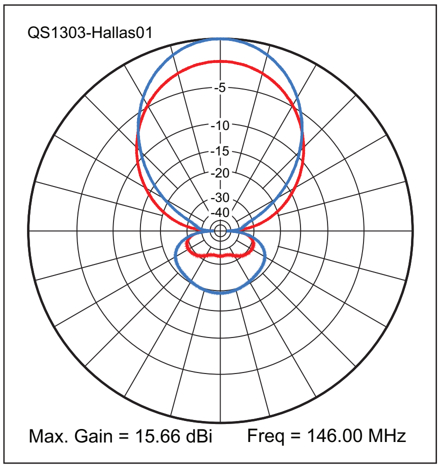


Figure 1 — Azimuth plots of 2 meter Yagi antennas. In red is a three element Yagi on a 2 foot boom, while in blue we have one twice as long. Note that the gain has increased not quite 3 dB, while the beamwidth has been reduced from 63.4° to 54.8°.

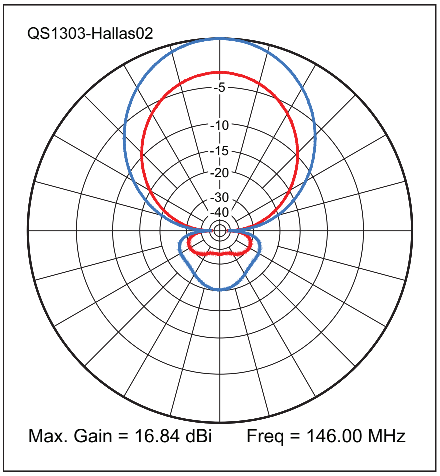


Figure 2 — Azimuth plots of 2 meter Yagi antennas. In red is a three element Yagi on a 2 foot boom, while in blue we have two such antennas, one 5⁄8 wavelength above the other, both fed in phase. Note that the gain has increased a bit more than 3 dB and the beamwidth is actually at 64°, about the same as the single Yagi.

A Longer Yagi

Doubling the boom length of a Yagi and adding and optimizing the element lengths and position will increase the gain by something less than 3 dB, or provide almost twice the received power at a distant location centered in the beam. It does this largely by narrowing the beamwidth, directly impacting the aiming accuracy. This can be seen in Figure 1, the azimuth plots of two 2 meter Yagis, one a three element on a 2 foot boom, the other with two more directors on a 4 foot boom. Note that the longer one is a design I quickly made in *EZNEC*, so it isn't quite optimized, but it still makes the point.[1]

Or a Taller Yagi

Instead of extending the boom and adding elements, we could also add another Yagi on top of the first. This is called *stacking*. In this case we also get additional gain with about the same boom length, but we need a taller mast. I chose a stacking distance of 5⁄8 wavelengths and realized a modeled gain of more than 3 dB.

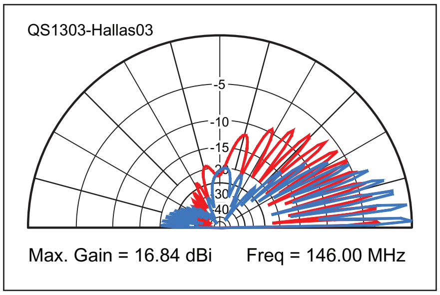


Figure 3 — Elevation plots of the single three element Yagi (red) and stack (blue). Note the reduction of higher angle signals in the stack. This energy has been focused at the lower angles to support long distance communication without reducing the azimuthal beamwidth.

Figure 2 tells the tale. We have higher gain with almost identical azimuth patterns, so avoid the aiming problems of the longer boom Yagi. What we have done in this case is to focus the energy from the higher elevations towards the horizon where we usually want it. This is illustrated in Figure 3.

So What's the Answer?

Both approaches yield higher gain than the single Yagi, and often arrays combine the methods with good results. While this discussion will mostly be of interest to V/UHF operators, serious HF operators often stack Yagis as well. In their case, by adjusting the phase, or just selecting different individual Yagis, they can optimize their signals for particular elevation angles.

The optimum for your situation may depend on physical and mechanical considerations — just be aware that both choices are available when you decide to add some more gain to your system.

Joel R. Hallas, W1ZR, is the Technical Editor of *QST*. You can reach him at **w1zr@arrl.org**.

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

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

The Technician 6 and 10 Meter Special

This coupled resonator addition makes for a simple Yagi for these two hot bands.

Larry King, N5AFY

I was inspired to adopt the modification described in the *QST* article, "Add 6 Meters to Your Triband Trap Yagi," to a commercial 10 meter Yagi.[1] This arrangement of that concept will provide directivity and gain for two of the most popular bands allocated to Technician class amateurs — in one compact package.

The article described the use of a coupled resonator driven element that operates without any direct connection to the 10 meter Yagi. This allows operation with a single feed line making it possible to avoid additional switching and lightning arrestors. I selected the Hy-Gain Model LJ-103BA three element 10 meter Yagi for this project after discussing the configuration with the original author, Joel Hallas, W1ZR.

It Pays to Check First

The article noted that the design was confirmed to work with split driven elements only. While the Hy-Gain's driven element is indeed split, it is matched using a beta match or hairpin impedance transformer so it is not just a split feed. Joel kindly modeled the proposed configuration and found that it would work with the beta match. [Note that other matching arrangements, such as gamma matches, will not work, at least according to the model. — *Ed.*]

Making it Fit the 10 Meter Beam

The boom of the Hy-Gain Model LJ-103BA is too short to allow the full spacing shown in the original article. Those dimensions, which fit within a full size tribander, don't make it into the shorter boom. There is, however, enough room for the compact version shown in Table 2 of the referenced article. This provides 0.15 wavelength director spacing, rather than the original 0.2 for a bit less forward gain.

Another problem particular to the selected 10 meter Yagi is that the two piece boom is fabricated from two 4 foot sections that join at the boom-to-mast clamp. While this was a fine arrangement for the original 10 meter design, the boom-to-mast clamp location interferes with the mounting of the 6 meter driven element. I solved this problem by purchasing a 5 foot length of 1¼ inch diameter aluminum tubing and using it for the reflector-to-driven-element portion of the boom. I maintained the same element spacing, just adjusted the position of the clamp so that the 6 meter driven element could fit between the 10 meter driver and the clamp. The slight change in balance is barely noticeable, but purists may wish to add a bit of weight to the director end of the boom to compensate.

Dimensions and Spacings

While it would have been possible to use the dimensions for the compact version in the article, I chose to make a few changes. First, instead of using insulated 6 meter elements as in the article, I used Hy-Gain boom-to-element clamps that electrically connect the center of each element to the boom. While this is a viable approach, it does require a change in element lengths. In addition, perhaps because of the beta match at the feed point, I found I needed to have the 6 meter driven element closer to the 10 meter driver than was predicted in the article. The resulting element dimensions and spacings are shown in Figure 1.

Construction Details

First, assemble the Hy-Gain Model LJ-103BA as described in the manual that is provided, with the exception of the change in the boom described above.[2] I chose to set mine up optimized for the Technician class frequencies, but any of the three choices in the manual should work equally well. Install the antenna in a location at least 12 feet above the ground — a temporary location is fine — and test the antenna on 10 meters. The SWR should be minimum in the selected segment of the band and, if you can hear a steady signal such as a beacon, check the front-to-back ratio (F/B) to confirm proper operation.

Once 10 meter operation is confirmed, add the 6 meter elements (see Figure 2) and return the antenna to its test location. If the SWR is not minimum near your desired frequency (typically 50.125 MHz for SSB operation) adjust the length and spacing of the 6 meter driven element until a satisfactory match is obtained. These two parameters interact, so be sure to record the dimensions and readings of all attempts as you adjust so you can identify trends and zero in on the best

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[1] Notes appear on page 47.

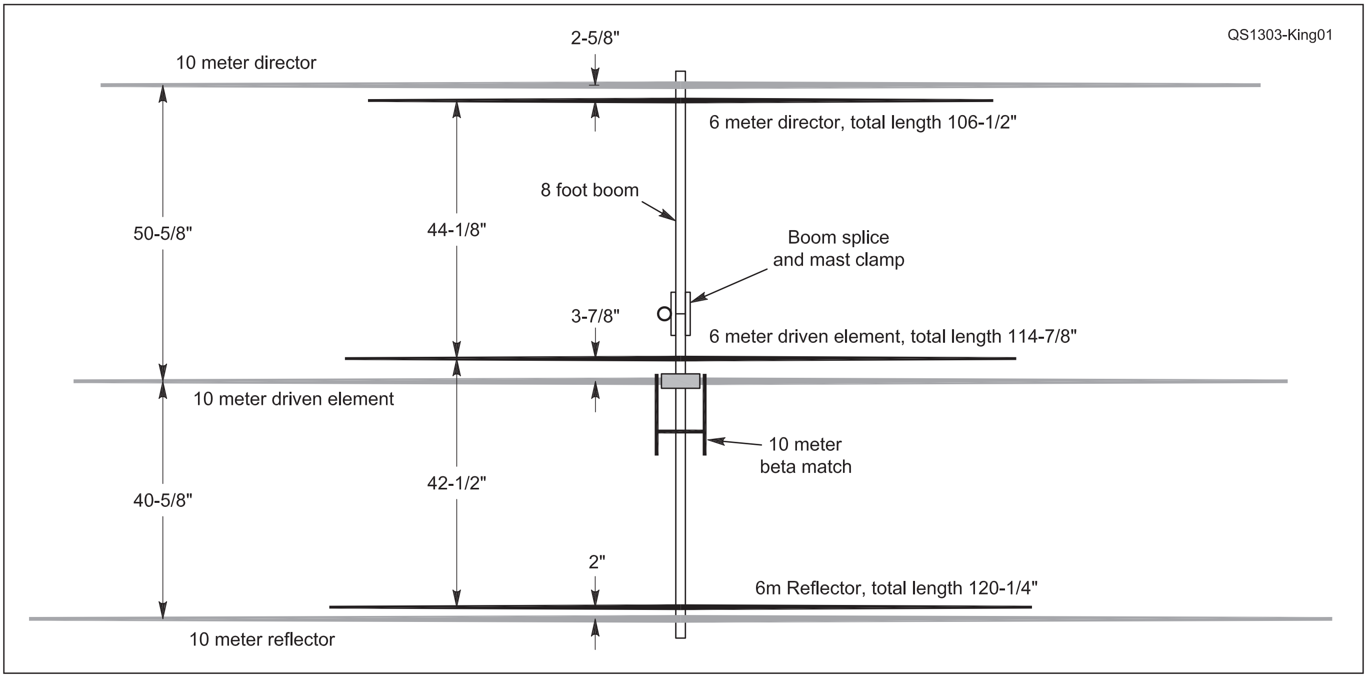

Figure 1 — Dimensions of the coupled resonator 6 meter Yagi as installed on the modified boom of a Hy-Gain Model LJ-103BA.

Figure 2 — Close-up view of the two band antenna. Note the beta match on the 10 meter driven element.

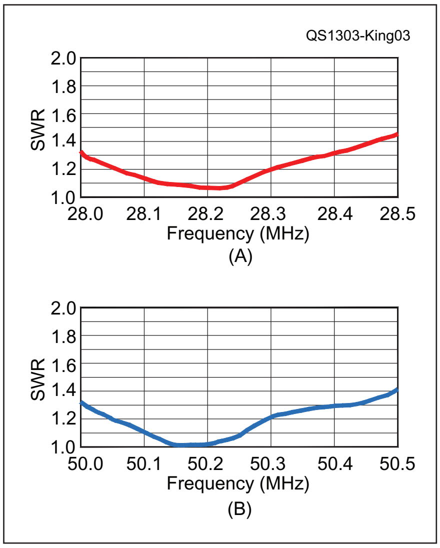

Figure 3 — Measured SWR of the antenna on 10 meters (at A) and 6 meters (at B). Measurements were taken with an MFJ-259 through 25 feet of LMR-400 coax.

setting. If you have a good steady signal source, you can try to optimize the dimensions for best F/B (best done by minimizing the rearward signal). Confirm that the forward gain is still good and recheck the SWR after any adjustments. If you don't want to go through that process, just use the dimensions from the original article if you have insulated elements, or use my dimensions if the 6 meter elements are connected to the boom.

Results

I have been quite happy with my results. The antenna is well matched on both bands (see Figure 3) and provides good performance as well. I have tested the gain and F/B between my station and KF5NML at a distance of 37 miles. We still have the same S-5 signal as before on an earlier homebrew 6 meter three element Yagi, and when I turn the back of the beam toward him I lose him completely. The 10 meter Yagi provides a dramatic improvement compared to my commercial multiband vertical. A signal that is S-7 on the vertical goes to 20 dB over S-9 on the Yagi, and disappears completely off the back.

Notes

[1] J. Hallas, W1ZR, "Add 6 Meters to Your Triband Trap Yagi" *QST*, Sep 2011, pp 40-42.

[2] A copy of the manual is available for download from the Hy-Gain website at **www.hy-gain.com/Product.php?productid=LJ-103BA**.

ARRL member and Advanced class licensee Larry King, N5AFY, has been licensed since 1977 and enjoys building homebrew antennas. He received his pilot license in 1973 and FCC Third Class Commercial Radio Telephone operator license in 1988. Larry completed many Lucent Technologies wireless and switching system training courses as well as courses at Tulsa Technical College.

Larry was a Senior Communication Service Technician with Western Electric, AT&T Technologies and Lucent Technologies from 1966 until he retired in 2002. While employed there he constructed, tested and turned to service many cellular wireless sites. Since retirement, he serves as a part time armed security officer at the Tulsa World Publishing Company. He thanks his brother and new Technician licensee Gary, KF5NML, for all his help.

You can reach Larry at 506 W Teel Rd, Sapulpa, OK 74066-6249 or at **n5afy@att.net**.

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

The Sun and the Ionosphere

The relationship between the Sun and our ionosphere establishes the limits of HF propagation.

Carl Luetzelschwab, K9LA

My article "Our Recent Solar Minimum and Sunspot Cycle 24 Progress," which appeared in the July 2012 issue of *QST,* reviewed the solar minimum period between Cycle 23 and 24. It also presented the latest data (at the time the article was written) for the progress of Cycle 24. Now let's take a look at the relationship between the Sun and the ionosphere.

Update on Cycle 24

The latest Cycle 24 data in my previous article was for February 2012. Figure 1 updates the data shown in Figure 6 in that article, but now in terms of the 10.7 centimeter solar flux.

Cycle 24 was ascending nicely (in terms of the smoothed 10.7 centimeter solar flux) until mid 2011. Then it leveled off for several months before having a short growth spurt. The latest data (December 2012 for the monthly value, which is then used to compute the June 2012 smoothed value) again shows a leveling off — and even a slight decrease. Could this be the maximum of Cycle 24?

According to the current solar cycle predictions from the Marshall Space Flight Center (**solarscience.msfc.nasa.gov/predict.shtml**) and from the International Space Environment Service (**www.swpc.noaa.gov/SolarCycle/**), we still have a little bit to go before solar maximum. Only time will tell how accurate these predictions are. I should mention that preliminary January 2013 monthly data shows a significant increase in solar activity, which has brought the higher bands back to life.

Measuring the Sun

I've mentioned sunspot numbers and 10.7 centimeter solar flux, and I've used them interchangeably. Why do we have two parameters and how are they related?

Sunspot reports are the oldest direct record of the activity of the Sun. Our *official* data starts in 1749, and this data shows the ups and downs of solar activity in approximately 11-year cycles. Sunspot numbers can be considered a *subjective* measurement, since visual counting is required and there is some human interpretation in the counting process. Sunspots also require a clear view of the Sun — we can't see them through clouds!

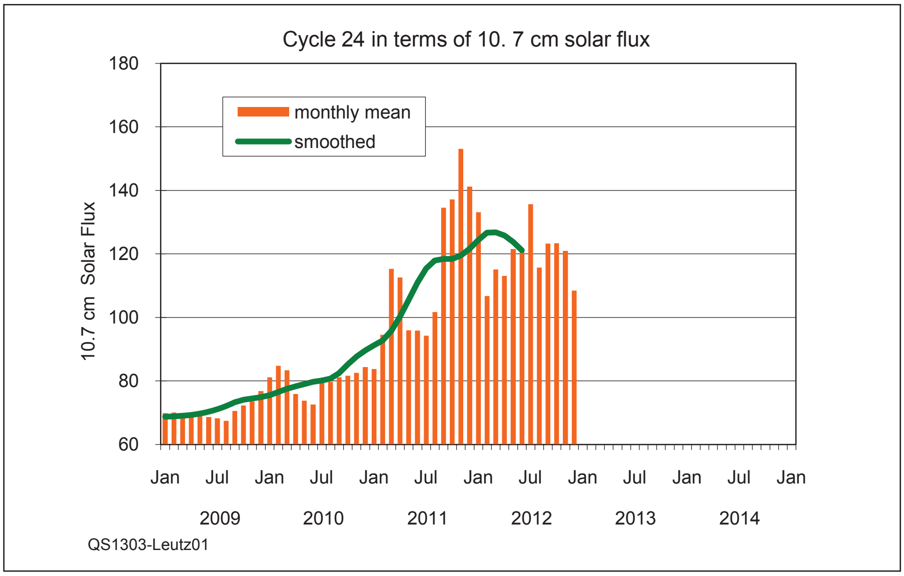

Figure 1 — Latest Cycle 24 data as of December 2012.

Measurements of the 10.7 centimeter solar flux began in 1947. This parameter is a measurement of the radiation from the Sun at a wavelength of 10.7 centimeters — a frequency of around 2800 MHz.[1] Although the data doesn't extend back in time as far as sunspot data, the 10.7 centimeter solar flux parameter is preferred as it can be considered an *objective* measurement since it's a measurement from the output of a receiver — no need for human interpretation.

On a daily basis, sunspots and the 10.7 centimeter solar flux are not well correlated. Even on a monthly basis (the average over a month), the correlation is not too good. But on a 12 month running average basis (this is called the *smoothed* value), the correlation is extremely high. The equation you see in the ionospheric literature is for translating between smoothed values.

More importantly, if you take the daily sunspot number or daily 10.7 centimeter solar flux and plot it over a long period of time, you'll see that the data is very spiky. Even if you use the daily values and plot the monthly mean (average) values, the data will still be spiky and it would be difficult to determine trends in solar activity. Thus the smoothed value of the sunspot number or the 10.7 centimeter solar flux is used to officially measure a sunspot cycle.

Measuring the Ionosphere

At every point on Earth there is an electron density versus altitude. This electron density profile varies according to the time of day, the day of the year and the phase of the solar cycle. It is also affected by other factors that will be discussed later. In lieu of defining a complicated electron density profile for propagation purposes, we can simplify this into two parameters that allow us to estimate the MUF (maximum usable frequency) for any given path at any given time.

These parameters are the maximum electron density of the E region and the maximum electron density of the F2 region. The two maximum electron densities can be related to frequency through a simple equation. The resulting frequencies are called *critical frequencies*. The critical frequency is the

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[1] J. White, VA7JW, and K. Tapping, "The Penticton Solar Flux Receiver," *QST* Feb 2013, pp 39-45.

highest frequency that will be reflected back to Earth from each of the regions at vertical incidence (straight up). The critical frequency of the E region is abbreviated foE and the critical frequency of the F2 region is abbreviated foF2, where the lower case “o” refers to the ordinary wave (the ordinary wave is one of two characteristic waves that propagate through the ionosphere, with the other being the extraordinary wave).

The critical frequencies are measured by the use of *ionosondes*. Ionosondes are essentially HF radars looking straight up. These vertical incident parameters are easily translated to E region and F2 region MUFs at oblique angles (for propagation at low elevation angles) through the inverse of the sine function applied in spherical geometry (because the Earth-ionosphere system is a spherical system).

The Formation of the Ionosphere

The ionosphere is that portion of the atmosphere from about 60 kilometers to over 1000 kilometers. For our radio endeavors on the HF bands (3-30 MHz), we are interested in three regions of the ionosphere: the D region (roughly 60 to 90 kilometers and a detriment to propagation due to absorption), the E region (with its peak electron density around 110 kilometers), and the F2 region (its most important altitudes are from about 200 to 400 kilometers and it is responsible for most of our DX contacts).

Solar radiation at different wavelengths ionizes the three regions of the ionosphere. Radiation at wavelengths from 0.1 to 1 nanometers (*hard* x-rays) and radiation at 121.5 nanometers ionize the D region. The E region is ionized by radiation at wavelengths from 1 to 10 nanometers (*soft* x-rays). Radiation at wavelengths from 10 to 100 nanometers (ultraviolet) ionizes the F region. Note that shorter wavelengths are generally needed to ionize the lower altitudes of the atmosphere because the shorter wavelengths have the necessary higher energy (per Planck’s law) to get down to the lower altitudes.

Now’s a good time to point out that solar radiation at 10.7 centimeter wavelengths (with energy about 1,000,000 times less than needed to ionize the F2 region) and sunspots have nothing to do with the ionization process. These parameters are *proxies* for the true ionizing radiation.

The Correlation Between the Sun and the Ionosphere

Okay, now that we have some fundamental knowledge of the Sun and the ionosphere, we can come up with the correlation between what the Sun is doing and what the ionosphere is doing. This should be easy, right? All we have to do is download solar data (we’ll use the 10.7 centimeter solar flux) to determine what the Sun is doing and compare it to data from an ionosonde (we’ll use the F2 region MUF as it’s the most important data for our long distance HF communication) to determine what the ionosphere is doing. Once we come up with the correlation between these two data sets, we’re on our way to developing a model of the ionosphere for propagation prediction purposes.

Once we come up with the correlation between these two data sets, we’re on our way to developing a model of the ionosphere for propagation prediction purposes.

Figure 2 is a plot of the F2 region MUF over the Wallops Island, Virginia ionosonde for a 3000 kilometer hop centered on the ionosonde and the 10.7 centimeter solar flux for every day in October 2012. October 2012 was one of several months with some great 10 meter propagation, so we should expect to see some MUFs at and above 28 MHz.

Indeed, the month of October had MUFs higher than 28 MHz during the first week in October and for mid October until the end of the month (although the ionosonde didn’t have any data for the last three days). The Wallops Island ionosonde is generally on the way to Europe from the southern US, so it’s a good indicator of what the ionosphere is doing for contacts from W4/W5 to Europe.

As for a correlation between the F2 region MUF and the 10.7 centimeter solar flux, the MUF was kind of flat for the first week while the 10.7 centimeter solar flux was decreasing. That’s not what we expected. We expected a decreasing MUF as the 10.7 centimeter flux was decreasing. The MUF was generally on the rise beginning mid month when the 10.7 centimeter solar flux was rising — what we expected. Towards the end of the month the MUF kind of held up while the 10.7 centimeter solar flux was again decreasing — again, not what we expected. We expected a decreasing MUF for decreasing 10.7 centimeter solar flux.

Based on the above paragraph, the correlation between the daily 10.7 centimeter solar flux and the daily F2 region MUF is a little confusing. A better way to look at this correlation is through a scatter diagram.

Houston, We Have a Problem

Figure 3 is a scatter plot of the daily F2 region MUF and the daily 10.7 centimeter solar flux data in Figure 2. Each green data point is the MUF on a given day and the 10.7 centimeter solar flux on the same day.

The red line is a linear trend line that best fits the data. The red R^2 value in the upper right corner is the correlation factor between the two parameters. If the correlation factor is 1, the correlation would be perfect — each data point would fall right on the trend line. In other words, you could take a 10.7 centimeter solar flux value and translate it into a unique MUF value.

If the correlation factor is 0, the correlation would be non-existent — each data point would fall far from the trend line. Given a 10.7 centimeter solar flux, you’d have extreme difficulty in pinning down a MUF value.

The trend line suggests that the MUF

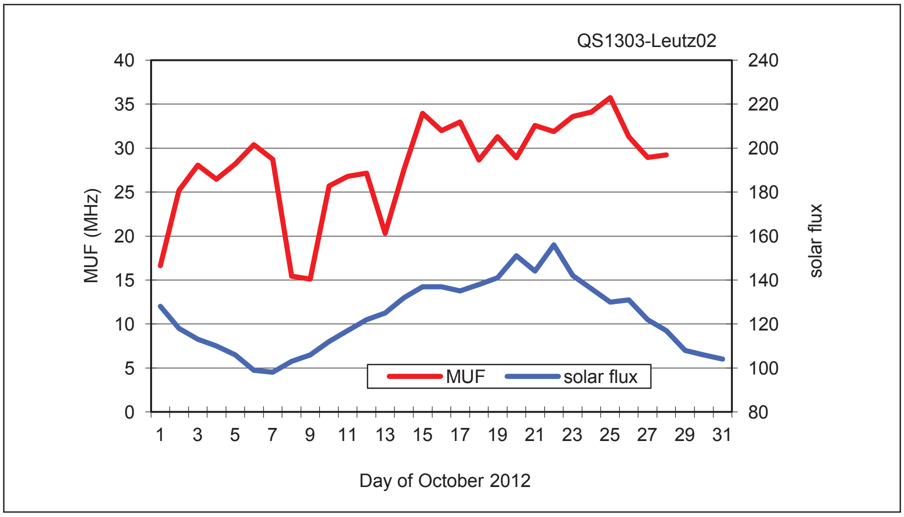

Figure 2 — Daily 10.7 centimeter solar flux and daily F2 MUF.

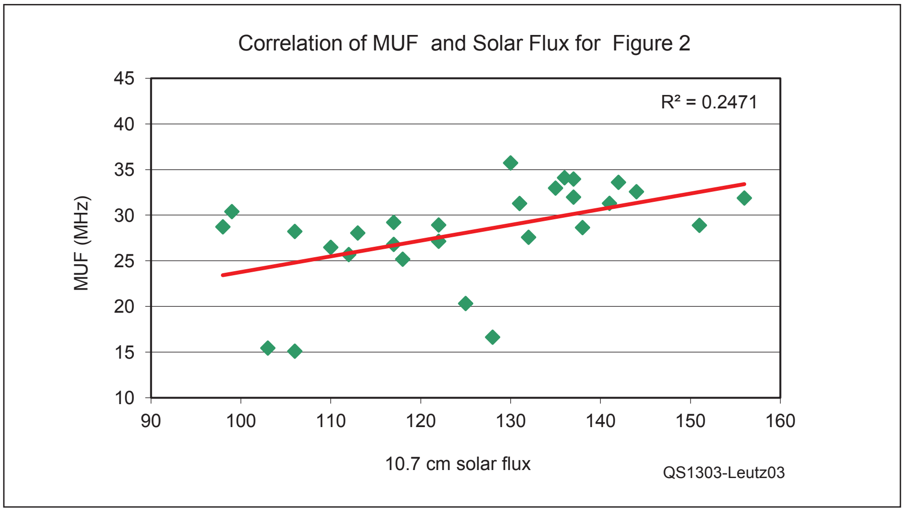

Figure 3 — Scatter diagram for 3000 km path over Wallops Island in October 2012.

Useful Propagation Literature

The ARRL Antenna Book, 22nd Edition, Chapter 4. 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**.

R. Brown, NM7M (SK), *Little Pistol's Guide to HF Propagation*, WorldRadio Books, 1996, out of print but available at **myplace.frontier.com/~k9la**.

G. Jacobs, W3ASK, T. Cohen, N4XX, and R. Rose, K6GKU, *The NEW Shortwave Propagation Handbook*, CQ Communications, 1995.

increases as the 10.7 centimeter solar flux increases. But the correlation factor is only 0.2471. That's more on the *non-existent* correlation side than on the *perfect* correlation side. Given a 10.7 centimeter solar flux of, say, 106, all you could say is that on one day the MUF could be around 15 MHz and on the other day the MUF could be around 30 MHz. That's a mighty big spread for the same 10.7 centimeter solar flux, and our conclusion here is that the daily MUF is not well correlated to the daily 10.7 centimeter solar flux (or the daily sunspot number, for that matter). We could have plotted data from another ionosonde and from a different time and month and phase of a solar cycle, but the result would still be the same — we can't identify a unique daily MUF for a given daily 10.7 centimeter solar flux value.

Our Model of the Ionosphere

So what's the problem? The problem is that solar radiation isn't the only factor that determines the ionization in the ionosphere. Yes, solar radiation *instigates* the ionization process, but two other factors (processes involving geomagnetic field activity and processes involving events in the lower atmosphere coupling up to the ionosphere) contribute to the electron density at any given point on Earth.

Once the developers of our propagation prediction programs realized there wasn't a good correlation between daily values, they searched for an acceptable correlation. For what the Sun was doing, the parameter turned out to be a smoothed solar index (either smoothed 10.7 centimeter solar flux or smoothed sunspot number), which is a running 12 month average of a monthly parameter. For what the ionosphere was doing, the parameter turned out to be monthly median values (median implies a 50% probability).

What this says is our propagation predictions are statistical in nature over a month's time frame. Thus the proper way to use our propagation predictions is to input a smoothed solar index, and realize that the MUF output (along with the signal strength output) is the median value for the month with a distribution about the median. Thus all we can say from our propagation predictions is that 10 meters, for example, will be open on, say, 40% of the days of the month. But unfortunately we don't know which days will be the "good" days.

As our models of geomagnetic field activity and events in the lower atmosphere coupling up to the ionosphere become more sophisticated, we may someday see a true daily model. Of course that will take some of the mystique out of HF propagation, but that's where we're headed.

ARRL Life Member Carl Luetzelschwab, K9LA, received his Novice license (WN9AVT) in 1961, and picked K9LA in the mid 1970s when the FCC first allowed Amateur Extra class licensees to select 1×2 call signs. Carl graduated from Purdue University with a BSEE (1969) and an MSEE (1972) degrees. Carl is an RF design engineer by profession, working mostly in power amplifiers, for Raytheon (formerly Magnavox) in Fort Wayne, Indiana. Carl enjoys writing and speaking about propagation, contesting (he was *NCJ* Editor from 2002-2007), DXing (he's at the Top of the Honor Roll), and playing with antennas. You can reach him at **k9la@arrl.net**.

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

New Products

Tinned Copper Antenna Rope from ABR Industries

ABR Industries is now offering a specialized tinned copper antenna rope. According to ABR, this material is very flexible and won't stretch, won't oxidize and is easy to solder. It is said to be the same material the US Army uses for antennas. Price: less than 100 ft, $0.80/ft; 100 ft, $75; 250 ft, $180; 500 ft, $345. For more information visit **www.abrind.com**.

Product Review

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

Tokyo Hy-Power Labs HL-550FX Linear Amplifier

This lightweight 550 W amplifier works equally well at home or on the go.

Reviewed by Mark Wilson, K1RO
Product Review Editor
k1ro@arrl.org

Years ago I owned a Heathkit SB-200 linear amplifier. It covered 80 through 10 meters and put out somewhere around 600 W on a good day. Although it didn't pack the punch of the legal limit amplifiers of the day, the price was right, it worked with my existing 120 V household outlet and it offered a significant signal increase over my barefoot transceiver. These amps were very popular, and Heathkit sold loads of them.

There is still demand for medium power amplifiers that can make a useful contribution to signal strength without breaking the bank. The Tokyo Hy-Power HL-550FX reviewed here is a desktop solid state amplifier that covers 160 through 6 meters. It's rated at 550 W PEP output for SSB and CW on HF and 500 W on 6 meters.

Operators who enjoy DXpeditions, ARRL Field Day and other activities away from home will appreciate the HL-550FX's compact footprint and especially its light weight — about 21 pounds. A carrying handle on one side and rubber feet on the other make it easy to transport. Cooling air is drawn in through a muffin fan on the back and escapes through vents in the top panel. The fan is fairly quiet and I hardly noticed it with headphones on.

Inside the Cabinet

The power amplifier (PA) module uses four Microsemi VRF150 power MOSFETs configured as a parallel push-pull amplifier operating in class AB. On the input side, the amplifier has a 6 dB attenuator to bring the required drive level in line with typical 100 W transceivers. We were able to drive the amplifier to its rated output with 50 to 80 W, depending on band. On the output side, switched low-pass filters ensure that harmonics and spurious emissions are within legal limits.

A built-in switching power supply contributes to the amplifier's light weight. The supply provides 44 V dc at high current for the PA MOSFETs. Power line requirements are flexible, another plus for operation away from home. The amplifier requires 100-130 V (15 A maximum) or 200-260 V (7.5 A maximum) 50/60 Hz ac. There are no jumpers or switches to move when changing from 120 to 240 V, but be sure you have the right fuses installed. The amplifier comes with a pair of 15 A fuses installed for 120 V operation. The accessory bag includes a pair of 8 A fuses for 240 V operation, along with spares for the other fuses in the amplifier. The ac line fuse holders are easily accessible from the top panel. Our amplifier came with a detachable power cord and standard 120 V, 15 A ac plug.

The HL-550FX includes protection against equipment malfunction or operator error. Front panel LEDs under the PROTECT heading will tell you what is wrong. When O.DRIVE lights, the drive power is too high or you have selected the wrong band (I know this one works...). The O.DRIVE LED may also light if over-current protection kicks in when you are operating the power supply from a 120 V line. PR lights if reflected power reaches 80 W. If the MOSFET drain voltage exceeds safe levels, O.VOLT lights. If one of the internal fuses on the PA board has failed from excessive drain current, the FUSE indicator illuminates. (The manual says this rarely happens and may mean the MOSFETs have failed.) If the power amplifier heat sink temperature reaches 80º C, the O.HEAT is illuminated.

If a protection circuit trips, the HL-550FX switches to standby. You can reset the amplifier by turning the ac power off and on. If it's an over-temperature or over-current problem, the amplifier will not reset for at least 5 minutes, a limit of the power supply on 120 V ac only, giving you time to ponder the error of your ways.

Putting the HL-550FX on the Air

The instruction manual devotes 18 pages to setup, operation, cautions, circuit description and troubleshooting. That's followed by seven pages of color photos of the circuit boards and interior layout and six pages of schematic diagrams.

It couldn't be easier to integrate the HL-550FX into your station. The rear panel has SO-239 jacks for the transceiver and antenna as well as phono jacks for TR switching (STBY) and ALC connection. The accessories bag includes a short RG-58 cable for connection to your transceiver and two phono plugs. Ground the STBY jack to transmit. I have a good 120 V line in my station, so I used that

Bottom Line

The Tokyo Hy-Power HL-550FX solid state linear amplifier covers 160 through 6 meters in a compact package that weighs about 21 pounds. Its small footprint makes it easy to pack up and take somewhere or tuck away in a corner of a home station.

Table 1
Tokyo Hy-Power Labs HL-550FX, serial number 1010059

Manufacturer's Specifications	Measured in ARRL Lab
Frequency range: All amateur frequencies in the range of 1.8 to 54 MHz.	As specified.
Power output: HF, 550 W typical, on 240 V ac, 500 W on 120 V (RTTY, SSTV, FM 250 W continuous); 50 MHz, 500 W typical.	As specified.
Driving power required: 65 to 90 W typical.	50 to 80 W typical.
Spurious and harmonic suppression: Not specified.	HF, –55 dBc, worst case*; typically –60 to –70 dBc; 50 MHz, –61 dBc; Meets FCC requirements.
Third order intermodulation distortion (IMD): Not specified.	3rd/5th/7th/9th: –30/–43/–50/–57 dB below PEP (14 MHz, 550 W PEP output).
Primary power requirements: 100-130 V, 15 A or 200-260 V, 8 A, 50/60 Hz, 1300 kVA max.	Transmit, 1100 W typical at 117 V ac at 550 W PEP RF output; standby, 35 W.
Size (height, width, depth): 5.7 × 9.1 × 16 inches (including fan); weight: 21 lbs.	
Price: $3000.	
*12 meters, at maximum output.	

rather than wiring a 240 V line.

If you have more than one antenna, you'll need an external antenna switch that can handle the power. The HL-550FX will quickly go to standby when the SWR exceeds the protection limits (about 2:1 SWR), so you may need to do some antenna adjustment if you don't use a high power antenna tuner.

The ALC connection is useful for avoiding overdriving the amplifier, especially because the drive power requirement varies by band. You can keep the transceiver's power control setting constant, and the amplifier ALC signal will help the transceiver adjust drive as needed. The manual gives detailed instructions for setting ALC, along with some typical ranges for various transceiver brands. ALC output can be adjusted to up to –10 V using the rear panel ALC ADJ knob.

Using the HL-550FX is straightforward and less involved than the manual tuning procedure for my old SB-200. Flip the POWER rocker switch, set the OPER/STBY rocker switch to OPER, select the band and you're good to go. The rotary BAND switch has positions for 1.8, 3.5/3.8, 7, 10/14, 18/21, 24/28 and 50 MHz. Yes, the HL-550FX works on 30 meters, but remember the 200 W PEP legal limit on that band. As I grow older and lazier, I might wish for automatic band switching to follow my transceiver and switching for more than one antenna — features that are available at the next step up with Tokyo Hy-Power's HL-1.5KFX amplifier.

You can keep an eye on important operating conditions with the analog panel meter. A METER switch selects P_F (forward power, 1 kW), P_R (reflected power, 100 W), V_D (drain voltage, 60 V) or I_D (drain current, 50 A).

With 550 W output, the amplifier provides more than 7 dB gain over a barefoot 100 W transceiver. That's just over an S unit, a noticeable increase if signals are weak or the band is crowded. I usually operate without an amplifier and noticed a difference right away, particularly on SSB and RTTY modes.

After reading the manual, I questioned the safe power level for RTTY operation. In one place, the manual says 250 W maximum, and in another it seems to suggest reducing the output power 20-30% (to about 400 W). An email to THP USA technical support brought a quick response from Tom Rum, W5RUM, who forwarded my question to THP President Nobuki Wakabayashi, JA1DJW. I learned that for continuous operation with RTTY, FM or other high duty cycle modes, the maximum output is 250 W. For intermittent RTTY operation that mixes short transmissions with listening periods, Tokyo Hy-Power recommends 400 W output. The amplifier's overcurrent and over-temperature protection circuits will let you know if you overdo it. I ran the amplifier at about 400 W output for several hours on 40, 20 and 15 meters during the 2013 ARRL RTTY Roundup contest, and it worked flawlessly.

As with other Tokyo Hy-Power amplifiers we've reviewed, the HL-550FX uses high speed mechanical antenna relays that will keep up with full break-in CW (QSK) up to at least 35 WPM (I didn't try it faster than that). The amplifier's TR relay clicking is noticeable, about as loud as the relays in my transceiver. With headphones it's fine for occasional use, but if high speed QSK CW is your main interest you may prefer equipment with PIN diode or vacuum relay switching.

The HL-550FX performed effortlessly in the ARRL Lab and in my station. It's a compact, lightweight medium power amplifier that is easy to hook up and use.

US Distributor: Tokyo Hy-Power Labs, USA, 6045 FM 2920 Rd, Suite 133, Spring, TX 77379; tel 713-818-4544; **support@tokyohypower.com**; **www.tokyohypower.com**. Available in the US exclusively from Ham Radio Outlet, **www.hamradio.com**. Repair and warranty service for Tokyo Hy-Power amplifiers is handled by Audio Visual Service Labs (AVSL), 829 Lynnhaven Parkway, Suite 128, Virginia Beach, VA 23452; **www.avsl.net**.

See the Digital Edition of *QST* for a video overview of the HL-550FX amplifier.

MFJ-976 and Palstar BT-1500A High Power Balanced Antenna Tuners

Reviewed by Joel R. Hallas, W1ZR
QST *Technical Editor*

The two antenna tuners in this review are specially designed to match balanced loads such as antennas fed with balanced feed line. They use inherently balanced — but different — design architectures. The MFJ-976 has a dual T network, while the Palstar BT-1500A uses a dual L network. Both topologies were described in an earlier review that compared several balanced tuners to the classic E. F. Johnson Matchbox of the 1950s.[1]

Both review units provide comprehensive metering, and each has a single active output port for connection to the antenna feed line. For stations with coax fed antennas and a dummy load in addition to an antenna fed with balanced line, a coax switch or patch panel must be provided on the input side of the tuner. (Most tuners designed with unbalanced loads in mind include antenna switching.)

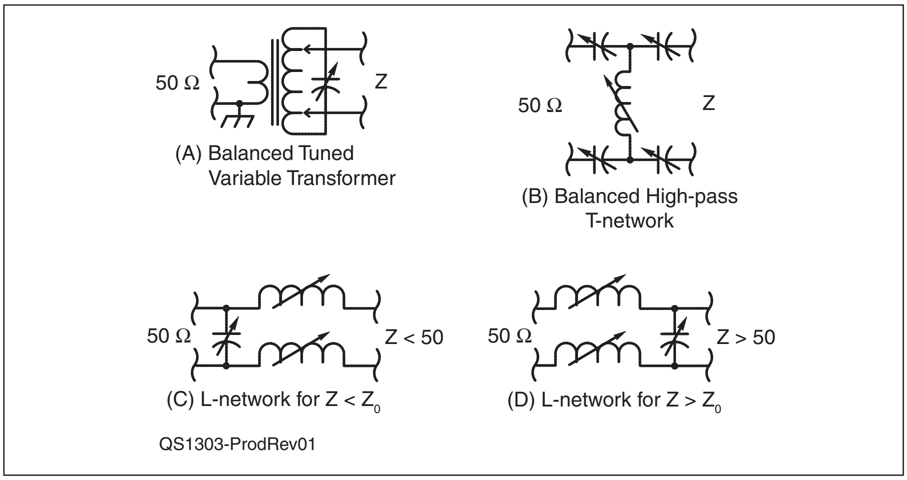

Figure 1 — Antenna tuner configurations for tuning balanced loads. At (A) is the traditional tapped parallel tuned circuit — in use since the 1920s and the basis of the popular 50s vintage E. F. Johnson Matchbox series of antenna tuners. The configuration at (B) represents the circuit of the MFJ-976. The configurations at (C) and (D) represent the circuit of the Palstar BT-1500A with capacitors relay switched between the two ends of the inductors to match different impedance loads. Note that topologies (B) through (D) all require a 1:1 balun or choke, not shown, on the left side to properly feed unbalanced coax.

Both of these tuners connect to their balanced loads via exposed terminals on the rear panel. Protect these terminals from coming into close proximity to people, animals or possible short circuits or arc points. With the typical high impedance loads encountered, the voltage can be well into the kilovolt range if the tuner is operated near the legal limit.

MFJ-976 1500 W Balanced Antenna Tuner

The MFJ-976 is described as a legal limit tuner rated to match loads from 12 Ω (4:1 SWR) to 2000 Ω (40:1 SWR) from 1.8 to 30 MHz. The range of complex (resistive plus reactive) loads is not specified, but it may be reasonable to expect it to match those loads within similar SWR limits. Most amateur antennas, after all, exhibit complex impedance on many frequencies.

Tuner Configuration

The MFJ-976 uses a dual T configuration, with series capacitors (two on each side) and a single shunt roller inductor (see Figure 1B). All tuning elements are continuously variable. The '976 is designed to transform the impedance of a balanced transmission system first to a balanced 50 Ω impedance and then through a 1:1 common mode choke "balun" to an unbalanced 50 Ω impedance for connection to a typical transceiver or power amplifier.

Adjustments are made with three controls: the dual TRANSMITTER capacitor, the rotary INDUCTOR and the dual ANTENNA capacitor. The capacitors have smooth 5:1 vernier knobs that make tuning easy and provide pointer resettability to within about 1⁄50 of the range. The rotary inductor includes a three digit turns counter dial that also aids resettability. It sounds like a lot of effort to get all three controls to a place that provides a match, and it can be. Fortunately, in many cases, only one of the capacitors requires fine adjustment.

Bottom Line

The MFJ-976 provides a good value in an antenna tuner that can match most balanced antenna systems on most bands. It can handle both its rated SWR and rated power simultaneously at high impedances. The built in peak and average wattmeter is also a real plus.

A competent dual needle power meter measures average or peak power in two power ranges — 300 or 3000 W full scale. The meter lamps need 13.8 V dc, the only tuner subsystem requiring power.

Operating the MFJ-976

The MFJ-976 is relatively easy to set up and operate. There are two coax connectors on the rear panel, one for the input and one output for use only if the tuner is to be used with an unbalanced antenna system. An insulating block includes two terminals for balanced feed lines, each equipped with a wing nut. Single wire antennas are to be connected to the upper balanced line terminal and fed against the tuner's GROUND terminal.

While it is implemented as a balanced tuner, the '976 includes jumpers that ground one side of the balanced output, and it has a coax connector in parallel with the other side to allow use with coax fed unbalanced antennas. An insulating block includes two more terminals with wing nuts adjacent to the ground terminal. To use the tuner with unbalanced loads, the two aluminum shorting bars are swung into place to short the two terminals together and to strap the lower terminal to ground. While this is a workable system, it is important that the bars not loosen and shake

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[1] J. Hallas, W1ZR, "A New Generation of Balanced Antenna Tuners," Product Review, *QST*, Sep 2004, pp 60-66.

into shorted position while using a balanced load — I would be inclined to remove them and put them in a desk drawer until they're needed. The output coax connector is tied to one side of the balanced output, so either an unbalanced or a balanced load can be connected, but not both at the same time.

Using the tuner is relatively straightforward. The manual provides multiple suggested starting points for each band for three different resistive loads. Preset the controls, apply a small amount of RF and move each control to find the spot that provides the best match as indicated on the reflected power scale of the meter. Set the meter to AVERAGE power for adjustments as the delayed needle movement needed for PEAK readings masks changes in tuning.

For some loads, a null in reflected power is found quickly, starting from the suggested settings in the manual. For other loads it can take a lot of adjustment to zero in and reach a matched setting. As the manual notes, in many cases more than one matched setting can be found, and the one with the least inductance is usually most efficient. It can be a tedious process, and you will definitely want to record the settings for each segment of each band once you've found them.

In comparing the two tuners, the rotary inductor in the Palstar operates somewhat more smoothly, and it has a slightly more readable turns counter. The MFJ-976 we tested was actually provided under warranty from MFJ. The first one had intermittent contacts as the inductor was rotated and we could not use it.

On the Bench

The MFJ-976 was able to match all the resistive loads we tested, ranging from 11.5 Ω (4.3:1 SWR) to 800 Ω (16:1 SWR), on all bands as shown in Table 2. As with many tuners we've reviewed, the loss near the edges of the operating impedance ranges was higher (in some cases much higher) than loss for those impedances closer to a matched condition.

We found frequencies where the MFJ-976 could be adjusted to obtain a match with open or shorted terminations. It is important to avoid these conditions, which can occur as a result of forgetfulness, lightning arrestor failure or transmission line breakage. In addition to resulting in few contacts, the prospect of dissipating 1500 W within the tuner enclosure is a bit of a concern. A good check to make sure power is getting to the antenna is to watch an inline RF ammeter in each of the feeders, or to observe a field strength meter that measures RF from the antenna.

Table 2
MFJ-976 Balanced Antenna Tuner

Circuit configuration: dual T network.
Frequency range: 1.8 to 30 MHz.
Matching range: 12 to 1200 Ω.
Power rating: 1500 W (PEP).
Measured current usage: 13.8 V dc at 41 mA (meter lamps only).
Size (height, width, depth): 6.9 × 12.3 × 17.6 inches (including protrusions); weight: 12.1 lbs.
Price: $495.

ARRL Lab Resistive Load and Loss Testing

SWR	Load (Ω)		160 m	80 m	40 m	20 m	10 m
4.33:1	11.5	Power Loss%	43	27	14	7	NT
		SWR	2.0	1.1	1.1	1.1	>3.0
2:1	25	Power Loss%	33	33	16	11	9
		SWR	1.4	1.1	1.0	1.0	1.1
1:1	50	Power Loss%	10	10	6	6	7
		SWR	1.1	1.1	1.0	1.0	1.1
2:1	100	Power Loss%	13	14	5	4	7
		SWR	1.0	1.0	1.0	1.0	1.0
4:1	200	Power Loss%	14	16	4	6	10
		SWR	1.0	1.0	1.0	1.0	1.0
7.6	380	Power Loss%	21	28	8	8	16
		SWR	1.1	1.0	1.0	1.0	1.0
16:1	800	Power Loss%	34	44	9	10	28
		SWR	1.0	1.0	1.4	1.0	1.4

Note: Roller inductor contacts were intermittent during initial testing. See text.

Additional ARRL Lab Testing

Frequency	Short	Open	
1.8 MHz	NT	NT	Will tune 6.25 Ω resistive load 40-10 meters
3.5 MHz	NT	NT	Will tune 2.5 kΩ resistive load 160-10 meters
7.0 MHz	NT	NT	
14 MHz	Yes	Yes	Yes = will tune into open or short circuit
28 MHz	Yes	Yes	NT = no tuning solution

High Power ARRL Lab Testing

Tests performed with 1500 W PEP keyed CW, 40% duty cycle, 10 minutes (see sidebar)

High Impedance Test

Band	Load	Result
160 m	1000 + *j*45.7 Ω	Passed, tuner got only mildly warm.
20 m	20:1 SWR	Passed, tuner ran cooler.
10 m	20:1 SWR	Passed, tuner got only mildly warm.

Low Impedance Test

Band	Load	Result
160 m	25 Ω resistive	Passed, tuner roller inductor got warm
20 m	25 Ω resistive	Passed, tuner roller inductor got warm
10 m	25 Ω resistive	Passed, tuner roller inductor got warm
160 m	12.5 Ω resistive	Failed at 1500 W and 500 W, rapid SWR increase
20 m	12.5 Ω resistive	Failed at 1500 W and 500 W, rapid SWR increase
10 m	12.5 Ω resistive	Failed at 1500 W and 500 W, rapid SWR increase

The MFJ-976 successfully passed the high power tests (see sidebar) at high impedances and with a 25 Ω load, but not with a 12.5 Ω load at the very low end of its ratings. MFJ indicated that at initial testing, their '976 had successfully matched 12.5 Ω at high power. They are investigating this as we go to press.

On the Air at W1ZR

I tested the MFJ-976 with my 135 foot dipole, center fed with about 100 feet of 450 Ω window line. While each station's antenna system will exhibit different characteristics on different bands, this is a typical application for a balanced antenna tuner. The 50 Ω SWR of my antenna alone (no attempt at matching) runs the gamut from 2.9:1 on 28.5 MHz to 86:1 on 160 meters, as measured at the tuner interface.

The MFJ-976 was able to reasonably match this antenna on all amateur bands, including 160 meters — somewhat to my surprise. Some bands took longer than others to set up, and I was never able to match this antenna on the CW portion of 80 meters to better than a 2:1 SWR, although it would do 1:1 at 3800

Figure 2 — MFJ-976 balanced antenna tuner.

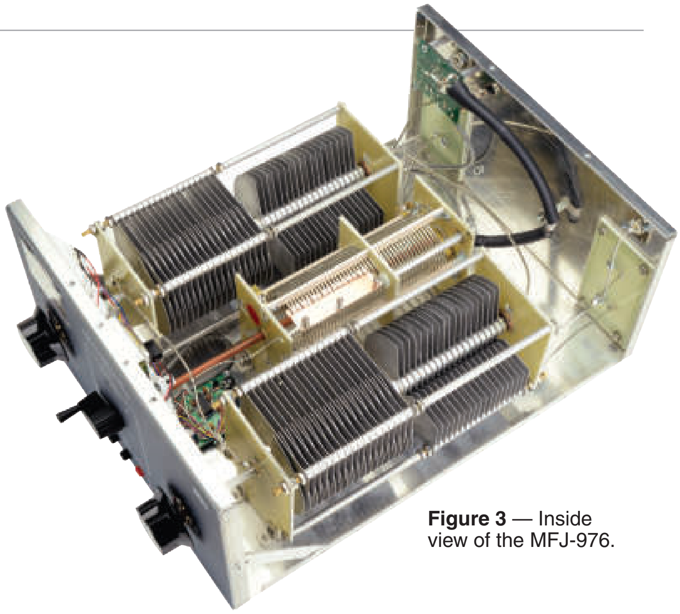

Figure 3 — Inside view of the MFJ-976.

kHz. In my station, 2:1 is fine and I had no problem operating there, and even ran it at 600 W without difficulty.

My procedure was to first adjust the capacitors and inductor for best match using my transceiver's 10 W TUNE setting and then trim up the adjustments with 100 W. It is important not to stop at the first setting of the three controls that provides a dip in reflected power, unless it drops all the way to 0. If the first null doesn't yield 0 W reflected power, note the reflected power reading and move one of the controls a bit off minimum in one direction. Tune the other two for minimum reflected power and see if it is higher or lower than the previously recorded value. If lower, tune the first control in the same direction a bit more and repeat dipping until zero or the minimum is found. If the minimum reflected power goes higher, change directions.

I put on the straps for unbalanced operation and loaded my three element tribander (20, 15 and 10 meters) with 6 meter coupled resonator. I was able to tune it reasonably well on its design bands, and also on 17 meters where it won't work without a tuner. I even got a 1:1 match on 6 meters, beyond the tuner's specifications — no harm in trying.

Documentation

The MFJ-976's 14 page manual offers generally useful information including instructions on tuning procedure with suggested starting points for each band. There is also an *Antenna System Hints* section that offers listings of antenna and feed line lengths to avoid, along with other suggestions. A schematic diagram is provided. There are a few missteps, including one that identifies the "maximum power rating" as 300 W PEP, perhaps erroneously copied from another tuner's manual. Another section warns "never change the INDUCTOR setting while power is applied to the tuner!" MFJ indicated that they have now corrected their manual, both in terms of power specifications and adjusting the tuner while low power is applied. New units will include the revised manual and others may request a replacement. I suspect they mean not to move the inductor while high power is applied, since it is difficult to adjust the tuner without turning the INDUCTOR control while watching the SWR meter. I would think that the suggested tuning power of 20-25 W would be a safe level to adjust the inductor.

Manufacturer: MFJ Enterprises, PO Box 494, Mississippi State, MS 39762, tel 800-647-1800; **www.mfjenterprises.com**.

See the Digital Edition of *QST* for a video overview of the MFJ-976 antenna tuner.

Palstar BT-1500A W Balanced Antenna Tuner

The Palstar BT-1500A is described as a redesigned AT1500BAL, one of the balanced tuners we reviewed in the 2004 Product Review (see note 1). It covers 160 through 10 meters and is rated to match impedances as high as 2500 ± *j*2500 Ω (100:1 SWR at 50 Ω) on 160 through 20 meters and 1000 ± *j*1000 Ω (40:1 SWR at 50 Ω) on 15 through 10 meters. The low impedance tuning range is not specified, nor is operation specified on 17 meters, although I suspect that was an oversight, since it works just fine there.

Tuner Configuration

This is a fully balanced double L tuner, as shown in Figure 1C and D. As with the MFJ-976, it is designed to transform the impedance of a balanced transmission system first to a balanced 50 Ω impedance and then through a 1:1 common mode choke "balun" to an unbalanced 50 Ω impedance.

The dual L configuration has two ganged series inductors and two variable capacitors that can be switched to either side of the inductors with relays. Relays are also used to switch variable capacitor sections in and out of the circuit (see below). Not shown on the simplified schematic are the control and indicator circuitry, including a competent dual needle average and peak reading wattmeter. This meter is sold separately as the Palstar PM2000A that we reviewed in March 2009.[2]

Changes Since the AT1500BAL

A frequent limitation of high power tuners is the minimum tuning capacitance, often affected by the interconnecting wires within the structure in combination with the capacitance of the circuit elements to the chassis and the minimum capacitance of the variable capacitor itself. A variable large enough to tune on 160 meters often has too high a minimum capacitance to tune some loads on 10 meters.

Palstar addressed this in the BT-1500A by using a two section capacitor. This allows the use of the lower capacitance section with reduced minimum capacitance on bands where needed, and the full capacitance on bands that require it. A front panel pushbutton operates a heavy duty relay to switch between high and low capacitance.

The other major change that I could observe is mechanical. The AT1500BAL drove its pair of side by side roller inductors through a set of nylon gears. The BT-1500A has the two inductors aligned in tandem and driven by a single coupled shaft. I must admit to not having noticed any problems with the earlier inductor drive system, but gears do tend to wear over time.

On the Bench

The BT-1500A was able to match all the resistive loads we tested, ranging from 11.5 to

Table 3
Palstar BT-1500A Balanced Antenna Tuner

Circuit configuration: double L network.
Frequency range: 1.8 to 29.5 MHz.
Matching range: 2500 ± *j*2500 Ω, 160 to 20 meters; 1000 ± *j*1000 Ω, 15 to 10 meters (resistive load).
Power rating: 1500 W PEP SSB, 1000 W single tone continuous.
Measured current usage: 13.8 V dc at 21 mA (meter lamps only), 0.2 A (<50 Ω relay on), 0.4 A (<50 Ω relay on, low C relay on).
Size (height, width, depth): 6.0 × 13.0 × 16 inches (incl protrusions); weight: 17 lbs.
Price: $695.

ARRL Lab Resistive Load and Loss Testing

SWR	Load (Ω)		160 m	80 m	40 m	20 m	10 m
4.33:1	11.5	Power Loss%	7	7	6	6	6
		SWR	2.75	2.35	1.0	1.0	1.0
2:1	25	Power Loss%	7	7	6	6	3
		SWR	2.0	2.0	1.1	1.1	1.1
1:1	50	Power Loss%	1	5	5	6	9
		SWR	1.0	1.1	1.0	1.0	1.0
2:1	100	Power Loss%	1	2	2	4	9
		SWR	1.1	1.0	1.0	1.7	1.0
4:1	200	Power Loss%	2	5	2	7	9
		SWR	1.0	1.0	1.0	1.0	1.0
7.6	380	Power Loss%	10	9	7	8	18
		SWR	1.1	1.0	1.0	1.1	1.4
16:1	800	Power Loss%	11	9	5	8	24
		SWR	1.0	1.0	1.0	1.0	1.6

Additional ARRL Lab Testing

Frequency	Short	Open	
1.8 MHz	NT	NT	Will tune 6.25 Ω resistive load 40-10 meters
3.5 MHz	NT	NT	Will tune 2.5 kΩ resistive load 160-10 meters
7.0 MHz	NT	NT	
14 MHz	Yes	NT	Yes = will tune into open or short circuit
28 MHz	NT	Yes	NT = no tuning solution

High Power ARRL Lab Testing

Tests performed with 1500 W PEP keyed CW, 40% duty cycle, 10 minutes (see sidebar).

High Impedance Test

Band	Load	Result
160 m	20:1 SWR	Passed, tuner ran cool.
20 m	20:1 SWR	Passed, tuner ran cool.
10 m	20:1 SWR	Passed, tuner ran cool.

Low Impedance Test

Band	Load	Result
160 m	25 Ω resistive	Passed, tuner ran cool. Best SWR = 1.7:1.
20 m	25 Ω resistive	Passed, tuner ran cool.
10 m	25 Ω resistive	Passed, tuner ran cool.

Note: A relay failed during initial high power, low impedance testing. Lowest rated resistive load is 25 Ω. See text.

Bottom Line

The Palstar BT-1500A is a rugged, well built and easy to use antenna tuner that can match most balanced antenna systems on most bands. This tuner may be the most efficient high power balanced tuner we've tested. A competent peak and average reading wattmeter adds to the value.

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[2] Bob Allison, WB1GCM, "Product Review — *QST* Compares Analog HF/VHF Wattmeters" *QST*, Mar 2009, pp 46-49.

Figure 4 — Palstar BT-1500A balanced antenna tuner.

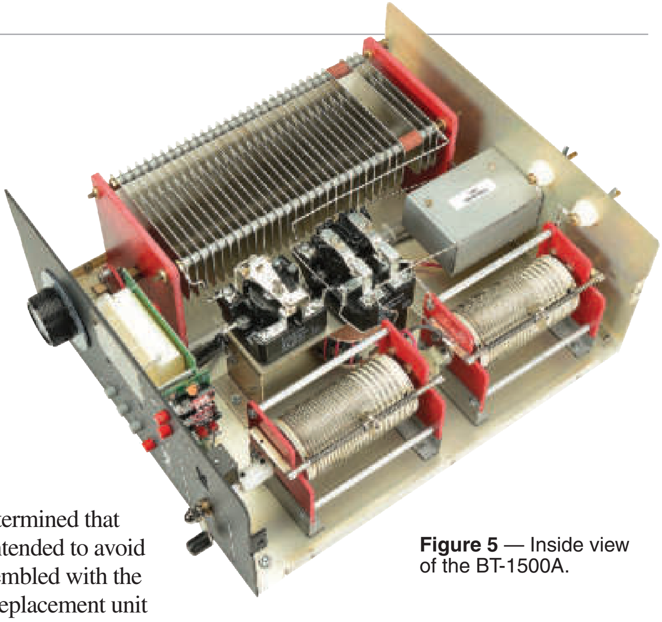


Figure 5 — Inside view of the BT-1500A.

800 Ω, on all bands as shown in Table 3. The efficiency of this tuner may be the best we have ever measured. It had a loss of less than 10% (0.46 dB) on all but three test points across the range of load and frequency, and those were pretty close.

In previous reviews, the minimum loss we listed was <10% because of test configuration uncertainty. We now have a new load box, developed and furnished by frequent *QST* contributor Phil Salas, AD5X, that uses Caddock precision noninductive power resistors. We are now comfortable calling the loss somewhat closer, but that means we can't directly compare very low losses with earlier reviews. We can't tell if a 5% loss for the BT-1500A in this review is better or worse than the <10% shown for a Johnson Matchbox in an earlier review. Arguably, in the tenths of a decibel region, it doesn't matter very much.[3]

As with the MFJ-976, we found that the BT-1500A would tune into shorts and open circuits on some frequencies. Of course, if you record the tuner settings with the intended loads, any change in matched settings should be investigated before attempting operation at full power.

The BT-1500A passed the high power tests with a high impedance load. We observed some problems during low impedance testing. On our original tuner, as we approached the legal limit on 160 meters with a 25 Ω load, operation became erratic and the tuner failed. ARRL Lab engineers found that the tuning components themselves were unscathed, but one of the relay coils had absorbed RF and started to melt.

Investigation by Palstar determined that an anti-resonance circuit intended to avoid this problem had been assembled with the wrong capacitor value. A replacement unit worked fine at 1500 W into 25 Ω on each test band. We then tried the 12.5 Ω test. It passed on 20 meters, but failed on 160 meters and so we suspended testing. Note that the manual does not specify a low impedance tuning range, but the manufacturer determined that 25 Ω should be considered the lowest rated resistive load. His assessment was that it is unlikely that real antennas will exhibit a lower load impedance (18:1 SWR at 450 Ω).

Operating the BT-1500A

The BT-1500A is designed for a single task — to transform the impedance of a balanced antenna system to 50 Ω coax. There is a single pair of heavy nylon insulated terminals on the rear for connection of the balanced feed line, a coax connector for the radio and a coaxial jack for 13.8 V dc to power the meter and the two relays.

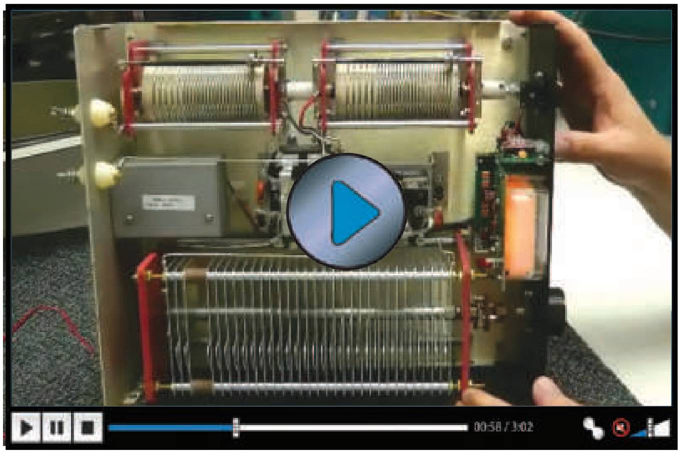
The BT-1500A performs its specialized task very nicely. The front panel has two primary variable controls. The first is a crank and turns counter to control the tandem roller inductors. It takes 25 turns to go end-to-end, and the position is indicated by a mechanical counter that reads 250 divisions over the travel. It's easy to interpolate between indications and reference about 50 positions per rotation. The other control is a variable capacitor with a smooth 5:1 vernier knob and a skirt with 100 divisions that make it easy to record and reset adjustments.

In addition to the variable adjustments, there are pushbuttons that actuate the two relays — one to select between high and low capacitance, and the other to move the capacitance from one end of the inductors to the other. Additional pushbuttons select wattmeter functions.

On the Air at W1ZR

I used the BT-1500A with the same 135 foot balanced antenna described previously. The

See the Digital Edition of *QST* for a video overview of the Palstar BT-1500A antenna tuner.



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[3] A compilation of Product Review data on antenna tuners is included in one chapter of J. Hallas, W1ZR, *The ARRL Guide to Antenna Tuners*. Available from your ARRL dealer or the ARRL Bookstore, ARRL order no. 0984. Telephone 860-594-0355, or toll-free in the US 888-277-5289; **www.arrl.org/shop/**; **pubsales@arrl.org**.

BT-1500A was able to match this antenna on all amateur bands, except 160 meters. That didn't really surprise me, since my usual unbalanced L tuner with a balun on the antenna side couldn't either, until I added external capacitance at the terminals that are provided for the purpose. Yes I did get it to match, but promptly melted the 1500 W rated switch contacts with 500 W, as reported in a recent *QST* article.[4]

I even got a reasonable match on 6 meters, but that is beyond specifications and perhaps I got lucky. Start with minimum inductance and capacitance.

I used the procedure described in the MFJ-976 section of this review to find the optimum tuning settings for each band. I find tuning with two controls somewhat easier than with three. While switching the capacitor from one side to the other is arguably equivalent to a third control, it only has two positions.

Documentation

The Palstar BT-1500A comes with a well written and illustrated 19 page manual that includes useful background information (a section on "Understanding Your Antenna Tuner," for example). Instructions on tuning procedures are provided, along with suggested starting points for each band. There are also suggestions on what to do in order to tune antennas that are not within range. A schematic diagram is provided.

Manufacturer: Palstar, Inc, 9676 N Looney Rd, Piqua, OH 45356; tel 800-773-7931; **www.palstar.com**.

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[4] J. Hallas, W1ZR, "My Tuner Tuned My Antenna — But Now it Doesn't!," *QST*, Aug 2012, p 46.

Testing Antenna Tuners to Full Ratings

For many amateurs, published antenna tuner ratings have been less than clear. If a tuner is rated to "handle the legal limit (1500 W PEP)," and also is able to "tune to a maximum SWR of 10:1," does that mean that it can do both at the same time? The stress on tuner components is, after all, higher at high SWR. Some tuner manufacturers suggest that power should be reduced at high levels of mismatch, while some leave it to the user to discover. The clearest specifications indicate the safe power levels for loads of different SWR or impedance.

The ARRL Lab works to improve testing methods to make *QST* Product Reviews more beneficial to readers. In past antenna tuner reviews, we have measured the loss and matching range of tuners over a wide variety of loads to determine the range of impedances they would match and the efficiency at each impedance that was successfully matched. These tests are performed at low power levels.

Determination of a tuner's ability to handle the task at high power was left to the reviewer based on operation in their station. While this method offered an indication of operation in what might represent a "typical" station, it did not provide a systematic evaluation of tuners operating near their limits with high power and known loads.

The Lab has added the capability to confirm the power level at which antenna tuners can successfully operate at their extremes of rated operation. The test configuration is shown in Figure A. For high impedance tests, the test fixture is a high power antenna tuner connected "backward" — the ANTENNA terminals are now the input, and the coax connector that is normally the input is connected to a high power 50 Ω load. An accurate impedance meter is first used to adjust the impedance at the input terminals (the antenna connections in normal use) to the desired complex value. Then the test fixture is connected to the output of the tuner under test. The tuner under test is adjusted to a match and then the power is increased to the rated level and the tuner is observed to determine if it is operating successfully at each power step. For low impedance tests, the "backward" antenna tuner in the test fixture is replaced with 25 Ω and 12.5 Ω loads made using a combination of 50 Ω power attenuators in parallel.

Tests are conducted at the tuner's lowest and highest rated operating band and a band in the middle, typically 160, 20 and 10 meters. A tuner that passes this test at all points will have a high likelihood of operating successfully at any station that uses it within its ratings. Do keep in mind that even though a tuner can tune to an antenna, it may be operating outside its ratings as discussed in a recent *QST* article.[1] — *Joel Hallas, W1ZR, Technical Editor,* QST.

[1] J. Hallas, W1ZR, "My Tuner Tuned My Antenna — But Now it Doesn't!" *QST*, Aug 2012, p 46.

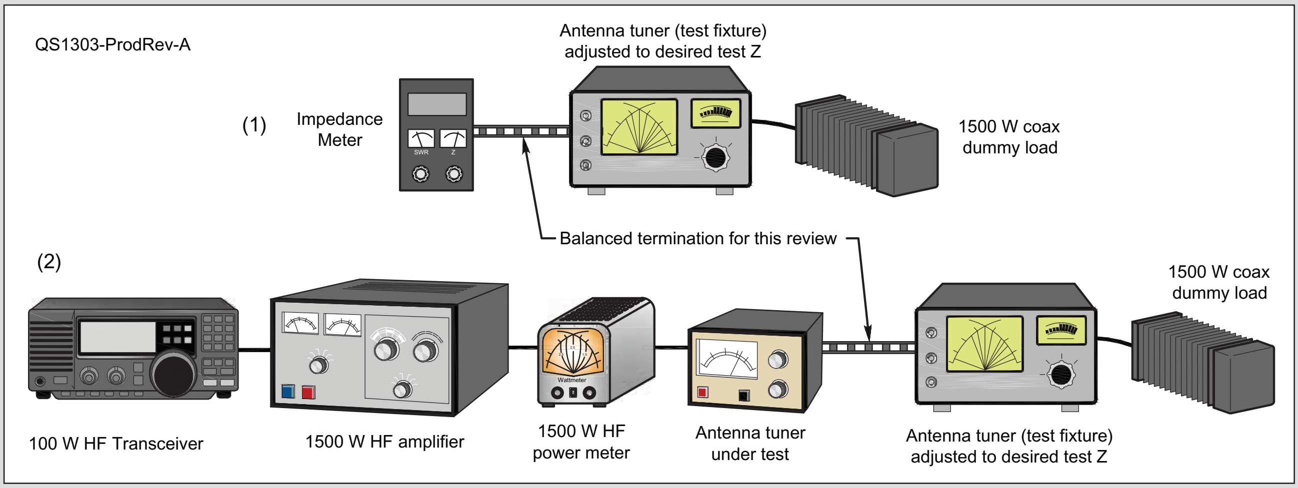

Figure A — At (1), the method used to establish a high power, high impedance load at different impedances. At (2), the complete test setup. Drive power is increased while monitoring the power to the tuner until there are problems or until the tuner demonstrates proper operation at its rated power. For low impedance testing, the test fixture is made from a combination of power attenuators.

Technical Correspondence

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Noise Problems for Broadcast and MF/HF Receivers

New Electromagnetic Interference (EMI) Troubles

EMI can present itself in many different ways, and can cause an Amateur Radio operator days, weeks or months of untold frustration resolving such matters. I am not immune to this problem. With the temperatures turning colder, sunlight disappearing and fall and winter fast approaching I was presented with an "all bands" EMI issue.

After recently moving to a new home, I found myself plagued by a constant 40 to 60 dB of hash every 20 kHz, which extended from 160 through 80 meters and continued with a bit less intensity on all the frequencies higher than 3.5 MHz. Below 1.8 MHz, I followed this hash every 20 kHz, down to as low as my TS940 would tune, which was 30 kHz.

This made any contacts virtually impossible, with the exception of very local HF contacts. Only once was I able to work Europe on 80 meters with any success.

Calling the local power utility provided no solutions and speaking with a representative from Industries Canada [The Canadian equivalent to the US FCC – *Ed.*] also yielded no real solutions. I realized I'd have to locate the cause of the EMI myself.

The cycle times of this EMI were such that it would begin in the morning around 6 AM and last until just after 8 AM. Then it would reappear close to 5 PM, and at times continue until I shut off the radio in frustration. Other nights the EMI was not there at all.

By analyzing the EMI's time pattern it seemed clear that it was caused by something people were doing at these specific times. This eliminated many possibilities such as door bell transformers or heating thermostats that function on 12/24 hour time periods Perhaps my neighbors had outdoor lights or a security system that turned on in the evenings; devices switched on by dusk to dawn sensors or motion activated devices.

During the late fall and winter, I'd drive around the block in the evening to see if I could identify the source of interference, but with no success. In fact I was finding more sources of the same EMI that I was experiencing, the farther away I drove. With no end in sight to my EMI problems, I began to despair of finding a solution.

I'm not a quitter, though, so after one more trip around the block in my car, I was forced to conclude that the EMI was close at hand, with one of the houses beside mine as the possible source of my troubles.

Getting out my emergency portable AM/FM radio, I tuned it to the high end of the AM broadcast band just above 1700 kHz. This was where I could start to hear a similar buzz in the speaker of the radio without all the BC band radio stations overpowering the EMI signal.

Hoping this noise on my broadcast radio was the same sound produced by the EMI, I turned on the HF rig and tuned to 3.795 MHz. The noise on my HF rig seemed to be fairly similar to the noise I was hearing on the AM broadcast radio, and the static seemed to be in sync as it popped, sizzled and buzzed.

Satisfied it was the same noise on both radios, with the portable AM radio in hand I walked to the rear entrance of my home — which is on the same level as my radio room (basement) — opened the door and held the radio outside. The noise diminished somewhat as I moved the radio farther away from the house.

I knew at that instant that I was on to something, and maybe it was not the neighbors' fault at all. I continued into another room adjacent to the radio room and held the radio close to a compact fluorescent fixture. The noise grew a bit in intensity but not to a point at which it was of any concern. I then proceeded to climb the stairs from the basement to the main level of the house, and the buzz from the AM radio increased in volume. As I walked into the one of bedrooms, I was able to null out the noise by turning the radio in different directions. Both bedrooms at this end of the house produced a similar effect when turning the radio. This made me even more suspicious as to where the noise might be coming from. I then moved toward the living room/kitchen area, which is a combined room.

The noise increased as I approached this area. As I approached the TV, which was turned off, the noise did not increase, so I turned and moved toward the kitchen area. The noise began to increase dramatically in volume. As I came closer to the over the counter lighting, the AM radio nearly jumped out of my hands because of the vibrations produced by the now over-driven

Figure 1 — Low voltage, high intensity halogen lamps were installed under the kitchen cabinets to illuminate the counter top.

speaker. What a racket! I turned these lights off, and an immediate and almost gentle hiss came from the radio. See Figure 1.

I dashed downstairs to listen to my HF rig, which had become almost silent. There was no static and I could hear all sorts of signals in the DX window on 80 meters.

Success! I had finally solved this annoying EMI issue in my new home. What a relief it was to not have this tremendous noise and to be able to once again hear HF DX on my radio.

The offending lights were low voltage, high intensity halogen lamps fed with open parallel GTF wire going to three 12 V ac halogen lamps powered by a 120/12 V ac, 20 kHz transformer. See Figure 2. There were two sets of this style of lighting used to illuminate our kitchen counter top. The wire harness became an antenna for the 20 kHz transformers, broadcasting harmonics a distance of about ½ km from my home. Figure 3 shows the lights and wiring harness.

The Model H084-3 class 2 transformer for my lights, made by Eurofase, shows the operating frequency as 20 kHz. This type of lighting is being sold by many outlets across North America. There are many other manufacturers using the same 20 kHz techniques to power lighting, as well as motor driven applications that use a 30 kHz ac/dc power supply to develop a variable dc voltage to power heating, ventilation and air conditioning systems in homes. (See my Technical Correspondence in the January 2013 issue of *QST* for more about my quest to solve that interference issue.)

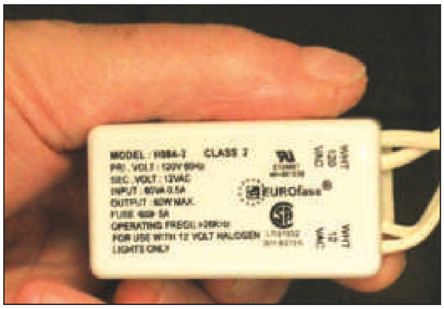

Figure 2 — The offending 120 V ac/12 V ac plastic encapsulated low voltage transformer used to power the over the counter high intensity halogen lamps.

As mentioned earlier, I did find other similar sources of the same noise in the neighborhood, but those were far enough away as not to bother my transceiver. They are there, however, and they are generating EMI.

I hope by describing this EMI issue, I will help readers resolve some RFI mysteries. *— 73, Larry Parker, VE3EDY, 1741 Lake Shore Rd, Sarnia, ON N7X 1C1 Canada*; **VE3EDY@cogeco.ca**

Another View on Noise Sources and Radio Reception

I recently returned from a vacation to Paris. I used to enjoy listening to the LF/MF broadcast stations across Europe, but this time it seemed that there were almost no MF broadcast stations still on the air.

It seemed that over the air broadcasts had been more or less turned off. The long wave band seemed dead. I used to receive the BBC long wave station on 198 kHz in Paris, but no more. In Paris I could receive one station during the day, and I could not even receive short wave broadcast stations — one or two on the 49 meter band is all. An Internet search revealed that Paris has forced English language stations on the FM band to stop broadcasting. Now it looks like one has to listen to radio online!

It turns out I was wrong, however! My impossibility to receive any LF broadcast stations in our apartment in Paris was not because the stations have gone off the air, it was because of EMI — probably due to the same problem Larry Parker, VE3EDY, described above.

This problem is going to get worse and worse, unless the radio regulatory agencies step in and stop further installations like these 12 V lights powered by a 20 kHz square wave transformer. To cut the cost of 120/240 V to 12 V power transformers, the suppliers of such devices have decided to use these 20 kHz switching transformers. I cannot believe what has happened.

While on our Paris vacation, I took a walk to the Bois de Boulogne, and I took along my miniature Grundig Radio GB Traveler II Digital (no S meter and a miniature ferrite rod antenna for LF/MF reception). Lo and behold, I could receive four LF Stations — the BBC Radio 4 broadcast was weak because of the time of day and season, and the fact that this radio only has a minuscule rod antenna. On all previous occasions I have taken my Grundig 400 receiver. All LF stations were there, however.

This situation should not have occurred. A 50/60 Hz conventional step-down power transformer is quiet. Devices that use a switching power supply operating at 20 kHz should never have been allowed to be manufactured and sold. The time stations in Boulder, CO operate on 20 kHz and 60 kHz.

I shared Larry's and my experiences with my friend Norm Rashleigh, VE3LC, who was very interested in this problem. Norm replied that being curious, he bought a Eurofase system at Home Depot. He uploaded the results of his brief evaluation onto YouTube, and your readers might be interested in seeing that video: **www.youtube.com/ve3lc**

He said he hopes he can repackage the light and transformer and get a refund. There is no way he is going to install them in his house! *— 73, John S. "Jack" Belrose, VE2CV/VE3CVV, 811-1081 Ambleside Dr, Ottawa, ON K2B 8C8 Canada;* **jhdeniseb@aol.com**

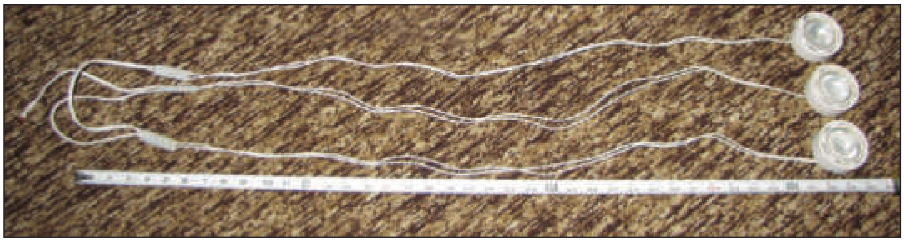

Figure 3 — The wiring harness that connects the high intensity halogen lamps to the 20 kHz low voltage transformer can act as a very effective antenna, radiating a strong signal that makes it difficult or impossible to hear amateur signals on the 160 and 80 meter bands and even higher frequencies.

Technical Correspondence items have not been tested by *QST* or the ARRL unless otherwise stated. Although we can't guarantee that a given idea will work for your situation, we make every effort to screen out harmful information.

Materials for this column may be sent to ARRL, 225 Main St, Newington, CT 06111; or via e-mail to **tc@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 a work, please send the author(s) a copy of your comments. The publishers of *QST* assume no responsibility for statements made herein by correspondents.

The Doctor is In

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

Smarten up that dummy load with a monitor port.

Q Bruce, AH0U, asks: I have a dummy load and want to add a jack to monitor the signal going to the load. The output of this jack needs to be 40 dB down from the signal going to the load. How do I sample the load without disturbing the SWR or impedance of the dummy load?

A Well, there's no way you can tap off a sample without having some effect on the rest of the system. However, the effect at 40 dB down will be slight.

The easiest way is to use a noninductive resistor, such as the early carbon type. If the monitoring equipment has a 50 Ω input impedance, a 4950 Ω resistor from the dummy load connection to the device will provide the 40 dB down signal. If your monitor has a high input impedance, then put a 50 Ω resistor to ground at the monitoring point. The accuracy of the voltage division will depend on the precision of the 50 Ω termination, and the lack of inductance in the wiring and the resistors.

If the dummy load SWR were 1.00:1 to start with, the SWR with the monitor connection will be 1.01:1. For minimum effect on the SWR, make the connection from the dummy load to the resistor as short as possible, with any wiring length on the monitor jack side (see Figure 1).

Q Carl, N3BGI, asks: I was browsing through some vintage equipment manuals recently and encountered some electrolytic capacitor tolerance specifications that surprised me. They had the following values: 10 µF –10% +100%, 8 µF –15% +100% and 100 µF –10% +75%. This is new notation for me. I have previously seen values such as ± 5%, ±10% or ±20%. Please help me understand how to interpret values of this sort.

A We're most used to tolerances that are equal in both direction, such as ±10%, but not all device uncertainties are uniform in both directions. In the case of 10 µF –10% +100, for example, the capacitance value will be between 10 µF –10% (9 µF) and 10 µF + 100% (20 µF). For the case of an electrolytic capacitor used to filter ac ripple in a power supply, being a higher value is not usually a problem, so this would be a reasonable application for such a device.

Q Ken, WB2UAW, asks: The recent *QST* article on baluns came at a good time since I purchased one, or a "line isolator."[1] I have received conflicting advice about where to best put a device. Where will it do the most good?

A While often described as a 1:1 balun, your line isolator is actually a common mode choke, which in many ways acts as a balun. It is intended to keep conducted currents from running along the outside of a length of coax by inserting a high impedance on the outside, but letting differential current (inside the coax, where you usually want it) to flow without restriction.

So the short answer is to place it wherever you have problems with common mode currents. One place that always makes sense is at the transition between coax and a balanced antenna, such as a dipole, as mentioned in the *QST* article. In addition, if there is coupling between the antenna and coax, usually if the coax isn't perpendicular to the antenna, it may be better on the coax below the coupling region (see Figure 2) — but then the coax above it will radiate, so both wouldn't be bad.

So the reason for the conflicting advice may be that the responders are relating their experiences, which may be different. What matters is the situation at your station. If in

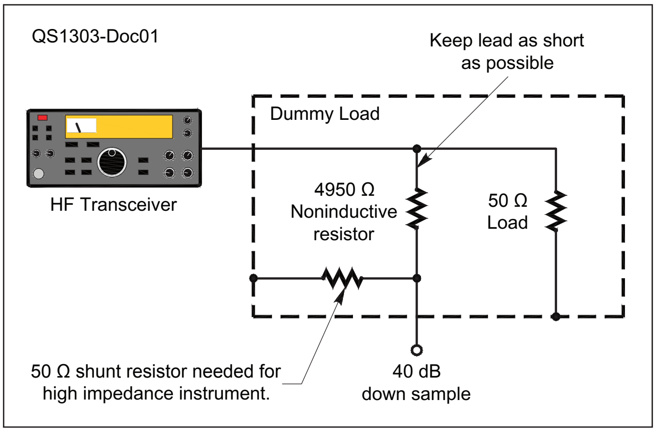

Figure 1 — Resistive divider that can provide a –40 dB sample of the RF signal with minimum change in SWR to a 50 Ω instrument. If the instrument has a high impedance input, also put a 50 Ω resistor to ground as shown.

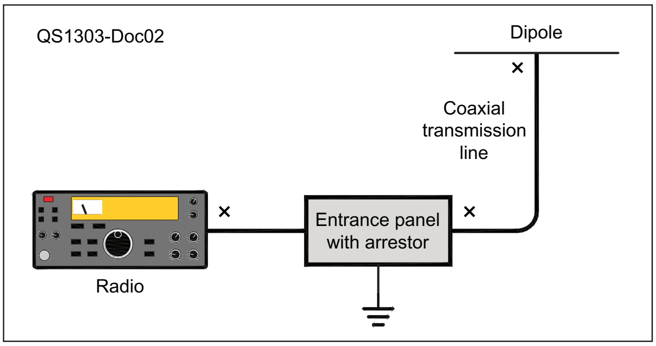

Figure 2 — The locations that could be suitable for a coax common mode choke. The primary one is usually at the antenna, although the others may be needed in some circumstances.

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[1] J. Hallas, W1ZR, "For Best Results, Consider a Balun in Your Antenna System," *QST*, Jan 2013, p 49.

doubt, I recommend starting between your coax and a dipole, or similar balanced antenna.

Q Carl, KN0WS, asks: I put together an earth-moon-earth (EME) setup this fall on a patch of fairly remote land. I used a portable generator to power a 180 W, 432 MHz linear amplifier into a quad Yagi antenna system. While I was successful in making a contact via the Moon, I can certainly see that additional transmit power would be helpful. I would like to be able to use my current generator, so a 1500 W tube amplifier sitting on a blanket in the field is not in the future for me.

If I have two identical solid state linear amplifiers, each capable of amplifying a 25 W input into a 180 W output, can I simply take the 50 W from my transceiver, divide the power using an commercial antenna power divider to drive each linear amplifier, then combine the two 180 W outputs from the pair of amplifiers back through another power divider (used backwards as a coupler) to produce a final 360 W to the antenna?

A If you pull off the covers of many high power solid state amplifiers, you will see that is exactly how they are constructed internally (see Figure 3). While it seems like a straightforward idea, and could be, the main issue, especially at EME frequencies, is relative phase delay. While a single dual-module amplifier is relatively easy to build and test as an integrated system, your separate amplifiers were not built with that in mind. At 70 centimeters, a wavelength is 70 centimeters long, but 1/10 of a wavelength is only 7, about 5 centimeters or 2 inches of coax.

I would think you would want tolerances to accumulate to well less than that for reasonable operation, and with independent assembly and device selection (not selected as matched components) and alignment, I would be surprised if two randomly selected amplifiers would be that close. If you have the capability to phase match them, the difference, if any, could be accommodated in a short length of coax, preferably on the input side.

If the amplifiers are linear and can amplify at very low levels, it would be safe, in my opinion, to drive them with an input splitter and measure the power at each output. If they are the same and you put them in a combiner and the level is twice each, less the attenuation of the combiner, you are probably good to go. I would bring up the power slowly and watch for heating and other undesired effects.

Of course, in real life, each of the power divider/combiners will introduce a little loss, so don't expect the full 360 W — still it should be close.

Q Tomm, W2BFE, asks: As a holdover from the vacuum tube era, I can understand operating various controls to match an antenna to a transmitter. One could use the receiver to tune for maximum noise or maximum signal strength to get a rough match. The final tune-up is then accomplished with low power applied to the antenna through the tuner. Now that we have automatic antenna tuners, the tuner sets its component parameters using a small amount of applied RF power to match the transceiver to the antenna. What if one only wants to listen? Can the intelligent tuner figure out what frequency a transceiver is tuned to?

A Some tuners can do exactly that, especially if they are designed to work with, and exchange information with, the connected radio. Of course, one problem with this approach is that it assumes that the tuner knows what to do at each frequency that the radio is set to. While this can be the case with frequencies across amateur bands that the tuner has adjusted to and memorized settings for, generally it won't help with frequencies that haven't been transmitted on, such as in shortwave broadcast bands.

Some other "auto" tuners allow manual setting of L and C values independent of transmit power. This can be used to peak the signal, just as with a manual tuner. The settings are usually shown so they can be set in again the next time.

Note that in many cases on HF, the S/N is limited by atmospheric noise. Thus, if a tuner is not optimally tuned, or even if bypassed, the receive S/N may stay the same, making tuner settings less important. As the frequency gets higher (typically above the 15 to 20 MHz range) with mismatched antennas, a properly adjusted tuner is more likely to be of benefit on reception.

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**.

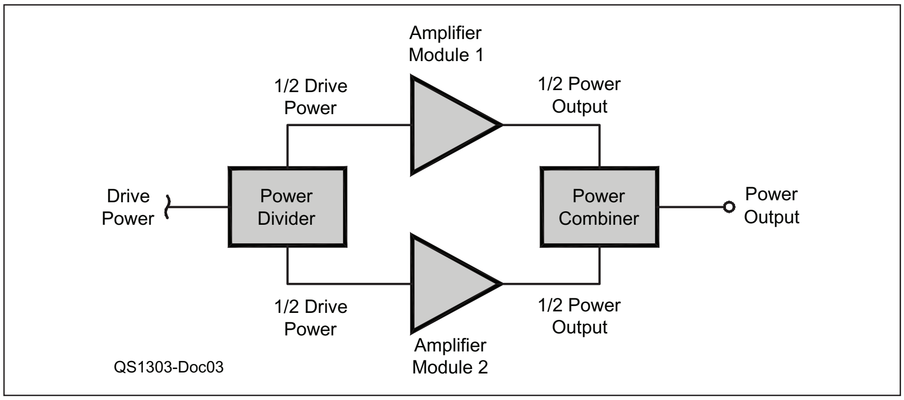
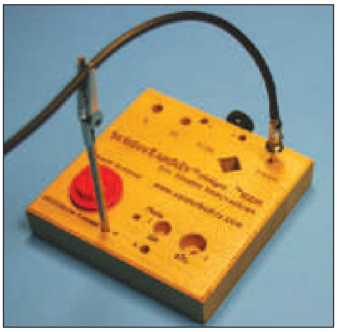


Figure 3 — Architecture of a high power amplifier composed of two separate medium power modules. To work properly the phase delays through both channels must be close to identical.

New Products

SolderBuddy Hobbyist HAM

The SolderBuddy Hobbyist HAM from Tingler Innovations provides a stable platform for soldering connections to the following connectors: ¼ inch phone plug, 5.5 mm coaxial plug, 3.5 mm mini phone plug, phono (RCA) plug and jack, DIN connector and 8 pin mic plug. A clip holds wires in place while they are soldered. The SolderBuddy also includes a vise with a square hole to hold PL-259 connectors and other odd sized items. Price: $41.75. Other versions are available. For more information, or to order, visit **www.solderbuddy.com**.



H. Ward Silver, NØAX, n0ax@arrl.org

Experiment #122

Battery Characteristics — *Part 1*

This month, we begin a two part article about batteries and battery characteristics with a discussion of what makes batteries "go" and how the different types behave electrically. Next month, we'll observe the differences for ourselves.

Basic Battery Construction and Chemistry

Viewed simply, the battery is a self-contained chemical reaction vessel in which chemical substances give up electrons that flow through an external circuit to other types of substances that accept electrons. The battery's *separator* keeps the chemicals, well, separated so that the electrons have to make the trip through the circuit to be exchanged.

The electrons do some useful work along the way, converting the chemical energy to electrical energy and then to whatever type of energy the user extracts from the circuit — mechanical, heat, electromagnetic, etc. The reaction continues until all of the available electrons have been exchanged through the external circuit, depleting the chemicals and discharging the battery.

The types of atoms or molecules involved in giving up and accepting the electrons — called the *battery chemistry* — determine the *electromotive force* (EMF) that pushes the electrons through the circuit. Each type of atom or molecule has a certain affinity for electrons: Via a specific chemical reaction, some want to get rid of them and some want to acquire them. The strength of that reaction's electron exchange is the reaction's *electropotential,* which is measured in volts. The difference in electropotential between the chemicals is what determines the *terminal voltage* of the battery. (The list of electropotentials for common materials and reactions is also known as the *galvanic series*.)

Batteries are classified in two groups; *primary* (non-rechargeable) and *secondary* (rechargeable). In both groups, giving up and accepting electrons changes the chemicals into different compounds. (The atoms are still the same types of atoms but the rearrangement of their electrons changes the structure of molecules made from those atoms.) In a *primary* battery, the reaction is not reversible even if a voltage is applied externally to make the electrons flow "the other way." In a *secondary* or rechargeable battery, the reaction will run in reverse if powered by an external voltage, restoring the original chemicals and recharging the battery.

Basic Battery Terminology

Let's start with *capacity,* which is given in *ampere-hours* (*Ah*). Amperes (coulombs of charge per second) multiplied by time results in an amount of charge. (1 Ah = 1 coulomb/s × 3600 s/h = 3600 coulombs) Thus, capacity measures the number of electrons that a battery can cause to flow through an external circuit. Because capacity is an amount of charge, it is abbreviated C for coulomb. Causing large numbers to flow (high current) discharges a battery's capacity quickly and low current discharges it slowly.

Capacity is independent of terminal voltage: A specific pair of chemicals has the same relative electropotential no matter what quantity of those chemicals is contained in the battery. Thus, terminal voltage is the same for large and small batteries of the same battery chemistry. The larger the quantity of chemicals in the battery, however, the more electrons can be exchanged.

Capacity also indicates the amount of energy stored in a battery. Since the terminal voltage is relatively constant and voltage is joules (J) per coulomb, multiplying capacity times terminal voltage yields energy, usually in units of *watt-hours* (Wh). For example, a capacity of 2 Ah and a 1.5 V terminal voltage represents 2 Ah × 1.5 V = 3 Wh. (Note that not all of the stored energy can be delivered to the external circuit and that terminal voltage drops as the battery is discharged.)

Another important battery characteristic related to its capacity is the battery's *specific energy,* which is given in watt-hours per kilogram (Wh/kg). Batteries with high specific energy store a lot of energy for a given weight.

Table 1
Characteristics of Common Battery Chemistries

Specification	Alkaline	Lead-Acid	NiCd	NiMH	Li-ion	Cobalt	Manganese-Phosphate
Specific energy (Wh/kg)	210	30-50	45-80	60-120	150-190	100-135	90-120
Cycle life	1	200-300	1000	300-500	500-1000	500-1000	1000-2000
Self-discharge/month	<1%	5%	20%	30%	<10%	<10%	<10%
Cell voltage (V)	1.5	2	1.2	1.2	3.6	3.8	3.3
Peak load current	<0.5C*	5C	20C	5C	>3C	>30C	>30C
Best discharge rate	<0.1C*	0.2C	1C	0.5C	<1C	<10C	<10C
Toxicity	Low*	Very high	Very high	Low	Low	Low	Low

*evaluation based on public literature
Reprinted from *Batteries In A Portable World*

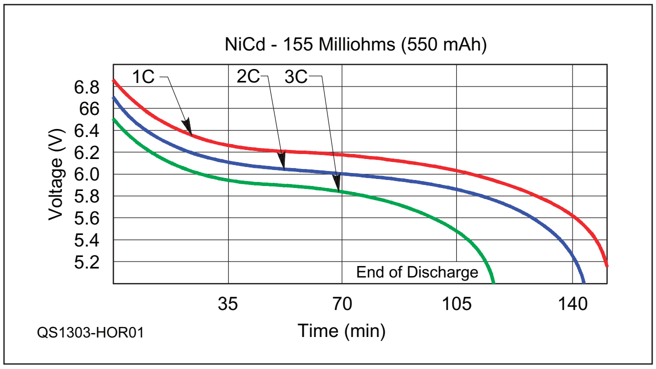


Figure 1 — The effect on a NiCd battery pack lifetime at discharge rates of 1, 2 and 3 C. [Courtesy of Isidor Buchmann and Cadex]

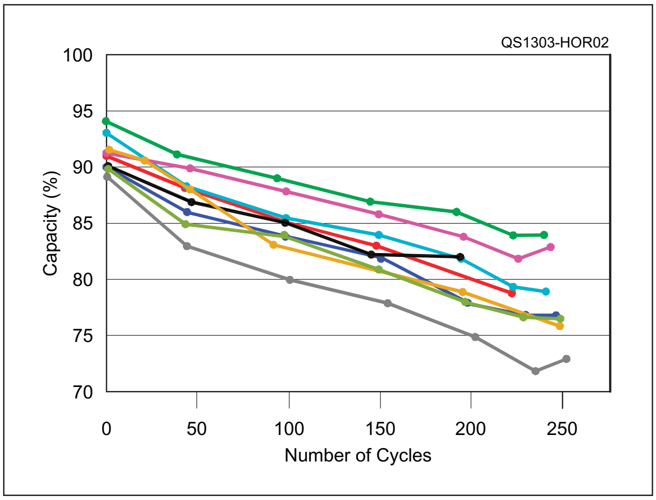


Figure 2 — The effect of repeated charge-discharge cycles on a set of new 1500 mA Li-ion batteries. After 200 cycles, most of the batteries had lost 10% of their capacity. [Courtesy of Isidor Buchmann and Cadex]

Table 2
Effect of Depth of Discharge (DoD) on Cycle Life

Depth of discharge	Discharge cycles
100%	500
50%	1500
25%	2500
10%	4700

Reprinted from *Batteries In A Portable World*

In battery literature, you will also encounter *C-rate,* which is the rate at which a battery is charged or discharged measured in terms of its capacity. If a 1000 mAh battery is discharged at a current of 1000 mA, it is being discharged at a rate of 1 C. At 500 mA, the rate is 0.5 C, and at 100 mA the rate is 0.1 C. Because batteries are made in so many different sizes using the same chemistry, C-rate is a useful way to talk about battery performance and maintenance independent of size.

Types of Battery Chemistry

Several battery chemistries account for most needs of the Amateur Radio operator: alkaline, lead-acid, nickel-cadmium (NiCd), nickel-metal hydride (NiMH) and lithium-ion (Li-ion). Table 1 gives the basic characteristics of these battery types.[1] Alkaline batteries are primary (non-rechargeable) and the rest are secondary (rechargeable). While rechargeable batteries offer higher specific energies and lower costs over the life of the battery, alkaline batteries do not require a charger, which can be important for emergency situations when ac power is not available. They also have a long shelf life.

Effect of Discharge Rate

Table 1 shows peak discharge rates for the various types of batteries in terms of capacity, however, that is not the recommended rate of discharge during normal use. The amount of energy a battery can deliver is maximized at a much lower rate, shown in the row "Best discharge rate" in Table 1. Note that all types of batteries perform best well below the peak discharge rate. Figure 1 shows the effect on a NiCd battery pack's lifetime at different discharge rates. Other types of batteries are even more strongly affected by discharge rate.

Effect of Depth of Discharge

Depth of Discharge (DoD) has a large effect on the number of charge-discharge cycles a battery can provide. The more, or "deeper," a battery is discharged, the more it is stressed. Table 2 provides an idea of the effect on a Li-ion battery lifetime when repeatedly discharged to a specific level. Partial discharges preserve battery life.

Effect of Repeated Charge-Discharge Cycles

As most users of rechargeable batteries quickly discover, a battery performs like new over a number of charge-discharge cycles and then begins to lose capacity. This is due to changes at the microscopic level in the materials of the battery. For example, when a battery is new, the chemicals are typically in the form of very small crystals that provide lots of surface area to exchange electrons. With each cycle, however, the crystals grow in size and that reduces the total surface area and battery capacity.

Figure 2 shows the effect of repeated cycling on the capacity of a set of identical, new 1500 mAh Li-ion batteries. Even though the battery may be able to support hundreds of cycles, after 200 cycles most of the batteries had lost 10% of their initial capacity.

Effect of Temperature

Because batteries are based on chemical reactions that vary in rate with temperature, capacity is also affected. For example, a lead-acid battery loses about 10 to 20% of its capacity between room temperature (23° C) and freezing (0° C). By –20° C, about half of the capacity is lost. Thus it is very important for capacity to be measured at a specific temperature when comparing batteries. Automobile and deep cycle batteries have a *Cold Cranking Amps* (*CCA*) rating that must be specified at –18° C (0° F) for just this reason.

That is not to say that everything gets better with increasing temperature. From *Batteries in a Portable World*, "The optimum operating temperature for a [lead-acid] battery is 25° C (77° F). As a guideline, every 8° C (15° F) rise above this temperature cuts battery life in half. At 33° C (95° F), that battery's lifetime is cut in half and is reduced to 10% at 45° C (107° F)."

Measuring Battery Performance

Next month we are going to both measure some of these effects on actual batteries and introduce you to a new type of voltmeter that has the ability to act as a *data logger*. Once you realize how useful data logging is, you'll find all sorts of uses for it in the shack and around your home.

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[1] I. Buchmann, *Batteries In a Portable World*, 2011, pp 34-37. Available from your ARRL dealer or the ARRL Bookstore, ARRL order no. 1156. Telephone 860-594-0355, or toll-free in the US 888-277-5289; **www.arrl.org/shop**; **pubsales@arrl.org**.

Short Takes

Steve Ford, WB8IMY, wb8imy@arrl.org

SSB Electronic ACS 2004-N Remote Antenna Switch

The ACS 2004-N control unit.

If you're like most amateurs you probably have more than one antenna. You may have two separate antennas for HF, another for 6 meters and yet another for 2 meters or beyond. The most convenient way of managing the connections to your radio is with an antenna switch — ideally a remote, weatherproof switch so you don't have to snake a bunch of cables back to your station.

But there is a catch. (Isn't there always?)

For everything to work properly, you need to be able to communicate with the remote switch, which means you still have to route a multi-conductor cable between the control unit in your station and the switch outside. Surely there must be an easier way.

Meet the ACS 2004-N

At my home I have a single run of LMR 400 coax that twists and turns through the walls and attic before finally making its exit to the outside world. I wanted to expand my meager antenna system with an outdoor switch, but the thought of having to run yet another cable through the maze was highly unattractive. Thanks to the SSB Electronic ACS 2004-N, I now have an elegant solution.

The ACS 2004-N is a remote antenna switch that does away with the need to install a separate control cable. Instead, all the switching commands are sent on the same coaxial line that carries your RF. The ACS 2004-N is rated for use from 80 meters through 70 centimeters. In terms of RF power, it can tolerate 1.5 kW PEP on 80 through 10 meters, 800 W PEP on 6 and 2 meters and up to 600 W PEP on 70 centimeters. The insertion loss figures are outstanding, from a mere 0.1 dB at HF to only 0.3 dB at 70 centimeters.

Installation and Use

I hate to invoke the cliché of "fine German engineering," but it truly applies to the ACS 2004-N. Both the control unit and the switch itself are superbly crafted, right down to the glistening N connectors. (Yes, you'll need PL259-to-N adapters if you aren't using coax with Type N connectors.) The control unit measures only 4.5 × 4 × 2.25 inches and has a surprising amount of heft. The front of the unit features four momentary pushbutton switches and accompanying LED indicators. On the back you'll find two Type N female coaxial connectors and a 9 pin female DB-9 connector for dc power and other functions.

The switch itself is housed in a rugged plastic shell. On the underside there are five female Type N connectors: One for the coaxial cable from your station and the remaining four to feed your antennas. I connected my trusty HF vertical to one port and added a new dipole for 80 meters and a 2 meter Yagi to the remaining ports.

Outdoors with the ACS 2004-N remote switch.

The instructions are in printed in German, so your first task will be to get on the Internet and download the English translation at **www.arraysolutions.com/SSB%20Electronics/EN-5055_ACS%202004-N.pdf**. After you've read the instructions, the next step is to assemble the male DB-9 connector that plugs into the control unit. For a basic installation you need only solder two dc power leads. If you want something more elaborate, such as PTT keying for a switching sequencer, you'll have to do some additional wiring.

Once you have the DB-9 in place and connected to a 13.8 Vdc source, everything else is a snap; you simply attach the coaxial cables and enjoy. The control unit (labeled AC 2004 B) "talks" to the outdoor unit from the moment you secure the main cable and it will alert you if something goes awry. If the outdoor unit should become disconnected, for example, you'll know right away because the LEDs on the control unit will begin to flash.

One very cool feature of the ACS 2004-N is the ability to not only switch antennas, but also to supply dc power to selected antennas. As the instructions point out, this feature is included for the sake of those who use antenna-mounted preamplifiers. To activate this function, you press and hold the pushbutton for a couple of seconds until the PREAMP indicator lights up. The control unit "remembers" which antenna lines require dc power. So, whenever you select **Antenna 1**, for example, the unit will place dc power on the coax going to Antenna 1. When you select any other antenna, no dc power will be applied.

You can do more with this feature than send dc to preamps. In fact, I used it to power a remote antenna tuner at the base of my HF vertical. Whenever I tap the button for **Antenna 1**, my remote tuner instantly comes online. An elegant solution indeed!

Manufacturer: SSB Electronic GmbH, Ostenfeldmark 21, 59557 Lippstadt, Germany. Distributed in the United States by Array Solutions, 2611 North Beltline Rd, Suite 109, Sunnyvale, TX 75182; tel 214-954-7140; **www.arraysolutions.com**. *$380.*

Eclectic Technology

Steve Ford, WB8IMY, wb8imy@arrl.org

A New Digital Mode for Low Frequencies

Many hams have become acquainted with the unusual signals heard around 14.076 MHz and other frequencies. They've discovered the music of JT65, a high-performance weak-signal mode that's rapidly emerging as one of the most popular forms of digital communication on the HF bands. JT65 was created by Dr Joe Taylor, K1JT, and popularized on HF through software developed by Joe Large, W6CQZ.

K1JT's work continues and he has recently pulled the wraps off a new mode designed for communication on the low bands where high noise levels present big challenges to weak signals. Known as JT9, it has at lot in common with JT65. In fact, JT65 operators will find much in the software and operating techniques that are familiar.

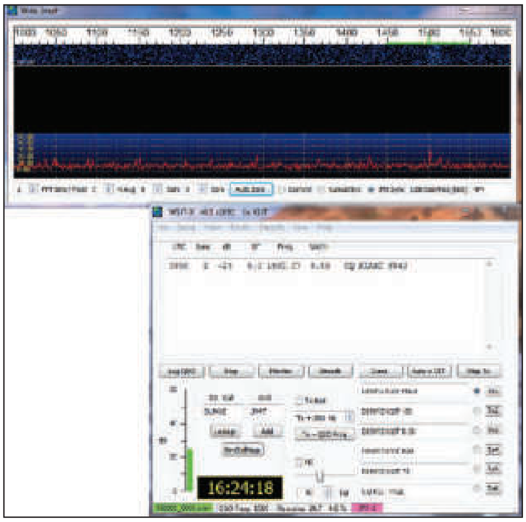
JT9 offers "submodes," the designations of which correspond to the durations of their transmit/receive sequences: JT9-1, JT9-2, JT9-5, JT9-10 and JT9-30. These submodes use 1, 2, 5, 10 and 30 minute intervals respectively. The longer the transmission, the smaller the bandwidth and the higher the sensitivity. The slowest submode, JT9-30, has a miniscule bandwidth of only 0.4 Hz and operates at signal-to-noise ratios as low as -40 dB!

American amateurs are already putting JT9 to work on 160 meters around 1838 kHz with the JT9-1 submode being the most popular. Amateurs in parts of the world with LF allocations are seeing remarkable results with JT9 using just a few watts of RF. With the recent news from the FCC that hams in the US may finally gain access to 135 kHz, the timing of JT9's debut couldn't be better.

JT9 is part of the experimental *WSJT-X* software suite that is free for downloading at **www.physics.princeton.edu/pulsar/K1JT/wsjt.html**. Be sure to download the *Quick-Start Guide* as well.

Hams are already asking if JT9 contacts count for digital DXCC and other ARRL awards. The answer is "yes."

At the time of this writing JT9 had not been included in the list of modes provided in the *TQSL* application used to "sign" logs prior to uploading to Logbook of The World. However, Norm Fusaro, W3IZ, ARRL Assistant Manager of Membership and Volunteer Programs, offers the following steps to link JT9 contacts to a mode that's already included in *TQSL*:



JT9, the new digital mode from K1JT for low-frequency communication.

- Open *TQSL*
- Select FILE - PREFERENCES - ADIF MODES
- Click the ADD button on right.
- In the mode window enter the mode as it is expressed in your logging program (JT9, for example).
- Use the drop-down menu on the left to select the mode that you want it to represent. Linking JT9 contacts to DATA will guarantee that they receive digital credit when you upload.
- Click OK and then click OK again.

When you export your log and sign it with *TQSL*, your JT9 contacts will automatically be uploaded as "DATA" (or whatever you've chosen) and will count as digital contacts in Logbook of The World.

3D Printing?

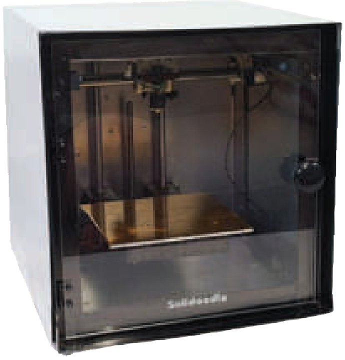
At the risk of oversimplifying, a 3D printer "prints" three dimensional objects by layering material in a manner analogous to the way an inkjet printer sprays ink onto paper. The result can be a work of art, a machine part or just about any solid object you can imagine.

The technology isn't all that new. Manufacturers have been relying on 3D printing for a number of years. What *is* new about 3D printing today is the fact that 3D printer costs are plunging.

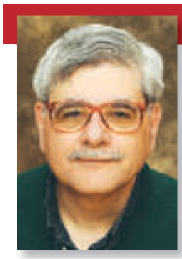
Remember how much flat-screen HDTVs cost when they were introduced? 3D printers used to cost tens of thousands of dollars, but today you can pick up a sophisticated model for well under $3000. There is even a limited-feature unit selling for less than $1000. That puts 3D printing technology well within the reach of many hobbyists.

For hams 3D printing offers the ability to create custom made parts for antennas and countless other homebrew projects. You could even print a custom chassis for your next homebrew transceiver, complete with mounting holes, standoffs and so on.

We're in the early adopter phase of 3D printing at the hobby level, but if you're one of the innovative few who are using this technology for Amateur Radio applications, drop me an e-mail and send photos of your creations. They may end up in a future column.



A typical 3D printer. This model retails for less than $2000.



Hints & Kinks

Steve Sant Andrea, AG1YK, hk@arrl.org

Bugged Beams, Dipole Quick Trim and Hearing Help

Is Your Antenna Bugged?

I once saw a relatively new 3 element aluminum Yagi lose the end of one of its elements. I asked the ham who owned the antenna what caused it to break off. He said the element vibrated (oscillated) in the wind and he thought metal fatigue caused the failure. Since that time, I have had many beam antennas vibrate in the wind but have yet to experience the same type of metal fatigue. (It does help to place small diameter piece of rope or heavy twine inside the elements to dampen the effects of this vibration or oscillation).

Recently, while removing a Mosley TA-33 from a tower, I found that one of the element tips was broken off and two others were on the verge of breaking off. A closer investigation revealed that all but one of the element tips were missing their end caps. Inside each element was an impacted mass of what looked like insect larvae. It appears that hornets had laid eggs inside the element tips and, as the larvae matured, they secreted formic acid, which began to eat away the inside of the element tips.

Figure 1 shows formic acid's effect on a piece of aluminum tubing removed from the affected beam antenna. Next to the corroded aluminum tubing is a piece of tubing that was not affected so you can see the difference in the thickness of the element walls.

Figure 1 — Insect infestations in antenna elements can be much more than a simple annoyance. Many insects produce corrosive chemicals that can be very destructive to aluminum. Keep those end caps on. [Lawrence W. Stark, K9ARZ, photo]

If you have a beam that is missing its end caps, lower the beam, clean out those elements thoroughly and replace the missing caps. This also applies to end caps on the boom. When I replace the end caps now, I usually give them a shot of super glue to help keep them in place. — *73, Lawrence W. Stark, K9ARZ, 1875 Chandler Ave, St Charles, IL 60174-4601*, **k9arz@arrl.net**

Quick Trim Your Dipole

After replacing the baluns on my loop antenna and dipole, I swept the band and found the lowest SWR on the dipole at the very low end of 80 meters, below where I wanted it to resonate.

I needed to know how much I should prune the antenna wires in order to achieve resonance. I came up with an idea but thought it was just too simple. However, I tried it anyway.

The principle was this: At 80 meters my minimum SWR was at 3.7 MHz; I wanted it to be at 3.8 MHz. I decided to calculate the wavelength for each frequency and simply subtract to determine what I need to cut.

I looked around the web for a basic frequency to wavelength calculator and found several. I settled on **www.wavelengthcalculator.com**. I entered 3.7 MHz and came up with a wavelength of 261.6 feet. I then entered the frequency of 3.8 MHz and came up with a wavelength of 254.7 feet. Next, I subtracted the two numbers and divided by four (because you have two quarter wave lengths for a dipole) the result was 261.6 – 254.7 = 6.9 feet. Divide by four and you get 1.73 feet.

I cut 1.73 feet (1 foot 9 inches) from both ends of the antenna. I swept the band again and voila! I was resonant at 3.8 MHz. The beauty of this method is that you already have the antenna up and all the various environmental conditions (height above ground, lengths of feed lines, wire size, surrounding structures, etc) affecting the antenna characteristics are present. Next time you put up a wire antenna follow this procedure: Cut the antenna to theoretical values. Run a sweep to find the frequency of minimum SWR. Do the simple math as above to find the difference in wavelength between the resonant frequency and the desired frequency, calculate the new antenna length, adjust the wires and you are done. [When adjusting the wire, don't cut the end off but fold it back onto the antenna. This will leave some excess for future adjustments. — *Ed.*] — *73, Gary Schmitz, KT7AZ, Oro Valley, AZ 85737*, **kt7az@arrl.net**

Hearing Aids as Headphones

If you're considering purchasing hearing aids (HAs), consider some of the new technology available. In addition to all the new tuning and intelligibility algorithms, many modern HAs have integrated Bluetooth wireless technology that allow them to interface with cell phones and television audio.

Apparently Bluetooth isn't yet available for Behind the Ear (BTE) units. In the case of my Oticon HA, there is a USB-charged receiver that you can slip in a pocket or wear with a lanyard antenna (see Figure 2). Its range to the HA is a short, but adequate. For the first use, it has to be linked to your HA by your audiologist, but afterward it can be paired by typical pushbutton methods to any Bluetooth device. Oticon offers a landline telephone interface and a line level audio box that plugs

Figure 2 — Modern Bluetooth enabled hearing aids permit the user to interface their devices to a variety of external audio sources, including your transceiver. [Don Pomplun, K2BIO, photo]

into a TV's audio outputs. I typically use the TV interface for enhanced clarity.

The user can link the pocket receiver with a dozen or so standard Bluetooth devices. Interestingly, it also has a 2.5 mm audio input jack. With the right adapter cable, you can connect your rig's headphone output to this unit and convert your HAs into custom headphones. The Oticon receiver has an option for listening only to its audio source or to mix in the HA's microphones so you can hear other noise in the room (like a call to dinner).

Though still obscenely expensive, with limited medical coverage options, my audiologist included these accessories in the HA purchase price. If it's time for you to purchase or upgrade, these are features to look for. — *73, Don Pomplun, K2BIO, 521 Van Buren Pl, San Ramon, CA 94583*, **k2bio@arrl.net**

High Voltage Parts

High voltage (HV) power tubes are still with us and probably will be for many years to come. I have found that discarded microwave ovens are a good source for some of the expensive high voltage parts that they require.

The transformer output voltages of microwave oven transformers vary, but they output high voltage, are powerful and are free for the taking on trash day. The secondary is also relatively easy to remove and rewind for other voltages. These ovens also contain a high voltage diode (which is often the reason for the oven's failure) and a high voltage capacitor, which contains a bleeder resistor. I find that the capacitance value is too low for use as a filter, but perhaps it's enough for other applications.

In addition, the oven is a source of some useful hardware such as a fan, a small "stirring" motor, sheet metal or an almost finished cabinet and some electronic parts on the control board. — *73, Jim Wallace, KB5MT, 111 Deer Island Rd, Mabank, TX 75156-6816*, **kb5mt@arrl.net**

Drill Chuck Helping Hand

Most of us have a battery powered drill. When the batteries finally die, we dispose of it and buy a new one. I had a couple of these drills and I was about discard them when I decided to open them up and see what I could salvage. The main part is the chuck. I thought it might be handy for holding things when soldering or brazing.

I modified the chuck by grinding off the main gear until it was flat and would stand by itself. I bent some wire, soldered alligator clips to the ends and now have a "third hand" to help with holding parts or wires (see Figure 3). Two of them are even better (see Figure 4). The chucks could be glued to a piece of wood or metal to create a support fixture. They are helpful in my construction projects and they aren't adding to the local landfill. — *73, Van Johnson, KH6UX, 4567 S Mulford Rd, Rockford, IL 61109*, **copperking12@comcast.net**

Figure 3 — Before discarding that worn-out drill, remove the chuck; it will make a great "third hand." [Van Johnson, KH6UX, photo]

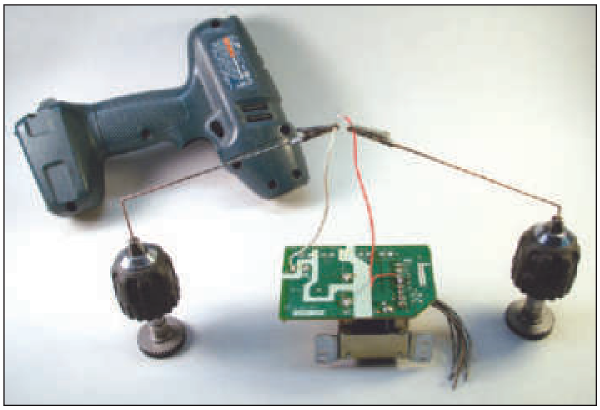


Figure 4 — The chuck from a worn-out drill and a stiff wire with an alligator clip can be a big help on the work bench. [Van Johnson, KH6UX, photo]

Fixing Ceramic Capacitors

I discovered this by accident while replacing a badly drifting temperature-compensating capacitor in one of my vintage VFOs. After removing the part and giving it the heat-gun test with my capacitor tester, it proved to be quite stable. Heating the leads apparently fixed it. I put it back into the circuit where it has been working since.

Heat each lead with a soldering iron until the body is too hot to touch. That seems to fix the problem. I've done this only on the old *dog-bone* style ceramic capacitors, all in the range of 30-100 pF. I don't know if it will work on any other types or values. [While this technique may work, the capacitor is suspect and should be replaced. — *Ed.*] — *73, Tom Webb, W4YOK, 3533 Teakwood Ln, Plano, TX 75075-1783*, **sam9lives1@verizon.net**

No-Scratch Mount

I recently replaced my car. I noticed that my 2 meter magnetic-mount antenna had scratched the paint on the roof of my old car. To keep this from happening on my new car, I used a piece of magnetic rubber sheet material commonly used for refrigerator magnets with advertising printed on them. If you don't have any on hand, a sign shop that makes magnetic signs for vehicles may give you a small scrap. The magnet material can easily be cut to the desired size. — *73, Al Forbes, KJ4YEV, 1908 Woodgreen Dr, Gastonia, NC 28052*, **alphaal@bellsouth.net**

Going Straight

I have several microphones with cords whose ends have been cut off or have had connectors soldered onto them. I wanted to change a connector but the coiled cord end presented a problem. There was only a short length of straight cable before the coils of the cord. I used a heat gun on the coiled area and straightened enough cable to be able to remove and replace the connector. I generally straighten out about 2-4 inches (7-10 cm). After straightening the cable, the connectors are easy to replace and it looks better too. — *73, Tony Fonseca, VA7TF, 44 Fulmar St, Kitimat, BC, V8C 1T4, Canada*, **va7tf@arrl.net**

Banishing Birds

I have discovered a great way to keep birds off my antenna — Tanglefoot Bird Repellent, available at many hardware or home and garden stores , such as Ace (81395) and True Value (380736). I applied the repellent (a clear sticky gel in a tube) to the elements with an old paint brush and it is very effective at discouraging bird landings. — *73, Lou Caldwell, W7HX, 10525 E Lehigh Ct, Sun City, AZ 85351*, **w7hx@cox.net**

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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.

The 11 Square Foot Ham Shack

You can create an efficient, comfortable station in even the smallest space with some compromise and careful planning.

Stan Levandowski, WB2LQF

Amateur Radio stations run the gamut from broadcast studio layouts in dedicated structures to an old door sitting on two sawhorses in a musty basement. Where on this continuum does your "shack" fall?

If you are an apartment dweller, own a condo or a townhome or otherwise have limited space available, designing your own attractive, functional shack becomes even more of a challenge. My own shack fits into a tiny corner of my home and offers the efficiency and comfort I need to help me get the most out of my operating time. Here's how I devised my setup.

Figure 1 —Thoughtful planning can turn a cramped space into a compact shack.

Establish Goals

Many amateurs meld their ham station with their test bench and building area. If you have limited space you might want to avoid this, especially if operating represents a significant portion of your hobby time. Trying to cram too much equipment and function into a small space can lead to loss of focus. This can cause an overall reduction in efficiency, comfort and aesthetic.

Yes, I said *aesthetic*. Don't underestimate this factor, especially if your ham station is going to intrude upon shared living space. My own modest inventory of test equipment, tools and supplies occupies an unobtrusive corner of my garage where I have an equally modest workbench. If you don't have a garage or basement, try using an under-the-bed storage container for your tools and equipment and a folding table as a workbench.

Finding the optimal location for your station is the key to comfortable and effective operation as well as satisfying the goal of continued harmonious relations with the family. From a technical perspective, you want to be near your antenna transmission line, not too far from a proper ground and close enough to a source of ac power. From an operating perspective, you want to be able to speak into a microphone, tap your key and tune around the bands without background noise from a television set or family conversation. You also want to minimize the impact of your operations on other family members. Basements, garages, attics, hallways, closets and other random nooks and crannies have all been used successfully.

It's unlikely that you will be able to find a location that meets all your needs and that's when ingenuity comes into play.

The Perfect Spot

My wife and I are retired and live in a two bedroom, two story townhome. There was a small nook at the far end of our second floor master bedroom that measured a mere 4.5 feet wide by 2.5 feet deep. It was warm, quiet and private. It was around the corner, out of sight from the bed and didn't intrude on the more public living space. There was a copper cold water pipe behind the wall, a 15 A outlet on the right wall and the left wall adjoined a linen closet that could provide easy access to the attic for cabling.

As a 100% low power CW operator, I don't make much noise operating late at night or very early in the morning. I always wear my headset. This location was perfect. I set about making maximum use of this sliver of space.

Figure 1 shows my station situated in the master bedroom alcove. A simple wooden desk that fits the available footprint of 11 square feet provides the anchor point. A local clearance house sold it for pennies on the dollar. Wood is nice because it can be easily modified. It weighs less than particle board and is easier to customize than metal.

I invested in an armless, height-adjustable, swiveling desk chair. A chair with arms might not fit completely under the desk. If you really need arms in order to sit back and relax then you're not working the DX hard enough!

When trying to conserve space, "going vertical" is good. Anything that frees up the desk surface can improve efficiency and reduce fatigue during operating periods. This is where a "cubby" comes in handy. Also known as "desk overheads," cubbies are simple to construct. Figure 2 shows the general concept. Designing your own cubby to suit your personal style is fun. Common 12 × ¾ inch shelf pine is a good choice and can stand a 48 inch span without sag unless you

Figure 2 — This view shows the main radio shelf with all the radios and accessories in a neat and efficient layout.

Figure 3 — A 1 inch opening that runs along the back of the cubby allows for passing wire and cable through from the operating area. Also visible are the halogen lights and the white enamel paint used to brighten the workspace.

Figure 4 — The computer sits on a wooden box mounted on drawer sliders. It can be slid out for operating and then back in when not needed.

have boat anchors. In that case, additional vertical support in the middle solves the problem.

Doublers can be used to support the cubby on the desk as well as provide strength for each additional shelf. The shelves rest on the doublers, which are end-fastened to the outer verticals with wood screws. The cubby itself is then end-fastened to the desk. Should you desire to compartmentalize any of the shelves just cut more doublers and end-fasten them with two wood screws, top and bottom. Use a level to insure the doubler is vertical. This is a simple yet sturdy arrangement that only requires simple hand tools to fabricate. I put a back on my cubby's base. This eliminates the annoyance of having pens and other things falling off the rear of the desk. A 1 inch top gap can be seen in Figure 3. This allows wires, cords and cables to be passed through to the rear from the desk's surface.

If you live in an apartment, condo or townhouse it's unlikely that you will have a fully outfitted woodworking shop at your disposal. So let's keep this simple! How high you go is your choice. The ceiling is the limit, but anything over 30 inches high should be fastened securely to wall studs with "L" brackets to avoid a topple hazard. You can paint or stain your cubby. I chose to stain mine but used high gloss white enamel paint for the entire bottom portion and for the undersides of all shelves. This brightens the surfaces, which scatters more light. Under-shelf lighting provides the finishing touch. I used 20 W (G8 base) halogen lights, which produce no RFI. The halogen lights do get quite hot so exercise appropriate caution (see Figure 3).

De-clutter the Desk

The actual desk surface is where the action happens and you will want to ensure that it helps, not hinders, your operating style. I chose to elevate my radios so that I could benefit from a large working area.

Today, most of us use a computer in our shacks. How we use the computer determines its placement. Because the computer is only adjunct to my operating, I located it off to my left on a sturdy, homebrewed sliding shelf (Figure 4). Common drawer hardware and pine scraps were used in the fabrication. I used 22 inch drawer slides. The left one is attached to the left cubby side; the right one is attached to a 20 × 2¼ × 2½ inch piece of pine that is "L" bracketed to the desk. The shelf is a simple three sided box dimensioned to fit within, and is attached to, the sliding rails. A pull handle finishes it off.

Certain operating aids are crucial. These may include a DXCC list, Q signals list, RST chart and band plans. A piece of ¼ inch custom cut

Figure 5 — The headset cable is routed above the operating area, which eliminates a major annoyance. It then runs down the left side of the desk to the headphones hanging conveniently by your side.

plate glass not only makes an excellent operating surface but allows these aids to be neatly arranged under the glass and readily available. Small vinyl retainers (visible in Figure 4) at the corners between the desk surface and glass eliminate any shifting. Figure 4 also shows a small, convenient undershelf just below the K1 transceiver that holds a world atlas and supplementary reference material.

Two remaining — and not so minor — annoyances can now be addressed: headset and key cables. The headset cable is routed along the front left of the lowest shelf, down the left side of the desk and around to the front where a sticky-back coat hook serves as a convenient headset hanger (see Figure 5). When not in use, the headset is completely off the operating desk and out of the way. During use, its cord remains off the operating desk as well. Leave enough slack in the headphone cord so that you can reach all your radios, as well as the computer. If your headphone cord is too short just buy an inline coupler and extension cord. The relief from not having to drag the headset cord back and forth across the operating surface is indescribable!

Key cables are another nuisance. Most modern rigs have their key jacks on the rear panel and switching keys and paddles often means reaching around back and working blind. I constructed a very simple "patch panel" to move all the key inputs to a convenient and visible location right behind my key as shown in Figure 6.

Radio Central

As a Navy radioman, I grew accustomed to operating racked equipment. It became evident that attention to the smallest layout detail made it possible to get the most out of the cramped quarters aboard ship. I spent some time experimenting until I was satisfied with the radio shelf and its contents. You need your transceiver's controls and displays at the correct height for comfortable operating and minimal eyestrain. You also need unfettered access to the rear, as well as sufficient air circulation. Toward this end I left 3 inches between the shelf and the wall.

Your power supply is not used frequently and can be placed at the end of a shelf. Mine is to the far left and above it is the dc power distribution strip. At the extreme right, two surge protected power strips can be seen. One is dedicated to lighting; the other is dedicated to equipment. Pulling those plugs out of the wall kills all power to the station — an important safety feature. Note the use of a battery operated digital clock for timekeeping so that disconnecting ac power doesn't affect the clock.

Finishing Touches

The left side of the middle shelf holds my SWR/power meter and an antenna/transceiver switch (see Figure 2). This switch permits any of six antennas to be connected to any of six transceivers. It's also a great place for my dummy load.

The remainder of the middle shelf was a perfect location in which to build a showcase for my key collection. In addition to allowing me to display my keys, it provides a dust-free storage environment and easy access via a sliding front.

I used picture frame molding to construct the left and right channels as well as the bottom stop. I then attached the top piece of molding to a piece of clear plastic. It's a push up/slide down affair. To build the actual display case, I cut out a back, bottom, ceiling and two sides from a single 2 × 4 foot piece of 3⁄16 inch luan plywood. I covered the bottom, back and sides with a rich, velvety material over a layer of cotton batting. This was stapled on the backsides. I painted the display cabinet's ceiling gloss white and installed another task light to provide attractive illumination.

All these pieces, except the ceiling, were then attached to the shelf interior with adhesive hook and loop fasteners. I screwed the ceiling to the underside of the top shelf for safety because of the task light. While the display case *looks* permanent, all the pieces, with the exception of the ceiling, can actually be removed without tools and the shelf can revert to another use. The uppermost shelf is used to hold my printer and my grab and go laptop low power station.[1]

Figure 6 — This homebrewed key cable patch panel places all the key inputs in an accessible location.

I use furniture sliders to pull the desk out so I can gain access to the back. All wires and cables attached to the back of the desk/cubby are organized, labeled and neatly secured with cable ties. Moving the desk moves all the cables and cords with it — truly self-contained.

Summary

I hope that some of the concepts and ideas presented here prove helpful to other amateurs in similar circumstances who may be striving to achieve a greater sense of permanence and "curb appeal" for their shacks. There's no reason to lead a gypsy's life, operating from a rickety card table while sitting in a folding chair and resting your feet on a tangled mess of wire and cable. A little thoughtful planning, along with a reconnaissance sweep through the house, may reveal substantial opportunities to define your shack.

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[1] S. Levandowski, WB2LQF, "A Laptop QRP Station," *QST*, Dec 2011, pp 30-33.

All photos by Stan Levandowski, WB2LQF.

Stan Levandowski, WB2LQF, an ARRL® member and Volunteer Examiner, earned his Novice license in 1960. In addition to his Amateur Extra class license, he also holds the General Radiotelephone Operator License (GROL) with Ship Radar Endorsement and the Second Class Radiotelegraph Certificate. He retired from IBM Corporation where he was a software development manager and now operates 100% HF low power CW. Stan can be reached at 6 Chatham Ct, Fishkill, NY 12524, **wb2lqf@arrl.net**

Catch Up With Pedestrian Mobile Operating

Create your own roaming radio for an adventure in the wilderness.

WA3WSJ/pm operating on frozen Hopewell Lake in French Creek State Park, Pennsylvania.

Edward R. Breneiser, WA3WSJ

In the spring of 2010, I worked Paul Signorelli, W0RW/pm, while he operated pedestrian mobile in Colorado with an HF backpack radio (HFpack). After that first contact with Paul, I worked him several times while he was operating pedestrian mobile from Devil's Head Fire Lookout, Bear Creek Park, Garden of the Gods Park and later from the Santa Fe Trail.

Paul suggested that I build an HFpack and try operating pedestrian mobile. My ICOM 703 Plus was sitting unused in the shack and I thought it might just do the trick.

Picking Up the Pieces

The first thing I needed was a pack frame. I searched eBay and found an ALICE backpack frame. ALICE is an acronym for All-Purpose Lightweight Individual Carrying Equipment. It is a very lightweight pack frame constructed from aluminum tubing. The US Army began using these frames in the early 1970s and they are available from many Army surplus stores.

I purchased an SLA 10 Ah battery and began considering the problem of how to mount the battery to the frame. I returned to eBay and found a removable shelf that fits on the bottom of the ALICE frame and makes a perfect support shelf for the battery.

After a few hours of building, I had my very own HFpack (see Figure 1). It fit like a glove and was rather lightweight. My last challenge was how to mount the remote head so I could use the pack while walking around. A trip to the hardware store yielded the perfect solution. I found plastic "paint clamps" (see Figure 2), which were angled perfectly for mounting the ICOM 703 remote-head bracket. With the head attached, I was able to just clamp it to the front of my ALICE frame waist belt.

Radio Rush

I made my very first contact as WA3WSJ/pm right from my front yard in Pennsylvania. I worked KE4ZIP, the Sun City Amateur Radio Net in Florida on 20 meter SSB. It was a real rush!

Why operate as pedestrian mobile? Just think about being able to operate from (almost) anywhere without being tied to your home or vehicle for power. I have operated from mountain summits, frozen lakes (see lead photo), fire towers and on the Appalachian Trail. Operating as pedestrian mobile is totally addictive. In just a few months, I have already worked 39 states and 10 countries!

When you're operating as pedestrian mobile, someone who sees you will inevitably ask what you're doing, which becomes a great opportunity to talk up ham radio.

For more information and pictures related to my HFpack radio and my other ham activities, visit **wa3wsj.homestead.com**. You can find more information about HF backpacking at **www.hfpack.com**.

Figure 1 — Here is the completed HFpack ready for some pedestrian radio action.

Figure 2 — These paint clamps were found at a home center for $3. They proved to be perfect for mounting the ICOM 703 remote head.

All photos by Ed Breneiser, WA3WSJ.

Ed Breneiser, WA3WSJ, an ARRL® member, was first licensed in 1974 and now holds an Amateur Extra class license. An engineer who retired from Agere Systems in Reading, Ed has lived in Pennsylvania most of his life and has become an avid outdoorsman. He has hiked sections of the Appalachian Trail in Pennsylvania, Maryland, West Virginia, New Hampshire, New Jersey and New York. Ed enjoys low power CW and always brings a radio with him on his adventures.

In other areas of ham radio Ed is AEC for Berks County ARES/RACES and has been involved in building the Berks County WL2K system. He assisted in the formation of the paNBEMS (Narrow Band Emergency Messaging System) Working Group and is a Pennsylvania SKYWARN Coordinator. Ed can be reached at 775 Moonflower Ave, Reading, PA 19606-3447, **wa3wsj@arrl.net**

Pole Vaulting On Six Meters

Six meter transpolar sporadic E propagation seems to be becoming more frequent and robust.

Dave Bernhardt, N7DB,
and Dave Lofgren, K7RWT

Six meter operators in the Pacific Northwest (PNW) states of Oregon, Washington, Idaho and Montana and the Canadian provinces of British Columbia and Alberta experienced a phenomenal sporadic E (E_s) opening to Europe on the morning of June 29, 2012. W7KNT in western Montana said, "This was probably the most amazing widespread opening into eastern Europe I have ever seen on 6 meters." This article explores both the historical and phenomenal aspects of the 2012 PNW-EU 6 meter opening and the possibility that E_s propagation patterns in the PNW are changing.

History of PNW-EU 6 Meter Openings

Six meter enthusiast Bill Sattler, NØXX/7, once said, "Working Europe on 6 meters from Oregon might not be probable, but it is certainly not impossible."

Prior to June 2001, the authors could find only two documented 6 meter PNW-EU E_s openings. (A few European contacts were made via F2 during solar cycles 19, 22 and 23, but that is another story). David Strawe, K7KV, in Auburn, Washington, reported working both the Canary Islands and England during openings on June 24 and June 28 of 1989.[1] Aside from K7KV's contacts, there were no other reported 6 meter PNW-EU contacts reported until June 2001.

The rarity of these contacts is due to the distance from the PNW to Europe and the nature of E_s. The region of the E layer responsible for 6 meter E_s lies 60-70 miles (100-110 km) above the Earth. Six meter signals refracted by E_s typically travel distances of 900-1400 miles (1450-2300 km) in a single hop. For PNW-EU propagation multiple hops — as many as four, five or even six — are needed.

It is possible that previous 6 meter PNW-EU openings went undetected. Prior to the June 2001 opening, most PNW 6 meter operators seldom turned their antennas toward Europe since it was widely considered impossible to work on 6 meters. The majority of PNW stations kept their antennas pointed toward the eastern or southern US. Such well designed Yagi antennas oriented in that manner have their side lobes pointed toward Europe greatly attenuating 6 meter European signals.

The apparent rise in frequency and intensity of PNW-EU openings that began in 2001 might be attributable both to a greater awareness of the potential for openings and to the larger number of both European and American stations using high power amplifiers and large antennas. The use of "real time" DX contact reporting via the DX clusters has been very important in spreading the news about European openings since 2001 and has probably been the greatest contributing factor to the climb in detection of European openings in the Pacific Northwest. It is also possible that the upward trend in levels of E_s in the Arctic region have been due to changes in the location of the North Magnetic Pole.

June 10, 2001 — The First Major PNW-Europe Opening

The Pacific Northwest to Europe 6 meter scene changed completely with an opening to Europe during the 2001 June VHF Contest. On June 10, 2001, Larry Tyree, N6TR, operating from the Boring (Oregon) Amateur Radio Club, K7RAT (CN85) was running the east coast on 6 when he worked his first European station. News of the opening spread like wildfire by landline and the 50 MHz Propagation Logger at **dxworld.com/50prop.html**. The band exploded with stations in the Portland, Oregon; Seattle-Tacoma, Washington and southern British Columbia areas, which were all working Europe for the first time. The 6 meter breakthrough to Europe was made for many that morning, along with the realization that it was indeed possible to work Europe on 6 meters from the Pacific Northwest.

2003 and 2010 European Openings

Two other significant European openings were observed in the Pacific Northwest prior to the June 2012 opening. The first of these occurred the morning of July 8, 2003, during which ON, PA, DL and I were worked in Oregon, Washington and British Columbia.

The second opening occurred Saturday June 19 and Sunday June 20, 2010. That opening was more widespread geographically than the previous two and included contacts between W7/VE7 and S5, 9A, OE, I, ON, HA, E7, SV, SU and EA. This opening was the first and only time 6 meters has opened from the Pacific Northwest to Europe on consecutive days. After seeing KØGU (Colorado) spotting Europe on DX Summit (**www.dxsummit.fi/**), stations in northwestern Oregon, Washington and southern British Columbia turned their antennas to the northeast and discovered an opening to Europe. The importance of DX cluster postings for alerting 6 meter and HF DXers alike to openings cannot be overemphasized.

The Phenomenal 2012 Opening

"Six meters is open to Europe and people better be getting out of bed and turning their radios on!" announced Dan, NN7J, at 5:45 AM PDT on 2 meter FM.

Danny, K7SS, enthused: "First EU ever on 6. A day to remember."

Still, as exciting and surprising as the 2001, 2003 and 2010 openings to Europe were, they paled in comparison with the 2012 opening. That opening was phenomenal in its duration of 6½ hours, its huge European footprint and the utterly astounding fact that 31 European countries were worked from the PNW. By comparison, the largest number of EU countries that had been worked in a single day in the PNW was 12 during the 2010 opening. The number of countries worked during the 2012 opening had nearly tripled from the previous number!

Beacons, Beacons, Beacons

The 2012 PNW-EU opening began to develop the evening of June 28 with a strong opening to 6 meter stations in VE5, VE6, VE8 and KL7. Nearly all of the Canadian 6 meter beacons were copied — at times S9+ — by stations in Oregon and Washington. The VYØSNO beacon — rarely heard in Oregon and Washington — was copied for several hours by K7RWT in Portland and was heard the next morning by NN7J, also near Portland, just before the band opened to Europe.

At the same time, the DX clusters showed that a major 6 meter opening was in progress between Japan, eastern China, and central and northern Europe. Based on DX Summit spots, that opening began at around 2230

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[1] B. Tynan, W3XO, "The World Above 50 MHz," *QST*, Sep 1989, pp 72-73.

UTC and lasted over 12 hours until about 1100 UTC, encompassing the period of the strong PNW opening to Canada. It seems clear that the two openings were part of an intense E_s event encompassing the entire northern Arctic region from Europe to Japan and China, the North Atlantic and all of northern Canada. When the sun rose in the Pacific Northwest on June 29, it lit up the E layer and set off the most intense and widespread 6 meter opening to Europe ever witnessed in the Pacific Northwest.

The European DX

Figures 1 and 2 show the enormity of the opening and the European DX worked in the Pacific Northwest. Figure 1 shows the map for 1730 UTC on June 29. Figure 2 shows the geographical extent of the opening. Each of the call signs shown on Figure 2 represents one of the 31 countries and 31 of the 73 grid squares worked from Oregon, Washington, Idaho and Montana, and the Canadian Provinces of British Columbia and Alberta.

The roughly triangular shaped footprint of the opening is defined by JW7QIA in Svalbard, EA8CQS in the Canary Islands, and 4X4DK and 4Z1UF in Israel. The area encompassed by the triangle, which does not include the stations in the United Kingdom, is roughly 5,100,000 square miles or 13,200,000 square kilometers — a truly phenomenal footprint for a multihop 6 meter E_s opening.

Countries and Contacts

Lew, W7EW, in Salem, Oregon, gave this report:

> The morning of June 29 I got up late as I had been up late the evening before due to the VE4 and VE6 beacons being in. When I turned on the radio I tuned to the first loudest signal. I thought it was K7RWT calling for SV1DH. 'Poor Dave...he's really lost it,' I thought. Then I figured out the station I was listening to *was* SV1DH and he was responding to K7RWT!
>
> I worked the SV1DH after Dave and then slid down to the clearest frequency and called CQ just as everybody had done during the contest opening many years ago. The pileup was as loud as any HF pileup I had in the past on the VP8 or ZL8 DXpeditions — except nobody would stop calling. I went into the DXpedition mode, except that it was transceive rather than split. I could always hear multiple callers but most were at the noise level or slightly above. I used another antenna at 70 feet to help with the higher angle stuff. The SV1DH contact happened at 1553Z and I kept after the pile until the last contact with GM3YTS at 1931Z. I worked 111 stations in 24 different countries.

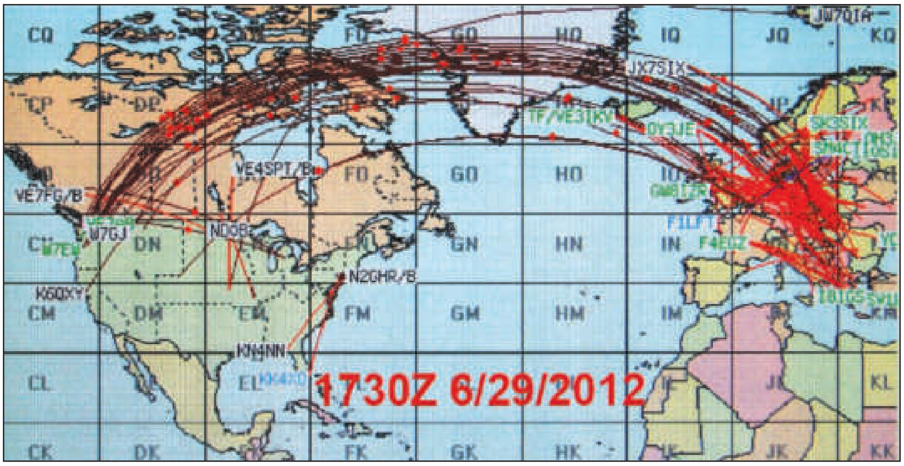


Figure 1 — This map shows the 6 meter path from the Pacific Northwest to Europe across northern Canada, Greenland and Iceland about two thirds of the way through the 6 hour event. [**www.dxmaps.com**, Gabriel Sampol, EA6VQ]

Many PNW 6 meter stations worked 10 or more European countries in this opening but the accolades for most countries clearly went to Lew, W7EW. He uses an array of six vertically stacked, 7 element LFA (loop fed array) Yagis on a 180 foot rotating tower in anticipation of Solar Cycle 24 F2 conditions. Little did he know that the June 29 E_s opening would exceed any opening to Europe on 6 meters seen in the Pacific Northwest. He also heard but was unable to work 9H, ZB and RV6 (European Russia where 6 meters is not allowed) bringing the total number of countries either worked or heard in the Pacific Northwest to 34.

N7NW in Washington, running 1500 W to a

Figure 2 — This map of Europe shows call signs for all 31 countries worked. With the exception of 4X4DK and 4Z1UF, each call sign represents one of 73 worked grids. [Dave Lofgren, K7RWT]

9 element M^2 Yagi at 130 feet, was close behind W7EW with 20 countries including eight new DXCC. K7RWT in Oregon, W7FI and KE7V in Washington and W7KNT in Montana each worked 16 countries. K7CW (Washington) and VE7SL (British Columbia) each worked 15 countries. K7CW and W7EW were able to work Finland.

K7RAT and NN7J each worked 11 countries including 4O4A by K7RAT and 4X, 5B4 and UT5 by NN7J. K7SS worked 10 countries. With the exception of W7KNT in western Montana, all of the stations that worked 10 or more countries were located in the narrow, north-south line of grids CN84 through CN88.

W7MEM in Coeur d'Alene, Idaho pushed his DXCC total to 97 and is close to becoming the first Idaho station to achieve 6 meter DXCC.

The longest and for some the most exciting DX of the day was 4X4DK and 4Z1UF at roughly 6900 miles (11,100 km) from Portland, Oregon. 4X4DK was worked by N7NW, K7RWT, W7LR and NØKE. NN7J, W7MEM and W7KNT worked 4Z1UF. Many stations worked JW7QIA and a few were fortunate enough to work 4O4A, Z32ZM, UT5JAJ and 5B4AGN.

A Tale of Extremes

Not every European contact was made by stations running high power and large antennas. WB8VLC (CN84) worked CT1HZE, SM7FJE and DK3WG with 35 W and a 5 element M^2 Yagi at 22 feet. K7SS in Seattle, Washington worked 18 stations in 10 countries with 100 W to a 3 element beam at 48 feet. K7BG in western Montana worked Belgium, England, Netherlands, Poland and Scotland with 100 W and a 5 element Cushcraft Yagi at 70 feet. As many longtime 6 meter operators have observed, it doesn't take a lot of power and big antennas to work 6 meter DX when the band is "really open."

Grids, Grids, Grids

If the 31 countries worked on 6 that day were not sufficient to make some operators "flip their lids," then the number of European grid fields and squares that were worked surely was. Overall, 74 European grid squares in 12 different fields were worked by PNW stations in 14 grids and three fields. All but two (4X4DK and 4Z1UF, both in KM71) of the European call signs shown on Figure 2 represent separate grid squares.

This Isn't Moonbounce

One of the most interesting stories of this opening is that of well-known EME enthusiast Lance Collister, W7GJ. Lance did not believe it would be possible to work Europe on 6 meters from his Montana location, which is on the wrong side of the Rocky Mountains. To combat this limitation he put up a very large antenna array to do it by moonbounce. After years of making successful EME contacts with European stations, imagine Lance's surprise when he started hearing 6 meter signals from Europe that were not coming from the moon! Lance worked nine terrestrial Europeans from Frenchtown, Montana to complement his many European EME contacts.

The PNW to Europe 6 Meter Path

Several possible reasons for the scarcity of 6 meter PNW-EU E_s openings prior to 2001 were mentioned earlier, but another factor — the movement of the Earth's North Magnetic Pole — might be contributing to the increase in PNW-EU 6 meter openings that has occurred since 2001.

During the 50 year period of 1962-2012 the North Magnetic Pole has moved approximately 522 mi (840 km) in a near northerly direction away from its former location near the southwest corner of Bathurst Island in northern Canada to its present location in the Arctic Ocean northwest of the Queen Elizabeth Islands. The migration of the North Magnetic Pole has been in a direction that is roughly at a right angle to, and directly away from, the 6 meter path between the PNW and Europe. The authors speculate that the migration of the North Magnetic Pole might be allowing more E_s ionization to occur in the Arctic middle portion of the PNW-EU path than was previously the case. The authors welcome comments regarding this idea.

Conclusions

The 6 meter band between the PNW and western Canada to Europe opened in phenomenal fashion on June 29, 2012 with the longest and most widespread opening yet observed. In this article the authors have described that opening and its predecessors with the intent of illustrating the near absence of PNW-EU 6 meter openings prior to 2001 and the appearance of 6 meter PNW-EU openings from 2001 that culminated on June 29, 2012 with the longest and most widespread opening yet observed. We have also speculated that propagation patterns in the Northern Hemisphere might be changing because of a shift in the location of the North Magnetic Pole.

Regardless of the cause, one thing has become increasingly clear since 2001 — the 6 meter band can and does open from PNW-EU. PNW 6 meter enthusiasts desiring to work Europe should monitor propagation conditions — especially Canadian beacons and openings to VE6, VE7, VE8, VY1 and VYØ — during the summer E_s season and point antennas toward Europe often, especially during the morning hours. Watch DX cluster postings for European openings in other parts of the US and Canada that may be moving westward.

Acknowledgments

Much of the information presented in this article was derived from DX Summit (**www.dxsummit.fi/**); *The Daily DX* spots by Allard Munters, PE1NWL; **www.dxmaps.com**, and the *205 Morning Report*. Additional information regarding the 2012 contacts and some historical information was obtained from PNW 6 meter operators and past columns of *QST* magazine's "The World Above 50 MHz." The authors thank those operators who provided information and trust that the reports of contacts — both past and present — from operators they were not able to contact or verify from published reports are accurate.

The authors would also like to thank Jon Jones, NØJK, writer and editor of "The World Above 50 MHz" column for his thoughtful review of the article during its preparation.

Dave Bernhardt, N7DB, an ARRL® Life Member, was first licensed in 1963 and has been active on 6 meters since 1972 when he developed an interest in 6 meter propagation. He has achieved 6 meter WAS and VUCC and is active in many VHF contests. Dave's was also the first continental US station to complete the Worked All Japan Prefectures Award (WAJA). Dave can be reached at 15871 SE 322nd Ave, Boring, OR 97009-7083, **n7db@arrl.net**

Dave Lofgren, K7RWT, an ARRL member, received his Technician class license in 1962 and later upgraded to his current General class license. Dave became interested in sporadic E propagation as a teenager after discovering summertime sporadic E TV DX. He studied for his amateur license after learning that the 6 meter Amateur Radio band experienced the same skip conditions that caused TV DX and he has been active on 6 meters ever since. He has worked 90 countries on 6 meters and hopes to achieve 6 meter DXCC from Oregon.

Dave lives with his wife Brenda and daughter Kinsie in Portland, Oregon. He can be reached at **bdlofgren@aol.com** or **k7rwt@aol.com**

Your On-the-Air Sound

All audio is not created equal; simply amping yours up may hurt more than it helps.

Rick Lindquist, WW1ME

There's nothing like a major contest to bring bad audio out of the woodwork. Like radio rock jocks, many hams believe they must "sound loud" to break through. The lengths to which some operators go to boost their audio profiles can be counterproductive, however, resulting in "big" audio that's hard to copy. Our overarching goal should be clean audio that sounds terrific and/or offers some traction for contesting and DXing.

Sound That Suits Your Style

Your on-the-air sound should suit your voice as well as your operating style. Casual operators often are happy with what's vaguely described as "good communications audio." A few tweak for the richest sounding audio they can muster within the bandwidth of a typical SSB signal — usually on the order of 2.8 kHz. Contesters and DXers primarily seek to maximize intelligibility under demanding circumstances, aiming for audio that's distinctive enough to stand out in a pileup.

Tailoring Your Audio

Most rigs sound okay right out of the box. To optimize your audio, though, you'll want to employ the tools your transceiver and microphone provide or use an external audio enhancement device. Many modern transceivers permit the adjustment of audio frequency response and provide an audio "compressor" or other audio processor. Some audio enhancement "boxes" on the market allow for considerable massaging of your audio waveform — at which point the limitation becomes your transmitter's AF passband. My transceiver lets me set up a basic AF response curve with BASS and TREBLE controls (a rudimentary audio "equalizer"), select transmit bandwidth (from 2.6-2.8 kHz) and apply from 2-20 dB of audio compression (see Figure 1).

Figure 1 — Optimizing your transmit audio is a matter of shaping the audio waveform. [Rick Lindquist, WW1ME, photo]

AF equalization lets you *boost* or *cut* your audio level according to the frequency range of the sound(s) involved. You've likely heard audio that's too "bassy" or "muddy" and hard to understand. This means the transmitter's audio chain has been set to pass lower audio frequencies to a greater degree than mid-range or high frequencies (perhaps in an effort to sound more "manly"). This isn't the best approach because, in general, vowel sounds fall in the lower registers, while consonant sounds fall in the higher registers. You need *both* for optimal intelligibility, so the obvious approach would seem to be a "flat" AF response curve that handles all audio ranges — low, mid-range and high — equally. But voices differ and so do ears (and headphones and speakers) on the other end of the circuit, adding another layer of complexity.

Slenderizing

During contests or in DX pileups you'll often hear operators with audio that is cut or "rolled off" in the lower ranges and boosted in the mid and high ranges, constricting the bandwidth. This setup essentially reduces your on-the-air footprint, making you "thin" enough to elbow into a crowd, while the enhanced mid and high ranges help cut through the clutter — although intelligibility can suffer. I've heard stations take this approach to such an extreme that their signals are difficult to tune, because they're simply *too* skinny!

Getting the Right Balance

The worst audio often results from some combination of poor equalization and excessive audio compression — and sometimes too much microphone gain. Some phone operators avoid compressors altogether, because they tend to make the voice sound less natural. For everyday work, you probably can leave yours off.

Notions of "more talk power" aside, a compressor does pretty much what it says. It squeezes your audio waveform at the top and bottom, so that there's less dynamic range — the distinction between softer and louder sounds. With lots of compression, pretty much *everything* sounds loud. Tread lightly! A little bit — maybe 5-10 dB — goes a long way. More compression is not necessarily better and too much can harm intelligibility and introduce "pumping," distortion and splatter. A "live" room — one with few sound-absorbing materials — can cause echo and truly hideous audio.

Microphone Response

Your microphone is a factor too. The popular Heil Audio headsets and microphones often feature "full range" and "DX" settings. Full range yields more of a flat, natural response, while DX rolls off the bass components in an effort to slice through the competition (see above). More obscurely marked switches on other mics serve the same purpose — to change the mic's "tone." The AF response curve of a given microphone may not be optimal for you and may even be altogether unsuitable. If you have more than one mic, experiment on the air and/or listen to your own audio (record it from your transceiver) and see which mic or element suits your needs.

How you speak is also part of the equation. When contesting or DXing, speak clearly and even be a little upbeat when dropping in your call sign or exchanging information. Putting a little spring in your delivery can help your signal to stand out. If you tend to "close talk" the mic, don't mumble, and use a "pop" filter (typical mics have foam rubber inserts or external boots for this purpose). Always monitor your audio for overly compressed, clipped or distorted audio too.

Rick Lindquist, WW1ME, is the Managing Editor of *NCJ* and can be reached at **ww1me@arrl.org**

To the Moon and Back at 24 GHz

Bouncing RF off the Moon is never easy, but it is even more challenging at 24 GHz.

Al Ward, W5LUA

Amateurs have been bouncing signals off the surface of the Moon for more than 60 years. At a distance of about 239,000 miles, the Moon is in an ideal position to "see" an entire hemisphere of our planet. Reversing the perspective, this means that the Moon is above the horizons of many Amateur Radio stations around the world at any given time. Those stations have a giant passive reflector hanging in their local skies, just waiting to be put to work as the critical link in a globe spanning communications channel.

Advances in digital communications have allowed more hams to try *moonbounce* — also known as *EME*, or Earth Moon Earth. Even so, it isn't an activity that most hams would call "easy." To bridge a nearly half million mile circuit, you need the right combination of RF output power, antenna gain and low-noise receive gain. Most moonbounce is conducted on 2 meters, but the difficulty increases as you move up the bands. At microwave frequencies it can be quite a challenge.

A Round Trip to Japan at 24 GHz

On January 2, 2013 at 1430 UTC, I finally achieved what I believe is the first EME contact between the US and Japan at 24 GHz when I exchanged reports with Shichirou Mori, JA6CZD. We had the Moon about 20 degrees above our horizons for an hour.

JA6CZD uses a 2.4 meter offset fed dish with a 30 W solid state power amplifier. At my end here in Allen, Texas, I also use a 2.4 meter offset fed dish and a Travelling Wave Tube amplifier mounted on the feed support providing 100 W. The noise figures at both stations were less than 2 dB. During the contact, Shichirou copied my CW transmission 559 and I gave him a 449.

The narrow beamwidths of these antennas require precise pointing at the Moon for optimum performance. I use US Digital Absolute encoders and auto-tracking software written by K5GW. Shichirou uses an OE5JFL/HB9DRI tracking controller with MAB25 absolute rotary encoders.

With the combination of the RF power and the gain of my antenna at 24 GHz, the effective radiated power at my station is about 20 million watts. Both of us run linear polarity and we must compensate for the 70 degrees of spatial offset between our two locations. JA6CZD was using horizontal polarization and I was vertically polarized. I use a W2IMU-type feed horn with an additional conical flare section added to improve the receive performance; Shichirou uses an expanded W2IMU feed horn.

JA6CZD uses a 2.4-meter offset fed dish with a 30 W solid state power amplifier.

W5LUA uses 2.4-meter offset fed dish and a Travelling Wave Tube amplifier mounted on the feed support.

Since the 24 GHz band is close to the 23 GHz moisture absorption region of our atmosphere, it is also desirable to have low humidity and dew points. The dew point at my station was slightly below freezing, which helped.

Another issue is Doppler shift. While a 2 meter signal reflected off the Moon may have up to 300 Hz of Doppler on moonrise or moonset, a signal on 24 GHz can have as much as 50 *kHz* of frequency shift! Adding to the complexity is *mutual* Doppler, but the exact frequency as received from the Moon can be calculated based on the location of both stations.

Both of us transmitted on 24048.100 MHz. At the start of the schedule, my own lunar echoes were on 24048.049 MHz (about 51 kHz of Doppler) and our mutual Doppler placed each of us at about 24048.108 MHz, which shifted down in frequency as we completed the contact.

A Small but Growing Community

JA6CZD has previously worked Johannes Woronzow, DF1OI and RadioClub OK1KIR in Europe on 24 GHz. Shichirou is my 12th unique EME contact on 24 GHz in 12 years. There are about 15 stations worldwide active or building 24 GHz EME stations.

For those interested in trying 24 GHz EME, please note that the common frequency is 24048 MHz. I hope to hear you there!

Al Ward, W5LUA, has completed EME QSOs on all bands, six meters through 47 GHz. He currently holds the US distance record on 10 GHz terrestrial with K0VXM at 1609 km. Al was instrumental in the formation of the North Texas Microwave Society and was the founding President. He has received the Central States VHF Society John Chambers Award, the Central States VHF Society Mel Wilson Award, the Southeastern VHF Society K4UHF Award and was the recipient of the 1997 Dayton Hamvention Technical Excellence Award. Al has also received the ARRL's 1999 Microwave Development Award. You can contact him at 2306 Forest Grove Estates Rd, Allen, TX 75002-8316; **w5lua@arrl.net**.

Better Educated Teachers Graduate Better Educated Students

The Teachers Institute gives teachers a real world approach to teaching science and technology.

Mark Spencer, WA8SME

Recent research indicates that students taught by teachers who have a deeper understanding of their subjects outperform students taught by less knowledgeable teachers. Therefore, investing in our teachers is one way to improve student performance.

Increasingly the education literature and media coverage of school activities includes the term "STEM" or Science, Technology, Engineering and Mathematics. There has been a resurgence of emphasis on STEM education in response to the economic challenges we face from high technology competitors overseas. This concern is far reaching, spurring initiatives at all levels, from the federal government, to school districts, to individual teachers, parents and even the students themselves. One such call to action, "Let's Solve This" (**letssolvethis.com/exxonmobil**) is a partnership between ExxonMobil and the National Math and Science Initiative that offers information for students, parents and teachers in the hope of strengthening math and science education in the US.

Today the prevailing wisdom is that STEM instruction should focus specifically on the *connection* between science, technology, engineering and mathematics, rather than on these content areas independently. It is the teacher's role to make these connections for students. To do so, teachers need to know the science and math content, and understand the relevant technologies in sufficient detail.

Meeting the STEM Challenge

To meet this challenge the ARRL® Education & Technology Program has been offering the Teachers Institute (TI) for the past 9 years. From the first pilot TI conducted in 2004, this in-service training program, supported entirely by donations, continues to evolve and to flourish. While donation levels have suffered recently due to the economic climate, two basic TIs and one TI-2 (an advanced TI for teachers who have completed the introductory seminar) are planned for this summer (see the box on this page for information).

2013 Teachers Institute Schedule

Date	Location
TI-1 Introduction to Wireless Technology	
July 8-11	ARRL Headquarters, Newington, CT
July 15-18	Parallax, Inc, Rocklin, CA
TI-2 Remote Sensing and Data Gathering*	
July 22-25	TBD

*Contingent on receipt of funding.

> **"The workshop was right on the mark with the curriculum that I wanted to bring into the classroom...It provided both the knowledge and a cost effective way to do so."**
> **— A TI attendee.**

The curricula of the TI courses are constantly being updated and refined to keep them relevant to the needs of today's teachers and students. This year, a TI-2 entitled *Remote Sensing and Data Gathering* is being tentatively planned. There has been rising interest among educators in high altitude balloons and robotic deployment of sensors to study remote and inhospitable environments. These kinds of activities are good examples of content that links science and math with technology and engineering in real world applications of fundamental concepts.

Design Your Own Mars Rover

The TI-2 *Remote Sensing* course focuses on the basic electronics behind the sensors, the analog to digital conversion of sensor data, the microcontroller programming involved in accessing the sensors and the use of radio (packet radio-like data links) to connect those sensor outputs to the user. Once the basics of remote sensing are introduced, the teachers will explore numerous deployment systems they might use in their classrooms including land and water robots, buoys, balloons and satellites.

The end goal of the TI-2 *Remote Sensing* course is to provide the in-depth knowledge and tools teachers need to help their students actually "do" remote sensing from start to finish. They will develop the sensor packages, collect the accumulated data and perform the math to understand the data. The aim is that the students themselves will be using technology to do research, rather than just passively watching someone else's activity.

The ARRL Teachers Institute is an intensive, expenses paid, 4 day in-service opportunity. It is designed to help participating teachers develop a deeper understanding of basic electronics, the science of radio, space technology, microcontroller programming and basic robotics. It also shows them how to make the connections between science and math concepts as well as the engineering and technical applications of those concepts — in other words, real STEM instruction that will result in *real* student learning.

> **"I have been to numerous training workshops, most sponsored by Fortune 100 companies. This one is right there with the best. Thanks for a terrific learning experience!"**
> **— A TI attendee.**

If you think a program like this would benefit your local school, encourage a talented teacher to consider attending a TI this summer. The schedule, application and the program specifics can be found at **www.arrl.org/teachers-institute-on-wireless-technology**.

If you need additional information, please contact ARRL Education Services Manager Debra Johnson at **djohnson@arrl.org** or at 860-594-0296.

Finally, please support ARRL's Education & Technology Program and the Teachers Institute with a donation at **www.arrl.org/education-and-technology-fund**.

Mark Spencer, WA8SME, is the ARRL Education & Technology Program Director. You can reach him at **mspencer@arrl.org**.

Happenings

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

2012 Marks All-Time High for Amateur Radio Licenses

At the end of 2012, there were almost 710,000 radio amateurs in the United States — the largest number in the history of Amateur Radio licensing.

"This past year was a banner year for the number of Amateur Radio operators in the US," said ARRL VEC Manager Maria Somma, AB1FM. "With almost 710,000 hams, it is wonderful to see that Amateur Radio is definitely alive and well, and these licensing totals prove that over and over."

In looking at new and upgraded licenses, as well as licensees per FCC call sign region, Somma also crunched the numbers looking for growth within each license class — and all of Amateur Radio — over the last 40 years. "This is an all-time high for Technician, General and Amateur Extra class licensees," she said. "When looking at the three current license classes, the number of Technicians, Generals and Amateur Extras peaked in December at 345,369, 163,370 and 130,736, respectively."

Somma explained that the total number of US amateurs in the FCC database also continues to grow each year: "As of December 31, 2012, the number of licensees reached an all-time high of 709,575; year-end totals were 702,056 for 2011 and 696,041 for 2010. The number of licensees increased at an average rate of 21 per day, while the number of US licensees has increased by 4 percent since 2001!" More than 3000 new licenses were issued in 2012 than in 2011, while upgraded license activity remained stable in 2012.

COMPARE AMATEURS PER FCC CALL SIGN REGION

CALL SIGN REGION	2001	2012
1	33,500	35,000
2	40,500	42,000
3	35,000	36,500
4	134,000	140,000
5	82,500	86,000
6	97,700	100,000
7	90,000	93,500
8	55,000	57,000
9	45,500	47,500
0	57,500	60,000
KL7 - Alaska	3,300	3,500
KP4 - Caribbean	4,200	4,000
KH6 - Pacific	4,300	4,500
Total US Amateurs	683,000	709,500

This chart shows the distribution of license holders by call sign region, comparing 2001 to 2012 and shows that the number of US licensees has increased by 4 percent since 2001!

In the past 40 years, the number of Amateur Radio operators in the US has grown at a steady rate:

- December 1971: 285,000
- December 1981: 433,000
- December 1991: 494,000
- December 2001: 683,000
- December 2012: 709,500

Source: 1971, 1981, 1991: print editions of Radio Amateur Callbook*. 2001, 2012:* **www.ah0a.org**. ***Please note:*** *While the number of licensees has grown considerably over the years, we realize that these numbers include some who are no longer active in Amateur Radio. A recent survey of ARRL members, however, indicates that more than 80 percent of those responding are active.*

New FCC Licenses
Totals issued per year: 2010 through 2012

Year	2010	2011	2012
Totals	27,528	23,953	27,082

Upgraded FCC Licenses
Totals issued per year: 2010 through 2012

Year	2010	2011	2012
Totals	10,726	10,337	10,283

These charts illustrate new and upgraded FCC license activity over the past three years, with results through the end of 2012 showing stronger than the previous year. More than 3000 more new licenses were issued in 2012 than in 2011, while upgraded license activity remained steady in 2012.

ARRL VEC Program Statistics

The ARRL VEC is by far the largest of the 14 Volunteer Examiner Coordinator (VEC) groups in the country, coordinating approximately 70 percent of all Amateur Radio exams. "When looking at the statistics over the last year, the ARRL VEC sponsored exam sessions and exam elements taken were up in 2012, which is a good sign for Amateur Radio overall," Somma said. "Compared with 2011, ARRL VEC exam sessions in 2012 were up by 8 percent. A total of 6831 exam sessions were administered in 2012, compared to 6352 in 2011. Exam elements were slightly up from 41,096 last year, to 42,473 this year. The total number of accredited ARRL Volunteer Examiners (VEs) has reached an all-time high of 36,682. The ARRL VEC has been busy meeting the needs of the Amateur Radio community by helping people become radio amateurs or upgrade their existing licenses. 2012 was a very good year for Amateur Radio — I can't wait to see what 2013 brings!"

FCC Finds New Jersey Ham Violated Communications Act, Reduces Forfeiture from $20,000 to $16,000

After unsuccessfully appealing to the FCC to cancel his $20,000 forfeiture, Joaquim Barbosa, N2KBJ, of Elizabeth, New Jersey was issued a *Forfeiture Order* stating that he must pay $16,000 for "willfully and repeatedly violating Section 301 of the Communications Act of 1934, as amended by operating a radio transmitting equipment on the frequency 296.550 MHz without Commission authorization.

Barbosa suggested that the forfeiture amount merited some reduction because he had been cooperative with the FCC agents during the investigation. "While we appreciate Barbosa's conduct in this investigation," the FCC said, "Barbosa's cooperative conduct is not a basis to justify a forfeiture reduction. The Commission expects all licensees to cooperate with its investigations and to provide truthful responses to any questions."

Barbosa contended that the forfeiture amount would present "a significant hardship" and therefore should be canceled or reduced, but he failed to provide any financial documents to support his request. With respect to a claim of financial hardship, the FCC will not consider canceling or reducing a forfeiture in response to an inability to pay claim, unless the individual or entity making the request submits either federal tax returns for the most recent three-year period, financial statements prepared according to generally accepted accounting principles or some other reliable and objective documentation that accurately reflects the individual's or entity's current financial status.

Barbosa also said that the proposed forfeiture amount should be reduced because of his overall history of compliance with the laws, including the FCC's rules. "We agree that a reduction of the forfeiture amount is warranted, based on our review of the record and finding that Barbosa (prior to the investigation) has a history of overall compliance with the Commission's rules," the FCC said. "Accordingly, after consideration of the entire record (including Barbosa's response to the *Notice of Apparent Liability*), the *Forfeiture Policy Statement* and the factors set forth in Section 503(b)(2)(E) of the Communications Act, we find that, although cancellation of the monetary forfeiture is not warranted, a reduction of the forfeiture amount from $20,000 to $16,000 is appropriate."

Barbosa had until December 31, 2012 to make full payment of the $16,000 or to contact the FCC to arrange a payment plan. If the forfeiture is not paid within the period specified, the case may be referred to the US Department of Justice for enforcement of the forfeiture. Find a link to the *Forfeiture Order* at **transition.fcc.gov/Daily_Releases/Daily_Business/2012/db1211/DA-12-2008A1.pdf**.

Senate Approves Second Term for FCC Commissioner Mignon Clyburn

In June 2012, President Barack Obama nominated Mignon Clyburn to serve a second term as FCC Commissioner. On January 1, 2013, the Senate confirmed her nomination, paving the way to Clyburn's first full term as one of five FCC Commissioners.

"It is an extraordinary honor to have the opportunity to serve on the Federal Communications Commission for another term," Clyburn said. "I am grateful to the President for his faith in re-nominating me, and am humbled by the Senate's support in approving my nomination. I look forward to working with the both the House and Senate as we share a mission to oversee communication policy that keeps the needs of American consumers paramount. It is a privilege to be surrounded by amazing colleagues and staff at the FCC, and I thank all of them for their collaboration, ideas, and friendship."

On January 1, 2013, the US Senate voted to confirm Mignon Clyburn to her first full term as an FCC Commissioner. Clyburn was appointed in August 2009 when she filled the seat made vacant by then-FCC Commissioner Deborah Taylor Tate.

In a written statement, FCC Chairman Julius Genachowski said that he was "... so pleased that the Senate has approved Commissioner Clyburn's re-nomination to the FCC. Commissioner Clyburn is an excellent and dedicated public servant and has been a strong advocate in seeking to extend the benefits of broadband to all Americans. I look forward to continuing to work closely with Commissioner Clyburn and congratulate her on her new term."

Clyburn's five-year appointment is retroactive to July 1, 2012, when her first term expired.

Icelandic Amateurs Get MF Privileges

According to the Íslenskir Radíóamatörar (IRA) — Iceland's IARU Member Society — radio amateurs in Iceland now have operating privileges on 472-479 kHz (630 meters) as of January 16. Amateurs in Germany, Sweden, the Netherlands, New Zealand and Monaco already have operating privileges in this portion of the MF spectrum.

Delegates at the 2012 World Radiocommunication Conference (WRC-12) approved this method of addressing Agenda Item 1.23, which proposed the allocation of approximately 15 kHz between 415 and 5265 kHz. After discussions and taking into account spectrum conflicts with the Maritime Mobile Service, delegates ultimately decided to allocate 472-479 kHz to the Amateur Radio Service on a secondary basis.

Extension of Temporary Permits on 160, 60 and 4 Meters

Iceland's Post and Telecom Administration (PTA) — the Icelandic equivalent to the FCC — extended temporary permits on 160 meters (1850-1900 kHz), 60 meters (5.260-5.410 MHz) and 4 meters (70.000-70.200 MHz), effective January 1.

160 Meters: The temporary allocation on 1850-1900 kHz has been renewed for 2013 on a secondary basis. This allocation may only be used during the duration of 10 designated international Amateur Radio contests and is in addition to the international Region 1 allocation of 1810-1850 kHz.

60 Meters: The temporary allocation on 5.260-5.410 MHz has been renewed for 2013 and 2014 on a secondary basis. Permissible modes are USB, CW and PSK-31 with a maximum bandwidth of 3 kHz and a power limit of 100 W.

4 Meters: The temporary allocation on 70.000-70.200 MHz has been renewed for the calendar years 2013 and 2014 on a secondary basis with a maximum bandwidth of 16 kHz and a power limit of 100 W.

Postage Rates Rose in January

Beginning Sunday, January 27, it cost more to mail first class letters, postcards and packages within the US. The cost to mail a first class letter rose to 46 cents, while the cost to mail a postcard increased to 33 cents, an increase of 1 cent for each; this is the third increase for postcard postage in less than two years. In January the USPS also introduced a First Class Mail Global Forever Stamp that allows customers to mail 1-ounce letters anywhere in the world for one set price of $1.10. The cost to mail flat-rate Priority Mail packages and letters also increases.

New York City Ham Wins Appeal, Can Keep His Tower

In September 2010, Paul Isaacs, W2JGQ, of New York City, obtained a building permit for his Amateur Radio antenna support structure, comprised of a 40 foot tower topped by a Yagi antenna. Isaacs installed his antenna system on the roof of his four story brownstone — 58 feet above ground — in lower Manhattan.

Almost four months later — months after the erection of the system — the New York City Department of Buildings (DOB) declared its intention to revoke Isaacs' properly attained building permit, claiming that his Amateur Radio antenna system was not, in the Department's opinion, "an accessory use." Isaacs appealed the decision through the Department's bureaucracy, and when that didn't reverse the decision, he had a series of hearings before the New York City Board of Standards and Appeals.

In November 2012, the Board ruled that though perhaps uncommon, an Amateur Radio antenna system is indeed an accessory use under New York City's zoning ordinance and the building permit was properly granted. "The Board agrees with DCP [Department of City Planning] that the size of a use can be relevant to whether it is 'incidental to' and 'customarily found in connection with' a principal use," the Board wrote in its decision. "However, it finds that in the case of Amateur Radio towers, unlike cellular [towers] and certain other uses, there is no articulated standard to guide DOB in determining at what height a particular radio tower becomes a non-accessory."

Isaacs was represented by attorneys Fred Hopengarten, K1VR, Stuart Klein and Chris Slowik. Find the full decision at **www.antennazoning.com/main/page_amateur_radio_legal_library.html**.

2012 Brought Increase in DXCC Applications, ARRL QSL Bureau Card Processing

With the coming of more sunspots comes more DX. And when more amateurs work DX, the ARRL's Membership and Volunteer Programs Department — especially the DXCC Desk and the ARRL Incoming and Outgoing QSL Bureaus — goes into high gear.

"In 2012, we saw an increase in the number of cards received from ARRL members that were sent to foreign QSL bureaus, as well as the number of cards we sent out to the bureaus," said Membership and Volunteer Programs Administrative Manager Sharon Taratula. "In addition, the number of DXCC applications — including those for initial awards and endorsements — also increased."

In 2011, the DXCC Desk processed 11,173 applications for initial awards and endorsements; these comprised 1,305,376 QSOs. In 2012, the DXCC Desk processed 14,301 applications, comprising 1,491,661 QSOs. "This represents a 14 percent increase in the number of QSOs and a 28 percent increase in the number of applications," Taratula explained.

As the number of DXCC applications has increased, so has the number of QSL cards passing through the ARRL Outgoing QSL Bureau. "Through December 31, 2012, the ARRL Outgoing QSL Bureau received 808,500 cards destined for foreign QSL bureaus from ARRL members in the US," Taratula said. "This represents an increase of 1 percent over the 2011 number of about 802,500 cards. In 2012, the ARRL shipped 731,440 cards — or close to 5000 pounds of cards — to foreign bureaus."

Outgoing QSL Bureau Associate Rose-Anne Lawrence, KB1DMW, manages the Incoming and Outgoing QSL Bureaus. Together with a slew of volunteers, Lawrence handled close to 1 million QSL cards in 2012. [S. Khrystyne Keane, K1SFA, photo]

Former *QST* Technical Editor Stu Cohen, N1SC (SK)

Former *QST* Technical Editor Stu Cohen, N1SC, of Colbert, Washington, passed away January 4 after a long battle with cancer. He was 70. An ARRL member, Cohen came to Headquarters in 2002 after an active career in television broadcasting. From 1974-1993, he was the Engineering Supervisor at ABC-TV in Los Angeles. During his tenure there, Cohen was awarded an Emmy®. After leaving the ARRL in 2005, he continued his relationship with the League, becoming a Technical Advisor.

First licensed in 1954 as K2IOC, Cohen loved operating CW and chasing DX on 40 and 20 meters. He also enjoyed 75 meters AM. Professing a love for vintage radio, Cohen had amassed a library devoted to books from the dawn of the wireless age.

In 2004, Cohen and then-Senior Assistant Technical Editor Bob Schetgen, KU7G (SK), discovered an unbuilt Johnson Viking Ranger II kit — serial #3114 — in the basement of W1AW. Cohen wrote about building this 1960s-era transmitter in the January 2005 issue of *QST* [*Editor's note: You can read the article at* **p1k.arrl.org/pubs_archive/662**, *but you must be an ARRL member and logged in to the ARRL website to read this article*].

"Despite the pressures of having to get a magazine out the door every 30 days, Stu always maintained a cool, upbeat disposition," recalled *QST* Editor-in-Chief Steve Ford, WB8IMY. "It was a genuine pleasure to work with him."

Former *QST* Technical Editor Stu Cohen, N1SC (SK)

Public Service

Rick Palm, K1CE, k1ce@arrl.org

Amateur Radio Goes to School

Carnegie Mellon University hosts a Disaster Management Initiative Workshop.

David T. Witkowski, W6DTW

Sometimes the best Amateur Radio gatherings aren't focused on Amateur Radio at all. Such was the case at the Third Annual Disaster Management Initiative Workshop 2012 (DMI), hosted by Carnegie Mellon University at their Silicon Valley campus. In today's increasingly globalized world, major universities have found they need to go beyond their ivy-covered walls by opening satellite campuses around the world. Carnegie Mellon University has a Silicon Valley campus (often called CMUSV) located at Moffett Field, a former US Navy airbase on the edge of San Francisco Bay. This location places it next door to NASA's Ames Research Center and a stone's throw away from world-famous technology companies such as Google and Yahoo!.

CMUSV is home to several research centers and initiatives, many of which focus on wireless communications. One of them is the Disaster Management Initiative, which hosts an annual workshop and conference that, in many ways, is like Field Day — but with a much larger budget!

A Serious Kind of Field Day

The event probably looks like Field Day because many of the DMI organizers and participants are also hams. Dr Bob Iannucci, W6EI, is director of the CyLab Mobility Research Center at CMUSV and formerly worked at Nokia as their chief technology officer. Dr Martin L. Griss, KJ6MIN, is the director of the CMUSV campus, serves as its associate dean and is also director of the Disaster Management Initiative. The DMI has several public and private partnerships including agreements with the California Emergency Management Agency (CalEMA), Sprint Clearwire, the Golden Gate Safety Network, Joint Venture Silicon Valley, NASA, Red Cross Silicon Valley, TechNet, Twiki, Unisys and the Wireless Communications Alliance.

While most of the DMI Workshop attendees are licensed amateurs, the event doesn't focus only on Amateur Radio in disaster response, but rather, it attempts to integrate a wide variety of communication technologies into a working solution. The workshop's activities include forums, lectures, discussions of recent case studies and simulated emergency response scenarios. As you might expect, the latter aspect of the workshop makes heavy use of communications technology and the hams in the workshop often draw on their Amateur Radio skills to resolve problems with commercial or military/government equipment.

Figure 1 — Everything from BGAN satellite to HF ALE was used during the workshop. Barrett ALE gear was used to establish NVIS communications with regional sites. [Photo courtesy David Witkowski, W6DTW]

A wide variety of communication technologies are used in the DMI Workshop: Inmarsat Broadband Global Area Network (BGAN) terminals providing satellite Internet links, ad hoc Wi-Fi networks using both consumer and commercial equipment, VHF/UHF voice and packet, and even HF ALE (Automatic Link Establishment) voice and data. Frequencies used for the DMI Workshop are primarily in the public safety and government bands. The DMI's exercises aren't limited to wireless, because many of the technologies being developed and tested at CMUSV are Internet protocol based — so the data can and does move from wireless to wire line and back again as it makes its way around the world and even up to satellites in geosynchronous orbit.

Problem Solving On the Fly

The 2012 DMI Workshop was in part set up to be a "plugfest" interoperability event. A simulated emergency scenario was played out in which many different agencies and companies used their communications trucks and equipment to implement deliberately vague instructions. For example, the teams would have to find a way to implement the following: "Sunnyvale PD shall connect to the Cisco NERV's web server, obtain the file containing damage maps, and post them to the Palo Alto PD's Common Operational Picture web server." The focus was not so much on developing plans in advance, but on learning to make something happen with limited and occasionally incompatible technology resources. In the process, everyone got a real sense for what worked, what didn't work and what we need to be prepared for next time. (Sounds just like Field Day, doesn't it?)

My day job is with Anritsu Company in their Microwave Measurement Division, so my job during the emergency simulation was to be a technical resource floater, using portable test instruments to help resolve equipment issues. At one point I was helping a team that was struggling to establish HF ALE communications (see Figure 1). It turned out that their HF whip antenna's integrated tuner had failed. We solved the problem by erecting an NVIS dipole using some oak trees to get on the air. When all else failed, we went back to basics!

One area of research in the DMI involves leveraging Internet and mobile data networks to help emergency managers and first responders communicate efficiently with civilians. In the same sense that the National Weather Service relies on data from SKYWARN (**skywarn.org**) volunteers, emergency response managers have found that information gathered from Twitter and Facebook can be very valuable in providing "ground truths" during initial phases of a disaster response. Of course the challenge is to "separate the wheat from the chaff" and not be overwhelmed by the flow of data, but emerging technologies like semantic tagging and natural language processing are being employed to help in that regard.

We solved the problem by erecting an NVIS dipole using some oak trees to get on the air. When all else failed, we went back to basics.

The DMI Workshop also included conference sessions that addressed issues such as how to develop a common alerting protocol for a commercial mobile/cellular public notification system. Apps that allow smart phones to be used as platforms for obtaining a common operating picture were tested and evaluated. Dr Bob Iannucci, W6EI, led a session that focused on CMUSV's research into "Survivable Social Networks" (SSNs), which are intended to provide an avenue of communication for citizens in neighborhoods and towns when Internet and cell towers are down.

Bubble-net

Rather than relying on a large telecommunications infrastructure, SSNs are small, solar-powered devices that create a standalone wireless network "bubble." These bubbles allow members of a community and emergency personnel to communicate within a local network to report incidents. They also allow local governments or emergency personnel to send out alerts and announcements such as evacuation instructions. While this technology does not make direct use of Amateur Radio, Dr Iannucci's experience in setting up Amateur Radio communications, under sometimes difficult conditions, has helped to shape the research team's design criteria so that the SSNs are truly survivable and able to maintain communications during times of adversity.

As a research effort, the DMI and the DMI Workshop also involves many university students. These students are actively working on the aforementioned technologies as well as developing the mesh and delay-tolerant network technologies needed to realize the Survivable Social Networks. [A mesh network is a group of nodes where each node can both accept data inputs and relay data accepted by other nodes; a delay-tolerant network is one where the paths between nodes are unstable (think HF packet) and a store-and-forward operation is used to move data to its destination — *Ed.*]

Obviously, the students gain a lot of exposure to Amateur Radio as they work with professors and DMI affiliates who are licensed hams. Some of the students have been working on gathering data to define commonalities in the failure points that typically occur during disasters and post-disaster response efforts. That research has meant that they're spending a lot of time interviewing people (including radio amateur participants in the DMI) who have real world experience with disaster response communications. I don't know if exposure to our service has resulted in any students getting licensed, but it makes it more likely in the long run.

Amateur Radio HF Link Proven in Asia-Pacific Interoperability Exercise

One of the DMI Workshop presentations more specifically focused on Amateur Radio was an update on the activities of the Multinational Communications Interoperability Program (MCIP). MCIP is a collaborative multinational, multi-entity communications planning effort focused on providing humanitarian assistance and communications support to the large and disaster-prone Asia-Pacific region.

In August 2012, as part of the annual Pacific Endeavor exercise, an MCIP communications exercise was successful in establishing HF Amateur Radio communications between Singapore's Changi Naval Base (which hosted Pacific Endeavor 2012) and Kathmandu, Nepal. "Well before any of the responders can make it to [a disaster] area, the only thing you have is what exists at the location and many times the only thing there is an Amateur Radio operator," said Scott Griffin, MCIP technical director. "It's a proven network amongst the HF infrastructure." The Computer Association of Nepal-USA (CAN-USA) under the guidance of Suresh Ojha, W6KTM, chairman of the Disaster Preparedness Committee for CAN-USA, championed the successful exercise. The exercise also tested communications using EchoLink/IRLP.

"Ham radio operators have been deeply involved in disaster response everywhere in the world for as long as there's been ham radio because there are very many of them scattered around geographically," said Arthur Botterell, KD6O, disaster management consultant from CMUSV and academic advisor for MCIP. "Most of them have some sort of relationship with their local governments. They are a great resource. People tend to think of them as a last resort when everything else fails, but the fact is frequently they're the first ones on the air from a disaster area because they were there already."

In the end, everyone at the DMI Workshop 2012 went home with a lot of good experience, information and many new ideas on how to apply Amateur Radio and other technologies to manage and respond to disasters. For those not able to attend, archived presentations and other DMI resources are available at **www.cmu.edu/silicon-valley/dmi**. The DMI Workshop was not intended to be just about Amateur Radio, but practitioners of our hobby — and the lessons we've learned in pursuing it — played a big role.

David T. Witkowski, W6DTW, an ARRL® member started his career 30 years ago as an electronics technician in the US Coast Guard and has since held positions of leadership and responsibility in the wireless and telecommunications industry at companies ranging in size from Fortune 500 multinationals to small pre-funded startups. He currently works as a senior product manager for Anritsu Company in their handheld instrument division. David serves as president of the non-profit Wireless Communications Alliance (**www.wca.org**), as an advisor to the Carnegie Institute of Technology Dean's Council at Carnegie Mellon University Silicon Valley and as a member of the Wireless Communications Initiative committee for Joint Venture Silicon Valley.

Mr. Witkowski is a senior member in the Radio Club of America and a life member of the IEEE Microwave Theory & Techniques Society. Licensed in 2006, he is actively involved in the Amateur Radio community as an operator, writer and conference presenter. David obtained his BSEE from University of California (Davis) with a study emphasis on modulation theory and RF/wireless design. He can be reached at 1525 Altamont Ave, San Jose, CA 95125-5002, **w6dtw@arrl.net**

Contest Corral – March 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				Bands HF / VHF+	Contest Title	Mode	Exchange	Sponsor's Website
Date-Time		Date-Time						
1	0200Z	1	0300Z	1.8-14 / -	NS Weekly Sprint	CW	Serial, name and S/P/C	www.ncccsprint.com
2	0000Z	3	2400Z	1.8-28 / -	ARRL Int'l Phone DX Contest	Ph	RS and state, province or power	www.arrl.org/contests
2	2000Z	2	See web	1.8-28 / -	Open Ukraine RTTY Championship	Dig	Regional abbreviation and serial	uarl.com.ua/openrtty
4	1600Z	4	See web	3.5 / 50, 144	OK1WC Memorial Contest	Ph CW	RS(T) and serial	www.hamradio.cz/ok1wc
5	0200Z	5	0400Z	3.5-28 / -	ARS Spartan Sprint	CW	RST, S/P/C, and power	www.arsqrp.blogspot.com
5	1900Z	5	2100Z	3.5 / -	YL CW Party	CW	RST, serial, if YL "YL," name	www.agcw.de
6	2300Z	7	See web	7,14 / -	John Rollins Memorial DX Contest	CW	RS, name, and S/P/C	www.antiquewireless.org
9	1000Z	10	1000Z	3.5-28 / -	RSGB Commonwealth Contest	CW	RST and serial (Commonwealth only)	www.rsgbcc.org
9	1400Z	9	2000Z	3.5-28 / -	AGCW QRP Contest	CW	RST, serial, class, AGCW number or NM	www.agcw.de
9	1500Z	9	1800Z	3.5-28 / -	QRP ARCI HF Grid Square Sprint	CW	RST, 4-char grid square, QRP ARCI nr or power	www.qrparci.org/contests
9	1600Z	10	1600Z	3.5-28 / -	EA PSK63 Contest	Dig	RST and serial or EA province	www.ure.es
9	1900Z	10	1900Z	3.5-28 / -	Idaho QSO Party	Ph CW Dig	RS(T) and ID county or S/P/C	idahoarrl.info/qsoparty
10	0000Z	10	0400Z	3.5-14 / -	North American RTTY Sprint	Dig	Both call signs, serial, name and S/P/C	www.ncjweb.com
10	1800Z	11	0100Z	3.5-28 / 50+	Wisconsin QSO Party	Ph CW Dig	WI county or S/P/C	www.warac.org
13	1100Z	14	See web	1.8-28 / -	CWops Monthly Mini-CWT Test	CW	Name and member number or S/P/C	www.cwops.org/onair.html
16	12 PM	16	2 PM	1.8-28 / -	Feld-Hell St Patrick's Day Sprint	Dig	RST, S/P/C, Feld-Hell member nr	www.feldhellclub.org
16	0000Z	17	2400Z	- / 144, 432	Worldwide EME Contest	Ph CW	TMO/RS(T) and "R"	www.dubus.org
16	0200Z	18	0200Z	3.5-28 / -	BARTG HF RTTY Contest	Dig	3-digit serial and 4-digit time	www.bartg.org.uk
16	1200Z	17	1200Z	1.8-28 / -	Russian DX Contest	Ph CW	RS(T), serial or oblast abbr	www.rdxc.org
16	1300Z	17	See web	3.5-28 / 50	Oklahoma QSO Party	Ph CW Dig	RS(T) and OK county or S/P/"DX"	www.k5cm.com/okqp.htm
16	1400Z	17	See web	1.8-28 / 50-440	Virginia QSO Party	Ph CW Dig	Serial and VA county/city or S/P or "DX"	www.qsl.net/sterling
17	0000Z	17	0400Z	3.5-14 / -	North American Sprint	Ph	Both call signs, serial, name and S/P/C	www.ncjweb.com
18	0200Z	18	0400Z	1.8-28 / -	Run For the Bacon	CW	RST, S/P/C, Flying Pig nr or power	www.fpqrp.org
19	1700Z	24	See web	3.5-28 / -	CLARA and Family HF Contest	Ph CW	RS(T), name, QTH and if CLARA mbr	www.clarayl.ca
21	0030Z	21	0230Z	3.5-14 / -	NAQCC Monthly QRP Sprint	CW	RST, S/P/C, and NAQCC mbr nr or power	naqcc.info
23	0000Z	23	2359Z	1.8-28 / 50+	FOC QSO Party	CW	RST, name, FOC nr if member	www.g4foc.org
23	0001Z	30	2359Z	1.8-28 / -	Lighthouse Spring Lites QSO Party	Ph CW Dig	ARLHS number or serial, name, S/P/C	arlhs.com
30	0000Z	31	2400Z	1.8-28 / -	CQ WPX SSB Contest	Ph	RS and serial	www.cqwpx.com

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 (February 1 for April *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.

The 2012 IARU World HF Championships

We've come a long way...

Carl Luetzelschwab, K9LA, k9la@arrl.net

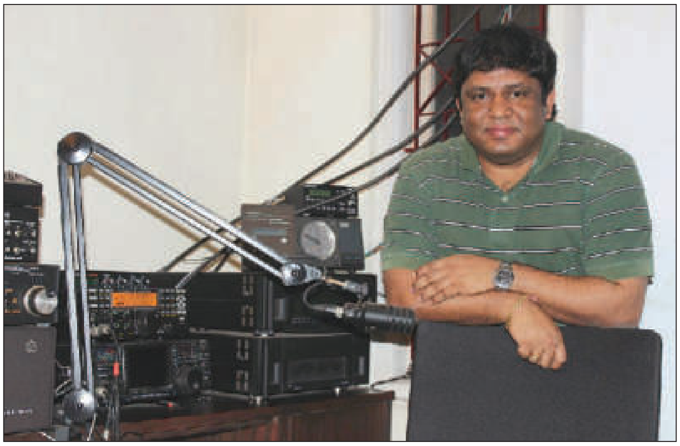
My first IARU contest. Addictive. Will be back next year! – K6JB

This is my first try at HF contesting. I had a ton of fun hearing and talking to people all over the world. – KB3YSR

First IARU HF Championship! Did pretty well with just 5W. Am very happy. – KJ6MQM

My first contest after getting my ticket two months ago. Thanks for all the fun! – VP9NNL

I am 14 years old. I got my license in December 2011. It is the first time that I am participating in your contest. – VU3TMO



Pai, VU2PAI, operated on 20 and 40 meter SSB for the AT1HQ team.

These ARRL Soapbox comments and many more (**www.arrl.org/soapbox**) highlight that the IARU contest in July is a great way to get into contesting. There are lots of people to work — in fact, the number of logs ticked up nicely this year — whether on Phone or CW or both. As you'll see in the "participation stats," you're in good company if you operate "barefoot" with 100 watts or less. So plan on jumping in this July!

Online Extended Writeup

In addition to this *QST* writeup, visit the ARRL website for more information on the 2012 IARU HF World Championships (**www.arrl.org/contest-results-articles**). Additional material includes a W1AW/7 narrative by the Arizona Outlaws Contest Club, photos from several of the HQ stations (9A20HQ, LX75HQ, OH0HQ, S50HQ, and AT1HQ), and a story from UT7DK operating at 4Z4AK.

Participation Statistics

As mentioned above, the number of logs received this year (4054) increased by 10.3% over last year. This also sets the all-time record for the number of logs received (the previous record was 3714 logs in 2010). Figure 1 is the number of logs by year. This contest has shown, as have other contests, great growth over the years — and there's no reason to think it will stop.

The most popular category was Single Operator, CW Only, Low Power, followed closely by Single Operator, Phone Only, Low Power. There were more HQ stations than those brave souls who weathered the Single Operator, Mixed Mode, QRP category!

If you're a Single Operator, the most popular mode was CW. Phone wasn't too far down from CW, and likewise Mixed wasn't too far down from Phone. Also if you're single op, the most popular power category was Low Power. The number of entries in Single Operator, Low Power was more than twice the number of entries in High Power. This bodes well for those participants without amplifiers. In terms of percent, Low Power was 65% of all Single Ops, High Power was 27% of all single ops, and QRP made up the 8% balance.

With respect to single op participation by zone, ITU Zone 28 (eastern and southern Europe) continued its dominance in this event. But this year Zone 8 (East Coast US) participation edged out Zone 29 (old European Russia) participation — this has happened before, but it is rare.

Finally, 20 meters continued its first place finish for the band with the highest number of QSOs. With Solar Cycle 24 on the upswing (at least back in July!), the number of QSOs on 15 meters topped the number of QSOs on 40 meters by a healthy amount. 10 meters had a decent showing for the summer, with 80 meters and 160 meters bringing up the rear.

And The Winners Are . . .

A list of the winners and runner-ups for the World and W/VE for all the Single Operator categories and the Multioperator category can be found on page 88. The right-most column is the winning percentage — in other words by how much, in terms of a percentage, the winner beat the runner-up. This table is a condensed version of the W/VE Top Ten and the Non W/VE Top Ten, but includes QSOs and multipliers.

The closest race was in W/VE Single Operator, Mixed Mode, High Power. VE3AT, using the call XM3AT, bested VY2ZM by only 1.8% by making both more QSOs and more multipliers.

The second closest competition was between UW2M (UR0MC, op) and C4W (5B4WN, op) in the World Single Operator, Mixed Mode, High Power category. Both had about the same number of QSOs, but UW2M significantly won in the multipliers to win by 3.0%.

The third closest race was also in Single Operator, Mixed Mode but for Low Power in W/VE. W4IX had fewer QSOs but enough additional multipliers to beat NR3X (N4YDU, op). The winning margin was 3.1%.

Congratulations to all the winners! And all you runner-ups — keep trying — your time may come.

Records

Four records were broken in the 2012 event: Single Operator, Mixed Mode, Low Power and Multioperator on the World side, and

Category Records

World Records	Call	Score	Year	W/VE Records	Call	Score	Year
Single Op Mixed HP	3V1A	4,414,517	2007	Single Op Mixed HP	VY2ZM (K1ZM op)	2,989,540	2011
Single Op Mixed LP	**4Z4AK (UT7DK op)**	**2,312,220**	**2012**	Single Op Mixed LP	VE3DZ	1,196,192	2011
Single Op Mixed QRP	HG5Y	1,067,647	2007	Single Op Mixed QRP	NØKE	187,590	2008
Single Op Phone HP	CN2R (W7EJ op)	4,718,736	2005	Single Op Phone HP	W9RE	1,658,038	2000
Single Op Phone LP	D4C	2,975,632	2008	**Single Op Phone LP**	**N1UR**	**1,004,036**	**2012**
Single Op Phone QRP	HG1W (HA1WD op)	348,517	2007	Single Op Phone QRP	KC5R	172,080	2007
Single Op CW HP	5B/W2TAA (RV1AW op)	4,219,995	2010	Single Op CW HP	VY2ZM (K5ZD op)	2,631,694	2005
Single Op CW LP	HA8DU	2,278,782	2006	Single Op CW LP	W1RM	1,135,630	2010
Single Op CW QRP	HA5KDQ (HA7ANT op)	1,412,260	2006	Single Op CW QRP	W2GD	427,392	2009
Multi-Op	**P33W**	**9,104,094**	**2012**	**Multi-Op**	**KØDQ**	**2,988,014**	**2012**

Continental Leaders

Table shows Call, Score, Class and Power. For class: A=Mixed Mode, B=Phone Only, C=CW Only, D=Multioperator. For Power, A=QRP, B=Low Power, C=High Power.

Africa

EA8AQV	60,444	A	B
ZS2NF	6,478	A	B
EA8BQM	2,982	A	B
3V8BB (KF5EYY, op)	3,340,763	A	C
EA8ZS	12,690	A	C
EA8MT	622,980	B	B
EA8ADL	73,437	B	B
D2QMN	1,003	B	B
CT3HF	297,405	B	C
ZS3Y	186,677	B	C
ZS5NK	11,800	B	C
EA8DP	408,342	C	B
V51YJ	229,296	C	B
EA8DA	220,605	C	B
EF8M	8,515,608	D	
CR3T	3,412,320	D	
EC8AFM	3,683	D	

Asia

JR3RWB	206,067	A	A
JK1TCV	93,906	A	A
JM1RPV/1	60,809	A	A
4Z4AK (UT7DK, op)	2,312,220	A	B
RV9UP	1,375,311	A	B
RT9S	1,257,538	A	B
C4W (5B4WN, op)	3,864,230	A	C
UP2L (UA9BA, op)	3,856,736	A	C
RG9A	3,842,450	A	C
JA2MWV	25,092	B	A
JI3CJO	2,310	B	A
JO7FGZ/1	230	B	A
RV9CBW	683,696	B	B
HZ1BW	463,344	B	B
A61ZX	188,194	B	B
H2T (5B4XF, op)	2,792,829	B	C
HZ1TT	520,245	B	C
RA9SK	305,943	B	C
JR1NKN	79,672	C	A
BA4II	76,560	C	A
JG1EIQ	61,321	C	A
C4Z (5B4AIZ, op)	1,148,350	C	B
RW9C	1,017,450	C	B
RA9DZ	949,620	C	B
RT9A	2,105,904	C	C
RM9I	1,522,787	C	C
R9DA	1,324,372	C	C
P33W	9,104,094	D	
C4N	5,573,800	D	
RF9C	4,256,647	D	

Europe

LZØM (LZ2SX, op)	510,068	A	A
HG6C (HA6IAM, op)	359,898	A	A
US2IZ	349,662	A	A
LY9A	2,018,549	A	B
IO4T (IK4VET, op)	1,727,100	A	B
LY4L	1,332,114	A	B
UW2M (URØMC, op)	3,979,660	A	C
E7DX (E77DX, op)	3,722,579	A	C
9A5X	3,352,365	A	C
HG1W	233,508	B	A
HA5BKV	203,840	B	A
USØMS	157,620	B	A
IB1B (IW1QN, op)	858,000	B	B
UV8M (UX3MR, op)	765,576	B	B
DF2DJ	700,570	B	B
EA1FDI	2,514,822	B	C
EA4KD	2,078,004	B	C
IR2M	2,054,360	B	C
OK3C (OK2ZC, op)	779,106	C	A
UU2CW	649,495	C	A
UX9Q (UR9QQ, op)	582,192	C	A
YT3M (YT6W, op)	1,760,525	C	B
LZ8E (LZ2BE, op)	1,675,520	C	B
LY6A	1,420,668	C	B
CR6K (CT1ILT, op)	3,461,080	C	C
UW1M (UR5MW, op)	3,020,108	C	C
OM3BH	2,854,028	C	C
RM5A	3,966,012	D	
OHØX	3,683,311		D
HG6N	3,310,200	D	

North America

KP4CPC	18,540	A	A
HR2/NP3J (JA6WFM, op)	90,972	A	B
FM5CD	438,472	A	C
XE1V	24,054	A	C
AL1G	16,796	A	C
CL8AKY	1,888	B	A
KP2/AA1BU	731,590	B	B
CO2CW	217,152	B	B
WP3GW	137,995	B	B
CO2GG	292,701	B	C
XE2URF	51,528	B	C
WP4WW (KP4JRS, op)	10,545	B	C
CO2IZ	28,710	C	A
HI8A	192,768	C	B
J35X	169,624	C	B
CO8ZZ	99,403	C	B
KP2MM (N2TTA, op)	1,761,844	C	C
TO5U	1,153,409	C	C
KL2R (N1TX, op)	140,104	C	C
NP4Z	2,539,064	D	
FP/KV1J	331,401	D	
V47JA	205,568	D	

Oceania

YB2LSR	107,640	A	B
YB3IZK	22,770	A	B
DU7RH	16,826	A	B
VK4CT (VK4EMM, op)	1,519,658	A	C
DU1EV	6,555	A	C
VK2ACC	1,840	A	C
VK4ATH	6,747	B	A
YBØMZI/4	2,856	B	A
KH6LC (NH6V, op)	1,490,580	B	B
KH6CJJ	141,204	B	B
YBØMWM	128,440	B	B
VK7ZX (VK7ZE, op)	985,800	B	C
E51TAI (W6TAI, op)	671,145	B	C
KH6/AA1LC	325,808	B	C
KH6CS	3,247	C	A
DX1X (DV1UD, op)	94,500	C	B
YB7XO	79,872	C	B
YC1BTJ	74,428	C	B
WH7M (K1YR, op)	1,667,079	C	C
VK2IM	1,061,948	C	C
VK6DXI	1,001,870	C	C
YB1C	825,988	D	
ZL1T (ZL1ANH, op)	175,489	D	
9M6SDX	118,342	D	

South America

PY2NY	823,446	A	B
YV8AD	89,376	A	B
PP2RON	74,955	A	B
CW5W (CX6VM, op)	2,774,250	A	C
PY1NX	2,278,290	A	C
LU5FC	2,041,224	A	C
LU6FHO	48	B	A
ZZ2T (PY2MNL, op)	649,066	B	B
PY1ZV	193,356	B	B
HK6F	186,528	B	B
PP5JD	2,252,868	B	C
CE3EEA	788,754	B	C
PY2LED	441,456	B	C
LU7HZ	147,340	C	A
LU8EHR	4,672	C	A
HK3TU	831,616	C	B
LU8QT	351,344	C	B
PY3OZ	349,700	C	B
PY2EX	700,946	C	C
PP1CZ	314,047	C	C
PY3AU	20,900	C	C
PS2T	4,086,720	D	
LT1F	2,954,518	D	
PY2PT	2,701,860	D	

Single Operator, Phone Only, Low Power and Multioperator on the W/VE side.

UT7DK at 4Z4AK bested the old World Single Operator, Mixed Mode, Low Power record by over 10%, originally set by HG3M (HA3MY op) in 2005. The P33W Multioperator group overtook their 2011 World record by 25.8%. Will they beat this new record in 2013?

The W/VE Single Operator, Phone Only, Low Power record of 633,060 set by W4SVO in 2011 was easily broken by N1UR with 1,004,036 and a new W/VE Multioperator record was set by the KØDQ crew.

The "Category Records" table lists the IARU HF World Championships records, with this year's new records in bold. Way to go, guys! So peruse the records, set your goal, and I hope to see your call in next year's list of records.

Also be advised that I made two errors in last year's records table. I erroneously had KH6ND listed as the W/VE Single Operator, Phone Only, High Power record holder (corrected to W9RE) — KH6 is not W/VE in this contest. And I erroneously had W1AW/4 listed as the W/VE Multioperator record holder — W1AW/4 was an HQ station. Sorry about that, guys.

WRTC-2014 Station Evaluations

An interesting aspect of the 2012 event was

W/VE Top Ten by Category

Single Operator, Mixed Mode, QRP

K0OU	175,824
W1MR	121,164
W6YX	77,448
W4UT	43,500
KS4X	43,043
W6AQ	38,367
ND3D	38,254
KU4A	27,360
K8ZT	25,134
K1TW	1,330

Single Operator, Mixed Mode, Low Power

W4IX	793,084
NR3X (N4YDU, op)	769,365
K2PO	646,600
K9OM	552,951
K0AD	401,718
N2KW	387,940
VE6EX	307,781
N9CM	274,446
N8II	250,756
N2ZN	206,448

Single Operator, Mixed Mode, High Power

XM3AT (VE3AT, op)	2,690,688
VY2ZM	2,642,444
VE3EJ	2,639,990
N5DX	2,294,334
K1LZ	2,243,568
K5GN	1,948,960
N8OO	1,870,429
K2TJ	1,794,962
NK7U (N6MJ, op)	1,767,987
N2NT (W2GD, op)	1,670,214

Single Operator, Phone Only, QRP

N1YWB	108,120
W6QU (W8QZA, op)	52,569
KC8IMB	27,667
NT4TS	24,150
W2TI	21,138
KC5WA	19,415
W2WGK	11,328
N8XA	9,894
N4ZAK	8,240
KB1HNZ	4,026

Single Operator, Phone Only, Low Power

N1UR	1,004,036
NV8N	415,140
WB4OMM	214,704
VE1WOW (K1WO,op)	182,268
NT8Z	172,291
W4FT	150,750
KT4ZB	135,408
N3WD	133,950
N9LB	113,577
K6GHA	112,350

Single Operator, Phone Only, High Power

K5TR	1,651,104
W7WA	1,508,046
W5WMU	1,189,377
W3LL	829,068
W6AFA	525,480
WA5OYU	479,675
K0RH	441,189
K5ER	424,080
W2IRT	334,464
K6AAX	277,065

Single Operator, CW Only, QRP

AA1CA	125,969
K8CN	90,725
K4MTI	71,344
K3TW	68,288
N5PJY	49,706
WA6DBC	47,885
VE3MGY	39,600
N7IR	37,200
AA4SD	31,135
KM6Z	28,512

Single Operator, CW Only, Low Power

VA2WA (VA2WDQ, op)	1,055,640
WA1Z	883,361
WX0B (AD5Q, op)	792,064
K3EL	758,735
W1NN	707,824
AA4NC	666,302
VE1RGB	610,870
N5DO	578,032
K7WP	566,202
W7YAQ	566,019

Single Operator, CW Only, High Power

NN1N	2,239,050
AA3B	2,045,463
N4AF	1,752,975
W9RE	1,648,861
W3UA	1,601,775
N9RV	1,570,176
W0UA	1,467,252
N8AA	1,444,860
K9CT	1,321,493
N6TV	1,304,772

Multioperator

K0DQ	2,988,014
NN3W	2,440,508
N2IC	2,201,620
K8AZ	2,157,705
NX5M	1,776,060
N3AD	1,523,340
NR4M	1,311,960
VE3YAA	1,255,093
VE3UTT	1,237,110
N1LN	1,172,451

DX Top Ten by Category

Single Operator, Mixed Mode, QRP

LZ0M (LZ2SX, op)	510,068
HG6C (HA6IAM, op)	359,898
US2IZ	349,662
JR3RWB	206,067
OK7CM	168,902
UT5DJ	150,087
IZ8JFL/1	148,827
G4DBW	132,174
HA6PJ	116,850
UA1CUR	111,244

Single Operator, Mixed Mode, Low Power

4Z4AK (UT7DK, op)	2,312,220
LY9A	2,018,549
IO4T (IK4VET, op)	1,727,100
RV9UP	1,375,311
LY4L	1,332,114
RT9S	1,257,538
7Z1SJ	1,225,736
RW0A (RA0AM, op)	1,220,334
R7MM	1,203,398
S53MM	1,078,650

Single Operator, Mixed Mode, High Power

UW2M (UR0MC, op)	3,979,660
C4W (5B4WN, op)	3,864,230
UP2L (UA9BA, op)	3,856,736
RG9A	3,842,450
E7DX (E77DX, op)	3,722,579
9A5X	3,352,365
3V8BB (KF5EYY, op)	3,340,763
ES5RR (ES2RR, op)	3,127,183
YL4U	2,956,728
OE3K (OE2VEL, op)	2,914,070

Single Operator, Phone Only, QRP

HG1W	233,508
HA5BKV	203,840
US0MS	157,620
R2AD	133,950
CT2JBG	120,132
SP8LXE	100,305
YO9FTN	65,670
SQ8MFB	53,568
HB9EGA/P	34,560
CT2KFA	32,930

Single Operator, Phone Only, Low Power

KH6LC (NH6V, op)	1,490,580
IB1B (IW1QN, op)	858,000
UV8M (UX3MR, op)	765,576
KP2/AA1BU	731,590
DF2DJ	700,570
RV9CBW	683,696
US0HZ	673,502
ZZ2T (PY2MNL, op)	649,066
EA8MT	622,980
EA2DT	600,667

Single Operator, Phone Only, High Power

H2T (5B4XF, op)	2,792,829
EA1FDI	2,514,822
PP5JD	2,252,868
EA4KD	2,078,004
IR2M	2,054,360
ES5RW	1,963,086
EA5DFV	1,701,366
RT4RO	1,493,263
YO3CZW	1,483,218
US5D (UT7DX, op)	1,434,928

Single Operator, CW Only, QRP

OK3C (OK2ZC, op)	779,106
UU2CW	649,495
UX9Q (UR9QQ, op)	582,192
HA6NL	557,760
UW5M (UT7MA, op)	474,237
F5VBT	432,718
EU1AA	354,750
SP9NSV/7	286,221
YL2CV	257,152
DD1IM	256,477

Single Operator, CW Only, Low Power

YT3M (YT6W, op)	1,760,525
LZ8E (LZ2BE, op)	1,675,520
LY6A	1,420,668
UW5Q (UR3QCW, op)	1,362,396
OK2ZI	1,302,300
C4Z (5B4AIZ, op)	1,148,350
LY3B	1,040,480
RW9C	1,017,450
EA5AER	1,015,322
S51F	980,280

Single Operator, CW Only, High Power

CR6K (CT1ILT, op)	3,461,080
UW1M (UR5MW, op)	3,020,108
OM3BH	2,854,028
UT5UGR	2,588,105
DJ5MW	2,523,618
UA5F	2,460,708
OL8M	2,383,740
RT5Z	2,374,984
4O3A (E73A, op)	2,247,654
YL8M (YL2KL, op)	2,246,864

Multioperator

P33W	9,104,094
EF8M	8,515,608
C4N	5,573,800
RF9C	4,256,647
PS2T	4,086,720
RM5A	3,966,012
OH0X	3,683,311
CR3T	3,412,320
HG6N	3,310,200
LT1F	2,954,518

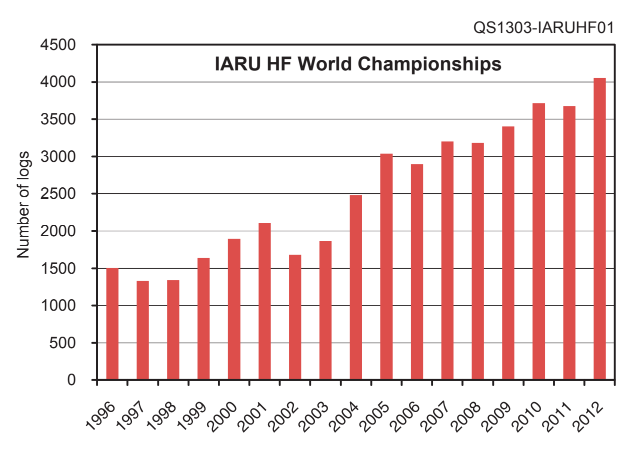


Figure 1 — The number of log submittals is showing steady growth, reaching a record level this year.

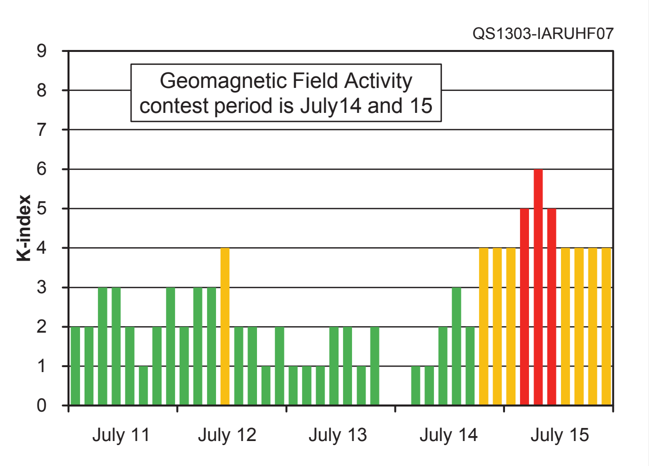


Figure 2 — Even though the conditions weren't optimal, it is clear that conditions got a lot worse right after the contest!

IARU Member Society Headquarters Stations

Headquarters and Administrative Council station scores were tabulated by the World Wide Radio Operator's Federation (www.wwrof.org) and are listed in *QST* as a courtesy to the Amateur Radio community.

Call	Score	QSO	Mults
TM0HQ	28,025,946	17,048	507
EF0HQ	26,919,279	15,857	493
DA0HQ	25,279,410	21,485	530
GO2HQ	22,440,108	15,136	474
IOxHQ	22,379,979	17,031	503
R3HQ	22,312,448	13,889	512
OL2HQ	22,262,882	15,433	514
S50HQ	19,645,892	14,214	491
YT0HQ	19,591,882	14,580	491
SN0HQ	19,515,470	15,929	494
9A20HQ	17,200,566	13,518	457
YR0HQ	16,698,825	13,039	495
EM5HQ	16,600,064	11,636	464
LZ7HQ	14,594,342	11,492	469
LRxF	13,371,060	7,602	370
LX75HQ	12,713,736	10,008	399
LY0HQ	12,003,762	9,710	417
HG0HQ	11,397,320	9,801	440
LN2HQ	9,978,045	8,643	371
HB9HQ	9,878,762	9,679	394
OZ1HQ	9,149,870	7,620	383
OP0HQ	8,345,625	6,869	375
ER7HQ	8,019,935	7,491	385
W1AW/7	7,830,256	8,320	302
SX0HQ	7,823,765	8,227	395
E70ARA	7,518,592	6,884	389
YL4HQ	7,021,839	6,457	389
NU1AW/9	6,358,623	7,375	339
XR3HQ	6,285,160	4,759	280
OH0HQ	6,149,430	6,316	315
8NxHQ	6,137,523	7,301	333
BxHQ	5,224,240	4,738	280
SK9HQ	4,887,240	5,270	293
UN1HQ	4,649,084	3,514	314
CX1AA	4,422,744	3,066	318
9K9HQ	4,358,720	3,544	265
ZZ7HQ	4,302,432	3,199	288
OE1A	3,985,820	3,953	340
ZL6HQ	3,296,345	2,933	235
TC50HQ	2,779,616	2,675	224
AT1HQ	2,460,772	2,385	236
9Y4HQ	1,689,852	1,743	212
HD2A	1,658,426	2,257	154
YE0HQ	1,543,310	2,070	157
VY2RAC	978,310	1,489	190
HL0HQ	746,595	1,609	141
DX0HQ	738,000	1,260	123
6D0LM	477,202	1,340	109
ZF1A	470,372	1,310	107
ZS9HQ	347,420	590	145
PI4HQ (PG2AA, op)	281,070	698	135
TG0AA (TG9ANF, op)	257,796	1,136	66
HS0AC (OZ1HET, op)	144,256	364	112
JU1HQ	121,662	641	54
YV5AJ (YV5JBI, op)	118,650	356	75
9M4DXX	106,500	368	75
ZP5AA	82,404	332	54
HB0HQ	54,963	241	93
VR2HK	21,300	119	60
EA8AKN	50	10	5

IARU Administrative Council Stations

Call	Score	QSO	Mults
SM6CNN	1,704,048	1,982	262
NB2T	1,422,450	2,019	218
YV5AM	1,010,844	1,269	172
XE1KK	833,248	1,218	208
G3PSM	243,300	558	150
JA1CJP	223,392	472	156
HB9JOE	150,054	369	178
PT2ADM	124,841	265	127
9A5W	111,312	530	72
CE3PG	93,176	296	76
VE6SH	39,292	292	47
LA2RR	20,056	108	92
9Y4X	18,424	102	49
VU2GMN	12,985	77	53
DL9KCE	6,288	67	48
LZ50US (LZ1US, op)	3,096	68	18
JE1MUI	4	2	2

Winning Percentages in Each Category

Category	Call	Score	QSO	Mults	Winning Percentage
SO Mixed QRP	LZ0M (LZ2SX, op)	510068	908	221	41.7
	HG6C (HA6IAM, op)	359898	670	209	
SO Mixed QRP	K0OU	175824	534	111	45.1
	W1MR	121164	302	138	
SO Mixed LP	4Z4AK (UT7DK, op)	2312220	1946	267	14.5
	LY9A	2018549	2283	299	
SO Mixed LP	W4IX	793084	1264	214	3.1
	NR3X (N4YDU, op)	769365	1471	205	
SO Mixed HP	UW2M (UR0MC, op)	3979660	3118	386	3.0
	C4W (5B4WN, op)	3864230	3120	265	
SO Mixed HP	XM3AT (VE3AT, op)	2690688	2628	273	1.8
	VY2ZM	2642444	2500	266	
SO Phone QRP	HG1W	233508	494	183	14.6
	HA5BKV	203840	496	182	
SO Phone QRP	N1YWB	108120	307	136	105.7
	W6QU (W8QZA, op)	52569	207	81	
SO Phone LP	KH6LC (NH6V, op)	1490580	1844	169	73.7
	IB1B (IW1QN, op)	858000	1130	275	
SO Phone LP	N1UR	1004036	1454	209	141.9
	NV8N	415140	1040	165	
SO Phone HP	H2T (5B4XF, op)	2792829	2425	247	11.1
	EA1FDI	2514822	2496	291	
SO Phone HP	K5TR	1651104	2279	224	9.5
	W7WA	1508046	2095	222	
SO CW QRP	OK3C (OK2ZC, op)	779106	1066	267	20.0
	UU2CW	649495	931	241	
SO CW QRP	AA1CA	125969	379	103	38.8
	K8CN	90725	395	95	
SO CW LP	YT3M (YT6W, op)	1760525	1681	325	5.1
	LZ8E (LZ2BE, op)	1675520	2118	308	
SO CW LP	VA2WA (VA2WDQ, op)	1055640	1348	228	19.5
	WA1Z	883361	1515	199	
SO CW HP	CR6K (CT1ILT, op)	3461080	2722	329	14.6
	UW1M (UR5MW, op)	3020108	2569	364	
SO CW HP	NN1N	2239050	2486	275	9.5
	AA3B	2045463	2425	257	
SO Multi-Op	P33W	9104094	4937	402	6.9
	EF8M	8515608	4566	398	
SO Multi-Op	K0DQ	2988014	2888	293	22.4
	NN3W	2440508	2496	301	

the participation by contesters who were evaluating station setups for the forthcoming 2014 WRTC. The calls used were K1GO, K1RQ, K1ZD, N2KW, N9NB, NI1L, W1HH, W1MA, W1MJ, W1SJ, W1UE, W1UJ, and WB1Z. For information about this interesting experiment, visit **www.wrtc2014.org/competition/2012-station-test**.

Propagation

The Sun did not cooperate this year — but it's still my favorite star! The 10.7 cm solar flux was certainly high enough for good propagation on 20 meters (the 10.7 cm solar flux was around 150 for the contest weekend), but an X1 X-ray flare on July 12 also triggered a CME (coronal mass ejection) that elevated the K indices later in the day on the first day of the contest (July 14) and into the second day of the contest. Figure 2 plots the eight daily mid-latitude K indices for July 11-15. Another great way to see the effect of the elevated K indices is to look at the output of the STORM Time Empirical Ionospheric Correction Model (offered by the Space Weather Prediction Center at **www.swpc.noaa.gov/storm/index.html**).

The ionosphere began to react early on July 15 with a reduction in electron density at all latitudes in the northern hemisphere. Nevertheless, IARU 2012 dodged a major bullet as the biggest effect of the elevated K indices was on Monday, July 16 (not shown in the graph — but you can see where things were headed).

Disqualification

HG7T (HA7TM, op) was disqualified from the 2012 IARU HF Championship for submitting a log deemed incompatible with the category entered.

This Year's Event

You have several months to get your station and antennas ready for this year's event, which will be the weekend of July 13 and 14. I hope to meet you on the air!

W/VE Region Leaders

Table shows Call, Score, Class and Power. For class: A=Mixed Mode, B=Phone Only, C=CW Only, D=Multioperator. For Power, A=QRP, B=Low Power, C=High Power.

Northeast Region

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

W1MR	121,164	A	A
ND3D	38,254	A	A
K1TW	1,330	A	A
N2KW	387,940	A	B
N2ZN	206,448	A	B
KA1WIF	111,320	A	B
VY2ZM	2,642,444	A	C
K1LZ	2,243,568	A	C
K2TJ	1,794,962	A	C
N1YWB	108,120	B	A
W2TI	21,138	B	A
W2WGK	11,328	B	A
N1UR	1,004,036	B	B
VE1WOW (K1WO,op)	182,268	B	B
N3WD	133,950	B	B
W3LL	829,068	B	C
W2IRT	334,464	B	C
W1PL	105,141	B	C
AA1CA	125,969	C	A
K8CN	90,725	C	A
K3TW	68,288	C	A
VA2WA (VA2WDQ, op)	1,055,640	C	B
WA1Z	883,361	C	B
K3EL	758,735	C	B
NN1N	2,239,050	C	C
AA3B	2,045,463	C	C
W3UA	1,601,775	C	C
K0DQ	2,988,014	D	
NN3W	2,440,508	D	
N3AD	1,523,340	D	

Southeast Region

(Delta, Roanoke and Southeastern Divisions)

W4UT	43,500	A	A
KS4X	43,043	A	A
W4IX	793,084	A	B
NR3X (N4YDU, op)	769,365	A	B
N9CM	274,446	A	B
N5DX	2,294,334	A	C
N8OO	1,870,429	A	C
AD4Z	1,441,763	A	C
NT4TS	24,150	B	A
KC5WA	19,415	B	A
N4ZAK	8,240	B	A
WB4OMM	214,704	B	B
W4FT	150,750	B	B
KT4ZB	135,408	B	B
W5WMU	1,189,377	B	C
WA5OYU	479,675	B	C
K5ER	424,080	B	C
K4MTI	71,344	C	A
AA4SD	31,135	C	A
NU4B	20,658	C	A
AA4NC	666,302	C	B
WD4AHZ	522,063	C	B
WB4TDH	485,472	C	B
N4AF	1,752,975	C	C
K5KG	1,292,936	C	C
N4OGW	1,275,513	C	C
N2IC	2,201,620	D	
NR4M	1,311,960	D	
N1LN	1,172,451	D	

Central Region

Central and Great Lakes Divisions; Ontario Section)

KU4A	27,360	A	A
K8ZT	25,134	A	A
AF9J	1,064	A	A
K9OM	552,951	A	B
AI4BJ	127,832	A	B
WD8S	92,610	A	B
XM3AT (VE3AT, op)	2,690,688	A	C
VE3EJ	2,639,990	A	C
K9CU (KB9UWU, op)	393,120	A	C
KC8IMB	27,667	B	A
N8XA	9,894	B	A
KC9AMM	308	B	A
NV8N	415,140	B	B
NT8Z	172,291	B	B
N9LB	113,577	B	B
VA3XH	114,625	B	C
VA3YOJ	101,038	B	C
K8ZZU	71,160	B	C
VE3MGY	39,600	C	A
VA3RKM	27,189	C	A
VE3IGJ	17,028	C	A
W1NN	707,824	C	B
NA8V	535,458	C	B
KV8Q	494,320	C	B
W9RE	1,648,861	C	C
N8AA	1,444,860	C	C
K9CT	1,321,493	C	C
K8AZ	2,157,705	D	
VE3YAA	1,255,093	D	
VE3UTT	1,237,110	D	

Midwest Region

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

K0OU	175,824	A	A
WA5DSS	477	A	A
K0AD	401,718	A	B
N1CC	181,830	A	B
N5AW/0	169,719	A	B
K5GN	1,948,960	A	C
W0EWD	1,293,796	A	C
K0SR	1,179,684	A	C
WB0TSR	105,374	B	B
N7MZW	95,535	B	B
KE5OG	66,339	B	B
K5TR	1,651,104	B	C
K0RH	441,189	B	C
K5RZA	251,988	B	C
N5PJY	49,706	C	A
KA8HDE	17,892	C	A
W5GAI	9,660	C	A
WX0B (AD5Q, op)	792,064	C	B
N5DO	578,032	C	B
W5RYA	222,885	C	B
W0UA	1,467,252	C	C
K5WA	1,161,215	C	C
N5RZ	446,732	C	C
NX5M	1,776,060	D	
N0AT	855,768	D	
W7CT	644,324	D	

West Coast Region

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

W6YX	77,448	A	A
W6AQ	38,367	A	A
K2PO	646,600	A	B
VE6EX	307,781	A	B
N6MI	188,980	A	B
NK7U (N6MJ, op)	1,767,987	A	C
K6XX	1,493,063	A	C
W6YI (K6AM, op)	1,426,095	A	C
W6QU (W8QZA, op)	52,569	B	A
KJ6MQM	1,482	B	A
K6GHA	112,350	B	B
K7XE	51,350	B	B
VE7NS	30,780	B	B
W7WA	1,508,046	B	C
W6AFA	525,480	B	C
K6AAX	277,065	B	C
WA6DBC	47,885	C	A
N7IR	37,200	C	A
KM6Z	28,512	C	A
K7WP	566,202	C	B
W7YAQ	566,019	C	B
WJ9B	363,465	C	B
N9RV	1,570,176	C	C
N6TV	1,304,772	C	C
K6NA	1,188,556	C	C
NX6T	833,831	D	
W7IJ	504,431	D	
K6MMM	404,192	D	

Sean's Picks

Sean Kutzko, KX9X, kx9x@arrl.org

- **State QSO Parties this month:** Idaho, North Dakota, Oklahoma, Virginia, Wisconsin.

- **QRP Contests this month:** ARS Spartan Sprint (March 5), AGCW QRP Contest (March 9), QRP ARCI HF Grid Square Sprint (March 9), Flying Pigs Run for the Bacon (March 18), NAQCC Monthly QRP Sprint (March 21)

- **ARRL DX Contest — Phone (March 2-3):** Can you work 100 DXCC entities in a weekend? Many have done it; see if you can, too! US & Canada works only DX, DX works only US & Canada.

- **North American Sprint — RTTY (March 10):** Do you love RTTY? If so, this 4 hour contest is for you! A limit of no more than two QSOs on the same frequency will keep all RTTY ops intensely busy.

- **Russian DX Contest (March 16-17):** Everybody works everybody in this event, which is fast becoming a must on the contesting calendar. Emphasis is on working Russian stations and oblasts (districts). Work as many oblasts as you can.

- **CQ WPX Contest — Phone (March 30-31):** Prefixes are the multipliers in this everybody-works-everybody contest. A WD4 is just as valuable as a P29! This event offers lots of activity and plenty of fun.

Strays

Tuskegee Airman in Pompano Beach

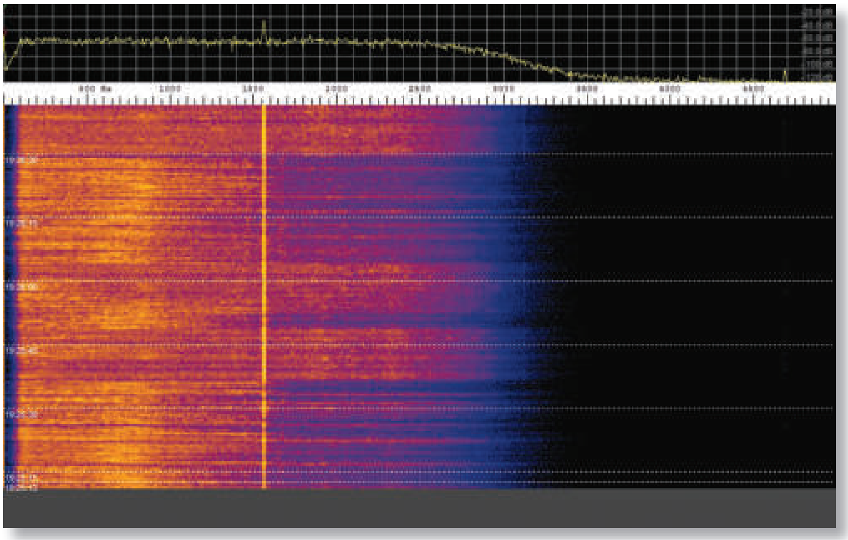
The Gold Coast Amateur Radio Association in Pompano Beach, Florida was fortunate to have as their special guest and keynote speaker US Air Force Lieutenant Colonel Leo R. Gray at their meeting last November. Colonel Gray is one of the original Red Tail pilots of the famous Tuskegee Airmen who distinguished themselves as combat pilots during World War II. [N4ZUW photo]

Radiosport

Frequency Measuring Test – April 2013

- The April Frequency Measuring Test will introduce a new format!
- Two unmodulated signals will be transmitted simultaneously with the frequency of one signal being published. The separation will be approximately 2 kHz. The object is to use the frequency of the published reference to compensate for equipment error and Doppler effects.
- The two-signal Frequency Measuring Test will take place on 20 and 80 meters. A traditional single-frequency signal will be transmitted on 40 meters. See the Frequency Measuring Test website at **www.arrl.org/frequency-measuring-test** for the complete schedule and instructions for submitting your measurements.

10:30 PM EST on April 10 - 0230 UTC on April 11



At the Foundation

Mary M. Hobart, K1MMH, k1mmh@arrl.org

Three New Scholarships to be Awarded in 2013!

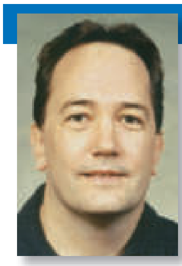
The ARRL Foundation is pleased to announce that three new annual scholarships have been added to the more than 70 scholarships awarded each year. All three scholarships honor the memory of Silent Keys.

The **Jake Driver, KC5WXA, Memorial Scholarship** has been donated by his parents, Debbie, KD5EFM, and Mickey, AK5Q, Driver to provide educational assistance to a young ham from Tennessee or the ARRL Delta Division (Arkansas, Louisiana, Mississippi and Tennessee) who will be studying electronics, computers or journalism.

The **Byron Blanchard, N1EKV, Memorial Scholarship** has been donated by his widow, Paula B. Blanchard, to provide educational assistance to a young ham from the ARRL New England Division (Massachusetts, Connecticut, Rhode Island, Vermont and Maine). There are no requirements as to the course of study.

The **Victor Poor, W5SMM, Memorial Scholarship** has been donated by The Amateur Radio Safety Foundation, Inc. (ARSFi) to provide educational assistance for a young ham pursuing studies in electrical engineering with a preference for a concentration in digital communications.

More information about these new scholarships and the many other awards can be found on the ARRL web site at **www.arrl.org**, including selection criteria, application instructions and forms. The application period for the ARRL Foundation scholarships opens on October 1 and closes February 1 of the following year. Applicants must be an active FCC-licensed radio amateur.



Bernie McClenny, W3UR, w3ur@arrl.org

PTØS — Radio on "The Rocks"

Rough seas, jagged rocks and sleepless nights make for a tough time putting Saint Peter and Saint Paul Rocks on the air.

This month's column about the recent DXpedition to Saint Peter and Saint Paul Rocks is written by one of the participants, George Wallner, AA7JV. — 73, Bernie, W3UR

"No DXpeditions allowed!" That was the position of the Brazilian Navy when considering our proposed trip to Saint Peter and Saint Paul Rocks (SPSP), a group of rocky islands that belong to Brazil. The Navy believed that ham activities would interfere with the mission of its scientific research station there. Thus, making PTØS happen was not only a substantial technical and physical challenge but also a political one. Atilano de Oms, PY5EG, was able to address the political obstacle. As Araucaria DX Group's chairman, he convinced the relevant political and naval authorities to give Amateur Radio a chance.

Because of our focus on 160-40 meters, we wanted to operate during the northern winter. In May 2012, Oms was able to get a tentative agreement from the Navy and we started organizing and building gear in earnest.

Fred Carvalho, PY2XB, and I went on a survey trip to the SPSP island of Belmonte in July. Once there we quickly confirmed there was no level space suitable for a tent. Other arrangements would have to be made.

The PTØS team (from left): Peter, PP5XX; Fred, PY2XB; Tomi, HA7RY; and George, AA7JV. [Photo courtesy George Wallner, AA7JV]

Preliminary Plans

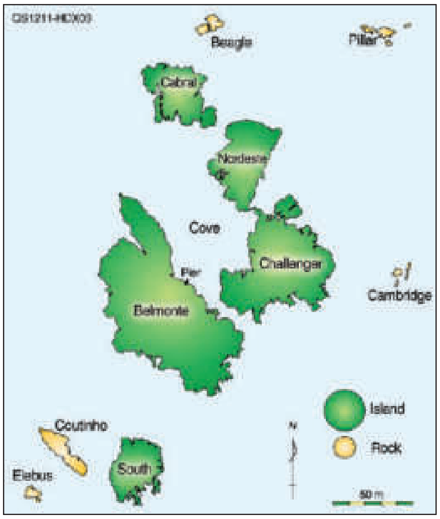
We decided on four operators: Fred; Peter Sprengel, PP5XX; Tomi Pekarik, HA7RY, and me. We arranged to have the DXpedition transported to Belmonte using the fishing company that took us on the survey trip. After a 3½ day crossing, we would arrive at Belmonte on November 10.

During the survey trip we had discovered a lot of RF noise. We decided to create a remote receiving system, which we intended to install on the island of Cabral. The system would consist of two Double Half-Delta Loop (DHDL) antennas, a two-channel remote 160-10 meter preselector with very low noise pHEMT (pseudomorphic High Electron Mobility Transistor) preamplifiers and a control box at each station feeding the K3 transceiver and the software defined receiver.

Casting Off

We arrived in Natal, Brazil on October 29 and were greeted by Ronnie Reis, PS7AB, and Mauricio Barreto, PS7RK. We had planned to buy much of our supplies and ancillary gear in Natal. Our two new friends were great hosts and essential in helping us find the many remaining items on our list. A big thank you to them for their hospitality and help!

We departed on November 6 on fishing vessel *Transmar II* and arrived early on November 10. Fred and Peter went ahead to work out the details of sharing the lab while Tomi and I, with the help of the crew, started to ferry the gear on Belmonte. Landing and loading on to Belmonte was an interesting experience due to the big sea surge that constantly lifted and dropped the small boat. The landing had a slippery steel ladder that required good timing to use safely. As soon as most of our essential gear was on land, we set to work erecting antennas and putting the first station together.



Verticals Over Saltwater

Working the low bands is all about antennas, especially on 160 meters. We learned on previous DXpeditions that the secret to strong signals is locating the transmit antennas over — or right in — saltwater, as opposed to over sand. Unless there is a large radial screen under a vertical, the sand will cause serious losses. The difference between placing antennas over sand versus saltwater can be up to 10 dB.

Fortunately, saltwater was in ample supply around SPSP. We mounted the main antenna on the top of a narrow rocky outcropping that jutted into the sea about 20 feet above sea level. We started at low tide and had to move quickly, as the coming high tide would wash over the rocks and make the work difficult and dangerous. Indeed, while draping the last radials we were hit by a few large waves, totally soaking us and forcing us to hang on for dear life.

The main antenna had two sections: one for the low bands (160-30 meters) and one for the high bands (20-10 meters). The low band section was an inverted L, which had an 18 meter tall vertical wire and a thin 12 meter long horizontal wire. With a short horizontal wire this antenna is also a good low angle radiator on 80 and 40 meters. The high band section of the antenna was a narrow, inverted 6 × 2 × 5 meter triangle of wire. At the base of the mast we attached a homebrew dual output tuner.

We laid about 40 radials of different lengths, with most of the radials ending in the saltwater. There was saltwater on three sides and in crevasses throughout the rocks and in pools around the antenna.

Radio On the Rocks

Meanwhile, Fred and Peter were building our power system, which consisted of a 3 kW generator, nine 12 V car batteries and six battery chargers: an elaborate but fuel efficient system to power three radios and two amplifiers.

Station 1 had a K3 transceiver and two combined SG-500 solid-state amplifiers for an output of 1 kW. The transceiver, amplifier and automatic antenna tuner were interconnected by a control box.

We turned on the power, set the K3 to 1825.5 MHz and pressed the START button on the control box. The tuner started running, with the SWR meter needles wildly dipping and jumping as various L and C combinations were tested. After a few seconds, the SWR needle dropped to near zero and the green OK light came on.

The Rocks On the Radio

At the start there was a strong wideband noise, which sounded like a switch mode power supply. With fingers crossed, we sent out a tentative CQ, hoping there would be somebody who could put an S9+10 dB signal into the middle of the Atlantic. Clive, GM3POI, came back immediately. We made over 300 contacts that night on 160 meters.

Nobody got enough sleep that night, but the next morning we set out to build the second station. The antenna for it was similar to the first antenna but without the horizontal wire, and it would cover 80-10 meters. We placed the antenna in a shallow crater. It was mostly covered with shallow pools of saltwater, in which we laid about 30 radials. This antenna was quieter than the main antenna and turned out to be our best antenna.

The second station was up and running the afternoon of the second day, with the 6 meter station following it closely. We worked all night making contacts on 160, 80 and 6 meters.

Our third day on Belmonte we started an intense search for noise sources. We built a small loop antenna and used a portable KX3 transceiver to sniff out the noise. We eventually determined that most of it was coming from a 30 W computer power supply. By the end of the day the noise on 160 meters was down to a "pleasant" S6.

This is the main antenna at high tide. [Photo courtesy George Wallner, AA7JV]

That day we also built our first receive antenna: a 4 × 4 meter flag connected to the remote preselector. The original plan called for this antenna (and a second one), as well as the remote amplifier, to be located on Cabral. Large waves and a huge surge, however, made landing there impossible.

To operate on 160 meters properly you need a separate receive antenna. For the first few days, while we were working the big guns, using the transmit antenna alone was fine, as most signals were stronger than the noise. Once the strong stations were out of the way and we started working the smaller ones, it became necessary to have a dedicated receiving antenna. The top three choices are: Beverage, four square or some kind of flag. Since we had no room for a Beverage or four square, it would have to be flags.

Unless they are large (10 × 10 meter), flags have very low gain, often −35 dBi or less. A low noise, high gain preamplifier is necessary even with a good transceiver like the K3. Before PTØS, I worked with Carlos, N4IS, and Gary, KD9SV, to develop such a preamplifier. It uses nine pHEMT transistors for a gain of 27 dB with a noise figure well below 1 dB. The combination of a 4 × 4 meter flag on a cliff face and the very low noise preamplifier gave us good ears on 160 meters. Indeed, we used this receive antenna with good results up to 15 meters.

The Sandman Cometh

Between maintenance, working the pileups and there not being a place to sleep during the day, we got extremely tired. By day five we were falling asleep mid-contact. The solution was a hammock hung under the building. Although it was hanging over running water, which was often quite deep, it enabled us to catch a few minutes of sleep during the day.

On day five we built a dedicated 10 meter vertical; this allowed the 6 meter station to work 10 meters between 6 meter openings. By then we were really rolling and the contact count was going up fast.

We posted the logs on LoTW beginning 36 hours after getting on the air and updated them daily. We brought an Iridium satellite phone for this purpose. Unfortunately, its data rate was a paltry 2400 bps. Log uploads that took 2-3 hours to upload every day required somebody to climb up to the base of the lighthouse, which was the highest point and had a clear shot at the satellites.

Most DXpeditions I have been on settle into a routine by day three or four. Not on PTØS. Because of the weather, maintenance issues, the changing Navy and scientific crews, and the need to constantly move our gear, we were never able to settle into a routine. The only constant we had was relentlessly working the pileups. We grabbed sleep, washing (saltwater only) and meals whenever and wherever we could.

Getting the Boot

The end to the operation came very abruptly. A large Navy construction crew arrived the morning of the 23rd. Although we were hoping to stay for the CQWW contest beginning on the 24th, we were told that the Navy needed all the space and we had to leave. After a quick sign-off transmission, we started a frantic teardown of the stations and the antennas. To arrive in Natal while it was still daytime the boat had to leave mid-afternoon. Under the agreement with the Navy, we were to donate our generators, batteries and chargers to the science station. This made loading of the gear somewhat easier but it was still a lot of work.

PTØS ended with a total of 44,000 contacts, of which 3000 were on 160 meters and 1000 on 6 meters. We were on the air for 12½ days. We felt that we had accomplished the bulk of our mission. Most important, we proved to the Brazilian Navy that Amateur Radio is compatible with the scientific activities on SPSP!

The World Above 50 MHz

Jon Jones, N0JK, n0jk@arrl.org

Six Meter Holiday Magic

Santa brought a 6 meter propagation present to North America with an opening to New Zealand.

Starting on December 9, 2012, Bob Sutton, ZL1RS, made many 6 meter contacts with lucky stations in North America. He made contacts as far to the northeast as KB3RHR (EN90) on the 30th. All together over 50 different stations in North America made it into his log by the end of December. What a great holiday treat. The propagation was not a one-time event as it occurred on five more days — the 10th, 29th, 30th, 31st and January 1.

Mike, K4PI (EM73) logged Bob on the 10th at 0048 UTC. "When I first tuned Bob in he was a true 579 to my ear. Q5 copy. I never pay much attention to S meters but he was really nice. Within 5 or so minutes fading started to overtake him and finally he was gone in less than 10 minutes. I don't know how long he might have been into this area. He was my first ZL and he said his rotator heading was off by 20°, so could he have been stronger if his antenna bearing had been correct?"

With a solar flux of only 100, what is the mode of propagation that allowed these contacts to take place? It was unlikely to be direct F2. The 10.7 cm solar flux was too low, with an average of around 100-110 in December. This would support an F2 MUF of 28 MHz but not at 50 MHz. Carl Luetzelschwab, K9LA, has investigated the ZL-NA path on 50 MHz and has some ideas about the mechanism.[1] I have added my own research as well.

New Zealand is in a location where transequatorial (TEP) and chordal hop propagation can take place. It is at about 42° south magnetic latitude. The locations of many of the contacts Bob made — California, Mexico, south Texas, the Gulf Coast and Florida — are 40° north magnetic latitude. So chordal hop transequatorial propagation appears possible. Chordal hop transequatorial propagation takes place when the two crests or "clumps" of high electron density on either side of the geomagnetic equator refract signals. TEP is a robust mode, and often the MUF may be higher than 50 MHz even if the solar flux is low. From Los Angeles, California the first crest is about 3600 km away and it is the same distance from New Zealand to the southern crest. Stations along the 40° magnetic north latitude in the southern states would hit the first crest, the signal refracts to the second and on to ZL1RS. Mystery solved!

Not so fast... First, how did stations north of geomagnetic latitude 40 work New Zealand? And it turns out the band of high ionization in the first TEP crest is too far for stations in North America to reach directly in the first place. The mid point for reaching the F layer where the crests are located is about 2000 km. Six meter signals from California or Texas would never hit it — 3600 km is far out of range. The southern crest also appears to be out of range of New Zealand. So how did the holiday magic happen?

Often the best openings take place on days with extensive E_s across the southern states and Central America.

Carl speculated some other propagation mode occurred between New Zealand and North America. "That mode was likely sporadic E (E_s). E_s occurs mostly in the summer months, which would be December, January and February in the southern hemisphere. E_s also has a minor peak in the northern hemisphere winter month of December, which fits the contacts on the North American end nicely. Thus the hypothesis is that these contacts involved E_s on both ends of the equatorial ionosphere, in which a chordal hop due to TEP occurred." Proving the "E_s link" can be difficult, as many of the E_s paths from New Zealand and the southern states land out in ocean water. Nevertheless, the E_s-TEP hypothesis fits the season of the year and the limited time frame these contacts took place. There is some circumstantial evidence for the E_s link hypothesis.

A number of DXers note that during solar minimums 28 MHz behaves much like 6 meters during a solar peak. Saturday night of the 2010 ARRL 10 Meter Contest, with a solar flux of 80, I recall working several ZL stations around 0200 UTC. This was well after dark and 10 had closed hours earlier for regular F layer propagation. I recall having E_s to Mexico, Arizona, New Mexico and California at the time. I suspect my 10 meter ZL contacts were E_s linked to TEP.

Tim Havens, NW0W, notes that he and other stations heard XETV (Mexican TV video carriers) as a precursor to the December ZL openings. From the southeast states, XETV is on the great circle bearing to ZL. One hop E_s from Georgia to Mexico City lines up with New Zealand. From Missouri, though, Tim reports that when he turns his Yagi to the XETV stations during the ZL openings, they drop out. They peak toward the southwest, possibly via E_s/F2 backscatter, at times up to 30 over S-9! He and others observed the ZL path peaks between 0000-0200 UTC with 0010-0030 UTC being possibly the best.

On December 12, K4QI noted stations to the west of him in Atlanta, Georgia were working ZL1RS. The Atlanta stations had a strong "E_s link to XE at that time." Most of the days the ZL path was open there were extensive E_s openings across North and Central America. Several of the ZL openings had "narrow footprints" in North America. On the 30th, many of the ZL contacts were in a small region of EM34, EM47, EM56 and EM66. Small footprints are typical of E_s links. E_s was spotted on the ZL end as well. On December 31, E51E spotted ZL1RS at 2323 UTC and VK5PO spotted Bob on January 1, 2013 at 0033 UTC both via E_s. The contacts between New Zealand and W3, W8, W9 and W0 may have been via a double hop E_s link to the northern TEP crest. Double hop E_s does occur during the winter season, though not often. The fact that most contacts between ZL1RS and the more northeastern North American stations were generally weak and with the better equipped stations is consistent with a double hop E_s link.

The December holiday 50 MHz openings have some discernible characteristics. They usually occur from mid December through the first week of January, with the peak period between Christmas and the new year. The optimum time frame is probably 2300-0200 UTC. A solar flux of 80 or more appears to be the minimum needed; the higher flux of 110 in 2012 may have caused the opening to last longer with stronger signals. Often the best openings take place on days with extensive E_s across the

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[1] C. Luetzelschwab, K9LA, "Up Over to Down Under: W6 to ZL on 6 meters," WorldRadio Online, Jun 2010.

southern states and Central America. XETV video carriers could signal these openings. Finally, Bob's dedication, persistence, skill — and his stacked 6 element G0KSC LFA Yagi array — were crucial.

Some questions to consider. Why were so few other Pacific countries heard/worked during the December ZL openings? Where was Hawaii? Summer in North America is the peak E_s season and the winter E_s season peaks "down under." Why are no ZL contacts reported by NA stations during the last week of June? Next month I'll present some possible answers.

On the Bands

50 MHz

The big news in December was Bob, ZL1RS, who gave out many a new DXCC. There were at least 5 openings between North America and New Zealand with December 29 (30th UTC) being probably the most widespread and longest with 28 NA stations making it into Bob's log that day. K4QI noted TI5KD and XE3N on the 4th. XE3/K5ENS (EL61) made many stateside contacts on the 4th from 2100-0000 UTC to W3, W4, W5, W8, W9 and W0 from IOTA NA-045 via E_s. He was loud to Kansas for KC0DEB (EM29) and N0JK (EM28) at 2230 UTC. Paul, WB0BBC (EL96) worked Zalo, XE3N (EL50) at 0040 UTC on the 5th using just a squalo at 25 feet. From the 6th-7th, Tom, K8CX, operated as P40CX on 6 meters. "I went to Aruba and got on 6 meters a couple evenings and here is what I worked, all on 50.110 MHz: LU5FF, ZP5YW, P49MR, LU3ARE, CX4AAJ, LU7HO, PY2VI, LU4EFC, LU4FPZ, CX1FK, PY2MC and PY3HN."

On the 9th, Jay, K0GU (DN70) logged ZL1RS at 0158 UTC. W6TOD spotted Bob "super loud" at 0223 UTC. K4QI (FM06) said he heard stations to the west in Atlanta working Bob on the 12th. Russ worked LU5FF on the 12th, likely E_s-TEP. Also on the 12th, Ed, VP9GE (FM72) worked W1IMM (FN42) and W4IMD (EM74) around 0040 UTC. On the 23rd, N7DB worked N5JEH on SSB at 0453 UTC. After Christmas through the new year, though, the band was red hot!

December 26 found NW0W (EM47), KA9CFD (EN40), K5BG (EM12) and others logging Rod, ZL3NW (RE66) around 0100 UTC for a late Christmas present. Charlie, N8RR (EM98) West Virginia reports how he almost worked ZL3NW:

> ZL3NW was into WV Dec 26 at 2044 UTC on 50.095 MHz, but I could not get my call through the stations to my west. Over a 10 or 15 minute period, I could copy Rod's CQ calls, but the QSB was brutal. It was close but I needed just a little bit more prop to get my call through.
>
> With ZL1RS, I seemed to have a clear shot and the prop was better. This time, the marginal conditions coupled with other more prop advantaged callers were obstacles. Every time I see a ZL spotted in 5 or 0 land, we are checking 6 meters these days!"

The next day K2DRH (EN41) found PY7RP (HI22) on 50.110 MHz at 0009 UTC December 27 though a pileup of 5s. Dave, N9HF (EL99) heard VK4CZ calling CQ on 50.092 MHz at 0155 UTC.

Yuri, UT1FG/mm was busy from the 28th-30th making many single hop E_s contacts from the FL grid field to the eastern states (see Figure 1). The K5N grid DXpedition group was active from EL28 for their second annual "winter DXpedition" December 29-January 2 on WSJT and E_s. Eden, ZF1EJ (EK99) worked KI0F (EN34) the 28th. Bill, K2UNK (FN20) worked VO1JM, VO1JA and heard VO1KVT around 1615 UTC. KC2TA ran the EM12 grid on CW with an indoor 17 meter dipole from New Jersey around 2200 UTC On the 29th N3DB spotted the 9Q1D/b at 1440 UTC. F2? This turned out to be one of the best days for E_s and DX in December. Todd, N4QWZ, says "Wow what a day (29th) on 6 meters, the band was open off and on in EM66 Tennessee all day. Well around 2200 UTC conditions really picked up and I worked PY1RO at 2328, C6AOD was booming in 59+20 at 0006 UTC and HR2/NP3J in at 0025 UTC."

The evening of December 29 (30 UTC) was probably the best opening to ZL1RS to North America. K9IL (EM56), N4QWZ (EM66), K8LEE (EM79), W5ZN (EM45) and many others worked Bob. Todd's, N4QWZ, tale of persistence: "I popped into the ON4KST chat room and noticed (Dennis, K7BV) heard and worked ZL1RS, so I hung around for a couple of hours listening hearing bits and pieces of ZL1RS calling CQ then at 0143 UTC I heard him call CQ. Bob was 539; by the end of the exchange I updated him to 559 then after I completed the contact he was peaking 579!" Dennis, K7BV, worked ZL1RS with his 7 element Yagi at 35 feet from FM04.

K5RK was spotted by 5W1SA on the 30th at 0129 UTC. N0JK (EM28) logged XE2PEA (DL95) while I was mobile at 0300 UTC. He was a solid 20 over S-9 with no fading and running just 10 W. I also heard the XE2O/b (EL05) strong (see Figure 2). This may have been off the same E_s center that created the link for N4QWZ and others to the east for ZL1RS. That afternoon on the 30th, K1TOL (FN44) and VE2XK (FN07) heard the

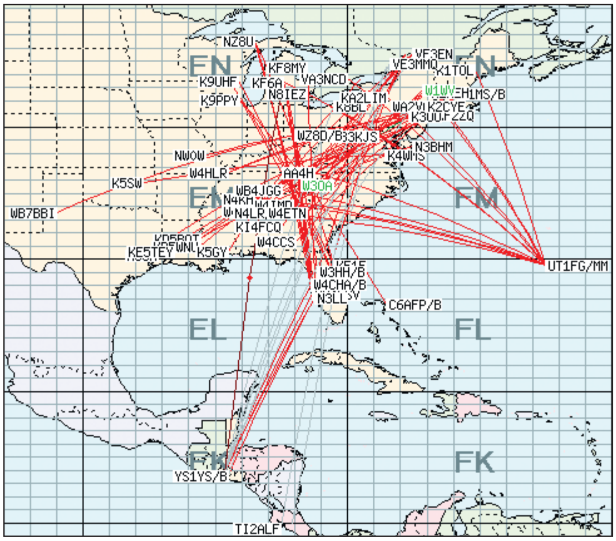


Figure 1 — Yuri, UT1FG/mm, at 2100 UTC December 28 worked single hop E_s to the East Coast from FL79. [**www.dxmaps.com**]

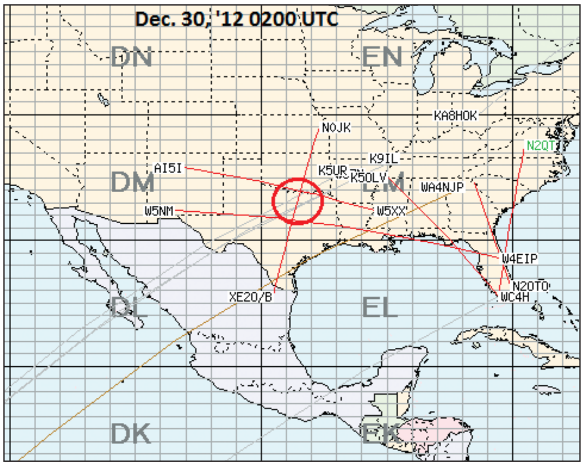


Figure 2 — The circle shows the location of the E_s cloud that supported the link between ZL1RS and W5ZN, K9IL, N4QWZ and others at 0200 UTC December 30. I heard the XE2O/b (EL05) via the same E_s cloud. [**www.dxmaps.com**]

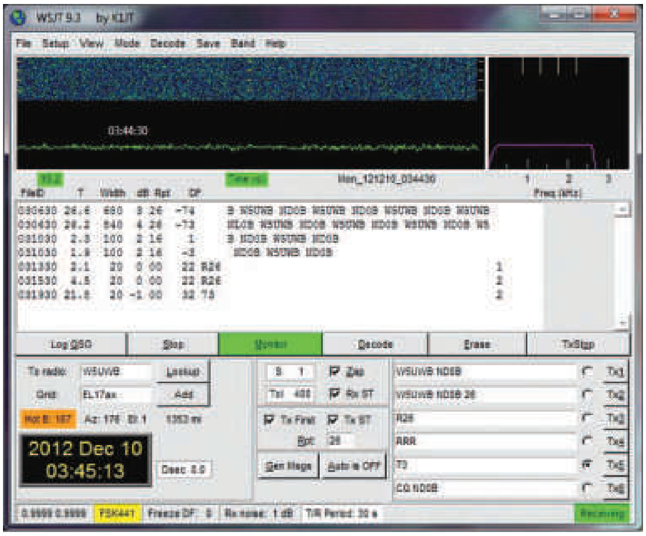
OA4TT/b (FH17) at 2217 UTC. VE1YX (FN74) and W3UR (FM19) spotted PY1RO around 2320 UTC. PY1RO, PY2VOX and PY4RGS made many contacts into the northeast states. K7ULS (DN41) logged K5N (EL28) at 0132 UTC. NØLL (EM09) found XE2JS (DL68) at 0136 UTC December 31, cross paths off the same E_s cloud. K5RK worked VK5PO at 0202 UTC. This is one of the few reports of other Pacific countries besides New Zealand to North America in December. Bill, K2UNK (FN20) worked W6FL (DM13) via double hop E_s at 0245 UTC with just 50 W and a 5 element Yagi up 30 feet. The afternoon of the 31st, KØYW (DM67), NWØW (EM47) and W9RM (EN52) spotted ZL1RS around 2325 UTC. Jay, W9RM, heard but did not work Bob, so others could have a chance. There was strong short E_s from NØJK (EM28) to W6OAL (DM79) at 2335 UTC.

144 MHz

A strong tropo opening appeared the morning of December 6 from the Midwest to the Gulf coast. JD, NØIRS (EM29) worked K5DDD and WB5OBS (EM20) at 1240 UTC. Conditions were so good JD was able to work KC5GTT (EL09) while mobile. K5SW (EM25) worked K5LLL (EM10). The Geminids meteor shower surprised many as one of the best in years with peak rates of over 120 meteors per hour. K7ULS (DN41) worked NØLWF (EN10), KI7JA (CN85), WØKT, NTØV (EN08) and W7OUU (DN22) Idaho on meteor scatter. KD4ESV (EL87) worked KE5JXC (EL39) on the 19th at 1540 UTC via tropo across the Gulf.

222 MHz

NØIRS (EM29) worked KC5GTT (EL09) December 6 at 1240 UTC on 222.100 MHz with 5×3 reports on tropo. NY2NY (FN30) worked W9RM (EN52) on the 13th and KN4OK (EM64) on the 14th via meteor scatter. KN4OK reports also working NDØB (EN07) in the Geminids shower. (Thanks *205 MorningReport.*) Jay, W9RM (EN52) focused on 222 MHz in the 2012 Geminids. "I was exclusively on 222 MHz and successfully worked NDØB and NTØV in ND, NY2NY in NY and had a partial with WA4NJP in GA, all on the evening *before* the peak. At the forecast peak on Thursday (December 13), I worked KN4OK in AL, N5OMG in LA and W4AS in EL95, south FL. The contacts with KN4OK and N5OMG were solid and quick with huge burns and the contact with W4AS, while tough, was a new distance record for me (1228 miles) and one of the longer contacts on 222 M/S in recent history. All in all, I worked three new states and five new grids on 222, all on WSJT FSK441. This year's Geminids was one of the best showers I've seen since the famous Leonid outbreak in 2002."



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030630 26.6  680  3 26  -74    3 W5UWB ND0B W5UWB ND0B W5UWB ND0B W5UWB
030430 28.2  840  4 26  -73    ND0B W5UWB ND0B W5UWB ND0B W5UWB ND0B W5
031030  2.3  100  2 16    1    3 ND0B W5UWB ND0B
031030  1.9  100  2 16   -2     ND0B W5UWB ND0B
031330  2.1   20  0 00   22 R26                                          1
031530  4.5   20  0 00   22 R26                                          2
031930 21.6   20 -1 00   32 73                                           2
```

To radio: W5UWB
Grid: EL17ax
Az: 176 El: 1 1353 mi
S 1
Tol 400
Rpt 26
Dsec 0.0
W5UWB ND0B
W5UWB ND0B 26
R26
RRR
73
CQ ND0B
Freeze DF: 0 Rx noise: 1 dB T/R Period: 30 s

Figure 3 — This is a WSJT screen shot of NDØB's 222 MHz meteor scatter contact with W5UWB on December 10. [William Ockert, NDØB, photo]

Figure 4 — W5UWB's 222 MHz antenna array for the record breaking 222 MHz m/s contact on December 14. The bottom antenna is a 17 el 2 meter (recently replaced with a 21 el 8wl). The middle antenna is the 222 17 el at 54 feet. The top antenna is ½ of the 11 element 222 with which he set the E_s record by contacting W6QIW on February 14, 2000. [John Butrovich, W5UWB, photo]

New 222 MHz Meteor Scatter Record Claimed

John, W5UWB (EL17), and Bill, NDØB (EN07), completed a WSJT meteor scatter contact at 0319 UTC on December 10 (see Figure 3 and 4). The distance is about 2177 km, subject to verification by Al Ward, W5LUA, who maintains the records. The existing 222 MHz North American meteor scatter record is: 2153 km K5VH (EM00xe)-VE3AX (FN02cw) 19-Nov-2002.

Bill has been on WSJT meteor scatter for only 1½ years. John runs 1500 W from an FT-2000 with a DEMI 222-28 transverter, which uses a 10 MHz referance for stability.

432 MHz

K5SW (EM25) worked K5LLL (EM10) on tropo the 6th. Rick, WØRT (EM27) worked Sam, K5SW, on December 29 with marginal signals on 432 MHz SSB.

1296 MHz

Sam, K5SW (EM25) logged K5LLL (EM10) on December 6 during the tropo opening.

Here and There

VK6JJJ will be active from Mawson station, Mac Robertson Land, Antarctica January 2013-January 2014 as VKØJJJ. He will be active on 6 meter SSB and digital modes. He plans to install a beacon operating on 50.300 MHz, which will use dual/stacked M^2 HO loop antennas with 3 meter spacing, the same used at VK3RMV (**www.qrz.com/db/VK3RMV**). QSL via VK3ZAZ. Thanks VK3ZAZ and the *205 MorningReport*.

Bo, SM7FJE, recently completed his Worked All States on 50 MHz. Rich, K7TNT, in Wyoming was state # 50 for Bo via EME. The only other European stations I am aware of as having achieved WAS on 6 meters are ON4IQ and G4IGO. Congratulations to Bo on an extremely difficult operating achievement. Bo's Kansas contacts were with WØEKZ and NØKQY.

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!

Feb 16-Feb 17, 1600Z-2100Z, K4US, Mount Vernon, VA. Mount Vernon Amateur Radio Club. George Washington Special Event. 14.240 7.240 7.036. Certificate. Mount Vernon Amateur Radio Club, Box 7234, Alexandria, VA 22307. **www.mvarc.org**

Feb 22-Feb 26, 1800Z-1800Z, W5D, Big Bend National Park, TX. DL89 Activation (Big Bend National Park). 50.290 50.170. QSL. Jason Merry, W5IPA, 6341 Megan Cir, Corpus Christi, TX 78414. *Activating DL89 on 6 meters.*

Feb 24-Feb 25, 1500Z-0059Z, W4C, Raleigh, NC. Raleigh Amateur Radio Society. North Carolina QSO Party. 146.580 14.260 7.260 3.860. Certificate. Marc Sullivan, 322 Windham Way, Clayton, NC 27527. *Operating as an Expedition Station from Dare County, NC, a bonus QTH, during the NC QSO Party.* **www.ncqsoparty.org**

Mar 1-Mar 3, 1800Z-1800Z, K2O, Branson, MO. Tri-Lakes Amateur Radio Club. Showboat *Branson Belle*. 28.477 21.277 14.227 7.178. Certificate.* Don McMahon, Senior Captain, QSL Special Event, 4800 State Hwy 165, Branson, MO 65616. *20th anniversary of the Showboat* Branson Belle *keel laying.* **n7bd@arrl.net** *(SBB Event in subject line) or* **sbbevent.com**

Mar 2, 1300Z-2100Z, W8VP, Cambridge, OH. Cambridge Amateur Radio Association. 210th Anniversary of Ohio Statehood. 14.260 7.235. Certificate & QSL. Cambridge Amateur Radio Association, PO Box 1804, Cambridge, OH 43725. *3rd Special Event in CARA's year-long 100th Birthday Celebration. Certificate for anyone who works all 12 of CARA's monthly 2013 Special Events.* **www.w8vp.org**

Mar 2, 1400Z-2200Z, K1SV, Bennington, VT. Southern Vermont Amateur Radio Club. 222 Year Anniversary of Vermont Statehood. 14.186 7.140 3.806. QSL. Randy Gates, 14 Mattison Rd, Pownal, VT 05261. *Frequencies will move as band conditions change.* **www.sovarc.org**

Mar 8-Mar 10, 2000Z-0200Z, WW7RC, Seattle, WA. American Red Cross Chapter of King and Kitsap Counties. National American Red Cross Month Special Event. 14.260 14.255 7.245 7.190. QSL. Tim Myers, KK7TM, 6326 247th Ave NE, Redmond, WA 98053. *Showcasing our Disaster Services Technology Amateur Radio Operators that provide a vital communication link in disasters.* **kk7tm@arrl.net**

Mar 9, 1700Z-2359Z, NI6IW, San Diego, CA. USS *Midway* (CV-41) Museum. Navy Seabees Birthday, Girl Scouts of America Founded 1912. SSB 14.320 7.250 PSK31 14.070 D-STAR 012C. QSL. USS *Midway* Museum Radio Room, 910 N Harbor Dr, San Diego, CA 92101.

Mar 9-Mar 10, 1400Z-2200Z, WM3PEN, Philadelphia, PA. Holmesburg Amateur Radio Club. Pennsylvania Charter Day. 14.265 7.190. QSL. HARC, 3341 Sheffield Ave, Philadelphia, PA 19136. **www.harcnet.org**

Mar 9-Mar 17, 0000Z-2359Z, K0KKV, Lincoln, NE. Lincoln Amateur Radio Club Inc. 60th Anniversary of the Lincoln Amateur Radio Club & Nebraska State ARRL Convention. 14.295 7.282 3.982. QSL. Lincoln Amateur Radio Club, PO Box 5006, Lincoln, NE 68505. **k0kkv.org**

Mar 15-Mar 16, 1600Z-2000Z, N9L, Indianapolis, IN. The American Legion Amateur Radio Club. The American Legion 94th Birthday. 14.270. Certificate. The American Legion Amateur Radio Club, The American Legion National Headquarters, 700 N Pennsylvania St, Indianapolis, IN 46204. *CW ops may be conducted on 21.040 intermittently, conditions permitting.* **www.legion.org/hamradio**

Mar 15-Mar 17, 1500Z-2200Z, W5G, Goliad, TX. Goliad County Amateur Radio Operators. 264th Anniversary of the Founding of Goliad. SSB CW all HF frequencies. QSL. Skip Stem, WB4DAD, 655 N Loop 337 #405, New Braunfels, TX 78130. *Operating in conjunction with the Goliad County Fair.*

Mar 16, 1330Z-2130Z, W4W, West Palm Beach, FL. Wellington Radio Club. Celebrate Wellington. 21.260 14.260 7.160 EchoLink WB2NBU. QSL. Georg Samulkewitsch, K4WRC, 12190 Broadleaf Ct, West Palm Beach, FL 33414. *Commemorating the founding of Wellington, FL, the World's Winter Polo and Equestrian Capital in 1996.* **qsl.net/k4wrc**

Mar 16, 1400Z-2000Z, W4BKM, Macon, GA. Macon Amateur Radio Club. 31st Annual Cherry Blossom Festival. 14.240 7.225 145.37. Certificate. MARC, PO Box 4862, Macon, GA 31208. **w4bkm.com**

Mar 16-Mar 17, 1300Z-2000Z, N4G, Greensboro, NC. Greensboro Amateur Radio Association. Battle of Guilford Courthouse Commemoration. 21.322 14.322 7.232 3.900. Certificate & QSL. Greensboro Amateur Radio Association/N4G, PO Box 7054, Greensboro, NC 27417. **www.w4gso.org/n4g**

Mar 23, 1300Z-2100Z, KE4HAM, Bluffton, SC. Sun City Hilton Head Amateur Radio Club. The Burning of Bluffton in 1863. 28.400 21.300 14.250 7.250. Certificate. KE4HAM, 19 Rose Bush Ln, Bluffton, SC 29909.

Mar 23, 1600Z-2000Z, KA4CSG, Dothan, AL. GMC Motorhome International. GMC Motorhome Rally. 28.400. QSL. Thomas Phipps, PO Box 820228, Vicksburg, MS 39182. *Other frequencies possible as operators become available.*

Mar 24-Mar 29, 0900Z-2000Z, GB5CT, Wimborne, Dorset, England. Radio Society of Great Britain. Chalbury Shutter Telegraph Over 200 Years. 14.300 21.300 7.190. QSL. RSGB buro or direct to John Wakefield, 'Oakhurst,' Lower Common Rd, West Wellow, Romsey, Hampshire SO51 6BT, England. **www.qrz.com/db/gb5ct**

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 **May** *QST* would have to be received by **March 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 January 10. You can view all received Special Events at **www.arrl.org/special-event-stations**.

Strays

A Net for US Veterans

A weekly net of US military veterans meets on the 146.610 MHz repeater in Washington, DC, but the net also has national and global reach via EchoLink node 8421 (K3GMR-R). The net meets every Wednesday at 7:30 PM EST (0030 UTC) and is sponsored by the Green Mountain Repeater Association.

I would like to get in touch with . . .

…anyone who would have been a member of the TECHNY ham club in 1966-1967 at TECHNY Illinois. I think the club call sign was W9VLP. Greg Neiers, KC9TMX; **capt1951@hotmail.com**.

March 2013 W1AW Qualifying Runs

W1AW Qualifying Runs are held at 10 PM EST Friday, March 8 (0200Z March 9) and at 7 PM EST (2300Z) Tuesday, March 19. The West Coast Qualifying Runs will be transmitted by station K6KPH on 3581.5, 7047.5, 14047.5, 18097.5 and 21067.5 kHz at 2 PM PST (2100Z) Saturday, March 16. Unless indicated otherwise, sending speeds are from 10 to 35 WPM.

Amateur Radio World

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

RSGB Celebrates 100 Years

To celebrate its 100th anniversary, the Radio Society of Great Britain (RSGB) is planning many events during 2013. In addition to a construction contest and operating awards, a Special Event Station is already on the air. Ofcom — the British equivalent of the FCC — has agreed to allow the RSGB to use the Special Event Station call sign G*x*100RSGB, where *x* is replaced by the secondary location identifier, such as M, W, I, D, U and J. Due to the special nature of the call sign, hams and RSGB-affiliated clubs will operate the call at each RSGB Region in sequence throughout the year.

The RSGB is the second oldest national Amateur Radio Society, founded in 1913; HRH The Prince Philip, Duke of Edinburgh serves as its patron. The oldest national Amateur Radio Society — The Wireless Institute of Australia (WIA) — celebrated its centennial in 2010. The ARRL will celebrate its first 100 years in 2014. Find out more information on the RSGB's centennial plans, including the G*x*100RSGB operating schedule, at **www.rsgb.org/aboutrsgbrsgbcentenary2013/?id=rsgb-centenary-home**.

Delegates Meet in Ho Chi Minh City for IARU Region 3 Conference

Officials from 16 International Amateur Radio Union (IARU) Member Societies in Region 3 attended the IARU Region 3 15th Triennial Conference. Hosted by the Vietnam Amateur Radio Club (VARC), the conference took place November 5-9, 2012 in Ho Chi Minh City, Vietnam. Delegates from ARRL (USA), ARSI (India), BDRA (Brunei Darussalam), CRSA (China), CTARL (Chinese Taipei Amateur Radio League), HARTS (Hong Kong), JARL (Japan), KARL (Republic of Korea), MARTS (Malaysian Amateur Radio Transmitters' Society), NZART (New Zealand), ORARI (Indonesia), PARA (Philippine Amateur Radio Association), RAST (Thailand), SARTS (Singapore), VARC (Vietnam) and WIA (Australia) — were present. The Pitcairn Island Amateur Radio Association (PIARA) was represented via proxy by JARL.

IARU President Tim Ellam, VE6SH, and IARU Secretary Rod Stafford, W6ROD, represented the IARU. IARU Region 1 President Hans Blondeel Timmerman, PB2T, and Secretary Dennis Green, ZS4BS, represented IARU Region 1 at the conference, with IARU Region 2 President Reinaldo Leandro, YV5AM, and Secretary Ramon Santoyo, XE1KK, representing IARU Region 2. ARRL International Affairs Vice President Jay Bellows, K0QB, led the ARRL delegation. ARRL Chief Executive Officer David Sumner, K1ZZ, was also in attendance.

VARC Chairman Nguyen Minh Duc, 3W2REH, opened the conference. Ellam and Lake also participated in the conference's opening ceremony, paying tribute to former IARU Region 3 Chairman Michael Owen, VK3KI (SK), who passed away September 22, 2012.

At the conference, two Region 3 Member Societies submitted resolutions for increasing the number of Directors from the present five to six or seven, in order to provide greater representation from the Member Societies, and to be able to work on the many issues that need attention. Delegates to the conference agreed to increase the number of Region 3 Directors to six.

Consequent to the decision to elect six Directors, the following six nominations were received and declared elected, unopposed: Peter Lake, ZL2AZ (New Zealand), Joong Guen Rhee, HL1AQQ (South Korea), Shizuo Endo, JE1MUI (Japan), Geoff Atkinson, VK3TL (Australia), Wisnu Widjaja YB0AZ (Indonesia) and Gopal Madhavan, VU2GMN (India). The newly elected group of Directors then elected Madhavan as its Chairman. Katsumi (Ken) Yamamoto, JA1CJP, was returned unopposed as Secretary.

Two Working Groups were formed: one to focus on education, training, the development of Amateur Radio and international and regional conferences involving radio administrations, and another focusing on operational and technical matters, including emergency communications, the IARU Region 3 Award and band plans.

The Finance Committee was convened, and one of the major items for consideration was the possible increase in subscriptions, a subject that had been initiated at the 2009 conference in Christchurch. The delegates recognized the need for an increase, voting for an increase of 20 percent over the current IARU Region 3 subscription rates.

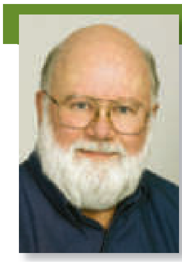
Delegates accepted a proposal from the WIA to sponsor and implement an annual award in memory of Michael Owen, VK3KI (SK). The award will be conferred upon the radio amateur who achieves the highest Region 3 individual score in the annual IARU HF Contest, held each year in July.

The next Region 3 conference, scheduled for 2015, will be hosted by ORARI and held in Jogjakarta in Central Java.

IARU Welcomes Two New Member Societies

In June 2012, the IARU notified its Member Societies that two new national Amateur Radio organizations wished to join the IARU and would need to be voted in: the Federation of Radio Sport of Azerbaijan (FRSA) and the St Vincent and the Grenadines Amateur Radio Club (SVGARC). Ballots from all the Member Societies that responded were counted on November 1.

Based in Baku, Azerbaijan, the FRSA was formally organized on December 30, 2001. There are 50 licensed members of the FRSA out of a total amateur population of approximately 50 in Azerbaijan. The SVGARC is based in St Vincent, St Vincent and the Grenadines and was formally organized in 1951. There are 21 licensed members of the SVGARC, out of a total amateur population of approximately 134 in the country. Both organizations have confirmed to the IARU that they have the ability to meet financial obligations as an IARU member, are legally able to act in the furtherance of IARU objectives within their respective countries and will adhere to the Constitutions of both the IARU and its respective Regional Organization. With the addition of FRSA and SVGARC, there are now more than 160 IARU Member Societies.



Vintage Radio

John Dilks, K2TQN, k2tqn@arrl.org

PR-35 Spy Radio

Bob Allison, WB1GCM, receives a piece of covert communications history as a gift.

I'm honored to be guest author of this month's Vintage Radio column. You may recognize me as the gent at the ARRL® Laboratory who tests modern Amateur Radio equipment for our monthly "Product Review" column. Back at my shack, I enjoy modern equipment and communication methods, but I also enjoy vintage equipment. Collecting technology is fun and educational, especially the latter. It's also gratifying to share historical information, so I'm pleased that John Dilks is allowing me to share a most interesting Christmas present with you.

I have a long time friend in Germany who likes to trade technological antiques with me. Sometimes, he sends me something really strange that's radio related, from either side of the old Iron Curtain. Last year, he sent me a surprise Christmas gift — two units that reminded me of the wireless microphones used in TV broadcasting during the 1970s. A crude manual, written in German, was included. I determined they were not broadcast relics, but a sinister Iron Curtain artifact: A pair of PR-35 surveillance transceivers; also known as "Stasi Radios."[1]

High-tech 1977

This three channel, crystal controlled FM transceiver was introduced in 1977 by the Tesla company in Czechoslovakia and was used by the secret police of the former German Democratic Republic (East Germany). Measuring about 7.2 inches tall, 3.2 inches wide and a thin 0.75 inches thick, this device was intended for covert operations. The PR-35 could easily be concealed under a person's clothing with the microphone and speaker tucked away in a coat collar. Though a standard helical antenna is supplied with the unit, a wire antenna, sewed into a garment, served as an antenna when these radios were actually put to use. The look of the PR-35 itself is typical of other late 1970s modern technology (see Figure 1).

Imagine this device as a typical amateur handheld transceiver. There are three controls, an antenna jack and the accessory jack, all located at the top (see Figure 2). The control at left turns the transceiver on and has four positions, O/K/N/T (Off, Traffic, Selective Call, Silent Call). Interestingly, in the silent call mode, an incoming call activates an external vibrator, not unlike today's cell phones. With its 2 foot cord, this 3 inch long, narrow, rather plain device, with no controls or markings, mystified me until I deciphered the wiring diagram in the manual. The application of a vibrator 36 years ago is particularly interesting — perhaps this technology led to the cell phone vibrator years later.

The second control is used to select one of three frequency channels. Between the channel selector and the antenna is a small recessed control for the squelch that must be adjusted with a small screwdriver. The antenna connector is of a female variety, unlike anything I've seen before. At the top right is the accessory jack for the vibrator, PTT, speaker and microphone. The PTT and volume controls are on a separate control shell that is concealed up a shirt sleeve, allowing the user to key the transmitter with the index finger and adjust the volume control with the thumb.

A 6 V rechargeable battery pack slides on sideways at the bottom of the unit. It has a 225 mAh capacity; enough to get through an evening of being sneaky. A larger, heavier battery pack hiding in an overcoat would make spying obvious. Current consumption is 300 mA transmit, 60 mA receive and 10 mA in standby mode. Power output is 300 mW, with an audio output of 80 mW. The battery must be removed for charging with the included battery charger. By the looks of it, the battery pack's four 1.5 V corroded cells can be easily replaced with a modern equivalent. Overall weight is 1 lb. Though this column is

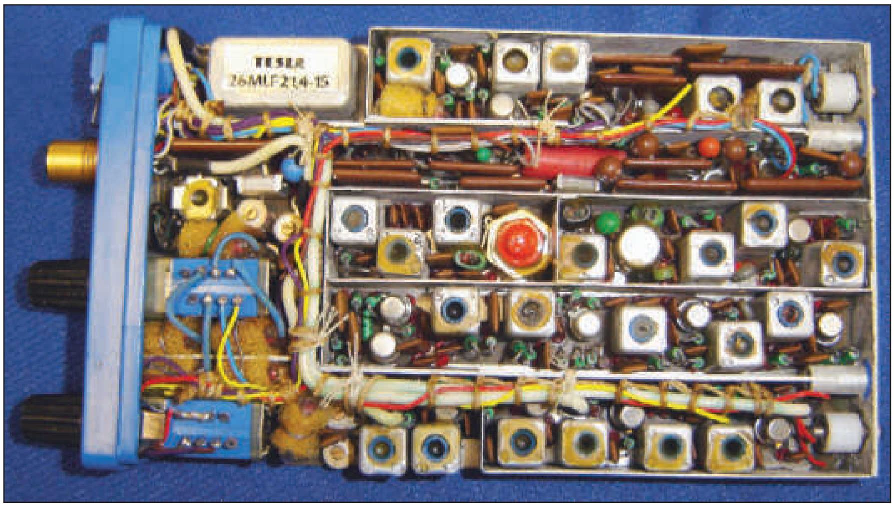


Figure 1 — With the cover removed the PR-35's compact construction is evident. The crystals are the yellow foam-covered components at the lower left. Converting the PR-35 to 2 meters would be a tough soldering job.

Figure 2 — This is a top view of the PR-35. From the left are the function control, channel selector, squelch control, antenna connector and accessory connector.

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[1] www.cryptomuseum.com/spy/index.htm

Table 1
PR-35 Data Table (Manufacturer's Specifications)

Specification (German)	Value	Specification (English)
Nennspeisespannung	6 V dc	Nominal Supply Voltage
Zugelassener Betriebsspannungabereich	5 to 7 V dc	Approved Operating Voltage
Stromaufnahme /Orientierungsangaben/Senden	300 mA	Transmit Current
Empfang /NF Ausgang (80 mW)	60 mA	Nominal Audio Current
Ohne Signal, unterdricktes Rauschen	10 mA	No Signal, Noise-Suppressed
Bereitschaft/Stellung N oder T, ohne Anzeire	8 mA	Ready position, N or D, Display Off
Frequenzband	160 MHz	Frequency Band
Anzahl der HF Kanale	3	Number of RF Channels
Betriebsart	F3, Simplex	Operating Mode
Frequenzbub	± 5 kHz	Deviation
Anruf – durch Ton	1750 Hz	Tone Code
HF Leistung des Senders	300 mW	RF Output Power
Empfindlichkeit des Empfangers/fur 20 dB S/R	1 µV	Receiver Sensitivity 20 dB S/N
NF Leistung des Empfangers	80 mW; k ≤ 10%	Receiver NF Performance
Abmessungen /Great mit Batterie	188 × 79 × 19 mm	Dimensions with Battery
Masse /Great mit Batterie	455 g	Weight with Battery
Betriebatemperaturbereich	–10 to +55˚C	Operating Temperature Range
Batteriekapazitat	225 mA	Battery Capacity

Figure 3 — One of the PR-35 units in its original packaging.

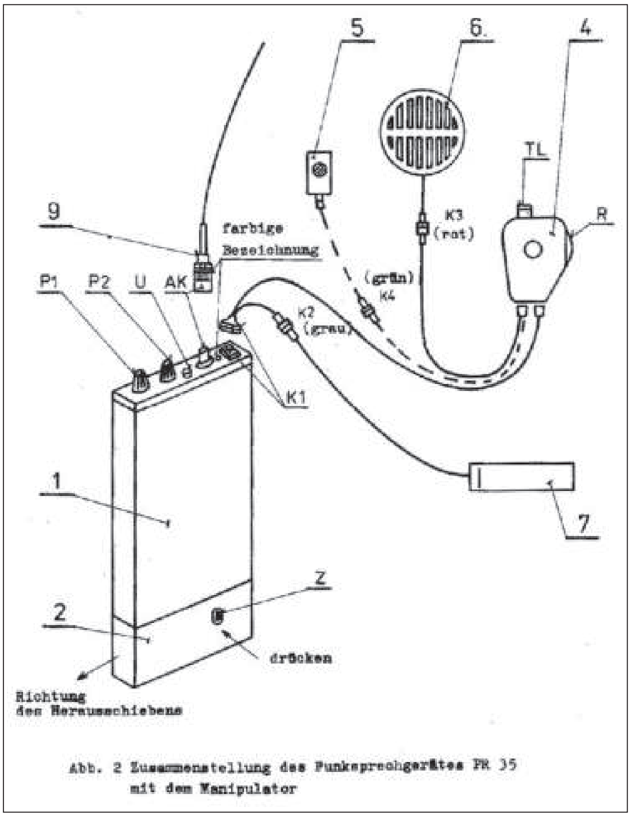


Figure 4 — A pictorial diagram showing how the PR-35 was connected for its intended covert operations.

not intended to be a product review, I hope readers will enjoy the data table (Table 1) — in both German and English.

Covert Communications

Each transceiver came in its original plastic packing, (see Figure 3) which was badly deteriorated after 35 years, but the overall condition of one transceiver unit is excellent and the other is good. Both look like they would work with the proper voltage applied. One unit came with a rather crude paper manual that included a wiring diagram showing how the various units were connected. (see Figure 4). The first page of the manual contained a line of instructions that is sometimes still not followed by many people in this day and age: "The user of this transceiver must read the instructions first before operation!"

Each PR-35 is designed to transmit FM simplex within one of three VHF ranges — either 152, 160 or 166 MHz. I'm tempted to re-crystal it to operate in the 2 meter band, but I'd have to ensure that the PR-35 would meet FCC Part 97 emission standards.

Though not powerful, a PR-35 could be used on 2 meter simplex with a Yagi antenna or for very local communications with the supplied antennas. Imagine getting on the air and saying, "Rig here is an Eastern Bloc spy radio!" I can imagine making this contact with my spouse, Kathy, at a local flea market: "Psst… KA1RWY, this is WB1GCM…I have found the high-wave adapter for the IP-501 at the east end of the flea market. Proceed in a calm manner, with funding."

All photos by Bob Allison, WB1GCM.

Bob Allison, WB1GCM, works in the ARRL laboratory as a test engineer and enjoys tinkering with historic radios. He can be reached at **wb1gcm@arrl.org**

Convention and Hamfest Calendar

Gail Iannone, giannone@arrl.org

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

ALABAMA SECTION CONVENTION

March 2-3, Birmingham
D F H Q R S T V

9 AM-4 PM. *Spr:* Birmingham ARC. Zamora Shrine Temple, 3521 Ratliff Rd. *TI:* 146.88 (88.5 Hz), D-STAR 145.41. *Adm:* $8. Tables: 6-ft $24, 8-ft $32. Bill Davidson, KW4J, 326 S Burbank Dr, Hoover, AL 35226; 205-587-1993; **bill.kw4j@charter.net**; **w4cue.com**.

Colorado (Longmont) — Apr 6 F H Q R V
8 AM-2 PM. *Spr:* Longmont ARC. Boulder County Fairgrounds Exhibit Building, 9595 Nelson Rd. *TI:* 147.27 (100 Hz). *Adm:* $5. Tables: $13. Gerald Schmidt, NØOUW, 1541 Judson Dr, Longmont, CO 80501; 303-772-6736; **nickijerry@comcast.net**; **w0eno.org**.

Connecticut (Dayville) — Mar 16 D F H R V
8 AM-noon. *Spr:* Eastern Connecticut ARA. St Joseph's Church Hall, 350 Hartford Pike. *TI:* 147.225 (156.7 Hz). *Adm:* $3. Tables: $10. Paul Rollinson, KE1LI, 182 Wrights Crossing Rd, Pomfret Center, CT 06259; 860-928-5147; fax 860-928-3844; **paulrollinson@sbcglobal.net**; **www.qsl.net/k1muj/**.

Connecticut (Southington) — Apr 7 D F H R S V
8 AM-noon. *Spr:* Southington ARA. Southington High School, 720 Pleasant St. *TI:* 147.345 (77 Hz). *Adm:* $5. Tables: advance $15, door $20. Norm Fusaro, W3IZ, 586 King St, Bristol, CT 06010; 860-584-1403; **w3iz@sbcglobal.net**; **www.chetbacon.com/sara.htm**.

Florida (Brooksville) — Feb 16 D H R T V
9 AM. *Spr:* Hernando County ARA. Sand Hill Scout Reservation, 11210 Cortez Blvd (Hwy 50). *TI:* 146.715. *Adm:* $6. Tables: $10. John Nejedlo, WB4NOD, 15430 Waxweed Ave, Spring Hill, FL 34610; 813-838-5432; **wb4nod@tampabay.rr.com**.

Florida (Fort Walton Beach) — Mar 15-16 D F H Q R S V
Friday 5-9 PM; Saturday 8 AM-3 PM. *Spr:* Playground ARC. C. H. "Bull" Rigdon Fairgrounds, 1958 Lewis Turner Blvd. *TI:* 146.79 (100 Hz). *Adm:* $6. Tables: $12. Paul Foster, WB8UNT, Box 873, Fort Walton Beach, FL 32549; 850-244-4490; **parcfest@w4zbb.org**; **www.w4zbb.org**.

Florida (Stuart) — Mar 16 D F H Q R S T V
7 AM-4 PM. *Spr:* Martin County ARA. Martin County Fairgrounds, 2616 SE Dixie Hwy. *TI:* 147.06 (107.2 Hz). *Adm:* Free. Tables: $15. Doug Shields, W4DAS, 1450 SE 11th St, Stuart, FL 34996; 772-349-7820; **w4das@arrl.net**; **www.stuarthamfest.com**.

Georgia (Dalton) — Feb 23 D H R T V
7 AM. *Spr:* Dalton ARC. North Georgia Fairgrounds, 500 Legion Dr. *TI:* 145.23 (141.3 Hz). *Adm:* $5. Tables: $10. David Stanley, WI4L, 3411 Riverbend Rd, Dalton, GA 30721; 706-537-5090; **w4drchamfest@yahoo.com**; **w4drc.webstarts.com**.

Georgia (Marietta) — Mar 16 D F H Q R S T V
8 AM-4 PM. *Spr:* Kennehoochee ARC. Jim Miller Park, 2245 Callaway Rd. 60th Annual Hamfest. *TI:* 146.88 (100 Hz). *Adm:* advance $5, door $7. Tables: $20. Ricky DeLuco, K4JTT, 4281 Moon Station Ln NW, Acworth, GA 30101; 770-833-2290; **hamfest@w4bti.org**; **www.w4bti.org/hamfest.html**.

Coming ARRL Conventions

February 15-16
Arizona State, Yuma*

February 16
Arkansas State, Hoxie*

February 23
Vermont State, South Burlington*

March 8-9
Louisiana Section, Rayne*
Oklahoma Section, Claremore*

March 2-3
Alabama Section, Birmingham

March 16
Nebraska State, Lincoln
West Texas Section, Midland

March 23
South Texas Section, Rosenberg
MicroHAMS Digital, Redmond, WA

March 29-30
Maine State, Lewiston

March 30
North Carolina State, Raleigh

April 13-14
Communications Academy, Seattle, WA

April 19-20
Southeastern VHF, Cocoa Beach, FL

April 19-21
International DX, Visalia, CA

April 20
Louisiana State, Monroe

April 26-28
Idaho State, Boise

May 4
South Carolina Section, Spartanburg

*See February *QST* for details.

Georgia (Thomasville) — Mar 30 D H R T V
8 AM. *Spr:* Thomasville ARC. Morningside United Methodist Church, 2007 Smith Ave. *TI:* 147.195 (141.3 Hz). *Adm:* Free. Tables: $5. Virgil Castleberry, KJ4ZNK, 1466 7th St NW, Cairo, GA 39828; 229-792-8091; **kj4znk@arrl.net**; **thomasvilleamateurradioclub.com/hamfest/**.

Indiana (Dugger) — Feb 23 F H R T V
7 AM-1 PM. *Spr:* Dugger ARC. Dugger Community Building, 776 S Hicum St. *TI:* 146.775 (136.5 Hz). *Adm:* $5. Tables: 1 free with admission; additional tables $1. Kyle Shipman, KB9ZGN, 7084 E Monroe St, Dugger, IN 47848; 812-648-2487; **kb9zgn@sbcglobal.net**.

Indiana (Terre Haute) — Mar 9 D F H S V
9 AM-1 PM. *Spr:* Wabash Valley ARA. Indiana State University Dede Activity Center, 500 N Fifth St. Hamfest and Computer Expo. *TI:* 146.685 (151.4 Hz). *Adm:* $7. Tables: Free. Kevin Berlen, K9HX, 308 W 4th St, Clay City, IN 47841; 812-239-9140; **k9hx@arrl.net**; **www.w9uuu.org**.

Iowa (Perry) — Feb 23 F H R V
7 AM-1 PM. *Spr:* Hiawatha ARC. Crossroads Church, 2810 1st Ave. *TI:* 145.19 (114.8 Hz). *Adm:* $5. Tables: $7 (half price for additional tables). Bob Dittert, NØQIX, 1722 1st Ave, Perry, IA 50220; 515-465-2383; fax 515-323-5445; **n0qix@arrl.net**; **www.harciowa.org**.

Kentucky (Elizabethtown) — Apr 6 D F H R S V
8 AM-2 PM. *Spr:* Lincoln Trail ARC. Elizabethtown Community College Campus, 630 College Street Rd. *TI:* 146.98. *Adm:* advance $5, door $6. Tables: $7. David Gregory, K4DCG, 426 Flat Rock Rd, Elizabethtown, KY 42701; 270-872-7634; **david.gregory@gmx.com**; **www.qsl.net/ltarc/**.

Louisiana (Kenner) — Apr 6 D F H Q R S V
8 AM-3 PM. *Spr:* Jefferson ARC. Woodlake Gymnasium, 131 W Esplanade Ave. *TI:* 146.86 (114.8 Hz). *Adm:* $5. Tables: $15. Keith Barnes, W5KB, 1014 Webb St, Franklinton, LA 70438; 504-289-1504; **w5kb@arrl.net**; **w5gad.org/home/hamfest**.

Louisiana (Springhill) — Mar 30 D F H R T
8 AM-2 PM. *Spr:* Springhill ARC. Frank Anthony Community Activity Center, 300 W Church St. *TI:* 146.73. *Adm:* Free. Tables: inside $5 (tailgating, bring your own tables). David Smith, K5ST, Box 812, Springhill, LA 71075; 318-382-4426; **k5st@arrl.net**.

MAINE STATE CONVENTION

March 29-30, Lewiston
D F H Q R S V

Friday 7-9 PM, Saturday 8 AM-noon. *Spr:* Androscoggin ARC. Ramada Inn Conference Center, 490 Pleasant St. "Andyfest." *TI:* 146.61. *Adm:* $7. Tables: advance $7, door $8 (Mar 30). Ivan Lazure, N1OXA, 440 Webber Ave, Lewiston, ME 04240; 207-784-0350; **n1oxa@arrl.net**; **www.w1npp.org**.

Maryland (Timonium) — Apr 6 D F H Q V
9 AM-4 PM. *Spr:* Baltimore ARC. Maryland State Fairgrounds, 2200 York Rd. 44th Annual Greater Baltimore Hamboree and Computerfest. *TI:* 146.67 (107.2 Hz). *Adm:* advance $8, door $9. Tables: $20 (basic indoor, plus admission, no table), $30 (flea market, plus admission, table and chair), $75 (commercial, pipe and drape). Sharon Dobson, K3DUH, Box 120, Reisterstown, MD 21136; 443-590-1444; **w3ft67@yahoo.com**; **www.gbhc.org**.

Massachusetts (Feeding Hills) — Mar 2 D F H R T V
Setup 6:30 AM; public 8:30 AM-1:30 PM. *Spr:* Mount Tom Amateur Repeater Assn. Springfield Turnverein Club, 176 Garden St. 25th Annual Hamfest. *TI:* 146.94 (127.3 Hz). *Adm:* $5. Tables: 8-ft $15; tailgating $10 per space. Mary Elkins, KB1ME, 24 Shoreline Dr, Ware, MA 01082; 413-222-1990; **kb1me@arrl.net**; **www.mtara.org**.

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

Massachusetts (Framingham) — Apr 7
D F H R V
9 AM-noon. *Spr:* Framingham ARA. Joseph P. Keefe Technical School, 750 Winter St. *TI:* 147.15. *Adm:* $5. Tables: 6-ft advance $20, door $25. Stephen Hewlett, KB1NIV, 44 Winter Park Rd, Framingham, MA 01702; 508-872-9336; **stevehewlett@verizon.net**; **www.fara.org/**.

Massachusetts (Marlborough) — Feb 16
D F H R V
Setup 6:30 AM; public 9 AM. *Spr:* Algonquin ARC. 1 Lt Charles W Whitcomb School (formerly Middle School), 25 Union St. *TI:* 147.27 (146.2 Hz). *Adm:* $5. Tables: advance $15, door $20. Timothy Ikeda, KA1OS, 7 Birchwood Rd, Hudson, MA 01749; 978-562-1594; **tpi.hormel@gmail.com**; **www.qsl.net/n1em/**.

Michigan (Lowell) — Mar 30 D F H R V
8 AM-noon. *Spr:* AR Group of Youth in Lowell. Lowell High School, 11700 Vergennes St. *TI:* 145.27, 146.62 (both 94.8 Hz). *Adm:* $5. Tables: 5-ft $9 (1 table and admission), $12 (2 tables and admission). Al Eckman, WW8WW, 725 Bowes Rd, Apt K6, Lowell, MI 49331; 616-450-4332; **al.eckman@comcast.net**; **www.argyl.org**.

Michigan (Marshall) — Mar 16 D H R V
8 AM-noon. *Spr:* Southern Michigan ARS. Marshall Activity Center, 15325 W Michigan Ave. 53rd Annual Michigan Crossroads Hamfest. *TI:* 146.66 (94.8 Hz). *Adm:* $5. Tables: $10. David Ashbolt, K8OLY, Box 934, Battle Creek, MI 49016; 269-223-7141; **crossroadshamfest@gmail.com**; **www.w8df.com**.

Minnesota (Buffalo) — Mar 23 D F H R V
8 AM-1 PM. *Spr:* Maple Grove RC. Buffalo Civic Center, 1306 County Rd 134. 32nd Annual Midwinter Madness Hobby Electronics Show. *TI:* 147.0. *Adm:* $8. Tables: $25. Jerry Dorf, N0FWG, Box 22613, Robbinsdale, MN 55422; 763-537-1722; **k0ltc@k0ltc.org**; **www.k0ltc.org**.

Minnesota (St Cloud) — Feb 16 D F H R V
9 AM-1 PM. *Spr:* St Cloud ARC. National Guard Armory, 1710 Veterans Dr. *TI:* 147.015. *Adm:* $7. Tables: $16 ($8 with your own table). Art Carlson, WA0NJR, 2707 15th St N, St Cloud, MN 56303; 320-252-0801; **wa0njr@hotmail.com**; **www.w0sv.org**.

NEBRASKA STATE CONVENTION

March 16, Lincoln
D F H Q R S V
8 AM-3 PM. *Spr:* Lincoln ARC. Lancaster Event Center, 4100 N 84th St. "End of Winter Hamfest," on-going Tech Demos, RV parking. *TI:* 146.76. *Adm:* $8 (non-member), $5 (member). Tables: advance $10 (by Mar 1), $20 (after midnight Mar 1). Reynolds Davis, K0GND, 3901 S 42nd St, Lincoln, NE 68506; 402-488-3706; **k0gnd@arrl.net**; **lincolnhamfest.org**.

New Hampshire (Henniker) — Mar 10
D F H R S V
8 AM-2 PM. *Spr:* Contoocook Valley RC. Henniker Community School, 51 Western Ave. *TI:* 146.895 (100 Hz). *Adm:* $3. Tables: $10. Donald Curtis, N1ZIH, 353 N State St, Concord, NH 03301; 603-651-8000; **n1zih@comcast.net**; **www.k1bke.org**.

New Jersey (Township of Washington) — Mar 3 H R (Auction)
Noon-4 PM. *Spr:* Bergen ARA. Westwood Regional High School, 701 Ridgewood Rd. *TI:* 146.79 (141.3 Hz). *Adm:* Free. Jim Joyce, K2ZO, 286 Ridgewood Blvd N, Township of Washington, NJ 07676; 201-664-6725; **k2zo@arrl.net**; **bara.org**.

NORTH CAROLINA STATE CONVENTION

March 30, Raleigh
D F H Q S V
8 AM-3:30 PM. *Spr:* Raleigh ARS. North Carolina State Fairgrounds, Jim Graham Bldg, 1025 Blue Ridge Rd. 41st Annual RARS*Fest*; Special Event Station W4DW; construction projects; youth lounge; GO KIT contest; foxhunt; ARRL Emergency Preparedness Manager Mike Corey, KI1U; full RV hookups. *TI:* 146.64, backup 146.88. *Adm:* advance $7 (by Mar 23), door $8 (or after Mar 23). Tables: $20. Chuck Littlewood, K4HF, 2005 Quail Ridge Rd, Raleigh, NC 27609; 919-872-6555; **k4hf@arrl.net**; **www.rars.org/hamfest**.

North Dakota (Bismarck) — Feb 23
F H R S V
8 AM-3 PM. *Spr:* Central Dakota ARC. St Mary's Grade School, 807 E Thayer Ave. 23rd Annual Hamfest. *TI:* 146.85. *Adm:* advance $6, door $7. Tables: $5. Dick Veal, KA0ETO, Box 7162, Bismarck, ND 58507; 701-223-7481; **georgerv@bis.midco.net**.

Ohio (Gallipolis) — Mar 23 D F H R T V
8 AM-noon. *Spr:* Mid-Ohio Valley ARC. Gallipolis Christian Church, 4486 Ohio SR 588. *TI:* 147.06, 442.0 (both 74.4 Hz). *Adm:* advance $5, door $8. Tables: $25. Matt Gregg, KD8OMT, Box 811, Mason, WV 25260; 304-919-3068; **kd8omt@gmail.com**; **sites.google.com/site/midohiovalleyarc**.

Ohio (Perrysburg) — Mar 17 D F H R S V
8 AM-2 PM. *Spr:* Toledo Mobile Radio Assn. Owens Community College, 30335 Oregon Rd. 58th TMRA Radio/Computer/Electronics Hamfest. *TI:* 147.27 (103.5 Hz). *Adm:* $6. Tables: $20 (regular), $25 (wall). Brian Harrington, WD8MXR, 4463 Holly Hill Dr, Toledo, OH 43614; 419-385-5624; fax 419-383-5880; **wd8mxr@gmail.com**; **www.tmrahamradio.org**.

Ontario (Brampton) — Mar 23. Mark Pulciani, VA3MPT, **va3mpt@rogers.com**; **ham-ex.ca**.

Tennessee (Union City) — Mar 23
D F H Q R S T V
7 AM-2 PM. *Spr:* Reelfoot ARC. Tennessee National Guard Armory, 2017 E Reelfoot Ave. *TI:* 146.7 (100 Hz). *Adm:* $5. Tables: Free (request in advance). Bob Miles, K9IL, 113 Greenacres Dr, Martin, TN 38237; 731-588-2840; **greenacres113@charter.net**; **www.reelfootarc.com**.

Texas (Georgetown) — Mar 16 D F H R V
9 AM-4 PM. *Spr:* Williamson County ARC. San Gabriel Park Community Center, 445 E Morrow St. *TI:* 146.64 (162.2 Hz). *Adm:* $2. Tables: $8. Rick Trommer, W5NR, 302 Rio Bravo Rd, Georgetown, TX 78628; 512-863-2428; **w5nr@arrl.net**; **wcarc.com**.

Texas (Longview) — Apr 6 D H R S T
7:30 AM-11 AM. *Sprs:* Longview East Texas ARC and LeTourneau University ARC. LeTourneau University, 2100 S Mobberly Ave. *TI:* 147.34 (136.5 Hz). *Adm:* Free. Todd Hoover, N5TJH, 7 Shady Ln, Longview, TX 75604; 903-399-3266; **hoover_tj@yahoo.com**; **letarc.org**.

WEST TEXAS SECTION CONVENTION

March 16, Midland
D F H Q R S T V
8 AM-2:30 PM. *Spr:* Midland ARC. Midland County Horseshoe Arena, 2514 Arena Tr. 58th Annual St Patrick's Day Hamfest, RV Hookups. *TI:* 147.3. *Adm:* advance $8, door $9. Tables: $10. John Wilder, WA5PFJ, 4405 Lennox Dr, Midland, TX 79707; 432-262-4682; **wa5pfj@grandecom.net**; **hamfest.w5qgg.org**.

SOUTH TEXAS SECTION CONVENTION

March 23, Rosenberg
D F H Q R S T V
8 AM-2 PM. *Spr:* Brazos Valley ARC. Fort Bend County Fairgrounds, 4200 Hwy 36. 12th Annual Greater Houston Hamfest; emergency vehicles and displays; Special Event Station; equipment test station; ARRL *QST* Contributing Editor Ward Silver, N0AX; foxhunt; RV camping. *TI:* 146.94 (167.9 Hz). *Adm:* $5. Tables: $15 ($5 extra for power). Kirk Kendrick, KK2Z, Box 2997, Sugar Land, TX 77487; 281-639-5088; fax 713-270-4625; **kk2z@arrl.net**; **www.houstonhamfest.org**.

Texas (Weatherford) — Mar 23 D F H R T V
7 AM-noon. ARC of Parker County. Couts Memorial Methodist Church, 802 N Elm St. *TI:* 147.04 (110.9 Hz). *Adm:* advance $4, door $5. Tables: $10. Elizabeth Hunkele, N5ONE, 1507 Old Garner Rd, Weatherford, TX 76088; 817-594-1700; **eliz@mesh.net**; **www.w5pc.org**.

MICROHAMS DIGITAL CONFERENCE

March 23, Redmond, WA
H R S
9 AM-5 PM. *Spr:* MicroHAMS Radio Club. Microsoft Main Campus, One Microsoft Way. 6th Annual Event, talks covering the full spectrum of digital ham radio. *TI:* 146.58. *Adm:* advance $45, door $55. Kenny Richards, KU7M, 12522 SE 75th Pl, Newcastle, WA 98056; 206-266-7827; **ku7mradio@gmail.com**; **www.microhams.com/mhdc**.

West Virginia (Charleston) — Mar 16
D H Q R S T V
9 AM-2 PM. *Sprs:* Charleston Hamfest Committee and Kanawha ARC. Coonskin Armory, 1707 Coonskin Dr. 29th Annual Charleston Hamfest and Computer Show. *TI:* 145.35 (91.5 Hz). *Adm:* $6. Tables: $6. David Ellis, WA8WV, 610 Hillsdale Dr, Charleston, WV 25302; **wa8wv@aol.com**.

West Virginia (Oak Hill) — Feb 16
D H R T V
8 AM-2 PM. *Spr:* Plateau ARA. Lewis Community Center, 469 Central Ave. *TI:* 146.79 (100 Hz). *Adm:* $5. Tables: $10 ($5 extra for power). Charles Hardy, WV8CH, 1203 Bachman Rd, Fayetteville, WV 25840; 304-719-2241; **wv8ch@arrl.net**; **www.parawv.com**.

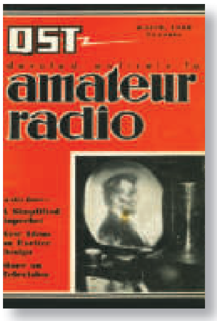
Wisconsin (Jefferson) — Mar 17 D H R V
8 AM-noon. *Spr:* Tri-County ARC. Jefferson County Fairgrounds Activity Center, 503 N Jackson Ave. *TI:* 145.49 (123 Hz). *Adm:* $5. Tables: advance 8-ft $8, door $10. Stan Lichtenberg, W9FIB, W3290 US Hwy 18, Helenville, WI 53137; 920-390-9068; **hamfest@w9mqb.org**; **www.w9mqb.org/**.

Wisconsin (Milwaukee) — Apr 5-6
D H Q R S V
Friday 2-6 PM; Saturday 8:30 AM-3 PM. *Spr:* Amateur Electronic Supply. AES Milwaukee, 5710 W Good Hope Rd. AES Superfest 2013. Special guests Gordon West and Bob Heil. *TI:* 145.130/144.530 (127.3 Hz); D-STAR 442.46875. *Adm:* Free. Tables: Free. Ray Grenier, K9KHW, 5710 W Good Hope Rd, Milwaukee, WI 53223; 414-881-3528; **rayk9khw@aol.com**; **www.aesham.com**.

75, 50 and 25 Years Ago

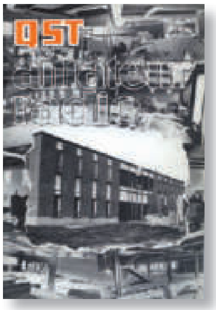
Al Brogdon, W1AB

March 1938



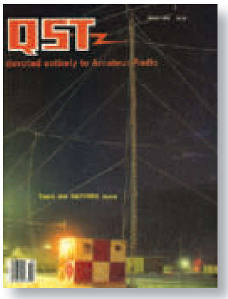
- The cover photo shows a sketch of Abraham Lincoln as received on a television set.
- The editorial addresses the League's recent work in their organization of amateur emergency-response efforts.
- "CQ WCFT," by Alan Eurich, W8IGQ, spins the fascinating tale of his being the radio operator aboard the schooner *Yankee* in 1936, as it sailed to circumnavigate the globe.
- By Goodman, W1JPE, describes how to build "A Double-Regenerative Superhet" at low cost that has good stability and selectivity.
- Ken Miles and J.L.A. McLaughlin (both of the Hallicrafters Company) discuss "The Infinite Rejection Principle Applied to Image Attenuation" in superhet receivers.
- James Millen, W1HRX, tells about his "New Approach to Amateur Transmitter Design."
- In "Compact Construction with High Power," T. M. Ferrill, W5CJB, provides details on his new homebrew 500 watt 'phone/c.w. transmitter.
- Marshall Wilder, W2KJL, describes "A Universal Test Unit for the Study of Television Images."
- "A Pack Set for 200 and 300 Megacycles," by L. C. Sigmon, W9YMJ, reports on his portable transmitters that are built using acorn tubes.

March 1963



- The cover photo shows the new yet-unfinished ARRL HQ building in Newington, a major work in progress.
- The editorial discusses the League's efforts at bringing new hams up to the technical level common among our old-timers.
- Ted Crosby, W6TC, presents "The HRB-8 Communications Receiver," a simpler (but expandable) design based on his popular HBR-16 receiver (which was described in *QST* in October 1959).
- George Grammer, W1DF, gives us Part I, "Energy Storage and Reactance," of his new series, "A.C. in Radio Circuits."
- Lew McCoy, W1ICP, asks "Have You Received an FCC QSL?" then tells us how to keep our harmonics at home and avoid that dreaded pink slip.
- In Part II of "Pulse: A Practical Technique for Amateur Microwave Work," Robert Guba, W1QMN, and John Zimmer, W2BVU, discuss pulse modulators.
- To write "DX, Where Is Thy Choice Location?" Ned Culler, W3JW, did a statistical study of DXers in the 10 US call areas. Ned discovered that, contrary to popular opinion, W6s do *not* work all the DX.
- George Grammer, W1DF, shows us how to go about "Checking Signal Quality with the Receiver" with a very simple setup.
- "The Chartreuse Panels," by ham humorist John Troster, W6ISQ, transcribes a QSO between two modern-day hams. You can almost believe the tale…

March 1988



- The cover photo shows one of the base stations of the SKITREK team, which is soon to trek on skis from Russia to Canada via a polar route.
- The editorial discusses a recent and ludicrous request to the FCC for an allocation in the 220 MHz ham band for system to relay TV viewers' comments to a central facility. The petitioner launched a PR effort and provided form letters for people to send to the FCC in envelopes marked "Postage will be paid by addressee." Yes, the FCC got a huge bill from the USPS!
- John Grebenkemper, KI6WX, presents Part 1 of "Phase Noise and Its Effects on Amateur Communications."
- "The Cordless Phone Link," built by Brian Brachel, KA8HLI, is a simplistic device to link an ordinary cordless phone to his 2 meter rig, so he can be on the air while painting his house.
- Doug DeMaw, W1FB, tells us how to build multiband loops, in "Transmitting Loops Revisited."
- Jim Neu, W8RJI, discusses what he has been up to in "Hidden Antennas—One Ham's Solution."
- V. Efremov, UA3-170-9. Secretary of the Radio Sport Federation of the USSR, describes "Radiosport in the USSR."

Field Organization Reports

DECEMBER 2012

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 are at this web page: **www.arrl.org/public-service-honor-roll**.

425
KT2D

345
K0IBS

327
WM2C

325
WE2G

310
WS6P

298
N8FVM

297
WB8R

272
WB9YBI

257
W2MTA

248
WD8USA

235
KB2ETO

233
KC5ZGG

205
W4SEE
KK4LSL

201
WB9FHP

200
KB5SDU

199
WB8RCR

197
K2HAT

196
WA2BSS

195
KA2ZNZ

190
KE5HYW
K7OAH

179
K2ABX
KB2KOJ

175
N8OSL

165
WB9WKO

164
KD7OED

160
W5DY
KG0GG
N7CM
K7EAJ

156
N9WLW

155
WV8CH
KJ4JPE
W4DNA

150
WK4P
N1UMJ

145
WB4ZIQ
KB2RTZ

140
K7BFL
KK3F
KB2BAA

137
W7JSW

135
N8IO
W3YVQ

132
KE5YTA

130
N9VC
K6JT
W8DJG
W7EKB
W9BGJ
WB2FTX
K4IWW
WI2G
KW1U
K2TV

128
KF7PDV

127
KJ4G

125
N2JBA
N2GJ
AK4RJ

122
N2DW

120
NN7H
KE4CB
KA4FZI
K6HTN
K6FRG
AG9G
KT5SR
KF5IOU
N5TMC
K4GK
WB6OTS
KB8RCR
WB8WKQ
NA7G

117
K0LQB

116
KK4BVR
KC2SFU

115
K9LGU

113
W2DWR
K4BEH

112
KB5PGY

110
K1PJS
W7QM
W7GB
NX9K
KC5OZT
WA3EZN
WA5LOU
N5NVP
KA1G
K4BG
W2EAG
KB1RGQ
KB1NMO
N7XG
N7YSS
N2WKT
N1IQI
K8RDN
K8VFZ
AA2SV
N7IE

109
KK5NU

106
NA9L

105
W9WXN
N3RB
KF7GC

103
K4JUU

100
K0VTT
K4SCL
N9VT
N5OUJ
WB8HHZ
WB8SIQ
WG8Z
WD8Q
K3RC
KD8HSV
KB5KKT
N1JX
N3SW
W3TWV
NU8K
KJ4RUD
W4TTO
AA3SB
K3IN
KB3LNM
W0CLS
N0MEA
WA0VKC
W2DER
WB8TQZ
KD8CYK
WA2NDA
KC2PDO
N2RAI
N2WGF

98
N2VC
W3CB

96
W0RJA

95
K7MQF
K5AXW
N8SY
WA0CGZ
K7FLI
N1TF

94
AB9ZA
KC2UMX

92
W2CC

91
AE5VY

90
WA4BAM
NC3F
N3KB
WA2STU
KB8HJJ
KD2AXP
WB6N
W9EEU
W3GQJ
KJ4HGH
W8IM
WB4BIK
KB3MXM
WB3FTQ
N3ZOC
K1HEJ
NX8A
KC8BW

88
AL7N
KC2EMW

87
KB9KEG

86
K2GW

85
N5MBQ
N2RTF
WB4Y
KK7DEB

84
KB8VXE

83
NS7K
KJ7NO

82
KC8YVF

80
WA9QIB
WB8YYS
W8MAL
N4ELI
K8KV
WB4RJW
KF4OCU
KS4PG
KZ8Q
KB7RVF
K0DEU
NI0I
N0MHJ
KF0XO
KC0ZDA
N1LKJ

79
KK7TN

78
N2GS

75
W5XX
KB0DTI
KD8RPP

74
K6RAU

73
W9RSX

72
KE1ML
WJ3P

70
N7EIE
N2YJZ
KD0AYN
K0DLK
N0DUW
N0DUX
W0FUI
N0MHJ
N3NTV
K0PTK
K0RXC
KD7ZUP
N2HJS
W8QZ

The following stations qualified for PSHR in previous months, but were not recognized in this column yet. (Aug 2012) KG4CSQ 89. (Sep) KG4CSQ 132. (Oct) KG4CSQ 126. (Nov) KE7QPV 78.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AK, AL, AR, AZ, CO, CT, EB, EMA, ENY, EPA, EWA, GA, ID, IL, IN, KS, LA, LAX, ME, MI, MS, NC, NFL, NLI, NNJ, NTX, OH, OK, OR, ORG, SD, SFL, SJV, SNJ, STX, TN, UT, VA, WCF, WI, WMA, WNY, WPA, WV, WY.

Section Emergency Coordinator Reports

The following ARRL Section Emergency Coordinators reported: DE, ENY, GA, ID, IN, MDC, MI, MN, MO, MT, ND, NLI, NM, NTX, STX, SV, 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.

WB9FHP 5009, KK3F 4967, NX9K 4576, WB2FTX 2161, K6HTN 1422, N1IQI 1302, N9VC 1263, W9WXN 1099, KW1U 924, W0RJA 886, WB8WKQ 613, K6FRG 587, WA4BAM 581, WD8Q 541, K6JT 514.

The following station qualified for BPL with Originations plus Deliveries: KJ4HGH 134, NM1K 110.

Silent Keys

Silent Keys Administrator, sk@arrl.org

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

N1AFL	**Hagen**, Robert C., Cromwell, CT
WA1GJL	**Weinberg**, Leonard, Waterford, CT
K1LWI	**Boyden**, Wendell F. Jr, Hull, MA
WA1MJE	**Jaworski**, Thomas P., Great Barrington, MA
N1OQX	**Garrity**, Andy Jr, Danvers, MA
W1PSK	**Desjardins**, Roland A., Lewiston, ME
WA1QHL	**Draine**, John A., Johnston, RI
K1QXU	**Di Censo**, Edward, Limestone, ME
N1SC	**Cohen**, Stuart A., Snohomish, WA
W1UAD	**Jackman**, John A., Bedford, NH
W1WW	**Felber**, George S., Rock Hill, SC
♦WA1ZJG	**Barrett**, Robert, Harvard, MA
♦W1ZPB	**Congdon**, Walton G., Northfield, MA
N2ASV	**Glans**, Russel, Williamstown, NJ
K2AXZ	**Green**, Graham, Saint Petersburg, FL
♦K2DIM	**Gemmill**, E. H. Jr, Troy, NY
K2FC	**Sullivan**, Vincent J., Blauvelt, NY
WD2G	**Winston**, Stanley C., Bridgeton, NJ
N2HDS	**Du Four**, Leonard A. Jr, Greenwich, NY
KC2HTN	**Suda**, Leonard R., Norwich, NY
KA2ISS	**Oriel**, Theron W., Pocono Lake, PA
WA2JLC	**Finegold**, George, Boynton Beach, FL
WA2KCN	**Poliseo**, Joseph W., Elmira, NY
K2KYG	**McGuinness**, Michael "Ken," Denville, NJ
KA2NRR	**Smith**, Martin, Wantagh, NY
WA2OFM	**Hillyer**, Carl L., New Hartford, NY
KC2RND	**Montana**, Matthew F., Utica, NY
K2RVM	**Aronson**, Richard, Delray Beach, FL
W2SBY	**Booth**, George L., Baldwinsville, NY
K2TEH	**Hayden**, David P., Rochester, NY
W2UNH	**Smith**, Frank H. Jr, Columbus, NJ
KC2YK	**Rabiner**, Raoul I., Perth Amboy, NJ
K2ZQG	**Stewart**, Lucille J., Loudonville, NY
K3AFU	**Callahan**, James, West Springfield, PA
KB3DAI	**Embleton**, Richard A., Fairdale, PA
WB3HZZ	**Metz**, Ernest P. A., Irwin, PA
WA3JMM	**Graves**, Russell E., Aston, PA
N3KJS	**Lebowitz**, Richard S., Brookeville, MD
W3NJ	**Sawtelle**, Bruce R., Austin, TX
W3OHP	**Bullard**, Robert L., Towanda, PA
W3PNC	**McLaren**, Thomas J., Erie, PA
N3ZHB	**Widdekind**, Millard H., Wilmington, DE
♦WA3ZHI	**Stricker**, Clinton E., Harrisburg, PA
W4BME	**Link**, John J. Jr, Cocoa, FL
W4CTH	**Thompson**, Needham J., Seguin, TX
KJ4ES	**Courson**, Herman C., Thomasville, GA
W4FAY	**Burt**, Fay, Mount Laurel, AL
N4GQV	**Gouge**, Wanda S., Independence, KY
AF4GZ	**Gilliland**, Lynn H., King George, VA
KD4JGX	**Reese**, Clyde R., Fairview, NC
KA4JIR	**Grover**, Carl Jr, Birmingham, AL
N4JRB	**Boyd**, Joel R., Warner Robins, GA
KI4JUD	**Bailey**, Matthew E., Johnson City, TN
K4KU	**Harrison**, Sherman A., Kingsport, TN
AC4L	**Robards**, Walter D., Okeechobee, FL
WA4MDS	**Rogers**, Frank W., Atlanta, GA
♦KI4ME	**Morris**, Bruce A., Raleigh, NC
WA4MHG	**Gardner**, Henry E., Hoover, AL
K4NBC	**Calvert**, Robert J., Indiantown, FL
AG4PA	**Usher**, William A., Wilmington, NC
KF4QAO	**Ivey**, Glenda K., Macon, GA
N4RAV	**Waits**, Cora, Hokes Bluff, AL
N4RNL	**Shelton**, George R., Kingsport, TN
K4RTN	**Dipolito**, Jack M., Brooksville, FL
KJ4WHW	**Devries**, Richard G., Atlanta, GA
W4ZTH	**Stacy**, Frank I., Brevard, NC
KC5CFV	**Toney**, Helen M., Austin, TX
W5CSJ	**Jackson**, Carolyn S., Yellville, AR
N5GCL	**Durosko**, John E., Kingston, OK
W5LJT	**Bell**, William W. Jr, Willis, TX
WB5LNG	**Thompson**, Alan R., Wynne, AR
♦W5POG	**Erickson**, George M., Waco, TX
♦W5YCK	**Ellis**, Richard H., Red Oak, TX
♦WB5YQT	**Lopez**, Antonio, Vanderpool, TX
W6BMG	**Zuckerman**, Walter, Sherman Oaks, CA
W6BWM	**Brown**, Alec W., Madera, CA
KF6CRZ	**Borkon**, Michael S., Oakland, CA
W6DNE	**Braudrick**, Jonathan E., Seaside, CA
KB6EMK	**Davis**, Robert M., Tracy, CA
KH6FGX	**Shak**, Harold K. Y., Aiea, HI
♦K6FQ	**Tiburski**, Kent L., San Diego, CA
WA6GON	**Smith**, Douglas M., Huntingtown, MD
ex-N6JQW	**Ross**, Frances, Fresno, CA
WA6L	**Graf**, John M., La Jolla, CA
KJ6MDM	**Walhood**, Dwight M., San Marcos, CA
W6OQ	**Anderson**, Thomas L., Stockton, CA
KG6WBO	**Hill**, Paul L., Costa Mesa, CA
WB6ZJA	**Poulos**, William J., Hesperia, CA
♦WA7ADK	**Peters**, Gerald E., West Point, UT
NA7DB	**Brown**, John D., Page, AZ
W7ICL	**McGregor**, Melvin H., Albany, OR
WA7IUA	**Anderson**, Joye F., Pleasant Grove, UT
KE7KFG	**Miller**, Stanley F., Albany, OR
WA7KRP	**Miniver**, Ludek C., Idaho Falls, ID
K7MZY	**Brubaker**, Eileen E., Carpenter, WY
W7NYG	**Rosenberg**, Franklin D., Pahrump, NV
W7QKQ	**Buchco**, Paul Jr, Welches, OR
W7UF	**Barry**, Thomas F., Scottsdale, AZ
K7YH	**Van Allen**, Jan M., Kent, WA
♦W8GKN	**Wheeler**, Dee D., Reynoldsburg, OH
AC8GW	**Piper**, Jerrold, Fairfield, OH
N8HDE	**Super**, Robert J., Grafton, OH
K8IG	**McCane**, Richard A., West Union, OH
W8KID	**Hathaway**, Richard G., Whitehall, MI
♦W8MNT	**Arnold**, Charles B., Saline, MI
WB8OWM	**Westrich**, Charles R. Jr, Canton, OH
KA8ZSO	**Sanders**, Kenneth R., Youngstown, OH
WA9AQT	**Richter**, Raymond E., Janesville, WI
W9BZI	**Rager**, Gilbert T., Muncie, IN
AA9DX	**Bates**, Robert M., Wood Dale, IL
♦KC9GW	**Mangerson**, John R., Rhinelander, WI
K9KWL	**Gerardi**, Louis E., Waterloo, IL
KC9LI	**Niewerth**, Robert F., Lafayette, IN
N9NCU	**Cole**, Dan, Two Rivers, WI
KB9OOA	**Wimberly**, Thomas C., Highland, IN
ex-W9OVR	**Dring**, William G., Lafayette, IN
W9SCH	**Rockey**, Charles F. Jr, Whitewater, WI
♦W9YYG	**Keck**, Norman A. Jr, Joliet, IL
N9YYR	**Robins**, Jerry A., Wood River, IL
N0ALM	**Colston**, Betty, Walters, OK
N0AYI	**Huff**, Thomas E., Versailles, MO
W0CGR	**Atkins**, Gary, Fort Collins, CO
KD0CYL	**Amor**, James E., Higginsville, MO
KB0ESX	**Boos**, William A. Sr, Olathe, KS
N0FOG	**Harrell**, Bruce D., Atlanta, GA
K0HDA	**De Boer**, Raymond L., Bismarck, ND
KB0ISS	**Hueben**, David, Overland Park, KS
AA0KN	**Moore**, Mary L., Long Lake, WI
K0MDB	**Schultz**, Raymond W., Grafton, ND
NC0O	**Hise**, Thomas L., Shellsburg, IA
♦W0QIN	**Clark**, Robert E., Edina, MN
W0RMX	**Gillis**, E. A., Fremont, MO
♦N0XN	**Johnson**, Merle W., Saint Paul, MN
N0YYC	**Carter**, Mark L., Derby, KS
W0ZI	**Melton**, Earl M., Stilwell, KS
VE3TIJ	**Faul**, David S., Pickeing, ON, Canada
ON4JD	**De Die**, Jean, Eeklo, Belguim

♦ Life Member, ARRL

Note: Silent Key reports must confirm the death by one of the following means: a letter or note from a family member, a copy of a newspaper obituary notice, a copy of the death certificate, or a letter from the family lawyer or the executor. Please be sure to include the amateur's name, address and call sign. Allow several months for the listing to appear in this column.

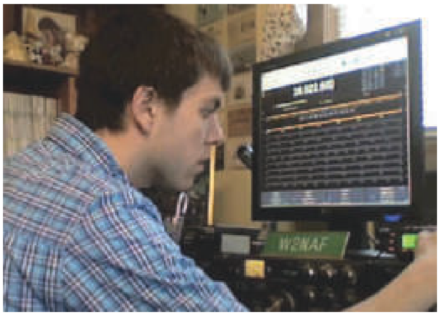
Many hams remember a Silent Key with a memorial contribution to the ARRL Foundation or to ARRL. If you wish to make a contribution in a friend or relative's memory, you can designate it for an existing youth scholarship, the Jesse A. Bieberman Meritorious Membership Fund, the Victor C. Clark Youth Incentive Program Fund, or the General Fund. Contributions to the Foundation are tax deductible to the extent permitted under current tax law. Our address is: The ARRL Foundation Inc, 225 Main St, Newington, CT 06111.

Strays

When Only a New Jersey Ham Will Do

One of the first 10-meter QSOs between the United States and France took place in 1928 between Charles Atwater, W2JN, in Montclair, New Jersey and Pierre Auschitzky, F8CT, in Arcachon.

This year marked the 85th anniversary of the event and the Radio Club Bassin D'Arcachon, F5KAY, wanted to re-enact the contact. The only problem was that they needed the help of American amateur, ideally one in Montclair, New Jersey.



Enter Nathaniel Frissell, W2NAF. Nathaniel lives in the next town over from Montclair, so he volunteered. With French news reporters looking on in Arcachon, the club established contact with Nathaniel on 28.033 MHz. After the QSO was over, Nathaniel spoke with the club members and reporters via Skype. A video of the contact is available on YouTube at **www.youtube.com/watch?v=4Ek1I3XmDjQ**.

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(Near Disneyland)
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(800) 854-6046
Janet, KL7MF, Mgr.
anaheim@hamradio.com

BURBANK, CA
1525 W. Magnolia Bl., 91506
(818) 842-1786
(877) 892-1748
Eric, K6EJC, Mgr.
Magnolia between
S. Victory & Buena Vista
burbank@hamradio.com

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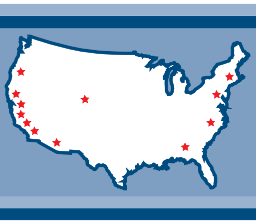

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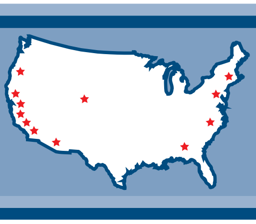

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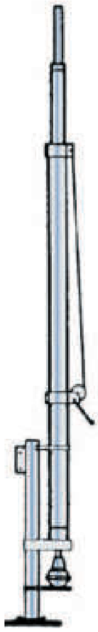

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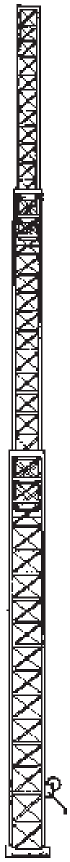

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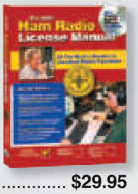

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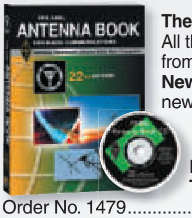

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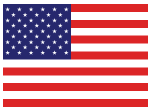
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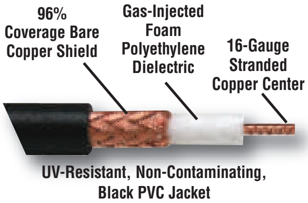

DXE-8X Low-Loss Foam Dielectric Cable (also known as RG-8X or Mini-8)

- 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.**
DXE-8X-1000	1,000 ft.	**$259.99**

Pre-cut Cable with Connectors

Part Number	Length/Ft.	Price
DXE-8XDU003	3	**$9.88**
DXE-8XDU006	6	**$10.88**
DXE-8XDU012	12	**$12.88**
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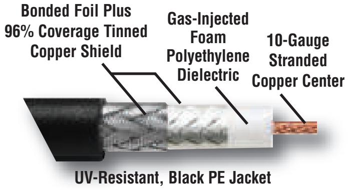

DXE-400MAX Low-Loss Cable

- 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.**
DXE-400MAX-500	500 ft.	**$364.99**

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Part Number	Length/Ft.	Price
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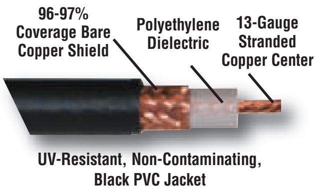

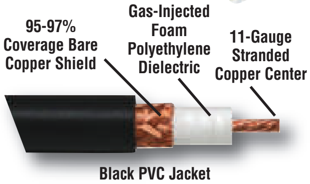

Gas-Injected Foam Won't Absorb Water.

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.**
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Pre-cut Cable with Connectors

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DXE-213UDU150	150	**$144.88**

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%
2.2 dB @ 150 MHz	1.0 kW	60%

Cable Only

DXE-8UDU	By the foot	**$.79/ft.**
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Our Clamps are Specified by Scientific, Military & Government Designers! Used by Antenna Builders: Both Commercial & Amateur!

Saddle Clamps with Cast Saddles

- Stainless steel flat washers, lock washers, nuts and bolts
- Corrosion-resistant aluminum saddles with as-cast rough finish for secure grip

U-Bolt Style, designed and sized to fit tubing

- Full 360° grip for specified tubing size

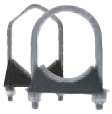
Part Number	Nominal Size	Thread Bolt Size	Price
DXE-SAD-050A	0.50	1/4-20	$5.25
DXE-SAD-075A	0.75	1/4-20	$5.65
DXE-SAD-100A	1.00	1/4-20	$6.05
DXE-SAD-125A	1.25	1/4-20	$6.85
DXE-SAD-150A	1.50	1/4-20	$7.75
DXE-SAD-175A	1.75	1/4-20	$8.90
DXE-SAD-200A	2.00	5/16-18	$10.05
DXE-SAD-200B	2.00	3/8-16	$11.25
DXE-SAD-250A	2.50	5/16-18	$12.05
DXE-SAD-250B	2.50	3/8-16	$13.55
DXE-SAD-300A	3.00	5/16-18	$13.60
DXE-SAD-300B	3.00	3/8-16	$15.25
DXE-SAD-400A	4.00	3/8-18	$34.70
DXE-SAD-450A	4.50	3/8-16	$39.95

Dimensions in Inches.

V-Bolt Style, sized to accommodate ranges of tubing sizes

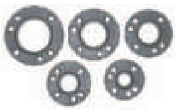
Part Number	Nominal Size	Thread Bolt Size	Price
DXE-CAVS-1P	0.50 to 1.75	1/4-20	$10.25
DXE-CAVS-11P	0.50 to 1.75	5/16-18	$10.75
DXE-CAVS-2P	1.00 to 2.00	5/16-18	$12.25
DXE-CAVS-3P	2.00 to 3.00	3/8-16	$15.25

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.

Guy Rings



You can use DX Engineering's newly engineered Guy Rings to secure your rope guys and stabilize your DX Engineering, Hustler or other aluminum vertical antenna. They work with three- and four-way guying systems and are a great complement to our tubing kits.

These guy rings are super strong, virtually impervious to the elements and fit 0.75", 1.0", 1.25", 1.50" and 2.0" O.D. tubing. For all the specs, please visit DXEngineering.com.

DXE-GR-5P Guy Rings..........**$7.95 set of 5**

V-Bolt Style Saddle Clamps with Stainless Steel Saddles

- Stainless Steel Saddles, serrated to secure hard pipe surfaces
- Stainless steel V-bolts and hardware

Part number	Nominal Size	Price
DXE-SSVC-1P	.50 to .75	$6.95
DXE-SSVC-150P	1.00 to 1.50	$9.95
DXE-SSVC-2P	1.00 to 2.00	$11.95
DXE-SSVC-3P	2.00 to 3.00	$14.95

Dimensions in Inches.

Also available with a tab and 1/4" hardware for grounding as shown.

Coaxial Cable Grounding Brackets

- Stainless steel bracket supplied with stainless steel V-Bolt and hardware
- Welded 10-24 stud

DXE-CGB-150	Fits .50" to 1.50" O.D. tube	$15.95
DXE-CGB-200	Fits 1.00" to 2.00" O.D. tube	$15.95

Connectors not included.
See website for complete selection.

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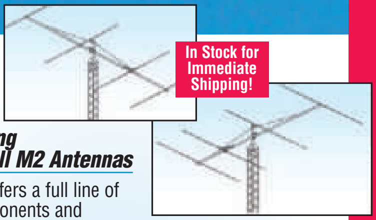
All fiberglass and aluminum tubing telescopes smoothly and comes in larger sizes and wall thicknesses.

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
DXE-FTK50	Fiberglass Antenna Tubing Kit, 50 Foot Max. Length	$138.00
DXE-ATK65	Aluminum Antenna Tubing Kit, 65 Foot Max. Length	$194.50

For more, visit DXEngineering.com



DX Engineering now stocks all M2 Antennas

M2 Antennas offers a full line of antennas, components and accessories—including big HF Antennas and Small UHF Arrays. See much more in stock at DXEngineering.com.

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MSQ-20M4DX	HF 20 Meter Monoband Beam;	$1,004.00
MSQ-15M4DX	HF 15 Meter Monoband Beam	$801.00
MSQ-10M4DX	HF 10 Meter Monoband Beam	$700.00
MSQ-KT34M2	HF Triband Beam, 4 Element	$1,468.00
MSQ-KT36XA	HF Triband Beam, 6 Element	$2,037.00
MSQ-1030LP8	HF 10-30 Meter Log Periodic	$2,183.00
MSQ-6M3	6 Meter Yagi, 3 element, 3 kW	$180.00
MSQ-6M3SS	6 Meter Yagi, 3 element, 500 W	$164.00
MSQ-2M9SSBFM	2 Meter Yagi Antenna	$220.00
MSQ-2MHOLOOP	2 Meter Horizontal Loop Antenna;	$87.00
MSQ-2225SS	1.25 Meter Yagi, 5 Element	$89.00
MSQ-EB144RK2M	Eggbeater Satellite Antenna, 135-150 MHz	$221.00
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MSQ-SATPACK1	Eggbeater Satellite Antennas Package	$378.00
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Super Duty Saddle Clamps

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
- Armor coated bolt sets sold separately

Part Number	Tube O.D.	Price
DXE-SDS-200P	2.00	$34.00
DXE-SDS-250P	2.50	$41.00
DXE-SDS-300P	3.00	$51.00

Dimensions in Inches.

Resin Support Blocks

Securely mount tubing to any flat surface. An insulated mount between tubing and plates, ideal for antenna construction and electrical applications.

- Optional stainless steel reinforcement plates available

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100 kHz-30 MHz Receive Four-Square Packages

A patented*, sophisticated receiving system with time delay phasing for broadband performance. Optimized to produce wider and deeper rear nulls and a narrower main lobe. Noise and undesirable signals are greatly reduced by a superior front-to-rear ratio (F/R) and RDF. Better control of phase and currents provides a cleaner pattern than found on available TX four-square arrays.

- Less susceptible to high angle signals compared to EWE, Flag, Pennant, and K9AY antennas
- Excellent directivity with better signal-to-noise ratio, RDF
- Switchable in four 90 degree-spaced directions
- Usable over a very wide frequency range with DXE-ARAV3 active elements
- Requires less area than a Beverage antenna
- Active elements require minimal ground system
- Enhanced relay contact reliability

The complete system includes all electronics, four ARA active antennas, TVSU sequencer, 1,000 feet of F6 flooded cable, connectors, and assembly tools.

DXE-RFS-SYS-2P	Controller and Switch only....**$389.95**
DXE-RFS-SYS-3P	160/80/40M Electronics........**$799.00**

**US Patent Number 7,423,588*

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 how this durable antenna 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**

ICOM D-STAR ready

Icom VHF/UHF radios are now in stock and ready for immediate shipping! Included are models that use Icom's exclusive D-STAR system—see how they can help you unlock a world of digital possibilities at DXEngineering.com!

ICO-IC-80AD	2M/70cm Dual-Band HT with D-STAR, Li-ion Battery ....**Call for Price**
ICO-IC-92AD	2M/70cm Dual-Band HT with D-STAR, Rugged, Submersible.................**Call for Price**
ICO-IC-2820H	2M/70cm Dual-Band Digital Mobile, D-STAR optional..........................**Call for Price**
ICO-ID-1	23cm Mobile with D-STAR, Cables, Remote Head and Speaker.........**Call for Price**
ICO-ID-880H	2M/70cm Dual-Band Digital Mobile with Mic and Brackets................**Call for Price**
ICO-ID-31A	70cm Digital HT with Built-in GPS Receiver.............................**Call for Price**

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SignaLink™ USB Unit from Tigertronics

- Software included on CD ROM
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- Supports all sound card digital and voice modes, including MT63, EchoLink®, PSK-31, SSTV, CW and RTTY

TGR-SL-USB **$84.50**

•Requires a radio interface cable

Any radio interface cable is only **$14.95** when purchased with a SignaLink™ unit

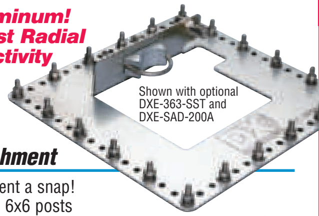
Super Duty Tilt Bases Available Separately.

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**

Not Cheap Aluminum! Guarantees Best Radial System Conductivity Over Time



Shown with optional DXE-363-SST and DXE-SAD-200A

Stainless Radial Plate with Coax Attachment

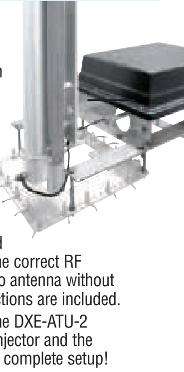
Makes radial attachment a snap!

- 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

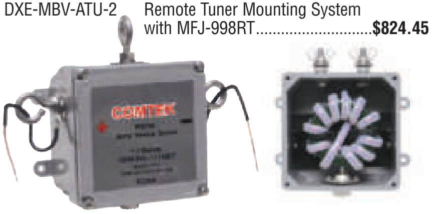


These Remote Tuner Mounting Systems provide an easy way to mount your MFJ-998RT tuner to any quarter-wave vertical antenna. They're the perfect solution for the Full Legal Limit Power DX'er who's using MFJ-998RT's great auto-tuning features. The ATU-2 mounts to the DX Engineering RADP-3 Radial Plate 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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The #1 Line of Autotuners!

Antennas

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!

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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

- ***RF Sensing***
- ***Tunes Automatically***
- ***No Interface Cables Needed***

AT-100ProII

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-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***

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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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.**

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!*

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.

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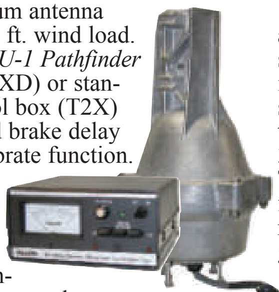


T-2X **$799.95**

T-2XD **$1229.95** with DCU-1

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.

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.**

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.**

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.**

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.**

Digital Automatic Controller

DCU-1 **$749.95**

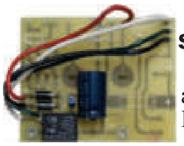
Automatically controls T2X, HAM-IV, V rotators. 6 presets for favorite headings, 1° accuracy, 8-sec. brake delay, choice for center of rotation, crisp *plasma* display. Computer controlled with many logging/contest programs.

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.

NEW! Automatic Rotator Brake Delay



RBD-5 **$29.95**

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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FT-60R 2M/440 FM HT

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VX-8GR 2M/440 FM HT Built-in GPS

- TX: 144-148, 430-450 MHz • RX: 108-999 MHz (cell blocked) • Memories: 1200+ • Power: 5/2.5/1/0.05W
- GPS unit and antenna is built-in for APRS® data

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- TX: 144-148 MHz • RX: 136-174 MHz
- Power: 55/25/10/5W • Memories: 221

FT-2900R 2M FM Mobile

- TX: 144-148 MHz • RX: 136-174 MHz
- Power: 75/30/10/5W • Memories: 221

FT-7900R 2M/440 FM Mobile

- TX: 144-148, 430-450 MHz
- RX: 108-520, 700-999 MHz (cell blocked)
- Power: 50/20/10/5W (2M), 45/20/10/5W (440 MHz)
- Memories: 1055 • YSK-7800 included!

FT-817ND HF/VHF/UHF All Mode

- TX: HF/VHF/UHF • RX: 0.1-56, 76-154, 420-470 MHz
- Power: 0.7-5W (AM 1.5W) • Memories: 200
- Field operation with AA batteries or Ni-MH pack

FT-857D 100W HF/VHF/UHF Mobile

- TX: HF/6M/2M/440 MHz • RX: 0.1-56, 76-108, 118-164, 420-470 MHz • Power: 5-100W (HF/6M), 5-50W (2M), 5-20W (440 MHz) • Memories: 200 • YSK-857 included!

FT-897D 100W HF/VHF/UHF Portable

- Same band coverage and power output as the FT-857D
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FT-950 HF/6M Transceiver

- TX: HF/6M • RX: 0.03-56 MHz • Power: 10-100W
- Memories: 100 • Auto Antenna Tuner
- 32-bit Floating Point DSP • Built-in high stability TCXO

FTDX-3000D HF/6M Transceiver

- TX: HF/6M • RX: 0.03-56 MHz • Power: 5-100W
- Large color display with high speed spectrum scope
- High end receiver based off the FTDX-5000
- Built-in USB interface • High speed auto tuner

FTDX-5000MP

Covers HF and 6M; Three different configurations all running 10-200W on CW, SSB, FM, RTTY and 5-50W on AM • RX: 0.03-60 MHz • Memories: 99 • The "D" and "MP" model comes with SM-5000 Station Monitor that features an excellent bandscope • The "MP" also comes with high stability ±0.05ppm OCXO & 300 Hz roofing filter

FTDX-5000 - Basic Model & ±0.5ppm TCXO
FTDX-5000D - With Station Monitor & ±0.5ppm TCXO
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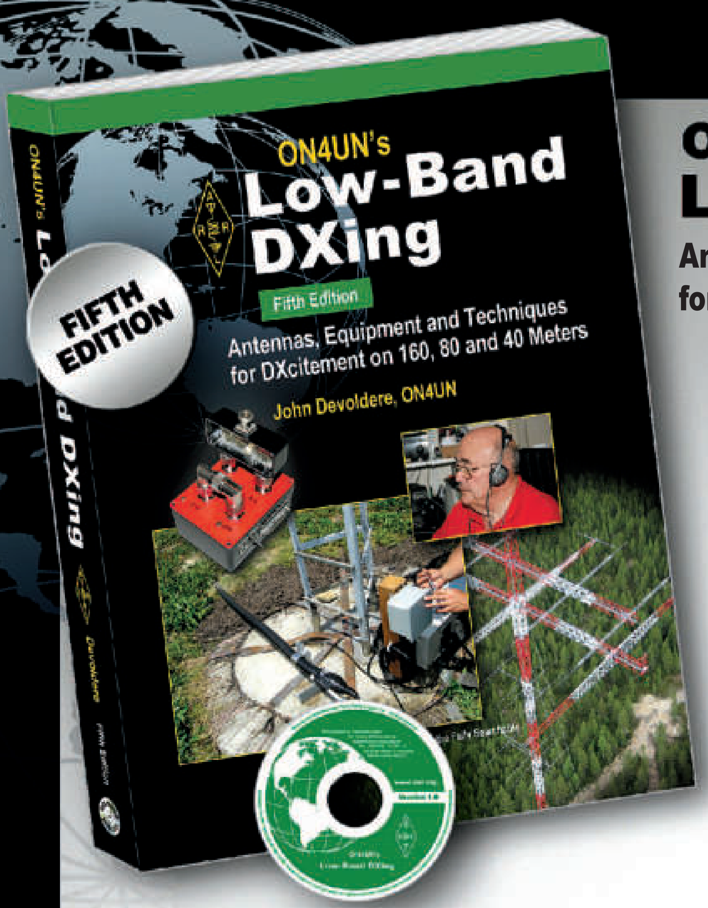

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- Comes with NiMH Battery and Wall Charger

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- TX: 420-450 MHz • RX: 400-479 MHz
- Power: 5/2.5/0.5/0.1W • Memories: 1252
- D-Star Digital Voice and GPS receiver is built-in
- Large Dot Matrix Display and Directional Keypad makes the radio easy to navigate through the menus

IC-2300H 2M FM Mobile

- TX: 144-148 MHz • RX: 118-174 MHz
- Power: 65/25/10/5W • Memories: 207

ID-880H 2M/440 FM & D-Star Mobile

- TX: 144-148, 430-450 MHz • RX: 118-173.995, 230-549.995, 810-999.99 MHz (cell blkd) • Power: 50/15/5W
- Memories: 1052 • D-Star built-in ready to go!

IC-2820H 2M/440 FM Mobile

- TX: 144-148, 430-450 MHz • RX: 118-549.95, 810-999.990 MHz (cell blkd) • Power: 50/15/5W
- Packet ready (9600 BPS) • Upgradable D-Star DV (digital voice) & GPS capabilities w/optional UT-123

IC-718 HF Transceiver

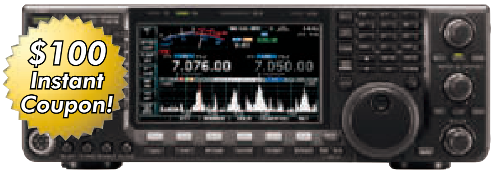
- TX: HF (except 60M) • RX: 0.03-30 MHz
- Power: 5-100W • Memories: 101 • DSP built-in
- SSB, CW, RTTY and AM (2-40W)

IC-7200 HF/6M Portable

- TX: HF/6M • RX: 0.03-60 MHz • Power: 2-100W
- Memories: 201 • Rugged design for outdoor use
- 32-bit IF-DSPs + 24-bit AD/DA Converters
- USB Port for CI-V Format PC Control & Audio In/Out

IC-7410 HF/6M Transceiver

- TX: HF/6M • RX: 0.03-60 MHz • Power: 2-100W
- 15kHz 1st IF filter and optional 3kHz & 6kHz filters to protect against strong unwanted adjacent signals
- Automatic antenna tuner • USB connector for PC control



IC-7600 HF/6M Transceiver

- TX: HF/6M • RX: 0.03-60 MHz • Power: 2-100W
- Memories: 101 • 5.8 inch color screen
- High-resolution real time spectrum scope using a dedicated DSP unit • Automatic antenna tuner

IC-9100 HF/6/2M/440 MHz All Mode

- TX: HF/6/2M/440 MHz • RX: 0.03-60, 136-174, 420-480 MHz • Optional 1.2 GHz, 1-10W Operation
- Power: 2-100W HF/6/2M & 2-75W 440 MHz
- Memories: 297 • Optional D-Star Board • Auto Tuner
- USB Port for CI-V Format PC Control & Audio In/Out

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3/18/13	Alinco DJC7T
3/25/13	Yaesu FT60R
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4/8/13	Alinco DJC7T
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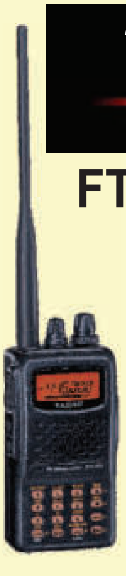

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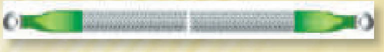
235-5X-20	20	$33.95
235-5X-10	10	$18.95
235-5X-5	5	$12.95
235-5X-3	3	$8.95
235-5X-1	1	$5.95



1/2" Tinned Copper Flat Ground Braid. 10ga 53/Amps
w/#10 Stud Ring Terminals. Quick & Easy Grounding Terminations.

Part#	Length/Ft	Price/ea
233/2-4X-12	12	$11.95
233/2-4X-10	10	$9.95
233/2-4X-5	5	$6.95
233/2-4X-3	3	$5.95
233/2-4X-1	1	$4.95

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

Attenuation per 100ft	Power Rating	Efficiency%
• 0.9dB @ 10MHz	2.16kW	80%
• 1.4dB @ 30MHz	1.24kW	69%
• 2.1dB @ 50MHz	0.96kW	62%
• 3.6dB @ 150MHz	0.55kW	43.5%
• 6.3dB @ 450MHz	0.31kW	23.2%

Part #	Length/Ft	Price/ea
218XA-PL-3	3	$10.95
218XA-PL-6	6	$11.95
218XA-PL-18	18	$16.95
218XA-PL-50	50	$29.95
218XA-PL-75	75	$39.95
218XA-PL-100	100	$48.95
218XA-PL-150	150	$68.95

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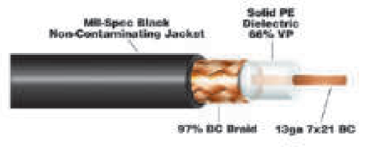
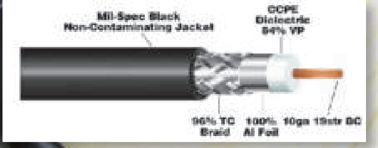


2213A RG213/U MIL-SPEC
Non-contaminating Direct-Burial Ultra-Violet Resistant Jacket.
W/SILVER-TEFLON PL259 & WEATHERPROOF HST each end.

Attenuation per 100ft	Power Rating	Efficiency%
• 0.6dB @ 10MHz	3.43kW	87%
• 1.0dB @ 30MHz	1.95kW	79%
• 1.4dB @ 50MHz	1.5kW	73%

Part #	Length/Ft	Price/ea
2213A-PL-3	3	$12.95
2213A-PL-6	6	$16.95
2213A-PL-50	50	$62.95
2213A-PL-75	75	$87.95
2213A-PL-100	100	$108.95
2213A-PL-150	150	$157.95



25400F 400-FLEX (RG8/U TYPE) FLEXIBLE LOW LOSS
Non-contaminating Direct-Burial Ultra-Violet Resistant Jacket.
W/SILVER-TEFLON PL259 & WEATHERPROOF HST each end.

Attenuation per 100ft	Power Rating	Efficiency%
• 0.8dB @ 30MH	2.77kW	83%
• 1.1dB @ 50MHz	2.14kW	78.5%
• 1.8dB @ 150MHz	1.22kW	65.4%
• 3.3dB @ 450MHz	0.69kW	47.3%

Part #	Length/Ft	Price/ea
25400F-PL-3	3	$13.95
25400F-PL-6	6	$16.95
25400F-PL-18	18	$28.95
25400F-PL-35	35	$48.95
25400F-PL-50	50	$60.95
25400F-PL-75	75	$91.95
25400F-PL-100	100	$109.95
25400F-PL-150	150	$164.95

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FiFi SDR kit with preselector · sound card chip on board!

Frequency range 0.1 ... 30 MHz

Super compact SDR receiver (3 1/8 x 2 1/8 x 1 inches only)! Si570 based, PC controlled and powered via USB. Firmware updates possible via Internet.

Kit w 2 PCBs (SMD parts assembled) and enclosure **BX-222P $ 169.00**

Comfortable software downloadable from www.bonito.net/manuals/radiojet/sites/ en_Overview.htm!

Voice Keyer kit designed by DH8BQA (eham rating 5,0)

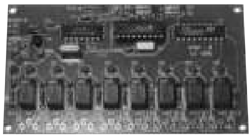
Stores up to 60 sec. of operators voice. Great for contests, QRP operation, hotel rooms etc. The new PCB with all SMD parts assembled replaces the original PCB of the Yaesu Mic MH-31 (FT-817/857/897, FT-950 etc.).
Via jumpers also usable for Kenwood and Icom transceivers.

Kit w PCB, PTT switch, electret mic **BX-184 $ 55.00**
BX-184M (incl. no name mic body, same size and style as MH-31) **$ 69.00**

Prices incl. S & H to USA and Canada · Oders via **www.box73.com** or german webshop on **www.funkamateur.de** (components and more kits)

Easy ordering w/o registration: PayPal transfer to shop@funkamateur.de
Please add your name, call sign and address in the message field!

DTMF decoder board with eight relays



Remote control eight devices via radio audio. Password protection against unauthorized entry. Unique board ID. Comes assembled **with relays.** 4.5" x 2.5".

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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. 4Wx6$^{3}/_{4}$Hx2D 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}

CoaxCalculator™

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. 3$^{3}/_{4}$Wx6$^{1}/_{2}$Hx2$^{3}/_{4}$D inches. 1.3 lbs.

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MFJ TUNERS

New, Improved MFJ-989D 1500 Watt *legal limit* Antenna Tuner

MFJ-989D
$389.95

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.

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. $12\frac{7}{8}$Wx6Hx$11\frac{5}{8}$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. $10\frac{3}{4}$Wx$4\frac{1}{2}$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. $10\frac{3}{4}$x$4\frac{1}{2}$x$10\frac{7}{8}$ 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. $3\frac{1}{2}$Hx$10\frac{1}{2}$Wx$9\frac{1}{2}$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. $3\frac{1}{2}$Hx$10\frac{5}{8}$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 $10\frac{1}{2}$Wx$2\frac{1}{2}$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

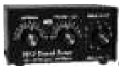
Tunes coax, balanced lines, random wire 1.8-30 MHz. Cross-Needle Meter. SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ transceivers. Tiny $6\frac{1}{2}$x$6\frac{1}{2}$x$2\frac{1}{2}$ in.

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 $4\frac{1}{2}$x$2\frac{1}{4}$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. $7\frac{1}{4}$x$2\frac{1}{4}$x$2\frac{3}{4}$ 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. $8x2\frac{1}{2}$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.

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World's most advanced Automatic Antenna Tuners feature world renowned MFJ AdaptiveSearch™ and AutomaticRecall™ algorithms -- world's fastest ultra-wide range tuning. Nine World Class models! Choose your features: Digital/Analog/Audio SWR-Wattmeter, Antenna Switch, Balun, Radio Interface, Digital frequency readout, Remoteable, Coax/Balanced Lines/Wire Tuning, Field Upgradeable . . .

MFJ-998 1500 Watt *Legal Limit IntelliTuner*™

MFJ-998
$699^{95}

Only the MFJ-998 gives you fully automatic antenna tuning for your legal limit full 1500 Watts SSB/CW linear amplifier!

Ultra-fast Automatic Tuning

Instantly match impedances from 12-1600 ohms using MFJ's exclusive *IntelliTune*™, *Adaptive Search*™ and *InstantRecall*™ algorithms with over 20,000 *VirtualAntenna*™ Memories.

Safe auto tuning protects amp

MFJ's exclusive *Amplifier Bypass Control*™ makes tuning safe and "stupid-proof"!

Digital/Analog Meters

A *backlit* LCD meter displays SWR, forward/reflected power, frequency, antenna selected, an auto-ranging bargraph power indication, and much more.

Has quick-glance auto-ranging Cross-Needle SWR/Wattmeter.

MFJ VirtualAntenna™ Memory

MFJ new *VirtualAntenna*™ Memory system gives you 4 antenna memory banks for *each* of 2 switchable antenna coax connectors. Select up to 4 antennas on each antenna connector. Each antenna has 2500 memories, 20,000 total. Has binding post for end-fed long wire antennas.

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Download from internet and upgrade your MFJ-998 firmware as new features are introduced.

Plus Much More!

Built-in radio interface controls most transceivers.

Automatically bypasses with excessive tuning power.

Use balanced line antennas with external **MFJ-912, $59.95,** 1.5 kW 4:1 balun.

Small 13Wx4Hx15D inches easily fits into your ham station. 8 pounds. Requires 12-15VDC at 1.4 amps maximum or 110 VAC with **MFJ-1316, $21.95.**

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For 600 Watt amps like Ameritron AL-811/ALS-600/ALS-500M. Matches 12-800 Ohms. 10,000 *Virtual Antenna*™ memories. Cross-Needle SWR/Wattmeter. 10Wx2$^{3}/_{4}$Hx9D inches.

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300 Watt...Best Seller

Digital Meter, Ant Switch, Balun

MFJ-993B
$259^{95}

The *world's best selling* automatic antenna tuner is *highly acclaimed the world over* for its ultra high-speed, wide matching range, reliability, ease-of-use! Matches virtually *any* antenna.

300 Watt *Extra*...Wide Range

SWR/Wattmeter, 10000 VA Memories

MFJ-991B
$219^{95}

***Extra** wide matching range at less cost.* Exclusive dual power level: 300 Watts/6-1600 Ohms; 150W/6-3200 Ohms. Cross-Needle SWR/Wattmeter.

200 Watt ... Compact

Digital Meter, Ant Switch, Wide Range

MFJ-929
$219^{95}

World's fastest compact auto tuner uses MFJ *Adaptive Search*™ and *InstantRecall*™ algorithms. 132,072 tuning solutions instantly match virtually any antenna with near perfect SWR.

200 Watt ... Econo

Small, Ant Switch, 20K VA Memories

MFJ-928
$199^{95}

High-speed, wide matching range and compactness at low cost! Leave in-line and forget it -- your antenna is *always* automatically tuned! 2-position antenna switch.

200 Watt *MightyMite*™

Matches IC-706, FT-857D, TS-50S

MFJ-925
$179^{95}

***No** extra space needed!* Just set your IC-706/7000, FT-857D, TS-50S on top of this matching low-profile automatic tuner -- it's all you need for a completely automated station using *any* antenna! Just tune and talk!

G5RV Antenna

MFJ-1778
$44^{95}

Covers all bands, 160-10 Meters with antenna tuner. 102 ft. long. Can use as inverted vee or sloper. Use on 160 Meters as Marconi.1500 Watts. Super-strong fiberglass center/feed-point insulators. *Glazed ceramic* end insulators. All hand-soldered connections. Add coax, some rope and you're *on the air!* **MFJ-1778M, $39.95.** G5RV Junior. Half-size, 52 ft. 40-10M with tuner, 1500 Watts.

200W...Weather-sealed

for Remote/Outdoor/Marine

MFJ-926B
$279^{95}

***Fully** weather-sealed for remote Outdoor/ Marine use*! Tough, durable, built-to-last the elements for years.

200 Watt...Remote

Coax/Wire Ant, No pwr cable needed

MFJ-927
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Weather protected fully automatic *remote* auto tuner for wire ***and*** *coax* antennas -- an MFJ exclusive. Powers through coax -- No separate power cable needed.

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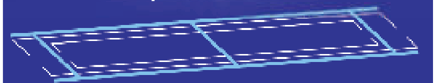

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Soft Limits support side mount or extended travel with quickest rotate to heading

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Allows shared IP access to your rotors, antenna relays and serial devices

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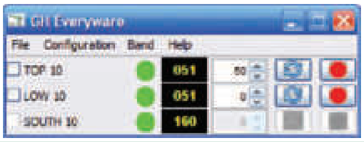
Reasonably priced base and remote modules allow flexible configurations



GH Everyware
File Configuration Band Help
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LOW 10 051 0
SOUTH 10 160

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Radios to Go!
Getting the Most from your Handheld Transceiver
Steve Ford, WB8IMY

Handheld Radios are More Powerful Than You Think!

Modern technology has allowed manufacturers to pack a wealth of features into handheld transceivers. With so many features, however, it isn't always easy to get the full benefit from your investment. Even the user manuals don't tell the whole story. Your radio may have "hidden" capabilities that aren't described in the manual at all.

If you own a handheld transceiver, or if you're trying to decide which transceiver to buy, *Radios to Go!* is the essential guide.

Includes:
- **Why Are They Called HTs?** (And Which One Should I Buy?)
- **The Care and Feeding of Batteries**
- **Memories**
- **Scanning**
- **Alphabet Soup: CTCSS, DTMF and DCS**
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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.

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Ham Radio's smallest and lightest 22 Amp continuous power supply is also its best selling!

MFJ-4125
\$84⁹⁵

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. $5^{3}/_{4}$Wx3Hx$5^{3}/_{4}$D".
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. $5^{1}/_{4}$Wx$4^{1}/_{2}$Hx6D in. Weighs 3.7 lbs. Use 85-135 VAC or 170-260 VAC input. Replaceable fuse.

MFJ-4225MV
\$99⁹⁵

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. $7^{1}/_{2}$Wx$4^{3}/_{4}$Hx9D inches. Use 85-135 VAC or 170-260 VAC input. Replaceable fuse.

MFJ-4245MV
\$149⁹⁵

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. $9^{3}/_{4}$Wx$5^{1}/_{2}$Hx$9^{1}/_{2}$D". Great for Ameritron's ALS-500M mobile amplifier!

MFJ-4275MV
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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 . . .

MFJ-1118
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MFJ-1116
\$59⁹⁵

MFJ-1112
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MFJ-1117
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MFJ-1128
\$104⁹⁵

MFJ-1126
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MFJ-1129
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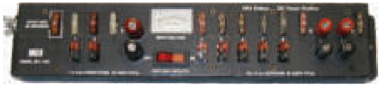

MFJ-1124
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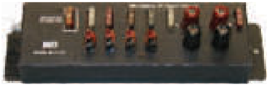


Versatile 5-Way Binding Posts

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. $12^{1}/_{2}$x$2^{3}/_{4}$x$2^{1}/_{2}$ in.

MFJ-1116, \$59.95. 8 pairs binding posts, 15A total. Voltmeter, on/off switch.

MFJ-1112, \$44.95. 6 pairs binding posts, 15 Amps total.

MFJ-1117, \$64.95. Powers *four* transceivers simultaneously (two at 35 Amps each and two at 35 Amps combined). 8x2x3 inches.

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. 12Wx$1^{1}/_{4}$Hx$2^{3}/_{4}$D".

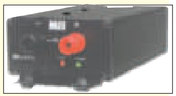
MFJ-1126, \$84.95. 8 outlets, each fused, 40 Amps total. Factory installed fuses: two 1A, three 5A, two 10A, one 25A, one 40A. *0-25 VDC Voltmeter*. Includes *extra PowerPoles*®, *extra* fuses -- *no extra cost*. 9Wx$1^{1}/_{4}$Hx$2^{3}/_{4}$ inches.

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*(R) and fuses, $12^{1}/_{2}$Wx$1^{1}/_{4}$Hx$2^{3}/_{4}$D inches.

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*.

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. $1^{1}/_{2}$ lbs. Tiny $3^{3}/_{4}$Wx$2^{1}/_{4}$Hx$3^{3}/_{4}$D inches fits easily in an overnight bag.

MFJ-4115
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30 Amps Continuous

Linear with 19.2 lb.Transformer

No RF Hash!

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. $9^{1}/_{2}$Wx6Hx$9^{3}/_{4}$D in.

MFJ-4035MV
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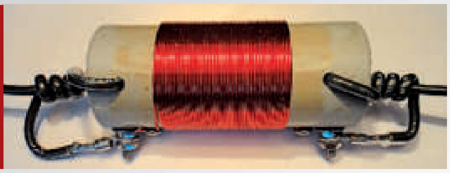

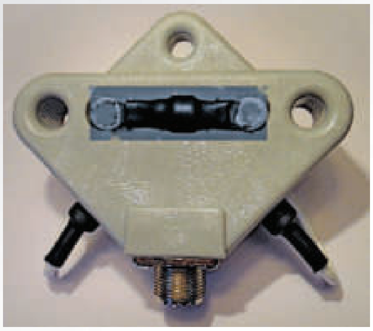

The ISO-RES™, Isolator-Resonator coils use the windings for L, and the inter-winding capacitance between turns for the C to perform band separation or loading, depending on the band. This is a very unique concept, custom designed by **Alpha Delta** to avoid lossy “traps”. **Alpha Delta** custom designed **Model DELTA-C** center insulator employs the **Model SEP** molded gas tube static voltage bleed-off protector on the back of the **Model DELTA-C** (shown above). Used in **Models DX-CC, DD, and EE** multi-band dipoles and mono-band dipoles for extra protection.

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- **Check WEB** site for SSB/CW power ratings. All models have 50 ohm SO-239 connector for your coax.

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Model DX-EE, 40-20-15-10 meters, 40 ft. long parallel dipole	**$140.00** ea.
Model DX-LB, 160-80-40 meters, 100 ft. long single wire dipole	**$160.00** ea.
Model DX-LB Plus, as above but adds 20-15-10 meters. Parallel dipole	**$190.00** ea.

NOTE: Models DX-LB/LB Plus require the use of a wide range tuner. Check WEB site.

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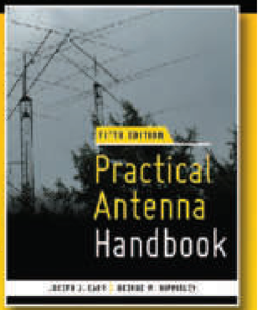

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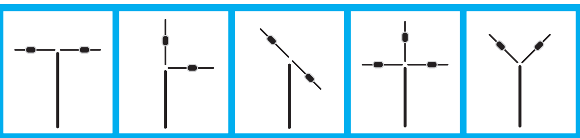

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From beaches to mountaintops, condos to RV parks and everywhere in between, the Buddipole line of portable HF antennas and accessories is ideal for both novice and expert operators alike.

We manufacture all of our antennas using custom CNC parts and injection molds with carefully selected materials.

We also manufacture A123 Nanophosphate battery packs for all portable radios. These power packs provide unparalleled performance in the field. See our website for more details.

BUDDIPOLE FEATURES

- Multi-band design works 9 bands (40 meters thru 2 meters) with one set of adjustable coils!
- Rated from QRP to 250 watts PEP
- Modular Design – create dozens of different antennas with interchangeable parts
- Rotatable/Directional
- Lightweight, rugged components
- Rotating Arm Kit allows users to instantly change antenna configurations
- Used by Emergency Services Groups throughout the world

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KH6BB

BATTLESHIP
MISSOURI
MEMORIAL
Pearl Harbor, Hawaii


Photo © David Rolla, 2013

KH6BB, the Battleship *Missouri* Amateur Radio Club, is working with the USS *Missouri* Memorial Association to restore and maintain antennas and related radio equipment. This effort provides a living legacy to the ship, which is open to visitors and is adjacent to the USS Arizona Memorial at Pearl Harbor, Hawaii.

Please support restoration of the *Missouri* through gifts to the USS *Missouri* Memorial Association. Specify restoration gifts as being designated for the "Antenna/Radio Fund." As a 501(c)(3) non-profit, donations to Association are tax deductible.

www.ussmissouri.org/kh6bb

Donors at the $250 level will receive a 'challenge coin' made from teak from the deck of the Battleship *Missouri*.
(Don't worry - we're not tearing up the deck for this. The teak is also being restored as part of ongoing preservation activities.)

Please Support USS *Missouri* Antenna & Radio Restoration

with KH6BB

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Amateur Radio Club

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One antenna most in need of repair is the Discone near the bow of the ship. After nearly 30 years of service the antenna platform and several elements have deteriorated. All ship's systems, and especially those exposed to the weather, need ongoing maintenance work and preservation. Please help support the efforts to keep the *Mighty Mo* a strong, capable and living monument.


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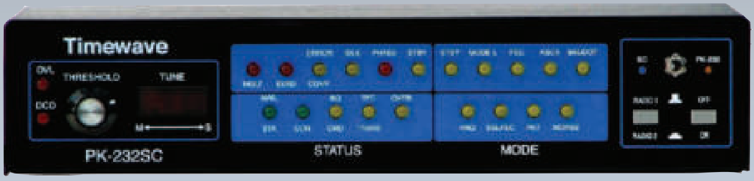

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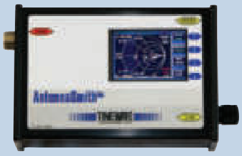

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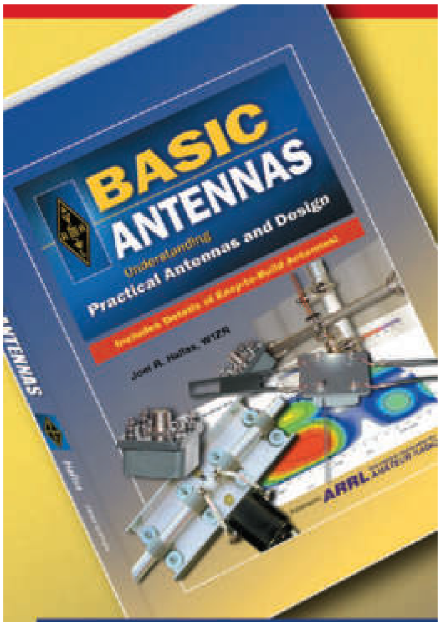
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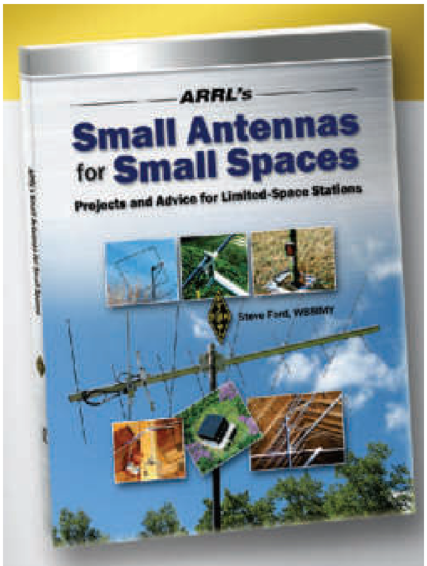
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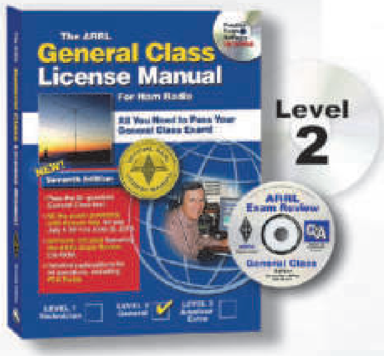

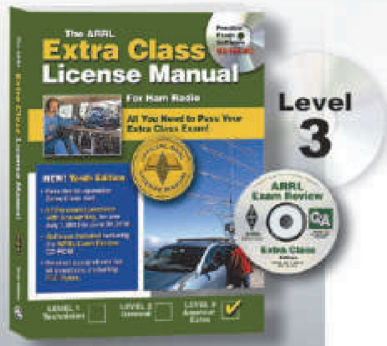

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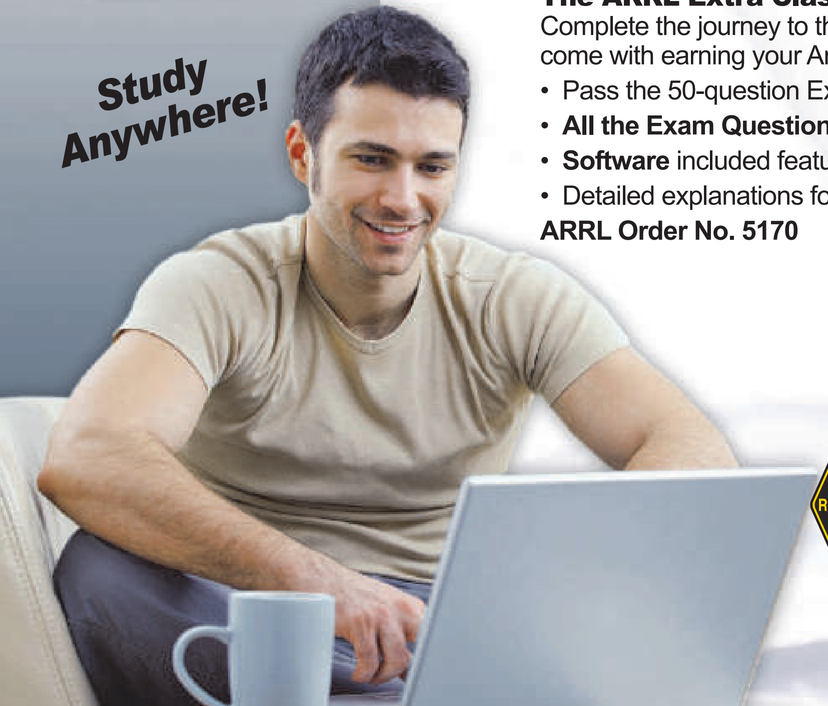

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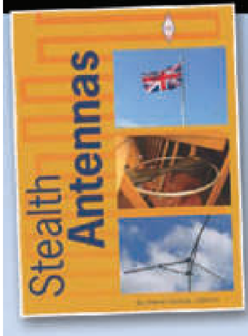
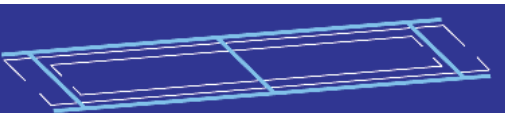
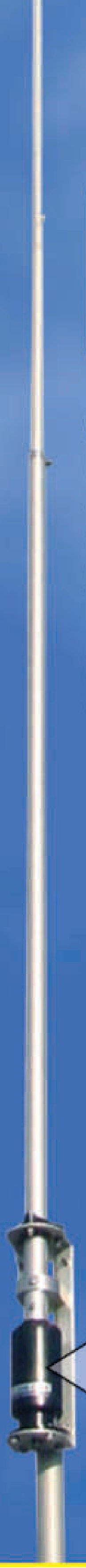
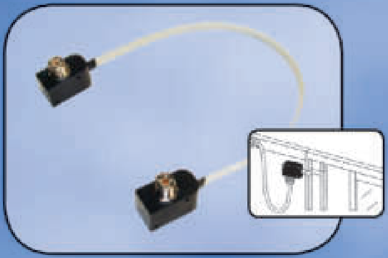


Stealth Antennas

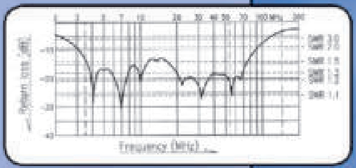
Intro Price
$199.00








H-422 "V" Shape
CBL-2500 2.5kW Balun
H-422 Horizontal


Return loss (dB)
Frequency (MHz)

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
$35995

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 $^{1}/_{2}$ 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-2990 includes this base mount and legal limit balun!!!

MFJ *Automatic* Tuners

MFJ-998
$69995

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
$25995

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
$38995

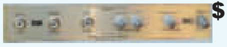
1500 Watts SSB/CW, 1.8-30 MHz. Active peak-reading Cross-Needle SWR/Wattmeter, balun, dummy load, antenna switch, aircore roller inductor.

MFJ-949E
$17995

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
$6995



Bring 3 coaxes, balanced line, random wire, ground thru window. Connectors mounted on *stainless steel* panel. $^{3}/_{4}$" thick *pressure-treated* weather-proof wood.

Free MFJ Catalog

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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, $3\frac{1}{2}$ inch high, $\frac{3}{4}$ 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®* SO-239 coax connectors lets you feed HF/VHF/UHF antennas at full legal power limit.

A 50 Ohm *Teflon®* 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.

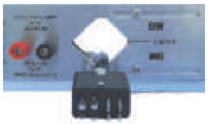
A pair of high-voltage *ceramic feedthru insulators* lets you bring in 450/300 Ohm balanced lines directly to your antenna tuner.

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 $1\frac{1}{4}$X$1\frac{5}{8}$ in). Adapts to virtually *any* cable size. Seals out rain, snow, adverse weather.



3 Coax, Balanced Line, Random Wire

Best Seller! 3 *Teflon®* 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®* coax connectors for HF/VHF/UHF antennas. Stainless steel ground post. Full 1500 Watt legal limit.

MFJ-4601
$\$59^{95}$

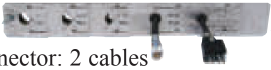
4 Balanced Line, 2 Coax

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 $1\frac{1}{4}$x$1\frac{5}{8}$ inches and 3 cables with UHF/N size coax connectors. Seals out weather.

MFJ-4604
$\$99^{95}$

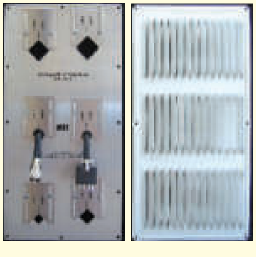
All-Purpose FeedThru/CableThru™

***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 $1\frac{1}{4}$x$1\frac{5}{8}$ inches!

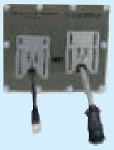
Sliding plates and rubber grommets adjust for virtually any cable size to seal out adverse weather, insects and varmints. Use existing vent hole, mounting screws and screw holes.

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 $1\frac{1}{4}$x$1\frac{5}{8}$ 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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Prices and specifications subject to change.

http://www.mfjenterprises.com for more info, catalog, manuals, dealers

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.

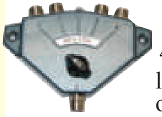
MFJ *Dual Band* 80/40 *or* 40/20M Dipoles

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.

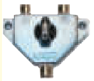
MFJ-17754, $59.95. Short coax fed 42 foot long *dual band* 40/20 Meter dipole antenna. *Full-size* on 20 Meters, ultra-efficient end-loading on 40 Meters. Same construction as MFJ-17758.

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. 6$^1/_4$Wx4$^1/_4$Hx1$^1/_4$D in.

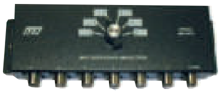


MFJ-1702C
$39.95
2-Positions

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. 4$^3/_4$W6$^1/_2$Hx3D inches.

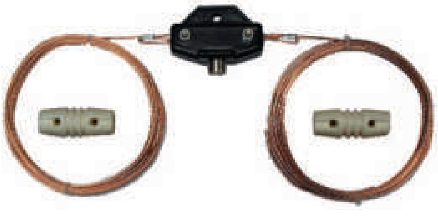


MFJ-1701
$69.95

MFJ-1701 *Antenna Switch* like MFJ-1700C but lets you select one of six antennas only. 10Wx3Hx1$^1/_2$D inches.

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	MFJ-1779B	MFJ-1779C
$69.95	$49.95	$29.95
160M, 265 ft.	80-40M, 135 ft.	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*(R) coax and *Teflon*(R) 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.

33 ft. Telescoping fiberglass Mast

3.8 feet collapsed, 3.3 lbs.

MFJ-1910
$79.95

Super strong fiberglass mast has huge 1$^3/_4$ 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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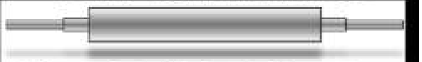
BALUN KITS



1:1 Current Balun Kits. Beads slip over the cable, shrink tubing holds them in place. Full legal power. 3.5-1000 MHz. Use two for 160M.
BA-8 fits 1/2" coax.........$18.95
BA-58 fits 1/4" coax.........$9.95
VISA +$8 S&H (for total order) Tax in Calif.

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MIRAGE. . .160 Watts on 2 Meters!

Turn your mobile, base or handheld into 160 Watt powerhouses and talk further, longer, clearer. . . All modes: FM, SSB, CW . . . Superb GaAsFET preamp . . . Overdrive, high SWR, Over-temperature protection . . . Remote controllable . . .

The MIRAGE B-5018-G gives you 160 Watts output for 50 Watts input on all modes -- FM, SSB, or CW!

Ideal for 25-50 Watt 2 Meter mobile or base. Weak signals pop out with its low noise *GaAsFET* preamp and its excellent 0.6 dB noise figure. Selectable 5, 8 or 14 dB preamp gain.

Exclusive MIRAGE *ActiveBias*™ circuit gives *crystal clear SSB* without splatter or distortion.

B-5018-G is legendary for its ruggedness and is fully protected -- high SWR or excessive input power automatically bypasses the B-5018-G to prevent damage.

Heavy-duty heatsink spans entire length of cabinet. Power transistors protected by MIRAGE's *Therm-O-Guard*™.

Has adjustable delay *RF sense* Transmit/Receive switch *and* remote external keying. 16-20 Amps at 13.8 VDC.12x3x5$^1/_2$ inches.

B-5018-G
$\$329^{95}$

B-1018-G, $409.95. MIRAGE's most popular *dual purpose* HT or mobile/base amplifier. 160 Watts out for 10 Watts in. For 0.25-10 Watt rigs.

B-2518-G, $329.95. Same as B-5018-G but for 10 to 25 Watt mobile or base. 160 Watts out for 25 Watts in.

RC-2, $49.95. Remote Control. On/Off,pre-amp On/Off, selects SSB/FM. With 25 foot cable.

Power Curve -- typical output power in Watts

B-1018-G	25	50	140	150	160	160	--	--	--	--
B-2518-G	5	7	40	60	80	100	125	160	--	--
B-5018-G	--	2	15	25	40	50	70	100	130	160
Watts In	.25	.5	3	5	8	10	15	25	35	50

35 Watts for 2 Meter HT

For handhelds up to 8 Watts. 35 Watts out for 3-8 Watts in (18 W out/1W in)! 18 dB *GaAsFET* preamp. All modes: FM, SSB, CW. RF sense T/R switch. Reverse polarity protection. Includes mobile bracket, 1 year warranty. 5$^1/_4$Wx1$^3/_4$Hx4$^3/_4$D in.

B-34-G
$\$129^{95}$

35 Watts, $\$109^{95}$, FM only

B-34, $109.95. 35 Watts out for 2 Watts in. Like B-34-G, FM only, less pre-amp, mobile bracket. 3$^1/_8$Wx1$^3/_4$Hx4$^1/_4$D in.

MIRAGE Dual Band
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- ***Built-in 4:1 Balun***
- ***Gear driven Turns Counter***

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HFT-1500
$\$479^{95}$

Large comfortable knobs and smooth vernier drives make tuning precise and easy. Bright red pointers on logging scales make accurate resetability a breeze.

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You can tune your SWR down to the absolute minimum! **Why?** Because all network components -- roller inductor and variable capacitors are fully adjustable.

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You can tune any *real* antenna from 1.8 to 30 MHz, including all MARS and WARC bands. You can tune verticals, dipoles, inverted vees, Yagis, quads, long-wires, whips, G5RVs, and more.

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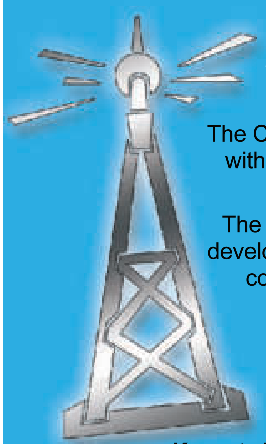
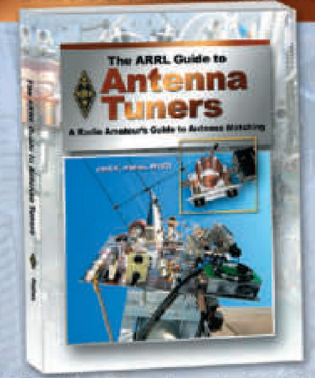



The ARRL Guide to
Antenna Tuners
A Radio Amateur's Guide to Antenna Matching


RIGOL DS2202

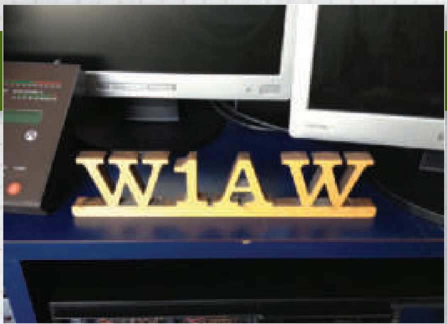
QST QuickStats

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 December 4, 2012 through January 2, 2013.
Get on the web and vote today at **www.arrl.org/quickstats**!

Is your call sign on prominent display at your home station?



Yes **62%**
No **35%**
I don't have a home station **3%**

Have you added the new Digital *QST* app to your iPad, iPhone or iPod touch?

Yes **21%**
No **19%**
I don't own any of these devices **60%**

What is your outlook for Amateur Radio in 2013?

Optimistic — I see good times ahead **55%**

Neutral — I see little change compared to 2012 **39%**

Pessimistic — Amateur Radio is in decline and the decline will continue in 2013 **5%**

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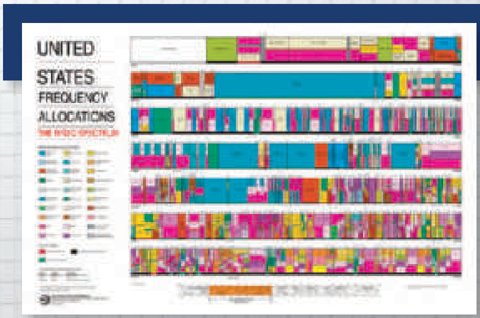
How do you feel about a possible Low Frequency allocation for US amateurs?



I'm excited! The sooner the better! **34%**

I'm unsure about what this band may have to offer. I'll wait and see. **42%**

Uninterested. I have no desire to operate below 160 meters **24%**

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*Optional microSD required

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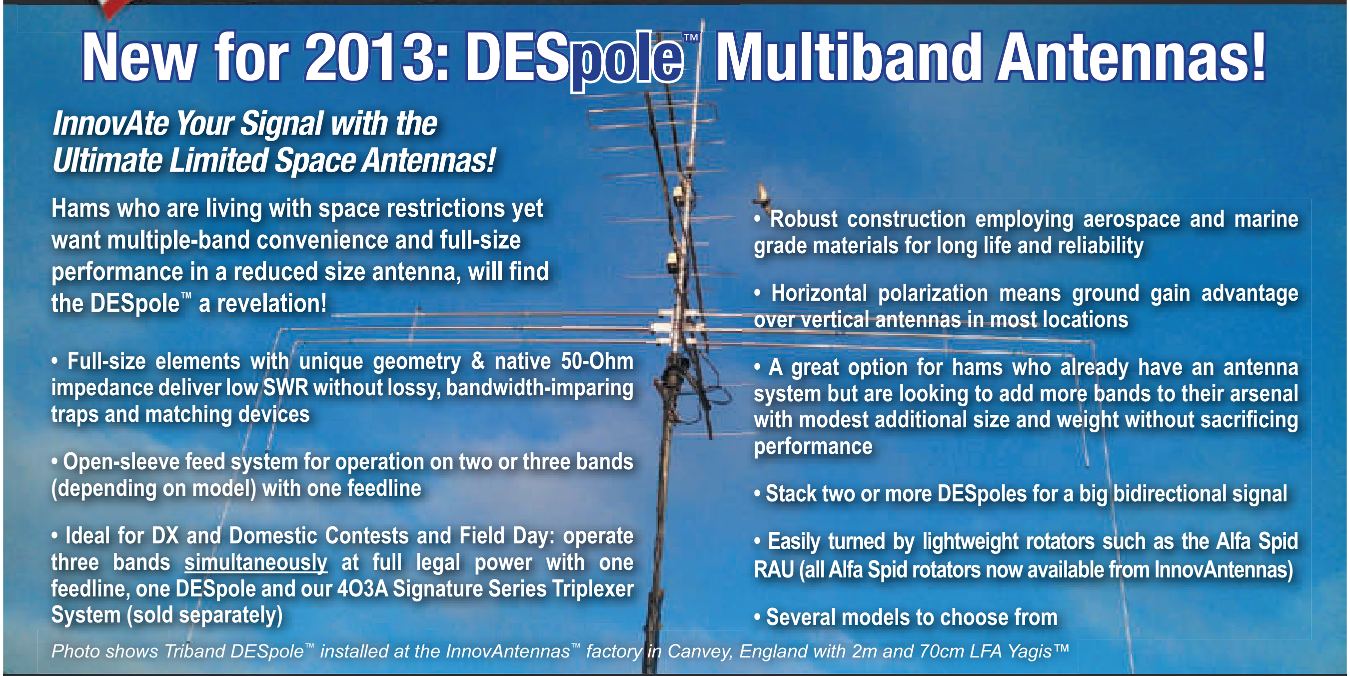

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- Ideal for DX and Domestic Contests and Field Day: operate three bands simultaneously at full legal power with one feedline, one DESpole and our 4O3A Signature Series Triplexer System (sold separately)
- Robust construction employing aerospace and marine grade materials for long life and reliability
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- A great option for hams who already have an antenna system but are looking to add more bands to their arsenal with modest additional size and weight without sacrificing performance
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- Easily turned by lightweight rotators such as the Alfa Spid RAU (all Alfa Spid rotators now available from InnovAntennas)
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Photo shows Triband DESpole™ installed at the InnovAntennas™ factory in Canvey, England with 2m and 70cm LFA Yagis™

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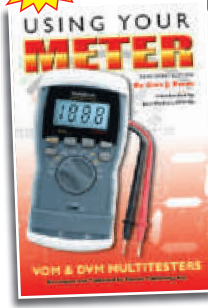

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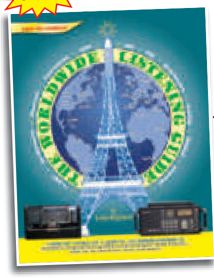

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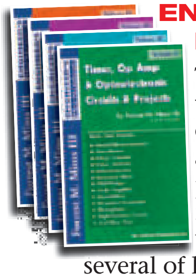

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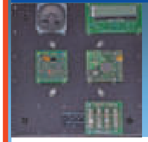

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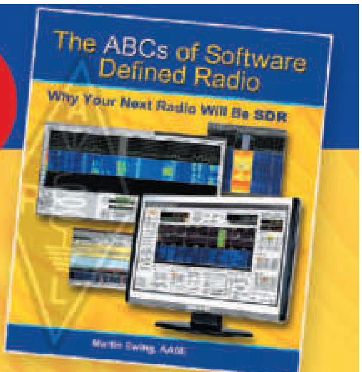

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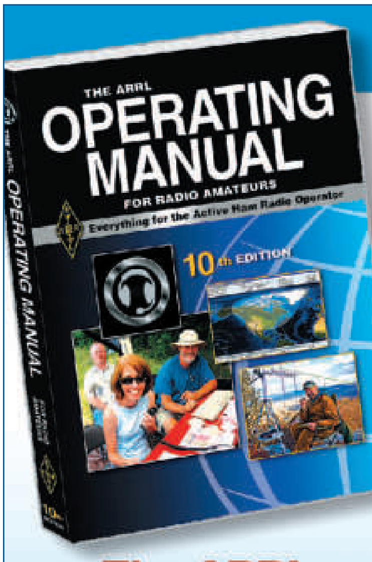

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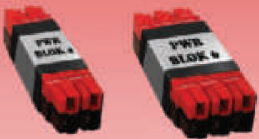

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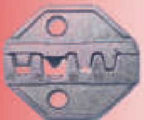

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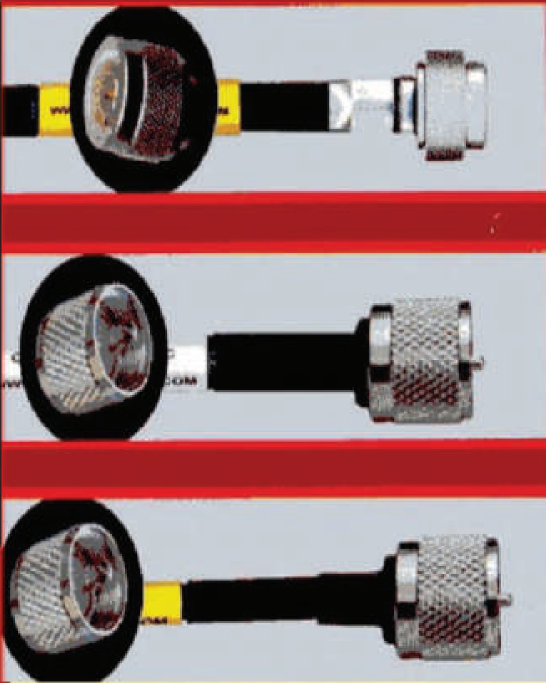

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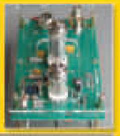

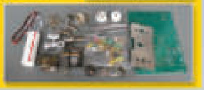

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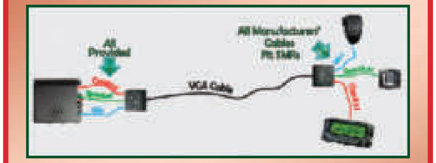

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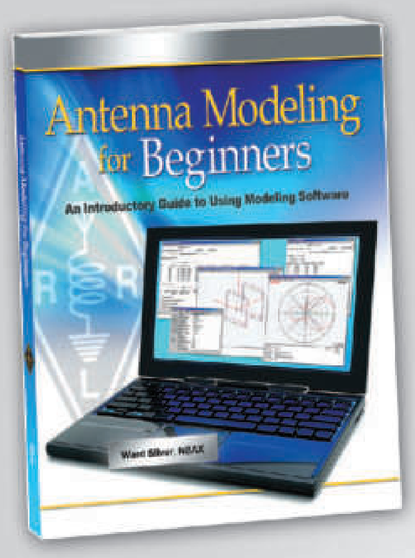

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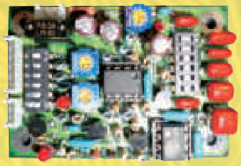

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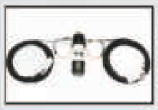

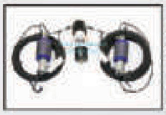

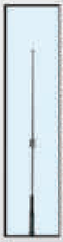

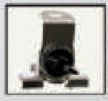

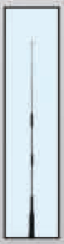

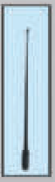

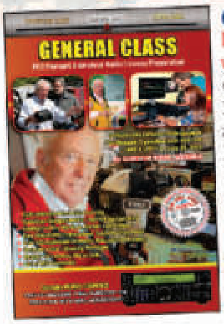

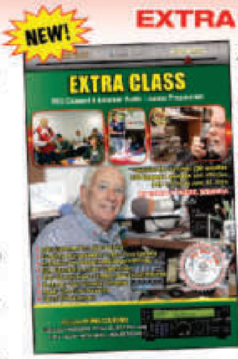

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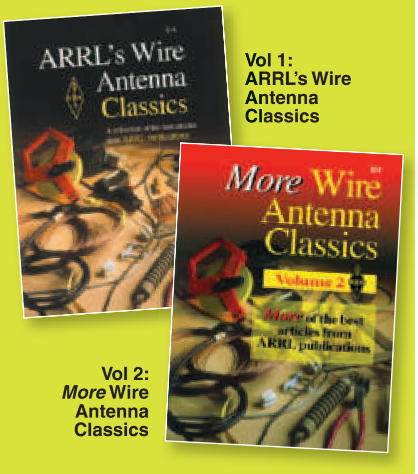

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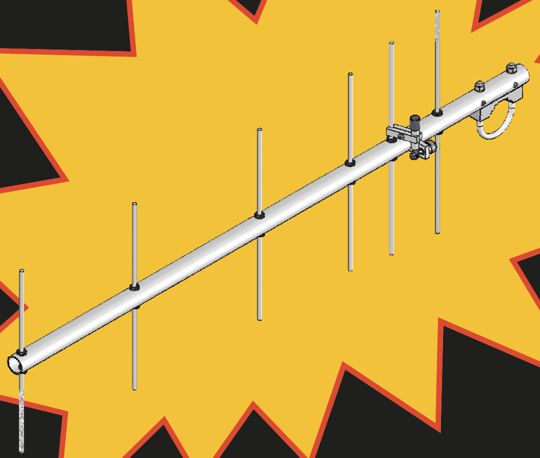

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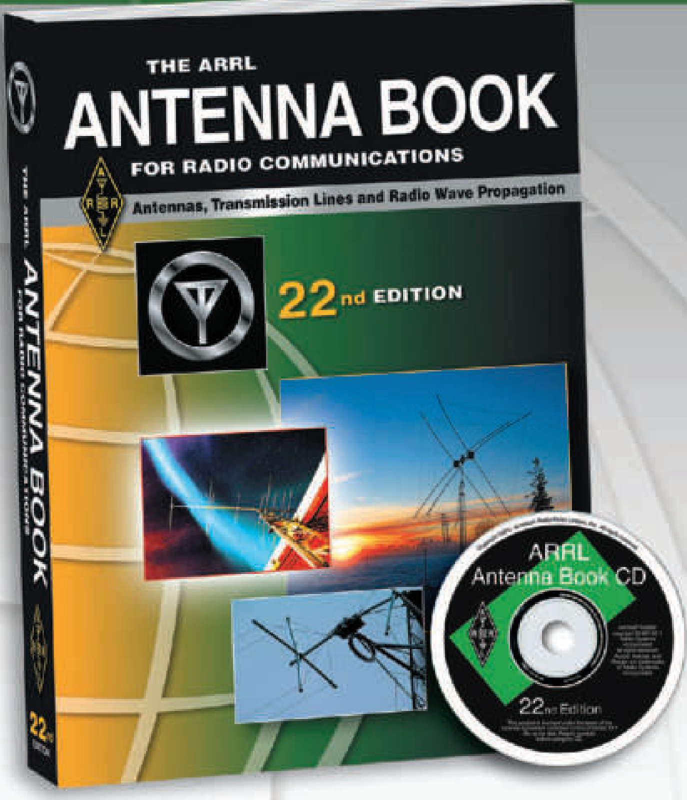

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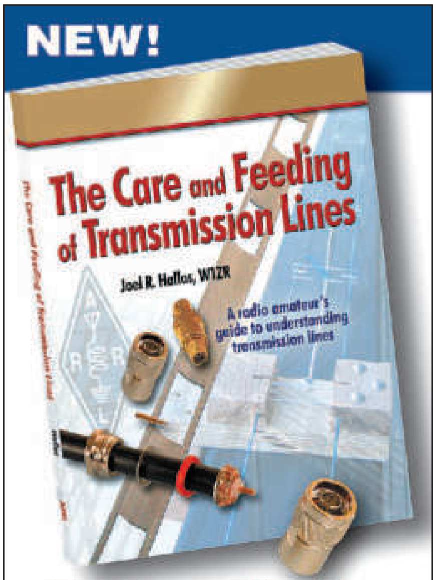
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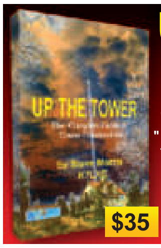

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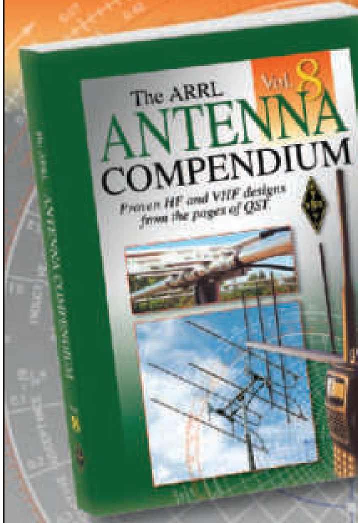

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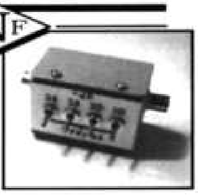

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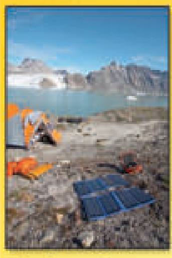

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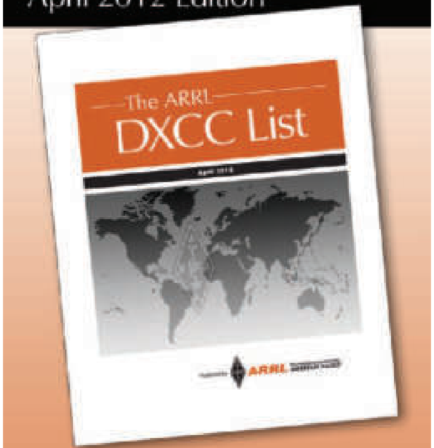
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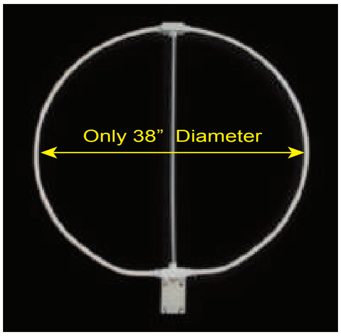
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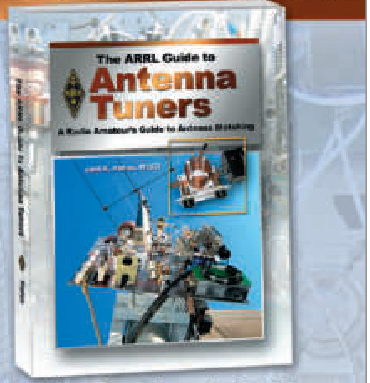
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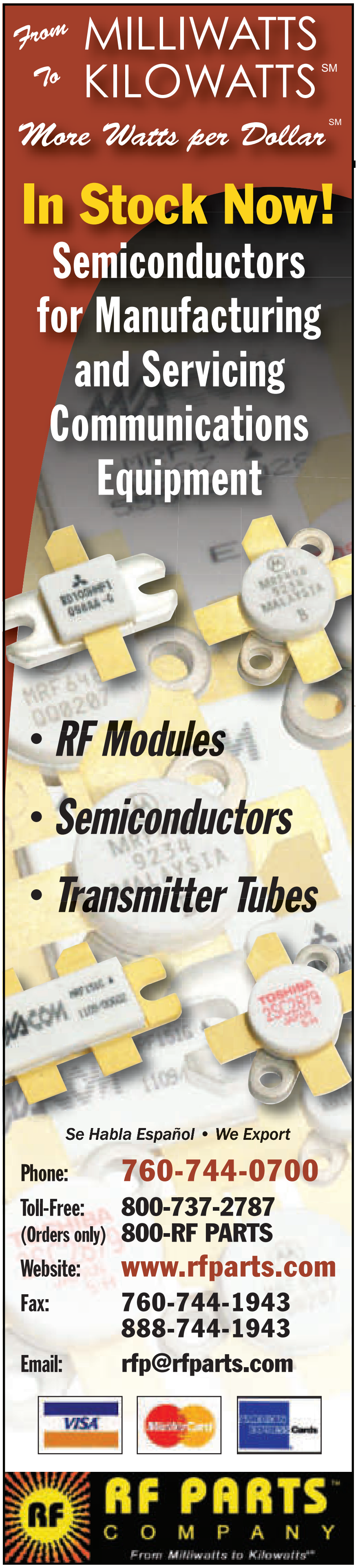

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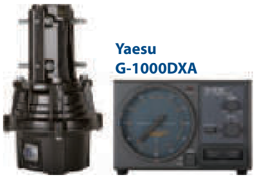

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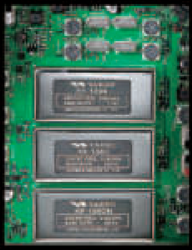

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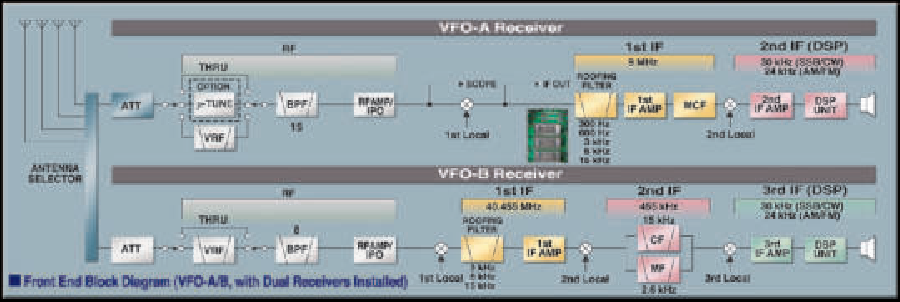
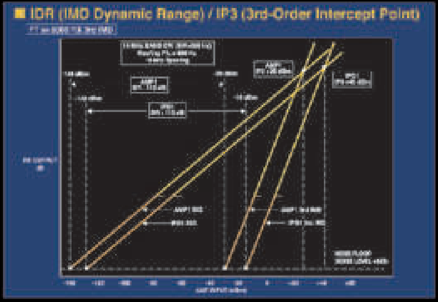


■ Front End Block Diagram (VFO-A/B, with Dual Receivers Installed)



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