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QST

DEVOTED ENTIRELY TO AMATEUR RADIO

November 2014 WWW.ARRL.ORG

DIGITAL EDITION

Special Product Review Issue!

QST reviews:

- **Hilberling PT-8000A** MF, HF, and VHF Transceiver
- **OM Power OM2500A** HF Power Amplifier
- **ERC-M** Rotator Controller and ***PSTRotatorAZ*** Software
- **Smart Tweezers ST5** LCR Meter
- **MFJ-4603** Antenna Window Feedthrough Panel
- **Telewave 44AP** RF Wattmeter
- **Radio Works Carolina Windom 80** Antenna

DIGITAL FEATURE

ARRL 100 YEARS

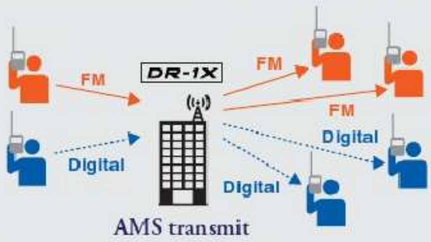
System Fusion

The Best Solution for the Future

System Fusion provides Total Integration of Digital and Conventional FM

FM Friendly Digital & Auto Mode Select (AMS)

System Fusion is designed to enable seamless intercommunication between conventional FM and C4FM Digital using a single unified platform, without manually switching between the communication modes.



This is made possible in System Fusion by the Auto Mode Select (AMS) function. With AMS, the modulation mode of your station is automatically selected according to the received signal. If a member transmits the conventional FM, the other System Fusion radios automatically select their modulation to conventional FM and permit communication between all members.

The Choice of C4FM Digital & New Attractive Digital Functions

System Fusion - C4FM Digital makes possible **9600 bps data speed** utilizing **12.5 kHz bandwidth**. **9600 bps data transmission speed** enables the high speed data communication and provide the new attractive digital functions to expand your enjoyment of the amateur radio communication.

Digital Group Monitor (GM)

Automatically checks whether members registered to a group are within the communication range, and displays the distance and the direction with each call sign on the screen.

Smart Navigation

Real-time navigation function enables Location checking at any time. With the simple touch of a button, you can start navigating to your departure point or any location previously saved. (Backtrack Function)

Snapshot (Image Data Transmission)

Simply connect an optional speaker microphone with camera (MH-85A11U), you can take snapshots and easily send them to other System Fusion radios.

For latest Yaesu news, visit us on the Internet: http://www.yaesu.com

System Fusion Lineup

C4FM Clear and Crisp Voice Technology

144/430 MHz DUAL BAND
C4FM/FM DIGITAL REPEATER

DR-1X

- Three digital modes and a Conventional FM mode
- Emergency Operation: Supports operation on an emergency battery

WIRES-X

Exciting New Amateur Digital Transceiver

C4FM Clear and Crisp Voice Technology

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

FT1DR Heavy Duty Package

(1800 mAh Li-Ion Battery FNB-102LI Included)

- Three digital modes and a Conventional FM mode
- Automatic Mode Select (AMS) Function
- Snapshot Picture Taking Capability
- Digital Group Monitor Function
- Smart Navigation Function

Equipped with advanced touch panel operation and full-color TFT large-scale display

C4FM Clear and Crisp Voice Technology

C4FM FDMA 144/430 MHz DUAL BAND
50W DIGITAL/FM TRANSCEIVER

FTM-400DR

- Three digital modes and a Conventional FM mode
- Automatic Mode Select (AMS) Function
- 3.5-inch Full Color Touch Panel Operation
- Snapshot Picture Taking Capability
- Digital Group Monitor Function
- Smart Navigation Function

Advanced VoIP wireless WIRES-X

C4FM Clear and Crisp Voice Technology

Amateur Radio Internet Linking Kit

HRI-200

- Advanced Internet VoIP radio communication is available with C4FM.
- Easy access to Node/Room stations by a simple operation.
- The NEWS Function enables exchanging messages, Images and Voice in the new communications method.

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

Includes video
Includes audio
Additional content

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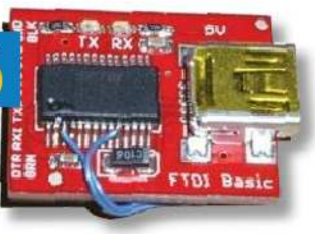

News and Features

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Our Cover

ARRL Senior Engineer Bob Allison, WB1GCM, is shown in the ARRL Laboratory's RF-shielded "screen room" where Product Review testing takes place. The Laboratory recently acquired new precision test equipment, including a Rohde & Schwarz FSUP 26 signal analyzer, a Rohde & Schwarz FSEM spectrum analyzer, and an Agilent MXA-9020A spectrum analyzer.

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Suggested Price $259.99
radio not included
AT-897Plus
Mounts on the side of your FT-897 just like the original 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.
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Matched in size to the Icom IC-7000 and IC-706. 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.
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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.
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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. 2000 memories cover 160 through 6 meters.
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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.
Suggested Price $159.99
Your Favorite Dealer has these tuners in stock NOW! Don't Miss Out - Call or visit them TODAY!

It Seems to Us

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

Re-Entry

"A new FCC rule should interest anyone who previously held a General, Advanced, or Amateur Extra class license, let it lapse, and would like to get back into Amateur Radio."

The August 2014 issue of *QST* reported the outcome of an FCC rule making proceeding, WT Docket No. 12-283, that dealt with several matters relating to licensing, examinations, and the use of TDMA emissions. The resulting changes to Part 97 of the FCC Rules took effect on July 21, and have been generally applauded by the Amateur Radio community.

Of particular significance to many former radio amateurs is an amendment to §97.505(a). This rule now instructs Volunteer Examiners to give credit for Elements 3 and 4 to an examinee holding an expired Amateur Extra class license, and credit for Element 3 to an examinee holding an expired Advanced or General class license. A longstanding provision that gave Element 3 credit to holders of "old" Technician licenses issued before March 21, 1987, when the Technician and General licenses had the same written exam, has been retained.

This change means that the FCC will issue a General license to someone who passes Element 2 (the current Technician exam) and demonstrates that they previously held an Advanced or General license without requiring that they retake and pass the Element 3 exam. Similarly, former Extras can regain their full-privilege licenses simply by passing Element 2.

The thought behind this accommodation of former licensees is that the Commission is willing to assume there is little or no difference between their qualifications and those of licensees who happened to complete the administrative process of renewing their licenses before their grace period expired. That's a reasonable assumption, and making the former licensee pass the current entry-level exam is a reasonable requirement to verify their commitment and their familiarity with the current rules.

While the news cannot yet have reached more than a small fraction of those who could benefit, the ARRL VEC Department reports that applicants already are taking advantage of this new opportunity. How do we get the word out to the rest?

This, dear reader/member, is where you come in. If you know someone who would qualify, pass it on!

But don't stop there. Explain that ham radio is better than ever, with new worlds to explore. The good things they remember are still here, but there's so much more! New digital data and voice modes — even new bands. Software defined radios that range from super-cheap to incredibly versatile. Ingenious new antenna designs for portable, mobile, and fixed station operation. Kits that outperform anything that ever came out of Benton Harbor. Compact gear that can be taken anywhere, with features that didn't exist when their license lapsed.

While the rule change opens up new possibilities, there is no reason to limit our outreach just to these former licensees. The same pitch is appropriate for other audiences. Inactive hams who still have their licenses. Former Novices and Technicians. Anyone who thought about becoming a ham somewhere along the way but never quite made it, either because of the former Morse code requirement, or for some other reason.

What's more, they are needed. In many places, the existing pool of trained operators for public service and emergency preparedness activities is not as big as it should be; their participation would be welcomed and would benefit their local communities. The knowledge, skills, and personal contacts they have developed in other walks of life can be put to good use through Amateur Radio.

We all know people, perhaps in our own families, who still hold licenses but are out of touch with today's Amateur Radio. Reaching out to inactive hams should be fairly easy; even if we don't know them personally, they're in the FCC database. By using the search tool on the ARRL website, at **www.arrl.org/fcc/search**, you can find every licensee in your city or ZIP Code.

Getting the message to former hams is more challenging. In our mobile society the "shelf life" of contact information is rather short, so old addresses are of limited value. Yet, there are hundreds of thousands of people across the United States who tried Amateur Radio at an earlier point in their lives but let their licenses lapse. Perhaps they were Novices when the license had a 1-year or 2-year term and was not renewable; in those days it was "up or out." Maybe the initial spark of interest didn't ignite, or life simply got in the way. Education, career, and family considerations can (and should!) come before one's avocation, and are bound to interfere to some extent. In the later phases of one's life, there may be more time to devote to earlier interests. All it may take to rekindle an interest is a reminder of the joy that came with the initial discovery of the world of Amateur Radio.

The ARRL's Centennial Year has been an energizing event. As we launch the Second Century, let's harness some of that energy to share our passion with those around us, either as individuals or through our clubs. This is always worth doing, but especially now, with the FCC offering an easier path to re-entry.

For all your 6m & HF needs; monoband to multi-band, base or mobile,
WE HAVE YOU COVERED!
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- Connecotr: SO239 female UHF
W735 Specifications
- Bands: 80m/40m
- Watts: 1.2kW (PEP)
- Length: 85.3'
- Connecotr: SO239 female UHF
W Series Wire Dipoles
SD330 Specifications:
- 3.5-30MHz or 7-50MHz
- 200 Watts (SSB)
- UHF Male or 3/8x24 connector
- 1/4 wave center loading
- Less than 2.0 VSWR
- 73" @ 3 MHz, 66" @ 28 MHz
HFV-5
HFV-5 Specifications:
- Bands: 40m/20m/15m/10m/6m
- Max Power Rating: 150W (SSB, 7/14MHz)
- 200W (SSB, 21/28/50MHz)
- Connector: SO239 female UHF
- Type: Trapped Dipole
- VSWR: Less than 1.5 (Within resonant frequency band)
Scan the code and check out our wide variety of antennas!
CP610 Specifications:
CP62 is identical, just without 10m Counterpoise.
- Frequency: 6m/10m
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- Connector: SO239 female UHF
Diamond Antenna is a division of RF Parts Company

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

The ARRL Laboratory Part 2 — RFI

Overview

Resolving member questions about Radio Frequency Interference (RFI) is a major function of the ARRL Laboratory. ARRL Laboratory Engineer Mike Gruber, W1MG, and Laboratory Manager Ed Hare, W1RFI, manage these areas. The first place to visit if you have an RFI question is the ARRL website, an excellent resource for RFI information, at **www.arrl.org/radio-frequency-interference-rfi**. This month we also have an article on this topic, *Locating RF Interference at HF*, on page 33.

RFI problems often fall into two categories: instances in which consumer devices cause interference to Amateur Radio reception, and interference to devices caused by Amateur Radio transmissions. Prior to the widespread acceptance of cable television, RFI problems occurred when Amateur Radio transmissions interfered with broadcast television. The Lab still deals with many RFI immunity cases where Amateur Radio interferes with poorly shielded and/or inadequately filtered devices such as telephones and audio equipment.

Today, most RFI problems occur when electrical and electronic devices interfere with Amateur Radio reception. Devices such as power lines, switching and wall-wart power supplies, motors, and lighting control devices are not radio transmitters per se, but they can generate RFI. These are unlicensed devices and FCC rules require that most of these devices meet limits for both radiated and conducted noise. The rules also require that the operator of any unlicensed device must use it in a way that does not cause harmful interference to licensed radio services.

Power Line Noise

Power line noise is a major concern for radio amateurs. Arcing on power lines and associated equipment usually causes this type of interference. Mike Gruber, W1MG, who handles most of the electrical power line cases, first works with the amateur who is having a problem to ensure that the ham has tried to resolve the problem with the power company. Mike then contacts and works with the power company involved in the complaint. The Lab staff makes their best efforts to solve these problems dealing directly with the involved parties, however, should that effort fail, the staff forwards the case to the FCC Enforcement Bureau. That way, the FCC, whose resources are limited, can focus their efforts on the cases that require the most attention. This arrangement between the ARRL Lab and the FCC is known as "the ARRL/FCC cooperative agreement on interference." Once a complaint becomes an FCC enforcement matter, the ARRL no longer has direct control of how the FCC handles the complaint since the ARRL does have any authority to enforce FCC Rules.

To properly evaluate power line noise and other unintentional RF emissions, the Lab has industry standard test equipment, including a special wideband receiver that can locate and identify RFI sources. This equipment enables the Lab staff to identify specific causes, and types of RF noise. The staff usually does not go out into the field and solve RFI cases, but the lab uses this equipment to train power company personnel in RFI location and prevention during periodic seminars that it hosts at ARRL Headquarters. The ARRL's website has extensive information about power line noise at **www.arrl.org/power-line-noise-faq** and **www.arrl.org/FCC-Power-Utility-Letter**.

Conducted Emissions Testing

For most devices that are connected to the ac mains, the FCC has set limits for the noise that is conducted onto the ac mains (conducted emissions). Once these emissions are conducted onto a device's power cord, a house's electrical wiring often radiates them fairly efficiently. This type of RFI can extend beyond a single household via radiation or conducted by the power lines to nearby houses.

The ARRL Lab measures conducted emissions in its LISN (Line Impedance Stabilization Network) test facility room. This facility lets the Lab measure conducted emissions to determine if devices comply with FCC conducted emissions specifications. As an example, using this resource, the Lab recently tested horticultural grow lights and determined that they exceeded the conducted emissions levels. As is the case with power line noise, the Lab staff first tries to work with a manufacturer to resolve an RFI issue. If that fails, a complaint is filed with the FCC.

In Summary

While many are easily resolved, some RFI issues are complicated to resolve because they involve equipment manufacturers, utility companies, regulatory and enforcement agencies and, quite often, our own neighbors. The more complex RFI cases require significant technical and legal expertise, specialized equipment, and superior people skills. It's not an easy or simple job, but the ARRL Lab is up to the task. Next month I'll be discussing our industry and technical/professional society involvement with RFI and ARRL Lab topics.

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

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

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Pinning the Calorie Meter at 40 dB over S9

For many QST readers, November is about Sweepstakes contesting and Thanksgiving, not necessarily in that order. So with all due respect to high-carbohydrate sweetness, be it for contest sustenance or holiday feasting, we say, "Let them eat cake!"

When Jonathan Setcer, N5QJ, and Sonia Picado, KE5EIW, said their marriage vows, the groom requested this impressive confection to celebrate the event. Incorporating an Amateur Radio theme made perfect sense because Jonathan and Sonia met at Field Day and became engaged in the park where Field Day was held. The father of the bride is Sergio, KE5CUY, and groomsmen were Nick, WA5BDU, and Dennis, W5RZ. [Dennis Schaefer, W5RZ, photos]

The groom's cake crowns multiple tiers of cupcakes.

A close-up of the cake, complete with a handheld transceiver.

When Bob Smith, KK3P, turned 80 years old, he was astonished to receive this cake from his son and daughter-in-law, Eric and Susan Smith. It was crafted to their specifications by Yum Bunnies Cakery in Belmont, Massachusetts. Despite the high noise levels at the birthday party, Bob reports that the rig's performance and taste were "FB."

John Crowell, KE5GFJ, received a tasty surprise from his wife to honor his 60th birthday. She created a cake decorated with the likeness of John's Yaesu FT-847 transceiver, including an MB-100 microphone.


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DR-135TMkIII
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29MHz FM MOBILE TRANSCEIVER
DR-03T
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Letters from Our Members

During 2014, in honor of the ARRL Centennial year, each "Letters from Our Members" column will feature a letter from a past issue of QST.

Spark Forever?

The 1950s and early '60s saw the rise of SSB as the preferred mode for HF voice communication. The transition was not without conflict, however, as this letter from the January 1963 issue of QST *illustrates. — Ed.*

Why don't we get some courageous leadership out of the ARRL for a change? I have reference to the elimination of a.m. from the 1.8- to 32-Mc. ham bands. The League has argued indirectly that a.m. takes up too much space, and only recently you decried the "chaos" on 20 phone.

Let's get on the ball and ask the FCC to give the a.m. boys six months to go s.s.b. or follow "spark."

K.A. Fichthorn, W1BGJ, Southington, Connecticut

Thanks to Penny Harts, N1NAG

When I begin flipping through the September issue of *QST*, I stopped at page 13. There at the bottom half of the page was the message, "Penny Harts, N1NAG, Retires," which triggered a flashback to September 2003. My employer had sent me to New Haven, Connecticut. The work was supposed take about a week, but I was able to get it done in 3 days. I had a couple of days to kill, so I figured I'd go up to Newington and visit HQ.

As I walked into the lobby, Penny, N1NAG, gave me an enthusiastic welcome. Her face lit up like the noonday sun, and I was immediately set at ease. After a few questions about who I was, where I was from, my call sign, etc, she took me on a guided tour of the building. Penny introduced me to the whole staff that day. She then handed me off to Joe Carcia, NJ1Q, to take me out to the antenna farm and W1AW itself.

Penny went out of her way to be courteous and kind. That is a trait missing in a lot of businesses today. It was obvious that she cared about the people who worked there, as well the members and others who came to visit. Forty-six years of service to the ARRL says it all, as far as I am concerned.

Hank Dean, KU8S
Sanford, Florida

Once in a Lifetime

Over 40 years ago, when I first got my Novice ticket, I heard a DXer lamenting about missing his "once in a lifetime" shot to work his last country. It seemed that he had been severely ill during the DXpedition in question, and had been unable to work them. I never could understand his feelings — but I do now.

Back in January, I noticed DX spots for W1AW/4 North Carolina and W1AW/8 West Virginia. It wasn't until January 18 that I heard from another ham about the W1AW portable operations.

Getting W1AW WAS became my goal. I worked hard to get the states I had missed. When May 7 came, I looked forward to catching up with Utah, but it turned out that they had been moved to July.

On July 1, disaster struck. I got a call from my wife. Her mother had fallen, and broke her hip. By the time I got back to ham radio on July 17, I had missed the Utah/Wisconsin week. Wisconsin was no big deal; I had worked them in February. But Utah was a deal killer. A W1AW WAS was no longer possible.

I revised my goals; now I'm just trying to get my last two states for Triple Play. Now I know how it feels to lose your "once in a lifetime" ham radio moment. Even with the setback, I still am enjoying the Centennial event. Who knows — I might live to be 157 years old for the second centennial celebration. It could happen, right?

Joe Sands, W7UV, Life Member
Las Vegas, Nevada

Thoughts on H.R. 4969

I read with interest David Sumner's, K1ZZ, "It Seems to Us" column, "H.R. 4969: Cosponsors Needed!" in the September issue of *QST*.

As David points out, and I agree with him on both of these facts, existing law does not protect amateur antenna systems from prohibitions in residential CC&Rs, as it does protect us from prohibitions in local or state zoning laws; and the incidence of CC&Rs in residential developments has grown significantly since the existing statute was enacted.

There is, however, an issue that goes beyond Amateur Radio — which is, after all, our hobby, even if it does serve the public interest. Unlike governmental restrictions such as zoning laws, which federal law can limit or trump under the "Supremacy Clause" of the US Constitution, CC&Rs are not local laws. They are the terms of private contracts. They may seem like governmental restrictions, since they can be enforced in the public courts if the related property owners care to do that, but they are not. CC&Rs come about by agreement between a developer and the initial holders of a property, and every subsequent purchaser is bound by them by their own private agreement to purchase the property.

As much as we may dislike no-antenna covenants (one of which forbids external antennas at my home QTH as well), there is a fundamental difference between the federal government trumping local governments, and the federal government trumping private contracts. H.R. 4969 would not be the first or the only such law; but we should be cautious in asking government to exercise its muscle against what are fundamentally private agreements. The precedent may well be unwise in the larger scheme of things. I do not mean to ask for organized opposition to the ARRL's position on the issue; but I would ask that we be cautious in what we ask for.

Edward A. Dauer, KN1CBR, LL.B., M.P.H.
Denver, Colorado

David Sumner, K1ZZ, notes: H.R. 4969 breaks no new philosophical ground and establishes no new precedents. Covenants against certain types of antennas are already prohibited. See ***www.fcc.gov/guides/over-air-reception-devices-rule****, which explains the limits on covenants affecting satellite dishes, TV antennas, and fixed wireless antennas.*

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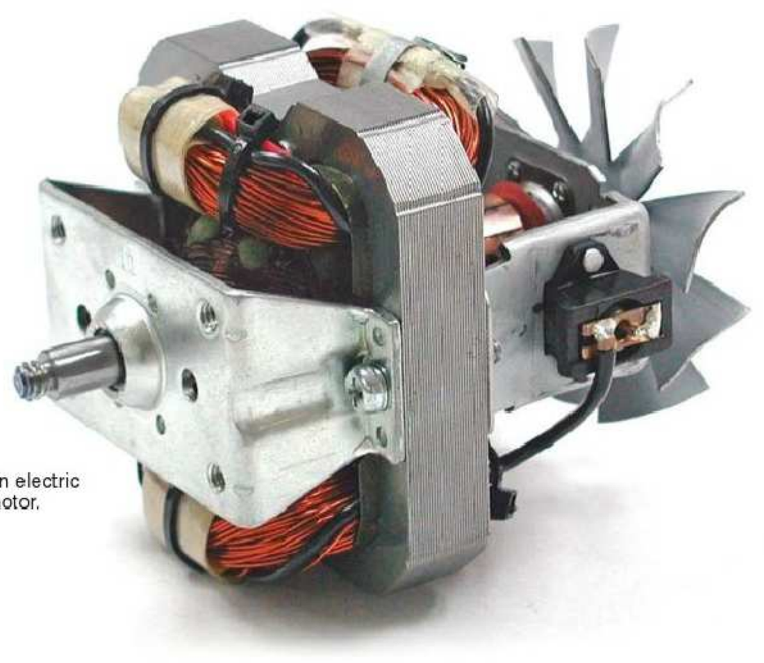
Motors and Mechanisms in the Ham Shack

Your shack contains many electromechanical devices that whir, rattle, clatter, and occasionally bang. Here's a brief guide to what they are and what they're for.

Eric P. Nichols, KL7AJ

It's easy to overlook the less glamorous electromechanical technology of motors and actuators in the ham shack. Motors can be mystifying, solenoids — annoying, and steppers can be staggering. We totally ignore them, until they fail to work in the proper manner. This article will take some mystery out of these devices, and describe some of the wonderful new developments in electromechanical gadgets that will infiltrate the ham shack of the future.



An electric motor.

Electromagnets

More than any other device, the *electromagnet* is responsible for moving things around in your ham shack, whether it's the rotator that twirls the cubical quad atop your tower, or the diaphragm that wobbles air between your dynamic headset and your ears. We'd be hard pressed to get much hamming done without electromagnets. Despite developments in electrostatic, piezoelectric, and fluidic actuators, the electromagnet still reigns supreme among electromechanical devices.

Solenoids

Most mechanically meaningful electromagnets appear as some form of *solenoid*, which is a coil of copper wire wrapped around some form of core. The *core* is nearly always an iron-bearing (ferrous) material, which serves to increase the permeability of the solenoid. The core concentrates the field, making a more powerful electromagnet for a given amount of occupied space. The iron core is typically made of laminated soft iron to minimize hysteresis effects, which tend to make an electromagnet a permanent magnet. Although permanent magnets have an important role in electromechanical devices, you don't want unintentional permanent magnets.

A solenoid is often used in conjunction with an *armature*, a movable slug or lever of soft iron in proximity to the solenoid. An energized coil attracts the armature. The *relay*, or electromechanical switch, is one of the simplest applications of the solenoid.

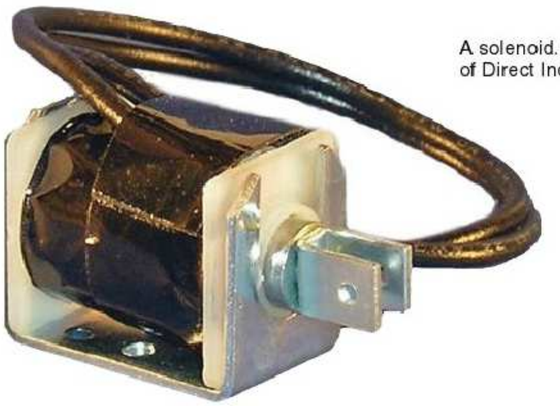
Relays range from nearly microscopic reed relays to monstrous contactors used in power substations. Solenoids can be extremely fast and powerful, but they are somewhat difficult to control in a linear fashion. Solenoids are generally either fully on or fully off. For a given coil current, the magnetic pull against the armature changes radically with distance. For this reason, straightforward solenoids are seldom used in robotic devices or with other electromechanical devices that need a smooth motion over a wide range. For robots, we need a more sophisticated actuator configuration of the electromagnet.

Before GPS, the 60 Hz power grid line frequency was by far the most accurate frequency standard available to the average ham.

Motors and Rotors

The next level of electromagnetic device complexity is the *motor*. There are countless varieties and configurations of motors; they all have some common elements. Motors can be broadly categorized as *dc* or *ac motors*. Commonly, dc motors often use permanent magnets. Generally, ac motors are synchronous, meaning their speed of rotation depends on the ac line frequency. Some motors, such as induction motors, are "semi-synchronous" in that their speed depends on both the line frequency and line voltage, as well as on the load.

Some form of commutation is needed with dc motors and generators. A *commutator* is a device for periodically reversing the polarity of the armature current. Commutators are generally troublesome



A solenoid. [Image courtesy of Direct Industry]

A servo motor.

and require maintenance, which is why most cars converted from dc generators to alternators in the late 1950s. Recently, *brushless dc motors* (where the commutator has been replaced with a solid state switch) have been appearing in ham radio and computer fans. The brushless dc motor is not a synchronous motor.

The surprisingly accurate old-fashioned ac wall clock uses a synchronous ac motor. This is because the 60 Hz line frequency of the US power grid is atomic clock accurate when averaged over long periods. In fact, before global positioning satellites (GPS), the 60 Hz power grid line frequency was by far the most accurate frequency standard available to the average ham. So, don't toss out your plug-in wall clock just yet.

Servo with a Smile

The *servomotor* or *servomechanical device* is a marvel of the last century. A servomotor has a feedback mechanism (loop) to reduce or compensate for mechanical errors somewhere in the system. The servo loop is analogous to the negative feedback amplifier. In fact, the math describing them is identical. Feedback theory became formalized after World War II.

There are several types of motor feedback loops that control speed, position, phase, or a combination of them. The nearly universal phase-locked loop (PLL) used in modern transmitters and receivers is actually derived from motor speed servo control. Any type of servo loop requires an independent reference, a comparator, and a controller. A typical antenna rotator, which uses a positional servo loop, employs all three items.

The *controller* is the bi-directional motor, which is often a split-phase ac motor. That is an ac semi-synchronous induction motor with two windings at 90-degree angles. Switching a proper capacitance into one of the windings creates a phase shift in the motor, causing the motor to run either clockwise or counterclockwise at a constant speed. You (or the controller) need some sort of feedback to tell you when the rotator is pointing where you want it. The simplest directional detector is a potentiometer attached to the rotator output. This is the independent reference. Finally, you need a *comparator*, which is another potentiometer in the control box that compares the voltage from the reference potentiometer in the rotator assembly with the position of the "big knob." When these two values are equal, the voltage to the motor shuts off. The motor may reverse briefly or it overshoots.

More than any other device, the electromagnet is responsible for moving things in your ham shack.

Servo loops are also used in automatic antenna tuners, although the trend favors using stepper motors, which are easier to design than tricky feedback loops.

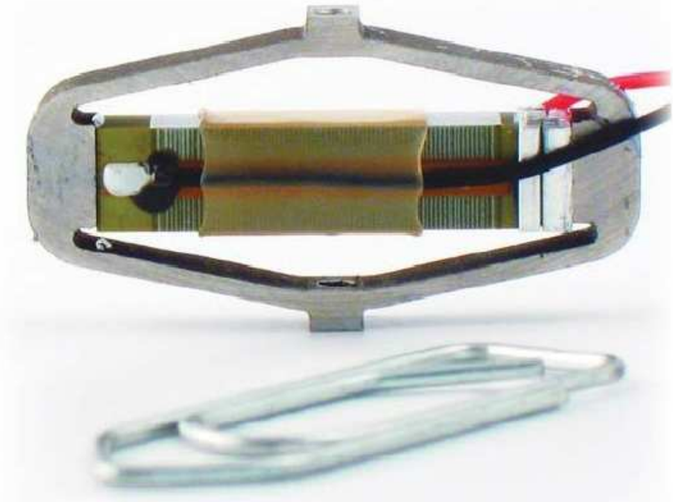
Selsyns and Synchros

The *synchro* or *selsyn* (for self-synchronizing motor), once very prevalent, is one of the coolest devices ever created. A selsyn set consists of two motor-like devices connected by five wires. Neither one of them rotates when you apply power. However, if you turn the shaft of one selsyn, the other one turns by the exact same amount. These were once used as rotational transducers on countless post-war ham antenna rotators. Earlier they were used extensively on radar systems or anywhere else you needed remote indication of a rotational value.

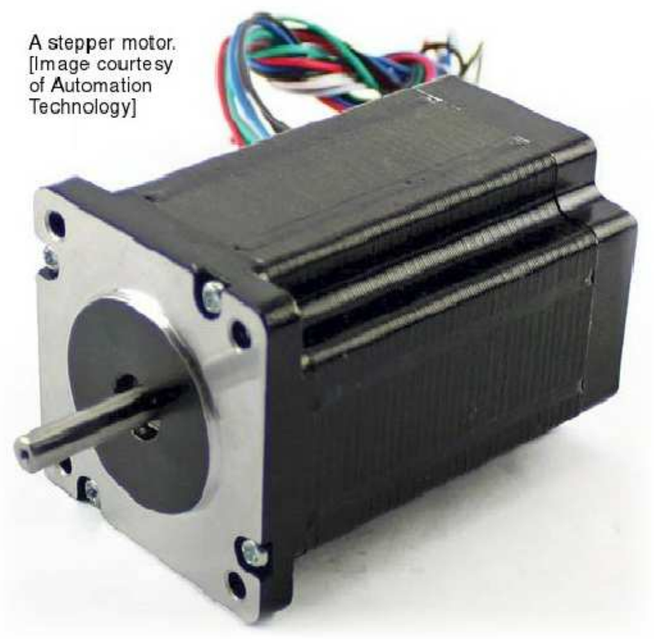
Most selsyns are designed to use 440 Hz ac, so if you plan on using one you might want to build a small 440 Hz inverter. Internally, the selsyn is a modified three-phase motor with a three-phase stator, and a two-phase armature. Each of these legs is connected to the matching legs on the complementary device. Power is applied in parallel only to the armatures.

Stepper Motors

The stepper motor may be the greatest departure from conventional motor design, and was made possible by very powerful and relatively cheap rare earth magnets. With the proper drive electronics and programming, the stepper motor is capable of very rapidly and repeatedly returning to a precise position. They are the heart of most computer printers and many computerized machine tools. However, a stepper motor can lose count of steps occasionally, which means some sort of reset or reboot function is needed in the more critical applications.



A piezoelectric actuator. [Image courtesy of Direct Industry]



A stepper motor. [Image courtesy of Automation Technology]

A servo-motor, on the other hand, won't lose its place.

The *linear actuator* is a useful variation of the stepper motor. It is basically a stepper motor driving a precision jackscrew. These are capable of tremendous amounts of pushing and pulling force and extremely high accuracy. Most micropositioners used in microsurgery and micro-manufacturing use some sort of stepper linear actuator. These require careful programming. Linear actuators are often used in robotic systems.

Small-scale Forces

There are electromechanical methods that do not rely on magnetism to move things. Most hams are familiar with piezoelectric properties of quartz crystals. When you apply an electric field to a hunk of quartz, it warps slightly. Until recently, this amount of warping was considered too minuscule to do any real work. However, *piezoelectric actuators* are now used for performing surgery on the cellular level. Only slightly less refined than the piezoelectric actuator is the magnetostrictive actuator. *Magnetostriction* is the distortion of a metal by an electric field, as used in the famous Collins mechanical filters. Magnetostrictive actuators are used in micro-manufacturing as well.

Finally, we have *electrostatic actuators*. These have the least amount of force available, but are very cheap and are useful for many special applications. Electrostatic transducers have been used for a long time as components of loudspeakers and headphones.

An electric motor armature.

Not all electromechanical devices are even solid. For example, spiders use hydraulic pressure to extend their limbs, as they lack extensor muscles. And in a similar fashion, tiny robots use tiny hydraulic systems. Special MHD (Magneto Hydro-Dynamic) fluids can be pumped directly with tiny electric currents instead of master cylinders, which can result in robots that are smaller — and creepier — than spiders. Now you know.

Back on Earth

It will probably be a while before armies of spider-droids are going to have much application in the typical ham shack. However, we need to realize that mechanical devices are not going to go away any time soon. There are certain things you just can't do with silicon and software.

ARRL member Eric Nichols, KL7AJ, has written numerous articles for many Amateur Radio and electronics experimenter publications over the past 30 years. He can be reached at PO Box 56235, North Pole, AK 99705 or **kl7aj@arrl.net**.

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

Locating RF Interference at HF

A proven and practical approach to dealing with RFI from grow lights and more.

Tom Thompson, W0IVJ

Radio frequency interference (RFI) increased dramatically in my neighborhood recently. Locating the sources was not easy, due in part to the distances involved. The typical range for a consumer device that meets the applicable FCC Part 15 or 18 emissions limits is usually no more than a few hundred feet. Some of the sources in my area, however, were more than a half-mile away. The usual "sniff" methods weren't practical, and without an initial heading, the sources were difficult to find. Furthermore, they were primarily HF sources. I needed a radio direction finder, but an HF handheld Yagi was not an option!

Looking for Noise Sources

Some noise sources are caused by arcing power lines, which, at close range, can wipe out all bands from AM broadcast to beyond 70 centimeters. The noise is relatively constant and uniform across the spectrum. It sounds like a constant harsh raspy buzz everywhere you tune, and can often go away during periods of rain or high humidity.

Many power companies lack the resources to find and fix noise sources in a timely manner. Thus, hams can attempt to locate such sources as an aid to their power company. Finding a distant source can be difficult. Nearby, you can track power line noise at VHF or UHF right down to the pole. At longer ranges, however, the noise might be heard only at HF. So, HF RDF to get you in VHF range can be a real time saver. See **www.arrl.org/power-line-noise-faq** for more information.

I also found that RFI from consumer devices can be problematic. While FCC Part 15 and Part 18 rules define emissions limits for most consumer electronics, the limits are high enough to allow interference to nearby radio receivers. FCC rules protect all licensed radio services from harmful interference, and the operator of an offending device must correct the problem. Therein lies the rub — someone must first find the device in order to identify the operator. Since the FCC generally does not provide RFI locating services, the burden became mine by default.

Some Typical RFI Sources

Switching-mode power supplies, usually associated with consumer electronic devices or battery chargers, often spew RFI at very high levels. They can emit signals in a regular and repeating pattern of spectral peaks, ranging from about 50 to 70 kHz, which exhibit a growling sound that may drift slightly in frequency. Such RFI noise "signatures" can sometimes help you distinguish between power line noise and noisy consumer electronics. If the audio noise bursts from your receiver seem to stand still on an oscilloscope with triggering set to LINE, the RFI might be power line related.

RFI from consumer devices that appears at regular intervals across the band likely comes from a switching-mode power supply. If the noise is pulsing it could be a battery charger. Sharp periodic ticks could be from an electric fence. Variable speed motors in appliances, like washing machines, increasingly rely on electronic speed controls and switching power supplies. See also *Light Bulbs and RFI — A Closer Look* for an additional discussion on FCC rules and interference from modern energy-saving light bulbs.[1]

Locating the Noise Source

Power-line noise, especially if it affects only the lower frequency HF bands, can sometimes be caused by a source several miles away. However, if the source is a consumer device that meets the FCC limits, it most likely will be located in your home or a neighbor's home. In this case, always start by temporarily turning off the main breaker to your residence while listening to a battery-powered radio. Also, disable any battery-powered devices. If the source proves to be external to your home, you can use the procedure from Mike Martin's RFI Services web page to find the residence.[2] This approach works well when consumer

[1]Notes appear on page 39.

Figure 1 — An RFI tracking system.

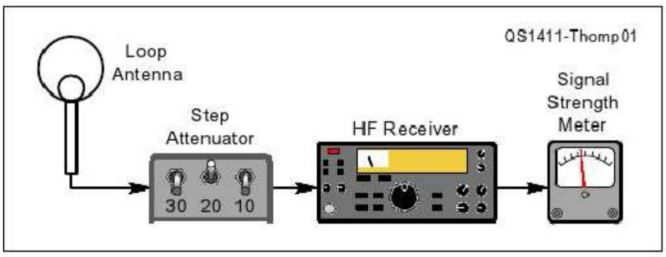


Figure 2 — Tracking loop antennas. Left to right: 24-inch copper loop, 20-inch aluminum loop, 16-inch #22 AWG wire loop with plastic tubing.

devices are within a few hundred feet of the ham. There are, however, some important exceptions.

The Grow Light Problem

A very cooperative manager of a hydroponic store allowed Larry Benko, W0QE, and me (Tom Thompson, W0IVJ) to test some of his ballasts and lights. Also, one grower loaned me his equipment for the day during his "lights off" period. Using a line impedance stabilization network (LISN), we measured conducted emissions 40 dB above FCC Part 18 limits. The RFI in the HF spectrum from these ballasts can easily be heard a half-mile away. These products are available from multiple vendors; some have a sort of FCC sticker, but appear to have never been tested. The RFI is of such a magnitude that common mode ferrite chokes alone do not eliminate the interference. Larry and I developed filters that decreased the RFI from S-9 +40 dB to S-5 as measured on my IC-7000 from a short distance.[A, B] Recently, an employee from the local power utility company said that about half of his RFI complaints were from grow light ballasts. In my experience, the 40 meter band seems to be where that sort of RFI is the strongest.

[A]www.w0qe.com/RF_Interference/grow_light_electronic_ballasts.html
[B]tomthompson.com/radio/GrowLight/GrowLightBallastFilter.html

Not Your Typical Source of RFI

In my experience, the most insidious and problematic RFI generators are high-power lighting systems, particularly grow lights used for cultivating plants indoors. Although classified as Part 18 devices, they are subject to similar emissions limits as Part 15 devices. Since these devices can cause detectable RFI for blocks if not miles, they would appear in many cases to be exceeding the FCC limits. One grow light tested in the ARRL Lab exceeded the applicable Part 18 FCC limits by 58 dB, and several that I have tested exceed Part 18 FCC limits by more than 40 dB. While the techniques in this article can be used to locate a wide range of RFI sources, my primary objective was to track down grow lights. Almost overnight, they had become the primary source of harmful interference affecting my station in Colorado.

Many amateurs keep a close eye on their RF background noise level. If an increase occurs randomly, and appears to coincide with periods of human activity such as weekends or evenings, it may be a consumer device. Power-line noise can also occur at random intervals but is often weather related. If, however, the noise comes and goes at regular intervals that appear to be controlled by a timer, then a grow light ballast is a likely culprit. These systems generally cycle on and off daily in approximately 12 to 16 hour intervals, although this timing sequence may vary depending on the plant. Another clue is the distance over which the interference can be heard. Typical consumer devices will fade away in 200 to 300 feet. Grow lights, on the other hand, can be problematic to well over 1000 feet.

So far in my neighborhood I have tracked down six grow light ballasts and three halogen light ballasts. Most of the grow light systems have been on a timer with a 12-hour on/off sequence. Some halogen yard lights, however, might be on a timer that is turned on and off at regular intervals. Grow light systems may also be off for a week or two during harvest, and can be on continuously during germination.

Both of these lighting systems, with the exception of a halogen desk lamp, can employ very high-current switching-mode power supplies. Some halogen systems run multiple bulbs totaling several hundred watts on a 12 V system. Grow lights, on the other hand, can require more than a kilowatt. The radiating antenna is generally the house wiring and associated cabling. To be clear, the bulbs themselves, whether they are halogen tract lights or high-pressure sodium grow lights, are not the problem. It is the poorly filtered electronic ballasts that cause the problem. See the sidebar, *The Grow Light Problem*.

If you can determine the on/off sequence of the RFI, listen to your radio when the RFI begins. The noise sounds stronger and has a burbling sound to it until the lamp warms up, which is generally less than 5 minutes. A free program, *Audacity*, will enable you to make an excellent audio recording from your receiver audio output.[3]

Finding the RFI Source

Once you have an idea of what might be causing the RFI problem, you still need to find the source. Figure 1 shows a block diagram of the HF RDF system that I use. Grow light RFI is often prevalent in the 40 meter band, but a Yagi antenna is obviously not practical. A short dipole has directional characteristics only for horizontally polarized signals. RFI from consumer devices seem to be mostly vertically polarized. Besides, the short dipole needs a preamp to make it effective. The preamp must have sufficient dynamic range to prevent intermodulation from strong broadcast stations. One locating approach is to walk around the suspect area with a handheld shortwave radio with a telescoping antenna. The antenna can be shortened to help minimize the signal at ranges close to the source. Driving around with a mobile rig can also work, especially if the source is some distance away. However, I found that a small tuned loop antenna used with a shortwave receiver and a good S meter (Figure 1) works best.

The Loop Antenna

A loop antenna is bidirectional. You can rotate the loop easily if you hold it above your head with the feed point at the bottom. In this position, vertically polarized signals peak when the loop is turned edgewise to the source. Additionally, a deep null in the signal occurs for vertically polarized signals when the loop is turned 90 degrees from the peak position. In other words, the signal is nulled when looking through the loop toward the source. That sharp null is most useful for determining the direction of the noise source since most consumer RFI seems to be vertically polarized as long as you are further than about one hundred feet from the source.

My loops are shown in Figure 2. They all consist of a tuned larger loop that is four times the diameter of the offset coupling loop. Note that the loop antenna efficiency is much lower than that of a full-size dipole. Signals are much weaker than what you typically hear with your base station antenna. The efficiency of the loop will increase as you increase the diameter of the loop or improve the conductivity of the tuned loop material. The coupling loop conductivity is less important.

As shown schematically in Figure 3, the larger loop is a tuned circuit and the coupling loop is a one-turn link into a choke

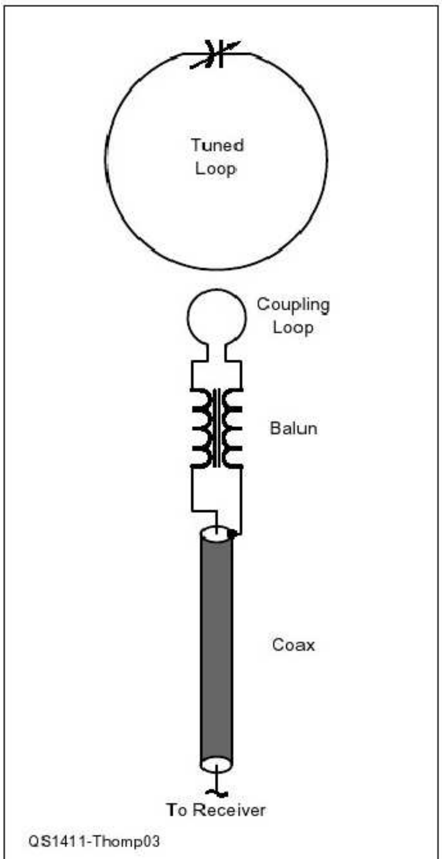


Figure 3 — Circuit schematic diagram of a tuned loop.

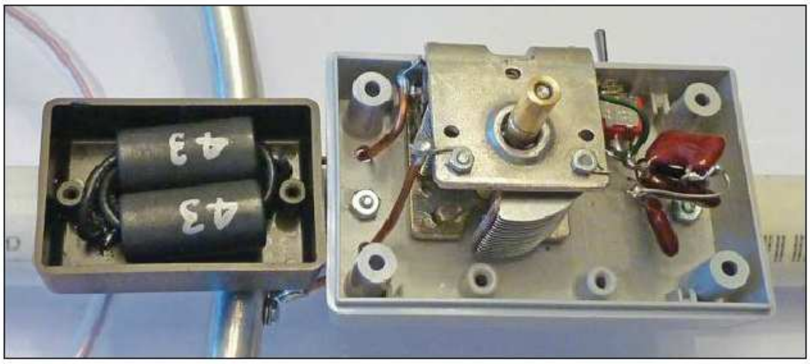


Figure 4 — Details of the 20-inch loop.

balun on the coaxial feed line. The tuning capacitor resonates the loop at the frequency of interest. A loop inductance calculator may be found on the web.[4] [One-turn loop inductance is $0.016a\left[\ln(8a/b)-2\right]$ µH, where *a* and *b* are loop and wire diameters in inches — *Ed.*]

I used a broadcast band capacitor with a built-in 8:1 reduction drive and a capacitance range of 16 to 390 pF.[5] The 20 inch diameter loop made from 0.5 inch diameter aluminum has an inductance of 1.2 µH. Using

$$F = \frac{1}{2\pi\sqrt{LC}}$$

where *F* is frequency (Hz), *L* is inductance (H) and *C* is capacitance (F), we find that the loop can tune from 40 through 10 meters. You may need to make the loop slightly larger than 20 inches to cover the lower part of 40 meters.

The 5-inch diameter coupling loop of #12 AWG copper wire is encased in a piece of 0.25 inch plastic tubing. The balun is 3½ turns of RG–174 through two FairRite 2643540002 type 43 material cores (see Figure 4). I use an SPDT (center off) toggle switch to switch in 1200 pF for 80 meters and 5400 pF capacitors for 160 meters. The center off position is for 40 through 10 meters.

Loop Performance and Considerations

Connect the loop to your transceiver, making sure the transceiver cannot transmit. You can hear the noise level increase when you resonate the loop. Tuning is sharper. Even though the VSWR is not very low, I could measure the resonance with an MFJ259 analyzer on all bands except 160 meters.

Let's say that normal band noise is S-5 using a dipole on 40 meters, where S-9 corresponds to –73 dBm, and let's further say that your receiver minimum discernable signal (MDS) is –125 dBm. At 6 dB per S-unit, S-5 corresponds to –97 dBm (28 dB above the MDS). The three loops shown in Figure 2 have the characteristics shown in Table 1 for 40 meters. The 20 inch loop will hear the band noise 9 dB above the MDS of the receiver. Keep in mind that antenna efficiency gets worse for lower frequencies, or smaller loops, or smaller wire diameters. If the RFI is much greater than the band noise, you may prefer the much lighter 16 inch loop. As you get closer to the noise source the RFI will become stronger so the RFI to band noise ratio improves.

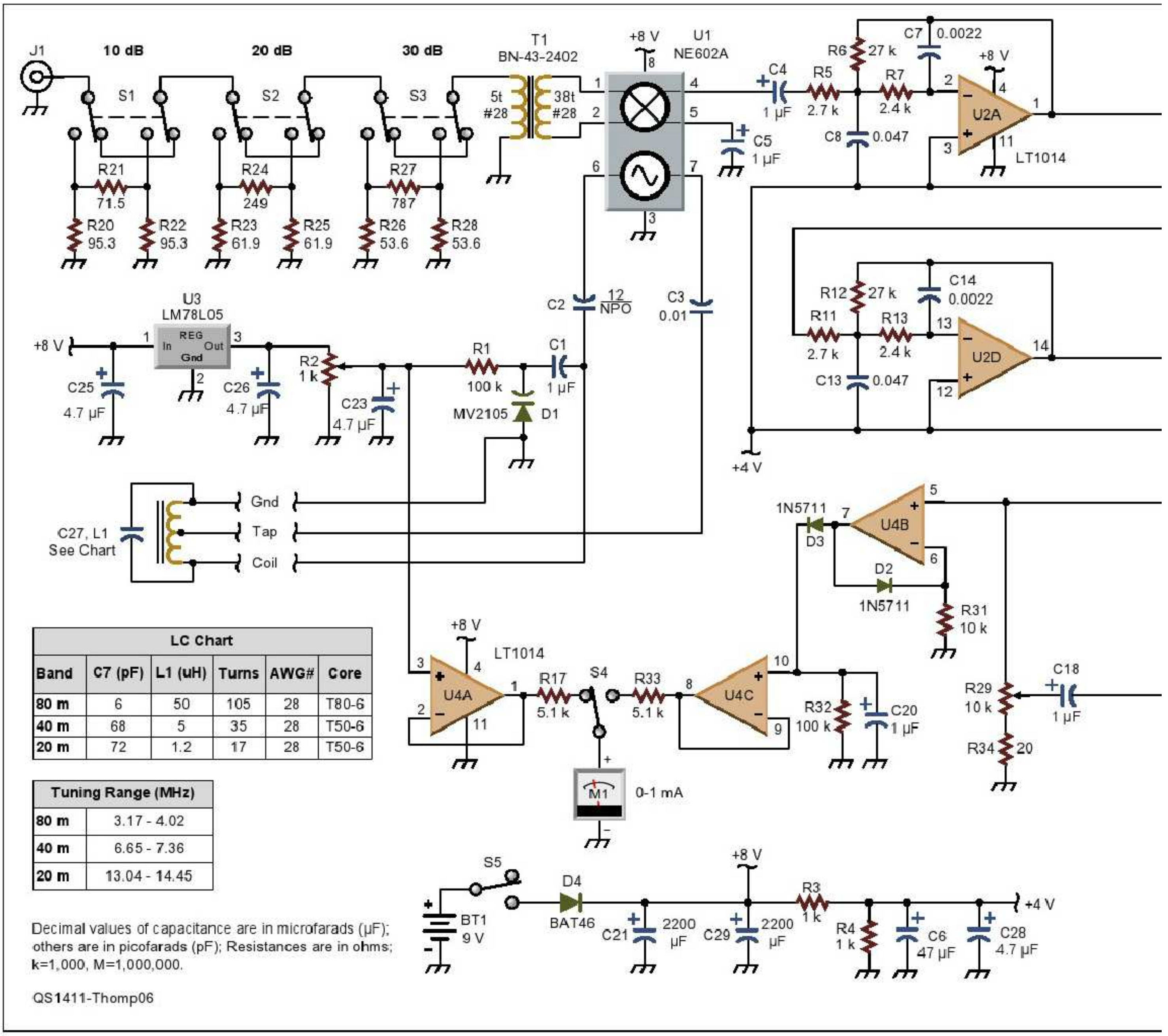
Table 1
Loop Antenna Details for 40 Meters

Loop Diameter (inches)	Loop Material	Conductor Diameter Antenna Gain
24	Copper ¼"	–13 dBd
20	Aluminum ½"	–19 dBd
16	Copper 0.025" (#22 AWG)	–27 dBd

The Step Attenuator

You may need a step attenuator when signals become very strong close to the noise source. I built a three-section Pi network resistive attenuator with 10 dB, 20 dB, and 30 dB sections. Combinations of these values will give an attenuation range from 0 to 60 dB in 10 dB steps. See Chapter 22 of *The ARRL Handbook* as well as *QST* for details.[6,7]

Figure 5 — Noise receiver front view.



LC Chart					
Band	C7 (pF)	L1 (uH)	Turns	AWG#	Core
80 m	6	50	105	28	T80-6
40 m	68	5	35	28	T50-6
20 m	72	1.2	17	28	T50-6

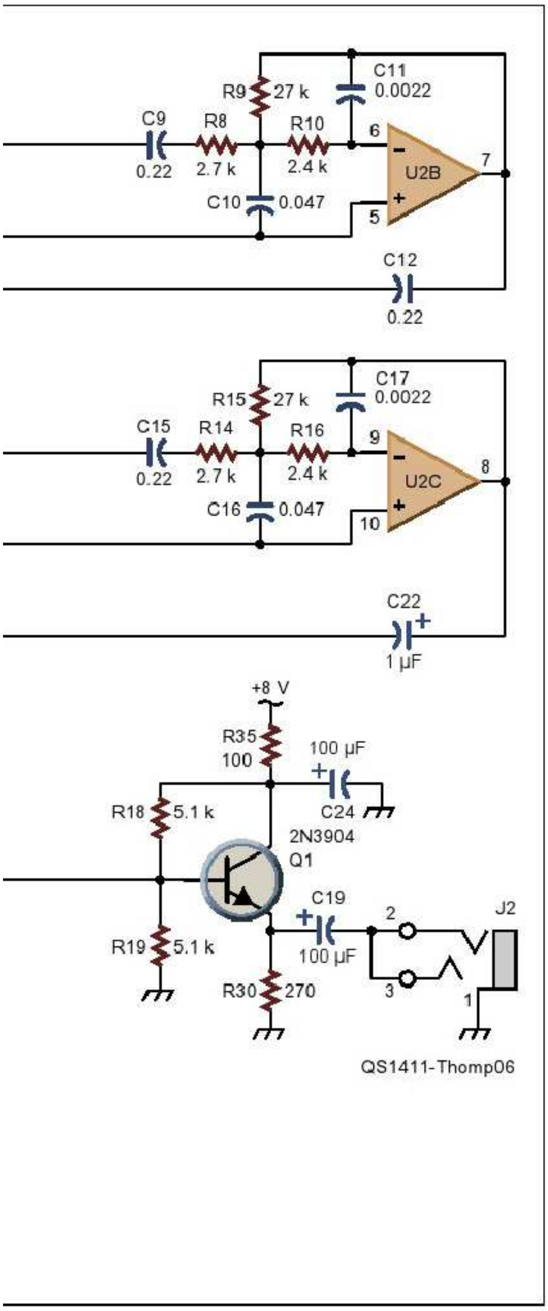
Tuning Range (MHz)	
80 m	3.17 - 4.02
40 m	6.65 - 7.36
20 m	13.04 - 14.45

Decimal values of capacitance are in microfarads (µF); others are in picofarads (pF); Resistances are in ohms; k=1,000, M=1,000,000.

QS1411-Thomp06

Figure 6 — Direct conversion noise receiver schematic diagram.

BT1 — 9 V battery
C1, C4, C5, C18, C20, C22 — 1 µF, 50 V ceramic capacitor
C2 — 12 pF, 25 V NPO ceramic capacitor
C3 — 0.01 µF, 50 V ceramic capacitor
C6 — 47 µF 16 V electrolytic capacitor
C7, C11, C14, C17 — 0.0022 µF, 50 V film capacitor
C8, C10, C13, C16 — 0.047 µF, 50 V film capacitor
C9, C12, C15 — 0.22 µF, 50 V film capacitor
C19, C24 — 100 µF, 16 V electrolytic capacitor
C21, C29 — 2200 µF, 16 V electrolytic capacitor
C23, C25, C26, C28 — 4.7 µF, 25 V tantalum capacitor
C27-80 m — 6 pF, NPO ceramic capacitor
C27-40 m — 68 pF, NPO ceramic capacitor
C27-20 m — 72 pF, NPO ceramic capacitor
D1 — MV2105 varactor diode
D2, D3 — 1N5711, Schottky diode
D4 — BAT46, Schottky diode
J1 — BNC female connector
J2 — stereo female connector
L1-80 m — 50 µH, 105 turns #28 AWG enamel on Amidon T80-6 core
L1-40 m — 5 µH 35 turns #28 AWG enamel on Amidon T50-6 core
L1-20 m — 1.2 µH 17 turns #28 AWG enamel on Amidon T50-6 core
M1 — 0 – 1 mA meter
R1 — 100 kΩ, ¼ W
R2 — 1 kΩ, 10 turn potentiometer
R3, R4 — 1 kΩ, ¼ W
R5, R8, R11, R14 — 2.7 kΩ, ¼ W
R6, R9, R12, R15 — 27 kΩ, ¼ W
R7, R10, R13, R16 — 2.4 kΩ, ¼ W
R17, R18, R19, R33 — 5.1 kΩ, ¼ W
R20, R22 — 95.3 Ω, 1%, ¼ W
R21 — 71.5 Ω, 1%, ¼ W
R23, R25 — 61.9 Ω, 1%, ¼ W
R24 — 249 Ω, 1%, ¼ W
R26, R28 — 53.6 Ω, 1%, ¼ W
R27 — 787 Ω, 1%, ¼ W
R29 — 10 kΩ potentiometer
R30 — 270 Ω, ¼ W



R31 — 10 kΩ, ¼ W
R32 — 100 kΩ, ¼ W
R33 — 5.1kΩ, ¼ W
R34 — 20 Ω, ¼ W
R35 — 100 Ω, ¼ W
SW1, SW2, SW3 — DPDT toggle switch
SW5 — SPST toggle switch
T1 — primary 5 turns #28 AWG enameled, secondary 30 turns #28 AWG enameled on Amidon BN-43-2402 core
U1 — NE602 or SA602 oscillator/mixer
U2 — LT1014 or equivalent quad operational amplifier
U3 — LM78L05, 3 terminal 5 V voltage regulator.

Figure 7 — Noise receiver inside view. The two modules are plug-in coils for 20 and 80 meters.

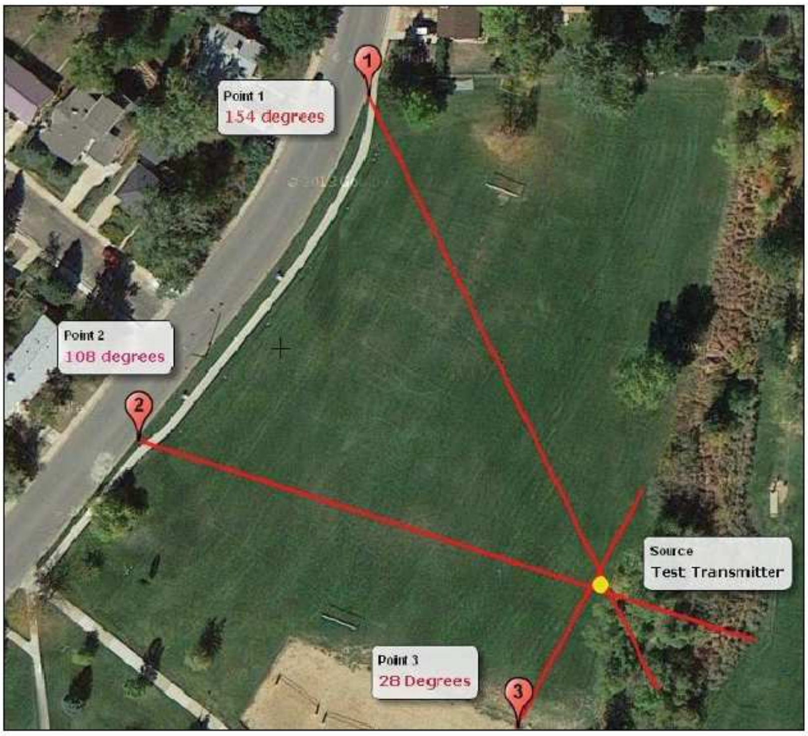


Figure 8 — Triangulation example using in a local park. [Image source: **www.scribble maps.com**, copyright 2013 Google]

The HF Receiver

An AM receiver (FM will not work) that covers the HF bands (or at least the band where the RFI occurs) is essential. The shortwave receiver should have an external antenna jack and preferably a signal strength indicator. You can add an S meter, to an inexpensive receiver by finding the AGC line and amplifying it. The receiver must have good sensitivity with an MDS at least –120 dBm. You can use a small transceiver like the FT-857D, FT-817, DZKit HT-7, or IC–7000, but make sure that it cannot transmit.

I built a small direct conversion receiver (Figure 5) with a built-in attenuator, S meter, and battery. The circuit diagram is shown in Figure 6, and construction technique is shown in Figure 7. The NE602 IC is used as an oscillator and mixer. The audio output from the mixer is filtered and amplified by four of the amplifiers in the quad package. Each operational amplifier is an active low-pass filter with 20 dB gain per stage. Between amplifiers, ac coupling provides a low frequency roll-off at about 200 Hz. The high frequency roll-off is at 3 kHz with 48 dB per octave attenuation in the stop band. Another quad operational amplifier provides buffering and detection. The NE602 oscillator is a varactor-tuned Hartley with plug-in coils for 80, 40, and 20 meters. The varactor diode is tuned with a 10-turn potentiometer, and a meter reads the varactor voltage to give an indication of the received frequency. Since the NE602 has a conversion gain of about 20 dB the total gain is about 100 dB. The input impedance of the NE602 is 1500 Ω so I used a broadband transformer with a 5:1 turns ratio to match a 50 Ω input. An emitter follower drives a pair of low-impedance headphones. Also, the output of the last active filter is rectified using an active detector and a peak detector. I use the same meter to read the varactor voltage and signal strength. This receiver has an MDS of better than –130 dBm.

If you are tracking down a noise source that is on a particular frequency, transmit a carrier on that frequency with a small wire connected to the noise receiver antenna. Locate the carrier and note the varactor meter reading. You should be able to tune in the RFI source using the varactor meter reading. Since this is a direct conversion receiver, you will hear both upper and lower sidebands simultaneously. The receiver is exactly on frequency when you hear a zero beat between the tones heard on the upper and lower sidebands as you tune the receiver.

Learning to Use Your RFI Detecting Equipment

I built a small test transmitter (see the *QST* in Depth web page for the details) to practice using the equipment.[8] The little transmitter radiates a small signal on 7159 kHz. You can orient it for either vertical or horizontal polarization and practice locating it. I found that the horizontally polarized signal is much weaker than the vertically polarized signal at various distances.

With the test transmitter oriented vertically, turn your loop edgewise to the source to get a peak while determining if the signal is getting stronger or weaker. Orient the loop broadside to get a null to determine the direction of the source. Using vertical polarization works in most cases for finding grow light RFI. Larry Benko, W0QE, and I have spent some time learning search techniques.[9] With a little practice, you will become an expert at locating the test oscillator.

Locating RFI in Sources

Locating a known RF test source and locating an unknown RFI source can be very different. With an unknown source, the direction and polarization are not known. However, I have found that assuming a vertical polarization initially is a good start.

Tracking a Source

Use the following as a guide to tracking a source.

(1) If you can hear the RFI on the loop near your house, tune the receiver so that only the noise source is heard. Twist the loop for maximum signal while holding the loop over your head.

(2) Walk in the direction that the edge of the loop is pointing. If the signal gets weaker, walk in the opposite direction while continually twisting the loop for maximum signal. As the signal gets stronger, switch in more attenuation to keep the S meter at about half scale.

(3) Once the signal is strong, twist the loop for a null and continue to walk in the same direction; now you will be looking through the loop for a refinement in direction.

(4) Alternate between maximizing the signal strength and refining the direction until you think you have located the RFI source.

Triangulating a Source

You can triangulate to find the source. In addition to your locating equipment you need a magnetic compass. Calibrate the compass for the magnetic declination for your area (see **www.ngdc.noaa.gov/geomag-web/#declination**). Use the following steps as a guide.

(1) Take a reading at your house and rotate the loop for a null. The RFI source should be located along the line perpendicular to the broadside of the loop.

(2) Walk about 500 feet perpendicular to the direction from the line where the null occurred and find another null. The RFI source will again be located along the line perpendicular to the broadside of the loop.

(3) The lines should cross at the source and diverge beyond the source. Hold the loop in front of you and rotate your body back and forth until the null is well defined. Site an object on the landscape by looking through the small coupling loop. Point your compass at the object and record the reading.

(4) Repeat steps (2) and (3) after moving about 500 feet in the other direction from your house.

(5) Go to **www.scribblemaps.com**, click on *Create Your Map Now*, and type your street address, city, and state in the *Search* window. Use the ± controls on the top right to zoom so that all of your reading points are on the map. Use the *Draw Lines* command to draw lines from each point using the compass readings you recorded. Zoom so the intersection of the two lines is on the map. Now pick a place on the map so that a new line can be drawn perpendicular to one of the two lines on the map. Go to that location with your loop and receiver and get another compass reading using the null method described in step (2). Place this line on the map just as you did previously. Due to measurement errors, these three lines will not intersect in a point but will form a triangle instead. This is the triangle of confusion. Ideally the RFI source lies within or near this triangle.

(6) Go to the triangle location on the map with your equipment and zero in on the source.

Figure 8 shows the results of this process when it was performed using the test transmitter and done in a nearby park. If you are not sure that you have compensated your magnetic compass correctly for magnetic declination, you can use *Scribblemaps* to get a vector down your street and see if it agrees with your compass.

Next Steps

After you think you have located the RFI source, make sure you have the correct house. I generally move across the street and walk up and down to make sure the loop is pointing to the correct house. [Close by, say within a half wavelength separation, the patterns of loops and sources may be dramatically different than far away. — *Ed.*] If you have determined the time when the RFI turns on, verify from across the street that you have the correct house.

At this point, take care. If this is an indoor growing operation, you do not know what could be growing in that house. You know your neighbors and the nature of your neighborhood better than anyone else possibly can, so use your own good judgment about how to approach a neighbor, or even whether you should approach the neighbor at all. Approaching a total stranger about an interference problem can result in unfortunate reactions. People can be dangerous, so approach a neighbor only if you feel completely comfortable and safe. ARRL can write letters to a neighbor on your behalf, anonymously if you wish (but if you have a visible ham antenna, it is likely that your neighbor will have a pretty good idea where the complaint originated).

Fixing the Problem

In most cases the problem can be fixed. Generally, it is not a good idea to do any work on your neighbor's equipment. You might feel comfortable applying external filters to solve RFI problems with some neighbors, but use your judgment. Commercial filters that might do the job are available, but I have not tested any of them.[10, 11] You need a differential and common mode current filter on the ac line that can handle the high current that these lighting systems require.

Your neighbor might not even cooperate with you to turn off the power, much less let you install filters on the system. If you do not get any cooperation, consult the ARRL on how to proceed. The FCC is just beginning to be aware of the magnitude of this problem, so a letter from the ARRL might be your best solution at this time.

Conclusions

RFI on the amateur bands is a growing problem. You can build the equipment to track down the RFI. You can also remedy the problem in most cases if you have a cooperative neighbor. The ARRL considers this to be such a problem that it has devoted a web page to it.[12] This web page covers the legal as well as the technical aspects of the problem.

I would like to thank Larry Benko, W0QE, for sharing his transmitter-hunting skills and for his technical support with this article.

Notes

[1]M. Gruber, "Light Bulbs and RFI — A Closer Look", *QST*, Sep 2013.

[2]**www.rfiservices.com/residence.htm**

[3]**www.audacity.sourceforge.net/download/**

[4]**www.eeweb.com/toolbox/loop-inductance**

[5]**www.midnightscience.com/catalog5.html#part3**

[6]Chapter 22 in *The ARRL Handbook*, Centennial Edition. ARRL order no. 0007, available from your ARRL dealer, or from the ARRL Store, Telephone toll-free in the US 888-277-5289, or 860-594-0355, fax 860-594-0303; **www.arrl.org/shop/**; **pubsales@arrl.org**.

[7]R. Shriner, WA0UZO and P. Pagel, N1FB, "A Step Attenuator You Can Build," *QST*, Sep 1982, p 11.

[8]**www.arrl.org/qst-in-depth**

[9]**www.w0qe.com/RF_Interference/tracking_down_rf_interference.html**

[10]**www.cor.com**

[11]**www.morganmfg.us/radio-products/ac-line-filters-protectors/**

[12]**www.arrl.org/grow-light-rfi**

Tom Thompson, W0IVJ, holds an Amateur Extra class license. He was first licensed as K5BHB in 1955 in Odessa, TX at age 14. Tom received a BA in psychology in 1963, and a BS in electrical engineering in 1969 from the University of Colorado in Boulder. He worked in electronics for the Department of Commerce at the Central Radio Propagation Laboratory at the National Bureau of Standards (now NIST) and National Oceanic and Atmospheric Administration (NOAA) for 44 years. He has applied his Amateur Radio knowledge to several projects during his career. Now retired, Tom devotes his time to designing and building Amateur Radio equipment. He is an active member of the Boulder Amateur Radio Club. You can reach Tom at **w0ivj@arrl.net**.

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

New Products

Multi-Mode Digital Signal Decoder from AOR

The ARD300 Multi-Mode Decoder converts digital voice signals into conventional analog audio. Designed to work with receivers having a 10.7 MHz or 45.05 MHz IF output, the ARD300 is capable of monitoring APCO P25, NXDN, Icom D-STAR, Digital CR, Yaesu, Kenwood, and Alinco EJ-47U digital signals. The ARD300 is also said to improve the readability of analog narrowband FM signals. The decoder can be used with older AOR receivers such as the AR8600 MK2, AR5000(A/+3) and newer models such as the AR2300, AR5001D, AR6000 and with factory modification, the AR8200MK3 handheld receiver. It is also usable with many other manufacturers' receivers that have a wide-band IF output of 10.7 MHz or 45.05 MHz, although AOR limits support to use with AOR receivers. The front panel features an LCD that shows the status of the decoder and when operating, the format of the decoded signal. Depending on the digital format being decoded, it may also display data such as call sign or other text. Rear panel connections include IF input, power input and output (12 V dc), speaker in, speaker out, power mode selector, and a service port. Price: $889. For more information, visit **www.aorusa.com**.

Add USB Connectivity to Your Kantronics KPC-3

Breathe new life into this packet radio TNC by converting its serial port to USB.

David Martin, K5DCM

I had been considering modifying my Kantronics KPC-3 packet radio TNC (Terminal Node Controller) to use USB rather than the serial interface. With so many modern computers having done away with serial ports in favor of USB, the old multipin serial connections have become an endangered species. Yes, you can purchase USB-to-serial adapters, but their performance is often questionable.

What finally pushed me over the brink was the failure of the RS-232 serial port chip in my otherwise reliable and functional KPC-3. The time had finally come to make the switch, and it was much easier than I thought. In fact, the techniques you're about to read about can probably be applied to other devices that are in desperate need of a USB conversion.

The first step was to purchase a FTDI Basic-v21-5V board from SparkFun. This little board uses the USB Mini-B connector for the USB function.[1] From that point it was a matter of integrating the board into my TNC.

Making the Modifications

Comparing signals between the TNC and the SparkFun FTDI devices, the TNC uses RTS, TXD, RXD, CTS, and DCD on its serial port. The signals on the SparkFun FTDI board interface connector are Ground, CTS, Power, TXO, RXI, and DTR. Additionally, RTS and DCD are available at the FTDI chip. The schematic diagram in Figure 1 shows the changes needed both to the SparkFun board and to the KPC-3 TNC circuitry. On the KPC-3, lift Pins 9 and 11 of U2 (a 74HC144) from the circuit board. On the SparkFun board, unsolder and lift Pins 3 (Power) and 6 (DTR) of connector JP1.

The new FTDI board fits nicely on its edge in the space beside the TNC power connector against the back panel of the case. Figure 2 shows the cutout dimensions for the new USB connector. There is enough space left between the board edge and the TNC cover to accommodate the routing of two #30 AWG wire-wrap wires (seen in Figures 3 and 4). The wires from Pins 3 and 6 of JP1 connect to Pins 3 (RTS) and 10 (DCD), respectively, on the FT232RLSSOP IC.

A soldering iron with a very small tip, and a magnifying glass or magnifying lamp will be very handy for that operation. I used

[1]Notes appear on page 42.

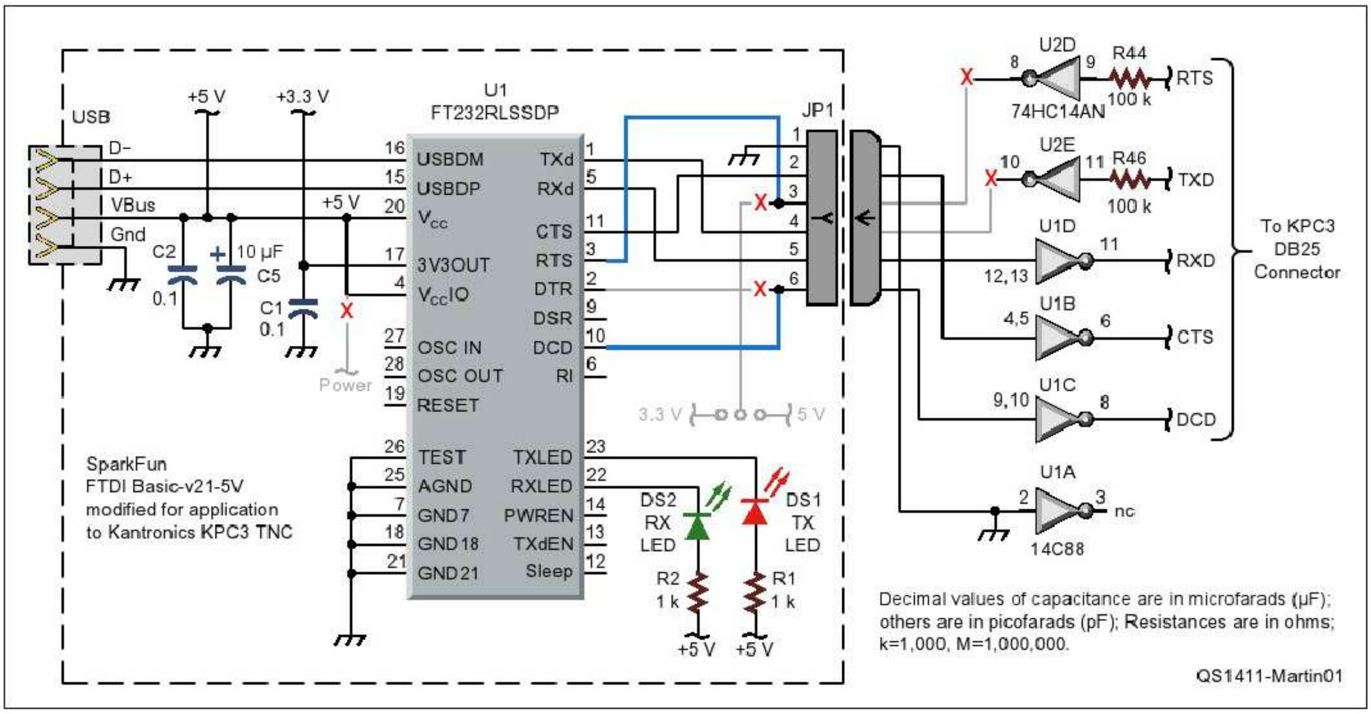


Figure 1 — Modifications to SparkFun FTDI board and KPC-3 RS-232 circuit.

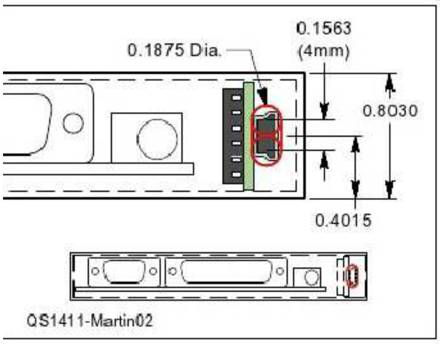


Figure 2 — Template drawing for cutout in KPC-3 enclosure to accommodate the SparkFun USB connector.

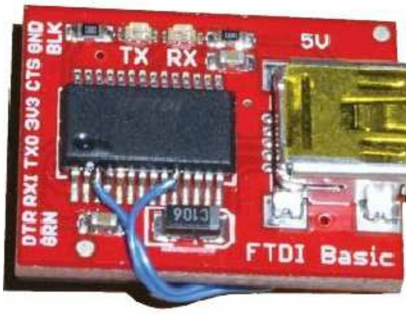


Figure 3 — SparkFun FTDI board, component side.

Figure 4 — SparkFun FTDI board, connector side.

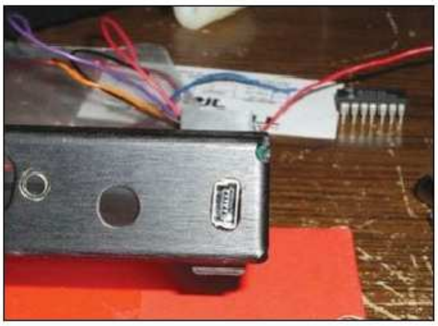


Figure 5 — Cutout on the KPC-3 back panel for the USB connector.

Figure 6 — Homemade latch for the SparkFun board fabricated from a small ring-lug.

some heat-shrink tubing for the wires at connector JP1, but you can use pieces of electrical tape.

Modify the KPC-3 case to accept the SparkFun FTDI board according to the sketch shown in Figure 2. Start by removing the board from the KPC-3 to keep metal shavings out of it. Disconnect the 9 V battery, then remove the front panel. The 9 V battery maintains power on the clock for time and date functions of the TNC. Remove the jack screws from the DB9 and DB25 connectors. The board should then just slip out.

Affix a sketch of the cutout template (Figure 2) to the back of the enclosure where the USB connector will come through. This template is also available on the *QST* in Depth web page along with additional photos.[2] Align the template carefully and center-punch two places for drilling 3⁄16 inch holes. Use small files (flat, triangle, and round) to patiently finish shaping the hole to allow the USB connector to poke through the back of the enclosure.

Fit the SparkFun board into the case, making sure the USB connector fits in the new hole and the board is fully seated against the back of the enclosure. Figure 5 shows the new USB connector on the back panel.

I worked a small ring-lug with side cutters, a hammer, and files until I had made a little latch (see Figure 6) that I could swivel into place to hold the board securely inside the case. The latch is secure enough to withstand the force required to plug in a USB cable. I used needlenose pliers to shape a notch that captures the board, but still fits between the board connector and the bottom of the TNC case. With the board inserted and the lug in position to hold it, I marked the location to drill a hole for a screw to fasten the lug. I reinstalled the KPC-3 circuit board and front cover. Figure 7 shows the SparkFun board with the homemade latch locking the board in place.

Unplug IC U2 from the TNC board, and use needlenose pliers to carefully bend pins 8 and 10 up about 90 degrees or so, to give access to those socket positions after reinserting the IC. Attach a six-pin PCB connector to JP1 of the FTDI board. Lay out and measure the 6 wires from JP1 to the connection points on the TNC circuit board, leaving enough extra wire to strip about an 1⁄8 inch to use as a "pin" to insert into the appropriate socket locations. Discard IC U1, and connect SparkFun JP1 Pin 6 to U1 socket Pin 9 (or 10); JP1 Pin 2 to U1 socket Pin 4 (or 5); JP1 Pin 5 to U1 socket Pin 12 (or 13); and JP1 Pin 1 to U1 socket Pin 2. Then, connect JP1 Pin 3 to U2 socket Pin 8; and JP1 Pin 4 to U2 socket Pin 10. You might find it easier to remove IC U2, then insert the wires and reinsert IC U2.

Inspect the new wires and make sure there are no copper conductors hanging out from the socket connections that might short to something else, especially on U2. Use your magnifying glass for a thorough inspection. Figure 7 shows how my board looks with the wires routed and plugged into the correct socket pins. Before replacing the lid make sure everything works correctly.

Connecting to Your Computer

Connect the TNC to your computer using a USB cable and apply power to the TNC. With the first-time connection, be patient while your computer installs drivers for the new device. Check for "new devices" on your computer and record the designation

Figure 7 — Completed modification with solid conductor wires routed from the SparkFun board to U1 and U2 IC sockets.

assigned by the computer: COM or TTY/USB, for example. Now choose your baud rate, and other settings for the new device to match the settings you formerly used with the TNC via the RS-232 connection. Start your terminal program and select the new port designation for your new USB connection. Cycle power on the TNC and you will see the power-up header message from the KPC-3. Your modified KPC-3 is now compatible with newer computers and laptops.

This is a good opportunity to install a fresh 9 V battery, and a fresh lithium 2032 cell on the board, then reattach the KPC-3 cover.

The tools I used include an X-ACTO® knife, soldering iron, small jewelers files, drill with ³⁄₁₆ inch drill bit, needlenose pliers, side cutters, magnifying glass or magnifying lamp, and a soldering iron with the small tip.

Notes
[1]**www.sparkfun.com**
[2]**www.arrl.org/qst-in-depth**

Photos by the author.

Amateur Extra licensee David Martin, K5DCM, was first licensed in 2005 as General class before code testing was eliminated. He is past President of the Ozark Amateur Radio Club in Mountain Home, Arkansas. David enjoys operating QRP, and has completed many DX QRP SSB contacts, including some mobile QRP SSB contacts. He supports the Four State QRP Group (**www.4sqrp.com**) and really enjoys its annual OzarkCon event (**www.ozarkcon.com**) in Branson, Missouri. David retired from a manufacturing automation engineering position with a major medical products manufacturer. You can reach him at 31 Cypress Court, Mountain Home, AR, 72653, or **davemrtn@centurytel.net**.

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

Radio Tips

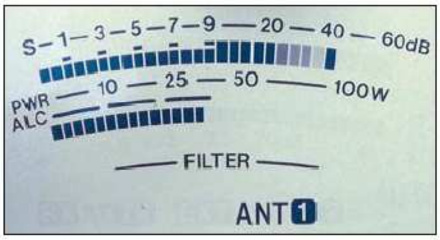
HF Digital and Audio Overdrive

Regardless of the type of HF digital mode you enjoy, there is an almost instinctual tendency among some operators to adjust their transmit audio levels while only watching their transceiver's RF output meter. They place their radios into the transmit mode and crank up the audio levels at their computer or interfaces until they see a satisfying 100 W RF output. At that point they assume they are finished and ready to take to the airwaves. This is known as "tuning for maximum smoke." They could not be more mistaken!

First of all, most HF digital modes do not require 100 W of power to make contacts. One of the benefits of HF digital, in fact, is that you can make contacts at surprisingly low power levels. For some digital modes such as JT65, 100 W output is almost considered obscene.

But most importantly, adjusting for full RF output ignores the fact that you may be grossly overdriving your radio to achieve your satisfaction. The result is often a wildly distorted signal that's not only difficult to decode, it splatters across the band, ruining every conversation in its wake.

Rather than gazing at the transceiver meter as it displays your RF output, switch the meter to monitor *ALC* (Automatic Limiting Control) instead. All transceivers display ALC activity differently. The display may simply indicate the presence and amount of transmit audio limiting taking place. Other displays may include a so-called "safe zone."



A Kenwood TS-2000 meter indicating an excessive ALC function.

If the ALC activity remains within the safe zone, your transmit audio levels probably are acceptable.

When you transmit a test signal, do not increase the audio level beyond the ALC safe zone, or beyond the point where ALC activity is excessive. When you see the needle or LEDs swing hard to the right, this is a warning that you are supplying way too much audio to the radio and that the ALC circuit is trying to rein you in.

The goal is to generate the desired RF output while keeping ALC activity to a minimum (or even zero), or while keeping the ALC meter in the safe zone. It is important to keep in mind that minimal ALC activity does *not* necessarily guarantee a clean signal. It does in many instances, but your best insurance is to ask for reports whenever you are in doubt. If someone reports that you are splattering, reduce the transmit audio level immediately until they say your signal is clean. Note this setting so that you can return to it again easily. — *Steve Ford, WB8IMY*

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

Hilberling PT-8000A MF, HF, and VHF Transceiver

This offering from Hilberling brings a new level of equipment to the US Amateur Radio marketplace.

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It's been a long time since we've seen Amateur Radio HF transmitting equipment manufactured in Europe offered in the US market, but that's changing. In the June issue of *QST,* we reviewed the Zeus ZS-1 software defined transceiver from SSB Electronic, and this month we explore the Hilberling PT-8000A, also from Germany. The PT-8000A is Hilberling's first offering in the Amateur Radio field, and they have entered with a very serious radio. It's important to note that Hilberling has been developing telecommunications equipment for the commercial marketplace for many years and is no stranger to high-end RF gear.

The PT-8000A is a nominal 200 W HF (160 through 10 meters), and 100 W VHF (6, 4 [European version only], and 2 meters) SSB, CW, AM, FM, and digital mode transceiver. The '8000A arrives fully equipped, with a separate dedicated power supply, all available IF filters, a very solid and good sounding push-to-talk (PTT) desk mic, interconnecting cables and matching plugs for many sockets on front and rear. In addition to its operational and technical features, the '8000A is sure to fit into your shack's décor with its choice of several designer front panel colors. We picked the medium blue, as shown in the photos. It might even make it into the family room!

This radio appears to be solidly engineered and constructed to a level not frequently seen in amateur gear. All controls and connectors appear to be a professional type, and of first quality, and there is unprecedented access to points within the signal paths via miniature coax jumpers with SMA connectors along the rear of the unit. The transceiver is not small, with plenty of space for all controls and indicators on the front panel. It also isn't a lightweight. At 62 pounds, it's a two-person lift — and once in place, it doesn't even think about moving while the headphone plug is seated or the controls adjusted.

> **Bottom Line**
>
> The Hilberling PT-8000A is a high-quality, full sized HF and VHF transceiver that combines a fine receiver and very good sounding transmitter in a well-made, professional package.

The separate power supply is actually lighter than I expected. It puts out both 13.8 V dc for the low level circuits and 50 V dc for the field-effect transistor (FET) based transmit power amplifier. It includes a large DC INPUT power meter on the front panel (0 – 0.8 kW scale) — an interesting and unusual touch — as well as a front firing speaker for the sub receiver.

Conversion Architecture

The transceiver is of dual-conversion architecture with the first receive IF at 40.7 MHz, including a 50 kHz wide filter. The analog noise blanker receiver and processor is tapped from the wideband 40.7 MHz IF. The main signal path next converts down to its 10.7 MHz second IF, at which point there are crystal lattice filters at 0.5, 3, and 15 kHz bandwidth. The FM demodulation occurs following the 15 kHz filter while other modes continue for additional processing, including a bank of 16-pole 10.7 MHz crystal filters with more bandwidth choices.

The 10.7 MHz IF includes the gate driven by the noise blanker, as well as the analog notch filter. The 10.7 MHz IF signal is demodulated for DSP processing, providing mode specific DSP bandwidth selection from 50 Hz to 6 kHz width. The DSP also provides a digital receive notch (in addition to the manually adjusted analog notch), and three bands of microphone equalization on transmit.

If a bandwidth is selected that matches the crystal filters, the DSP can be bypassed with the receiver using just the competent crystals filters to set the operating bandwidth. For the many more available bandwidths, the DSP is inserted in the process. It is so seamless that you have to look at the indicator to see which filters you are using — very nice!

A very flexible automatic gain control (AGC) system is provided. Hang times of 100 or 500 ms can be selected as well as 1, 2, or 3 seconds, with the system automatically going to 100 ms while tuning to avoid missing weak signals near strong ones. The AGC is driven by the RF level past the analog crystal filters; AGC threshold is adjustable.

The entire receiver described above is duplicated for the sub receiver. The sub receiver audio can be combined with the main receiver audio output or maintained as separate audio paths for use with stereo headphones, external speakers, or even the two internal speakers, one on the main unit, the other on the front of the power supply.

The sub receiver can operate from either of the two HF antenna inputs, the separate receive antenna input, or the VHF antenna port. It is designed to be always available in order to monitor another frequency, perhaps a local 2 meter repeater, even while the transceiver is in two-way operation on HF. In the version of software available during the review period, it is muted during transmit only if the radio is operating in SPLIT mode. It took a note to the factory to find out why I was getting feedback or hash in the sub receiver audio while transmitting on the same band. They noted that the next firmware version will allow sub receiver muting, even if not in SPLIT mode. This will facilitate diversity reception using a separate antenna on the RX ANT port, for example.

Each receiver has a dedicated front panel tuning knob, each with a very smooth weighted feel. The SUB-VFO knob is considerably smaller but has just as good a feel. It is easy to move frequencies between the VFOs, as well as a second frequency avail-

Table 1
Hilberling PT-8000A, serial number 13040144

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: Receive, 0.009 – 30, 50 –54, 69.9 – 70.5, 110 – 148 MHz; transmit, 160, 80, 60, 40, 30, 20, 17, 15, 12, 10, 6, and 2 meter amateur bands.	Receive and transmit, as specified.
Power requirement: 90 – 260 V ac, 12.5 A, 50-60 Hz.	660 VA (transmit, maximum RF power output), 122 VA (receive, full volume, no signal, maximum display brightness), 119 VA (minimum display brightness).
Modes of operation: SSB, CW, AM, FM, data.	As specified.
Receiver	**Receiver Dynamic Testing, Main Receiver**
CW sensitivity, 10 dB S+N/N: 0.5 µV (9 kHz – 1.8 MHz); 0.1 µV (1.8 – 30, 50 – 54 MHz); 0.09 µV (69.9 – 70.5, 144 – 148 MHz); 0.14 µV (110 – 143.999MHz) for 500 Hz filter bandwidth.	Noise floor (MDS), 500 Hz DSP bandwidth, 500 Hz roofing filter:

	Preamp off	*Preamp on*
0.137 MHz	–127 dBm	n/a
0.475 MHz	–127 dBm	n/a
1.0 MHz	–127 dBm	n/a
3.5 MHz	–127 dBm	–140 dBm
14 MHz	–128 dBm	–140 dBm
50 MHz	–123 dBm	–143 dBm
70 MHz	–120 dBm	–141 dBm
144 MHz	–123 dBm	–144 dBm

Manufacturer's Specifications	Measured in the ARRL Lab
Noise figure: Not specified.	Preamp off/on: 14 MHz, 19/7 dB; 50 MHz, 24/4 dB; 70 MHz, 27/6 dB; 144 MHz, 24/3 dB.
AM sensitivity, 10 dB S+N/N: 2.0 µV (9 kHz – 1.8 MHz); 1.2 µV (1.8 – 30 MHz); 1.0 µV (50 – 54, 69.9 – 70.5, 144 – 148 MHz); 1.5 µV (110 – 143.99 MHz) for 6 kHz filter bandwidth.	10 dB (S+N)/N, 1 kHz, 30% modulation, 6 kHz DSP bandwidth:

	Preamp off	*Preamp on*
1.0 MHz	5.30 µV	n/a
3.8 MHz	3.39 µV	0.82 µV
50.4 MHz	7.15 µV	0.60 µV
70.4 MHz	8.00 µV	0.62 µV
120 MHz	3.75 µV	0.40 µV
144.4 MHz	6.30 µV	0.55 µV

Manufacturer's Specifications	Measured in the ARRL Lab
FM sensitivity, 10 dB S+S/N: 0.5 µV (9 kHz – 1.8 MHz); 0.18 µV (1.8 – 30 MHz); 0.16 µV (50 – 54, 69.9 – 70.5 MHz); 0.15 µV (144 – 148 MHz); 0.18 µV (110 – 143.99 MHz) for 15 kHz filter bandwidth.	For 12 dB SINAD, 3 kHz deviation, 15 kHz bandwidth:

	Preamp off	*Preamp on*
29 MHz	1.55 µV	0.33 µV
52 MHz	3.05 µV	0.25 µV
70 MHz	2.88 µV	0.22 µV
146 MHz	2.26 µV	0.18 µV

Manufacturer's Specifications	Measured in the ARRL Lab
Blocking gain compression dynamic range: Not specified.	Blocking gain compression dynamic range, 500 Hz DSP BW, 500 Hz roofing filter:

	20 kHz offset Preamp off/on	*5/2 kHz offset Preamp off*
3.5 MHz	>137/143 dB	>137/>137 dB
14 MHz	>138/144 dB	>138/>138 dB
50 MHz	>133/138 dB	>133/126 dB
70 MHz	>130/137 dB	>130/>130 dB
144 MHz	>133/139 dB	131/123 dB*

Manufacturer's Specifications	Measured in the ARRL Lab
Reciprocal mixing dynamic range: Not specified.	14 MHz, 20/5/2 kHz offset: 118/115/111 dB.

ARRL Lab Two-Tone IMD Testing (500 Hz bandwidth, 500 Hz roofing filter)**

Band/Preamp	*Spacing*	*Input Level*	*Measured IMD Level*	*Measured IMD DR*	*Calculated IP3*
3.5 MHz/Off	20 kHz	–34 dBm	–127 dBm	93 dB	+13 dBm
		–14 dBm	–97 dBm		+28 dBm
14 MHz/Off	20 kHz	–24 dBm	–128 dBm	104 dB	+28 dBm
		–9 dBm	–97 dBm		+35 dBm
		0 dBm	–70 dBm		+35 dBm
14 MHz/On	20 kHz	–36 dBm	–140 dBm	104 dB	+16 dBm
		–18 dBm	–97 dBm		+22 dBm
14 MHz/Off	5 kHz	–24 dBm	–128 dBm	104 dB	+28 dBm
		–12 dBm	–97 dBm		+31 dBm
		0 dBm	–60 dBm		+30 dBm

Manufacturer's Specifications			Measured in the ARRL Lab		
Band/Preamp	*Spacing*	*Input Level*	*Measured IMD Level*	*Measured IMD DR*	*Calculated IP3*
14 MHz/Off	2 kHz	–28 dBm	–128 dBm	100 dB	+22 dBm
		–12 dBm	–97dBm		+31 dBm
		0 dBm	–58 dBm		+29 dBm
50 MHz/Off	20 kHz	–25 dBm	–123 dBm	98 dB	+24 dBm
		–16 dBm	–97 dBm		+25 dBm
50 MHz/On	20 kHz	–45 dBm	–143 dBm	98 dB	+4 dBm
		–29 dBm	–97 dBm		+5 dBm
70 MHz/Off	20 kHz	–20 dBm	–120 dBm	100 dB	+30 dBm
		–13 dBm	–97 dBm		+29 dBm
144 MHz/Off	20 kHz	–26 dBm	–123 dBm	97 dB	+23 dBm
		–18 dBm	–97 dBm		+22 dBm
144 MHz/On	20 kHz	–41 dBm	–144 dBm	103 dB	+11 dBm
		–25 dBm	–97 dBm		+11 dBm

Manufacturer's Specifications	Measured in the ARRL Lab
Second-order intercept point: Not specified.	Preamp off/on, 14 MHz, +71/+47 dBm; 50 MHz, +93/+51 dBm; 70 MHz, +89/+75 dBm; 144 MHz, +77/+57 dBm.
DSP noise reduction: Not specified.	10 dB.
Notch filter depth: Not specified.	Auto notch, 50 dB; attack time, 22 ms.
FM adjacent channel rejection: Not specified.	Preamp on: 29 MHz, 89 dB; 52 MHz, 90 dB; 70 MHz, 89 dB; 144 MHz, 87 dB.
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset, preamp on: 29 MHz, 89 dB*; 52 MHz, 87 dB; 70 MHz, 89 dB*; 144 MHz, 87 dB*. 10 MHz offset: 29 MHz, 100 dB; 52 MHz, 87 dB; 70 MHz, 98 dB; 144 MHz, 89 dB.
S-meter sensitivity: Not specified.	S-9 signal, preamp off/on: 14 MHz, 50.1/48.4 µV; 50 MHz, 41.6/58.8 µV; 144 MHz, 42.6/56.2 µV.
Squelch sensitivity: Not specified.	At threshold, preamp on: FM, 29 MHz, 0.8 µV; 50 MHz, 0.33 µV; 144 MHz, 0.32 µV; SSB, 0.6 µV (14.2 MHz).
Receiver audio output: 4.48 W into 8 Ω (main and sub receiver combined).	Main receiver, 2.25 W at 10% THD into 8 Ω. THD at 1 V RMS, 3.3%.
IF/audio response: Not specified.	Range at –6 dB points (bandwidth)†: CW (500 Hz): 340 – 850 Hz (510 Hz); Equivalent Rectangular BW: 501 Hz; USB (2.7 kHz): 122 – 1910 Hz (1788 Hz); LSB (2.7 kHz): 123 – 1913 Hz (1790 Hz); AM (6.0 kHz): 393 – 3923 Hz (7054 Hz).
Spurious and image rejection: Not specified.	First IF rejection, 14 MHz, 91 dB; 50 MHz, 88 dB; 70 MHz, 111 dB; 144 MHz, 110 dB. Image rejection, 14 MHz, 116 dB; 50 MHz, 74 dB; 70 MHz, 86 dB; 144 MHz, 105 dB.

Receiver	Receiver Dynamic Testing, Sub Receiver		
CW sensitivity, 10 dB S+N/N: 0.5 µV (9 kHz – 1.8 MHz; 0.1 µV (1.8 – 30, 50 – 54 MHz); 0.09 µV (69.9 – 70.5, 144 – 148 MHz); 0.14 µV (110 – 143.999 MHz) for 500 Hz filter bandwidth.	Noise floor (MDS), 500 Hz DSP bandwidth, 500 Hz roofing filter:		
		Preamp off	*Preamp on*
	0.137 MHz	–122 dBm	n/a
	0.475 MHz	–122 dBm	n/a
	1.0 MHz	–122 dBm	n/a
	3.5 MHz	–129 dBm	–142 dBm
	14 MHz	–130 dBm	–142 dBm
	50 MHz	–122 dBm	–142 dBm
	70 MHz	–120 dBm	–140 dBm
	144 MHz	–121 dBm	–143 dBm
Noise figure: Not specified.	Preamp off/on: 14 MHz, 17/5 dB; 50 MHz, 25/5 dB; 70 MHz, 27/7 dB; 144 MHz, 26/4 dB.		

able for either VFO, all clearly shown on the multicolor screen.

A four-channel voice recorder function allows recording from the audio stream of either receiver or from the mic or transmit audio. The recordings can be listened to, or they can be transmitted by pushing the mic PTT switch or the TX/ON button. They are thus usable as a contest voice keyer.

Transmitter Architecture

Not surprisingly, the transmitter architecture follows that of the receiver, with separate processing and filtering of SSB, AM, and CW at 10.7 MHz, joining up with 10.7 MHz FM and dc driven FSK before conversion to 40.7 MHz and then to the operating frequency. All amplifier stages, including the 200 W PEP FET final amplifier, are used on all bands, with just filtering changing for the different bands and ranges. If the 50 V dc output of the external power supply is not turned on, or if just a 13.8 V supply is provided, the transmitter will still operate, but with 10 W maximum output and a corresponding change in the POWER meter display. During normal operation, the transmitter can be switched to low power with a front panel button, handy for adjusting antenna tuners or amplifiers or checking general operation. An adjustable 0 to 20 dBm output is also provided for transverter or instrumentation use. A manually activated automatic antenna tuner is provided to trim loads that are not quite matched.

Control and Display Functionality

The PT-8000A is run from the front panel. There are seven groups of controls clustered within lined boxes on the panel and labeled by function, such as BAND, MODE, VFO, ANT-TUNER. In addition there are the usual knobs for functions such as MIC GAIN, IF NOTCH, MAIN, and SUB audio level that are not within clusters. In addition to front panel controls, there are a number of recessed, screwdriver-adjusted, set-and-forget controls on each side panel for functions that are not generally needed.

The display (Figure 1) is a crisp and bright multicolored TFT screen that provides lots of information in an easy-to-grasp fashion. The main VFO frequency is shown in large text, with resolution dependent on the tuning step — to 1 kHz, 100 Hz, 10 Hz, or 1 Hz. A bar above the digital frequency readout is a simulated analog dial showing where you are within the band — a nice touch. The secondary VFO is in slightly smaller text and a contrasting color, while the sub receiver VFO frequency is shown in a small block at the top. Additionally, there is a small graphical display of bandwidth, showing the width, notch, and shift compared to the carrier frequency.

The bottom of the display includes metering with a large bar-type S meter above the similar power output meter. The calibrated S meter can read in S units, dBm, or microvolts. A nice feature is that the squelch threshold is shown as a mark on the S meter, so you can adjust it to any desired level and see the level it is set to in comparison to ambient noise. (Squelch is usable in all modes.) The power meter scale automatically shifts between 250, 100, and 10 W full-scale, depending on band and selected power level. A 100 mW range is available for the low level output. Below the S/POWER meter are bar graphs for SWR and ALC, along with indications of CPU and PA TEMPERATURE.

The right-hand edge of the display includes six indicators that correspond to six buttons just outside the display window. These are indicators for "soft keys" that control functions that shift depending on the context of your control operation. For example, if you hit the SSB/CW button in the MODE cluster, the indicators and buttons become: USB, LSB, CW, CW–, STEP-UP, STEP-DOWN, with the step buttons setting the tuning step increment. Alternately, if you hit the A/B button in the VFO cluster, the buttons become: A>SUB, SUB>B, A>B, SPLIT, STEP-UP, STEP-DOWN. While it does take a bit of getting used to, I found the context-sensitive buttons to be intuitive and easier to deal with that the typical off-line MENU mode of many current transceivers.

The receive audio can feature either combined or separate paths. In order to shift to separate audio paths, the MENU button in the DISPLAY cluster in engaged. The soft keys that appear include one that can be toggled between AUDIO NORM and AUDIO SPLIT. Note that this is independent of the choice of split frequency operation (the SPLIT soft key appears in the menu that comes up when the A/B button of the VFO group is pressed, as noted above). Note that a return to the default AUDIO NORM occurs whenever power is cycled.

Unlike many receivers, plugging in headphones does not disable the speakers.

Manufacturer's Specifications **Receiver (continued)**	**Measured in the ARRL Lab** **Receiver Dynamic Testing, Sub Receiver**
AM sensitivity, 10 dB S+N/N: 2.0 µV (9 kHz – 1.8 MHz), 1.2 µV (1.8 – 30 MHz); 1.0 µV (50 – 54, 69.9 – 70.5, 144 – 148 MHz); 1.5 µV (110 – 143.99MHz), for 6 kHz filter bandwidth.	10 dB (S+N)/N, 1 kHz, 30% modulation, 6 kHz DSP bandwidth: *Preamp off* / *Preamp on* 1.0 MHz: 4.36 µV / n/a 3.8 MHz: 2.69 µV / 0.65 µV 50.4 MHz: 6.23 µV / 0.60 µV 70.4 MHz: 8.60 µV / 0.69 µV 120 MHz: 5.37 µV / 0.58 µV 144.4 MHz: 6.52 µV / 0.54 µV
FM sensitivity, 10 dB S+S/N: 0.5 µV (9 kHz – 1.8 MHz), 0.18 µV (1.8 – 30 MHz), 0.16 µV (50 – 54, 69.9 – 70.5 MHz), 0.15 µV (144 – 148 MHz); 0.18 µV (110 – 143.99 MHz) for 15 kHz filter bandwidth.	For 12 dB SINAD, 3 kHz deviation, 15 kHz bandwidth: *Preamp off* / *Preamp on* 29 MHz: 1.27 µV / 0.22 µV 52 MHz: 2.37 µV / 0.20 µV 70 MHz: 2.88 µV / 0.23 µV 146 MHz: 2.57 µV / 0.21 µV
Blocking gain compression dynamic range: Not specified.	Blocking gain compression dynamic range, 500 Hz DSP BW, 500 Hz roofing filter: *20 kHz offset, Preamp off/on* / *5/2 kHz offset, Preamp off* 3.5 MHz: 135‡/145 dB / 135‡/135‡ dB 14 MHz: >140/144 dB / >140/>140 dB 50 MHz: >132/135 dB / >132/>132 dB 70 MHz: >130/135 dB / >130/>130 dB 144 MHz: >131/139 dB / >130/129 dB
Reciprocal mixing dynamic range: Not specified.	14 MHz, 20/5/2 kHz offset: 112/111/103 dB.

ARRL Lab Two-Tone IMD Testing (500 Hz DSP bandwidth, 500 Hz roofing filter)**

Band/Preamp	*Spacing*	*Input Level*	*Measured IMD Level*	*Measured IMD DR*	*Calculated IP3*
3.5 MHz/Off	20 kHz	–34 dBm	–130 dBm	96 dB	+14 dBm
		–13 dBm	–97 dBm		+29 dBm
14 MHz/Off	20 kHz	–27 dBm	–130 dBm	103 dB	+25 dBm
		–17 dBm	–97 dBm		+23 dBm
		0 dBm	–54 dBm		+27 dBm
14 MHz/On	20 kHz	–42 dBm	–142 dBm	100 dB	+8 dBm
		–28 dBm	–97 dBm		+7 dBm
14 MHz/Off	5 kHz	–32 dBm	–130 dBm	98 dB	+17 dBm
		–18 dBm	–97 dBm		+22 dBm
		0 dBm	–48 dBm		+24 dBm
14 MHz/Off	2 kHz	–33 dBm	–130 dBm	97 dB	+16 dBm
		–18 dBm	–97 dBm		+22 dBm
		0 dBm	–48 dBm		+24 dBm
50 MHz/Off	20 kHz	–26 dBm	–122 dBm	96 dB	+22 dBm
		–18 dBm	–97 dBm		+24 dBm
50 MHz/On	20 kHz	–46 dBm	–142 dBm	96 dB	+2 dBm
		–32 dBm	–97 dBm		+1 dBm
70 MHz/Off	20 kHz	–23 dBm	–120 dBm	97 dB	+26 dBm
		–16 dBm	–97 dBm		+25 dBm
144 MHz/Off	20 kHz	–21 dBm	–121 dBm	100 dB	+29 dBm
		–15 dBm	–97 dBm		+26 dBm
144 MHz/On	20 kHz	–41 dBm	–143 dBm	102 dB	+10 dBm
		–28 dBm	–97 dBm		+7 dBm

Second-order intercept point: Not specified.	Preamp off/on, 14 MHz, +71/+67 dBm; 21 MHz, +51/+33 dB; 50 MHz, +93/+51 dBm; 70 MHz, +89/+75 dBm; 144 MHz, +77/+57 dBm;
DSP noise reduction: Not specified.	10 dB.
Notch filter depth: Not specified.	Auto notch, 45 dB; attack time, 23 ms.
FM adjacent channel rejection: Not specified.	Preamp on: 29 MHz, 88 dB; 52 MHz, 89 dB; 70 MHz, 89 dB; 144 MHz, 86 dB.

Manufacturer's Specifications Receiver (continued)	Measured in the ARRL Lab Receiver Dynamic Testing, Sub Receiver
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset, preamp on: 29 MHz, 88 dB; 52 MHz, 83 dB; 70 MHz, 86 dB; 144 MHz, 86 dB*; 10 MHz offset: 29 MHz, 111 dB; 52 MHz, 88 dB; 70 MHz, 98 dB; 144 MHz, 88 dB.
S-meter sensitivity: Not specified.	S-9 signal, preamp off/on: 14 MHz, 47.3/42.6 µV; 50 MHz, 48.9/54.9 µV; 144 MHz, 45.1/54.9 µV.
Squelch sensitivity: Not specified.	At threshold, preamp on: FM, 29 MHz, 0.12 µV; 50 MHz, 0.09 µV; 144 MHz, 0.09 µV; SSB, 0.43 µV (14.2 MHz).
Receiver audio output: 4.48 W into 8 Ω (main and sub receiver combined).	Sub receiver, 2.25 W at 10% THD into 8 Ω. THD at 1 V RMS, 3.2%.
IF/audio response: Not specified.	Range at –6 dB points (bandwidth) †: CW (500 Hz): 350 – 850 Hz (500 Hz); Equivalent Rectangular BW: 503 Hz; USB (2.7 kHz), 123 – 1655 Hz (1643 Hz); LSB (2.7 kHz), 122 – 1655 Hz (1644 Hz); AM (6.0 kHz), 370-3980 Hz (7220 Hz).
Spurious and image rejection: Not specified.	First IF rejection, 14 MHz, 96 dB; 50 MHz, 81 dB; 70 MHz, 83 dB; 144 MHz, 128 dB. Image rejection, 14 MHz, 110 dB; 50 MHz, 73 dB; 70 MHz, 82 dB; 144 MHz, 108 dB.
Transmitter	**Transmitter Dynamic Testing**
Power output: HF, 200 W (50 W AM); VHF, 100 W (25 W AM).	1.8 MHz, 4 – 189 W; 3.5 MHz, 8 – 215 W; 5.3 MHz, 0 – 93 W; 7.0 MHz, 3 – 192 W; 10.1 MHz, 3 – 187 W; 14 MHz, 2 – 180 W; 18.1 MHz, 2 – 187 W; 21 MHz, 2 – 187 W; 24.9 MHz, 2 – 183 W; 28 MHz 3 – 183 W; 50 MHz, 3 – 92 W††; 144 MHz, 4 – 100 W; AM, HF typically 3 – 30 W; VHF, 3 – 13 W.
Spurious-signal and harmonic suppression: Not specified.	1.8 MHz, 55 dB; 3.5 MHz, 46 dB; 5.3 MHz, 46 dB; 7.0 MHz, 56 dB; 10.1 MHz, 63 dB; 14 MHz, 55 dB; 18.1 MHz, 59 dB; 21 MHz, 54 dB; 24.9 MHz, 57 dB; 28 MHz, 56 dB; 50 MHz, 60 dB; 144 MHz, 65 dB. Complies with FCC emission standards.
SSB carrier suppression: ≥ 70 dB.	65 dB.
Undesired sideband suppression: >70 dB.	>70 dB.
Third-order intermodulation distortion (IMD) products: Not specified.	3rd/5th/7th/9th order, HF, 200 W PEP, –26/–41/–50/–52 dBc (worst case, 160 m), typically –35/–48/–54/–59 dBc; 50 MHz, –40/–44/–57/<–60 dBc; 144 MHz, –29/–41/–55/<–60 dBc.
CW keyer speed range: Not specified.	5 to 54 WPM, iambic modes A and B.
CW keying characteristics: Not specified.	See Figures 3 and 4.
Transmit-receive turn-around time (PTT release to 50% audio output): Not specified.	S9 signal, AGC fast, 40 ms.
Receive-transmit turn-around time (tx delay): Not specified.	SSB, 43 ms; FM, 51 ms.
Transmitted phase noise: Not specified.	See sidebar.

Size (height, width, depth, including protrusions: transceiver, 6.8 × 16.8 × 18.3 inches; power supply, 6.8 × 9.0 × 17.0 inches (including protrusions). Weight, transceiver, 62 pounds; power supply, 22 pounds.

Price: 13,290 Euros including 19% VAT, not including shipping (about $17,500).

*Measurement was noise-limited at the value indicated.
**ARRL Product Review testing includes Two-Tone IMD results at several signal levels. Two-Tone, Third-Order Dynamic Range figures comparable to previous reviews are shown on the first line in each group. The "IP3" column is the calculated Third-Order Intercept Point. Second-order intercept points were determined using –97 dBm reference.
†Default values; bandwidth adjustable via DSP.
‡Threshold of receiver overload was +6 dBm at 3.5 MHz.
††Power output was measured at 55 W at 50.1 MHz.

Instead, each receiver VOLUME control includes a push ON/OFF function that can silence each speaker independently. These also return to the default ON position following a power cycle.

Band selection can be accomplished in a number of ways. A keypad, which also serves as a numeric frequency entry device, has indicators for each HF band; the 0 numeric key indicates VHF. Pushing one of the band keys moves the main VFO and receiver to the last frequency you used on that band, including the last mode and bandwidth (DSP or analog). Push it again and you will switch to the second to last mode and frequency.

If the band buttons don't suit you, you can enter your frequency of choice using the numeric keypad, or you can select one of the memory channels in three banks of 99 channels each. Each memory channel includes frequency, mode, and receive bandwidth.

Connections and Connectors

The front panel MIC connector is of the popular eight-pin round type. The connections for dynamic mic and PTT match the Kenwood configuration, but the rest of the connections are different. It should work fine with a commercial adapter designed to connect a Kenwood radio to a dynamic headset, for example. The other connections in the MIC jack are interesting — such as audio outputs for main and sub receiver, a separate input for electret mics that want the operating voltage in line with the audio, and a line level (0 dBm) input — perhaps designed for a remote audio connection. Thus if you make your own adapter, there can be additional flexibility.

The front-panel HEADPHONE jack is a standard ¼-inch stereo jack that can provide the same audio feed to each ear, or the main receiver output can be in one ear, while the sub receiver is in the other, as described above — just what you want for SPLIT operation while chasing DX.

Next to the HEADPHONE jack is the CW KEY jack, also a ¼-inch stereo jack. By pushing the KEYER soft key (in the TX menu), you will be able to select EXT keyer (can also be used with a straight key), NORMAL or REVERSE connected paddles, or specify ULTIMATIC, IAMBIC A or B modes. The KEYER SPEED, DELAY, and MONITOR controls are located near the CW KEY jack.

Figure 1 — The PT-8000A's colorful display prominently indicates the main receiver's VFO A and B frequencies, mode and filter bandwidth. The sub receiver frequency, mode and bandwidth are shown in the upper right corner. Metering functions (S meter, transmitter power, ALC, and SWR) are shown along the bottom. Along the right-hand side are soft buttons — button functions change to allow quick access to various settings and menu options.

Figure 2 — The Hilberling PT-8000A rear panel, showing the available connections.

A bit of an unfortunate design choice (for this operator) is that the MONITOR control serves as both voice monitor in voice modes and CW keyer monitor in CW mode. Thus if you change modes frequently, you always have to remember to change the control to match the new mode. The audio feedback with the MONITOR turned up for CW will remind you quickly if you change to a voice mode while the speaker is on and forget to readjust.

Rear Panel Connections

The rear panel (Figure 2) provides Type N sockets for two HF antennas and another for a VHF antenna. There is also a BNC socket for a receive-only antenna. There is no question that Type N coax connectors are electrically superior to the UHF type usually found on commercial amateur gear, although it's not clear that the advantages are necessary in the usual HF home station environment. I used Type N to UHF adapters for each connection to my UHF terminated antenna cables, along with right-angle UHF adapters, because space behind the radio was not sufficient for the needed bend radius of the RG-213 coax runs leaving the radio. This worked fine, although if it were my radio, I would change out the connectors on the cables to match those on the radio and select Type N right angle adapters.

Along the bottom edge of the rear panel are many of the typical connections, along with a few that are not commonly seen on an amateur transceiver. Starting from the left, there is a typical ground stud, but also a proprietary GROUND socket intended for the supplied ground cable that goes to a similar connector on the power supply. Next there are two BNC sockets. One provides an output of the internal 10 MHz reference oscillator, in case you want to synchronize your other gear. The other is for a 10 MHz reference input that could be used to lock the radio to a high-accuracy frequency standard. Next are two 3.5 mm stereo jacks. The first is a 60 kHz modulated carrier containing I and Q samples of both the main and sub receiver. This is designed to connect to a sound card for use with Hilberling's supplied spectrum scope software (more on this later). The second is a jack for external stereo speakers. An input is provided for an ALC voltage to control the transmit output level. Next is a nine-pin D-SUB socket that provides PTT in and out, dc samples of the forward and reflected power level, ALC and other functions that might be useful to control a connected linear amplifier.

Near the middle is the DC INPUT connector. This is a sturdy four-pin connector of a type I haven't seen, designed to bring in the 13.8 V and 50 V supply voltages from the companion power supply using the supplied cable. Next is a socket for a PS/2 keyboard for communicating with the main CPU. This appears to be a development connection, since no functions are defined. A 15-pin D-SUB socket that provides audio-in for data modes, as well as audio out for both receivers and PTT is next. Then there is a 25-pin D-SUB socket that is intended to support audio, PTT control, data and 1 A at 12 V for interconnection of up to two transverters. On the far right of the bottom row is a standard USB connector, which can be used with a supplied cable to connect to a USB port on a PC for computer control of the radio (Kenwood emulation) or updating of software.

What is really unusual is the set of eight SMA coaxial sockets along the rectangular box at the upper left of the rear panel. These sockets provide samples of — or in two cases, allow insertion of — processing within the RF signal path of each receiver. One pair (interconnected by a short jumper) is in the antenna circuit after the selection matrix and TR switching of the main receiver; the other in the same position of the sub receiver. Two more are at the 40.7 and 10.7 MHz IFs, right after the first and second mixer of the main and sub receiver. In each case they provide a wideband sample of what each receiver has to work with at that point in the signal chain. These could be used for an alternate parametric display, within the bandwidth limits, or many other off-line processing functions — left for the user to contemplate.

How Does it Play?

As you might expect, this radio performs very well as measured by most key parameters. Initial testing in the ARRL Lab indicated a non-uniform two-tone IMD dynamic range response in the main receiver — on HF, the IMD levels were different above and below the desired frequency — and levels were not consistent from test to test. In the sub receiver, IMD levels were consistent and uniform, but the reciprocal mixing dynamic range at 2 kHz spacing measured only 93 dB and noise created by reciprocal mixing made receiver tests difficult. After discussing these issues and some transmitter issues (see below) with Hilberling, we returned the transceiver to Germany for repair.

Table 1 shows the results of ARRL Lab testing of our PT-8000A after its return from Germany. Of particular note is the receiver dynamic performance. This is a very good receiver in terms of the important near-in (2 kHz) intermodulation and blocking dynamic range. Even better is the reciprocal mixing dynamic range, one of the best we've measured in a traditional heterodyning receiver. What was surprising to me was that I had come to believe this kind of receiver performance could only be achieved with a down-converting architecture. The folks at Hilberling have shown that with careful system design and component selection, it can be achieved in other configurations as well.

On the transmit side, the performance is good, but perhaps not quite as remarkable. Almost all of the parameters are within or close to specifications. The spurious responses are also within FCC requirements, although it took some work on its trip back to Germany to get the spurious response on 60 meters within FCC requirements. They also improved spurious suppression on 80 meters, blocked transmission on the 4 meter band (for US versions), and fixed a CW keying problem on 20 – 10 meters.

The transmit output power was not quite up to specification on most bands, a surprising result. This is not a big deal in most circumstances since the difference between 200 and 183 W, for example, is less than 0.4 dB. I did find that the AM HF carrier power of 30 versus the specified 50 W did cause me some operational problems, as noted below.

The internal automatic antenna tuner is specified to tune an SWR of up to 2:1 to within 1.5:1. I found that it could easily deal with antennas with a somewhat higher SWR, but this should be considered a *trimming* tuner, not the kind of wide-range tuner needed for many multiband antenna systems.

On the Air at W1ZR

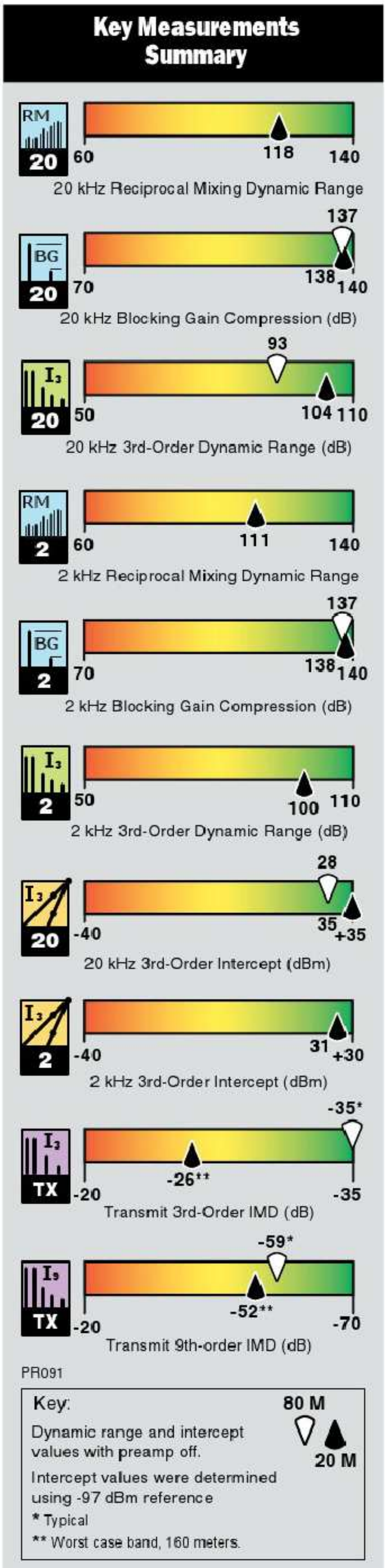
I used this transceiver as my regular HF and VHF radio over several months. My impressions were generally positive, although there were a few areas that would have suited me better if done somewhat differently.

Not surprisingly, the receiver is a joy to operate in all modes. It sounds very good and is smooth and precise to operate. One surprise that wasn't a problem, but might be for some, is that the separate receive antenna can be used only while transmitting on ANTENNA 1. This might be a matter of just arranging your antennas accordingly, but it could be an issue for some who need more flexibility. In a similar fashion, 6 meters is permanently routed toward the VHF antenna port, along with the signals for operation on the 2 and 4 meter bands. For many, this will be the perfect arrangement, but this is not the case at W1ZR where the HF tribander also serves as home to the 6 meter coupled resonator Yagi, sharing the same coax run. There are a number of commercial HF antennas that also include coverage of 6 meters and they will run into this issue, as will those using one of the many available linear amplifiers that cover HF through 6 meters. This is not the end of the world, but it either means a couple of extra coax switches, or perhaps an antenna patch panel, for those with a similar antenna configuration.

SSB Operation

As with many current transceivers, the PT-8000 is built around SSB operation. It includes speech processing and a smooth and easy to adjust ALC function. I received excellent signal reports, especially after I adjusted the internal three-band equalizer to maximum (9 dB) high end boost and low end cut. I thought it might be the microphone, but another mic I tried wanted the same settings. Perhaps my voice is not the one they were expecting — still, once adjusted, I had fine reports. VOX is initiated by a push to the MIC GAIN control knob. VOX has its own mini-cluster of VOX GAIN, DELAY, and ANTI VOX knobs located just above and to the right of the MIC connector, a sensible place. Although the knobs were small, it was easy to set them up so it worked smoothly with all but very loud speaker audio.

Available receive selectivity in SSB mode includes bandwidths of 1.8, 2.0, 2.4, 2.7, 3.1, and 6 kHz using the excellent 16-pole crystal analog filters only and 1.0 to 1.8 kHz in 200 Hz steps, 1.9 to 3.5 kHz in 100 Hz steps, as well as 4.6 and 6 kHz, with DSP following the next higher bandwidth



analog filters. They all provided extremely good sounding receive response and each filter could be easily moved up and down ±600 Hz across the passband to minimize adjacent channel spillover. Both the DSP and analog notch filters could be used independently to eliminate any pesky carriers or heterodynes. This is a very nice receiver — and you get two of them!

CW Operation

The PT-8000A puts out a fine CW signal. In fact my regular (since 1974) 80 meter CW schedule partner, W1WO, thought it sounded better than most radios he's heard. This is likely due to the nicely shaped waveform (Figure 3) and narrow CW transmit sidebands (Figure 4), one of the cleanest we've seen.

The internal keyer works well, in NORMAL or IAMBIC modes A or B through the push of the appropriate soft-key buttons. The keyer can also be disabled by poking the EXT KEYER button to use either a straight key or external keyer connected via the front panel KEY jack. There do not seem to be any other key ports, nor any provision for keying memories, so that will need to be handled from outside the transceiver.

The monitor function is also crisp, but

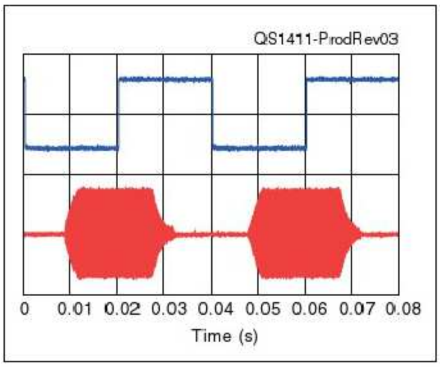


Figure 3 — CW keying waveform for the PT-8000A showing the first two dits in full-break-in (QSK) mode using external keying. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. (Note that the first key closure starts at the left edge of the figure.) Horizontal divisions are 10 ms. The transceiver was being operated at 180 W output on the 14 MHz band.

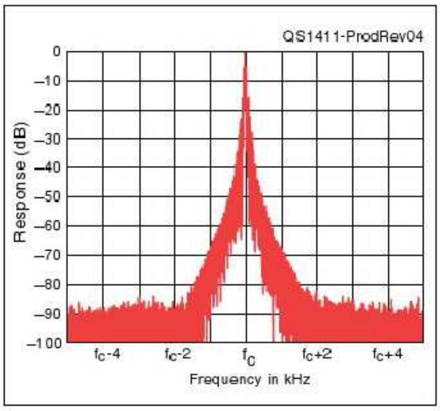


Figure 4 — Spectral display of the PT-8000A transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 180 W PEP output on the 14 MHz band, and this plot shows the transmitter output ±5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dB.

Phase Noise Testing in the ARRL Lab

Bob Allison, WB1GCM
ARRL Senior Test Engineer

Most radio amateurs today will agree that receiver performance has improved dramatically over the past generation or two of transceivers. With the widespread use of better filtering and improvements in digital signal processing, the effect of intermodulation distortion (IMD) at close signal spacing has been reduced greatly. Many software defined receivers (SDRs) now experience little to no reciprocal mixing or reduction of audio level on the received frequency from strong adjacent signals. Signals generated within the receiver during reception of one or more strong nearby signals are not the problem they once were, and it's possible to operate effectively in a crowded band.

While the ARRL Laboratory staff is impressed by the new receiver technology at our fingertips, we believe transmitter performance has not kept pace. Although today's receivers can hear weak signals very close to adjacent strong signals, even the best receivers cannot eliminate the effects of a wide signal from an adjacent transmitter. Transmitted signal issues include excessive keying bandwidth on CW, poor suppression of transmitted IMD products (which causes splatter on SSB), or transmitted phase noise (which raises a receiver's noise floor) in the speaker. ARRL Lab Product Review test reports include transmitter IMD products (both typical and worst case), a plot showing keying sidebands, and a plot showing transmitted phase noise.

Phase Noise

Phase noise is essentially the noise generated above and below an oscillator's frequency, also called sideband noise. All oscillators generate some level of phase noise. This is most evident while receiving when a close adjacent signal is very strong and the receiver's background noise increases. This is due to the mixing of the first local oscillator's phase noise with the incoming signal at the first IF (reciprocal mixing). The Lab reports the effects of reciprocal mixing in the receiver as "Reciprocal mixing dynamic range" or RMDR. In most receivers we've tested, RMDR is the limiting dynamic range. In other words, third order IMD dynamic range and blocking dynamic range are better than RMDR.

A transmit oscillator, the heart of the transmitter, has phase noise too. A transmitter's phase noise is a fixed characteristic and, at times, can be a nuisance to other operators. A good example of observed phase noise can happen at Field Day or other environment where several transmitters are operating in close proximity. When two stations are operating on one band, the CW station blasts the phone operator's

Figure A — The ARRL Lab's new Rohde & Schwarz FSUP 26 Signal Analyzer, used for transmitter phase noise testing.

you have to remember to turn it back up if you've been using voice modes with the speaker, since the MONITOR knob controls both voice and CW monitor levels. The sub receiver is not normally muted during transmit, so it is also possible to use the sub receiver as a CW monitor. This is one of the few transceivers that actually allows you to monitor your own signal while you transmit — never a bad idea.

The PT-8000A supports full break-in (QSK) with a TR delay of typically 15 ms, fast enough for all but the highest speed operators to hear between dots. I didn't find it a problem while using headphones, but I found the TR relays noisy enough to be distracting if using QSK with the speaker. For my usual casual operation, I backed off on the delay so it went from transmit to receive between characters instead of code elements and was much happier.

Figure B —The FSUP 26 screen shows quite a bit of detail during testing of the Hilberling PT-8000A on the 14 MHz band.

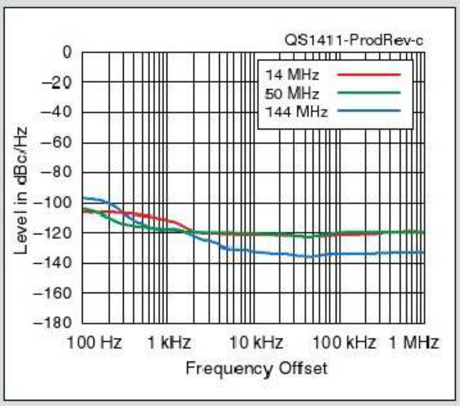


Figure C — Spectral display of the PT-8000A transmitter output during phase noise testing with the FSUP 26 and plotted on the grid used in previous Product Reviews. Power output is 180 W on the 14 MHz band (red trace), and 100 W on the 50 MHz band (green trace) and 144 MHz band (blue trace). The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 100 Hz to 1 MHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dB.

ears with bursts of noise, and vice versa. Using a transmitter exhibiting high phase noise with an RF amplifier magnifies the problem.

Another example is two radio amateurs living in the same neighborhood. The noise floor increases every time the neighbor is on the air. The effect is more noticeable on VHF, where the noise floor is considerably lower.

The solution for the reduction of both transmitted phase noise and receiver reciprocal mixing is the employment of high quality oscillators by the manufacturer. Generally, the better the oscillator (the lower the phase noise), the better the RMDR and the lower the transmitted phase noise.

ARRL Lab Testing

At the ARRL Laboratory, we have been measuring transmitted phase noise for several years with a Hewlett-Packard HP-3048A Phase Noise Test System. Product Reviews of HF transceivers include a chart showing the transmitted noise from 100 Hz to 1 MHz away from the carrier. Because our original test setup measured both phase and amplitude components, we used the term "composite noise" rather than "phase noise" in the test results. The HP-3048A eliminated the amplitude components but we continued to refer to the results as *Composite Noise* testing. Starting with this review, we will use the term *Phase Noise* in the test results.

While the HP-3048A is older, it is accurate. However, we could only measure phase noise on one frequency in the 20 meter amateur band. This was adequate for HF transmitters but the VHF and UHF side of multiband transceivers had to be overlooked.

The Lab is pleased to announce it has acquired a new Rohde & Schwarz FSUP 26 Signal Source Analyzer (Figures A and B), which will allow us to measure phase noise on any frequency up to 26.5 GHz. Dr Ulrich Rohde, N1UL, an ARRL technical advisor, helped us to acquire this instrument, which is one of the best of its kind. First unveiled at the ARRL's open house during the Centennial Convention this past July, the FSUP 26 was pressed into service to measure the phase noise of the Hilberling PT-8000A. In addition to the usual measurement at 14 MHz, we now happily include phase noise test results for 50 and 144 MHz, as shown in Figure C.

The goal is to have each line on this chart as low as possible. I consider –100 dBc/Hz within 1 kHz, with the plot receding away from the carrier down to –130 dBc/Hz, as good performance. The effect of one transmitter is not that significant (unless you're in proximity to it!), but the effect of every transmitter on an amateur band at once is *cumulative.* I'm sure many radio amateurs with high gain antenna arrays have experienced an increased noise floor from multiple strong signals within 1 MHz or less.

Manufacturers of Amateur Radio equipment are aware of phase noise, and some transceivers we have reviewed exhibit fairly low transmitted phase noise while others do not. The use of better oscillators will allow better weak signal work and more effective operation during crowded band conditions. We hope that manufacturers will pay close attention to phase noise in the design of new transceivers in all price ranges.

On receive in CW mode, you have selectivity choices of 250 or 500 Hz using the provided 16-pole analog crystal filters or, in addition, 50, 100, 200, or 400 Hz using the DSP. Even at 50 Hz bandwidth, I found the reception quite pleasant without any noticeable ringing or distortion.

Other Voice Modes

The PT-8000A provides for AM and FM operation. Within AM, one can choose the usual dual-sideband full-carrier operation, or a carrier and just one sideband. This is the kind of AM that the classic Collins KWS-1 provided, and can be useful if the receiver at the far end can just copy one sideband at a time, thus reducing interference.

I tried the standard double-sideband AM and initially had a problem. I believe it was largely because our test sample had a carrier output of 30 W, rather than the specified 50 W. While 30 W by itself is not a problem — similar to the output level of the popular 1950s Johnson Ranger transmitter — it meant that with the audio gain set for proper operation on SSB, the transmitter was significantly overmodulated on AM. The PEP output should be no more than four times the output carrier level (in this case, 120 W rather than the expected 200 W). There is no instrumentation provided, nor any clipping or limiting, as with the ALC on SSB, so one must watch the PEP output meter. After my first unhappy experience on the AWA AM net, I thought to use the sub receiver to provide real-time monitoring (be sure to turn the sub receiver speaker off to avoid feedback) while I watched the meter and was able to get myself calibrated. Of course any of the standard AM modulation monitoring techniques, such as using a 'scope, could also be used — but not many stations are set up that way these days. My next AWA net appearance received very good reviews. I have a feeling that if the carrier output were at the 50 W design point, the SSB mic gain level would likely have been just about right.

VHF FM shared the same lack of built-in instrumentation, but seemed to have the appropriate level of deviation with the gain set for SSB. While the radio has provision for repeater offsets, and can memorize channels for repeater use, unfortunately it does not currently support CTCSS tone access. I couldn't use any of my local repeaters, which all require CTCSS, but did have some successful simplex contacts. With 100 W output, I was also able to simulate being a repeater and check in with some folk who were looking for repeater contacts. CTCSS is not used in Europe, explaining this deficiency for the US market. Hilberling indicated that a future firmware release will include CTCSS tones, making FM operation much more useful to North American operators.

Digital Modes

Digital mode operation with the '8000A can be supported using SSB transmission in concert with a PC sound card. Both rear and front-panel (MIC) connectors can be used to support PC-driven digital modes. In addition, direct FSK is supported for those who prefer it for RTTY, with all required connections available at the rear panel. The only feature that I might have expected to find in a top-drawer transceiver was the availability of dual filtering centered around the mark and space frequencies. This can improve both S/N and interference rejection on receive. Perhaps this will be on their upgrade list.

Spectrum Scope

The PT-8000A offers a 60 kHz carrier output with I and Q channels for both the main and sub receivers. The supplied disk provides spectrum scope software, but it is of somewhat limited utility compared to many other similar offerings. Hopefully it is a work in progress, but it does work within its limitations if you have a sound system with sufficient resolution (192 kHz sample rate) — mine was not up to the task. The limitation that I found most troubling was that it required the full PC screen and could not even be minimized to allow access to other programs. Even though the PC had access to serial data to provide frequency information for other programs, the spectrum scope software just provided relative frequency information — 0 Hz in the center and ± offset frequency indication. There was also no provision to allow the scope display to control the radio. My guess is that this will improve over time, or perhaps others will adapt their spectrum display programs to the Hilberling signal format.

Documentation

The PT-8000A comes with a professional quality 104-page, loose-leaf-bound, full color instruction manual and a packet containing CD-ROMs for the firmware upgrade and spectrum scope software. The manual includes appendices describing the firmware upgrade process and the use of the spectrum scope software, with illustrated step-by-step instructions for each.

While I believe everything is covered within the manual, I think it would be helpful to add a page that summarized the soft-key menus and indicated how to get to each. While the trial-and-error process does work, and the menus do become second nature after a while, I think it would make it much easier for new users to get started.

Final Thoughts

Hilberling's PT-8000A is certainly an impressive new take on the Amateur Radio transceiver. It brings together many desirable features — excellent transmit and receive performance, a 200 W transmitter, operation on all bands through 2 meters, two equally capable receivers, ease of use — in one attractive, well made package. With a price tag around $17,500, it's not for everyone, but it shows what is possible with great engineering and attention to detail. Think of it as a Porsche 918 Spyder for the ham shack.

Manufacturer: Hilberling, Kieler Strass 53, D-24768 Rendsburg, Germany; **http://hilberling.de**. US distributor: **www.hilberling-usa.com**.

Click here for a video overview of the Hilberling PT-8000A MF, HF, and VHF transceiver.

OM Power OM2500A HF Power Amplifier

Reviewed by Norm Fusaro, W3IZ, Assistant Manager, Membership and Volunteer Programs Department
w3iz@arrl.org

I have a friend who is an avid collector of vintage radio gear. During one visit to his home, he demonstrated a Collins ART-13 transmitter that was considered cutting edge technology for its time. The transmitter had five dials across its lower front section. When he put it into the TUNE mode, all the dials would spin, whirring around back and forth until each one arrived at the correct value to tune the transmitter to the desired operating frequency. He told me that this technology was introduced during the latter part of World War II and was used in the B-29 bombers that flew over Europe and the Pacific, and later during the Korean War.

The OM2500A from OM Power in Slovakia is a legal-limit RF power amplifier for 160 through 10 meters that offers manual or automatic tuning. I mention the ART-13 because that is the first thing that came to mind when I fired up the OM2500A amplifier and heard the whizzing and whirring of electric motors and witnessed the rotating control knobs on the front of the amplifier. It's an interesting blend of vintage technology and microprocessor control. (A similar model, the OM2500HF, is manual tune only.)

The OM2500A uses a GU84b (4CX2500A) tetrode tube that requires 60 W or less to drive this rock crusher to 1500 W output. The pi-L output circuit will tune into an SWR of 2:1 and the amplifier incorporates a number of protection features. Automatic operation is compatible with many popular transceivers.

Initial Impressions

The OM2500A is a heavy amplifier — just over 90 pounds — as expected for any legal limit device using ceramic tubes and requiring a high voltage power supply. The amplifier is fitted with side handles to make lifting and positioning a bit easier than other amps in this category. I was able to lift it out of the shipping carton and onto the table without assistance, but help was required with the hand truck getting the unit down the stairs to my station.

The front panel is neatly laid out and has a clean, modern look. Two bar graph indicators display RF output power and reflected power. Another bar graph displays screen current. A multifunction bar graph handles display of anode voltage, anode current, and a tuning aid. A bright and easy to read LCD screen displays mode (auto or manual), type of transceiver in use, and frequency of operation as well as all menu items when selected. Rounding out the visual display is a variety of colored LEDs to indicate status such as fault, standby or operate.

The amplifier has protection circuits for excessive anode, screen or grid current, excessive reflected power, low anode voltage, excessive output power and incorrect tuning settings. Faults can be diagnosed from flashing LEDs or from a combination of flashing LEDs. When a fault is detected, the amplifier goes into standby for two seconds and then automatically returns to operation. If the fault repeats three times, the control circuitry places the amplifier in standby. The operator must use the OPR/STBY switch to return to operation after correcting whatever condition caused the fault.

Figure 5 shows the amplifier interior. On the left are the power supply components,

Figure 5 — Interior of the OM2500A.

Bottom Line

The OM2500A from OM Power is a rugged, legal-limit, automatic amplifier for 160 through 10 meters that will integrate seamlessly into most stations.

Table 2
OM Power, OM2500A, serial number U2 12001

Manufacturer's Specifications	Measured in ARRL Lab
Frequency range: All amateur frequencies in the range of 1.8 to 29.7 MHz.	Tested on 160, 80, 40, 30, 20, 17, 15, 12, and 10 meters. (US power limit is 200 W on 30 meters.)
Power output: 1500 W, continuous, no time limit.	Tested at 1500 W continuous output for 5 minutes.
Driving power required: 40 to 60 W.	48 to 60 W (typical) for 1500 W output.
Spurious and harmonic suppression: >52 dB (2nd harmonic), >65 dB (3rd harmonic).	2nd harmonic: 43 dB worst case (18 MHz)*, typically 57 to 63 dB; 3rd harmonic, 49 dB worst case (21 MHz band), typically >70 dB. Meets FCC requirements.
Third-order intermodulation distortion (IMD): 36 dB below full power output.	14 MHz, 3rd/5th/7th/9th: 43/44/>60/56 dB below PEP.
TR switching time: Not specified.	Amplifier key to RF output: 10 ms; amplifier un-key to RF power off: 10 ms.
Primary power requirements: 240 V ac, 60 Hz.	
Size (HWD): 8.0 × 22.1 × 22 inches (including protrusions); weight, 92 lbs.	
Price: $7995; remote control console, $395.	

*Second harmonic suppression was at the FCC limit (43 dB) at 18.070 MHz. The suppression improved to 49 dB at the top end of the band.

Figure 6 — The OM2500A rear panel.

including two massive toroidal power transformers underneath PC boards with some of the control and power supply circuitry. On the right you can see the GU84b with its large blower, and the pi-L tank circuit components. An auxiliary fan on the rear panel supplies additional cooling if the air exiting the amplifier reaches 70 °C.

Station Integration

Generally speaking, connecting an amplifier is a simple procedure: connect a cable from your transceiver's RF output to the RF input of the amp, connect an antenna to the output of the amplifier, add a keying line to switch the amplifier from standby to operate when the transceiver is keyed, and plug the amplifier into a properly rated ac power source (240 V ac in this case). This is pretty much all that is needed to use the OM2500A in its manual mode — perhaps better described as semi-automatic operation because the user is not required to make any tuning adjustments after changing bands manually.

To take full advantage of the automatic tuning and band switching features of this amplifier, you must make a few more connections and configure the amp for use with your radio. In addition to standard rear panel connections, the OM2500A has a nine-pin D-SUB male TCVR jack, which is an RS-232 interface to connect to supported Yaesu, Kenwood, TEN-TEC, or Elecraft transceivers to receive band data and make changes to the amplifier as the operating frequency changes on the radio. Icom transceivers are supported with the CI-V interface jack. Another serial interface, a nine-pin D-SUB female jack labeled PC, connects to your station computer's serial port, allowing communication between the radio and software such as a logging program running on the PC. See Figure 6.

To complete setup of the transceiver-to-amplifier communications, the user enters a menu via the front panel of the OM2500A and selects from a list of supported radios. In addition to instructions and diagrams for connecting the OM2500A to several popular brands of transceivers, the manual includes information that may be helpful for connecting the amplifier to unsupported radios.

I didn't find my transceiver in the menu, but selecting another model from the same manufacturer allowed communication from radio to amplifier. At the time, I checked the OM Power website but did not find any downloads for updating the amplifier's firmware or list of supported transceivers. After selecting a compatible transceiver from the menu, I had to set the serial port speed. The RS-232 configuration worked well with a USB-to-serial converter as I set it up in my station on both a desktop PC and a laptop running *Windows 7*. I found the use of RS-232 a bit curious as these connections are rare on newer computers and laptops.

I soon discovered that unless the amplifier is powered on, the computer control to the radio was disabled. Rechecking the user manual showed that I needed to apply 12 V dc to the BYPASS COM jack on the rear of the amplifier to allow independent communication between PC and transceiver without having to power on the OM2500A. I thought that this is an important connection that should be included in the connection schematics. Nonetheless, what I first considered to be a deal breaker was resolved with a connection to an external 12 V dc supply.

I should note that the instruction manual shipped with our review amplifier did not show the BYPASS COM jack and seemed to be missing other information. Array Solutions quickly sent an updated copy of the manual, and this version contained pictures and descriptions matching the unit under review. Overall, the user manual is well laid out with diagrams, close-up photos, and simple descriptions making it very easy to use.

Other Connections

The OM2500A has two other interface jacks. The ANT & BPF SW jack permits automatic selection of antennas and band pass filters via external third party switches. Antenna ports are configured via a menu accessible on the front of the amplifier. This feature greatly reduces the chance of being on the wrong antenna when transmitting and sending the amplifier into fault.

My station is outfitted with a Top Ten Devices band decoder and antenna switches providing automatic antenna switching via the transceiver. I didn't sample this feature of the amplifier because it involves fabricating a cable from the amplifier to the antenna switches and disconnecting the existing configuration. If the OM2500A were to be a permanent fixture in any station, making the cable would not a big project and could be simplified by using a store-bought cable with a DB-25 male connector on one end. Based on the performance of everything else on the OM2500A, I doubt there would be any problem switching antennas or filters via the ANT & BPF SW connection.

The second interface provides a number of signals, including ALC output, TX inhibit (prevents the transceiver from transmitting while the amplifier is tuning), key out and key in. If your transceiver doesn't have provisions for TX inhibit, the manual recommends connecting the OM2500A's ALC output to your transceiver's ALC input and using the SET MUTE menu to ensure that there is no RF output from the transceiver while the amplifier is tuning.

As with any power amplifier, the TR switching relays must close before RF is applied, and must open after the transceiver is finished transmitting (ie, avoid "hot switching" the relays). Most modern transceivers have adjustable PTT-switching-to-RF-output times, and the amplifier's switching times as measured in the ARRL Lab are shown in the data table. If your transceiver's switching times can't be adjusted to avoid hot switching the OM2500A, you can connect a foot switch or other PTT device to the amplifier's KEY IN jack and use the KEY OUT jack to key the transceiver PTT.

On the Air

Before using the OM2500A on the air, it's a good idea to check the default automatic tune settings and, if needed, touch up the TUNE and LOAD controls for your antenna system. The amplifier memorizes tuning settings for band segments ranging from 15 kHz wide on 160 meters to 70 kHz wide on 10 meters. Following the procedure in the manual, start with the first segment on a band, make any needed adjustments, store the new settings and the amplifier steps to the next segment. Next time you return to a band segment, the amplifier will recall the TUNE and LOAD settings and adjust itself automatically.

Once this brute is configured to your station, operation is basically hands off. In the automatic mode, the amplifier quickly follows the band changes made at the transceiver. The OM2500A did a fantastic job of amplifying signals. As shown in the ARRL Lab tests, it provides full legal limit on all bands, with low IMD products. The OM2500A has plenty of headroom, loafing along at 1500 W output all day long (or all weekend long in the case of serious contest operators), even when using full duty cycle modes. I had no issues on any band using CW, SSB, or RTTY. The amplifier performed flawlessly and followed the transceiver everywhere using the CAT interface.

Each band change, whether in manual or automatic mode, requires the amplifier to perform a retuning of the TUNE and LOAD controls as described in the opening paragraphs of this review. To change bands manually, you press the UP/DWN to move up or down one frequency band and then select the desired segment within the band. The amp stops at each band as you step up or down through the spectrum. For example, to go from 40 meters to 12 meters you must tab through each band along the way (40, 30, 20, 17, 15, 12 meters) and wait as the amp stops and tunes itself at each band. I found this to be tiresome — consider the manually tuned version if you don't plan to make full use of the transceiver interface for fully automatic operation.

The OM2500A is not a silent amplifier. The first time I powered it on, I thought that the blower seemed excessively loud — loud enough to be heard when wearing high-quality headphones. After a few sessions with the amplifier, I decided to try to quantify what I was hearing. Using a sound level meter, I took measurements from my operating position of the noise level with the amplifier turned off. Then I turned on the OM2500A while leaving everything else the same, and took a reading from the same position. The OM2500A blower measured 19.4 dB above the ambient noise in the room. I then took measurements of my normal legal limit amplifier under the same conditions, and it measured 7.2 dB quieter than the OM2500A. Measurements of three other legal limit automatic amplifiers in use at ARRL indicated blower noise about 5 dB above the ambient noise in the room. Of course this is not a scientific sampling in an anechoic chamber, but these simple measurements validated my subjective observations. The OM2500A surely makes its presence known.

Remote Control

One way I could alleviate the blower noise is by placing the amp further away from the operating positing and using the optional OM2500A remote control. The remote control is a nice compact box that sits at the operating position and controls the amplifier through approximately 30 feet of supplied control cable. It permits the user to power the amp on or off and put it in operate or standby modes. An LED bar graph displays output power, and LEDs indicate a fault or an SWR issue. The remote control box requires a 12 V dc power supply.

Final Thoughts

Most operators consider an amplifier

Click here for a video overview of the OM Power OM2500A HF power amplifier.

a station accessory and something that should not take center stage in any station configuration. The designers of the OM2500A seem to have a different view, and they have designed this product to be an integral component of the modern ham shack, ready to be included in the station automation system. Today's radio amateur must be a systems integrator, configuring transceivers, switches, accessories, specialized computer software, and other components into a fully functioning station. Integrating the OM2500A into the modern ham shack is relatively easy, and the reward of a big clean signal from an amplifier that automatically follows the transceiver is worth the time and effort.

Manufacturer: OM Power, s.r.o. 930 30 BÁČ 126, Slovakia; **www.om-power.com**. Distributed in North America by Array Solutions, 2611 North Belt Line Rd, Suite 109, Sunnyvale, TX 75182; **www.arraysolutions.com**.

ERC-M Rotator Controller and *PSTRotatorAZ* Rotator Control Software

Reviewed by Pete Smith, N4ZR
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In this era of software defined radios and surface mount components, one of the remaining pleasures for those of us with an urge to build things is in the area of station control. I've done quite a bit of station automation, but sometimes, with two rotators, I still feel a little like a one-armed paper hanger. I went looking for a relatively simple, low cost way to automate control of my rotators, while not adding anything to my operating desk if I could help it.

Figure 7 — The completed Rotorcard installed in a Yaesu G-800SA rotator control box.

A Solution from Germany

Casting around through all the usual sources, one of the first Google hits was the Easy Rotor Controller (ERC) from the German firm Schmidt-Alba. Schmidt-Alba's proprietor, Rene Schmidt, DF9GR, is a well-known member of the Bavarian Contest Club. His ERC controller line includes one- and two-axis rotator controllers, assembled or in kit form, that can connect to virtually every rotator ever made. The controller does the heavy lifting in firmware, translating commands from your logging or station control software, as well as storing calibration, rotation stops, and so on. It connects to control-ready rotators through a six-pin mini-DIN connector.

For those rotators that aren't control-ready, Rene offers a couple of solutions. One is a "Rotorcard" that mounts inside the existing controller, providing relays that emulate pressing the left or right rotator controls. Another is the ERC Version 4 kit, just announced. It has the necessary relays included and is designed to mount inside most rotator control boxes. For one rotator, Version 4 would be the easiest, cheapest solution by far.

ERC-M is the two-axis model, which can be used either for azimuth-elevation (az-el) control in a satellite or EME system, for example, or to control either one or two azimuth-only rotators. All of Rene's controllers connect to the station computer through USB or RS-232 serial ports (choose the version you need when you order), while the ERC-M has a LAN option suitable for remote control applications. Finishing touches include either a desktop controller box with front panel displays and pushbuttons, or a minimal enclosure for behind-the-scenes control.

Bottom Line

The ERC-M rotator controller, Rotorcard interface, and *PSTRotatorAZ* software provide tools to include control of one or more antenna rotators in a station automation system. Excellent vendor support is available to help with complicated requirements.

In my station, I needed control for two Yaesu rotators — one ready for computer control (a G-1000DXA) and the other in need of a Rotorcard (G-800SA). I wanted to rotate my tribander stack and a 40 meter short Yagi above the top tribander. The lower Yagi in the stack is on a side mount with less than 360 degree rotation, and the 40 meter Yagi is offset 90 degrees from the tribander below it, so I knew my requirements might be difficult.

A quick exchange of e-mails with Rene persuaded me both that his hardware would work for me and that tech support would not be a problem. So, off went my order and PayPal payment, about $175 including shipping. I consider this quite competitive with other solutions available on the US market, particularly for two rotators. I could have added a desktop controller case, but I chose not to.

Getting the Hardware Ready

Only six days later, the package arrived. Inside were a ready-to-go ERC-M USB controller, a very small "slimline" enclosure, a Rotorcard in kit form, a couple of mini-DIN cables, and a CD with software and extensive, systematic documentation. The Rotorcard kit took me about an hour to build, soldering relays and a half-dozen through-hole components on a nice-quality glass-epoxy PC board. At first, I anticipated the hardest part might be installing the Rotorcard inside my G-800SA, but after a little thought and study of the instructions I felt confident to proceed. Six wires soldered

Figure 8 — The ERC-M rotator controller in its slimline case. A USB cable connects to the station computer, and both rotators are connected to a single 15-pin connector.

to readily accessible connections, guided by a schematic drawn from the original rotator manual, gave me all I needed, and the Rotorcard fit neatly into the controller cabinet (Figure 7).

For the other rotator, all that was required was to cable it to the ERC-M, with both cables passing through a single 15-pin D-SUB connector (Figure 8). Again, with care and a little thought, I had no trouble wiring the connector specifically to match the two rotators. You do need to be careful to label the cables, though, because the hookup is different for a Rotorcard than for the Yaesu rotator that is controller-ready, but both use a six-pin mini-DIN connector.

With this complete, I connected a USB cable to the ERC-M, and its driver self-installed on my *Windows 7* PC; the CD also included a driver for *Windows XP*, had I needed it. If you use a Rotorcard or have the RS-232 version, the ERC-M requires a 12 V dc supply (10 mA for the ERC-M, 300 mA for the Rotorcard). A wall cube power supply works fine. The USB version of the ERC-M without a Rotorcard can be USB-powered.

I then installed two pieces of software: a *Service Tool* that is used to test and calibrate the ERC-M, and a *Rotor-Control*, with two compass rose indicators, one for each axis. I should note that calibration was particularly quick and easy, which I understand is exceptional in the rotator control field.

I tried the controller, and of course it didn't work. A couple of quick e-mail exchanges with Rene corrected my mistakes, and he also provided an update of the *Service Tool* to better manage the less-than-360-degree rotation of one tribander. Turnaround time was less than a day, due in part to a 6 hour time difference. As Rene observed wryly, "this rotator business can't be my only job," but in any case, both rotators were quickly dancing to my tune.

Integration with Logging Software

I then turned to the problem of interfacing the ERC-M to *N1MM Logger*, the logging and station control software I use during contests. This revealed an unexpected problem, because *N1MM Logger* requires one serial port per rotator, while ERC-M looks to handle all communications for both rotators through a single port. Rene had the answer, which brings me to the second part of the story. It would be necessary, he said, to use *PSTRotatorAZ* (*PSTRA*) by Codrut Buda, YO3DMU, between *N1MM Logger* and the ERC-M controller.

PSTRA costs 15 Euros by download, and I very quickly had a licensed copy of the software. There is a lot to *PSTRA* — one friend called it the "Swiss Army Knife" of rotator control software. It can act as a smart controller for virtually any rotator ever built, with lots of ways to tell the rotator(s) where to turn. It also functions as an intermediary between any of those rotators and a large number of logging programs. For my purposes, the essential thing it does is to read the UDP (User Datagram Protocol) messages that *N1MM Logger* sends to its own *N1MMrotor* program, which is not used in this case, and translate them into messages on a single COM port in the appropriate format to control two rotators through the ERC-M (Figure 9).

With some more long-distance help from Rene and Codrut, I soon had *PSTRA* controlling my rotators, and *N1MM Logger* talking to *PSTRA*. The one thing that was still lacking was proper handling of *N1MM Logger*'s way of indicating the offset of my 40 meter Yagi. Until that was resolved, I could point my upper rotator to a station using the built-in N1MM command keystrokes, but on 40 meters it was not taking the offset into account. I mentioned this in passing in an e-mail to Codrut, saying

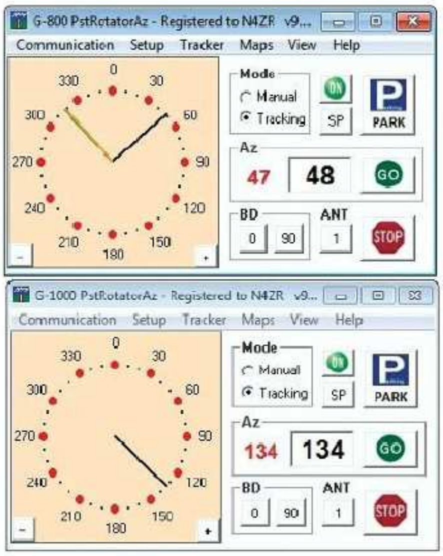

Figure 9 — The *PSTRotatorAZ* display showing the direction of both of the author's rotators.

I thought it was probably a matter for the N1MM team. The very next day, Codrut released an update of *PSTRA* that delivered a perfect solution.

A Happy Ending

Where do things stand now? With a stream of DX Cluster or Reverse Beacon Network spots displayed in *N1MM Logger*, I can click on a needed station and depending on the band, either the whole stack turns (for 20 – 10 meters), or the top rotator turns and points the offset 40 meter Yagi in the correct direction. It's all automatic. The ERC-M protects the lower tribander against over-rotation, and the calibration of both rotators is as good as I can resolve by eye.

Even more to the point, these two vendors have demonstrated that in the Internet era, distance is no longer a significant barrier to superb service and support. (I should add that neither Rene or Codrut knew that I was thinking of doing this review, so I believe the level of support is indicative of what any customer can expect.)

Manufacturer: ERC-M controller — Eida Alba de Schmidt, Kreuzangerstr. 58, 86399 Bobingen, Germany; **http://easy-rotor-control.com**. Price: ERC-M (USB version, assembled and tested), $120. Rotorcard kit, $23. Slimline case, $22. (Prices are approximate, not including VAT or shipping. Pricing is in Euros, exchange rate will vary.) *PSTRotatorAZ* software — PstRotator. **www.qsl.net/yo3dmu/index_Page346.htm**. Price: about $20 (pricing is in Euros, exchange rate will vary).

Smart Tweezers ST5 LCR Meter

Reviewed by Phil Salas, AD5X
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Table 3
Smart Tweezers ST5 Specifications

Measurement rate: 1 sample/second.
Tolerance offset: 1%, 5%, 10%, and 20%, selectable for automatic component sorting.
Measurement frequencies: 100 Hz, 120 Hz, 1 kHz, 10 kHz.
Test signal levels: 0.2, 0.5, and 1 V RMS sine wave.
Resistance: 0.05 Ω – 9.9 M Ω, ±0.2% from 100 Ω – 10 k Ω, ±0.5% from 1 Ω – 1 M Ω.
Capacitance: 0.5 pF – 4999 µF, ±0.2% from 10 nF – 10 µF, ±0.5% from 100 pF – 1 mF.
Inductance: 0.5 µH – 999 mH, ±0.2% from 10 mH – 100 mH, ±0.5% from 100 µH – 999 mH.
Dissipation factor: 0.001 – 1000 (Q = 1/D: 1000 – 0.001).
Component sorting: Settable to 1%, 5%, 10%, or 20% tolerance.
Weight: 52 grams (less than 2 oz).
Price: ST5 with carrying case and charger: $400. ST5S with carrying case and charger: $400.

Surface mount device (SMD) components are inexpensive and small, and they lend themselves well to modern automatic manufacturing processes. As SMD components grow in popularity, leaded (through-hole) components are becoming more expensive and even obsolete. As much as I dislike working with SMD components because of their small size, more and more projects seem to require them — even some kits that are currently available.

When I work with SMD components, I have to be extremely careful to keep the parts properly sorted. If I accidentally mix the parts, I have to measure multiple components in order to make sure I don't install the wrong one. Unfortunately, measuring these tiny parts is extremely difficult with typical test equipment in the ham workshop. Enter the Siborg Systems ST5 Smart Tweezers — a compact, highly accurate LCR (inductance, capacitance, resistance) meter that is especially made for measuring SMD components. (While I was preparing this review, Siborg Systems introduced the ST5S, a newer model that is smaller and lighter than the ST5 but has the same specifications and capabilities.)

The ST5 is a precision instrument with a basic accuracy of ±0.2% and supplied with a NIST-traceable calibration certificate. Its gold plated tweezers tips can easily hold SMD components down to 0201-size. In addition to measuring inductance, capacitance and resistance, the ST5 also displays Q, ESR, and impedance. It also performs diode and continuity tests, and provides a selectable component tolerance offset test. The ST5 specifications are given in Table 3.

Using the ST5

When you open the ST5 package, you might think there is a computer interface as you'll find a USB cable. However, this cable is only used for charging the internal Li-ion battery from your computer's USB port or with the supplied USB charger. Charging time is approximately 2.5 hours for a fully discharged battery.

The ST5 is turned on by momentarily pressing the navigation button, after which the last selected measuring function is displayed. The navigation button may be rocked to select different measuring parameters and test functions. Rock the button up cycles through test signals levels of 0.25, 0.5, or 1.0 V RMS (default). Rock the button left to select the device type to be measured: R, L, C, |Z| (absolute value of impedance), ESR, diode test, Rdc (dc resistance), and AUTO. Rocking the button down selects one of three test ranges or AUTO. Finally, rocking the button right selects one of four test frequencies, or AUTO. The ST5 automatically powers off after 30 seconds (default) of inactivity. The power-off time is settable from 10 to 200 seconds.

Bottom Line

If you have the need for a highly accurate LCR surface-mounted component measuring and evaluation instrument, the Smart Tweezers ST5 is worth considering.

When in AUTO mode, AM shows in the bottom left of the display. For most uses the AUTO mode works well as the ST5 will determine the component type and best measuring range and frequency at the default signal level of 1 V RMS. The 1.0 V RMS signal level provides the best accuracy for most resistors, capacitors, and inductors. Lower signal levels may be better for very low value, high-Q induc-

Figure 10 — The ST5 measuring a precision 0201 50 Ω SMD resistor.

Table 4 **Auto vs Manual Frequency Measurement**		
Component Marking	**Measured Value with Auto Mode & Freq**	**Measured Value with Manual Entry**
2 pF +5%	2.1 pF/10 kHz	N/A
1000 µF +20%	916 µF/100 Hz	N/A
1 µH +5%	675 mΩ/1 kHz	1.03 µH @ 10 kHz, Selected L

Figure 11 — The author's leaded component adapter.

tors. Some ceramic capacitor data sheets specify lower test voltages depending on the capacitor voltage rating.

According to the manual, the AUTO mode is accurate when measuring capacitance from 3 pF to 199 µF and inductance from 5 µH to 500 mH. Outside of these ranges the frequency can be changed manually for better accuracy (lower frequency for higher inductance and higher frequency for lower capacitance). I checked a few parts outside of the AUTO range to see how the ST5 would do in the AUTO mode. The results are shown in Table 4.

As you can see, the AUTO mode worked well, even for capacitors out of the AUTO range. The ST5 correctly selected the highest test frequency for the 2 pF capacitor, and the lowest test frequency for the 1000 µf capacitor. However, the 1 µH inductor measured as a low value resistor in the AUTO mode. But when I manually selected L as the component type, the ST5 automatically selected a 10 kHz measuring frequency and displayed the inductance accurately.

The ST5 fit my hand well and is very easy to use. In addition to easily picking up almost any size SMD component for measuring (see Figure 10), the ST5 tweezers tips are perfect for measuring an SMD component mounted on a PC board, probing nearby pads on a PC board, and even measuring leaded components on a PC board. Once you touch the ST5 tweezers tips to a component's leads, the component type and value are determined instantly, along with loss shown as a series or shunt resistor on the display. For highest accuracy, you can set the ST5 to automatically subtract out the tweezers' residual resistance (typically 30 milliohms), stray capacitance (typically 0.5 – 1.2 pF), or stray inductance (typically 0.1 µH). And incidentally, the ST5 "knows" when a component is being measured and will not power off until after the component is no longer being measured.

Finally, the tolerance sorting feature may be of interest to hams designing active filters. Often the actual component-to-component variation is just as important as the calculated component value, especially in multisection filters. Or perhaps you need to sort 5% or 10% resistors to find some within 1% for a critical project. Using the tolerance sorting capability, you can quickly sort parts to be within the desired tolerance from a reference component. The ST5 beeps once when a component is within the tolerance specified, and three times if it is out of tolerance.

Most of my components still have leads, and are through-hole components, and the ST5 is a little clumsy to use when measuring these components. Therefore, I soldered two pairs of alligator clips (Mouser 534-5033) together so as to make a leaded-component adapter as shown in Figure 11.

As you can see in Figure 11, a 20 pF silver-mica capacitor is being measured in the AUTO mode. The capacitor value and parallel shunt resistance are displayed along with the measuring frequency and signal level.

Conclusion

The ST5 is a very nice multifunction handheld device that is perfect for surface mount component measurement and evaluation. While pricey, you do get a precision instrument that is applicable for both tight manufacturing process control and home lab measurements. The new ST5S model is the same price as the one I reviewed. Another new model, the LCR-Reader, is a lower cost (about $200) instrument for those who can tolerate a bit less accuracy. The LCR-Reader has a basic accuracy of 1%, a fixed 0.5 V RMS test signal, and does not come with a NIST-traceable calibration certificate.

Manufacturer: Siborg Systems, 24 Combermere Crescent, Waterloo, Ontario N2L 5B1 Canada. US Distributor: SIBBIS International LLC, 1998 Lancashire Drive, Potomac, MD 20854; tel 301-762-1021; **www.smarttweezers.us**.

MFJ-4603 Antenna Window Feedthrough Panel

Reviewed by Mark Wilson, K1RO
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When we moved to a new house a couple of years ago, I located the ham shack in a corner of our walkout basement. My operating position has two windows with a nice view of the lake and distant hills. The first order of business was to hang my trusty 130-foot inverted V fed with window line through an antenna tuner. That antenna has served me well over the years with contacts on all bands from 80 through 10 meters.

To get the window line in the house, I just opened the top half of one of the double-hung windows, sandwiched the feed line between two pieces of foam, closed the window, secured it with a piece of wood and called it good. That worked fine for the flat window line, but within a few months the cables had multiplied. I needed to bring in several runs of RG-8, a run of RG-58, and a rotator cable too — clearly a better solution was needed.

MFJ Window Feedthrough Panels

MFJ offers several different panels designed to provide a clean and weatherproof way to route cables through a double-hung or glider window. These window antenna feedthrough panels (MFJ-46xx series) are all similar in appearance but accommodate different types of connectors. Five of the six available models are made from a 48 inch length 1 × 4 piece of wood (actual dimensions ¾ × 3½ inches) with metal plates on each side. The last version, the MFJ-4605, is 7 inches tall and has two plates.

I chose the MFJ-4603, which would accommodate the cables I currently have and leave some room for expansion later. This model has four UHF type bulkhead connectors, one Type N bulkhead connector, one 75 Ω F bulkhead connector, a pair of high-voltage ceramic feedthrough insulators for balanced line and another for a random wire, two five-way binding posts for low voltage dc, a ground post and one "Adaptive Cable Feedthru" to bring in rotator cable.

Installing the Panel

The first order of business is to carefully measure the window opening and cut the wood panel to size. All four edges of the panel will be wrapped with adhesive-backed foam insulation, so the panel needs to be just slightly shorter than the opening. If you make the panel too short, it won't seal well. Note that supplied pressure treated wood doesn't have the nice smooth finish you'd expect from material intended for interior trim. However, it is intended for outdoor use and should resist damage from insects and moisture. The metal plate is not quite square in the wood, but that doesn't affect use of the panel, and I didn't notice it once the panel was installed and the cables connected.

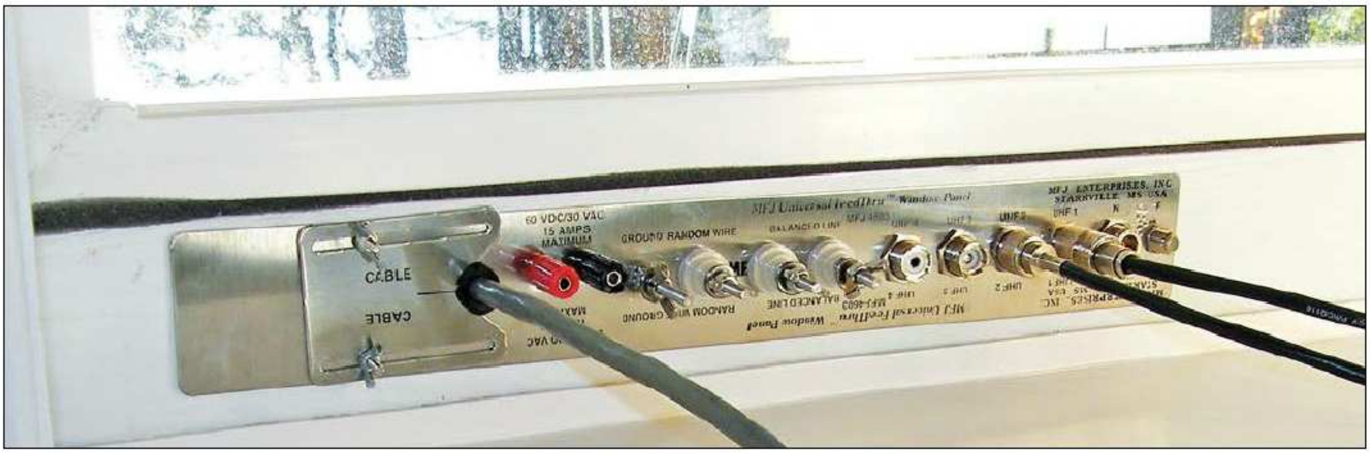
> **Bottom Line**
>
> The MFJ-4603 offers a convenient way to get a variety of feed lines and control cables into your station if a window is available. Some care is required to make the installation weatherproof, and the UHF bulkhead connectors could be better quality.

After wrapping the panel with insulation, place it at the bottom of the windowsill and close the window. It makes a weather-tight fit. Next, seal the gap where the lower sash overlaps the top sash (same routine as installing a window air conditioner). The instructions show how to use two pieces of the supplied foam insulation to seal the gap, but unfortunately the remaining piece of supplied foam was way too short. I ended up plugging the gap with a piece of foam I normally use with a window air conditioner.

The final step is to cut a supplied piece of 1 × 2 pine to the correct length to secure the lower sash and prevent someone from opening the window. I ended up using a piece of wood on each side of the window.

Using the Feedthrough Panel

First order of business was running the rotator cable through the Adaptive Cable Feedthru. A plate on each side of the panel slides open to reveal a diamond-shaped opening large enough to pass a cable, perhaps with connector installed (depending on connector size). Run the cable through the opening, slide the plates closed, and tighten the wing nuts on the machine screws that secure the plates. Grommets are supplied to protect the cable and make a weather-tight seal. (You may need to cut the grommets to fit the cable.) To make a good weather-tight seal, you need one person inside the house and one outside to hold both plates snug and hold the screws while you tighten the nuts.



This system worked very well.

Next I connected my window line to two of the ceramic feedthrough insulators. No issues there. The Type N bulkhead connector worked fine. I didn't use the F connector, five-way binding posts, or the single ceramic insulator for a random wire.

I wasn't as impressed with the four UHF bulkhead connectors. The center conductors are hollow all the way through the connector, allowing a noticeable amount of outside air (and perhaps insects) to pass through. Unused connectors will need to be capped, and MFJ indicates that they now include end caps for unused connectors.

Also, the supplied UHF bulkhead connectors are not very sturdy. They rattle a little bit, and one actually pulled apart when I disconnected a PL-259 plug. I ended up replacing that one with a good quality Amphenol bulkhead connector left over from another project (and this one is not hollow all the way through).

An interesting quirk showed up the first night the temperature dipped to around zero degrees. With metal plates on both sides of the panel, the cold is conducted from the outside to the inside plate and moisture from the inside air condensed and formed a noticeable amount of frost on the inside plate and connectors — it looked like the inside of a vintage freezer! Then the frost melted when the sun came out, and dripped water onto the windowsill. This was only an issue on the coldest nights, but we had quite a few of those last winter. According to MFJ, the design has been changed to include insulation between the metal plates to keep out cold and help with condensation.

Overall I'm happy with MFJ-4603 window feedthrough panel. It solved my feed line entry problem without damaging the window or house and allows a weatherproof installation if you cut everything carefully. I do plan to replace the UHF bulkhead connectors with better quality ones the next time I order some coax connectors and will follow MFJ's lead by adding insulation to reduce the condensation.

Manufacturer: MFJ Enterprises, PO Box 494, Mississippi State, MS 39762, tel 800-647-1800; **www.mfjenterprises.com**. Price: $89.95.

Telewave 44AP RF Wattmeter

Reviewed by Phil Salas, AD5X
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The Telewave 44 series is a bidirectional RF wattmeter that directly measures forward and reflected power from 1 W to 500 W in a coaxial line. The model 44A covers 20 MHz to 1000 MHz. The 44AP, reviewed here, also includes an RF sampling port that is coupled nominally 40 dB below the transmission line level. This coupled port may be used to inject a signal into a unit under test, or for frequency measurement and/or spectrum analysis. Normal operation of the 44AP is unaffected when using the sampling port. There are also two lower frequency versions. The model 44L1 covers 2 MHz to 200 MHz, and the 44L1P is similar but with a –40 dB sampling port.

The Telewave 44AP is similar in construction, size, and functionality to the popular Bird 43 wattmeter. However, the Telewave 44AP includes both a wide-band coupler and a high dynamic range power sensor, so it does not require the use of additional elements to cover its full power and frequency range. The meter movement can be turned off for rough handling when not in use. It has rubber feet on the back and bottom, along with a leather carrying strap. The 44AP uses quick change connectors, and Type N female is standard. Options include UHF, DIN, TNC, and BNC. The sampling port connector is a BNC female.

Bottom Line

The rugged Telewave 44AP accurately measures power levels from 5 to 500 W from 20 to 1000 MHz. It is particularly useful for measuring VHF and UHF transmitters and antenna systems, and for use in the field or harsh environments.

Operational Details

The Telewave 44AP is not a peak-reading instrument. Its precision directional coupler and detectors sample forward and reverse continuous current which is then scaled to drive an analog, multiscaled meter. Forward and reflected power are displayed by selecting FWD or REV on the front-panel switch. SWR is determined by using a chart on the back of the instrument (Figure 12) or with an equation provided in the manual. The five power levels — 5, 15, 50, 150, and 500 W full scale — provide for testing most transmitters. Table 5 lists the Telewave 44AP specifications.

Detailed Testing Results

Table 6 details power measuring tests that compare the 44AP to my NIST-traceable MiniCircuits PWR-6GHS+ power sensor and calibrated attenuators. I used the scales that gave the maximum reading achievable with the equipment I had available. For measurements below 150 MHz, the Telewave manual shows a chart of correction values that must be applied to the value displayed on the meter. Table 6 shows my measurements with correction values applied (+39% at 21 MHz, +9.5% at 50 MHz, and 0% from 144 MHz and up). The greatest difference between the 44AP and my PWR-6GHS+ occurs on the lowest frequency, where the correction factor is changing rapidly.

Next I measured SWR accuracy. For this

Table 5
Telewave 44AP, s/n 34780

Manufacturer's Specifications	Test Results
Frequency range: 20 – 1000 MHz	As specified.
Full-scale power ranges: 5, 15, 50, 150, 500 W.	As specified.
Accuracy: 20 – 150 MHz, ± 6% of full scale after correction; 150 – 1000 MHz, ± 6% of full scale.*	See Table 7
Impedance, primary line: 50 Ω.	As specified
SWR (max): 1.1:1.	As specified to 800 MHz; increases to 1.27:1 at 1000 MHz
Insertion loss: 0.1 dB maximum	See Figure 16.
RF sample port attenuation: 40 dB ±2 dB below total power.	As specified 100 to 1000 MHz; increases to 55 dB at 21 MHz.

Size (height, width, depth): 6.625 × 4 × 3.25 inches. Weight: 3 lbs.

Price: Model 44AP, $1035. Model 44A (20 MHz – 1000 MHz, no sampling port), $953. Model 44L1 (2 – 200 MHz), $953. Model 44L1P (2 – 200 MHz with sampling port), $1035.

*With N connectors. Accuracy not specified with UHF connectors.

Figure 12 — The rear panel includes an SWR chart and table of correction factors for various frequencies so you don't need to carry the manual.

test I used 4.8 dB (2:1 SWR) and 3 dB (3:1 SWR) microwave attenuators with open-circuit and short-circuit outputs so as to provide both low impedance and high impedance SWR loads. The loads were measured on an Array Solutions VNAuhf and the results are compared with the 44AP in Table 7. As with the power measurements, 44AP meter scales were used that gave the largest meter deflection. The SWR determined from the 44AP's forward and reflected power readings compared reasonably well with the measurements from my VNAuhf.

Next the 44AP was terminated in a precision 50 Ω load (load return loss >30 dB). The input SWR was measured with an Array Solutions VNAuhf. The 44AP meets its 1.1:1 SWR spec to about 800 MHz. It degrades slightly to about 1.27:1 at 1000 MHz.

I also used the VNAuhf to scan insertion loss. As shown in Figure 13, the 0.1 dB insertion loss spec is met to about 370 MHz, and insertion loss rises gradually to about 0.6 dB at 1000 MHz.

The final test was a check of the attenuation at the RF sampling port. The 40 dB ±2 dB spec is met from 100 to 1000 MHz. Below 100 MHz the attenuation increases rapidly, to about 55 dB at 21 MHz.

A Few Comments on Measurement Accuracy and Precision

The Telewave 44AP uses an analog meter, so there may be some parallax error when reading it. The readings must also be interpreted when they don't fall exactly on

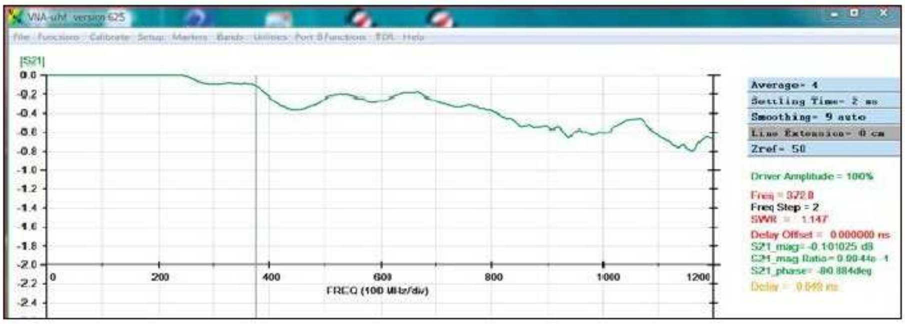


Figure 13 — Insertion loss of the Telewave 44AP as measured with the author's Array Solutions VNAuhf. Insertion loss is 0.1 dB or less to about 370 MHz, rising to about 0.6 dB at 1000 MHz.

Table 6
Telewave 44AP Power Measurements

	5 W Range			15 W Range			50 W Range			150 W Range		
Frequency	Pact	44AP	Difference	Pact	44AP	Difference	Pact	44AP	Difference	Pact	44AP	Difference
21 MHz	5.0	5.4	+8%	15	16.7	+11%	50	55.6	+11%	100	111	+11%
50 MHz	5.0	4.9	–2%	15.0	14.8	–1%	50	49	–2%	97	95	–2%
146 MHz	4.7	4.5	–4%	—	—	—	49	47	–4%	—	—	—
222 MHz	—	—	—	11	11	0%	27	27	0%	53	53	0%
450 MHz	4.0	4.0	0%	8.2	8.2	0%	43.5	43.5	0%	—	—	—

Measurements by the author of power measured with a MiniCircuits PWR-6GHS+ power sensor and calibrated attenuators (Pact) compared with the 44AP. The 44AP power measurements include correction factors shown in the manual.
— = not measured

Table 7
Telewave 44AP SWR Measurements with High and Low Impedance (Z) Loads

Frequency (MHz)	2:1 SWR Low Z		2:1 SWR High Z		3:1 SWR Low Z		3:1 SWR High Z	
	VNAuhf	44AP	VNAuhf	44AP	VNAuhf	44AP	VNAuhf	44AP
21	2.0	1.73	2.02	2.38	3.14	2.51	3.0	3.52
50	2.0	1.84	2.03	2.25	3.13	2.54	2.99	3.50
146	1.99	2.41	2.01	1.99	3.13	3.19	2.99	3.42
220	1.97	1.79	2.01	2.46	3.14	3.49	2.96	3.00
450	2.04	2.13	2.03	2.38	3.09	3.17	2.87	2.78

Measurements by the author of various loads with the Telewave 44AP compared to Array Solutions VNAuhf.

a meter mark, keeping in mind that power markings are divided into five segments on some power ranges, and four segments on other power ranges. Below 150 MHz, you must apply a correction factor that is read from a relatively coarse graph that changes rapidly below 100 MHz. However, the bottom line is that the Telewave 44AP is accurate enough for most transmit power and transmission line or antenna measurements.

Final Thoughts

The Telewave 44AP is a compact, self-powered through-line wattmeter that provides a wide power measurement range along with wide frequency coverage. While it is easiest to read when measuring transmitters and antenna systems from 140 to 1000 MHz, it can be used down to 20 MHz by adding in a correction factor. Its rugged, self-contained package makes it a good choice for measurements in the field as well.

Manufacturer: Telewave, 660 Giguere Ct, San Jose, CA 95133; **www.telewave.com**.

Radio Works Carolina Windom 80 Antenna

Reviewed by Steve Ford, WB8IMY
QST *Editor*
wb8imy@arrl.org

The traditional ½-wavelength dipole offers an impedance around 70 Ω when fed at the center, which is close enough for a simple connection to 50 Ω coaxial cable. On the other hand, a center-fed dipole is often only resonant on a single band. Yes, you can use an antenna tuner and load a center-fed dipole on almost any frequency you desire, but that raises the specter of RF loss due to high SWR on the feed line, not to mention the complication of adding an antenna tuner to the system.

But rather than feeding a dipole at its 50 Ω point, why not try feeding it somewhere else? In an off-center-fed (OCF) dipole, the feed point slides to the 200 Ω point, which is about ⅓ of the way from one end of the antenna. If you place a 4:1 current balun there, you'll have a 50 Ω impedance for your coaxial cable (200 / 4 = 50). Best of all, the impedance will be at or near 50 Ω on more than one band.

Some amateurs refer to OCF dipole antennas as "Windoms," but true Windom antennas are rather different. The original design was the creation of Loren Windom, W8GZ, and his idea was to feed a horizontal antenna with a single wire at the 600 Ω point. The single wire acted as a feed line, after a fashion, but it also radiated RF.

The Radio Works Carolina Windom 80 takes an interesting approach. According

Bottom Line

The Carolina Windom 80 from Radio Works allows operation from 80 through 10 meters with a single feed line. This 133 foot long OCF antenna can be installed horizontally or as an inverted V, but it must be at least 25 feet off the ground.

Figure 14 — The complete Radio Works Carolina Windom 80 arrives in a large plastic bag. The kit includes stranded copper wire, insulators, a matching unit and line isolator.

to the Radio Works website, the Carolina Windom was the result of experiments by Jim Wilkie, WY4R, Edgar Lambert, WA4LVB, and Joe Wright, W4UEB, to create an antenna that would provide decent coverage on 75 meters between Norfolk, Virginia and northern North Carolina, while still being resonant on several additional bands. The antenna is fed at the 200 Ω point using a matching unit, which is also connected to a 22 foot vertical length of coaxial cable that is deliberately designed to radiate, providing both horizontally and vertically polarized radiation patterns. The RF is kept off the feed line to your station through the use of a sizeable line isolator.

This 80 through 10 meter antenna is 133 feet long. One leg is 50 feet in length and the other leg is 83 feet in length. If you have enough room to mount the Carolina Windom 80 in a straight horizontal line, more power to you, but the antenna can be installed in several different configurations — even an inverted V. The antenna is rated at 1500 W for SSB and CW (it's not rated for continuous duty cycle modes such as AM and RTTY).

Figure 15 — The matching unit at 28 feet above ground.

Installation and Testing

The Radio Works Carolina Windom 80 arrives in a large plastic bag that contains everything you need, including a detailed manual and connector-sealing putty. Figure 14 shows the kit. Construction quality is excellent; the antenna is almost entirely pre-assembled with large gray insulators at the ends of both legs.

The instructions state that center of the antenna should be at least 35 feet off the ground. Since the line isolator hangs at the end of a 22-foot cable, you certainly have to get the center at least 25 feet high. In the case of the Carolina Windom 80, higher is better, but the best I could do was about 28 feet which brought the bottom end of the line isolator to eye level. Considering the postage-stamp-sized lot I live on, my remaining options were few. Figure 15 shows the apex of the installed antenna.

To keep the legs of the antenna from dangling over the property lines, I had to use an inverted V configuration with one end 8 feet high and the other end about 20 feet high. When I attached my antenna analyzer to the feed line, I wasn't optimistic. This was far from an ideal installation, so I was prepared to see high SWR on most bands.

To my astonishment, the Carolina Windom 80 provided SWRs of less than 2.5:1 on 80, 40, 30, 20, 15, 12, and 10 meters. The manual indicates that the antenna will work on 6 meters with a 200 W rating, but I didn't try it there. I'm confident that with a better installation the low-SWR points would be less than 1.5:1 on the bands shown.

Taking it On the Air

One of the pernicious myths in Amateur Radio is that a low SWR guarantees good antenna performance. In truth, a low SWR only means that you can deliver the maximum amount of RF power to the antenna system. "Performance" depends on what happens to the RF once it reaches the antenna.

Yet another myth is that one can measure performance by how many stations one can contact. This is true to a point, but so often you'll hear an amateur proclaim that his new sky wire is a super performer because "I worked a Serbian station [or fill in the DX entity of your choice] on my first attempt with the antenna!" This conveniently ignores the fact that there many variables in play. What if the DX station was aiming a high gain directional antenna at you? And running full legal power? And using a high-performance transceiver that could make your mediocre signal intelligible?

If you can switch between antennas, you might be able to get a sense of how one compares to another. You can also use certain digital modes such as JT65 and WSPR to obtain objective signal reports as you swap antennas.

With that in mind, allow me to make a few *subjective* statements about how the Radio Works Carolina Windom 80 performed at my station. I switched back and forth between the Windom and my 40 meter delta loop and I have to say that the Carolina Windom 80 seemed to outperform the loop by a noticeable margin, especially on the higher bands. On 20 through 10 meters, it was consistently one to two S units above the loop. Because of the Windom's low height, my range on 80 and 40 was somewhat limited, but the performance was still impressive, perhaps because of its combination of horizontal and vertical radiation.

Radio Works has a well-made product in its Carolina Windom 80. If I can realize such impressive results from my compromised low-height installation, imagine what it could do when installed in its optimum configuration.

Manufacturer: Radio Works, Box 6159, Portsmouth, VA 23703; tel 757-484-0140, 800-280-8327; **www.radioworks.com**. Price: $170.

The Doctor is In

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

Folded Dipoles — Wideband or Not?

Q **Sam, K4AME, asks: I have heard differing opinions on the three-wire folded dipole as to the difference in bandwidth created by using more space between the elements. Some say it broadens the bandwidth, some say it makes no difference. I had my nephew run the *NEC* models on a three-wire folded dipole and *NEC* agrees with the no-difference camp. Have you experimented with three-wire folded dipoles? If so, can you share your findings as to bandwidth of the antenna?**

A fellow ham told me that he uses a three-wire folded dipole with a 9:1 balun on 80 meters, and claims the SWR never gets higher than 1.5:1 on either end of 75/80 meter band — no antenna tuner necessary. Is that possible? If it is so, I expect the balun may be lossy. However, since I am vision impaired, an antenna with that much bandwidth is of interest even with some loss in the system because tuning quickly can be tedious for me.

A This is an interesting question, but I think you are close to having the answers already. A single #14 AWG 80 meter half-wave wire dipole (see Figure 1) in free space has a 70 Ω SWR of about 5:1 at the band edges (see Figure 2), as predicted by *EZNEC*.[1] Its 2:1 SWR bandwidth is about 210 kHz while its 1.5:1 bandwidth is about 120 kHz. Thus, you need three or four single-wire dipoles to cover the entire band without a tuner, depending on your SWR requirements. Note that this is largely an 80 meter problem, since the higher frequency bands are of narrower percentage bandwidth and a single dipole will usually do the trick, although some are right on the edge.

One technique that will increase the bandwidth of an antenna is to make the conductor(s) thicker. While this is frequently used at VHF and above, it would take a 1.5 foot diameter tube to increase the bandwidth of our 80 meter dipole to cover the whole band with a 2:1 SWR. Instead of a tube, a cage of wires can be used, or even a pair of parallel wires. The W1AW 75/80 meter antenna consists of a four-wire cage using 3-foot PVC pipe and T joints as spacers (see Figure 3). It covers the band with an SWR of less than 2.5:1.

A two-wire folded dipole in free space with two #14 wires spaced 0.2 feet (2.4 inches)

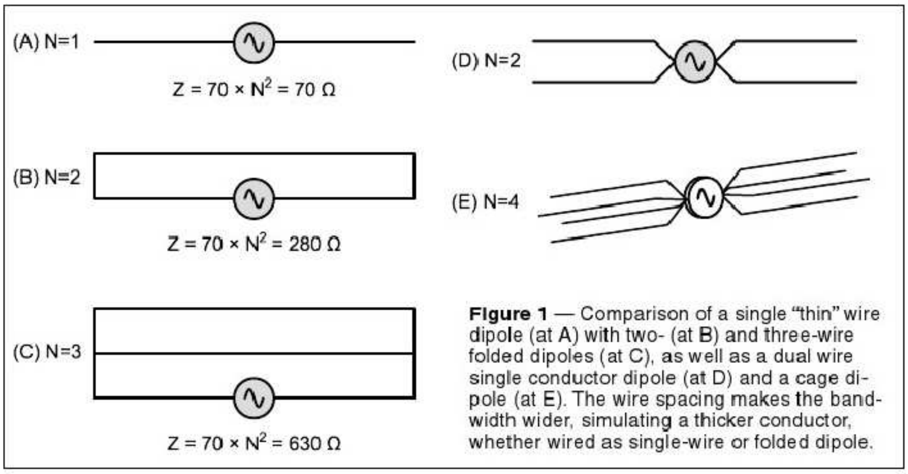


Figure 1 — Comparison of a single "thin" wire dipole (at A) with two- (at B) and three-wire folded dipoles (at C), as well as a dual wire single conductor dipole (at D) and a cage dipole (at E). The wire spacing makes the bandwidth wider, simulating a thicker conductor, whether wired as single-wire or folded dipole.

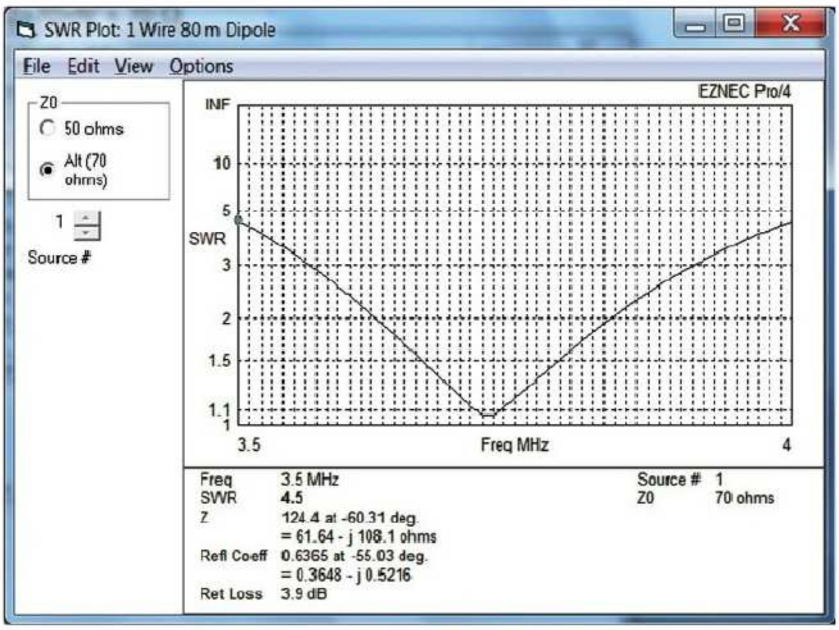


Figure 2 — *EZNEC* predicted 70 Ω SWR of the #14 AWG single-wire half-wave dipole shown in Figure 1 (A) in free space.

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

Figure 3 — The center of the 75/80 meter four-wire cage dipole at W1AW. Note the PVC cross T supports. This antenna provides an SWR of less than 2.5:1 across the entire band.

will have an SWR referenced to 280 Ω of a bit more than 3:1 over the band.[2] But if you make a "single wire" dipole from two parallel wires the same 0.2 feet apart driven in parallel, the result will be an almost identical 3:1 SWR at 70 Ω. Note that all the impedances assume a dipole height that would result in a 70 Ω impedance. The ratio remains the same for other heights. For example, at a height at which a single wire dipole would have an impedance of 50 Ω, the two-wire folded dipole would have an impedance of 200 Ω.

Similarly, a three-wire folded dipole with 0.2 foot spacing will have a 630 Ω SWR of somewhat less than 3:1 (see Figure 4). If I increase the spacing to 1.0 foot between each wire, the SWR goes down to about 2.5:1 across the band, while with a 2 foot spacing (4 feet total) it goes down to 2.2:1. I think we are approaching diminishing returns here.

In summary, the two- or three-wire folded dipoles do not offer increased bandwidth compared to standard dipoles composed of the same number and spacing of wires. Folded dipoles are, however, very useful for those who would like to feed a wire antenna with either 300 Ω or 600 Ω low-loss feed line, and at the same time gain an increase in bandwidth. They are also sometimes used as the driven element in a Yagi beam, for which the impedance in a single element can be quite low. For example if a Yagi's single split driven element has an impedance of 15 Ω, replacing it with a two-wire folded dipole driven element will result in an impedance of 60 Ω, much easier to deal with.

You don't say what the spacing your friend was using, but I think with a total span of 4 feet we are probably at or beyond what is reasonable, especially since the actual impedance above ground will not likely be a perfect match at resonance. I tend to believe that he either has a lossy transformer or his SWR meter is optimistic.

As a side note, I think that the difference between a 5:1 and a 3:1 SWR may be significant, and worth thinking about. Many radios with internal automatic *trimming* tuners can adjust and compensate for a 3:1 SWR without much operator interaction, while they may have trouble matching a 5:1 SWR, especially on 80 meters. By having a coax-fed two-parallel-wire dipole, or a folded dipole fed with 300 Ω transmission line and a 4:1 balun near the station, you can get into the range of such a tuner in a way that probably makes more sense than building a very large antenna system.

Of course, if you don't now have a tuner, it is possible to get a wide-range automatic antenna tuner that will handle the 5:1 SWR of a thin dipole at the band edges. There will be some transmission line loss but with, for example, 100 feet of RG-8X coax, the total loss will be less than 1.4 dB at the band edges, of which about half is due to the mismatch. With the larger RG-213 type coax, the loss drops to about 1.0 dB for the same 100 feet.

Q **Joseph, N3TTE, asks: Since I got into ham radio fairly late in life, I'm living in a less than ideal location for a ham station. In addition, because of my work situation, I don't have a great deal of time for radio, so even though I hold an Amateur Extra class license, I end up doing most of my radio operating on 2 meters, even though I do have a small HF station.**

I really would like to get into HF operations, but what I really need is a resource that would predict what bands to use for

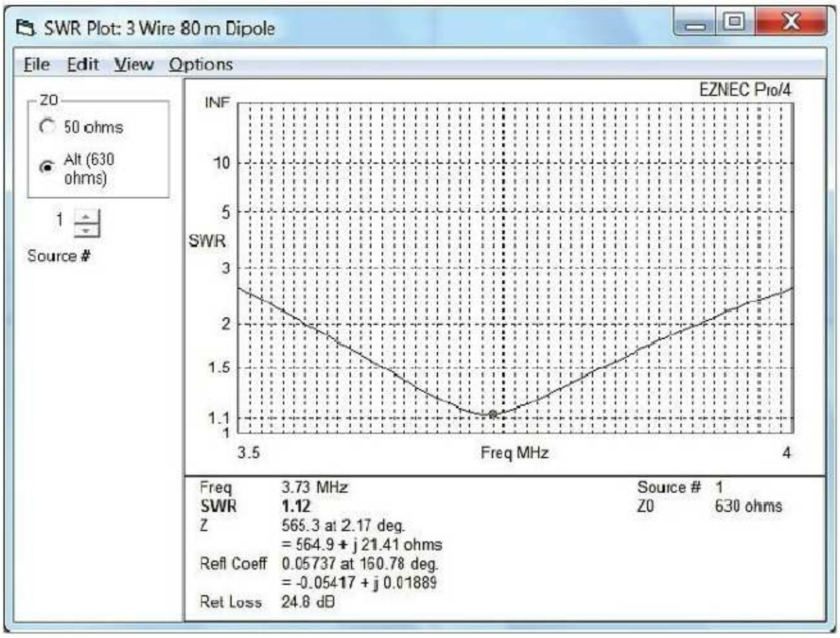


Figure 4 — *EZNEC* predicted 630 Ω SWR of the #14 AWG three-wire half-wave folded dipole shown in Figure 1 (C) in free space. The shape of the 70 Ω SWR curve would be similar if the three wires were connected in parallel, to form a "fat" single wire dipole.

[2] J. Kraus, W8JK (SK), *Antennas*, First Edition, Section 14-14. McGraw-Hill Book Company, New York, 1950.

HF DX so I can make the best use of my available hours. Would it be possible for *QST* to publish a column that would give recommendations for what bands to use based on desired path, time of year, and predicted sun conditions, in easy to understand terms?

A In the mid-1970s, the ARRL published such prediction charts in *QST* each month. While they were impressive looking and quite precise, because of the long production cycle (typically material must be in about 3 months before the publication date), they were not generally very accurate by the time they got to our readers.

Fortunately, the availability of PCs and free software has made it possible to predict propagation much more accurately in almost real time. There are many ways to do it, but the simplest is probably to make use of an online package such as *VOACAP* (**www.voacap.com/prediction.html**), developed for the Voice of America. An advantage of *VOACAP*, is that it has the sun parameters built in so you do not need to gather the solar information to get your results. *VOACAP* and other available government prepared prediction software is described at **elbert.its.bldrdoc.gov/hf.html**.

While *VOACAP* gives useful real-time information, it is also possible to do predictive analysis based on forecasted solar data. To get the forecasts of solar activity every week, sign in to the ARRL Member Web Page and click on EDIT YOUR PROFILE on the top banner. Then click on EDIT E-MAIL SUBSCRIPTIONS. Near the bottom, select PROPAGATION. While you're there, click on DX so you'll know who will be out there. Each will get you a useful weekly bulletin with the information you seek.

Once you have the forecasted solar predictions, you can use a program such as *W6ELProp*, available free at **www.qsl.net/w6elprop** to predict what bands will be open to different regions on an hourly basis.

There are also a number of software packages such as DXLab (**www.dxlabsuite.com**) that include modules that provide up to date propagation forecasts to help you pick the best times and bands for various parts of the world.

Q **Carl, N3BGI, asks: I was looking through one of the ARRL publications and ran across the formula f=300/λ, where f is the frequency in MHz and λ is the wavelength in meters. If I were to use 20 meters for λ, I get a frequency of 15 MHz — not part of our 20 meter band [14 to 14.35 MHz — *Ed.*]. If this calculation is accurate, then why do ham radio operators regard 14 MHz as part of the 20 meter amateur band? There seems to be a discrepancy. If you solve the formula for wavelength (λ=300/f) and evaluate with f= 14 MHz, then you get 21.42 not 20 meters. What does this all mean about our ham bands?**

A That is indeed the *approximate* formula for wavelength in meters. I say approximate because the actual speed of light in free space is actually 299.792, not 300 million meters per second. Band designators are approximations, not exact wavelengths. The numbers used go back to the early days when 20 meters went from 14 to 16 MHz, so 15 MHz was indeed in the middle of the band.

In the very early days of radio, both frequency and wavelength were used to define signals, with most receivers having scales that indicated both. Sometime in the late 1920s, frequency became the dominant descriptor, at least for MF and HF ranges, and wavelength gradually became used to designate general regions of spectrum, or bands, rather than particular channels.

Early amateurs were relegated to the apparently "useless" frequencies above 1.5 MHz.[3] By 1924, others had become aware that the short waves could indeed be very useful and wanted them back for various services. US radio regulations, such as existed at that time, were in the hands of the US Department of Commerce. It was recommended that amateurs could use harmonically related ham bands, so that our harmonics would only interfere with other amateurs. The bands of 1924 were as shown in Table 1.[4]

Table 1
The Amateur Radio Bands as Recommended in 1924

Band (meters)	Wavelength (meters)	Frequency (MHz)
160	200 - 150	1.5 - 2.0
80	85.7 - 75.0	3.5 - 4
40	42.8 - 37.5	7 - 8
20	21.4 - 18.7	14 - 16
5	5.35 - 4.69	56 - 64

Note that in those days wavelength was used as much as frequency to define a signal — hence the listings for both. The band descriptors shown were not officially incorporated in the regulations, but are for reference, and were adopted to general use sometime later, as mentioned previously.

The US Radio Act of 1927 created the Federal Radio Commission, which focused entirely on radio matters and modified the allocations somewhat in the Radio Service Bulletin of March 31, 1928, which added bands at 10 meters (28 to 30 MHz at that time) and 400 to 401 MHz.[4] It is interesting to note that at that time amateur voice operation was only permitted in portions of the 160, 20 and 5 meter bands.

By World War II, a band at 2½ meters (112 to 128 MHz) was added with the 5 and 2½ meter bands moved to our current 6 and 2 meter allocations after the war to accommodate the new VHF television low range (54 to 88 MHz) channels, and the aircraft navigation and communications allocation (108 to 137 MHz).

[3] *Recommendations for Regulation of Radio, Third National Radio Conference, Called by Herbert Hoover, Secretary of Commerce, October 6-10, 1924*, C1.2:R11/924, Government Printing Office, Washington, DC, 1924.

[4] *Radio Service Bulletin No. 130*, Department of Commerce, January 31, 1928, Government Printing Office, Washington, DC, 1924.

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; for fastest response, e-mail **doctor@arrl.org**.

H. Ward Silver, N0AX, n0ax@arrl.org

Experiment #142

Inductors at RF

In one of the many strange-but-true things that happen at RF, that innocent-looking coil of wire or cable has more than one personality as the frequency changes! This month we'll explore the wacky world of inductors and learn how to use a neglected function of a common antenna analyzer along the way.

Inductor Basics

This formula for the inductance L of a basic single-layer, air-wound inductor has been in articles and handbooks for generations[1,2]:

$$L(\mu H) = \frac{d^2 n^2}{18d + 40\ell}$$

Where d is the diameter of the coil in inches from wire center to wire center, ℓ is the coil's length in inches, and n is the number of turns. This approximation works reasonably well but there are innumerable corrections.[3] The formula makes several assumptions that the coil: is made from wire that is not too thick; is not too long or too short; has leads not too long; and has a reasonable *pitch* (the number of turns per unit of length).

Why does frequency matter? The inductor model in Figure 1 gives part of the answer. This parallel-series circuit represents what an RF signal encounters in an inductor. Instead of just inductance (L in the schematic), there are three other *parasitic characteristics* shown; C_P, R_P, and R_S resulting from the physical construction of the inductor. L is the inductance independent of parasitic effects.

R_P is the simplest of the three parasitics, representing *leakage resistance*, resistive current paths "around" the inductor for current. Dirt or grease on a circuit board and dust buildup on the turns of the inductor or the body of an encapsulated inductor are the most common sources of leakage resistance. It becomes significant when there is a high voltage across the inductor, such as might exist in a transmitter or tuning unit. This is a good reason to vacuum out high-power circuits from time to time.

R_S has a larger effect on the inductor's performance than R_P, especially at high frequencies. At dc, R_S is specified as *DCR*, or dc resistance. The resulting voltage drop or resistive heating can be important when the inductor has to carry dc current, such as when an RF choke is used in a bias T or a plate blocking choke.

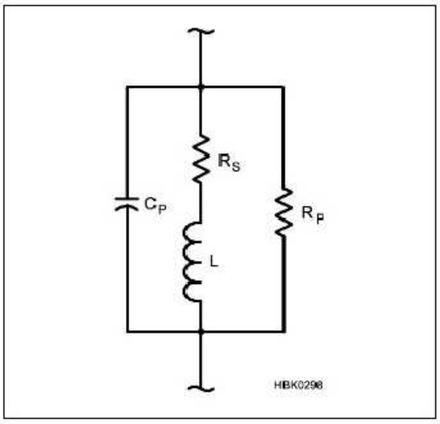


Figure 1 — General model for an inductor with parasitic capacitance (C_P) and resistances (R_P and R_S). R_S can change with frequency due to the skin effect. The combination of C_P and L are the cause of self-resonance in the inductor.

If the inductor is used at RF, *skin effect* comes into play, restricting current flow to a layer near the surface of the conductor.[4] This causes R_S to increase with frequency. Inductors used in transmitters and tuning units often carry significant current so it is important to consider skin effect when selecting the size of a coil's wire or tubing. Resistive losses lower the inductor's Q, its ratio of reactance to resistance: X_L / R_S.

C_P has the largest effect on inductor performance at RF. By creating a parallel-LC circuit, the combination of C_P and L means the inductor will resonate without any other external components. This creates the inductor's *self-resonant frequency* or *SRF*. We observed the effects of self-resonance in Experiment #111 on coiled-coax chokes.[5] The coiled-coax choke makes use of the parallel resonance's high impedance to block current flow on the outside of the coax shield over a range of frequencies.

Where does C_P come from? Figure 2 shows that C_P results from *inter-turn capacitance*. Each spot on the inductor wire forms a small capacitance to every other spot on adjacent turns, even though they are connected together by the wire. Over the entire inductor, C_P is called *distributed capa-*

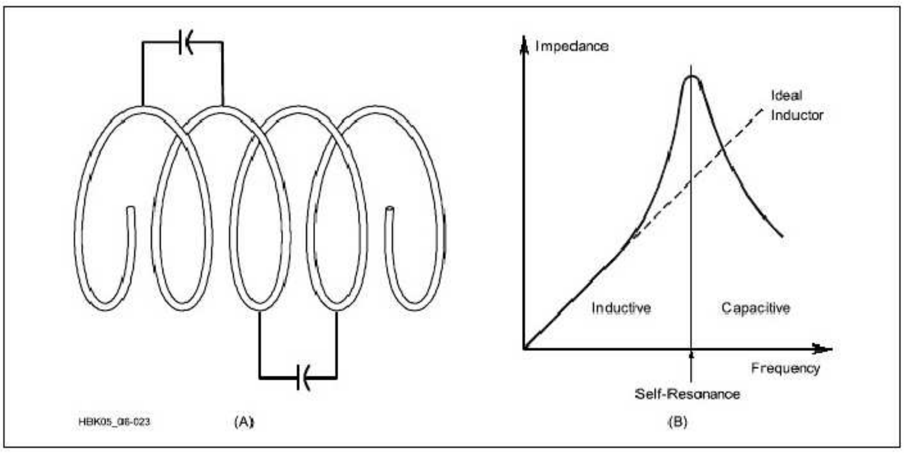


Figure 2 — Inductors have distributed capacitance created by the capacitance between turns of the coil. Over the whole inductor, this capacitance creates C_P as shown in the model in Figure 1. The graph at B shows how the inductor behaves above and below its self-resonant frequency.

Figure 3 — Using an antenna analyzer to measure the inductance of a coiled-coax choke. The coil is wound around a 3-inch diameter peanut butter jar. The jacket at each end of the cable is stripped back about 1 inch to allow the braid to be made into a lead and connected to the analyzer using a binding post adapter.

citance. Ways to reduce C_P include stretching the coil so that the turns are farther apart or in the case of multi-layer coils, carefully arranging the winding layers and winding the coil in sections.

Measuring Inductance

If you have access to an antenna analyzer that displays reactance, you can measure an inductor's SRF and see the effects for yourself. As in Experiment #111, we'll use the popular MFJ-259/269-series of antenna analyzers.

Start by obtaining 8 to 10 feet of coaxial cable. Any of the RG-8/213/58/59 family will do — the characteristic impedance of the cable is unimportant as we are only interested in what happens on the *outside* of the shield. Wind the cable around a non-conducting form such as the peanut butter jar in Figure 3. Remove a short section of jacket from each end, twist the shield into a lead, and connect it to the analyzer.

My coil of RG-58 cable has 9½ turns, it is 3 inches (76 mm) in diameter, and is 2 inches (51 mm) long. According to the equation at the start of this article, its inductance should be 6 µH. However, the equation isn't intended to apply to a close-wound coax coil, so I turned to the online inductance calculator by ON4AA at **hamwaves.com/antennas/inductance.html**. This calculator takes the diameter of my "wire" (4.5 mm) into account, as well, producing an inductance of 5.6 µH at a frequency of 1 MHz.

Connect the coil to your antenna analyzer, using a binding post adapter as shown in Figure 3. (Keep the analyzer and coil away from metal surfaces.) The following instructions apply to the MFJ-259/269 analyzer. Turn on the analyzer and press the MODE button until the display shows INDUCTANCE IN UH. Clockwise from the upper left, the display shows frequency, reactance value, the label XL, and inductance in µH. The manual explains that the calculation is based on reactance and the analyzer itself can't tell whether the reactance is inductive or capacitive. You have to figure that out — if increasing the frequency causes reactance to increase, the reactance is inductive.

Start with your analyzer at its lowest frequency. (1.7 MHz on my analyzer.) The inductance value of my coil was 6.6 µH. This is not too far from the calculated value which didn't account for the jacket plastic's effect on C_P or the extra lead length from the coil to the analyzer. Slowly increase frequency. My inductance value stayed fairly steady near the calculated value until I passed 3 MHz and then began increasing. Why? As Figure 3B shows, the impedance of the resonant circuit of the inductor increases faster than that of an ideal inductor, causing the analyzer to see a "bigger" inductance.

Press MODE until you are back in the analyzer's usual "Impedance R&X" mode. Keep increasing frequency while watching the X value. (Ignore the SWR and RESISTANCE meters.) You'll see it increase faster and faster until it exceeds the meter's ability to measure reactance and it displays Xs = 0. Keep increasing frequency and watch the *Rs* display, the equivalent series resistance value of the impedance. It will continue to increase, exceeding the analyzer's range of 1500 Ω as it approaches the coil's SRF.

Continue to increase frequency and after you pass the SRF, impedance will eventually come back into range and keep dropping as frequency increases, just like in Figure 3B. Switch back to inductance measurement and repeat the sweep through the coil's SRF. Note that above the SRF, reactance drops as frequency increases, showing that the reactance is capacitive. The inductor has changed into a capacitor!

Connect a 1.5 kΩ resistor (carbon composition or film will do) across the analyzer terminals to keep the impedance within the analyzer's range and switch back to impedance mode. You can find the coil's SRF by adjusting frequency to find the maximum value of *Rs*. My coil's SRF was 13.6 MHz where the meter displayed 1488 Ω. This would be a good choke for a 20 meter antenna! Now try spreading the turns apart, reducing C_P, to see how that affects the SRF. You can also try an equivalently sized inductor out of insulated wire. A simple inductor? Not really!

What would happen if I tried to use this coil at VHF? C_P would make the inductor unusable. In fact, even small coils can become unusable at and above VHF due to parasitic capacitance. Capacitors with significant amounts of parasitic inductance can become unusable at those frequencies for similar reasons. Knowing the actual characteristics of your components is important for successful RF design and construction.

Notes

[1] H. A. Wheeler, "Simple Inductance Formulas for Radio Coils," *Proc. I.R.E.*, Vol. 16, p 1398, Oct 1928.
[2] F. E. Terman, *Radio Engineers' Handbook*, McGraw-Hill, p. 55, 1943.
[3] F. W. Grover, *Inductance Calculations*, Dover Publications, 2009.
[4] *The ARRL Handbook*, 91st edition, ARRL, Sections 5.3.4 through 5.3.7.
[5] All previous Hands-On Radio experiments are available to ARRL members at **www.arrl.org/hands-on-radio**.

Steve Ford, WB8IMY, wb8imy@arrl.org

FreeDV Goes Portable

If you read this column in the February 2014 issue of *QST*, you may recall the discussion of *FreeDV*, the digital voice software that uses the non-proprietary Codec2 voice codec developed by David Rowe, VK5DGR. A number of amateurs have been using *FreeDV* on the air, primarily at 14.236 MHz, with good success. If you tune around that frequency and hear a signal that sounds like a continuous roar or buzz, chances are you're hearing a *FreeDV* conversation. Despite the fact that it's digital voice, the signal bandwidth is actually narrower than a typical SSB transmission.

As I mentioned in the February column, you can download the *FreeDV* software at **freedv.org/tiki-index.php** and use it to eavesdrop on the discussions. Just feed the audio from your receiver to your computer's sound card input, or to an interface with a sound device built in. When the signal decodes successfully, what you'll hear is crystal clear, telephone-quality audio. To transmit with *FreeDV*, you need to install another sound device to digitize the microphone audio, although this can be a simple USB sound fob that you can pick up for less than $20.

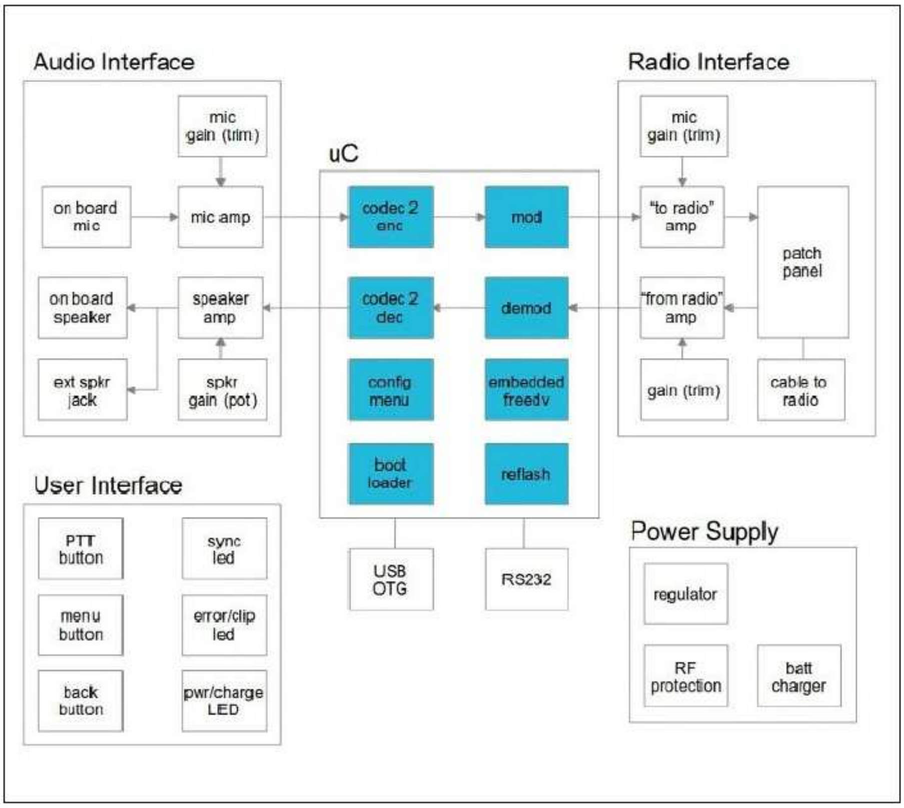


Figure 1 — SmartMic block diagram courtesy of David Rowe, VK5DGR.

Simplify, Simplify

FreeDV is intriguing to use and amazing to hear when signals are strong enough to decode consistently. However, to get into the *FreeDV* game you need a computer, an interface, and two sound devices.

But that's about to change.

Last spring, VK5DGR announced that he and Rick Barnich, KA8BMA, had begun work on a piece of hardware known as SmartMic. With SmartMic, you'll be able to enjoy *FreeDV* without a computer or interface of any kind. You simply connect SmartMic to your transceiver and you are on the air.

SmartMic keys your radio and, as you speak, encodes your voice and passes the audio signal to your rig. In receive mode, SmartMic decodes the *FreeDV* signal and plays the result through a tiny speaker.

The SmartMic is designed around an STM32F4 microcontroller (see Figure 1). It includes a built-in microphone, speaker amplifier, and transformer-isolated lines for the signal connections to your radio. The package is only about 3 × 4 inches and is light enough to hold in your hand. David anticipates the SmartMic will be in production before the end of this year and will sell for $195. You can find out more at David's blog at **www.rowetel.com/blog/?p=3125.**

SmartMic uses an open hardware design (TAPR license) and runs an embedded version of the open-source *FreeDV* software. As a result, like the codec, the entire SmartMic platform is non-proprietary. You can take a look at the schematic, PCB, and other design files at **https://svn.code.sf.net/p/freetel/code/smartmic/**.

HF or VHF

Although most *FreeDV* activity has been on HF to date, there is no reason why you cannot use the technology on VHF and above — with or without SmartMic. I've tried *FreeDV* on 2 meter SSB with good results. Just for grins, I also ran it on FM simplex. There is no particular advantage to using *FreeDV* on FM, but it wouldn't be Amateur Radio if I didn't try anyway!

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

Antenna Notes

A Coaxially-Linear-Loaded Compact Transmitting Loop

Coaxial linear loading may be applied to a compact transmitting loop as a means of increasing the effective length of its conductors.[1] Figure 1, Part A shows a dipole made from two coaxial structures, each with a capacity hat at its end.

Following the arrows of Figure 1, Part B, RF current flows along the inner conductors until it reaches the internal ends near the capacity hats, then flows back along the inside surfaces of the outer coaxial conductors, then "around the edges" and back along the outer surfaces of the outer conductors to the capacity hats, and finally out to the outer edges of the capacity hats.

Now, imagine that the dipole of Figure 1 is bent around to form a loop, such that its capacity hats form a disc capacitor that is common to the outer ends of the original dipole, as shown in Figure 2. This dipole is fed by magnetic coupling at the inner conductor of the coaxial lines. In Part A, the dipole is fed through a Faraday shielded link consisting of a small loop of the coaxial feed line with the center conductor soldered to the shield to complete the Faraday loop. In Part B, the dipole is fed with a toroidal transformer that uses a few turns of wire connected to the center conductor and shield of the coaxial feed line, with the center conductor passing through the toroid as a single turn coupling.[2]

The result is a coaxially linear-loaded compact transmitting loop. For use at HF, to make the antenna tunable, and to provide a sufficiently high voltage rating, as well as high efficiency, the capacity hats would likely be replaced by a vacuum variable capacitor.

Because the radiation resistance of a loop at a given frequency is a function of its physical area (in wavelengths) only, use of coaxial linear loading will have both advantages and disadvantages. Advantages include a smaller required capacitance, which can lower cost (especially when using high voltage vacuum variable capacitors) and/or the physical size of the capacitor. By closing the gap in the outer conductor, (if magnetic excitation is used) the configuration reverts to a common compact loop; this can be used as a means of "band-changing," to provide an extended tuning range.

Disadvantages include the added complexity and possible reduction in efficiency because of the use of a smaller loop for a given frequency. It may still be worth doing, depending on your needs. Another disadvantage is that the ends of the outer conductor, to either side of the feed point, will be at a high voltage, although not as high as at the capacitor. A coaxial structure would almost certainly be more efficient

[1]Eric Gustafson, Patent Drawing, US Patent 20030189526 A1.

[2]Ken Hirschberg, K6HPX, "Toroid Coupling Feeds Compact Transmitting Loop," *QST*, March 1995, pp 72-73.

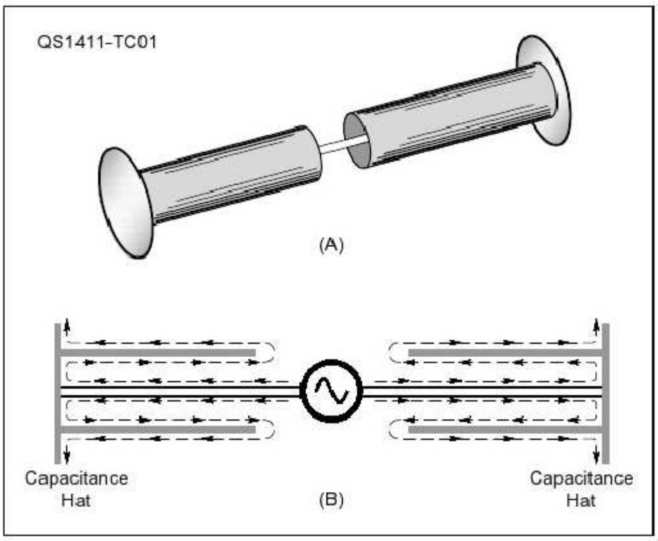


Figure 1 — Part A illustrates a coaxial dipole with capacitance hats at the ends of the dipole. Part B illustrates the current along the conducting surfaces of the coaxial cable and capacitance hats.

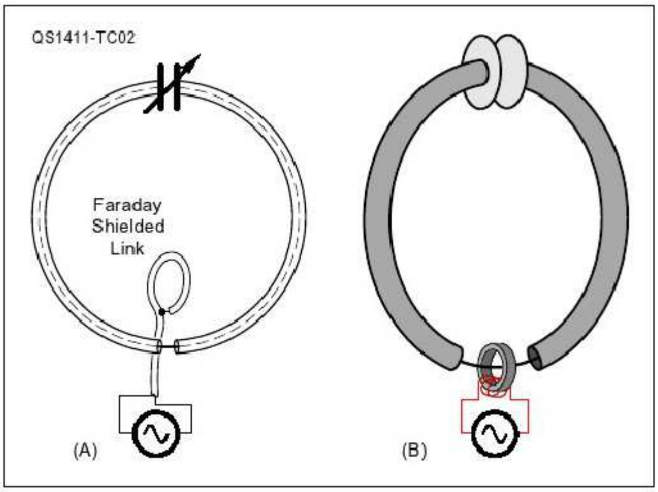


Figure 2 — These drawings illustrate the loop antenna created by curving the coaxial cable ends around to meet, with the capacitance hats replaced by a variable capacitor. Part A shows the antenna fed by a Faraday Link coupling and Part B shows the antenna fed by passing the center conductor of the loop through a toroid to form a single turn transformer.

Figure 3 — The concept demonstration antenna that I built. This loop was resonant at 70 MHz. Note the small variable tuning capacitor at the top of the loop and the Faraday link coupling used to feed the loop at the bottom of the loop.

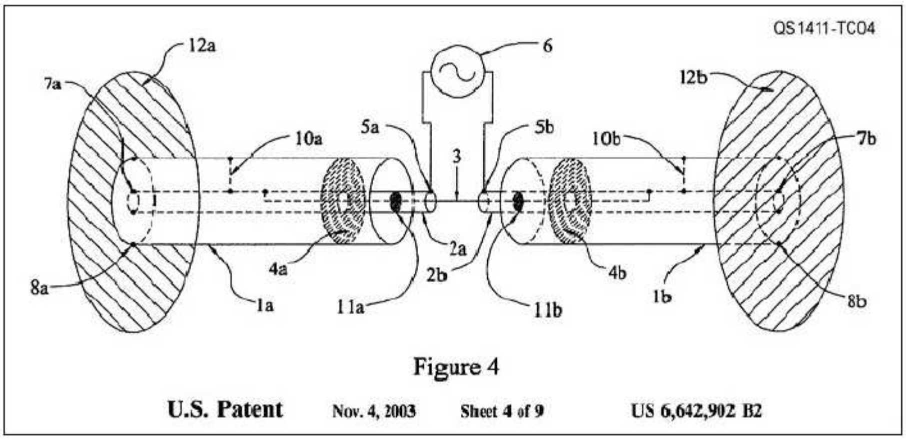


Figure 4 — This drawing is from Eric Gustafson's US Patent for a low loss loading, compact antenna and antenna loading method. See Note 1.

than, say a second turn, to achieve more inductance for a loop of the same size.

When it comes to compact loops, the importance of good implementation cannot be overstated. That said, I made and tested a "quick-and-dirty" bench-size concept demo antenna.

Concept Demo Model

I made the loop shown in Figure 3 from a piece of RG-213/U coaxial cable. Each end had its center and shields connected, and each end was connected to the resonating capacitor. The loop was excited with a Faraday link — that is, a link formed into a 2-inch loop, with the end center conductor connected to the shield as shown. This smaller loop was placed near the larger loop opposite the resonating capacitor, but not connected to it, except by magnetic field. At this point, it was a common compact loop; it resonated at 110 MHz.

Then, without disturbing capacitor setting, and using the same link coupling, a gap in the outer conductor was cut. The loop was then a coaxial linear loaded version; it then resonated at about 70 MHz. A smaller gap length would have produced a still lower resonant frequency.

Note that the 2-inch feed line loop, in the form of a Faraday link, could have been a same-size infinite balun, a piece of wire, a toroid core with the large loop passing through it as the secondary of a transformer (see Note 2), or any other of about a dozen common ways to feed a compact loop.[3, 4]

Please note also, that while the use of braided coax, with a polyethelene dielectric was okay for demonstrating the concept, a large diameter air-insulated line or other very-low-loss coaxial structure, preferably copper, should be used for actual construction.

This loop antenna is a simplified version of the one shown in the patent drawing of Figure 4 within the patent referenced in Note 1. — *73, Ken Hirschberg, K6HPX, 2440 N Coyote Dr Ste 116, Tucson, AZ 85745;* **info@cal-av.com**

More on Great Balls of Fire (March 2014)

I read with interest the letter from Charles Frank Ridolfo, WB1EEU, about the fire balls he observed with his first antenna. I had a similar event a few years ago. I have a G5RV dipole up about 35 feet over a low spot near my house, fed with a length of 450 Ω twinlead and then RG-11A/U coax to my basement shack. The coax runs beneath a gravel driveway through a length of PVC pipe and through a gap in the basement wall.

On an occasion when our snow drifts were particularly high and it was snowing again, I was handling the end of the coax when I received a static electricity shock. It was there again when I handled the connector a second time.

I placed my digital voltmeter (DVM) across the connector and read a very high voltage before the 10-dollar, 1000 V maximum DVM gave up the ghost. It seemed that the dry snow was creating a static charge on the G5RV — not quite your "balls of fire," but still an electrical phenomenon.

I wrote to "The Doctor" in *QST*, and he suggested that I place a 1 MΩ resistor across the antenna terminals. I did so in the shack, with a good ground to a water pipe, and have had no further trouble. I also bought a new DVM.

This high-value resistor across antenna terminals doesn't appear to affect antenna operation, and may save my rig's front end if I don't have the antenna disconnected from the rig when the static buildup occurs. For more on preventing static buildup on antennas, see the August 2014 *QST* article by Phil Salas.[5] — *73, Charles Hooker VE3CQH, 431068 19th Line, East Garafraxa, ON L9W 7E4, Canada*; **ve3cqh@arrl.net**

[3]Hans Wuertz, "DX Antennen Mit Spiegeinden Flaechen," *CQ-DL*, Feb, 1983.

[4]Roberto Craighero, I1ARZ, "Transmitting Short Loop Antennas for the HF Bands," *Communications Quarterly*, (Part 1), Summer 1993 pp 63 – 69, and (Part 2), Fall, 1993, pp 95 – 104.

[5]Phil Salas, AD5X, "Antenna Feed Line Control Box," *QST*, Aug 2014, pp 40 – 44.

Steve Sant Andrea, AG1YK, hk@arrl.org

High Current Shunt, Karo Coating, and Powerpoles in a Bind

Build a Current Shunt Resistor

I needed to take current readings that exceeded the 10 A rating of my digital multimeter (DMM). The solution was to build a 0.01 Ω current shunt resistor capable of handling up to 20 A of current flow.

A current shunt resistor is placed in series between the equipment load to be measured and its power source. A voltmeter is connected in parallel with the resistor and is used to measure the voltage drop across the resistor. Ohm's Law is used to determine the amount of current in amperes I for a given voltage E and resistance R using the formula $I = E / R$. For example, if you were to measure 0.2 V across the 0.01 Ω resistor then the corresponding current would be 0.2 / 0.01 = 20 A.

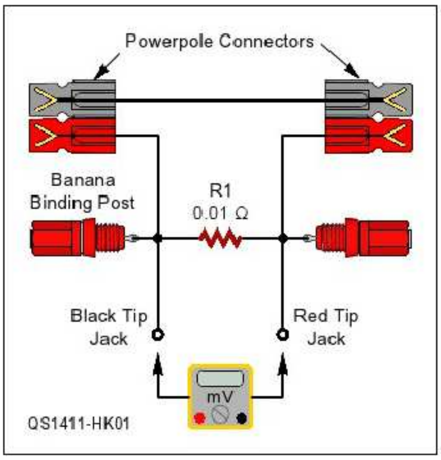


Figure 1 — Current shunt resistor schematic.

I decided to build a 0.01 Ω current shunt resistor because it produces a negligible 0.2 V drop in the supply voltage when presented with a 20 A load. Also, the current through the shunt is 100 times the voltage across the shunt; that is with a resistance of 0.01 Ω, each 0.01 V that appears across the shunt indicates a current flow of 1 A. So if 0.03 V appears across the shunt, by Ohm's Law, 3 A must be flowing through the shunt (0.03 / 0.01 = 3).

Construction

I made the current shunt resistor from a 6-foot piece of 12 AWG insulated solid copper wire (see Figure 1). The resistance of 12 AWG wire is 1.588 Ω per thousand feet or 0.001588 Ω per foot and an ampacity [The maximum safe current carrying capacity. — *Ed.*] rating of 25 A. I formed the wire into a multiturn coil having an inside diameter of 1¼ inches, which allows it to fit into a 5 × 2½ × 2 inch plastic project box (see Figure 2). Banana binding posts and Anderson Powerpoles are used for connecting the resistor (see Figure 3). Tip jacks are used for connecting the millivoltmeter or DMM test leads across the resistor.

Setup and Use

Attach the positive lead (B+) from your power source to the shunt binding post next to the red tip jack, and your load equipment supply lead (B+) to the other binding post. Your power source's negative lead (B-) is connected directly to the equipment load.

If your equipment has Anderson Powerpole connectors, then you can connect your power source to the connector pair near the red tip jack and your equipment load to the other pair. Observing meter polarity, insert the test leads of your millivoltmeter or DMM into the black (meter-negative) and red (meter-positive) tip jacks. Turn on your power source and load equipment. Observe the voltage reading on your meter, which will be in millivolts.

Calibration

Calibration of the shunt requires a calibrated ammeter, a voltmeter with a 10 MΩ or greater input impedance, and an adjustable load. I used a 100 W HF transceiver (in CW mode) terminated into a RF dummy load as my adjustable load; I changed the amperage level by adjusting the RF drive level as needed. I used my DMM for the calibrated ammeter and voltmeter. To calibrate the shunt you need to record several

Figure 2 — The resistor is made from a 6-foot length of 12 AWG copper wire formed into a multiturn coil having an inside diameter of 1¼ inches. [David Warner, W7SZS, photo]

Figure 3 — The current shunt resistor mounted in a small plastic project box. [David Warner, W7SZS, photo]

current and voltage readings as follows:

1. With the power off, connect the load to the power source, turn on the power, and set the load to draw a minimum current; turn the power off. Set the DMM for an ammeter scale and connect it in series with the load. Turn on the power and adjust the load until the ammeter reads 1 or 2 A. Note the current.

2. Turn the power off. Replace the ammeter with the shunt resistor. Set the DMM for a voltage scale and connect it to the tip jacks on the shunt.

3. Turn the power on. Note the voltage reading on the DMM.

4. Turn the power off and repeat the procedure, raising the current an ampere or two each time until you reach the limit of the ammeter.

Using Ohm's Law $R = E / I$, divide the measured voltage E by the measured current I to obtain the corresponding resistance value R for each current point you recorded. Find the average of all the resistance values R_{AVG}.

If your shunt has too much resistance, you can trim a calculated length off your wire. Two calculations are needed. First, determine the wire resistance per inch R_{INCH} by dividing R_{AVG} by the length of the wire. Next calculate the number of inches to be trimmed using the formula: $(R_{AVG} - 0.01) / R_{INCH}$. Cut about ½ inch less than your calculated trim length to compensate for the wire attached to the banana binding posts.

Final Comments

The current shunt resistor can also be used on ac power circuits. For example, you might have a portable generator and need to know how much current a load is drawing. This can be done by connecting the ac line (L, black) conductor to the two binding posts, with one side going to the power source and the other going to the load. The ac neutral (N, white) and protective ground (PG, bare copper or green) conductors would be connected directly between the ac power source and load. [When measuring ac, make sure your DMM is set to an appropriate ac scale. — *Ed.*] — *73, David Warner, W7SZS, 19658 Schaefer Dr, Oregon City, OR 97045*, **w7szs@arrl.net**

Karo Corrosion Cure

Early in my broadcast engineering career I did maintenance on mountaintop microwave relay stations, which had large banks of lead-acid batteries. The maintenance exercises at these stations consisted primarily of cleaning corrosion from battery terminals until one of the technicians came up with what was a stroke of genius — using clear Karo syrup for corrosion protection.

At the time I learned this trick, the battery in my Jeep had top terminals. I cleaned the whole battery and the clamps, then re-assembled everything, including the wire I'd attached to the positive clamp for my rig. I carefully poured clear Karo syrup over each terminal. I used just enough to cover the battery post and most of the terminal, finally using a small screwdriver to encourage the syrup to migrate beneath the clamps. I kept that car for another 2 years and never saw a spot of corrosion on either battery terminal again.

It is necessary in using this technique to be careful not to get syrup into the cells. I never applied the syrup anywhere near the battery ventilation openings. Also, make sure the container you use to apply the syrup is nonconductive. Your car or emergency battery may be low voltage but lead-acid batteries can deliver hundreds of amperes. Shorting the hot side to ground will cause very rapid overheating of the battery that could result in fire and explosion.

With the presence of fiber in today's world, the days of microwave relay stations with their house-sized battery banks are pretty much over. But this interesting trick of using small amounts of Karo syrup to neutralize battery acid may still be useful today. — *73, Tom Norman, KQ7T, 452 N Section Ext, South Lebanon, Ohio 45065*, **tom1norman@live.com**.

Powerpole Soldering Jig

I devised a simple jig to keep everything in proper alignment when soldering Anderson Powerpoles. I made the jig from a 2 × 4 cut down to about 1½ inches square and 6 inches long. Then I made a 22.5° cut on one end and attached a ¾ inch black binder clip as shown in Figure 4. The bend on the end of the Powerpole contact seats nicely on the rolled edge of the binder clip maintaining proper alignment. The rubber bands are used hold both electrical conductors in place. — *73, Dean Sheeley, W7DWS, 3957 Purple Sage, Prescott, AZ 86301*, **deansheeley@gmail.com**.

Figure 4 — This simple wooden jig simplifies the soldering of Powerpole connectors. [Dean Sheeley, KG7DKC, photo]

Plotting Your Antenna

I appreciated the Doctor's item in the December 2013 *QST* showing how to overlay an azimuthal map with antenna plots.[1] For many years I have been using a similar technique that uses a simple tool.

I scanned an azimuthal map centered on my hometown, San Francisco, from an old ARRL® Antenna Book (14th edition), then printed it on a sheet of 8½ × 11 inch Apollo CG7033S Quick-Dry Inkjet Printer Transparency Film.[2, 3] I then overlay this on my *EZNEC* plots — on paper or right on the monitor screen — to see how my proposed antennas should behave. Transparency film is available at Office Depot, Staples, or other office supply stores. — *73, Jerry Boucher, WA6CDO, 212 Waterside Cir, San Rafael, CA 94903-2794*, **wa6cdo@jdboucher.com**.

[1] J. Hallas, W1ZR, "The Doctor Is In," *QST*, Dec 2013, p 46.

[2] Available from your ARRL dealer, or from the ARRL Store, ARRL order no. 6948 (22nd Edition). Telephone toll-free in the US 888-277-5289, or 860-594-0355, fax 860-594-0303; **www.arrl.org/shop/**; **pubsales@arrl.org**.

[3] Note that the current editions of the *Antenna Book* and *Operating Manual* no longer contain azimuthal equidistant maps. Azimuthal equidistance map generators can be found on many ham-oriented websites. **AC6V.com** has many such links and a general search for "azimuthal equidistant maps" will yield numerous results.

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

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

Colorado Cliffhanger

Ham radio provides a crucial safety net for off-roaders traveling Colorado's Black Bear Pass.

Gene Chapline, K5YFL

Black Bear Pass is a heartless, frosty place. In 2011 and 2014, the snow was not cleared from the road over the pass until mid July. The trail is nature's tollway between the towns of Ouray and Telluride in the San Juan Mountains of Colorado. You don't pay money for passage. Instead you pay very close attention. The US Forestry Service describes the route as "very technical" and "difficult," which, in layman's terms, means "terrifying" and "treacherous." Black Bear Pass always delivers unforgettable moments. Some are of the white-knuckle terror kind and others are of rapturous disbelief at the beautiful vistas unknown and unimagined on any strip of interstate asphalt.

Enter the Amateur Radio service. On Black Bear Pass, hamming is not a hobby. It's what the FCC calls it — a service. Hams are there for 1 week each summer to help fellow hams and other off-roaders cope with the unpaved, rocky, narrow-ledged, and sometimes vague path of treacherous switchbacks hanging like an afterthought alongside the mountain's steep drop-offs.

These Amateur Radio operators are participants in the FJ Summit, an annual event that brings together owners of vehicles suitable for unpaved mountain trails and old mining roads. Hams provide crucial communication from key locations. Some hams are trail leaders in front of a small convoy, while others are "tailgunners" at the rear of the procession, keeping the trail leader informed of any problems. Other hams, equipped with handheld transceivers, are spotters at dangerous switchbacks, directing and coaxing drivers around the turn. Nearly all the drivers communicate among themselves with Citizens Band radios, but hams provide the more reliable longer-distance communication through local repeaters and HF.

The author and his mobile driving through Corkscrew Gulch, in the San Juan Mountains. [Josie Chapline, K5JTC, photo]

Robbie, KD0CMN, acting as a spotter on a difficult turn.

Reliable Communications

Each year drivers who are ham radio operators demonstrate the benefits of the amateur service, and each year the ham population at the event grows larger. Drivers witness what hams accomplish and show up the following year with call signs and radios. They recognize the value of reliable communication when facing trail hazards, punctured tires, broken tie-rods, and the plethora of other problems that traveling the Pass entails.

When the first FJ Summit was held several years ago, the organizers did not plan on utilizing Amateur Radio. They relied upon CB and Family Radio Service (FRS) radios for communications. Then hams began to contribute ideas and support. Shane Williams, K2TRL, the publisher and editor of *FJC Magazine*, prepared a page devoted to communication for the event's 2010 guidebook. Shane published suggested simplex frequencies for hams to use, along with frequencies and coverage maps of local repeaters. During the 2011 event, Lee Petersen, N5MUD, presented a demonstration of Amateur Radio, as did the author of this article in 2012. In 2013 and 2014, Tsuyoshi Nagano, WH7JJ, led VE teams in testing sessions that produced several new hams.

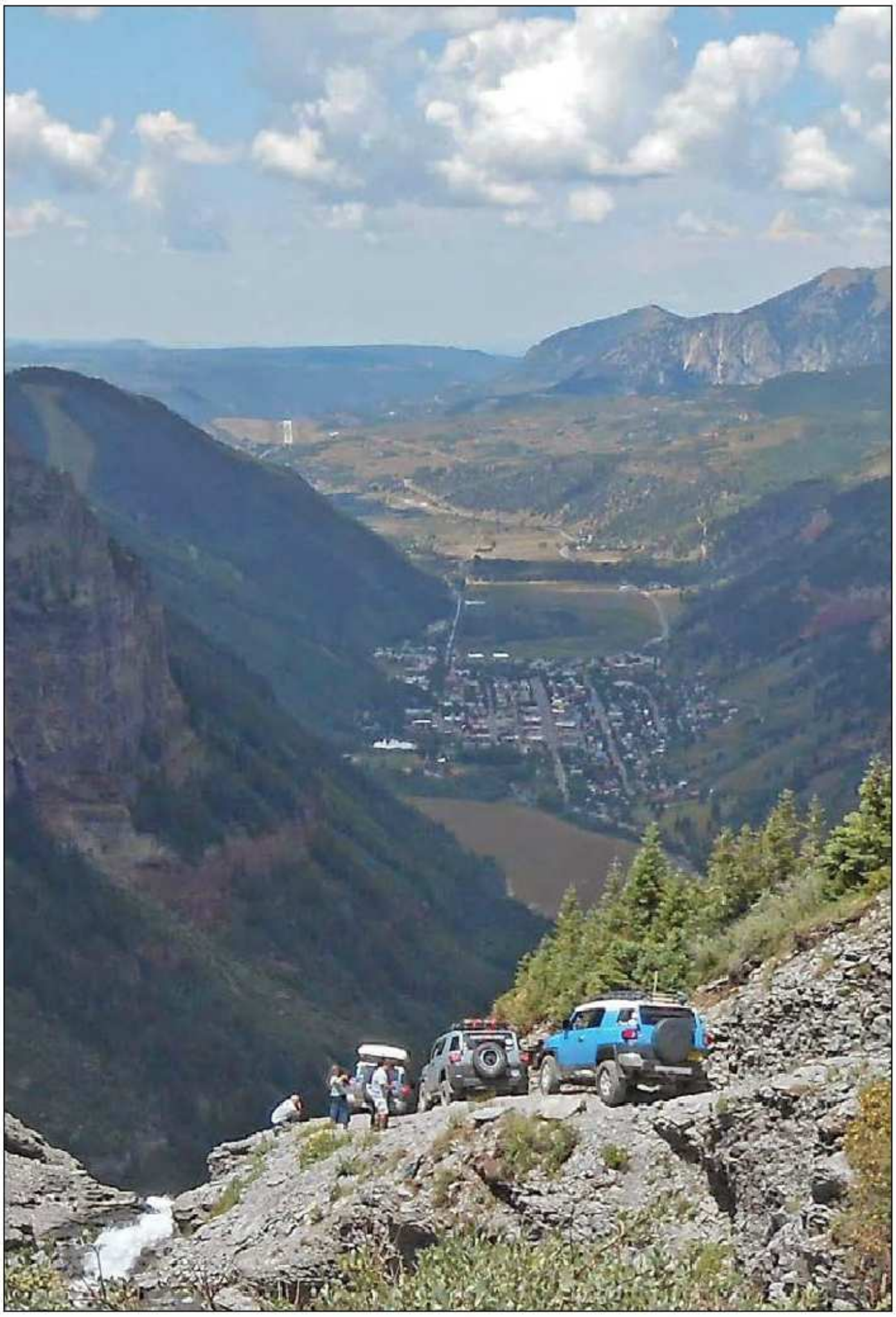
Each year hams with antenna analyzers have helped non-ham participants tune their CB antennas. Hams have lent FRS radios to convoy drivers who had no radios, which enabled the hams to relay convoy information to them. In 2013 and 2014, Robbie Antonson, KD0CMN, acted as a spotter for drivers maneuvering through two especially tricky switchbacks on Black Bear Pass. Robbie carried a handheld transceiver tuned to 146.46 MHz as a safety measure to communicate emergency information to hams in Ouray and Telluride, if necessary.

Trail leaders have always been eager to assign hams the task of "tailgunner," the last vehicle in the convoy, because of their ability to spot trouble anywhere in the convoy and to communicate that information up the line or to hams in Ouray. During the 2013 and 2014 events, more than 30 Amateur Radio operators attended the Summit, representing more than 10% of the attendees.

Radio Rescue

The rescue of a vehicle during the 2013 Summit substantially proved the value of Amateur Radio for off-roaders. A miner, on his way to his claim, misjudged the narrow end of a shelf road and ended up high-centered on a rock, with the two passenger side wheels of his vehicle hanging off the shelf. The vehicle was precariously perched, close to tumbling down the mountainside. There was no cellular telephone service in the area and the CB coverage was severely limited and essentially useless. Seeking help, the driver walked down to a trail that was being traversed by Summit drivers and encountered a convoy in which there were several hams, including Tsuyoshi Nagano, WH7JJ; Tamami Stump, KG7DDQ, and Laurence Bierner, KF7CUT.

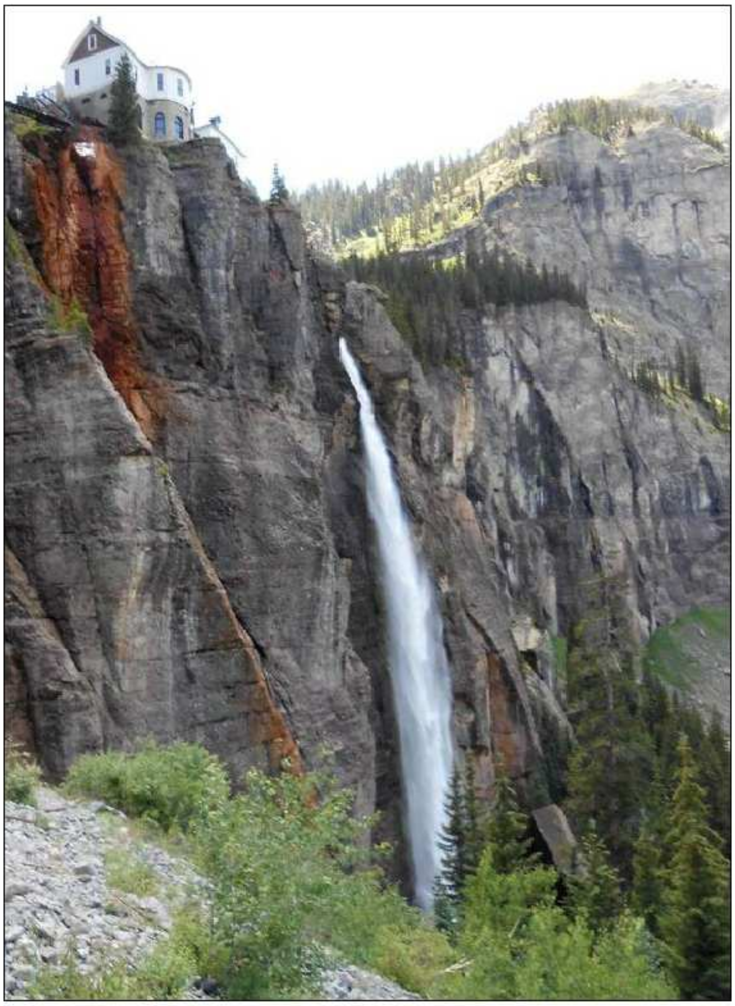
Laurence established radio contact with fellow hams on a trail closer to the miner's vehicle and asked if they could assess the situation. The closer group included Mark Seiferth, K2RBA; Mike Harrison, K1ZZM, and Jim Long, K9JBO. These three hams and the other drivers with them found the miner back at his vehicle within half an hour. The miner was dumbfounded that someone had responded with help so quickly. The hams explained that it was all because of Amateur Radio.



Near the end of the trip, the convoy descends Black Bear Pass, heading toward Telluride in the distance.

Mark, K2RBA, had a treasure trove of recovery gear that was quickly put to use. The hams and their companions attached shackles, tow ropes, and snatch straps to anchor the vehicle to nearby rocks. They relayed GPS coordinates to Tamami, KG7DDQ, who relayed the location back to Ouray in an effort to summon a commercial wrecker, but there was no wrecker available.

Back at the scene of the mishap, the hams and their companions decided to take a more aggressive approach. They strung out the winch on the miner's vehicle and attached it to a large nearby rock, then carefully and cautiously winched the vehicle off the hazard. The miner, a seasoned off-roader, acknowledged that he should



The trip through Black Bear Pass is not all white-knuckle curves, as this view of Bridal Veil Falls demonstrates. The building at the top houses the second-oldest ac generating power station in the country.

Kyla, the traveling companion of Alan "Ace" Brown, KJ4UML, helps tune a CB antenna. [Josie Chapline, K5JTC, photo]

have picked a better path. He thanked the group and insisted that he foot the bill for their supper. At supper, everyone in the group who did not have an Amateur Radio license resolved that it was necessary to have one in 2014 for safer off-roading.

Two weeks later, each ham who participated in the communication for the recovery received an unexpected surprise — a Good Operator Report from ARRL® Official Observer Tsuyoshi Nagano, WH7JJ. Tsuyoshi remarked, "Great contribution for the off-road rescue and recovery effort at Colorado Mountain. Your operating practices were consistent and a model for others."

The number of Amateur Radio operators now participating in the FJ Summit event justifies the establishment of a monitoring station for future events. The plan is to establish a station at the event headquarters for APRS tracking and monitoring of the HF and VHF frequencies used by hams participating in trail runs on the surrounding mountains, thereby fulfilling the amateur's creed to always be ready for service to country and community.

All photos by the author, except as noted.

Gene Chapline, K5YFL, an ARRL member, serves as the county attorney of Live Oak County, Texas. He has been licensed since 1959 and holds an Amateur Extra class license and a commercial General Radiotelephone license.

Gene has been an Amateur Radio on the International Space Station (ARISS) technical mentor since 2001 and has mentored more than 60 contacts between schools and the International Space Station. A former Scoutmaster, he coached the two Boy Scouts who operated the ground station during the school contact, which became the subject of a scene in the IMAX movie, *Space Station*.[1]

Gene is a delegate to the 30-member executive council that reviews and revises the Texas Statewide Communications Interoperability Plan and is certified by the state of Texas as an All-hazards Communications Unit Leader in accordance with the standards set by the US Department of Homeland Security Office of Emergency Communications. He can be reached at PO Box 902, George West, TX 78022, **k5yfl@yahoo.com**.

[1]R. White, K1STO, "Amateur Radio Hits the *Big Screen*," *QST*, Jul 2002, pp 43-45

The USS *Shenandoah*

The cross-continent flight of this airship had reliable communications, thanks to radio amateurs.

Michael Marinaro, WN1M

During the first World War, Germany was the leader in airship technology and demonstrated their superiority with devastating high-altitude bombing raids over English cities. The largest took place on the evening of October 19, 1917. Eleven L-series rigid Zeppelins, rated for 20,000-foot altitude, conducted the raid on London and northeast England. On the return leg, the airships were dogged by Allied aircraft. Six returned safely to their German base. Of the remaining five that were then scattered over Northern France, one, identified L-49, landed behind French lines and was captured intact and undamaged.

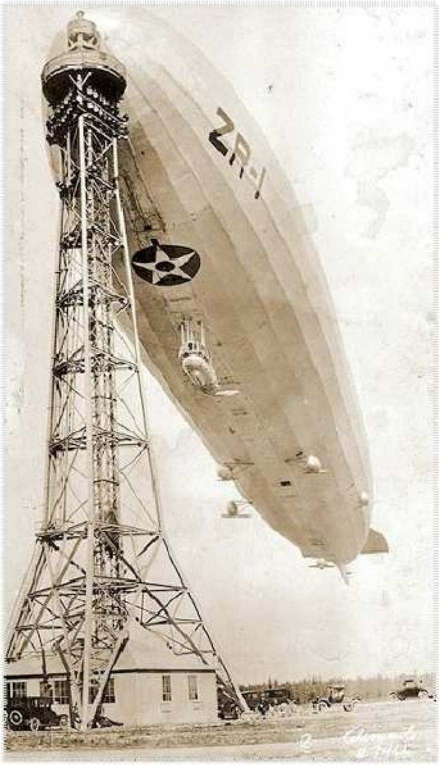
The Birth of the Shenandoah

The L-49 would become the prototype for the first American-built rigid dirigible, the USS *Shenandoah* — a Native American word believed to mean "Daughter of the Stars." Carrying the Navy designation ZR-1, the craft was 680 feet long and 80 feet in diameter.

The Navy had ambitious plans for ZR-1. The ZR-1 ultimately was to traverse the North Pole from west to east — from Alaska to Norway. But first it was to conduct demonstration and training flights, ending in a flight to the west coast and back. These continental flights gave Amateur Radio operators an opportunity to participate in these historic events and demonstrate their abilities and skills.

Amateur Radio Involvement

In preparation for the cross-country journey, the sixth engine of the ZR-1 was removed from the rear of the control cabin and a radio shack was built in the space. Installed was a powerful but conventional Navy longwave transmitter for ACCW operation on 500 to 200 kilocycles and a shortwave CW station set up specifically for contacting radio amateurs. The shortwave station, with call letters NERK, included a transmitter with a 50 W input final tube set for operation at 3000 kc. The ARRL provided the Navy with a list of prominent amateurs capable of operating within the 3500 and



The USS *Shenandoah* was the first airship to be filled with expensive and rare helium; this was considered safer than the highly flammable hydrogen that had been used previously.

7000 kHz bands, and issued bulletins detailing the flight. Amateurs were encouraged to submit reception reports and logs of cross-band contacts.

The flight started on October 7, 1924 with the route taking the craft over Washington and on to Fort Worth with a crossing over the Rockies through three passes in New Mexico. Then it went onward to San Diego and up the coast to Seattle with no difficulties. After 19 days and 210 flying hours, ZR-1 was moored again within its hangar at Lakehurst, New Jersey.

In a letter to the League from the Secretary of the Navy, published in the January 1925 issue of *QST*, there appeared an excerpt of a report from the Commanding Officer of the USS *Shenandoah*. The Commanding Officer commended the amateur community for their effort. Underscoring the effectiveness of the shortwave system, he stated that NERK maintained satisfactory communications with amateurs for about 18 out of the 24 hours of every day, even over the remote deserts of the Southwest. He went on to state that approximately 250 amateur and commercial stations in the US, Canada, and Mexico had been worked; and that amateurs had handled traffic that was sometimes more than 1000 words in length.

Fate of the Airship

Regrettably, the future of the USS *Shenandoah* did not parallel that of its Amateur Radio airmates and supporters. The Navy and the government were reluctant to fulfill the objective of a polar flight. After being unused for some time, a slightly modified ZR-1 embarked upon its 57th and final flight on September 3, 1925. The first destination was St Louis, and then the airship went on to a series of other demonstrations in the Midwest.

En route, the USS *Shenandoah* encountered an unusually heavy squall line over Ohio, and was twisted in two by torsional winds, resulting in the loss of 14 of the 41 crew members. Despite this tragedy, this was not the end of organized Amateur Radio engagement in the efforts to fly airships over the North Pole. Amateurs supported the successful crossing of the Pole by the *Norge* in 1926, and the rescue of the crew of the airship *Italia*. You can read more about the flight of the *Italia*, and the related tragedy, in the July 2014 issue of *QST*.

Michael W. Marinaro, WN1M, an ARRL member, was first licensed in 1952 as KN2CRH and has been licensed continuously ever since. He now holds an Amateur Extra class license.

Mike is the ARRL's volunteer historian. You can reach him at PO Box 404, 250 Cold Brook Rd, South Glastonbury, CT 06073-0404 or by e-mail at **wn1m@arrl.net**.

The Bill Leonard, W2SKE, Professional Media Award

Nominations are due by December 5!

Sean Kutzko, KX9X
ARRL Media and Public Relations Manager
kx9x@arrl.org

We all like to give credit where credit is due. In 2014, Amateur Radio received a lot of excellent publicity covering our response to numerous natural disasters, as well as highlighting educational programs like Amateur Radio on the International Space Station (ARISS), and instances of community goodwill. In appreciation for their efforts, ARRL sponsors the Leonard Award to honor media professionals for helping present Amateur Radio in a positive light.

Bill Leonard, W2SKE (SK)

The award was created in 1999 as a tribute to Bill Leonard, W2SKE, an avid Amateur Radio operator who was a longtime employee of CBS as a reporter, manager, and ultimately President of CBS News. He was the author of the famous 1958 *Sports Illustrated* article about contesting called, "The Battle of the Hams," hosted a weekly program on the Voice of America in the 1950s that was focused on Amateur Radio news, and narrated a documentary on Amateur Radio contesting in the 1980s called "To Win The World." Leonard became a silent key in 1994 after suffering a stroke. He was posthumously inducted into the *Broadcasting & Cable* Hall of Fame in 1996.

Details on the Award

The Leonard Award has three categories: Audio, Visual, and Print/Text. Amateurs are welcome to nominate members of professional media outlets, and the ARRL Public Relations Committee will review the nominations. Recipients must be professional journalists in print, electronic media or multimedia. For awards standards, "professional" is defined as full- or part-time journalists, stringers, freelancers, and contract journalists. In the case of a group project, only one prize will be awarded on behalf of the group. The piece must be truthful, accurate, concise, and reflect the highest journalistic standards. The award will be granted to works deemed the best reflection of the enjoyment, importance, and public service value of Amateur Radio.

The final decision will be made by the ARRL Board of Directors at their January 2015 meeting. Winners of the Leonard Award receive an engraved commemorative plaque, and a $250 donation will be made in their name to the charity of each winner's choice.

Who should you nominate? Did your club or group get great coverage for Field Day, a public service event, or your efforts during an emergency or educational outreach? This is a way you can thank the journalist who gave you that exposure. Media professionals can submit their own work, but it's far better to have a member of the Amateur Radio community submit the work.

Submission Criteria

Send us a letter or e-mail with the name of the journalist, the media outlet they work for, and why you feel they should be considered. A copy of their work must be included with the submission.

Audio: Submit a CD with audio file(s) in MP3 or WAV format with the name of the candidate written on the CD.

Video: Submit a CD with the file in MP4 format or a DVD of the work with the name of the candidate written on each disk.

Print/Text: Submit clear, easily readable copy of printed text, any related web addresses and 8.5 × 11" sheets displaying the writing exactly as it appeared to the public. Photocopies are acceptable.

For more information on the Bill Leonard Award, complete rules and nomination forms, visit **www.arrl.org/bill-leonard-award** or call the ARRL Public Relations Department at 860-594-0238.

Deadline: All nominations and supporting materials must be received at ARRL HQ by end of business on Friday, December 5, 2014. No late entries will be accepted. Mail them to: Sean Kutzko, KX9X Media and Public Relations Manager ARRL 225 Main St, Newington, CT 06111.

Strays

A Real Astronaut!

Lucas Tyre was clearly astonished by the opportunity to meet former NASA astronaut Steven Nagel, N5RAW, US Air Force Colonel (retired) at last year's ARRL Midwest Division Convention in Lebanon, Missouri. (Mr Nagel recently became a Silent Key. Please see page 81 for details.) The event also featured Carole Perry, WB2MGP, former teacher and 1987 Dayton Hamvention Ham of the Year, as well as 1987 ARRL Instructor of the Year. From left: Carole Perry, WB2MGP; Midwest Division Convention staffer Wanda Tyre (wife of Greg Tyre, WX0E), Wanda's grandson Lucas Tyre, and astronaut Steven Nagel, N5RAW.

Rick Lindquist, WW1ME, ww1me@arrl.org

Gift Will Preserve Rare DX and DXpedition Logs of Yesteryear

Major ARRL Second Century Campaign Gift from JA1BK Will Support DX Log Archive

A major donation from noted DXer Kan Mizoguchi, JA1BK, to the ARRL Second Century Campaign will support "The DX Log Archive Endowed by JA1BK." Earnings from the generous gift will fund the creation and management of a DX Log Archive Program for paper DX logs of rare and significant DXpeditions that took place predominantly in the 1950s, 1960s, and 1970s. The archive also would include pre-1950 paper logs, as well as those from rare operations, and logs kept by longtime residents of very rare entities.

Kan Mizoguchi, JA1BK. [Rick Lindquist, WW1ME, photo]

The ARRL will be reaching out to the DX community to collect paper DX station logs for inclusion. All logbooks will be inventoried and housed at ARRL Headquarters.

Confirmations from archived logs will be made available via Logbook of The World (LoTW) or, upon request, with a traditional QSL card.

The ARRL Membership and Volunteer Programs Department will manage the DX Log Archive Program. A qualified volunteer or part-time ARRL employee will execute the project. Earnings also will fund any equipment, software, and materials needed to maintain the program.

On behalf of the League, ARRL Individual Giving Manager Lauren Clarke, KB1YDD, expressed thanks and appreciation to Kan for his financial contribution that will make this new program possible.

Southern Florida Section Manager Wins Full Term, New SMs on Deck in Two Other Sections

ARRL Southern Florida Section Manager Jeff Beals, WA4AW, has won a full term in his own right, after being appointed to the post earlier this year. In the summer election cycle, Beals, of Loxahatchee, received 570 votes to 270 for his challenger, Tom Gallagher, NY2RF, of West Palm Beach. Ballots were counted on August 19, at ARRL Headquarters. Beals' 2-year term of office began on October 1. He had served as Southern Florida Section Manager since June 1 after being tapped to complete the term of former Section Manager David Fowler, K4DLF, who stepped down.

An ARRL Life Member, Beals has been licensed since the early 1960s. Prior to becoming SM, Beals was an Assistant Section Manager. He served as ARRL Southeastern Division Vice Director from 2009 until 2011.

Two other sections — Oklahoma and Western New York — got new SMs on October 1. The Oklahoma Section will be led by Lloyd Colston, KC5FM, of Altus, the only nominee for the volunteer post. Current SM Kevin O'Dell, N0IRW, of Perry, decided not to run for a new term of office after serving since 2010.

In the Western New York Section, as Laura Peters-Mueller, N2LJM, of Falconer — the only nominee for the position — takes the reins from her husband, John Mueller, K2BT, who opted not to run for another term. He is a candidate in a three-way race for Atlantic Division Vice Director. Peters-Mueller has been a Western New York Assistant Section Manager for the past 2 years.

Several sitting ARRL Section Managers faced no opposition and have been declared elected for 2-year terms beginning October 1. They are Betsey Doane, K1EIC (Connecticut); Edward Stuckey, AI7H (Idaho); Skip Jackson, KS0J (Minnesota); Lynn Nelson, W0ND (North Dakota); Scott Yonally, N8SY (Ohio); Rene Fonseca, NP3O (Puerto Rico), and Frederick Kleber, K9VV (Virgin Islands).

Ballots in contested races will be counted and successful candidates announced on November 18. Those elected take office for 3-year terms starting at noon Eastern Time on January 1, 2015.

Balloting Set in Two ARRL Divisions

When the ARRL Board of Directors gathers for its Annual Meeting in January 2015, some new faces will be at the table. ARRL members in the Atlantic Division will elect a new Director and Vice Director, while members in the Great Lakes Division will choose a Vice Director. Two sitting directors have opted not to run for election: Cliff Ahrens, K0CA, who was appointed in 2010 to succeed Director — now Honorary Vice President — Bruce Frahm, K0BJ, in the Midwest Division, and Bill Edgar, N3LLR, who has headed the Atlantic Division since 2006.

Succeeding Ahrens as Midwest Division Director next January 1 will be current Vice Director Rod Blocksome, K0DAS, the sole candidate for the position. He has served as Vice Director since 2010, when he was appointed to succeed Ahrens. Both Ahrens and Blocksome were elected to full terms in 2011.

Two candidates hope to succeed Edgar in the Atlantic Division. They are current Vice Director Tom Abernethy, W3TOM, and Phil Theis, K3TUF, who ran for the office in 2011. There is a three-way race for the Vice

Midwest Division Director-Elect Rod Blocksome, K0DAS. Because no candidates stepped forward to run for the Vice Director's slot that he is vacating, ARRL President Kay Craigie, N3KN, will appoint someone to the post once it is officially declared open.

Director's position. Running are Scott Bauer, W2LC, who served previously as Western New York Section Manager; Bob Famiglio, K3RF, the current Eastern Pennsylvania Section Manager, and John Mueller, K2BT, the outgoing Western New York SM.

In the only other contest, members in the Great Lakes Division will choose between incumbent Vice Director Tom Delaney, W8WTD, and Steve Putman, N8ZR, to fill the Vice Director's chair. Delaney was appointed as Vice Director earlier this year after the former Vice Director, Dale Williams, WA8EFK, became Director when Jim Weaver, K8JE, stepped down from the Board. Williams is the only candidate for Great Lakes Division Director and has been declared elected.

Incumbents in the Dakota and Delta divisions also ran unopposed and have been declared elected. They are Dakota Division Director Greg Widin, K0GW, and Vice Director Kent Olson, KA0LDG, and Delta Division Director David Norris, K5UZ, and Vice Director Ed Hudgens, WB4RHQ.

Amateur Radio Operators Delighted with California City Council's Antenna Decision

The nearly 300 radio amateurs who live in Poway, California, may erect antenna support structures of up to 65 feet with only a building permit and a courtesy notice to their neighbors. The Poway City Council unanimously approved the new ordinance on August 5.

ARRL General Counsel Chris Imlay, W3KD, said the League had worked with Poway's Amateur Radio community for "a very long time" on the matter. ARRL's Amateur Radio Legal Defense and Assistance Committee contributed funding for the effort. "It represented a big change in well-entrenched attitudes in Poway spanning decades, so this is a big win for us," Imlay said.

A technical report prepared by members of the Poway Amateur Radio Society and submitted to City Council concluded that antenna support structures of up to 65 feet would represent "reasonable accommodation" for Amateur Radio communication under PRB-1, due to the area's varied topography. The subject of Poway's Amateur Radio antenna ordinance arose in the case of Howard Groveman, W6HDG, who sought to install a 59-foot crank-up tower. Poway's previous ordinance had set a maximum height of 35 feet and required a variance for anything taller.

Under the new regime, installing an antenna support structure taller than 65 feet would require a new antenna permit and City Council approval.

Silent Keys

NASA Astronaut Steven R. Nagel, N5RAW

Astronaut and Space Shuttle veteran Steven Nagel, N5RAW, of Houston, Texas, died August 21. He was 67. In April 1991, Nagel was the commander of the first all-ham Space Shuttle crew aboard *Atlantis* with Kenneth Cameron, KB5AWP; Jay Apt, N5QWL; Linda Godwin, N5RAX — whom he later married — and Jerry Ross, N5SCW, during the SAREX (Shuttle Amateur Radio EXperiment) program, the forerunner to ARISS — the Amateur Radio on the International Space Station program.

Steven Nagel, N5RAW, at the 2013 Midwest Division Convention. [Midwest Division Newsletter photo]

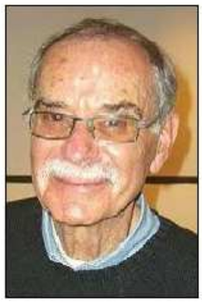
Nagel joined the Astronaut Corps in 1979 and was the pilot on the last successful mission of *Challenger* in the 1980s, the only time eight people were launched into space aboard the same spacecraft. Following the *Challenger* disaster in January 1986 that killed seven astronauts, Nagel was part of the effort to develop a crew escape mechanism.

Nagel retired from the Air Force and the Astronaut Office in 1995 and went to work for Johnson Space Center in Houston. A year later, he transferred to NASA's Aircraft Operations Division as a research pilot. He retired from NASA in 2011 and joined the faculty of the University of Missouri at Columbia. One of his last public appearances was at the 2013 ARRL Midwest Division Convention in Lebanon, Missouri.

Survivors include Godwin and the couple's two daughters. — *Thanks to NASA, NPR, ARRL Midwest Division Newsletter*

"Archie's Ham Radio Adventure" Comic Artist Stan Goldberg

Stan Goldberg, the artist who, with Mike Esposito, drew the "Archie's Ham Radio Adventure" comic for ARRL in the 1990s, died August 31. He was 82. A New York City native, Goldberg was Marvel Comics' chief colorist during the 1960s, when most of the characters now associated with Marvel were created.



Cartoonist Stan Goldberg.

"He's the reason Spider Man's costume is red and dark blue, the reason the Incredible Hulk's skin is green," said Jim Massara, N2EST, who penned *QST* cartoons in the 1980s and also once worked for Marvel. "Goldberg was a giant in our industry."

Goldberg started as a staff colorist at Marvel Comics in 1949, when he was just 16. He went on to work for DC Comics and, finally, for Archie Comics starting in the early 1970s. "He was Archie Comics' prolific lead artist for a number of years, and along with Dan DeCarlo was one of two artists who defined the look of Archie and the gang for several decades," Massara told ARRL.

In 1994, Goldberg was honored with an Inkpot Award at Comic-Con International in San Diego, and in 2012 he was inducted into the National Cartoonist Society's Hall of Fame.

FCC News

New Amateur Radio Vanity Call Sign Fee Set at $21.40

The FCC has settled on $21.40 as the Amateur Service vanity call sign regulatory fee for Fiscal Year 2014. In June the Commission said it intended to hike the current $16.10 vanity fee to $21.60 for the 10-year license term. In a *Report and Order and Further Notice of Proposed Rulemaking* (*R&O*) on August 29, the fee was recalculated to $21.40 for the 10-year license term. The $5.30 increase still represents the largest vanity fee hike in many years. Notice of the new fee appeared in the September 11, 2014 edition of the *Federal Register* and is now in effect.

The FCC's Office of Managing Director sets the actual fee vanity call sign fee, based on Wireless Telecommunications Bureau projections of new applications and renewals, taking into consideration existing Commission licensee databases, such as the Universal Licensing System (ULS) database. The vanity call sign regulatory fee is payable when applying for a new vanity call sign or when renewing any vanity call sign designated as "HV" in the FCC's ULS database.

FCC Ups the Ante in Proposing Huge Fines on CB Operators

Right on the heels of a whopping $14,000 proposed forfeiture for a Florida CBer for failing to allow a station inspection, the FCC Enforcement Bureau recommended a $22,000 fine for a New York CBer, alleged to have interfered with the communications of other CBers, operated with an external RF amplifier, operated without authorization, and disregarded earlier FCC warnings. The FCC issued a *Notice of Apparent Liability* (*NAL*) in the case of James Engle of Lewiston, New York, on August 28.

The FCC said that last October 23, agents from its Philadelphia office, responding to a complaint from a CB operator on 27.325 MHz, tracked the transmissions to Engle's station and "heard him repeatedly interrupt ongoing transmissions of another CB operator." The following day, the agents inspected Engle's CB station and discovered two linear RF amplifiers. The FCC said Engle admitted using one of the amplifiers the previous night; testing showed that it was capable of putting out nearly 150 W.

CBers who operate "in a manner that is inconsistent with the CB rules" are required to have an FCC authorization, the *NAL* pointed out. FCC rules prohibit using an external RF amplifier with a FCC-certificated CB transmitter, and if an amplifier is on the premises, the FCC assumes that it has been used.

The FCC cited what it called Engle's "deliberate disregard for the Commission's requirements and authority" in making an "upward adjustment" of $5000 in the proposed forfeiture.

Less than a week earlier, the FCC proposed fining a Florida Citizens Band operator $14,000 for failing to allow FCC agents to inspect his station. The Commission issued an *NAL* to Tommie Salter of Jacksonville on August 22. The Commission alleged that Salter had denied permission for agents from the FCC's Tampa Office to check out his station in the wake of renewed complaints of interference to a neighbor's "home electronic equipment." Salter had previously received a *Notice of Violation* for refusing an inspection request in 2004, the *NAL* noted, and he also had been fined for operating with a non-certificated transmitter during Commission-imposed restricted hours, following similar interference complaints.

The FCC made an upward adjustment of $7000 in Salter's proposed forfeiture, asserting that his alleged misconduct "exhibits contempt for the Commission's authority, and threatens to compromise the Commission's ability to fully investigate violations of its rules."

Section Manager Nomination Notice

To all ARRL members in Arizona, Arkansas, Iowa, Kentucky, Mississippi, Montana, North Texas, Orange, and Wyoming. You are hereby solicited for nominating petitions pursuant to an election for Section Manager (SM). Incumbents are listed on page 16 of this issue.

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

We suggest the following format:

(Place and Date)

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

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

(Signature_____ Call Sign___ City___ ZIP___)

Any candidate for the office of Section Manager must be a resident of the Section, an Amateur Radio licensee of Technician class or higher and a full member of the League for a continuous term of at least 2 years immediately preceding receipt of a nominating petition. Petitions must be received at Headquarters by 4 PM Eastern Time on December 5, 2014. If more than one member is nominated in a single section, ballots will be mailed from Headquarters on or before January 2, 2015, to full members of record as December 5, 2014, which is the closing date for nominations. Returns will be counted February 24, 2015. Section Managers elected as a result of the above procedure will take office April 1, 2015.

If only one valid petition is received from a section, that nominee shall be declared elected without opposition for a 2-year term beginning April 1, 2015. If no petitions are received from a section by the specified closing date, such section will be resolicited in the April 2015 *QST*. A Section Manager elected through the resolicitation will serve a term of 18 months. Vacancies in any Section Manager's office between elections are filled by the Membership and Volunteer Programs Manager. — *David Patton, NN1N, Membership and Volunteer Programs Manager*

Rick Palm, K1CE, k1ce@arrl.org

Operating in Winter

Winter is almost upon us — and it brings special challenges.

Hams are creatures of habit, and when we think of preparations for deployments for public service events and disaster communications responses, we think of our radios and accessories first: what to put in our go-kits before leaving the house. But there's more to think about before a deployment, including the operating environment, which can be extreme. Previous columns have addressed the demanding operating aspects of wildfire scenarios, for example. Hams are also creatures of comfort, and this month we'll examine the special challenges of operating in the cold.

They don't call Mt Washington, New Hampshire, "the home of the world's worst weather" for nothing! It's safe to say this vehicle, parked at the summit, won't be going anywhere for a while. [NOAA photo]

Winter Operating Considerations

First and foremost, before you are ready to forsake a warm home to head out into the cold, ask yourself if you are physically and mentally fit for the deployment at hand. Operating in winter places a premium on physical fitness. If you are obese, smoke, or have diabetes or other risk factors for heart attacks or stroke, then you should not be out in the field in winter. Similarly, the cold and wind sap your mental reserves as well. Your cognitive function and reasoning skills are undermined in such conditions. Having said this, let's turn to the next consideration — cold weather gear.

Cold Weather Gear

A long and safe history of winter mountaineering on Mount Washington in New Hampshire's White Mountains, the home of "The World's Worst Weather," taught me about clothing. Two critical principles apply to anyone going out into cold, icy, and snowy weather: First, cotton kills. Second, light is right.

Leave your jeans and flannel shirts at home. As soon as they're wet, which is almost instantly, they become about as useful as a screen door on a submarine. Wool is a viable option, but is heavy and uncomfortable, as anyone who has put on a pair of wool pants knows. Historically, wool was the weapon of choice against the cold for fishermen, loggers, and train coal tenders from a bygone era. Technological advances, many of them fueled by the needs of mountaineers, have resulted in incredibly efficient and effective synthetic cold-weather clothing. Undergarments made from polypropylene or Capilene®, coupled with fleece pullovers and jackets, are very warm and wick away moisture from the skin. An outer shell of Gore-Tex® is breathable and allows the moisture to escape while also being water-resistant.

Another great advantage of these high-tech fabrics is that they are lightweight. But wait, there's more: Capilene, fleece, and Gore-Tex can be crumpled into small balls for transporting efficiently in a backpack. You can wrap the garments around your radios and batteries to keep them warm and safe from potentially damaging bumps and abuse. At the end of the day, take off your synthetic undergarments and know that they'll be dry within minutes, not hours as with cotton or wool.

Batteries Discharge More Quickly in Cold Weather

Batteries generate electricity through various chemical reactions. As with all chemical reactions, the temperature of the chemicals involved plays a significant role in determining the rate of the reaction.

If you take a battery pack that you fully charged at home in your nice warm shack and expose it to cold temperatures, the electricity-producing reactions in the battery slow down. This slowing down of the reactions reduces the total power that the battery can deliver. If that fully charged battery pack is allowed to get cold enough, it will not be able to generate sufficient power to operate your radio. Further, if the pack actually freezes, this will usually damage the battery.

When participating in field operations in a cold environment, you must take steps to keep your radio's battery warm to maximize its power capacity and lifespan.

How to keep your batteries warm? I used to take a small handheld transceiver with me on technical ice climbs up the steep gullies of Huntington Ravine on Mount Washington, where problems and accidents were almost inevitable. I carried the radio in a Dachstein wool mitten, and if necessary planned to warm a battery pack by tucking it into the groin, where there is a lot of body heat. The only time I had to use the radio was to call for assistance on the 146.655 MHz repeater at the top of the mountain at night, far later than we had planned to be in the ravine. We were lost. The radio worked fine, but I couldn't dial the repeater's frequency in the dark, owing to the almost catastrophic oversight of failing to bring a flashlight.

Technological advances, many of them fueled by the needs of mountaineers, have resulted in some incredibly efficient and effective synthetic clothing. This Capilene jacket, for example, will effectively wick away moisture from the skin. Add a layer of Gore-Tex to allow moisture to escape while blocking moisture entering from the outside.

Amateurs assisted with communications as New England dug out after the big blizzard of February 2013. Hams operating outdoors learned quickly the value of keeping power sources warm. [Steve Ford, WB8IMY, photo]

Cold-Weather Camping

Chances are if you are deployed for a winter incident or event that runs over the course of several days, you may end up camping in a tent or pop-up trailer without heat. Winter camping skills are essential for safety, and obviously, comfort. Skills are learned and practiced, not intuitive. If you have never camped in summer, then you should learn basic skills first, before attempting it in winter.

The cold is an unforgiving environment: if the cold undermines your safety or the safety of others, it's time to pack it up and find warmth. The golden rule of winter camping is, if any operator in your group needs to call off the mission and he or she is dependent on the rest of the team for evacuation, then you coordinate with the leaders and you all get him or her out.

Allow more time to perform tasks: they take longer to do in the cold. Body motion slows and arms and legs become clumsier. Work hard to maintain a positive attitude, and do what you can to keep the morale of your team members up, as the cold will most certainly work to sap it. Leaders should have a knowledge of cold weather physiology (eg, detecting the early signs of hypothermia), winter camping techniques (anchoring tents in the snow, or even building a snow cave — one of the scout crafts taught at the old Klondike Derbies in my experience in the '80s), physical fitness training, and proper nutrition. Practice techniques in the backyard in summer.

Bring plenty of water as dehydration is a major concern in any winter activity. Fill Nalgene bottles and place them in fleece insulation covers designed for the purpose. Other essentials include plenty of food as fuel to keep the body warm. Nutrition bars, trail mix, and beef jerky always worked well for me as between-meal snacks in the cold. Learn how to cook in the snow, and melt snow for water and treat it against bacteria like *giardia*.

Practice using sleds or toboggans to haul your gear over ice and snow. I used a rock climbing harness and tow ropes to pull sleds with 100 pound loads over snowy roads and trails to get into the mountains. That system worked well.

In blizzard conditions, anchoring tents and even small structures is critical. This anchored building is at the summit of Mt Washington. [NOAA photo]

Check out the resources and website of the Boy Scouts of America, with which the ARRL has a formal agreement, for cold weather camping information and training: **www.scouting.org/scoutsource/sitecore/content/scouting/training/adult/supplemental/coldweathercamping.aspx**.

Conclusion

There are numerous aspects and special risks that pose challenges to radio operators in cold operating theaters. Detrimental effects of cold are insidious and subtle at first. Good, safe operators know how to identify them in team members and are able to effect evacuations to safety and hospitals, if necessary, quickly. Learn winter camping skills well — they will carry over to all aspects of operating in winter, even when not camping. And lastly, know how to maintain your radios and batteries against the cold, so they will keep working for you, the safety of your team, and the event leaders and participants. It's November, and winter is around the corner.

SKYWARN Recognition Day, December 6

The annual SKYWARN™ Recognition Day (SRD) will be Saturday, December 6, 2014. This is the day when Amateur Radio operators visit National Weather Service (NWS) offices and contact other operators around the world. The purpose of the event is to recognize the vital public service contributions that Amateur Radio operators make during National Weather Service severe weather warning operations. It also strengthens the bond between Amateur Radio operators and the local National Weather Service. The event is co-sponsored by ARRL and the National Weather Service. Please remember that this is not a contest, so no scoring will be computed.

Object: For all radio amateur stations to exchange contact information with as many National Weather Service stations as possible on 80 – 10 meters, 6 meters, 2 meters, and the 70 centimeter band. Contacts via repeaters are permitted.

Date: National Weather Service stations will operate December 6, 2014, from 0000 – 2400 Z.

Exchange: Call sign, signal report, location, and a one- or two-word description of the weather occurring at your site.

Modes: National Weather Service stations will work various modes including SSB, FM, AM, RTTY, CW, and PSK31. While working digital modes, special event stations will append "NWS" to their call sign (eg N0A/NWS).

Station Control Operator: It is suggested that during SRD operations, a non-National Weather Service volunteer who is a licensed radio amateur serve as a control operator for the station that is set up at a NWS office. More details about this event may be found at **www.wrh.noaa.gov/mtr/hamradio**.

Nominations Open for the George Hart Distinguished Service Award

The ARRL Board of Directors first established the George Hart Distinguished Service Award in July 2009, to be given annually to an ARRL member whose service to the League's Field Organization is of the most exemplary nature. The Distinguished Service Award is named in honor of George Hart, W1NJM (SK), a longtime Communications Manager at ARRL Headquarters and chief developer of the National Traffic System (NTS).

Selection criteria include: Operating record with the National Traffic System; or participation within the Amateur Radio Emergency Service® (ARES®); or Station appointments and/or leadership positions held within the ARRL Field Organization.

Nominations should document as thoroughly as possible the nominee's lifetime activities and achievements within the ARRL Field Organization. It is expected that nominated candidates will have 15 or more years of distinguished service. The Programs and Services Committee will serve as the Review Committee, with the Board of Directors making the final determination at its Annual Meeting in January.

Nominations including any related supporting material and letters of recommendation, may be e-mailed to ARRL Headquarters to the attention of Field Organization Team Supervisor Steve Ewald, WV1X (**wv1x@arrl.org**). Nominations and supporting materials must be received no later than November 1, 2014, to be considered.

Contest Corral — November 2014

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

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

Start - Finish Date-Time		Date-Time		Bands HF /VHF+	Contest Title	Mode	Exchange	Sponsor's Website
1	0600Z	2	See website	3.5-28 / -	IPA Contest	Ph CW	RST and serial or "IPA" and state	www.iparc.de
1	1200Z	2	1200Z	1.8-28 / -	Ukrainian DX Contest	Ph CW	RST and serial or Ukraine oblast	urdxc.org
1	1200Z	2	1200Z	3.5-28 / -	Himalayan Contest	Ph CW	RS(T) and Indian state or power	www.arsi.info/contests/himalayan
1	1700Z	2	0500Z	3.5-21 / -	Radio Club of America QSO Party	Ph	RST, QTH, name, equipment	www.radioclubofamerica.org
1	2100Z	3	0300Z	1.8-28 / -	ARRL November Sweepstakes	CW	Serial, category, call, check, ARRL/RAC sec	www.arrl.org/contests
1	2100Z	3	0300Z	1.8-28 / -	Collegiate ARC Championship	CW	See ARRL Sweepstakes	www.collegiatechampionship.org
2	1100Z	2	1700Z	28 / -	DARC 10-Meter Digital "Corona"	Dig	RST and serial	www.darc.de/referate/ukw-funksport
3	1630Z	3	1730Z	3.5, 7 / -	OK1WC Memorial Contest	Ph CW	RS(T) and serial	www.memorial-ok1wc.cz
4	0200Z	4	0400Z	3.5-28 / -	ARS Spartan Sprint	CW	RST, S/P/C, and power	www.arsqrp.blogspot.com
6	1300Z	7	See website	1.8-28 / -	CWOps Weekly Mini-CWT Tests	CW	Name and member number or S/P/C	www.cwops.org/cwt.html
7	0145Z	7	0215Z	3.5-14 / -	NS Weekly RTTY Sprint	Dig	Serial, name, and S/P/C	www.ncccsprint.com
7	0230Z	7	0300Z	1.8-14 / -	NS Weekly CW Sprint	CW	Serial, name, and S/P/C	www.ncccsprint.com
8	0000Z	9	2400Z	3.5-28 / -	Worked All Europe DX Contest	Dig	RST and serial (see web for QTC rules)	www.waedc.de
8	0000Z	9	2359Z	- / 50-1296	ARRL EME Contest	Ph CW Dig	Call signs, signal report, acknowledgement	www.arrl.org/contests
8	0001Z	9	2359Z	28 / -	10-10 Fall Digital QSO Party	Dig	Call, name, 10-10 number, S/P/C	www.ten-ten.org
8	0700Z	9	1300Z	3.5-28 / -	Japan International DX Contest	Ph	RST and JA prefecture or CQ Zone	jidx.org
8	1200Z	9	1200Z	1.8-28 / -	OK-OM DX Contest	CW	RST and serial or OK/OM district	okomdx.crk.cz
8	1200Z	9	2359Z	3.5-28 / -	Straight Key Weekend Sprintathon	CW	RST, S/P/C, name, SKCC nr or "none"	www.skccgroup.com
8	1400Z	9	0200Z	1.8-28 / 50	Kentucky QSO Party	Ph CW Dig	RST and KY county or S/P/C	www.wkdxa.com
8	1900Z	10	0500Z	1.8-28 / 50-440	CQ WE (Western Electric)	Ph CW Dig	Call, name, Bell QTH, years of service	cqwe.cboh.org
15	1600Z	15	1800Z	3.5-28 / -	Feld-Hell Turkey Shoot Sprint	Dig	RST, S/P/C, Feld-Hell member nr	www.feldhellclub.org
15	1200Z	16	1200Z	3.5-28 / -	LZ DX Contest	Ph CW	RST and ITU Zone or LZ district	lzdx.bfra.org
15	1200Z	16	1159Z	1.8-28 / -	Russian WW Multi-Mode Contest	Ph CW Dig	RST and serial or 2-char oblast code	www.rdrclub.ru
15	1600Z	16	0700Z	1.8 / -	All Austria 160 Meter Contest	CW	RST, serial, OE district	www.oevsv.at
15	2100Z	16	0100Z	1.8 / -	RSGB Second 1.8 MHz Contest	CW	RST, serial, UK district	www.rsgbcc.org
15	2100Z	17	0300Z	1.8-28 / -	ARRL November Sweepstakes	Ph	Serial, category, call, check, ARRL/RAC sec	www.arrl.org/contests
15	2100Z	17	0300Z	1.8-28 / -	Collegiate ARC Championship	Ph	See ARRL Sweepstakes	www.collegiatechampionship.org
16	0000Z	16	2359Z	1.8-28 / 50	ARS HF Contest	Ph CW Dig	RS(T) and serial	www.arsitalia.it
16	1300Z	16	1700Z	3.5-7 / -	Homebrew and Oldtime Contest	CW	RST, serial, and category	www.qrpcc.de/contestrules/hotr.html
17	0200Z	17	0400Z	1.8-28 / -	Run For the Bacon	CW	RST, S/P/C, Flying Pig nr or power	www.fpqrp.org
20	0130Z	20	0330Z	3.5-14 / -	NAQCC Monthly QRP Sprint	CW	RST, S/P/C, and NAQCC mbr nr or power	naqcc.info
26	0000Z	26	0200Z	1.8-28 / 50	SKCC Straight Key Sprint	CW	RST, S/P/C, name, SKCC nr or power	www.skccgroup.com
27	0000Z	27	0600Z	1.8 / -	Top Band Sprint	Ph CW	RST, S/P/C, ARCI number or power	www.qrparci.org/contests
29	0000Z	29	2359Z	1.8-28 / -	Full Day of Hell	Dig	RST, S/P/C, Feld-Hell mbr nr, 4-char grid square	www.feldhellclub.org
29	0000Z	30	2359Z	1.8-28 / -	CQ World Wide CW Contest	CW	RST and CQ zone	www.cqww.com

All dates refer to UTC and may be different from calendar dates 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 (December 1 for February *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.

World Radiosport Team Championship — WRTC2014

One hundred and eighteen hams from throughout the world journeyed to New England to compete for the most prestigious medals in Amateur Radio.

Randy Thompson, K5ZD

The World Radiosport Team Championship 2014 (WRTC2014) was held July 8 – 14 and kicked off a week of Amateur Radio activities in New England leading up to the ARRL National Centennial Convention. Fifty-nine two-operator teams representing 38 countries came together to compete in an over-the-air radiosport event for gold, silver, and bronze medals. When all was settled, a team from the USA captured the gold over teams from Slovakia and Germany.

The WRTC concept began in Seattle in 1990 with 22 teams, including a historic first with several from the Soviet Union. From that simple beginning, the WRTC team competition concept moved on to San Francisco (1996), Slovenia (2000), Finland (2002), Brazil (2006), and Russia (2010). Each event was conducted in the Olympic style with opening and closing ceremonies, intense competition, and a moment on the medal stand for the winners.

WRTC is much more than a competition — it also fulfills the Amateur Radio mission to foster international goodwill. Many of the competitors have worked each other thousands of times over the air, but had never met in person. A handshake and conversation makes future contacts more meaningful.

Team Selection

Selection of the team leaders was based on a 3-year qualifying process that used the best scores from 55 qualifying events. The world was divided into 29 qualifying regions to insure global diversity of participants. The top qualifier in each region was invited to become the team leader and was free to select a teammate. Some chose close friends they had operated with before, while others sought out a partner with complementary operating skills. Jeff Briggs, VY2ZM, selected his son Patrick, KK6ZM. Hamilton Oliveira Martins, PY2YU, chose his brother Rafael, PY2NDX. Sandy Raeker, DL1QQ, chose Irina Stieber, DL8DYL, to create an all-female team. Regardless of how the teams were formed, all came to New England with an eye on winning the gold medal.

Each team in the competition was also assigned a referee to monitor the operation and provide a decision on rules if needed. There were 64 referees selected from around the world. Many were experienced and successful contesters in their own right.

Gathering in Westborough

Competitors and referees began arriving at the WRTC2014 headquarters hotel in Westborough, Massachusetts on Tuesday and Wednesday. The lobby of the hotel grew noisier and more joyful as handshakes, hugs, and greetings were exchanged. A CW Skills competition on Wednesday evening allowed everyone a chance to show off their abilities by copying call signs from a simulated 5-minute pileup.

The opening ceremony was held Thursday evening. In addition to the more than 300 people in attendance, the ceremony was also broadcast live over the Internet. The referees, dressed in red shirts, were brought up to the stage where they vowed to uphold the standards of the competition. The parade of nations was led into the hall by a traditional

WRTC2014 medal winners (left to right) OM3BH, OM3GI, N6MJ, KL9A, DL1IAO and DJ5MW. [Nodir Tursoon-Zadeh, EY8MM, photo]

Fred, K9VV, and John, VE3EJ, operating from station N1M [Dave Pease photo]

A beam team installs the tribander on the tower [Marian Deacutis, KB1YLJ, photo]

New England fife and drum corps. The competitors dressed in blue filled the stage, with each delegation proudly holding a sign identifying their country, with the flags of all participating nations in the background. The Competitor's Oath was conducted and the games were declared open.

Only one team was not complete just hours before the opening ceremony. Ivo Pezer, 9A3A, had passport issues and was unable to get them resolved in time to make the trip. The organizers worked with team leader Ranko Boca, 4O3A, to find a replacement. Zoli Pitman, HA1AG, happily exchanged his red referee shirt for the blue one of a competitor. A call for some needed equipment that Ivo was not able to bring was quickly answered by locals and other teams.

Site Preparation

The work began in two warehouse locations where the equipment for one to four sites was loaded into delivery trucks. There were 16 "beam teams" of five to six persons each that were responsible for assembling the antenna and raising the tower. Each beam team was expected to set up four sites. A clever "falling derrick" method was used to pull up the tower and antenna without anyone having to leave the ground.

To keep the competition as fair as possible, the WRTC organizers provided each team with the same antennas and operating environment. Each site included a tent, generator, desks, chairs, 40-foot tower, and three antennas. The antennas were a TX-38 tribander by Cycle 24 and separate inverted Vs for both 40 and 80 meters hanging from the tower. The teams brought their own radios, switching systems, computers, and logging software. Power was limited to 100 watts.

The rules for WRTC2014 allowed both operators to make contacts at any time. The teams had to make maximum use of the three antennas to provide full operation for two stations. While the station sites all looked the same from the outside, they were very different on the inside. Each team had its own switching and filtering schemes with a mix of commercially made products and homebrewed gear. In some ways, the biggest challenge for the teams was maximizing their gear in terms of airline baggage rules!

The station draw occurred on Friday morning. The defending champions from WRTC-2010 were given the first pick, with the rest of the selection order determined randomly. As teams were called to the stage, they selected an envelope from the table that indicated who their referee would be and that included a map and directions to their operating site. The next stop was the transportation table, where they were assigned a volunteer driver. These drivers would be responsible for getting the teams to and from the site on Friday, and then back to their site on Saturday morning.

Finding equal sites in the hills of New England had not been easy. The sites needed to be in good locations, with land to install the station, and permission for the station to be set up from Thursday to Sunday. Site locations included a high school, apple orchards, conservation land, an airport, a decommissioned military base, athletic fields, and several state parks. Sites were between 30 and 90 minutes from the hotel.

Saturday Morning

It was an early morning on Saturday, with most of the teams out of the hotel by 6 AM. The teams did some last-minute testing and prepared for 24 hours of continuous operation. According to the rules, the teams were required to turn off all receivers 15 minutes before the start of contest. This was also the moment that they learned what their call sign would be for the event. The referee handed each team a sealed envelope containing a 1 × 1 call sign. They had just a few minutes to program their software and be ready to go. Random selection of stations and call signs is a tradition of WRTC events and is done to protect against unfair outside cheerleading or manufactured contacts. The teams are not allowed to announce their identity except by the assigned call during the competition.

It was eerily quiet in the command center as the 8 AM starting time approached. No issues were reported. There was great relief as the contest began and the Reverse Beacon Network started reporting all of the team calls as being active. Only one team did not immediately appear. A call to the site team revealed that they had started the contest on SSB chasing multipliers. All sites were operational and the contest was underway.

Real-Time Score Collection

One of the innovations of WRTC2014 was a real-time score collection and reporting system. A small computer captured the score from the logging computers and transmitted it every 5 minutes to the central server. A few of the sites did not have sufficient cell coverage to report consistently. In these cases, the referee would report the score by text message every 15 to 20 minutes. The scoreboard web page became the focus of attention for visitors and spectators worldwide. The teams were not allowed to view the scoreboard during the contest.

Given the low power and low antennas, CW was the dominant mode, accounting for over 65% of the total contacts. Scoring emphasized working stations outside of North America. From New England, that meant focusing on working as many Europeans as possible. The multipliers were IARU

The referees being welcomed by Chief Judge Dave Sumner, K1ZZ, during the Opening Ceremony. [Jeremy Breef-Pilz, KB1REQ, photo]

Headquarters stations and DXCC countries on each band.

Operating strategies varied among the teams. Most concentrated on 20 and 15 meters during the day, while trying to catch the occasional opening on 10 meters. This created a lot of pent-up demand on the East Coast for stations trying to work all 59 teams. When the WRTC teams made it to 40 meters, competitors were amazed at the pileups, given that they were just using an inverted V with the top at 40 feet.

Exhausted Competitors

There was plenty of conversation as teams returned to the hotel at the close of the contest on Sunday. They were all tired after nearly 24 hours of continuous operation in the warm outdoor conditions. Most immediately headed up to their rooms for some much-needed rest.

The bar was full for the World Cup match at 3 PM and the war stories began. It is unusual to have all of the competitors for a contest in the same place immediately following an event, so everyone enjoyed comparing experiences and trying to figure out what made one strategy more effective than another.

While all the fun was going on, the Judging Committee, led by Dave Sumner, K1ZZ, was already immersed in their job of collecting the logs and beginning to perform the cross checking. Nearly 3400 logs were received from around the world within 6 hours of the end of the contest. These provided the ability to directly cross check more than 50% of the contacts made by the teams. From the logs received, there were 1330 stations that worked the teams on more than 30 bands/modes and 303 that worked all 59 teams.

There was little doubt as to who would win the gold, but the race for the next seven places was extremely close and required thorough log checking. As the Judging Committee worked through the night, the order of finish for 3rd and 4th shifted back and forth as contacts were verified. After working all night and through the next morning, the judges certified the final results.

Closing Ceremony

The closing ceremony took place Monday evening. Once again, the ceremony was broadcast live over the Internet. At this point, no one outside the Judging Committee knew who would win the silver and bronze medals. A video of photos from throughout WRTC2014 week played on the screens while everyone enjoyed dinner. This was followed with a presentation by Rui Amen of Azores Tourism, one of the sponsors for WRTC2014.

The awards began with the team making the most SSB contacts. The winner was K1M operated by Carlo De Mari, IK1HJS, and Fabio Schettino, I4UFH. They had accomplished their goal of winning the SSB award.

The award for highest CW total went to N1S operated by Philippe Lutty, LX2A, and Andy Ruse, YO3JR. This was somewhat unexpected, as LX2A focused mostly on SSB all weekend.

The highest multiplier went to K1A, operated by Daniel Craig, N6MJ, and Chris Hurlbut, KL9A. Certainly no surprise that the team with the highest claimed score was also the one with the highest multiplier.

The award for highest logging accuracy went to the German team of Manfred Wolf, DJ5MW, and Stefan von Baltz, DL1IAO, the operators at W1P. It is a high honor to win this award in an event filled with world-class operators. When the bronze was announced, DJ5MW and DL1IAO returned to the stage with expressions of amazement and joy. Their accuracy had moved them up from 5th in the claimed scores to 3rd after checking!

The silver medal went to the Slovakia team of Rastislav Hrnko, OM3BH, and Jozef Lang, OM3GI, operators of W1L. After three previous attempts at WRTC, they had achieved a place on the podium.

While there was no suspense regarding the gold medal award, the camera flashes and applause reflected the respect that the competitors had for Daniel Craig, N6MJ, and Chris Hurlbut, KL9A, the operators of K1A. Dan had finished 3rd and 2nd in previous WRTC attempts and was now the only person in WRTC history to have one of each type of medal.

The party and conversation continued well into the evening. A very successful WRTC2014 was concluded with one question on everyone's mind, "Where will the WRTC2018 be held?"

Randy Thompson, K5ZD, has been licensed since 1973 at age 13. He is an accomplished contester, having multiple single-operator wins in major DX and domestic events. Randy was a past editor of the *National Contest Journal* and a co-founder of the **eHam.net** website. He is the Director of the CQ World Wide DX Contest and a member of the *CQ Magazine* Contest Hall of Fame. Randy has competed in five World Radiosport Team Championships and served as Vice President for the WRTC2014 organizing committee. When not in front of a radio, Randy is in technical sales for an Internet software company. You can contact Randy at **k5zd@wrtc2014.org**.

Frequency Measuring Test

See how accurately you can measure W1AW/5 this month.

- The Frequency Measuring Test will begin 10:00 PM EST on Wednesday, November 12, 2014 (Thursday, November 13 at 0300 UTC). See the Frequency Measuring Test web page at **www.arrl.org/frequency-measuring-test** for any changes or updates to the test schedule.

- The standard Frequency Measuring Test format will be used, in which a single, unmodulated carrier is transmitted. Information on how to measure the frequency of a carrier is available at **www.k5cm.com**. All transmissions will be made from a single station in Oklahoma (K5CM).

- Submit the measured frequency using the data entry website provided by WA7BNM at **www.b4h.net/fmt/fmtentry.php**. Results will be published immediately following the data entry deadline, which is 10:00 PM EST on Friday, November 14 (Saturday, November 15 at 0300 UTC).

- A Frequency Measuring Test certificate with the call sign W1AW/5 will be available to stations submitting a measured frequency within ±10 Hz of any of the three transmitted frequencies.

ARRL 100 YEARS

— Certificate of Participation —

ARRL Centennial – W1ØØAW/5

April 2014 Frequency Measuring Test

April 10, 2014

This certifies that

Hiram Percy Maxim, W1AW

submitted frequency measurements taken during the April 2014 Frequency Measuring Test. The results are as follows:

Band	Measured Frequency (Hz)	Frequency Error (Hz)	Error (± Parts Per Million)
80m	3,598,137.83	0.09	0.02
40m	7,058,632.07	-0.30	0.04
20m	14,121,134.96	-0.36	0.03

W1ØØAW/5 Transmit Frequencies
80 meters – 3,598,137.74 Hz
40 meters – 7,058,632.37 Hz
20 meters – 14,121,135.32 Hz

K1ZZ
W1AW Station Trustee

Similar to this certificate from the April 2014 FMT, a certificate showing the Frequency Measuring Test call sign W1AW/5 will be provided to stations reporting measurements within 10 Hz of the actual transmission frequency.

Frequency Measuring Test Schedule

Start Wednesday, November 12, 2014 at 10:00 PM EST (November 13 at 0300 UTC).

40 Meters near 7055 kHz	80 Meters near 3598 kHz	160 Meters near 1840 kHz
10:00 call up (3 min)	10:15 call up (3 min)	10:30 call up (3 min)
10:03 key down 2 min)	10:18 key down (2min)	10:33 key down (2 min)
10:05 end announcement	10:20 end announcement	10:35 end announcement

November 2014 W1AW Qualifying Runs

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

W1AW Qualifying Run, 225 Main St, Newington, CT USA 06111

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

November Qualifying Runs will be transmitted by W1AW in Newington, Connecticut at 9 AM EST on Wednesday, November 5 (1400 UTC) and at 7 PM EST on Wednesday, November 26, (0000 UTC, November 27) at 1.8025, 3.5815, 7.0475, 14.0475, 18.0975, 21.0675, 28.0675, and 147.555 MHz. The West Coast Qualifying Runs will be transmitted by K6YR on Wednesday, November 12, at 9 PM PST (0500 UTC November 13) at 3590 kHz. Unless indicated otherwise, sending speeds are from 10 to 40 WPM.

Listen for W1AW Portable Centennial QSO Party Operations in November!

ARRL 100 YEARS

October 29 – November 4	W1AW/1 W1AW/7 W1AW/KP2	Massachusetts Wyoming US Virgin Islands
November 5 – November 11	W1AW/7	Washington
	W1AW/0 W1AW/KH8	Kansas American Samoa
November 12 – November 18	W1AW/1 W1AW/5 W1AW/KH8	Rhode Island Mississippi American Samoa
November 19 – November 25	W1AW/4 W1AW/5	Florida Arkansas
November 26 – December 2	W1AW/3 W1AW/5 W1AW/KP4	Delaware Louisiana Puerto Rico

2014 ARRL 10 Meter Contest

0000 UTC Saturday, December 13 – 2359 UTC Sunday, December 14

A favorite contest that welcomes everybody — from Technicians to Extras, HF newcomers to seasoned veterans. Growing in popularity over the last several years, it's a great opportunity to introduce fellow members of your local club to contesting. You need only a small, simple dipole to work lots of stations, so it's easy to get on the air and see what surprises 10 meters has in store for us.

- The contest is the second full weekend of December. It starts 0000 UTC Saturday (Friday afternoon in North America) and runs through 2359 UTC Sunday (**December 13 – 14, 2014**).
- New categories for 2014 — Single Operator Unlimited, High and Low Power.
- Single operators may enter CW-only, Phone-only, or Mixed mode.
- US and Mexican states, Canadian provinces, and DXCC countries (excluding the US, Mexico, and Canada) count for multiplier credit.

LU/K3ZJ and LW3DG at LW3DG's station in Buenos Aires Province, Argentina during the 2013 10 Meter Contest. [Photo courtesy LW3DG.]

Full rules, multiplier lists, and forms can be found at www.arrl.org/10-meter

2014 ARRL 160 Meter Contest

2200 UTC Friday, December 5 – 1559 UTC Sunday, December 7

Top Band competition returns for the all-CW ARRL 160 Meter Contest! Competitors old and new will compete using everything from elaborate arrays at superstations to simple wire antennas on small city lots. String up that antenna now and get ready for fun on 160 meters!

- The contest starts 2200 UTC Friday and ends at 1559 UTC Sunday (**December 5 – 7, 2014**). This is a 42-hour period with no operating time limits.
- New categories for 2014 — Single Operator Unlimited, High and Low Power.
- Operate using CW only.
- DX stations work stations in ARRL/RAC Sections.
- W/VE stations work stations in ARRL/RAC Sections and DXCC entities.
- KL7, KH0 – KH9 (including KH6), and KP1 – 5 stations count as US sections and may be contacted by DX, US, and VE stations.

WB9Z ops in the 2012 160 Meter Contest included (l-r) Jerry, KE9I; Don K9NR; Val, NV9L; Mike, K9XZ, and Carl, K9CS. Look for the WB9Z station during the 2014 160 Meter Contest operating as W1AW/9! [Jerry Rosalius, WB9Z, photo]

Full rules, multiplier lists, and forms can be found at www.arrl.org/160-meter

Bernie McClenny, W3UR, w3ur@arrl.org

Andaman and Nicobar Islands

One of the rarest of the IOTA islands is coming to the bands this month.

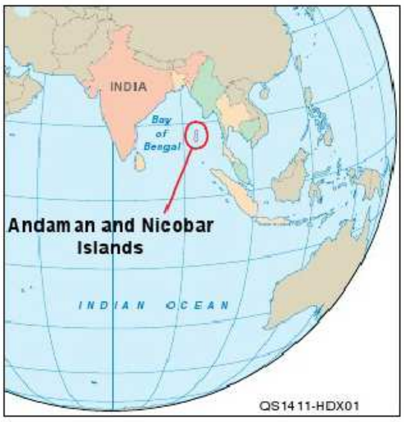
There are some 572 islands, islets, and rocks that make up the union territory of Andaman and Nicobar Islands. At least 36 of the islands are inhabited. Located between the southeastern Bay of Bengal and the Andaman Sea, they are spread out over some 800 kilometers mostly running north to south between 92° and 94° east. Within the union territory there are three districts, which are Nicobar, North and Middle Andaman, and South Andaman. The 2011 census for the territory was just over 380,000 people, with almost 37,000 inhabitants in the Nicobar Islands.

History of the Andaman and Nicobar Islands

It's not exactly clear when the islands were first inhabited, but it is safe to say several thousand years ago, if not more. During the 1014 – 1042 CE time frame, the Indian Tamil Chola dynasty ruler and military leader Rajendra Chola I successfully overtook the region to install a strategic naval base. During the 17th and 18th centuries, the islands served as maritime bases, which were later established as part of India thanks to Admiral Kanhoji Angre.

European colonization (including Denmark, Austria, and England) began to take place in late 1755. The infamous Cellar Jail, which the British used to exile political prisoners, was constructed between 1896 and 1906. During World War II, the Japanese were essentially in control of the islands. On October 7, 1945, both British and Indian forces reoccupied the islands. India became independent in 1947. In 1950 the islands were turned over to India again, and became a union territory in 1956.

Most of our readers will probably remember the devastating tsunami that took place after the Indian Ocean earthquake on December 26, 2004, killing more than 230,000 people throughout 14 different countries. DXers will no doubt also remember that the first and only communications in and out of the Andaman Islands was that of the Andaman DXpedition,VU4NRO, which was operating from the island at the time of the disaster. Shortly after the quake, which was followed by the tsunami, the VU4NRO team of Bharathi (team leader), VU2RBI; Sarath, VU3RSB; Mohan, VU2MYH; Varun, VU3DVS, and Prasad, VU2DBP, earned the gratitude of the region for their vital communications efforts.



Map showing the location of Andaman and Nicobar Islands.

DXCC History

The Andaman and Nicobar Islands were listed on the original DXCC list from November 15, 1945. Currently this DXCC entity uses the VU4 prefix and ranks # 39 worldwide on the Club Log Most Wanted list. In the past the following operations have taken place (year):

G3BMJ/VU4 (1947), VU2ANI (1960, 72, 75, 76), VU2ANI/VU5 (1960), VU2DIA (1966, 67, 68), VU2FBZ (1972), VU2HMD/VU7 (1985), VU2NRA (1965), VU2PB (1947), VU4AN (2006 operators VU2JOS, VU3CHE, VU3JLW, VU3KIE, VU3NZB, VU3NZC, VU3OHA, VU3OHB, VU3PLM, VU3RWN, VU3RWO, VU3RYB, VU3RYC, VU3RYE, VU3RYF, VU3RYG, VU3RYJ, VU3SID, VU3SIE, VU3SIG, and VU3TLY), VU4APR (1987), VU4GDG (1987), VU4K (2014), VU4MY (2008), VU4NRO (1987, 2004), VU4PB (2011), VU4RBI (2004), VU4RG (2008), VU7AN (1981), VU7ANI (1973, 74, 75, 76, 77), VU7GV (1975, 76), and VU9KV (1971).

VU4 — IOTA

The Andaman Islands count as AS-001 and the Nicobar Islands count as AS-033 for the Radio Society of Great Britain (RSGB) Islands on the Air (IOTA) program. Only 5.1% of all IOTA participants have the very rare AS-033 confirmed for this award. There has only been one operation from the Nicobar Islands — VU4NRO, which took place in March 1987. As with previous Andaman and Nicobar DXpeditions, the VU4NRO team used the "double-barreled" call signs VU4NRO/SUS, VU4NRO/BL, VU4NRO/SU, VU4NRO/MY, and VU4NRO/DS, with the last two or three letters indicating the operator. So, for example, VU4NRO/BL was actually VU2BL operating.

Upcoming VU4 DXpedition

As I mentioned in last month's "How's DX?" column, there are currently two VU4 DXpeditions in the works. Members of India's National Institute of Amateur Radio (NIAR) are working on an international DXpedition to the Andaman Islands in the December 2014 – January 2015 time frame. Prior to that, an all-India team has announced plans to activate both the Nicobar Islands (AS-033) with three operators, followed by the same three teaming up with seven more VU operators to activate the Andaman Islands (AS-001) during November.

In early August, I received a telephone call from Krish, W4VKU (aka VU2VKU), to say that he and Pai, VU2PAI, were planning a DXpedition to both halves of the VU4 DXCC entity of the Andaman and Nicobar

Islands. The preliminary details of the upcoming VU4KV DXpedition are as follows:

The last operation from this semi-rare one was a single operator DXpedition by Krish, W4VKU/VU2KVU, operating as VU4K in March of this year. Now members of the 2013 VU7AG Lakshadweep DXpedition are planning to be QRV from both the Andaman (AS-001) and Nicobar Islands (AS-033) in November of this year. They have received the call VU4KV and are hoping to get a second call to distinguish between the two different operating locations. The exact dates have not been announced as of press time.

IOTA AS-033

First, a small team including Krish, W4VKU/VU2VKU; Pai, VU2PAI, and Chetz, VU3DMP; plan to operate from Campbell Bay on Great Nicobar Island (AS-033) from about November 3 – 13. They originally thought they might take a boat, however there is a very strong possibility they will take a helicopter, which would get them there faster. There have only been a handful of valid operations from this very rare IOTA counter with just over 5% of IOTA participants claiming this one.

Due to the rarity of AS-033, the three-man team will put an emphasis on a few bands, working CW and SSB with power and good antennas. Because it is so rare the team is requesting DXers "to avoid working band-fills" to allow IOTA chasers "an opportunity to log their share of one QSO." For equipment, the team plans to have two stations including Elecraft K3 and Kenwood TS-480 transceivers with two KPA-500 amplifiers. They will have a five-band hex beam and a vertical for 40 and 30 meters. A separate QSL card is planned for this operation.

IOTA AS-001

Next, a bigger team plans to operate from Neil Island in the Andaman Islands (AS-001), again using the VU4KV call, sometime around November 15 – 30. They will have five high-power stations. The team members scheduled for this operation will be Krish, W4VKU/VU2VKU; Prasad, VU2PTT; Pai, VU2PAI; Nandu, VU2NKS; Kumar, VU2BGS; Chetz, VU3DMP; Deepak, VU2CDP; Sangeeth, VU2WH/A45WH; Kiran, VU3KPL, and Aravind, VU2ABS.

Plans are to be QRV on all bands from 160 – 6 meters on all modes for at least 10 days. Five stations are expected to be used from Neil Island, including K3, TS-590, and TS-480 transceivers (four on HF and one on 6 meters). As for the antennas, plans are to have phased vertical arrays on 160 – 30 meters with separate receive antennas. On 20 – 10 meters they'll use directional and vertical antennas. They are planning to have five amplifiers, including three KPA-500s and two Acom 1000s.

The Nicobar team expects to have a log search "after the end of the operation" and for the Andaman operation during the DXpedition. QSLing will be handled by W4VKU, including the Online QSL Request Service in December. The operations will require "extensive support from the worldwide DXing fraternity" and those wishing to offer support will be able to use PayPal. The VK4KV website is at **www.vu4kv.info**. Watch the website and your favorite DX news outlet for any updates, as well as **@DAILYDX** on Twitter.

Breaking KP1 — Navassa Island News

Just as I was getting ready to e-mail this month's column to Newington, the KP1-5 Project team announced news about Navassa Island, which ranks number 1 on Club Log's Most Wanted List. According to the KP1-5 Project team:

> The US Fish and Wildlife Service (USFWS) has agreed to allow an Amateur Radio operation from Navassa National Wildlife Refuge (KP1). The operation will occur within the next 18 months and will be coordinated with the USFWS workflow.
>
> Over the past year, the KP1-5 Project has had numerous meetings with various levels of USFWS management. The KP1-5 Project team says that, throughout the discussions, USFWS personnel have been courteous, professional, and cooperative, and that the project has been treated with sincere interest and respect.
>
> As with the Desecheo Island operation in 2009, and in order to be transparent and fair, the USFWS has requested proposals for the Amateur Radio operation from those individuals and groups who have already applied for a Special Use Permit in the past. The KP1-5 Project will be submitting a proposal and is hoping to be selected, as they were for the very successful Desecheo (K5D) operation.

This is indeed some very exciting news, especially for any DXer who started DXing after April 3, 1993. Navassa Island, KP1, is the longest inactive DXCC entity on the current list. It has not been on the air for more than 21 years! If you have never worked Navassa Island, you will not want to miss this one. Watch your favorite DX publication and the KP1-5 website (**kp1-5.com**) to keep up with the latest news on Navassa Island.

Erratum

I am noting a change of plans for the three Czechs heading to Togo, 5V, in late September and early October 2014, which was mentioned in both the September and October "How's DX?" columns. Due to the Ebola outbreak in West Africa, OK6DJ, OK1FPS, and OK1FCJ changed their plans and went to St Eustatius, PJ5, instead. They are still planning to go to Togo in late September of next year.

Tony McClenny, N3ME — SK

Earlier this year my father Tony, N3ME, was diagnosed with a glioblastoma multiforme (GBM) brain tumor, which is the most common and most aggressive kind of malignant brain tumor. Tony became a Silent Key on August 25.

Less than a week before his passing, I mentioned I didn't know what I was going to do for the November "How's DX?" column. Dad and I were in the process of sending a huge box of envelopes with used stamps, from all over the world, to our friend Krish, W4VKU/VU2VKU, who was going to eventually give them to Pai, VU2PAI. Dad suggested, why not write about the upcoming VU4 DXpedition to the Andaman and Nicobar Islands?

This month's column was inspired by, and is likewise dedicated to, my dad — my mentor, Elmer, and best friend, without whom I probably wouldn't have been an Amateur Radio operator, or much less writing this column. Until we have that next QSO in DX Heaven — *Thanks, Dad.*

Wrap Up

That's it for this month with thanks to my dad Tony, N3ME; Krish, W4VKU, and the KP1-5 Project team for helping to make this month's column possible. Don't forget to send your DX news, photos and club newsletters to **w3ur@arrl.org**. Until next month, see you in the pileups! — *Bernie, W3UR*

Jon Jones, N0JK, n0jk@arrl.org

An End-of-Season Look at Trends

The ebb and flow of the good and the bad during this summer's E_s season.

As the summer turned to fall, I reflected on some trends noted on the VHF bands during this summer's E_s season. Some were good, others not so.

Positive

I noted more JT-65a activity for E_s and iono-scatter on 6 meters. This mode allows modest stations to work weak E_s and make DX contacts. Some stations, both DX and stateside, were working split during the openings. Operating "split" — that is, transmitting on one frequency and listening on a different frequency either down or up — is a common practice for HF DXpeditions. Split operation allows callers to hear clearly who the DX station responds to and the DX station can separate callers more easily. It can facilitate contacts during a 6 meter opening. Bo, OX3LX, operated split listening up 1 – 2 kHz, allowing many to make a rare Greenland contact.

Negative

Some "bad habits" I noted included hams calling CQ on a DX Cluster Network spot (discussed by W3UR in the August 2014 "How's DX?" column), "camping out" on the 6 meter call frequency (50.125 MHz) to work stations, and stateside stations working each other in the DX window (50.100 – 50.125 MHz).[1] Keeping the DX window clear of stateside contacts helps everyone, including yourself. It gives you a chance to work DX. W9ZIH noted similar issues with the 70 centimeter call frequency (432.100 MHz). Please keep the call frequency clear during openings.

Several DX stations mentioned receiving e-mails asking "did you get my report OK?" If you have to e-mail or ask on a chat page to verify a contact — you didn't make one.

Remote Internet operation has been a boon to people living in areas restricted by CC&Rs, but it can cause confusion. Consider a California station using an Internet remote in New York to work a 6 meter E_s opening to Europe. Europeans may think they are working a new state or rare grid on the West Coast, but in reality it is New York. Please sign your call to indicate where the remote is. For example, W6***/W2 in this case. Giving the grid locator of the Internet remote station during contacts is helpful to keep matters clear.

K6CS/p in CN71xg

Charlie Swim, K6CS, operated portable this summer on 6 meters on a one-man grid expedition from rare CN71 in California. This is his account:

> My quest to activate CN71 started back around 2011 when I worked a couple of FFMA members from my home station in CN80. Those guys knew I vacation in Orick, California, and asked if I could do portable. I said sure, but all I had was 100 W and a squalo. They said that that would work, but a beam would be better, so I purchased a five-element 6 meter 6M5X.
>
> I took my 16-foot rooftop tower to Bill, N6WAR, and he fabricated a steel bar that attached to two tower legs. This bar pins into my pickup's existing fifth wheel hitch mounts. With the beam and a rotator installed in the tower, my wife Donna, KE6DS, and I can raise the tower into operating position. That was okay for the summer of 2011.
>
> I chatted with Mike, KB7ME, who was in CN71 at the same time in Crescent City. He Elmered me on procedures, which got me my first pileup — *exciting* to say the least! He talked me into getting an amp, which I did the following year. I purchased a 1 kW converted Heathkit SB-221 built by Lou from King Conversions (see Figure 1).
>
> From there, things got better. My wife and I now use a 16-foot car trailer to transport the tower, beam, and a Honda 6500 W generator (see Figure 2). It cost me a chunk of money to do this, but I'm happy to say it is paying off. My sole purpose is to help those seeking the FFMA award get closer to their goal by activating CN71.
>
> Just this past June/July, operating three times, I have handed that grid out to over 300 hams. I consider my best contact to have been Lefty, K1TOL, in Maine. We were blessed that weekend with incredible propagation. I started working California through Texas, Alabama, several in Florida, up to Tennessee, North Carolina, and Maine. Then I rolled back around to Michigan, Illinois, North Dakota, Montana, and Washington. I also had several Canadian contacts.
>
> I knew that Bill, ND0B, was after this grid and I tried 2 years in a row for him, but the propagation didn't cooperate. During this opening, I heard W4TTU/B, which Bob had *just* activated. Knowing this was a straight line to Bill, I texted him to get on the air. Within 10 minutes I worked him via CW and a short time later he was almost 599 on SSB! This was also about the time that Gary, AG0N, called

Figure 1 — Charlie Swim, K6CS, operating 6 meter portable as a one-man grid expedition from rare CN71 in California. [Photo courtesy Charlie Swim, K6CS]

[1]B. McClenny, W3UR, "How's DX?," *QST*, Aug 2014, pp 90-91.

Figure 2 — Charlie's, K6CS, 16 foot car trailer together with his tower and beam. [Charlie Swim, K6CS, photo]

me. He was 20/S9 for almost 2 hours!

Budd, W3FF, of Buddipole has helped me along the way with my setup. We only live 5 miles apart here in Redding and it helps to have a DXer such as Budd for advice. I have a 6 meter beacon in CN71 now at 50.076 thanks to Jim, WA6IO, and Ed, NN6AA. This beacon has been very helpful for those seeking contacts to CN70, 71, 72, and 73.

My friend Chuck, W6ZX, is located in CN72. At the height of prop, we tag-team each other handing out both grids to one contact. If I could work them and they needed CN72, I'd hand them off to Chuck. Mel, KD7DCR, was just one instance on a double-grid contact.

It took me 2 – 3 years of searching, but I finally found the owner of the property I operate from. It has a perfect 360° view of the Pacific Ocean, and a very sharp drop-off for low-angle takeoff. I have my own lock on her gate but have to be careful of the wild elk herd and horses.

It's not bad for a small operation, I think! My wife and I can be set up and operational in just 45 minutes.

N0LL/mm on Princess Cruise to Alaska

Long time 6 meter DXer Larry Lambert, N0LL, went on a Princess Lines cruise to Alaska, June 29 to July 6, 2014. He planned to operate 6 and 2 meters along with several UHF bands. He had some challenges on the trip, including his luggage with antennas, amplifiers, and accessories not making it to the ship. Here is his story:

> The ship's communication officer was Kieren Boyles, and he was fascinated with my CW keyer paddles. He knew Morse code but had never used paddles. I had turned in a letter at the purser's desk, asking for permission to operate and Kieren arrived to give me that permission.
>
> Some of my equipment missed the ship. Kieren felt bad about the situation and he managed to find me some coax. Captain Ronald Wilson also called me on the phone and I explained that some of my equipment didn't make the cruise.
>
> I tried to get the equipment flown to the next port, but wasn't able to arrange it. The wire antenna Kieren helped me put up on the balcony was my last choice. I had this in my luggage from the airplane; what I didn't have was the brick preamp/amplifier, the power supply, four pieces of coax, plus the antennas.
>
> I did have a new Par Yagi for 6 and Barry's, K7BWH, Cushcraft A270S for 2 and 432. I had a dipole for 222 MHz, but never got to make a contact on that band. My FT-736R made the trip in good shape, but something was wrong with the 50 MHz module. It only put out 6 W.
>
> Operating from CO42 on the way up to Alaska, with our stateroom facing west, N7AOK from Wyoming DN62 was coming in good at 0303Z on June 30th, but I could not get his attention. I heard some strong, fast CW on 50.081 MHz, but I didn't get an ID. I also heard the EL15 grid.
>
> On the return trip, our stateroom balcony was on the east side. I heard K5WE (EM25) Oklahoma on CW strong on July 5 at 1849Z from CN69. The W4TTU/B from DN54 Wyoming was in loud several times while I was in CN69 and CN68. VE7DAY was calling CQ on CW 2040 – 2100Z on July 5, but I didn't have enough power to be heard.

On the Bands

50 MHz. I've received more reports of EA8DBM and Europe working the Pacific Northwest in July. K7RWT "worked Alex, EA8DBM, on July 6 at 2002Z, 519. Lou, WA7GCS, also worked EA8DBM on the 6th and WA7GCS and Dan, NN7J, worked EA8YV, EA7KW, and CT1HZE on the 7th." Alex did a remarkable job handing out the Canary Islands this summer. Russ, K6KLY, commented on a massive JA – California opening July 11. It started "about 0415Z to Japan. Started with JE1BMJ as always, but then opened big time on both SSB and CW. K6MYC on 50.105 MHz SSB worked over 100. I worked over 50 on 50.145 MHz."

On August 9 there was a widespread E_s opening with some foreign DX tossed in. K9GY/VP9 was active from Ed's, VP9GE, home and made numerous contacts in W4, W5, W8, W9, and W0 (see Figure 3). Later a strong opening occurred for Pedro, NP4A (FK68), to the midwestern states from 1600 – 1740Z. W0FHK Kansas was able to work NP4A with just a dipole. Wenty, 6Y5WJ, was active from Jamaica and spotted by KC0CF (EN32), K0GU (DN70), and N0IN (EM19) around 1630Z.

Dan, N5TM, was operating as K5N in rare DL99 on the 11th made FSK-441 meteor scatter contacts to the Midwest. N5OMG (EL49) was strong to N0JK (EM28) and XE2OR (DL98) to KF4WE (EM56) at 1520Z via meteor bursts. That evening the main K5N group set up in DM71. E_s popped up, Julian, XE2JS (DL68), was strong at 0155Z August 12 to N0JK (EM28). I heard K5N just as they started on 50.265 MHz FSK, then they switched to SSB. They were fading as the E_s hop was moving out beyond DM71. Bob, K2DRH (EN41), worked them. "K5N was in solid here on FSK so I called SSB and Marshall picked right up on it!" Later K5N had a strong E_s opening to the West Coast working many lucky 6s and 7s until 0510Z.

August 13 was the peak of the Perseid meteor shower. K5N worked many stations in W4, W5, W6, W7, W9, and W0 (see Figure 4). Some wondered if it was E_s or meteor scatter. The Perseids radiant was in an ideal position at 45° elevation for SW – NE meteor scatter paths from 1500 – 1700Z. But sometimes signals were in for longer than a couple of minutes, suggesting to N0LL and K0GU there may have been some E_s in the mix. K5N (DM71) and W1AW/5 (both OK and LA) appeared in many people's logs that morning. From work, I checked several times for K5N from my car on breaks. No luck. I listened one last time at 1525Z and boom! K5N was there calling CQ 59++ on 50.125. "In the log" on the first call but down in the noise and gone after a few minutes. Bob, W4GCB (EM73), caught K5N at 1630Z. As the shower faded,

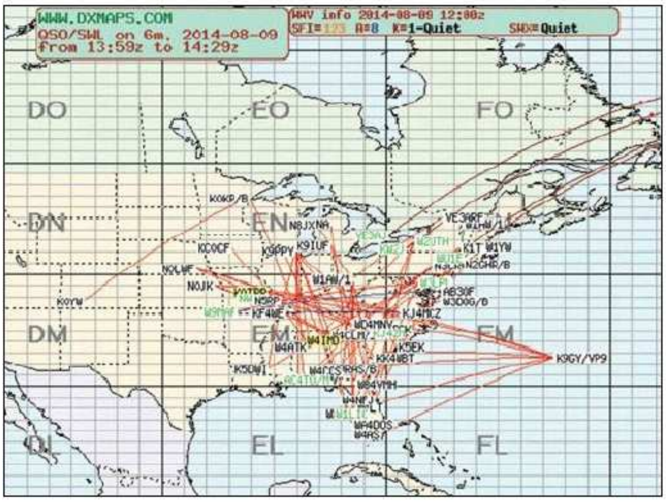


Figure 3 — K9GY/VP9 was active from Ed's, VP9GE, home and made numerous contacts in W4, W5, W8, W9, and W0. **[dxmaps.com]**

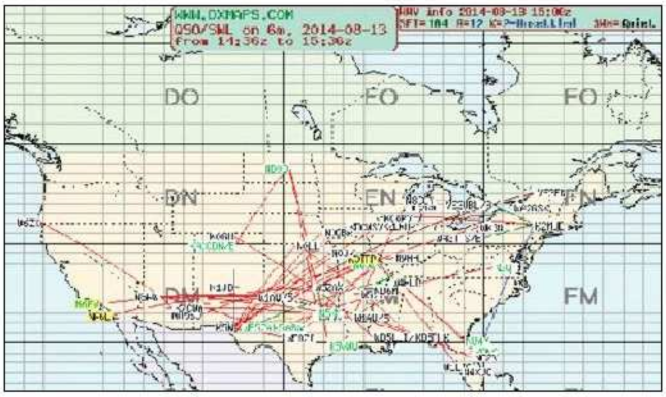


Figure 4 — The Perseid meteor shower peaked on August 13. K5N worked stations almost from coast to coast. **[dxmaps.com]**

K0GU (DN70) worked CT1HZE (IM57) via meteor enhanced E_s at 1929Z.

Strong E_s on August 14 from Pedro, NP4A (FK68), to NG4C (FM16) and stations on the eastern seaboard at around 1330Z. XE2JS (DL68) was in to N0LL (EM09), W4HLR (EM56), and N0JK (EM28) on E_s at 1455Z. E_s was spotted by K0GU (DN70) upon hearing K4TQR/b (EM63) and N8PUM/b (EN66) at 1520Z. Paul, K7CW (CN87), worked W4UDH (EM52) via double hop E_s at 1545Z. Paul notes that during major meteor showers "double hop" meteor scatter contacts may occur on 6 meters off of two long-lasting, well-placed bursts.

On August 15, a strong E_s opening occurred from the Midwest to Texas. K5WLT (EL19), KA5WZY (EL18), KH6MB/W5 (EM20), and others were in for hours. Jay, W9RM (DM59), was strong for N0JK (EM28) at 1615Z. Jay, K0GU (DN70), worked a rare late season opening to Japan 2330 – 0030Z August 16. JA9SJI spotted Jay 579 at 2359Z.

A weak CME impact occurred August 19/20 from a CME erupting on August 15. Aurora E_s from the Pacific Northwest to VE8WD/b (DP22) were spotted. Jim, K6MIO/KH6, notes:

> It is common for the number of eruptive events, such as flares and CMEs, to persist in the decline of the solar cycle. The northern solar hemisphere broadly peaked in the second part of 2011 and the first quarter of 2012. Flare activity in the north continued to outpace the south, especially the X-class events, until about June 2013. Since then, the flare activity in the south has been considerably outpacing the north. The August 15 CME was also in the southern solar hemisphere.

On the 27th, KA9CFD (EN40) worked CX9AU (GF15) via E_s – TEP at 2227Z. CX9AU earlier spotted the WZ8D/b (EM89) at 2222Z.

144 MHz. KF6A (EN73) worked W0WOI (EN22) on tropo August 10. W4LES (EM84) worked Dan, N5TM/K5N (DL99), via meteors on the 11th at 1120Z. K2DRH (EN41) also worked Dan "with solid tones on FSK. They thought it was tropo but more likely iono-scatter at about 950 miles." On the morning of August 12, Sam, K5SW (EM25), worked KA1ZE/3 (FN01), W3IP (FM19), and KB3TNZ (FN11) around 1230Z via SSB on random meteor bursts. Newcomer Brad, KB3TNZ, said the "highlight of the week is catching K5SW SSB on a meteor trail!" Most meteor scatter activity nowadays is via WSJT. During shower peaks, consider trying CW or SSB.

The K5N (DM71) group made 36 EME contacts, perhaps helped by the "super full moon," using their portable station on 2 meters including CT1HZE at 0524Z August 14:

K5N DM71 051700 0 −26 2.9 −73 3 *
K5N CT1HZE IM57 5

CT1HZE 052400 1 −27 1.4 156 3 #
CT1HZE K5N DM71 000

222 MHz. K5SW (EM25) worked the following stations during the ARRL UHF contest: WB5AFY (EM04), W0RT (EM27), AA5AM (EM13), KB0HH (EM06), KC5DPT (EM16), and KF0M (EM17). Jay, NY2NY (FN30), reports a successful Perseids meteor scatter contact with WA4NJP (EM84) on August 13 at 0330Z.

432 MHz. W0RT (EM27) worked KB0HH (EM06), K5SW (EM25), and KF0M (EM17) in the UHF contest. N7DB Oregon notes contest activity from WW7D/r CN85/86.

1296 MHz. Sam, K5SW (EM25), logged contest contacts with WB5AFY (EM04), W0RT (EM27), KB0HH (EM06), and W7QJQ (EM25).

Here and There

Shelby Ennis, W8WN, notes that John, K4IXC, is now SK. He was very active on meteor scatter from Florida.

Operators Chris, PA2CHR (Z21CHR); Lins, PA3CMC (Z21CMC); John, ZS6JON (Z21EME), and Paul, ZS6NK (Z21NK), will be active on an EME DXpedition to Zimbabwe as Z21EME, November 1 – 8. Activity will be on 6 and 2 meters as well as 70 and 23 centimeters. — Thanks *Ohio/Penn DX Bulletin*, #1168, 27 Jun 2014.

Rick Lindquist, WW1ME, ww1me@arrl.org

Global Amateur Radio Emergency Communications Conference 2014 Takes a Technological Tack

The 2014 Global Amateur Radio Emergency Communications Conference (GAREC 2014) held August 14 – 15 in Huntsville, Alabama, and hosted by the ARRL Alabama Section and the Huntsville Hamfest, offered an opportunity for participants to share presentations and perspectives from around the globe. Greg Sarratt, W4OZK, organized this year's GAREC event, which focused on the application of advanced technologies in emergency communication.

(L-R) IARU Region 1 Emergency Communications Coordinator Greg Mossop, G0DUB, Greg Sarratt, W4OZK, and Johnny Tan, 9M8DB, observe as The Salvation Army's Bill Feist, WB8BZH, demonstrates the SATERN remote station control system. [Photo courtesy of Greg Sarratt, W4OZK]

"GAREC 2014 participants included Amateur Radio operators from around the world who are highly dedicated to emergency communication," Sarratt said. "GAREC participants realized that the role of Amateur Radio in emergency communication is constantly changing and that we must continue to adapt to the needs of our partner served agencies, including embracing emerging technologies and new challenges, in order to remain relevant and provide the high level of service our partners have come to rely on."

Delegates attended from all three International Amateur Radio Union (IARU) regions. In addition to hearing IARU regional reports, attendees took part in a "desktop" exercise. Presentations covered the use of Amateur Radio's emergency communication role as a tool to help promote Amateur Radio, The Salvation Army Team Emergency Radio Network (SATERN) program, employment of digital modes and remote station control, the deployment of the Military Auxiliary Radio Service (MARS) for humanitarian assistance and disaster relief, and a combined Emergency Services Dispatch Center to provide interoperability.

Emerging themes included the importance of regularly reaching out to served agencies to ensure that their communication needs are being met and to promote Amateur Radio as a trusted emergency response partner.

The second day of the conference concentrated on emerging and advanced technologies. "Participants shared information about recent disasters and how advanced technologies are playing a critical role in Amateur Radio emergency communication," Sarratt said.

Reports on emergency and disaster situations in which Amateur Radio played a crucial role included Typhoon Haiyan in the Philippines and flooding in Brazil and Thailand. Delegates reaffirmed that disaster response needs differ from one country to another, to reflect the local and regional landscape. They also agreed that while the IARU HF *Emergency Message Procedures*, including net procedure and messaging and activation protocols, should provide a baseline standard among countries and regions, these should not replace existing standard operating procedures.

The 10th GAREC Conference next June will mark a return to the location of the first — Tampere, Finland. — *Thanks to Greg Sarratt, W4OZK, and Jim Linton, VK3PC*

Radio Amateurs Named to Order of Canada

Two radio amateurs were among those recently named to the Order of Canada — the third-highest award in Canada — to recognize outstanding merit or distinguished service.

Telecommunications researcher Veena Rawat, VA3ITU, was honored as a "Companion of the Order of Canada" for contributions to telecommunications engineering and for her leadership in establishing a global regulatory framework for radio spectrum management. She has served as president of the Communications Research Centre at Industry Canada and as a vice president at Research in Motion. Rawat chaired the World Radiocommunication Conference in 2003 and was instrumental in resolving the 40 meter "harmonization" issue that led to shifting international broadcasters from part of the 7 MHz band.

Canadian astronaut Chris Hadfield, VA3OOG/KC5RNJ, was honored as an "Officer of the Order of Canada" for "his commitment to promoting scientific discovery and for sharing the wonders of space exploration with the world." Hadfield was the International Space Station Expedition 35 commander during his 2013 duty tour.

A Legacy of Magic

A strong sense of optimism and wonder is essential for the future of Amateur Radio.

Dr Glenn Johnson, W0GJ
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My great-grandfather was happy as a hotel desk clerk until someone challenged him to become a doctor, which he did! He set up practice in a small Iowa town and made house calls with his horse, buggy, and black bag. He had no electricity (initially). I've seen his "income" ledger, which noted very little cash flow, and payments made with produce, chickens, and other interesting things. His only diagnostic tools were his senses and his mind.

My great-grandfather died in 1942. If he were alive today, he would have been in awe of the laboratory and imaging diagnostics we take for granted. He would also be astounded at the medications and procedures routinely used to improve the quality of our lives.

After the World Radiosport Team Championship (WRTC) in July of this year, our family visited our ancestral cemetery in Sandwich, Massachusetts, on Cape Cod. Most of those buried there arrived shortly after the *Mayflower,* and died in the late 1600s. I used my iPhone to take pictures of the gravestones, which were instantly seen by my father 1500 miles away. Can you imagine what they would think of that technology? The word "witchcraft" comes to mind.

Recently, the 150th anniversary issue of *Scientific American* magazine reviewed the astounding advances of scientific knowledge. At the same time, the editors speculated that devices that will be commonplace 50 years from now have yet to be invented, much less even dreamed about. This is no doubt true. In my great-grandfather's time he marveled at how the pen and quill were replaced with the typewriter, and how lanterns were replaced with electric lights. Today we enjoy almost instantaneous multimedia communication in most places throughout the world. I'm sure my great grandfather could not have conceived of this either, or, as a physician, dreamed of robotic surgery, which is a standard of care in many hospitals today. As the late Arthur C. Clarke said, "Any sufficiently advanced technology is indistinguishable from magic."

Throughout the ARRL Centennial Year, *QST* is sharing the thoughts of selected members as they consider the current state of Amateur Radio and the future of our avocation at the dawn of its second century.

When I became a ham 49 years ago, the *magic* of radio — the ability to communicate with others worldwide with a few crystals, a couple of watts and a wire in the trees — was what hooked me into this hobby. Jump ahead almost half a century and you have a world where the radios are software defined, with antennas connected directly to microprocessors. The magic is still there; only the technology has changed.

The Next 100 Years

Can you imagine what is in store for the next 50 years, much less what we'll be using at the end of the second century of Amateur Radio? With ever-faster processing power, the expansion of nanotechnology (that is an oxymoron!), and manipulation of the laws of physics, the possibilities are mind boggling indeed.

Will we have ultra-high-speed digitized voice and data on all bands? Will contesting rates exceed 1000 Qs or more per hour? How will the contest and DX rules change? Will the Moon and Mars count for multipliers and DXCC entities? We cannot imagine the technology, much less the rules.

Keep the Excitement Alive

Don't laugh, but several decades ago, on our first or second date, I showed my then-girlfriend my HF slow-scan TV station. A ham in Peru put his camera out the window to show a beautiful mountain panorama with clouds in the valley. That girl was so impressed with the magic of radio, she ended up marrying me. This year is our 40th anniversary and we still love ham radio ...and each other! Our four kids are hams, and the two who are married have ham spouses.

My father, WD0GOS, was a ham and for years kept twice-daily schedules with his friends on 20 meters from his home in Iowa. My wife or I would check in with him almost daily when we lived in Alaska.

One of his friends, Ralph, WB1AEI, was chief pilot of the Woods Hole Oceanographic Institution's deep sea submarine *Alvin*. We were chatting with my father when Ralph came on frequency, so excited he could hardly talk. That was the day they discovered geothermal vents in the deep Pacific, each supporting incredible ecosystems totally unknown to the scientific world. I'll never forget that day. A few years later, when the *Alvin* was overhauled, our family came into possession of a piece of *Alvin*'s fin — what a "QSL card" to remember!

I am proud to be a Life Member of the ARRL and a contributor to the Maxim Society. It is my effort to help ensure that our legacy lives. Oh, that I could be alive 50 and 100 years from now to see what our hobby is like! I'm sure the technology will be mind-boggling.

One thing I hope that never changes is the personal and humanitarian side of Amateur Radio, the global community of knowledge and friendship. I would encourage everyone who reads this to support the League and consider a legacy gift to the ARRL, as my wife and I have done. No gift is too small.

The Drake TR-7 Transceiver

From the late '70s through the mid '80s, the TR-7 was one of the most coveted amateur transceivers in the world.

Steve Ford, WB8IMY
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Thirty-seven years ago disco music was at its peak, Jimmy Carter was President of the United States, today's median-age ARRL members were young men and women fresh out of high school or college, and the R.L. Drake Company of Miamisburg, Ohio released its revolutionary TR-7 transceiver.

If you were a ham in 1977, you could hardly have missed the debut of the TR-7. You would likely have been familiar with the Drake name, a venerable technology firm founded by Robert L. Drake in 1943. The company had already established a reputation for making high-quality communication equipment. In fact, it is accurate to say that at that point in history, Drake was one of the most widely respected Amateur Radio equipment manufacturers in the world.

A Drake TR-7 transceiver atop the PS-7 power supply. [Photo courtesy of Universal Radio]

So it wasn't all that surprising that Drake would create a new product that would effectively dismantle the old vacuum tube (or tube/transistor hybrid) paradigm. In the TR-7 we saw the world's first 100 W all-solid state Amateur Radio transceiver. The TR-7 was a true game changer that would have an enormous impact on all transceiver designs to follow.

A Rig Like No Other

QST advertisements of the day trumpeted the appearance of the new TR-7 in all its colorful glory. From the beginning the TR-7 was considered not only a high-performance transceiver, but also a status symbol. Owning a TR-7 conferred "elite" status on the fortunate ham, especially considering the fact that TR-7s carried suggested list prices of $1500, which is about $4200 today. You'll occasionally encounter used TR-7s being sold on Internet auction sites such as eBay, but they still command prices of $1500 and up.

The TR-7 was rated at 250 W PEP *input* power, which was the required specification at the time. This translated into output power levels between 130 and 150 W on the lower bands and 90 and 100 W on 15 and 10 meters. The transceiver included a protection circuit that reduced output in the presence of an excessive SWR. That's a common feature in today's radios, but it was decidedly uncommon at the time.

If you installed the optional FA-7 cooling fan, the TR-7 could transmit at full output with 100% duty cycle modes such as RTTY. Compare that capability with many modern rigs that still caution owners to reduce output by 50% with most digital modes.

An innovative feature of the TR-7 design was its "broadbandedness." There was no need to adjust preselectors and other controls when changing frequencies across its 1.5 to 30 MHz range. Hams of the day were accustomed to having to twist various knobs to "peak" a radio when moving from one band to another. Not so with the TR-7. It was the first transceiver of its type to offer simple pushbutton band changes — the type of operation we all take for granted today.

Another hallmark of the TR-7 was its high-performance frequency synthesizer and Permeability Tuned Oscillator (PTO). The result was smooth tuning with a 1 kHz analog dial and a 100 Hz digital readout. The frequency synthesizer provided tuning ranges in 500 kHz steps selectable with UP and DOWN front panel buttons.

Upconversion and Full Passband Tuning

In the TR-7 Drake unveiled the first use of "upconversion" technology for amateur transceivers. In a typical superheterodyne receiver, the incoming signal is mixed with a local oscillator signal to create *sum* and *difference* signals. The higher sum frequency is rejected while the lower difference (or "downconverted") frequency — often anywhere from 455 kHz to 10 MHz — is sent to the IF amplifier stages

How Does the TR-7 Compare to Today's Radios?

Bob Allison, WB1GCM, ARRL Senior Test Engineer

Thirty-seven years ago, the Drake TR-7 was considered to be one of the best-performing HF transceivers on the market. Its innovative use of upconversion (first IF at 48 MHz) gave the flexibility of general coverage reception with superior IF and image rejection. A four-pole crystal filter placed at the first IF, with a bandwidth of 8 kHz, minimizes the effect of strong signals with improved Third-Order Intermodulation Distortion Dynamic Range (IMD DR) and Blocking Gain Compression Dynamic Range (BDR). It is also one of the first examples of the use of a roofing filter. The TR-7's second IF filters of 300, 1800, 2300 (standard), and 6000 Hz bandwidths are equivalent to today's DSP filter bandwidth settings of today's mid-range and top of the line receivers, though not as flexible. Solid state circuitry, with 100 W RF output on 160 through 10 meters, simplified operation; all the user has to do is change bands. How does the Drake TR-7's performance compare to today's transceiver performance?

QST reviewed the Drake TR-7 in the May 1979 issue (pages 37 and 38). At that time, the ARRL Laboratory only performed limited testing and the methods of testing differ from those used now, so I will rely on input from ARRL Laboratory consultant and test expert Rob Sherwood, NC0B. Rob's website at **www.sherweng.com/table.html** is an excellent source of receiver test data, including data for the TR-7.

Rob's data shows a noise floor figure of –134 dBm, which is normally lower than the background noise level with an antenna. This figure is quite comparable to today's noise floor figures for most transceivers, though it would be nice to have a bit more sensitivity for weak signal work on 10 meters.

At 100 kHz spacing, a BDR of 145 dB shows the effectiveness of the first IF filter and with 20 kHz spacing. This would be on par with today's mid-range transceivers. Rob's data shows an IMD DR figure of 99 dB, which is also very good at 100 kHz spacing, and would likely equate to 90 dB or higher of IMD DR at 20 kHz spacing. While good, it is not the best when compared to modern rigs. The TR-7's 75 dB figure of IMD DR with 2 kHz spacing is considered only fair among current radios, but it is by no means the worst we've seen in the Lab. The true limiting factor of the Drake TR-7 is the local oscillator sideband noise, indicating the Reciprocal Mixing Dynamic Range (RMDR) would be the most limiting of all dynamic ranges.

With a modest antenna system, a properly aligned Drake TR-7 is a good performer, even by today's standards. If you'd like to dig deeper into the meanings of these test results, I recommend my book, *Amateur Radio Transceiver Performance Testing*, which you can purchase from the ARRL at **www.arrl.org/shop**.

for additional processing and, potentially, further downconversion.

The upconversion approach turned that process on its head. The Drake engineers discovered that they could eliminate annoying image products by upconverting the output of the high-level double-balanced mixer and placing the first IF stage at 48 MHz, well outside the tuning range of the rig itself. Combined with carefully designed filtering in the IF stages, the result was receiver performance that exceeded that of virtually all other transceivers available at the time.

The TR-7 upconversion architecture was designed specifically to deal with crowded conditions where selectivity and dynamic range performance become critical. Compared to the highly regarded Drake R-4C receiver, the new TR-7 easily surpassed its two-tone dynamic range performance on all bands. This raised quite a few eyebrows in the amateur community.

Another innovation to appear in the TR-7 was full passband tuning, known simply as *PBT*. This wasn't the same as the as limited passband tuning, sometimes referred to as *IF Shift*, offered in many other transceivers at that time. Unlike traditional IF Shift, which moved the IF filter window relative to the signal, the TR-7's PBT did the opposite. The Drake PBT effectively shifted the "position" of the received signal within the bandwidth of a selected IF filter. The TR-7 accomplished this through the use of a voltage-controlled crystal oscillator, the output of which controlled the second Local Oscillator.

The TR-7 shipped with a standard 2.3 kHz crystal IF filter. However, it could accommodate optional filters at 1800, 500, and 300 Hz.

The TR-7 and the "WARC Bands"

Two years after the introduction of the TR-7, the 1979 World Administrative Radio Conference (WARC) brought substantial changes to Amateur Radio. In the wake of the conference, hams would eventually gain access to new HF bands at 30, 17, and 12 meters. However, most transceivers available at the time could not operate on the new frequencies.

The Drake TR-7 was the exception. TR-7 owners could use the optional AUX7 board to easily expand the transceiver's coverage to include the WARC bands. With the AUX7 users could program up to eight auxiliary 500 kHz frequency range modules (known as RTM7s) for instant selection from the front panel. In addition, a crystal socket was provided on the AUX7 for each of the eight auxiliary ranges to allow fixed-frequency receive or transmit operation. Back in the day, you had to provide proof of your amateur license before Drake would sell you an RTM7 module, which could be programmed at the factory for the range you specified. Obviously, with three RTM7 modules you could have access to all the new bands.

R.L. Drake Today

Drake exited the Amateur Radio equipment market before the turn of the century, although it continued to produce the R8 shortwave receiver until 2005. By the mid-'80s Drake had become a powerful force in the consumer and commercial satellite TV market, which finally led to its high-profile position as a manufacturer of standard and high-definition video encoders, video distribution devices and digital TV reception systems.

Blonder Tongue Laboratories acquired Drake in February 2012. However, the companies operate as separate entities with Blonder Tongue headquartered in Old Bridge, New Jersey and Drake retaining its offices in Miamisburg, Ohio.

Convention and Hamfest Calendar

Gail Iannone, giannone@arrl.org; www.arrl.org/hamfests-and-conventions-calendar

Abbreviations

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

Arizona (Congress) — Nov 15 D F H R T V
7 AM – noon. *Spr:* Hassayampa ARK. North Ranch Escapees RV Park, 30625 S Hwy 89. *TI:* 146.58. *Adm:* Free. Doug Jarmuth, N0DAJ, 928-231-2616; **n0daj1950@gmail.com**; **www.arca-az.org/main/calendar.html**.

Arizona (Mesa) — Dec 6 D H Q R T V
7 AM – 2 PM. *Spr:* Superstition ARC. Mesa Community College, 1833 W Southern Ave. *TI:* 147.12 (162.2 Hz). *Adm:* $5. Dan DeVlieger, KG7EOL, 480-335-4914; **kg7eol@arrl.net**; **superstition superfest.com**.

Florida (Coral Gables) — Nov 15 F T
7 AM – noon. *Sprs:* Flamingo Net and University of Miami ARC. University of Miami, Physics/Gifford Arboretum Parking Lot, 5101 San Amaro Dr. *TI:* 147.15 (94.8 Hz). *Adm:* Free. Bill Moore, WA4TEJ, 305-751-1874; **wa4tej@juno.com**; **www.flamingonet.8m.net**.

Florida (Ocala) — Dec 6 D H T
7 AM – 1 PM. *Spr:* Silver Springs RC. Green Clover Hall, 319 SE 26th Terr. *TI:* 146.61 (123 Hz). *Adm:* Free. Roger Staley, K4ZFW, 352-427-3437; **k4gso2012@gmail.com**; **k4gso.us**.

Florida (Okeechobee) — Nov 29
D F H R T V
7 AM – 3 PM. *Spr:* Okeechobee ARC. Freedom Ranch, 11655 US Hwy 441 SE. "Hamfest in the Woods." *TI:* 147.195 (100 Hz). *Adm:* $5. Charles Whipple, W4PHD, 863-467-2487; **charles.whipple4@gmail.com**; **K4OKE.com**.

INDIANA STATE CONVENTION

November 15 – 16, Fort Wayne, IN

D F H Q R S V
Saturday 9 AM – 4 PM, Sunday 9 AM – noon. *Spr:* Allen County AR Technical Society. Allen County War Memorial Coliseum, 4000 Parnell Ave. 42nd Annual Fort Wayne Hamfest and Computer Expo *TI:* 146.88. *Adm:* $6 for both days or $4 for just Sunday (at the door only), under 12 free with adult. AC-ARTS/Fort Wayne Hamfest, 260-579-2196; **chairman@fortwaynehamfest.com**; **www.fortwaynehamfest.com**.

Maryland (Davidsonville) — Oct 19 F R T
7 AM, Auction at noon. *Spr:* Mid Atlantic Antique Radio Club. Davidsonville Family Recreation Center, 3789 Queen Anne Bridge Rd. Equipment Auction. *Adm:* Free. Bruce Pellicot, KA3EIE, 410-461-7441; **brucepellicot.md@netzero.net**; **www.maarc.org**.

Massachusetts (Bourne) — Nov 8
D F H R T V
9 AM – noon. *Spr:* Falmouth ARA. Upper Cape Regional Vocational School, 220 Sandwich Rd. *TI:* 146.655 (88.5 Hz). *Adm:* $5. Ralph Swenson, N1YHS, 508-548-0422; **depsher911@comcast.net**; **www.falara.org**.

Michigan (Harrison Township) — Dec 7
D F H R V
8 AM – noon. *Spr:* L'Anse Creuse ARC. L'Anse Creuse High School, 38495 L'Anse Creuse Rd. *TI:* 147.08 (100 Hz). *Adm:* $5. Gregg Crump, N8GEO, 248-670-7021; **n8geo@arrl.net**; **www.qsl.net/n8lc/**.

Mississippi (Biloxi) — Nov 14 – 15
D F H Q R S V
Friday 5 – 9 PM, Saturday 8 AM – 3 PM. *Spr:* Jackson County ARA. St Martin Community Center, 15008 Lemoyne Blvd. *TI:* 145.11 (123 Hz). *Adm:* $5. Chris Swift, K5MOZ, 228-826-4116; **k5moz@arrl.net**; **www.jcmsara.com**.

New Jersey (Fair Lawn) — Nov 28 H R
6:30 PM. *Spr:* Fair Lawn ARC. Fair Lawn Senior Citizen Center, 11-05 Gardiner Rd. Amateur Radio Auction. *TI:* 145.47 (107.2 Hz). *Adm:* Free. Gene Ottenheimer, WO2W, 201-791-3841; **w2npt@arrl.net**; **www.flarc.net**.

New Jersey (Toms River) — Nov 16
D F H R T
8 AM – noon. *Spr:* Jersey Shore ARS. Riverwood Park, Riverwood Dr. *TI:* 146.91 (127.3 Hz). *Adm:* $5. Don McGlaughlin, K2HCW, 732-237-9448; **k2hcw@comcast.net**; **JSARS.org**.

North Carolina (Benson) — Nov 16
D F H R T V
8 AM – 3 PM. Spr: Johnston ARS. American Legion Complex, Hwy 301 N. TI: 147.27. Adm: advance $6, door $7. Michael Callam, KD4UJC, 919-934-9623; **jarsmember@yahoo.com**; **www.jars.net.**

Texas (Lubbock) — Oct 18 F H R T
8 AM – 5 PM. *Spr:* Lubbock ARC. Noble Stidham Memorial Clubhouse and Grounds, 1110 98th St. *TI:* 147.2. *Adm:* Free. Rodney Davis, W3LDR, 251-895-4235; **president@k5lib.org**; **www.k5lib.org/2014-larc-hamfest**.

Wisconsin (Appleton) — Nov 2 D F H R V
8 AM. *Spr:* Fox Cities ARC. Monarch Gardens, 2311 W Spencer St. *TI:* 146.76 (100 Hz). *Adm:* advance $5, door $6. Anthony Mach, AB9IO, 920-722-0482; **ab9io@yahoo.com**; **www.fcarc.us/hamfest.php**.

Wisconsin (Milwaukee) — Nov 1 D H R
8 AM – 1 PM. *Spr:* Milwaukee Repeater Club. Elks Lodge, 5555 W Good Hope Rd. *TI:* 146.91 (127.3 Hz). *Adm:* $5. Matt Moog, KC9COY, 414-254-2849; **kc9coy@themoog.com**; **www.mrc91.org**.

Coming ARRL Conventions

October 18
Arkansas State Convention, Batesville, AR*
Wisconsin ARES/RACES Conference, Wisconsin Rapids, WI*

October 24 – 25
Oklahoma Section Convention, Ardmore, OK*

November 1
TechFest Convention, Lakewood, CO*

November 1 – 2
Georgia State Convention, Lawrenceville, GA*

November 8
Alabama State Convention, Montgomery, AL*

November 15 – 16
Indiana State Convention, Fort Wayne, IN

December 12 – 13
West Central Florida Section Convention, Plant City, FL

January 4
New York City/Long Island Section Convention, Bethpage, NY

January 10
Techfest Convention, Lawrenceville, GA

*See October *QST* for details.

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

To All Event Sponsors

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

Events that are sanctioned by the ARRL receive special benefits, including an announcement in these listings and online. Sanctioned conventions are also listed in the *ARRL Letter.* In addition, events receive donated ARRL prize certificates and handouts.

For hamfests: Once the form has been submitted, your ARRL Director will decide whether to approve the date and provide ARRL sanction. *For conventions:* Approval must come from your Director and the ARRL Executive Committee.

The deadline for receipt of items for this column is the **1st of the second month preceding publication date**. For example, your information must arrive at HQ by **November 1** to be listed in the **January** issue. Information in this column is accurate as of our deadline; contact the sponsor or check the sponsor's website for possible late changes, for driving directions and for other event details. Please note that postal regulations prohibit mention in *QST* of games of chance such as raffles or bingo.

Promoting your event is guaranteed to increase attendance. As an approved event sponsor, you are entitled to special discounted rates on *QST* display advertising and ARRL web banner advertising. Call the ARRL Advertising Desk at 860-594-0207, or e-mail **ads@arrl.org**.

Special Event Stations

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

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

Oct 12 – Oct 17, 1000Z-1700Z, KK4OCL/AA4P, Moultrie, GA. Moultrie Technical College Amateur Radio Club/Colquitt County Ham Radio Society. **Sunbelt Agricultural Exposition** 21.300 14.280 7.200. Certificate & QSL. Andrew T. Clark, 5402 Old Adel Rd, Moultrie, GA 31788. **www.wd4kow.org**

Oct 15 – Oct 18, 1430Z – 0600Z, WB8RC, Pahrump, NV. WBCCI-ARC/Region 12. **First Annual Region 12 Airstream Rally ARC Event**. 14.265; 7.250 (backup); 7.245 (main). QSL. Roger Peeples, 765 Farrell St, Woodland, CA 95695. *See URL for times/frequencies.* **region12.wbcci.net/about/2014-region-12-rally/pahrump-r12-ham-events**

Oct 17 – Oct 19, 1600Z – 1600Z, N3G, Port Penn, DE. US Coast Guard Auxiliary. **75th Anniversary US Coast Guard Auxiliary**. 146.520 14.070 14.059 7.039. QSL. Robin M Begley, 3 Pancoast Ave, Aston, PA 19014. *Air mobile on 146.520 MHz activating Old Reedy Island Light USA-568. Operating HF CW & PSK31, SSB if band conditions allow. QSL via N3CJM.* **n351ba@comcast.net**

Oct 18, 1400Z – 2200Z, N4Z, Anderson (Portman Marina), SC. USCG AUX District 7 Flotilla 25 Lake Hartwell. **Commemorating US Coast Guard Auxiliary 75th Anniversary**. 21.330 14.270 7.270. QSL. Joe Mracna, AA3XE, 113 Abaco Ln, Seneca, SC 29672. **a0700205.uscgaux.info**

Oct 18, 1400Z – 2300Z, N4U, Benton, KY. Coast Guard Auxiliary. **Coast Guard Auxiliary 75th Anniversary**. 21.070 14.070. QSL. Mary Husfield, 4156 Barge Island Rd, Benton, KY 42025. *Operating mostly PSK31; maybe some phone on 20 meters.*

Oct 25, 1600Z – 2100Z, WE7GV, Green Valley, AZ. Green Valley Amateur Radio Club. **50th Annual Green Valley White Elephant Parade**. 14.246 14.244 14.242. Certificate & QSL. Green Valley Amateur Radio Club, 601 N La Canada Dr (SAV), Green Valley, AZ 85614. **gvarc.us**

Oct 25 – Nov 2, 1400Z – 2300Z, W0O, Frankenstein, MO. Mid-MO Amateur Radio Club. **Frankenstein 2014 Halloween FunExpedition**. 3.963 3.535. QSL. Kent W. Trimble, K9ZTV, 2210 Heartland Ridge, Jefferson City, MO 65109. *Operating CW-SSB-digital; frequencies spotted.*

Oct 26 – Oct 27, 1500Z – 2300Z, K0R, Kansas City, MO. Sons of Confederate Veterans. **Battle of Westport Memorial**. 14.230 14.050 7.230 7.050. QSL. Jason Peck, 626 Fickinger St, Sulphur Springs, AR 72768.

Oct 31 – Nov 2, 1300Z – 2200Z, K4ZK, Stuart, FL. Martin County Amateur Radio Association. **Stuart Air Show/40th Anniversary of Martin County Amateur Radio Association**. 21.280 14.280. Certificate. MCARA, PO Box 1901, Stuart, FL 34996. **www.mcaraweb.com**

Oct 31 – Nov 2, 2200Z – 2200Z, N1A, Tuscaloosa, AL. W4UAL & Alumni. **Alabama Crimson Tide Special Event**. 28.425 14.247 7.188 3.821. QSL. M.D. Smith WA4DXP, 307 Clinton Ave, Ste 100, Huntsville, AL 35801. *Will also be on 2 meter repeater 145.21, IRLP Node # 4719.* **www.31alumni.com/ham**

Nov 1, 1200Z – 2359Z, AA4XG/W4AQL, Atlanta, GA. Georgia Tech Alumni Amateur Radio Club. **Georgia Tech Homecoming**. 14.250 7.250. QSL. Sherman Banks, 2310 Kings Point Dr, Atlanta, GA 30338. *Students will activate W4AQL and alumni members AA4XG from the campus of Georgia Tech.* **aa4xg.com**

Nov 1, 1200Z – 2400Z, KC5OUR, Belen, NM. Valencia Country Amateur Radio Association. **20th Year Anniversary**. 28.483 21.283 14.283 7.283. QSL. KC5OUR, PO Box 268, Peralta, NM 87042. *Custom QSL card with SASE only; LoTW good for DX contacts.* **www.qrz.com/db/kc5our**

Nov 1 – Nov 2, 0000Z – 2359Z, various calls, North America. 630/600-Meter Operators. **106th Anniversary of the Berlin Treaty**. US: 465 – 480 kHz and 495 – 510 kHz; Canada: 472 – 429 kHz. QSL. *The Berlin Treaty created the international distress frequency at 500 kHz. Event includes US experimental, Canadian amateur and US heritage maritime stations. See URL for complete details.* **www.500kc.com**

Nov 1 – Nov 2, 1500Z – 2345Z, W0JH, Two Harbors, MN. Stillwater Amateur Radio Association, Courage Kenny Handiham System & Radio City. **Remembering the Edmund Fitzgerald (Split Rock Lighthouse)**. 14.260 7.260 21.360 3.860. Certificate. Stillwater Amateur Radio Assoc, W0JH, via **splitrock2014@radioham.org**. *Certificates will only be sent via e-mail in PDF format. Operating SSB and digital modes from Split Rock Lighthouse, Split Rock, MN (ARLHS: USA 783; Grid Square: EN47).* **www.radioham.org**

Nov 8, 1000Z – 1400Z, W4BUG, Pompano Beach, FL. Gold Coast Amateur Radio Association. **Hillsboro Lighthouse Special Event**. 14.240 14.220 14.200 14.180. QSL. Gold Coast Amateur Radio Association, PO Box 773, Pompano Beach, FL 33060. **www.w4bug.org**

Nov 8, 1100Z – 1700Z, WC5C, Azle, TX. Tri-County Amateur Radio Club of North Texas. **NCTECH Hamfest Anniversary Station**. CTCSS 147.160+ 110.9; 7.260. QSL. Daryl Pate, KC5SLQ, 6225 Featherwind, Fort Worth, TX 76135. **www.wc5c.org**

Nov 8, 1300Z – 2100Z, W5SLA, Slidell, LA. Ozone Amateur Radio Club. **50th Birthday Celebration**. 18.145 7.283. Certificate & QSL. Ozone Amateur Radio Club, PO Box 553, Slidell, LA 70458. **www.w5sla.net**

Nov 8, 1500Z – 2200Z, W0FSB, Waterloo, IA. Five Sullivan Brothers Amateur Radio Club. **Honoring Veterans for Veterans Day**. 18.124 14.240 7.240. Certificate & QSL. Five Sullivan Bros ARC, 3186 Brandon Diagonal Blvd, Brandon, IA 52210. *For QSL card: Send card and #10 SASE; For Certificate & QSL: Send QSL, address label and three "Forever" stamps; For eQSL & Certificate: Send eQSL, then an e-mail to* **w0fsb@outlook.com**, *requesting a .jpg file of the certificate that you can print yourself.* **www.qrz.com/db/w0fsb**

Nov 8, 1500Z – 2300Z, W9V, Hopedale, IL. Peoria Area Amateur Radio Club. **Veteran's Day Commemoration**. 28.445 21.345 14.245 7.245. QSL. Peoria Amateur Radio Club, PO Box 3508, Peoria, IL 61612. **www.w9uvi.org**

Nov 8, 1600Z – 2200Z, N4F, Dadeville, AL. The Smith Mountain Group. **Smith Mountain Fire Tower Anniversary**. 14.325 7.205. Certificate & QSL. N4F, 44 Timberwood Dr, Dadeville, AL 36853. *See website for QSL info and updates on bands & frequencies.* **www.kc4z.com**

Nov 8 – Nov 9, 1400Z – 2100Z, NB9QV, Manitowoc, WI. USS *Cobia* Amateur Radio Club. **USS *Cobia* World War II Sub Celebrating Vets Day and Commemorating the 52 Subs and Their Crew Members Lost in World War II**. 14.250 7.240. QSL. Fred Neuenfeldt, W6BSF, 4932 S 10th St, Manitowoc, WI 54220. **www.qrz.com/db/nb9qv**

Nov 9, 1600Z – 2000Z, WE7GV, Sahuarita, AZ. Green Valley Amateur Radio Club. **150th Anniversary of Pima County, Arizona**. 14.246 14.244 14.242. Certificate & QSL. Green Valley Amateur Radio Club, 601 N La Canada Dr (SAV), Green Valley, AZ 85614. **gvarc.us**

Nov 11, 1000Z – 1800Z, W4NPT, North Port, FL. The North Port Amateur Radio Club. **Veterans Day Special Event**. 14.230. QSL. The North Port Amateur Radio Club, PO Box 7716, North Port, FL 34290. **www.w4npt.org**

Nov 11, 1400Z – 2100Z, W9L, Indianapolis, IN. The American Legion Amateur Radio Club. **Veterans Day Tribute**. 14.275 146.460 IRLP Node 4816. Certificate. The American Legion Amateur Radio Club (TALARC), c/o The American Legion Nat'l HQ, 700 N Pennsylvania S, Indianapolis, IN 46204. **www.legion.org/hamradio**

Nov 11, 1600Z – 1900Z, KC2UFO, Merritt Island, FL. Skywatchers and Communicators Amateur Radio Club. **Veterans Day at the Veterans Memorial Center**. 14.265. Certificate. *E-certificate only, see website. We ask callers to share their military service stories and experiences.* **www.kc2ufo.org**

Nov 15 – Nov 16, 1800Z-0600Z, W6SFM, Carmichael, CA. Samuel F. Morse Amateur Radio Club. **W6SFM Bug Round Up**. 28.045 21.045 14.045 7.045 3.540. QSL. Mike Aretsky, N6MQL, 5443 Tierra Gardens Ln, Carmichael, CA 95608. **www.w6sfm.com**

Nov 15 – Nov 23, 0500Z – 0500Z, W1G, East Berlin, PA. WO4L. **151st Anniversary of *The Lincoln's Gettysburg Address***. 24.945 18.150 14.260 7.185 other bands as prop allows. Certificate & QSL. Bob Hess, 74 Curtis Dr, East Berlin, PA 17316. See website for QSL/certificate instructions. **www.qrz.com/db/wo4l** or **www.qrz.com/db/w1g**

Nov 17, 1500Z – 2400Z, K7NRA, Paulden, AZ. Yavapai Amateur Radio Club. **NRA 143rd Birthday Party**. 21.335 14.250 14.050 7.250. Certificate. Yavapai Amateur Radio Club, PO Box 11994, Prescott Valley, AZ 86314. **www.w7yrc.org/special_events.htm**

Nov 21 – Nov 24, 1800Z – 0000Z, KC9HYY/WSL3, Muskego, WI. **98th Anniversary of HMHS *Britannic* Sinking**. 28.365 21.265 14.265 7.165. QSL. Nathan Banks, Attn: HMHS SES, PO Box 324, Muskego, WI 53150. **kc9hyy@yahoo.com** *or* **www.qrz.com/db/kc9hyy**

Nov 22, 1000Z – 1800Z, W9TY, Orland Park, IL. Metro DX Club. **35th Anniversary**. 14.265 7.230. Certificate. John Holmes, 3820 N Chamlin Dr, Morris, IL 60450. *E-certificate available at* **w9ty@arrl.net**. **www.metrodxclub.com**

Nov 22 – Nov 23, 0000Z – 2359Z, W6OI, Burlington, WI. Ten-Ten International. **W6OI and VE9TEN and DL0X Special Event.** All modes, 10 meters. QSL. Jerry Kopstein for W6OI QSL, 8041 W Lakeshore Dr, Burlington, WI 53105. *Ten-Ten International club stations W6OI, VE9TEN, and DL0X will be in operation from all US call areas, in Canada, and Germany to keep 10 meters active, to promote 10-10 International Organization, and to have fun. Special Event QSL cards available on request. For contacts with W6OI send SASE to N9AC, Jerry. For further information contact N9AC.* **www.ten-ten.org**

Nov 22 – Nov 23, 1313Z – 2222Z, W4YBV, Steinhatchee, FL. W4YBV. **Turkey Islands for Thanksgiving Expedition**. 28.370 21.240 14.260 7.260. QSL. Terry Joyner, PO Box 881, Steinhatchee, FL 32359. *Two new islands way down upon the Suwannee River. Contacts will also count toward the US Islands Awards Program* **www.usislands.org**. **w4ybv@yahoo.com**

Nov 29 – Nov 30, 0720Z – 0720Z, N4S, Franklin, TN. Williamson County ARES. **Battle of Franklin**, TN. 21.310 14.260 7.220 3.850; gen portions of most bands. Certificate & QSL.* Jeff Standifer, 111 Gilbert Dr, Franklin, TN 37064. **wb5waj@arrl.net**

Nov 29 – Nov 30, 1300Z – 1900Z, NI1X, Plymouth, MA. Whitman Amateur Radio Club. **The First Pilgrim Landing at Plymouth**. 18.160 14.260 7.260 3.860; EchoLink: WA1NPO-R, IRLP:8691. Certificate & QSL. Whitman ARC, PO Box 48, Whitman, MA 02382. **www.wa1npo.org**

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 **Jan** *QST* would have to be received by **Nov 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. ARRL reserves the right to exclude events of a commercial or political nature.

Special Events listed in this issue include current events received through Sep 8. You can view all received Special Events at **www.arrl.org/special-event-stations**.

Silent Keys

Silent Keys Administrator, sk@arrl.org

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

N1ATC **Evans**, John B., Maryville, TN
KA1AVA **Dresner**, William W. Jr, Middleboro, MA
WA1BWS **Burnham**, Roger L., Bangor, ME
WB1EEY **Bourque**, Edward E. Sr, Manchester, NH
♦W1FDH **Anderson**, Jack G., College Station, TX
KA1GNB **Mahlecke**, Andreas G., Pawtucket, RI
K1HKI **DeForge**, Robert L., Brookfield, VT
KA1LGK **Callahan**, Lydia J., Manchester, NH
WA1MXM **Legowski**, Florence L., Rocky Hill, CT
W1NZP **James**, Philip G., Groton, CT
KB1OWT **Charles**, Seymour W., Skowhegan, ME
W1PIE **Sawyer**, David E., Portsmouth, NH
N1RP **Perkins**, Richard E., Nobleboro, ME
W1RPK **Pollard**, Kenworth G., Windsor, VT
W1RRP **Brown**, Richard B. III, Medway, MA
KB1SOL **Riling**, Jack W., Southbury, CT
KB1SQS **Kelley**, Malcolm C., Stamford, CT
♦W1TEE **Kowalewski**, Eugene M., Vancouver, WA
W1TMC **Howard**, James K., Scituate, MA
KB1TO **Gibson**, Richard C., Surry, ME
N1VEB **Winson**, David S., Rochester, NH
W1WAW **Walker**, William, Ocala, VT
KB1WWV **Smith**, Robert J., North Attleboro, MA
K1YCQ **Piette**, Byron J., Somerset, MA
K1YSY **Sneed**, Peter A., Prospect, ME
KA1ZZS **Lawhorne**, Preston, Hope Valley, RI
K2CZ **Chodkowski**, Steven, Binghamton, NY
K2DFZ **Field**, Dudley B., Onancock, VA
W2DHH **Metter**, Harold, Pompano Beach, FL
KF2EF **Coughran**, Albert R., Jackson, NJ
W2EKD **Breinin**, Goodwin M., New York, NY
KC2ELC **Damiano**, Daniel, Hammonton, NJ
WA2EXQ **Montcalm**, Lloyd S., Hyannis, MA
WB2FOC **McCarthy**, Robert V., Oaklyn, NJ
W2FOR **Merry**, John M., Melbourne Village, FL
WA2HPD **McEowen**, James R., Severna Park, MD
KB2HTV **Mahan**, Leo J., Wanaque, NJ
K2GKM **Fredericks**, Duane G., Lockport, NY
K2GVI **Effland**, William L., Westmoreland, NY
W2HGT **Anzalone**, Salvatore, Cape May Court House, NJ
K2HPT **Soper**, Charles E., Syracuse, NY
W2JUE **Mackvick**, Eugene A., Raleigh, NC
WA2LEE **Schutt**, Harold L., Clifton Springs, NY
KC2LZV **Dannelley**, Donald R., Elmira, NY
N2MC **Cooper**, Marvin R., Calhoun, GA
W2ME **Archibald**, John O. Jr, East Aurora, NY
WB2MWD **Fillman**, A. D., Manahawkin, NJ
W2QNR **DiBlasi**, John S., Manchester, NJ
KC2RIS **Mokides**, Valerie S., Huntington, NY
KB2TSV **Matheson**, Jeffrey I., Lumberton, NJ
N2UD **Handy**, Brian N., Bozeman, MT
W2UXH **Sambalino**, John C., Haddonfield, NJ
W2VZQ **Cola**, Andrew A., South Ozone Park, NY
KB2WGE **Gilmartin**, James J., Saugerties, NY
W2XK **Casa**, Thomas J., Auburn, NY
W2YRD **Baab**, Peter T., Summit, NJ
W2ZZC **Metzger**, H. P., Boulder, CO
♦W3AAF **Vivino**, A. E., Walkersville, MD
WB3COS **Baum**, Robert S., Johnstown, PA
W3EJK **Morris**, Robert E., Spring Branch, TX
K3FFR **Muney**, William S., Lanham, MD
WA3GJH **Szymanowicz**, Joseph M., Erie, PA
KB3JKR **Wick**, William R. Jr, Downington, PA
W3JPG **Jenkins**, Joseph M., Baltimore, MD
KB3KP **Hilf**, Kenneth F., Ohio Township, PA
WA3MDY **Dolaway**, David W., Bradford, PA
♦N3ME **McClenny**, Anthony B., Bethany Beach, DE
WA3NSR **Gipe**, Robert C., White Hall, MD
N3OMP **Starkey**, William J., Wilmington, DE
W3OOP **Harper**, Mark G., Little Orleans, MD
♦W3PTV **Hively**, Henry L., Pittsburgh, PA
W3PUD **Reiss**, Lillian T., Exton, PA
N3PXV **Kibler**, Richard J., Cosby, TN
KC3QU **Hankinson**, A. Hank E., Lillian, AL
W3SWK **Kinley**, Stephen W., Howard, PA
K3UJC **Brimer**, Clifton P., Crisfield, MD
K4ALL **Lambert**, Arlin L. II, Concord, GA
N4ARW **Waters**, Alfred R., Washington, NC
♦K4ASF **Watkins**, Lindy, Fayette, AL
KF4AX **Lello**, Joseph M., Dahlonega, GA
KK4BYY **Batten**, Gary W., Swansboro, NC
AA4CA **Cason**, Robert E., Spartanburg, SC
W4CGK **Wagoner**, Sydney S. Jr, Fairfax, VA
K4CPQ **Rasnake**, Cecil M., Fort Pierce, FL
♦W4CZ **Price**, William David., Blountville, TN
N4ECA **Barrett**, Maxine, Ringgold, GA
KG4FFP **Walters**, Dibbon C. Jr, Reevesville, SC
N4FJW **Wickwire**, Franklin Jack, Bushnell, FL
K4FQR **Long**, Allen C., Greensboro, NC
WA4FWR **Thompson**, Ross E. G. Jr, Satellite Beach, FL
WB4GJD **Nail**, David M., Chattanooga, TN
W4GWB **Blevins**, George W. Jr, Rossville, GA
K4GWL **Bond**, William R. Jr, Palmyra, VA
N4HDY **Nowling**, Harvey D. Jr, Mobile, AL
KF4HFU **Frimel**, Robert L., Clarksville, TN
K4HIX **Peel**, David L., Flower Mound, TX
WD4HRP **Williams**, John F., Largo, FL
♦K4HTY **Kay**, E. D. Jr, Portsmouth, VA
KK4HXA **Taylor**, Rodney S., Taylors, SC
KE4IDB **Elliott**, Rufus D., Signal Mountain, TN
AE4IE **Pond**, William R., Warrior, AL
KB4JF **Wetherington**, Curtis, Nashville, GA
KC4JKQ **Showker**, Doug, Lizella, GA
KD4JOW **Tedford**, Walter E., New Bern, NC
W4KKX **Houser**, Jean P., Maysville, KY
KG4KUJ **Bowden**, Jerry L., Eatonton, GA
WB4KVZ **Hooker**, David L., Chattanooga, TN
W4LMH **Hudgins**, Lewis M., Kill Devil Hills, NC
N4LIU **Austin**, Alice A., Ooltewah, TN
KE4LZK **Beard**, Kenneth D., Glasgow, KY
AK4M **Collins**, Robert I., Daphne, AL
W4MCE **McKenzie**, Robert G., Panama City, FL
K4MQI **Grigsby**, William H., Cleveland, TN
W4NOJ **Smith**, William E., Owensboro, KY
WB4MRH **Bowers**, Warren W., Gloucester, VA
KA4NPK **Lakeman**, Robert B., Merritt Island, FL
WD4NVH **Kerins**, James B., Hartselle, AL
KE4NVN **Hamilton**, John W., Saint Petersburg, FL
AI4OD **Coulter**, Robert B. Jr, The Villages, FL
KJ4OJT **Hedden**, Christopher, Franklin, TN
K4ONB **Mangano**, Joseph N., Nashville, TN
♦W4OTR **Clarke**, Victor E., Coral Gables, FL
N4OXM **Woerz**, Melvin W., Ocoee, FL
N4PRJ **Bruhn**, James T., Ozark, AL
W4PWR **Croom**, William D., Savannah, GA
♦K4PY **Hernandez**, Celimo F., Miami, FL

WB4QAC	**Kluwe**, George E. Jr, Ormond Beach, FL
KE4QEB	**Harriman**, Garry D., Mount Airy, NC
KB4RIU	**Morris**, Robert L., Lexington, KY
♦KG4RJM	**Neff**, Catherine P., Bethlehem, GA
K4SEQ	**Morgan**, Norman E., Oliver Springs, TN
WB4TLQ	**Coleman**, Stuart H., Fairhope, AL
WB4TP	**Penson**, Tom R., Marion, NC
K4TRY	**Doelger**, Michael M., Fair Haven, NJ
KB4TTX	**Nanney**, Robert F., Rutherfordton, NC
W4UQM	**Jacobsen**, Charles H., Ormond Beach, FL
W4WIJ	**Hord**, William J., Fort Walton Beach, FL
KB4XW	**Smith**, Jerrol D., Chattanooga, TN
W4YLH	**Whisnant**, William C., Geneva, AL
KC4ZVU	**Callan**, John F., Orlando, FL
W5AEW	**Windham**, Anse E., Kingsville, TX
♦W5AFR	**Bazzell**, John S., Longview, TX
♦W5BQO	**Murphy**, Claude I. Jr, Dodson, LA
N5DCF	**Stiles**, Victor V. Jr, Fort Worth, TX
W5DEM	**Hassell**, Andrew M., Dallas, TX
♦K5ELN	**Hastings**, Walter E., Jackson, MS
WD5ELU	**Baker**, Don P., Benton, LA
W5FIT	**Musgrove**, Sanford A., Kingsland, TX
WB5FXD	**Carey**, Willis E., Brownwood, TX
♦KE5GKK	**Poindexter**, Tom, Grand Prairie, TX
♦W5GXH	**Gordon**, James H., Seminole, FL
KF5HVB	**Armantrout**, Robert J., Granbury, TX
W5HW	**Winship**, Harry A. Jr, San Antonio, TX
K5HWQ	**Hammitt**, Raymond W., Arlington, TX
K5HZL	**Carpenter**, Hazel L., Springtown, TX
♦W5ILY	**Price**, Earl P. Jr, Fort Worth, TX
WS5J	**Woods**, Gary P., Cleburne, TX
W5JCB	**Black**, Elmo, Oklahoma City, OK
KI5JE	**Williams**, Edward A., Mesquite, TX
K5JFJ	**Young**, Julia E., Farmers Branch, TX
KD5JWJ	**Turnbow**, Danny E., Big Lake, TX
W5KDD	**McCutcheon**, Bill, Dallas, TX
W5KX	**Matthews**, Roy M., San Juan Capistrano, CA
WW5L	**Anderson**, Thomas L. Jr, Colleyville, TX
KG5LB	**Taylor**, James F., Los Alamos, NM
♦W5LCN	**Linthacum**, James W., Corpus Christi, TX
AD5M	**Middleton**, Morris H., Eupora, MS
NA5M	**Vincent**, Britton T. Jr, Dallas, TX
W5MDJ	**Belson**, James M., Oklahoma City, OK
WA5MZK	**Sherron**, Hubert Gene., Gulf Shores, AL
W5OSG	**Dounson**, Pepos S., San Antonio, TX
KC5PAV	**Town**, Eugene A., Altus, OK
N5PTR	**Gorman**, Edmund T. III, Lumberton, MS
N5QA	**Pattan**, Paul C. Sr, Port Allen, LA
N5QLW	**McAdam**, John E., Dallas, TX
N5RAW	**Nagel**, Steven R., Houston, TX
♦WA5RIO	**Haro**, Emile G. III, Metairie, LA
KC5TMV	**Krebs**, Carl A., Shreveport, LA
♦W5VTA	**Pflug**, Andrew P., Rio Rancho, NM
KD5WT	**Holcombe**, Billy F. Sr, Lufkin, TX
W5WTT	**Tibbles**, Walt T., Mesquite, TX
KD5WYU	**Willcox**, Brent D., Lewisville, TX
W5YGX	**Yarbrough**, Virgil R., Springfield, MO
W5ZEX	**Brown**, Mackie N., Willis, TX
♦W5ZGZ	**Calhoun**, Cecil R., Waxahachie, TX
K5ZL	**Shaw**, Stanley D., El Paso, TX
♦W6AE	**Stillman**, Thomas H., Squaw Valley, CA
KF6BAS	**Lin**, Paul M., Van Nuys, CA
W6CGB	**Brooks**, Cary G., Los Angeles, CA
KF6CL	**Reeks**, Harold O., Fresno, CA
♦WB6CYX	**McGuffey**, Gale W., San Diego, CA
K6DZT	**Harsin**, Donald W., Claremont, CA
WB6EVG	**Lange**, Lawrence T. Jr, San Jose, CA
W6FTV	**Falls**, Edward L., Fallbrook, CA
WA6GCR	**Alexander**, Robert W., Seal Beach, CA
W6HMD	**Johnson**, Letha I., Esparto, CA
WB6ISA	**Storne**, Wilma L., Gridley, CA
♦WB6IZB	**Dodero**, Barbara J., San Diego, CA
KG6KKT	**Ruzicka**, Lee M., Goleta, CA
WA6KSZ	**Hood**, Joseph V., Citrus Heights, CA
AD6LW	**Curran**, Roy W., Buellton, CA
K6LYT	**Nudson**, Kenneth H., Redding, CA
W6MI	**Simmons**, Warren A., San Diego, CA
W6MQ	**Groce**, John C., Prescott, AZ
N6NND	**Daugherty**, Ralph F., Grass Valley, CA
K6OHM	**Thompson**, John, Tustin, CA
KD6OZH	**Stephensen**, John B., Fresno, CA
♦N6QD	**Harton**, John P., Port Angeles, WA
♦K6RXU	**Silvern**, Leonard C., Clarkdale, AZ
KA6SCL	**Miller**, Stephen D., San Jose, CA
WA6SOI	**Morton**, Robert W., Elk Grove, CA
W6SYY	**McClure**, Andrew E., Red Bluff, CA
W6TCG	**Wallace**, William H. II, Long Beach, CA
W6UNF	**Biondi**, Walter E., San Francisco, CA
K6USI	**Bradley**, Burton N., Mission Viejo, CA
K6VBQ	**Snyder**, Barry V., Huntington Beach, CA
KM6VN	**Cope**, Jerald C., Delaware, OH
♦K6VW	**Coleman**, Thomas J., Arcadia, CA
W6WRJ	**Wilson**, John, Los Banos, CA
N6WT	**Moore**, James J., Bakersfield, CA
KG6ZO	**Sutton**, William R., Fresno, CA
W6ZOO	**Carruth**, Leroy V., Bellflower, CA
WA7AVI	**O'Sullivan**, Patrick D., Everett, WA
KK7BM	**Phipps**, Edward L., Chino Valley, AZ
WL7BNW	**Yerks**, Lawrence E., Anchorage, AK
♦AL7C	**Fromm**, Alfred J., Bartlesville, OK
KL7CUS	**Brown**, Frederic E., Fairbanks, AK
KC7CYL	**Methven**, Eugene R., Renton, WA
KS7DX	**Garratt**, Barry D., Las Vegas, NV
N7FLA	**Countryman**, Charles E., Spokane, WA
K7FP	**Piskur**, Frank T., Seattle, WA
N7HSD	**Cunningham**, Merton A., Las Vegas, NV
KE7IEE	**Honey**, Dick B. Jr, Portland, OR
KI7JA	**Junkin**, Bruce A., Portland, OR
W7JFD	**Wolfe**, Raymond G., Redmond, WA
W7JHM	**Spencer**, Carl V., Salt Lake City, UT
W7JNT	**Osterhaug**, Thomas A., Seattle, WA
KE7JTG	**Turley**, Glenae, Holladay, UT
♦W7KCJ	**Anderson**, Richard W., Port Townsend, WA
W7KIN	**Weichel**, Paul V., Santa Rosa, CA
W7LAP	**Saari**, Norris, Tukwila, WA
♦W7MKH	**Lambrecht**, Donald W., Ocean, NJ
KF7MLX	**Speed**, Thelma G., Phoenix, AZ
K7OZU	**Linn**, Orlie, Saco, MT
AE7PY	**Pierrard**, John M., Sun City, AZ
K7QAJ	**Geehan**, John W. Jr, Bellingham, WA
W7QAN	**Nelson**, Blaire G., Idaho Falls, ID
N7QCO	**Catterlin**, Richard L., Belgrade, MT
W7QHR	**Jensen**, William G., College Place, WA
KB7QVS	**Parmele**, Richard C., McMinnville, TN
K7SMP	**Knemeyer**, Emelyn M., Kent, WA
K7TT	**Hatley**, James P., Renton, WA
N7UHJ	**Emery**, Edwin P., Great Falls, MT
K7UKD	**Bruce**, Alan J., Scappoose, OR
KB7USM	**Settle**, Ivan R., Tucson, AZ
W7VDW	**Hiatt**, Theron D., Aloha, OR
W7VLG	**Morgan**, Dolores E., Albany, OR
♦W7WDL	**Schur**, Gene B. Sr, Cheney, WA
W7ZEL	**Perkins**, Forrest M., Enumclaw, WA
W7ZEM	**Cook**, James H., Tigard, OR
KB8AF	**Ricketts**, Robert L., Kalkaska, MI
♦KO8B	**Bassette**, Caesar S., Cincinnati, OH
K8BGP	**Ronning**, Russell J., Spring Lake, MI
W8BML	**Kiefaber**, Myron F., Canton, OH
♦WD8CAA	**Momberg**, Howard E. Jr, Cincinnati, OH
WB8DMF	**Edie**, Harold E. Sr, New Philadelphia, OH
W8EAX	**Jacob**, Fred M., Fort Myers, FL
W8FMH	**Hoover**, Floyd M., Mansfield, OH
♦W8HSI	**Wellman**, H. James, Cincinnati, OH
N8IID	**Fahle**, Steven P., Bellefontaine, OH
N8IOJ	**Dean**, Donald R., Fredericktown, OH
WB8IXV	**Pulsifer**, Robert L., Muskegon, MI
W8IYI	**Mayer**, John L., Bloomfield, MI
N8JEG	**Gaffney**, James E., Baltimore, OH
W8KDW	**Nuss**, Raymond J., Doylestown, OH
KA8KME	**Crosby**, Earl W., Brookville, OH
N8KPM	**Faulkner**, Robert L., Chillicothe, OH
K8LOY	**Ricketson**, Ronald W. Sr, Byron Center, MI
WB8MJW	**Lyons**, Donald H., Chillicothe, OH
♦K8PEP	**Phelps**, Paul E., Grand Rapids, MI
AA8PI	**MacPhee**, Donald F., Kalamazoo, MI
W8PIU	**Sabetto**, Onerio L., Lyndhurst, OH
K8REM	**Morris**, Frederick E., Lima, OH
N8RMY	**Courtney**, William W. Jr, Parkersburg, WV
KC8SDS	**Hahn**, Harry W. III, Kalamazoo, MI
W8TBU	**Garrett**, Roy T., Marysville, MI
KC8TJ	**Blake**, Richard H., Huntington, WV
W8TWO	**Alexander**, Richard L., Warren, OH
W8UEL	**Ketcham**, Arthur R., Toledo, OH
KD8YC	**Alexander**, William R. Jr, Toledo, OH
KG9BC	**Eggert**, Hollis, Green Bay, WI
N9BCY	**Cook**, William D., New Smyrna Beach, FL
♦WB9CER	**Timmerman**, David L., New Castle, IN
K9CFG	**Buehler**, Ervin R., Galveston, IN
W9CM	**McGuyer**, Clifford C., Evansville, IN
WA9CMR	**Martner**, William O., Aurora, IL
KA9DYJ	**McKeehan**, William R., Joliet, IL
W9EFD	**Costello**, Louis B., Niles, IL
W9ESD	**Coats**, Robert B., Costa Mesa, CA
AA9JI	**Kilgore**, Robert A., Westfield, IN
W9KC	**Dragoo**, John Steve., Seneca, SC
WA9KFR	**Stasiowski**, Walter A., Port Washington, WI
K9KJM	**Meyer**, Kenneth J., Sturgeon Bay, WI
KC9KQF	**Goldberg**, Michael L., Skokie, IL
W9MBO	**Hall**, Jack L., Danvers, IL
KB9MZ	**Unwin**, Arthur H., Bloomington, IL
W9NJH	**Bade**, Raymond P., Madison, WI
WB9NLI	**Diggs**, William E., Woodstock, IL
AB9OB	**Turner**, Robert D., Joliet, IL
KA9POX	**Osell**, Liel B., De Pere, WI
♦W9PVD	**Lauder**, Gordon, Webster, WI
K9RJZ	**Belter**, Richard A., Rolling Meadows, IL
KB9RPB	**Dixon**, Edward E., Indianapolis, IN
KA9SSB	**Alport**, Bertram J., Niles, IL
WA9SZY	**Kahle**, William W., Yorkville, IL
W9ZJA	**Blodgett**, Benjamin F. Jr, Danbury, WI
KF0BA	**Easley**, Forest N., Gainesville, MO
KB0CDD	**Shaw**, Billie C., Independence, MO
KG0CJ	**Preglers**, Robert L., Dubuque, IA
♦W0DLQ	**Shapiro**, Eugene, Kansas City, MO
W0DRB	**Linn**, J. D., Baldwin City, KS
♦N0DT	**Copeland**, Daniel T., Springfield, MO
AA0HQ	**Steele**, Thomas S., Saint Paul, MN
W0KGJ	**Lang**, Robert H., Fayette, MO
♦WA0LEM	**Buchanan**, Warren W., Kansas City, MO
W0LMA	**Caswell**, Robert V., Broomfield, CO
AC0M	**Christensen**, Cleo M., Shalimar, FL
WA0MJT	**Morris**, Robert S., Overland, MO
K0MWC	**Bergmann**, Delford J., Minneapolis, MN
WB0NAL	**Robinson**, Helen F., Boulder, CO
♦N0NO	**Boller**, Stephen E., Excelsior, MN
♦WA0OQA	**Gilcrease**, Richard, Scott City, KS
W0OV	**Cain**, Carl L., Maplewood, MN
KC0PDY	**Elliot**, James B., Overland Park, KS
K0QEP	**Parker**, Ray F., Allison, IA
♦WB0QGH	**Baldwin**, Dale, De Soto, KS
W0QI	**Wales**, Wendell O., Richfield, MN
KB0QLH	**Houseman**, Jo A., Springfield, MO
K0QQW	**Fleming**, Donald A., Worthington, MN
K0RES	**Scott**, Marshall M., Grand Junction, CO
W0RHT	**Booen**, Sherman P., Richfield, MN
KB0RMF	**Clark**, Robert D., Shawnee, OK
W0RPO	**Post**, Terry L., South Bend, IN
KB0RZC	**McDaniel**, William D., Kansas City, MO
KC0VPL	**Robinson**, James R., Ballwin, MO
N0WF	**Flearl**, Warren J., Omaha, NE
WA0WVR	**Schieffert**, Rose A., Mounds View, MN
W0YHG	**Brown**, Mary S., Littleton, CO
WB0ZAY	**Scott**, J. N., Kearney, MO
VE3BZB	**Pierce**, Gordon F., Peterborough, ON, Canada
VE3SV	**Boyd**, Robert N., Kingston, ON, Canada
KB4IEE	**Vandenbelt**, Arnold R., Orleans, ON, Canada
VE6BAT	**Tymchuk**, William A., Edmonton, AB, Canada
♦SM0BDS	**Forsberg**, Lars, Jarfalla, Sweden

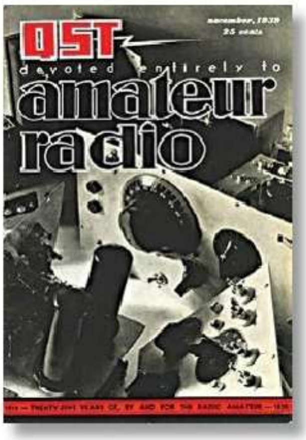
♦ Life Member, ARRL

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.

75, 50, and 25 Years Ago

Al Brogdon, W1AB

November 1939



- The cover photo shows an attractive array of homebrew equipment.
- The editorial points out that hams should not try to be "radio detectives," intercepting messages from Germany and forwarding them to US authorities — a breach of the secrecy of communications laws.
- Arthur Lynch, W2DKJ, gives us "More Thoughts of Effective Antennas," including proven designs for 20, 10, and 5 meters; beam supports; and how to tune the array.
- Also looking at 5 meters, Edwin Sanders, ex-W1EDY, tells about "Stacking Coaxial Antennas" to make a four-element collinear array.
- Frank Jones, W6AJF, and Frank Edmonds, W2DIY, tell readers about "Cathode Modulation."
- Charley Winkler, W9AKC, gives us "Pointers on Design and Adjustment of High-Efficiency Grid-Modulated Amplifiers,"
- "A Single-Control Wide-Range Tank Circuit" that covers three bands with a constant L/C ratio is presented by T. M. Ferrill, W1LJI.
- W. T. Bishop, W9UI, discusses safety points that we should all observe, in "A Safety Kilowatt Amplifier."
- I. V. Iversen, W7AW, tells about "The Portable at W7AW," a complete low-power 'phone and C.W. rig.

November 1964

- The cover photo shows W1HDQ's lightweight portable station for 50 Mc, presented in this issue.
- The editorial looks at the past year's considerable accomplishments in Amateur Radio and at ARRL HQ, as well as at the FCC's relaxation of rules.
- James O'Hern, W2WZR, and Thomas Sly, K2QCX, describe the use of "Balanced Modulators for V.H.F. and U.H.F. Sideband."
- Ed Tilton, W1HDQ, describes "A Featherweight Portable Station for 50 Mc." that weighs only 3 pounds — including power supply, mike, and an effective portable antenna system.
- National Emergency Coordinator George Hart, W1NJM, instructs us in "Some Fine Points in Message Handling."
- N. H. Davidson, K5JVF, tells about his "Flagpole without a Flag" — a vertical antenna for 160, 80, and 40 meters, built using inexpensive materials.
- The always-funny John Troster, W6ISQ, gives us an "Introduction to the Principles and Practices of Hamsmanship."

November 1989

- The cover photo is a photo collage of "Field Day through the Years," including the well-known W6AM/mobile.
- The editorial discusses "License Fees," trying to get to the factual bottom of the proposal.
- "White Water Portable," by Michael Dale, reports on a canoe trip down the Verde River in central Arizona, with fellow paddler KA7GQX, making 10 meter contacts — often with difficulty from their bottom-of-the-canyon location. The canoeists fell behind their schedule and had to get word to the aircraft crew to delay their pickup. They finally made contact with VK3AHT, who relayed the information to KC6BFM, who called Phoenix with the message!

- Mitchell Lee, KB6FPW, tells us about "An Adapter for Powering Hand-Helds from 12-V Sources."
- Mark Mandelkern, KN5S, discusses "Protecting Power Tetrodes" using some now control circuits.
- Donald Huff, W6JL, helps us with information on the new mode, with "An AMTOR Operating Primer."
- Doug DeMaw, W1FB, presents "Some Power-Supply Design Hints" that will help with RF suppression in regulated supplies.

Field Organization Reports

August 2014

Public Service Honor Roll

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

856 WA7PTM
642 W5KAV
533 KI6LNB
405 KT2D
395 WM2C
389 N8OSL
340 K0IBS, WB8RCR
312 KD8EBY
304 KB8VXE
285 KW4EMG
280 W8QAS
268 W4SEE
243 WB8R
240 N7CM, K7EAJ
230 N8FVM, N7YRT
226 KJ6PCC
220 W7GB
210 KB2RTZ
209 KF4DVF
205 K9LGU, W8DJG
200 WB8YYS
197 KC5ZGG
190 WS6P, K7OAH, K7RDB
185 N5NVP
182 KD8VUI
181 WB9FHP
180 K6FRG, N1UMJ
179 W7PAT
175 VE7GN, N5TAA
170 W7FQQ, N5TMC
165 KE5HYW, WD8USA
163 WA4STO
160 K6HTN, WB9QPM, KE4CB, WA3EZN, W4DNA
155 W5DY, WB9WKO
150 W4VX, WB4ZIQ, KK3F, W8CPG
145 KD5RQB
142 KC8YVF
140 KJ6IJJ, K7BDU, W9BGJ, K1PJS, N8SY, K0VTT
138 WA2BSS, NE8B
135 W3YVQ
132 KK7DEB
130 N2JBA, WE2G, K6JT, K4IWW, WK4WC, K8RDN, KW1U, K7BFL
125 W0LAW, KT5SR, AG9G, KB8QKC, KF4DAX, KB3LNM
123 W1INC
120 KJ6CNO, W9WXN, NN7H, WA1STU, NA7G, NS7K, WB6UZX, KB1RGQ, NM1K
118 KJ4JPE, KA8ZGY
117 N1ZIH
115 KC9UJP, KF5IOU, KF5TTN, K0PTK, WB9JSR
114 N1IQI
111 N2GJ
110 W1KX, KA9QWC, NX9K, N9VC, KA4FZI, K4GK, N7EIE, KB2QO, KC5OZT, N9MN, W2EAG, KO4OL, AA2SV, N7XG, K1HEJ, K1MLG
108 W4CPG
107 W8ARR
106 KC8QWH
105 KF7GC, KK7TN, N9WLW, KA2HZP, WB6OTS, N1TF
104 NA9L
103 N3RB, KA1G
102 K3JL
100 K9JM, WA1MXT, N3SW, WA4BAM, NC3F, WA0CGZ, W8MAL, KC8WH, WB8QLT, N1JX, K5KV, KE5YTA, KA2GQQ, AK4RJ, W4TTO, KB0DTI, KB1NMO, AA3SB, WB8WKQ, WB8TQZ
99 AB9ZA
97 W0PZD
96 KB5SDU, N2RTF
95 WA2BSS
94 KJ6JGL
92 W9EEU
90 W6KJ, KU6J, WO0W, N5RL, K5RG, KB9KEG, KU6J, W6KJ, WB4BIK, N8IBR, WB8SIQ, WG8Z, KB8HJJ, WA6IAF, KA5AZK, N3KB, KB5KKT, KC7ASA, KZ8Q, WB4FDT, WD8DHC, KC8BW, K8KV, KB8RCR
88 KJ4G, K4VWK, W3CB
87 AB1ST
86 N2DW, KM7N, KA0DBK
85 KC5TGF, KJ4HGH
84 KF7PDV
83 W3CB, W4OTN
82 KN7NO
81 WD0GUF
80 WA9QIB, AJ7B, W8WDS, WB4RJW, AF7FT, K8ED, KB1WXC
79 K6RAU
78 KC1AAQ, KC2EMW, W7JSW
76 W8KWG
75 N5MBQ, KF4OCU, K5JAW
74 K9DUR, AB1AV
72 WA5LOU, W5XX
71 KR6LH, N2VC
70 W8IM, N2YJZ, NF8I, KD8HPG

The following stations qualified for PSHR in previous months but have not been recognized in this column yet: (July) WA7PTM 390, KC1AAQ 229, KE6WEZ 140, N2QPJ 120, KO4OL 115, WS4P 110, AJ4TH 100. (June) KC1AAQ 164. (May) K1PJS 140, W1INC 130, AB1ST 113, WA1MXT 110, AB1AV 93.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AK, AL, AR, AZ, CO, CT, DE, EB, EMA, ENY, EPA, EWA, GA, IA, ID, IL, IN, KS, KY, LA, LAX, MDC, ME, MI, MN, MS, NC, NE, NFL, NH, NNJ, NTX, OH, OK, OR, ORG, SD, SFL, SJV, SNJ, STX, SV, TN, UT, VA, WCF, WI, WMA, WPA, WV, WY.

Section Emergency Coordinator Reports

The following ARRL Section Emergency Coordinators reported: GA, ENY, EWA, IA, ID, IN, MDC, ME, MN, MO, NC, ND, NFL, NLI, NM, OK, SJV, 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 1683, K6HTN 1420, KK3F 1219, WA4STO 1071, K7BDU 770, KW1U 695, W4VX 681, N1IQI 663, NX9K 590, N9VC 579, KZ8Q 504.

BPL with Originations + Deliveries: KB2RTZ 170, W5KAV 151, NM1K 122.

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- *218XATC-PL-(length) RG8x (240UF) w/PL259 Connectors Each End. Weather-Proof Heat Shrink Tubing.*
  - *Stranded Center Conductor.*
  - 95% TC Braid + bonded 100% Foil Shield.
  - *Very Flexible, Light Weight, and Smaller than RG8 sizes.*
  - Non-Contaminating-UV Resistant-Direct Burial-Black Jacket.

- *235-5X-(length) 1" Wide Tin-Copper w/Ring Terminals Each End. Adhesive-Lined Heat Shrink Tubing.*
  - *Grounding Braid Heavy Grade.*
  - Construction: 38x48x18/864 7ga 85 Amps.
  - *Easy termination: ¼" Stud Ring Terminals.*

REMOTE RIG

RRC-1258 MkII-S-Set

This set of interfaces allows remote control of your Amateur Radio Station via Internet in a user-friendly and cost effective way! RemoteRig gives you control of the radio coupled with crystal clear TX & RX audio and sending CW with your own Paddle!

New! Now Stereo Version for Dual Receiver radios.

Works with all Computer-controllable radios from:
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For radios with detachable front panels no PC is required for:
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Just simply insert your control box in place of your front panel interconnect cable, place the body of the radio on the remote end and you are on the air as if you are there! Extra Controller and Remote interface units sold individually for multiple sites/users.

Now includes 12V power supply, $12.95 value!

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DXE-RG-5000 Receiver Guard 5000.............. **$69.95**

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This clamp is the perfect mounting platform for up to six of the common coaxial protector models from PolyPhaser and Alpha Delta, sold separately. It secures to a 1/2"-5/8" O.D. ground rod using the included stainless hardware. *The clamp is shown with optional parts.*

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This unit has eight individual terminals that will automatically shunt to ground when voltage spikes above 82 Vdc, in either polarity. It features a gasketed, weatherproof metal enclosure with an integrated stud for easy mounting.

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The Dual Vertical Array is an easy-to-install two-element vertical antenna phasing system that offers great HF performance. It uses a new design to increase array efficiency by eliminating the waste load port found on previous systems. The array can handle 2 kW, with a front-to-back over 20 dB and up to 3 dB of gain over a single vertical.

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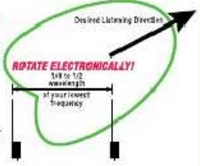
DXE-DVA-160-P Dual Vertical Array, 160M with Controller............ **$469.90**

DXE-DVA-80-P Dual Vertical Array, 80M with Controller.............. **$454.90**

DXE-DVA-40-P Dual Vertical Array, 40M with Controller.............. **$439.90**

See the August 2014 issue of QST for the DXE-AAPS3-1P Review.

Receive Antenna and Noise Phasing Controller



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DXE-NCC-1 Receive Antenna Variable Phasing Controller only....... **$599.95**

DXE-AAPS3-1P Active Antenna Phasing System with Controller.................. **$1,133.95**

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Cable Grippers

These grippers are the perfect complement to DX Engineering's Coaxial Cable Prep Tools. They help you securely hold your cable while you're doing the proper prep. They're also effective for holding the cable as you're pulling it off a spool or out of a box for a run.

DXE-CG-8U Cable Gripper for RG-8U Size Cable.................... **$14.95**

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NCC-1 Optional Receive Filters

New!

These filters are an upgrade to your NCC-1 Receive Array Phasing Unit, offering enhanced, frequency-specific directional noise and signal nulling performance. They're an excellent addition to your NCC-1 if you enjoy AM DXing, HF operation and SWL. By reducing or excluding frequency-specific signals that normally cause interference, these filters lower the noise floor of the desired pass-band to dramatically improve reception.

They have a nominal insertion loss of 1 dB. and are sold in pairs, so you can match each receive antenna input to its corresponding pass-band slot on the NCC-1.

Part Number	Description	Band(s)
DXE-NCCFL-LP160M	Low Pass	160M & below
DXE-NCCFL-LP80M	Low Pass	80M & below
DXE-NCCFL-LP40M	Low Pass	40M & below
DXE-NCCFL-LP20M	Low Pass	20M & below
DXE-NCCFL-LP15M	Low Pass	15M & below
DXE-NCCFL-LP10M	Low Pass	10M & below
DXE-NCCFL-HP160M	High Pass	160M & above
DXE-NCCFL-HP80M	High Pass	80M & above
DXE-NCCFL-HP40M	High Pass	40M & above
DXE-NCCFL-HP20M	High Pass	20M & above
DXE-NCCFL-HP15M	High Pass	15M & above
DXE-NCCFL-HP10M	High Pass	10M & above
DXE-NCCFLBPF160M	Band Pass	160M
DXE-NCCFL-BPF80M	Band Pass	80M
DXE-NCCFL-BPF40M	Band Pass	40M
DXE-NCCFL-BPF20M	Band Pass	20M
DXE-NCCFL-BPF15M	Band Pass	15M
DXE-NCCFL-BPF10M	Band Pass	10M

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DXE-UT-808X	Cable Stripper for RG-8X, 9258, and Similar Sizes	$49.95
DXE-UT-80P	PL-259 Assembly Tool	$22.95
DXE-UT-80N	2-Piece N Connector Tool	$22.95
CNL-911	Coax Cable Cutters	$18.97
DXE-170M	Precision Shear Cutters	$7.95

The tools also come in cost-saving kits, complete with case.

DXE-UT-KIT3	Basic Coax Cable Prep Kit	$119.95
DXE-UT-KIT4	Complete Coax Cable Prep Kit	$199.95

Amphenol® Connex

AMP-112116	BNC Male, RG-58/LMR-195	$1.59
AMP-112533	BNC Male, RG-8X/LMR-240	$1.78
AMP-172100	Type N Male, RG-58/LMR-195	$4.01
AMP-172102	Type N Male, RG-8/RG-213/RG-393	$4.35
AMP-172102H243	Type N Male, DXE-8U/DXE-400MAX/LMR-400	$3.91
AMP-172135	Type N Male, RG-8X/LMR-240	$4.38
AMP-182100	PL-259, RG-58/LMR-240	$4.14
AMP-182102	PL-259, RG-8/RG-213/RG-393	$3.95
AMP-182115-10	PL-259, RG-8X/LMR-240	$4.50
AMP-182130-10	PL-259, DXE-8U/DXE-400MAX/LMR-400	$4.50

DXE-UT-KIT-CRMP2

Ultra-Grip 2 Crimp Connector Hand Tool Kit

This kit includes everything you need to make professional-quality crimps on coaxial and Powerpole® connectors. The ratcheting steel crimper is designed to fit ergonomically in your hand to reduce fatigue. The kit comes with the Ultra-Grip 2 Tool, 5 crimp dies, shears, braid trimmer, Allen wrench and case. You get crimp dies precisely sized for RG-8U, LMR-400, RG-8X and LMR-240 type cables, along with specialized dies for Powerpole 15A, 30A and 45A connectors, as well as insulated and un-insulated wire terminals.

The Ultra-Grip 2 Crimp Tool, interchangeable dies and specialized carrying case are also available separately. You can expand the functionality of your UT-CRIMP and UT-CRMP2 Crimp Tool with extra crimp dies. They're made to handle various common crimp connector types in several sizes.

DXE-UT-KIT-CRMP2	Complete Kit, 5 Die Sets	$154.95
DXE-UT-CRMP2	Crimp Tool for RG-8U/LMR-400 Size Cable	$49.68
DXE-UT-CRMP2-8X	Crimp Tool for RG-8X/LMR-240 Size Cable	$49.68
DXE-UT-CRMP2-PWR	Crimp Tool for Powerpole® 15, 30, 45A	$49.68
DXE-UT-DIE-INS	Crimp Die for Insulated 22-10 AWG Terminals	$19.73
DXE-UT-DIE-UNIS	Crimp Die for Uninsulated 22-8 AWG Terminals	$19.73

DXE-PL259

DXE-PP30

DXE-UG176S

DXE-UG175S

Solder-On Two-Piece Connectors

Silver plated and featuring PTFE insulation, these low-loss connectors have an extraordinarily high electrical breakdown point.

DXE-PL259	UHF Male Connector	$2.75
DXE-N1001-S	Type N Male Connector	$6.95
DXE-UG175S	Adapter for RG-58	$0.95
DXE-UG176S	Adapter for RG-8X	$0.95

Anderson Powerpole® Connectors

DXE-PP30	For 12-16 AWG, 30 Amps, 10 Pairs	$12.95
DXE-PP45	For 10-14 AWG, 45 Amps, 10 Pairs	$17.95

DXE-UT-KIT-CRIMP

Ultra-Crimp Tool Connector Kit

Made precisely for coaxial and Powerpole® connectors, this kit is filled with the exact prep tools and dies you'll need to make full-ferrule connections. The kit comes with the Ultra-Crimp Tool, shears, braid trimmer, Allen wrench and case. It also includes crimp dies for RG-8U, RG-8X, LMR-400 and LMR-240 cable, plus a crimp die for Powerpole 15A, 30A and 45A connectors.

DXE-UT-KIT-CRIMP	Ultra-Crimp Connector Kit	$117.95

The Ultra-Crimp Tool, interchangeable dies and specialized carrying case are also available separately.

DXE-UT-CRIMP	Ultra-Crimp Tool with RG-8U Die Set	$39.95
DXE-UT-CRIMP-PWR	Ultra-Crimp Tool with Powerpole® Die Set	$38.95
DXE-UT-CRIMP-8X	Ultra-Crimp Tool with RG-8X Die Set	$39.95
DXE-UT-DIE-8U	Crimp Tool Die, for RG-8U Sized Cable	$19.73
DXE-UT-DIE-8X	Crimp Tool Die, for RG-8X and RG-58U Sized Cable	$19.73
DXE-UT-DIE-PP	Crimp Tool Die, for Powerpole® 15A, 30A, 45A Contacts	$19.73
DXE-CRIMP-CASE	Crimp Connector Tool Case	$25.95

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TGR-SL-USB	SignaLink™	$85.00

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Highest Quality Cable and Assemblies

Always the Best Cable at the Lowest Price

- Made to DX Engineering's rigid specifications
- Available in full spools or cut to your custom length

Bulk Cable	Impedance	Length	Price
Low-Loss Mini-8 Cable			
DXE-8X	50 Ω	per foot	$0.38
DXE-8X-1000	50 Ω	1,000'	$299.99
Low-Loss Cable			
DXE-213U	50 Ω	per foot	$0.89
DXE-213U-500	50 Ω	500'	$389.95
DXE-11U	75 Ω	per foot	$0.52
Premium Low-Loss Cable			
DXE-400MAX	50 Ω	per foot	$0.92
DXE-400MAX-500	50 Ω	500'	$399.95
Low-Loss Foam Cable			
DXE-8U	50 Ω	per foot	$0.84
DXE-8U-500	50 Ω	500'	$369.95
Highly Flexible Cable			
DXE-58AU	50 Ω	per foot	$0.29
Flooded Jacket Cable			
DXE-6UF-CTL	75 Ω	per foot	$0.19
DXE-6UF-1000	75 Ω	1,000'	$149.95

New!

DX Engineering's Revolutionary PL-259 Connector*

A "Better Mousetrap" Approach to Your Cable.

This brand new PL-259 design has a full-diameter, full-length soldered center pin, which means it will fit snugly into a well-worn SO-239. The large center pin also makes it easier to flow solder inside, further securing the conductor. The silver plated and deeply knurled shell has precise threads to promote a solid connection with the SO-239. Each of these PL-259 connectors is insulated with a PTFE dielectric for exceptional RF characteristics. You can only get this new connector design at DX Engineering.

*Patent Pending

The New PL-259 is Used Exclusively on DX Engineering Cable Assemblies.

DX Engineering starts with the highest-performance, low-loss 8U, 213U and 400MAX coaxial cable, and then finishes each assembly with its revolutionary new PL-259 connectors. The connectors feature a machine-crimped shield that provides a 360° electro-mechanical connection. Every weather-shielded, hand-soldered assembly is hi-pot and continuity tested in the USA. They come in multiple lengths; custom lengths are also available.

DX Engineering is the Best Place to Get Coax, Here's Why:

- 100% High Voltage (Hi-Pot) Tested
- Weatherproof: Adhesive Shrink Tubing Seals Connections
- Silver-plated PTFE-insulated Connectors
- Hand Crafted by Top Techs
- See DXEngineering.com for more connector options

Black PVC Jacket

DXE-8U 50 Ω Low-Loss Foam Dielectric Cable

- .405" high-flex PVC jacket

Attenuation per 100 feet	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%

UV-Resistant, Non-Contaminating, Black PVC Jacket

DXE-213U 50 Ω MIL-Spec Cable

- .405" Type II UV-resistant jacket is non-contaminating and suitable for outdoor use

Attenuation per 100 feet	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%

UV-Resistant, Non-Contaminating, Black PE Jacket

DXE-400MAX 50 Ω Premium Low-Loss Cable

- Gas-injected foam, polyethylene dielectric bonded tape foil covered by a braided copper shield
- .405" low-density UV-resistant polyethylene jacket is ideal for outdoors
- Direct-bury

Attenuation per 100 feet	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	0.7kW	47%

UV-Resistant, Black PE Jacket

DXE-8X Low-Loss Foam Dielectric Cable

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 per 100 feet	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%

DX Engineering Cable is Available in Pre-Cut Assemblies with Connectors.

DX Engineering Cable Assemblies are built by our techs, right here in Ohio. They're fully tested and are ready for installation in your shack. For all lengths and connector options, visit DXEngineering.com.

Pre-cut Cable, PL-259 Connectors		
Part Number	**Length**	**Price**
DXE-8UDX002	2'	19.95
DXE-8UDX003	3'	$20.95
DXE-8UDX006	6'	$23.95
DXE-8UDX025	25'	$43.95
DXE-8UDX050	50'	$68.95
DXE-8UDX100	100'	$118.95

Pre-cut Cable, PL-259 Connectors		
Part Number	**Length**	**Price**
DXE-213UDX003	3'	$20.45
DXE-213UDX006	6'	$22.45
DXE-213UDX012	12'	$26.45
DXE-213UDX025	25'	$43.45
DXE-213UDX050	50'	$68.45
DXE-213UDX075	75'	$96.45
DXE-213UDX100	100'	$118.45
DXE-213UDX150	150'	$178.45

Pre-cut Cable, PL-259 Connectors		
Part Number	**Length**	**Price**
DXE-400MAXDX003	3'	$21.45
DXE-400MAXDX006	6'	$24.45
DXE-400MAXDX018	18'	$31.45
DXE-400MAXDX025	25'	$44.45
DXE-400MAXDX050	50'	$69.45
DXE-400MAXDX075	75'	$97.45
DXE-400MAXDX100	100'	$119.45
DXE-400MAXDX150	150'	$179.45

Pre-cut Cable, PL-259 Connectors		
Part Number	**Length**	**Price**
DXE-8XDU003	3'	$18.45
DXE-8XDU006	6'	$19.45
DXE-8XDU012	12'	$24.45
DXE-8XDU025	25'	$29.45
DXE-8XDU050	50'	$37.45
DXE-8XDU075	75'	$44.45
DXE-8XDU100	100'	$54.45
DXE-8XDU150	150'	$79.45

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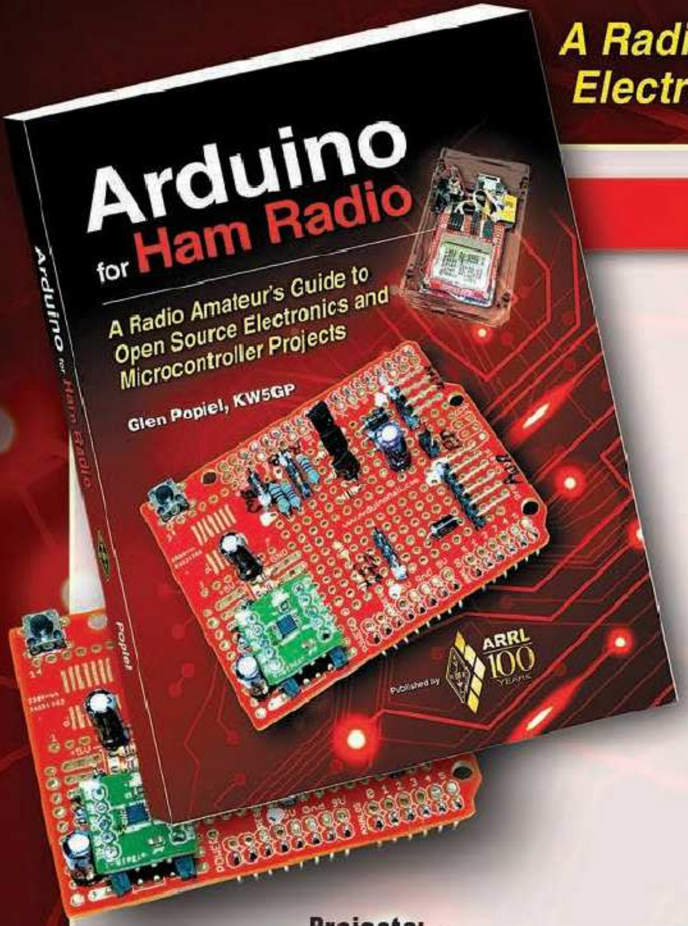

By Glen Popiel, KW5GP

The Arduino has become widely popular among hobbyists and ham radio operators. Hams are exploring these powerful, inexpensive microcontrollers, creating new projects and amateur station gear. With its Open Source model, the Arduino community freely shares software and hardware designs, making projects easier to build and modify.

Arduino for Ham Radio introduces you to the exciting world of microcontrollers and Open Source hardware and software. It starts by building a solid foundation through descriptions of various Arduino boards and add-on components, followed by a collection of ham radio-related practical projects. Beginning with simple designs and concepts and gradually increasing in complexity and functionality, there is something here for everyone. Projects can be built quickly and used as-is, or they can be expanded and enhanced with your own personal touches.

Projects:

- Random Code Practice Generator
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- Fan Speed Controller
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• TX:HF/6M • RX: 0.5-60 MHz • Power: 10-200W (with two optional 22A PS's) • Memories: 99 • IF/stage DSP on main band, AF/stage DSP on sub-band

TS-480SAT $250 INSTANT COUPON
100W with auto antenna tuner.

TS-2000 HF/VHF/UHF Transceiver
• TX: HF/6M/2M/440 MHz • RX: 0.03-60, 142-152, 420-450 MHz • Power: 10-100W (10-50W on 440 MHz) • 99 Memories • HF/6M Auto Antenna Tuner • IF/stage DSP on main band, AF/stage DSP on sub-band

TS-2000X $250 INSTANT COUPON
All the features and coverage of the TS-2000 and also includes 1.2 GHz @ 10W.

TS-590S 100W HF/6M Transceiver
• TX: HF/6M • RX: 0.03-60MHz MHz • Power: 5-100W • 110 Memories + 10 Quick Channels
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• TX: HF/6M • RX: 0.13-60 MHz • Power: 2-200W
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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. *Has* 5-second brake delay, Test/Calibrate function. Low temperature grease permits normal operation down to -30 degrees F. Alloy ring gear gives extra strength up to 100,000 PSI for maximum reliability. *Precision* indicator potentiometer. Ferrite beads reduce RF susceptibility. Cinch plug plus 8-pin plug at control box. Dual 98 ball bearing race for load bearing strength and electric locking steel wedge brake prevents wind induced movement. North/South center of rotation scale on meter, low voltage control, max mast 2¹/₁₆".

HAM-VI **$749.95** with DCU-2

HAM-VII **$799.95** *with DCU-3*

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

TAILTWISTER SERIES II

T-2X **$799.95**

T-2XD2 **$899.95** with DCU-2

T-2XD3 **$949.95** with DCU-3

For large medium antenna arrays up to 20 sq. ft. wind load. Has 5-second brake delay, Test/Calibrate functions. Low temp grease, tough alloy ring gear, indicator potentiometer, ferrite beads on potentiometer wires, weatherproof AMP connectors plus 8-pin plug at control box, triple bearing race with 138 ball bearings for large load bearing, electric locking steel wedge brake, North/South center of rotation scale meter, low voltage control, 2¹/₁₆" max mast. **MSHD, $109.95.** Above tower heavy duty mast support. T2X, HAM-IV, HAM-V, HAM-VI. Accepts 1⁷/₈-2⁵/₈" OD.

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

CD-45II

CD-45II **$449.95**

For antenna arrays up to 8.5 sq. feet mounted inside tower or 5 sq. ft. with mast adapter. Low temperature grease good to -30 F degrees. *New* Test/Calibrate function. Bell rotator design gives total weather protection, dual 58 ball bearing race gives proven support. Die-cast ring gear, stamped steel gear drive, heavy duty, trouble free gear train, North center scale, lighted directional indicator, 8-pin plug/socket on control unit, snap-action control switches, low voltage control, safe operation, takes maximum mast size to 2¹/₁₆ 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.**

hy-gain® *Programmable* DCU-3 Digital Rotator Controller

New!

DCU-3 **$449.95**

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

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

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

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

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

Calibrate lets you accurately match your display to your *true* beam heading. Has USB/RS-232 ports for computer control. Adjustable LCD sleep time. Field upgradeable firmware. 8.5Wx4.3H x9D". 110 VAC. Order **DCU-3X** for 220 VAC.

DCU-2 Digital Rotator Controller

$399.95. Like DCU-3, but less programmable memories. 110 VAC. Order **DCU-2X**, for 220 VAC.

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. 2¹/₁₆ 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.**

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Easy-to-use -- dial in your beam heading and tap *GOTO* button. *Exclusive* 180 degree *AutoReversal*™ for fast longpath operation.

Has all features of DCU-2. Bright blue LCD shows current, dialed-in and computer controlled beam headings and your call. USB port for computer control. Extra heavy-duty AC power supply.

Variable DC motor speed for minimizing damaging antenna overshoot and fast operation. Intuitive menu for calibrating, offsetting, or changing parameters. Field upgradeable firmware. Use with Yaesu G-800/1000/2800/G450/650. For AC or DC motors.

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World's most popular 1500 Watt Legal Limit Tuner just got better -- much better -- gives you more for your money!

New, improved MFJ-989D *legal limit* antenna tuner gives you better efficiency, lower losses and a new *true* peak reading meter. It easily handles *full* 1500 Watts SSB/CW, 1.8 to 30 MHz, including MARS/WARC bands.

New dual 500 pF *air variable capacitors* give you twice the capacitance for more efficient operation on 160 and 80 Meters.

New, improved *AirCore*™ *Roller Inductor* gives you lower losses, higher Q and handles more power more efficiently.

New *TrueActive*™ peak reading Cross-Needle *SWR/Wattmeter* lets you read *true* peak power on all modes.

MFJ-989D **$409.95**

New high voltage *current balun* lets you tune balanced lines at high power with no worries.

New *crank knob* lets you reset your roller inductor quickly, smoothly and accurately.

New larger 2-inch diameter *capacitor knobs* with easy-to-see dials make tuning much easier.

New cabinet maintains components' high-Q. Generous air vents keep components cool. $12^7/_8$Wx6Hx$11^5/_8$D inches.

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

The MFJ-989D uses the superb time-tested T-Network. It has the widest matching range and is the easiest to use of all matching networks. Now with MFJ's new 500 pF air variable capacitors and new low loss roller inductor, it easily handles higher power much more efficiently.

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Every MFJ tuner is protected by MFJ's famous one year *No Matter What*™ limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

More hams use MFJ tuners than all other tuners in the world!

MFJ-986 Two knob *Differential-T*™

MFJ-986 **$369.95**

Two knob tuning (differential capacitor and *AirCore*™ roller inductor) makes tuning foolproof and easier than ever. Gives minimum SWR at only one setting. Handles 3 KW PEP SSB amplifier input power (1.5 KW output). Gear-driven turns counter, lighted peak/average Cross-Needle SWR/Wattmeter, antenna switch, balun. 1.8 to 30 MHz. $10^3/_4$Wx$4^1/_2$Hx15 in.

MFJ-962D *compact* kW Tuner

MFJ-962D **$319.95**

A few more dollars steps you up to a KW tuner for an amp later. Handles 1.5 KW PEP SSB amplifier input power (800W output). Ideal for Ameritron's AL-811H! *AirCore*™ roller inductor, gear-driven turns counter, pk/avg lighted Cross-Needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8-30MHz. $10^3/_4$x$4^1/_2$x$10^7/_8$ in.

MFJ-969 300W *Roller Inductor* Tuner

MFJ-969 **$229.95**

Superb *AirCore*™ Roller Inductor tuning. Covers *6 Meters* thru 160 Meters! 300 Watts PEP SSB. *Active* true peak reading lighted Cross-Needle SWR Wattmeter, *QRM-Free PreTune*™, antenna switch, dummy load, 4:1 balun, Lexan front panel. $3^1/_2$Hx$10^1/_2$Wx$9^1/_2$D inches.

MFJ-949E *deluxe* 300 Watt Tuner

More *hams use MFJ-949s than any other antenna tuner in the world!*

MFJ-949E **$179.95**

Handles 300 Watts. Full 1.8 to 30 MHz coverage, custom inductor switch, 1000 Volt tuning capacitors, *full size* peak/average lighted Cross-Needle SWR/Wattmeter, 8 position antenna switch, dummy load, *QRM-Free PreTune*™, scratch proof Lexan front panel. $3^1/_2$Hx$10^5/_8$Wx7D inches.

MFJ-948, $159.95. Economy version of MFJ-949E, less dummy load, Lexan front panel.

MFJ-941E *super value* Tuner

The *most for your money!*

MFJ-941E **$139.95**

Handles 300 Watts PEP, covers 1.8-30 MHz, *lighted* Cross-Needle SWR/Wattmeter, 8 position antenna switch, 4:1 balun, 1000 volt capacitors, Lexan front panel. Sleek $10^1/_2$Wx$2^1/_2$Hx7D in.

MFJ-945E HF/6M *mobile* Tuner

Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna.

MFJ-945E **$129.95**

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

Tunes coax, balanced lines, random wire 1.8-30 MHz. Cross-Needle Meter. SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ transceivers. Tiny 6x$6^1/_2$x$2^1/_2$ in.

MFJ-971 **$129.95**

MFJ-901B *smallest* Versa Tuner

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-901B **$99.95**

MFJ-902 *Tiny Travel* Tuner

Tiny $4^1/_2$x$2^1/_4$x3 inches, full 150 Watts, 80-6 Meters, has tuner bypass switch, for coax/random wire.

MFJ-902B **$99.95**

MFJ-904H, $149.95. Same but adds Cross-needle SWR/Wattmeter and 4:1 balun for balanced lines. $7^1/_4$x$2^1/_4$x$2^3/_4$ inches.

MFJ-16010 *random wire* Tuner

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-16010 **$69.95**

MFJ-906/903 *6 Meter* Tuners

MFJ-906 has lighted Cross-Needle SWR/Wattmeter, bypass switch. Handles 100 W FM, 200W SSB.

MFJ-906 **$99.95**

MFJ-903, $69.95, Like MFJ-906, less SWR/Wattmeter, bypass switch.

MFJ-921/924 *VHF/UHF* Tuners

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8x$2^1/_2$x3 in.

MFJ-921/924 **$89.95**

MFJ-931 *artificial* RF Ground

Eliminates RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding. Creates artificial RF ground or electrically places far away RF ground directly at rig.

MFJ-931 **$109.95**

MFJ-934, $209.95, Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

Dealer/Catalog/Manuals

Visit: http://www.mfjenterprises.com

or call toll-free 800-647-1800

• 1 Year *No Matter What*™ warranty • 30 day money back guarantee (less s/h) on orders direct from MFJ

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Tech Help: (662) 323-0549
FAX:(662)323-6551 8-4:30 CST, Mon.-Fri. ***Add shipping.***

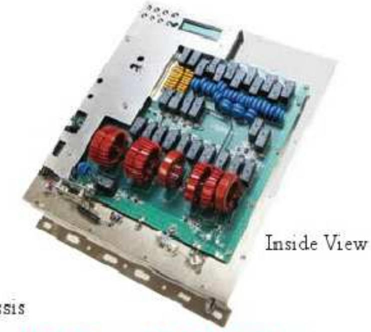
MFJ 1500 Watt *Remote* Auto Tuner

Place this MFJ-998RT remote tuner at your antenna to match high SWR antennas/long coaxes -- greatly reduce losses for high efficiency

. . . Match 12-1600 Ohms, 1.5 kW, SSB/CW, 1.8-30 MHz . . . Match coax/wire antennas . . . Weather-sealed . . . Remotely powered thru coax . . . Amplifier, radio, tuner protection . . . Output static/lightning protection . . . StickyTune™ always tunes when power folds back . . . DC power jack . . .

MFJ-998RT
$769⁹⁵

Bottom Chassis



Inside View

Tune your antenna AT your antenna!

Get greatly reduced losses and high efficiencies with long coax runs and high SWR antennas with this new MFJ-998RT 1.5 kW Remote Antenna Tuner.

Weather-Sealed

A tough, durable weather-sealed ABS cabinet with over-lapping lips, sealing gasket and stainless steel chassis protects the MFJ-998RT from all kinds of weather.

No Power Cable Needed!

No power cable needed -- remotely powered through coax. Includes MFJ-4117 Bias-Tee with on/off switch for station end of coax. Has 12 VDC jack for power cable, if desired.

Fully Protected

MFJ exclusive algorithms protect your tuner, radio and RF power amplifier from damage.

Automatic inductor and capacitor limiting prevents tuning extreme loads which can destroy your tuner.

Your tuner will not tune if more than 75 Watts with SWR greater than 3:1 is applied or if more than 125 Watts is applied.

Tuner output is static electricity and lightning induced surge protected.

MFJ exclusive StickyTune™

Very high SWR can fold back transmitter power and *prevent tuning* caused by extreme differences in loads (example: changing bands and other conditions).

But MFJ exclusive *StickyTune™ always* tunes with a simple on/off power cycle and re-transmit.

Tunes Coax fed and Wire Antennas

Tunes both coax fed and wire antennas. Has *ceramic* feed-through insulator for wire antennas. 2 kV *Teflon*® insulated SO-239 -- prevents arcing from high SWR.

High Power, Highly Efficient

A highly efficient L-network matches 6-1600 Ohms at *full* 1500 Watts legal limit SSB/CW 1.8 to 30 MHz with Hi-Q Ls, Cs.

MFJ-998RT Learns as you Operate

As you operate, the MFJ-998RT automatically tunes for minimum SWR and remembers your frequency and tuner settings. The next time you operate on that frequency and antenna, its tuner solution is restored in milliseconds and you're ready to operate!

Highly Intelligent, Ultra-fast Tuning

MFJ *InstantRecall™* recalls stored tuning solutions from 10,000 memories. For new frequencies, MFJ *Intelli-Tune™* measures your antenna impedance and instantly determines the correct matching components. If antenna impedances cannot be measured, MFJ *AdaptiveSearch™* searches *only* the relevant components that can match your antenna giving you ultra-fast tuning.

Field upgradeable firmware. Requires 12-15 VDC at 1.4 Amps maximum or 110 VAC with optional MFJ-1316, $21.95. Weighs 9.5 lbs. 13¼Wx6¾Hx17½D inches.

600W *Remote IntelliTuner™*

MFJ-994BRT
$399⁹⁵

MFJ-994BRT -- perfect for 600 Watt SSB/CW amplifiers like Ameritron's AL-811/ALS-600/ALS-500M. Matches 12-800 Ohms. Coax/wire antennas, 1.8-30 MHz. Fully *weather-sealed* for outdoor use. Remotely powered through coax. Tough, durable, *built-to-last* cabinet, 9¼Wx3Hx14¼D inches, 4 lbs. Includes MFJ-4117 BiasTee Power Injector.

300W *Remote IntelliTuner™*

MFJ-993BRT
$299⁹⁵

MFJ-993BRT handles 300 Watts SSB/CW and matches an *extra-wide* 6-1600 Ohm impedances. Coax/wire antennas, 1.8-30 MHz. Fully *weather-sealed* for remote outdoor or marine use. Remotely powered through coax. Tough, durable, *built-to-last* cabinet measures 9¼Wx3Hx14¼D inches. Weighs just 4 pounds. Includes MFJ-4117 BiasTee Power Injector.

200W *Remote IntelliTuner™*

MFJ-926B
$279⁹⁵

MFJ-926B, 200 Watts SSB/CW, matches 6-1600 Ohms, Coax/wire antennas, 1.8-30 MHz. Includes BiasTee.

200W *Remote Econo Tuner™*

MFJ-927
$259⁹⁵

MFJ-927, 200 Watts SSB/CW, 6-1600 Ohms, Coax/Wire antennas, 1.8-30 MHz. Weather-sealed, BiasTee. 7½Wx5¼Hx8½D in.

160-6 Meters 43 foot Vertical Antenna

MFJ-2990
$359⁹⁵

Operate all bands 160-6 Meters at full 1500 Watts with this self-supporting, 43 foot high performance vertical! Assembles in less than an hour. Low profile blends in with sky and trees -- barely see it. Entire length radiates. Exceptional low angle DX performance on 160-20 Meters and very good performance on 17-6 Meters. Telescope it shorter for more effective low angle radiation on 17-6 M if desired. One of these wide-range *MFJ automatic tuners* at the antenna easily matches all bands 160-6 Meters. There's no physical tuning adjustments on the antenna -- you *simply put it up!* Requires ground system, at least one radial, more the better. Includes balun and base mount. **MFJ-1932, $34.95.** All band ground radial system.

Free MFJ Catalog

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http://www.mfjenterprises.com

10 Bands: 80-2 Meters

$399.95

MFJ-1799

- *10 Bands: 75/80, 40, 30, 20, 17, 15, 12, 10, 6, 2 Meters including 75/80M*
- *Handles 1500 Watts PEP SSB/CW*
- *No ground or ground radials needed!*
- *Low radiation angle for great DX, omni-directional, automatic bandswitching*

Only 20 feet tall! Mounts anywhere!

Self-supporting and just 20 feet tall. Mounts easily from ground level to tower top -- small lots, backyards, apartments, condos, mobile homes, roofs, tower mounts.

Highly Efficient End-Loading

No lossy traps! *End-loading*, the most efficient loading known -- gives you highly efficient performance, excellent bandwidth, low angle radiation and automatic bandswitching.

High-Q loading coils are wound on tough, low loss fiberglass forms with *Teflon*® wire where needed.

Entire Length Radiates

End-loading results in uniform current distribution and the *entire length radiates*. This puts the radiating elements up high giving you more QSOs.

No Feedline Radiation/Distorted Pattern

MFJ's center-fed *balanced* halfwave vertical dipole design is decoupled and isolated from the feedline with MFJ's *AirCore*™ high power balun. It can't saturate, no matter how high your power.

This gives you consistently high performance by killing feedline radiation, pattern distortion, SWR shifts, RFI, noise pickups.

Easy to Tune!

Tuning to your favorite part of one band does not affect other bands and is done at the *bottom* of the antenna by simply adjusting a length of the capacitive hat.

Built-to-Last!

Incredibly strong *solid* 1¼ inch diameter fiberglass center insulator and 1⅜ inch diameter 6061 T6 aircraft strength aluminum tubing will make it the only antenna you will ever need.

MFJ 6-Band Halfwave Vertical Antenna

MFJ-1796 $229.95 **MFJ-1796,** like MFJ-1799, but for 6 bands: 40, 20, 15, 10, 6 and 2 Meters. 12 foot high, 24 inch foot print, mounts anywhere. No ground, no radials, self-supporting.

MFJ's Super High-Q Loop™ Antennas

MFJ's *tiny* 36 inch diameter loop antenna lets you operate 10 through 30 MHz *continuously* -- including the WARC bands!

Ideal for limited space -- apartments, small lots, motor homes, attics, or mobile homes. Enjoy DX and local contacts mounted vertically. Get both low angle radiation for excellent DX and high angle radiation for local, close-in contacts. Handles 150 watts.

Super easy-to-use! Only MFJ's super remote control has *Auto Band Selection*™. It auto tunes to desired band, then beeps to let you know. No control cable is needed. Fast/slow tune buttons and built-in two range Cross-Needle SWR/Wattmeter lets you quickly tune to your exact frequency.

All welded construction, welded butterfly capacitor with no rotating contacts, large 1.050 inch diameter round radiator -- *gives you highest possible efficiency.*

Each plate in MFJ's tuning capacitor is welded for low loss and polished to prevent high voltage arcing, welded to the radiator, has nylon bearing, anti-backlash mechanism, limit switches, continuous no-step DC motor -- smooth precision tuning. Heavy duty thick ABS plastic housing has ultraviolet inhibitor protection.

Cover 40-15 Meters. MFJ-1788, $499.95. Like MFJ-1786 but covers 40 - 15 Meters continuous. Includes remote control.

6-Band, 40-2 Meters *Rotatable* Mini-Dipole

Low profile 14 feet . . . 7 ft. turning radius . . . 40, 20, 15, 10, 6, 2 Meters . . . 1500 Watts . . .

MFJ-1775 is inconspicuous and low profile -- not much bigger than a TV antenna and is easily tuned by a lightweight rotator like Hy-Gain's *AR-35*.

It's no Wimp! Its directivity reduces QRM/noise and lets you *focus* your signal in the direction you want -- work some real DX.

You can operate 6 bands -- 40, 20, 15, 10, 6 and 2 Meters -- and run *full 1500 Watts* SSB/CW on all HF bands!

Features automatic band switching and uses highly efficient end-loading with its *entire length* always radiating. With 6 and 2 Meters thrown in, you have ham radio's most versatile *rotatable* dipole!

Each HF band uses a separate, efficient end-loading coil wound on fiberglass forms with *Teflon*™ wire, and capacitance hats at each end (no lossy traps). 6 and 2 meters are *full-length* halfwave dipoles.

Built-to-last -- incredibly strong solid rod fiberglass center insulator and 6063 T6 aircraft strength aluminum tubing radiator. Assembles in an afternoon. Adjusting one band has little effect on other bands.

MFJ-1775W, $249.95. WARC band version for 12, 17, 30, 60 Meters only.

MFJ *G5RV Antenna*

MFJ-1778 $44.95 **Covers** all bands, 160-10 Meters with antenna tuner. 102 feet long. Can use as inverted vee or sloper. Use on 160 M as Marconi. 1500 Watts. Super-strong fiberglass center/feedpoint 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.

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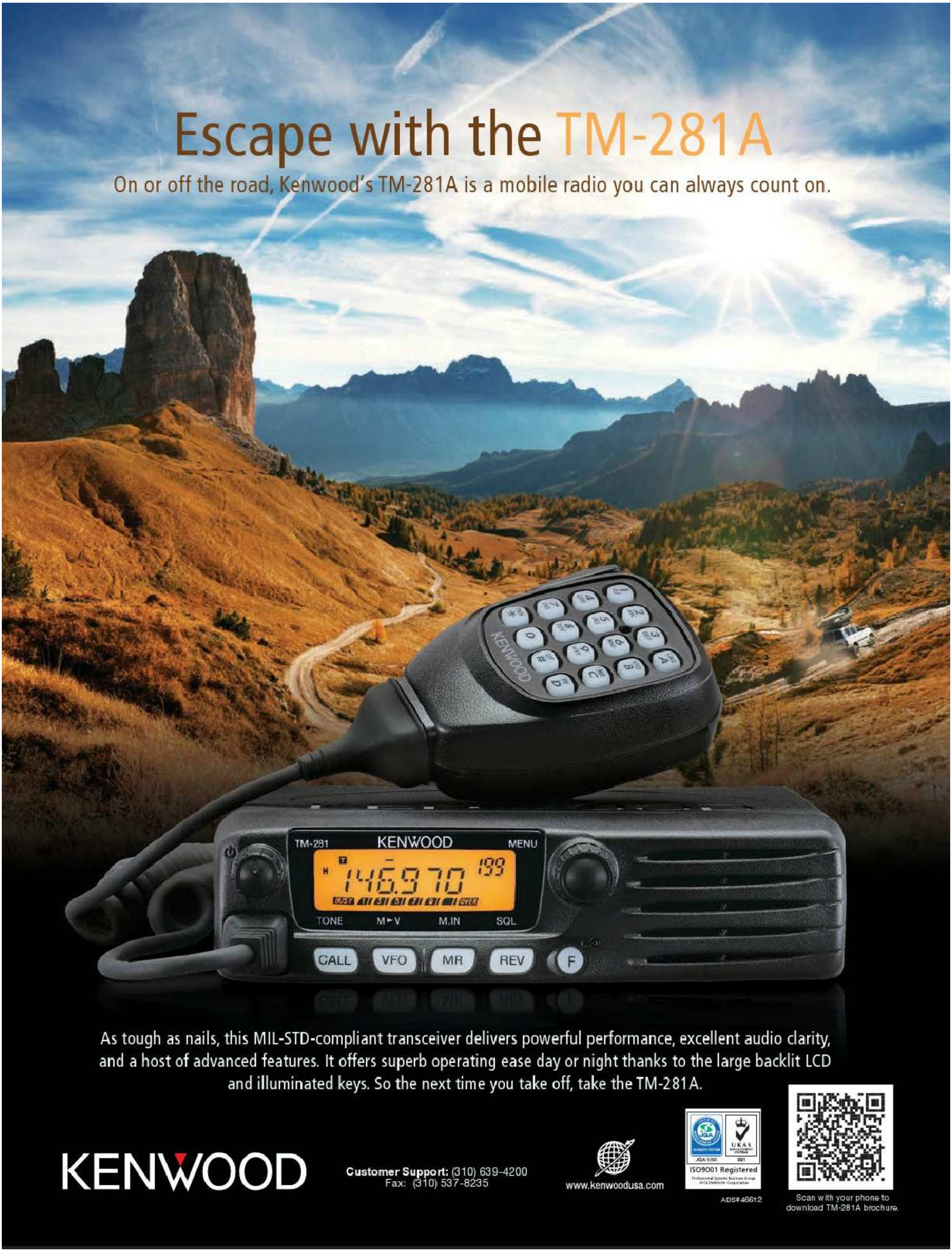
MFJ . . . the world leader in ham radio accessories!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On or off the road, Kenwood's TM-281A is a mobile radio you can always count on.
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MFJ Weather-Proof *Window Feedthrough Panels*

Weather-proof window feedthrough panels bring coax, balanced lines, HF/VHF/UHF antennas, random wire antennas, ground, rotator/antenna switch cables and DC/AC power into your hamshack without drilling through walls!

MFJ Weather-Proof *Window Feedthrough Panels* mount in your window sill. Lets you bring all your antenna connections into your hamshack *without* drilling holes through walls.

Simply place in window sill and close window. One cut customizes it for any window up to 48 inches. Use horizontally or vertically. Connectors are mounted on inside/outside stainless steel plates and attached to a 4 foot long, 3½ inch high, ¾ inch thick *pressure-treated* wood panel. Has excellent insulating properties. Weather-sealed with a heavy coat of long-lasting white outdoor enamel paint. Edges sealed by weather-stripping. Seals and insulates against all weather conditions. Includes window locking rod.

Inside/outside stainless steel plates ground all coax shields. Stainless steel ground post brings ground in.

MFJ-4603 Universal Window Feedthru Panel

MFJ-4603 **$89.95**

Four 50 Ohm *Teflon*® 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 1¼X1⅝ 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 1¼x1⅝ inches and 3 cables with UHF/N size coax connectors. Seals out weather.

MFJ-4604 **$99.95**

All-Purpose FeedThru/CableThru™

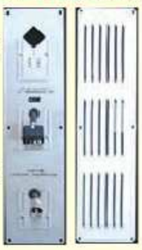
Stacks *MFJ-4603* ***and*** *MFJ-4604!* Gives you every possible cable connection you'll ever need through your window without drilling holes in wall -- including UHF, N and F coax connectors, balanced lines, random wire, ground, DC/AC power and cables of any size for rotators, antenna switches, etc.

MFJ-4605 **$159.95** **New!**

Bring cables thru eave of your house

MFJ-4616
shown with standard full-size vent (not included) it replaces. *For 6 Cables*
$26.95

MFJ-4613
shown with standard half-size vent (not included) it replaces. *For 3 Cables*
$14.95



Replace your standard air vents on the eave/sofitt of your house with these *MFJ AdaptiveCable*™ *Air Vent Plates* and...

Bring in coax, rotator, antenna switch, power cables, etc. *with connectors* up to 1¼x1⅝ inches!

Sliding plates and rubber grommets adjust for virtually any cable size to seal out adverse weather, insects and varmints. Use existing vent hole, mounting screws and screw holes.

AdaptiveCable™ **Wall Plates**

MFJ-4614
For 4 Cables
$34.95

Bring nearly any cable -- rotator, antenna switch, coax, DC/AC power, etc. -- through walls *without removing connectors* (up to 1¼x1⅝ inches). Sliding plates and rubber grommets adjust hole size to weather-seal virtually any size cable.

Includes *stainless steel* plates for each side of wall, sliding plates, rubber grommets, weather stripping and screws.

MFJ-4612
For 2 Cables
$24.95

MFJ-4611
For 1 Cable
$14.95

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MFJ Big Stick™

18 Foot *Portable* Telescoping Antenna

Only 28 inches collapsed . . . Covers 40-6 Meters -- No gaps!

MFJ-2286
$99⁹⁵

The MFJ BigStick™ antenna is for the on-the-go Ham who is hungry for the next great QSO anywhere or anytime!

Full Size Performance

For top portable performance, carry a *Big Stick* for the loudest, strongest on-the-go signal on the band!

MFJ's extra long 17 foot stainless-steel telescoping whip gives you *full-size antenna* for full size performance 20 to 6 Meters but collapses to just 28 inches.

An ultra low loss, high-Q adjustable *air-wound* loading coil gives you highly efficient operation 30 and 40 Meters.

This extra long radiator and ultra low loss loading coil is a winning combination that stands head and shoulders above shorter backpack antennas.

True Backpack Portability

Antenna is over 18 feet long fully extended, but disassembles and collapses to 28 inches in seconds. Fits into most backpacks or suitcases! And at just over 2 pounds you'll hardly know you are packing it!

True General Coverage

Tapped loading coil covers 7.0-55.0 MHz without gaps. Great for Ham Bands and outstanding for image-free shortwave broadcast!

Everything you need

Everything is included for instant operation. Pipe/Mast mount quickly and easily mounts to any pipe or mast up to 1/2 inch. SO-239 for coax. 3/8-24 antenna connector.

Counterpoise kit included: Ensures low SWR, high efficiency.

Rugged Construction

All aluminum, stainless steel construction ensures years of excellent performance. *One Killowatt rated* components guarantee electrical safety.

40-2 Meters Apartment Antenna

MFJ-1622 universal mount/clamp lets you attach it to window frames, balconies and railings. Works great indoors mounted to table/bookshelf. It's not a 5-element yagi, but you'll work your share of exciting DX! Highly efficient air wound *"bug catcher"* coil, telescoping 4½ foot radiator. Collapses to 2½ feet for easy storage and carrying. Includes coax, choke balun, counterpoise wire, safety rope. Operating frequency adjusted by moving "wander lead" on coil and adjusting the counterpoise for best SWR. ***Optional DX-Getter,*** MFJ-1977, $44.95. Stainless-steel 12-ft whip, 26 inches collapsed.

MFJ *BigEAR™*

8-Band Portable Dipole

34 feet Radiators, 7-55 MHz

For hams on-the-go!

Operate anywhere, anytime with a strong QSO grabbing signal!

34-Feet stainless steel radiator gives you *full-size dipole* performance on 20-6 Meters and highly efficient ultra *low loss* loaded dipole performance on 30/40 Meters. Collapses to 27 inches to fit into any suitcase or backpack. No ground or counterpoise needed.

True general coverage -- tunes up with low SWR on any frequency 7-55 MHz. Handles QRP to full killowatt PEP.

Ultra low loss high-Q *air-wound* loading coil. Built-in Guanella current balun kills feedline radiation, pattern distortion, RF shifts, RFI and noise pickup.

Distinctive V-shaped elements are set 45 degrees from the horizon to keep element tips high in the air. This maximizes radiation, minimizes ground loss and prevents hazardous contact.

MFJ's heavy-duty *NoTool™* mast lock lets you easily and quickly mount on any tripod or mast up to 7/8 inches. SO-239 for coax. With fewer parts to assemble, set-up and tune-up is much faster!

18 foot Telescopic Fiberglass Mast with Tripod

MFJ-1919EX, $159.95.

Put your antennas anywhere and get them up high with this super-strong 18 foot telescoping fiberglass mast and heavy-duty steel MFJ-1919 tripod.

QuickClamps™ easily collapses mast to 5 feet. Mast has thick 1/8 inch wall, .75 inch diameter top, 1.5 inch bottom. 15 lbs.

All tripods are black heavy-duty steel with braced triangle base, non-skid feet and mast lock.

MFJ-1918EX, $89.95. MFJ-1918 *tripod with super strong 9.5 foot telescoping fiberglass mast.* Collapses to 3.8 feet. *QuickClamps™*. Mast has thick 1/8" wall, ¾ inch top, 1 inch bottom. Weighs 6.5 lbs.

Tripods Only

MFJ-1919, $89.95, *Large tripod.* Supports 100 lb. antenna. Built-in 1.4 inch diameter mast extends 7.8 feet. Collapses to 4.5Hx.5D feet. Triangle base spreads to 4.8 feet on a side. Weighs 9.75 lbs.

MFJ-1918, $49.95, *Smaller tripod.* Supports 66 lbs. 1 inch diameter mast extends 6 foot. Collapses to 3.2Hx.3D feet. Triangle base spreads to 2.75 feet. Weighs 6.75 lbs.

17 foot *Stainless Steel* Telescoping Whip

MFJ-1979, $59.95. Super-strong, super long *17 foot stainless steel* telescoping whip. 27 in. collapsed. 10 sections. 3/8-24 threaded base.
MFJ-1977, $44.95/12ft;**MFJ-1796, $39.95**/10ft
MFJ-1974, $34.95/8ft;**MFJ-1972,** $14.95/4½ft

Single-band Rotatable *mini*-Dipoles

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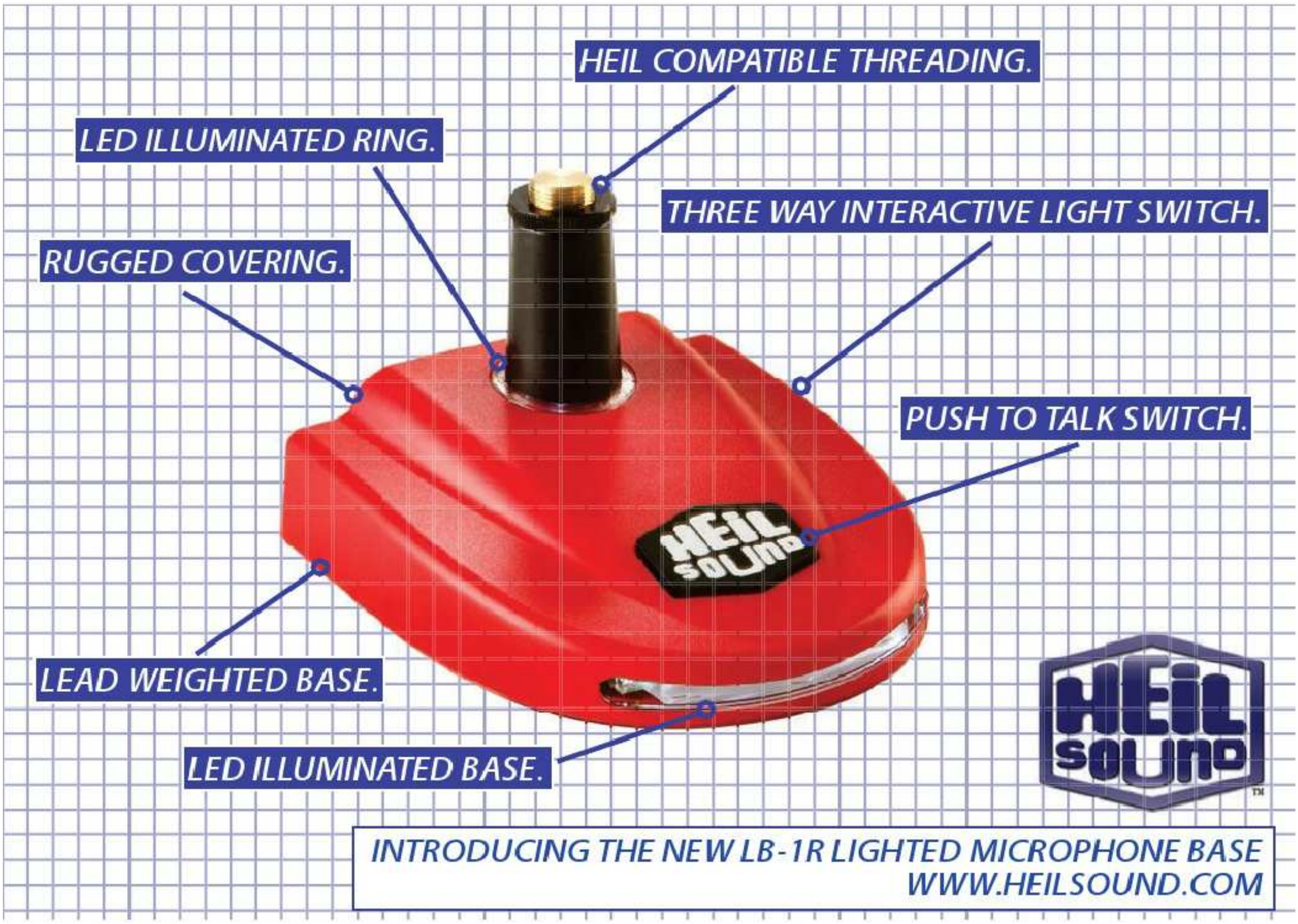
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Electronic advertisements feature active links for each radio.

As of 9/1/14, the IC-7850 has not been approved by the Federal Communications Commission.
This device may not be sold or leased, or be offered for sale or lease, until approval of the FCC has been obtained.
*Frequency coverage may vary. Refer to owner's manual for exact specifications.

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 August 5, 2014 through September 3, 2014.
Get on the web and vote today at **www.arrl.org/quickstats**!

Do you send reception reports to shortwave broadcast stations and collect their QSLs?

Yes 13%
I used to, but not any more 35%
I've never done this 52%

Do you use a separate receiving antenna when operating on 160 meters?


Dan Schaaf, K3ZXL, photo

Yes 12%
No 35%
I don't operate on 160 meters 53%

How many spare batteries do you have for your primary FM handheld transceiver?

One 27%
Two 19%
More than two 18%
None 25%
I don't own an FM handheld transceiver 11%

Have you ever operated analog Slow Scan TV (SSTV)?

Yes, recently 8%
Yes, but it was a long time ago 21%
No 71%


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V.S.W.R: <1.5
Length (M): 0.92
Weight(g): 135
Connector: PL-259
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Frequency (MHz): 144/430 MHz
Z (ohms): 50
Max Power: 10W
Length (mm): 400
Weight: 42g
Connector: SMA or BNC
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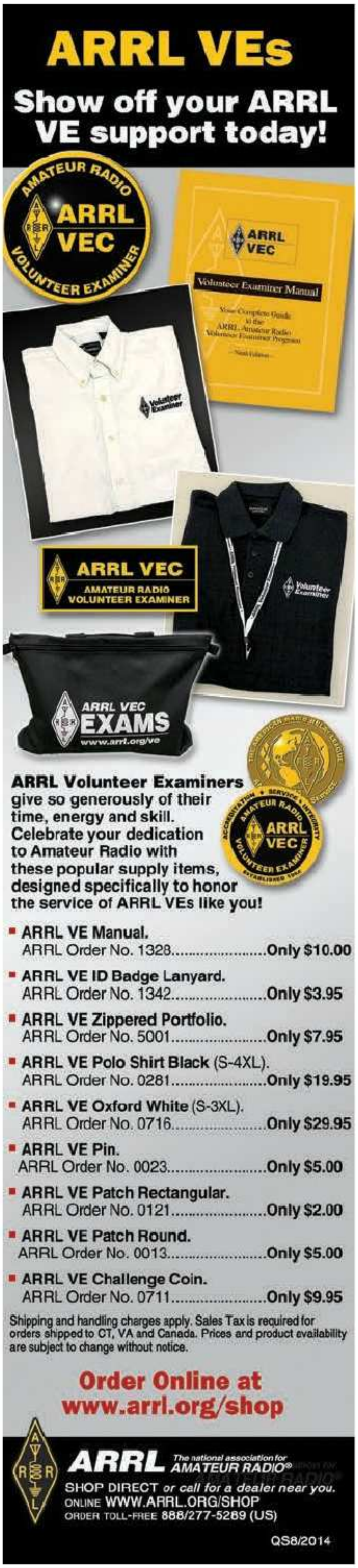

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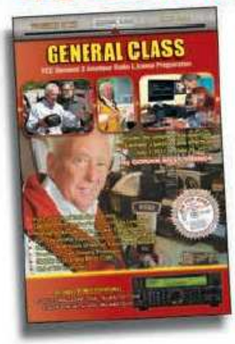

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