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QST

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December 2014 WWW.ARRL.ORG

DIGITAL EDITION

Season's Greetings

QST reviews:

- **CommRadio CR-1a** Communications Receiver
- **HobbyPCB Hardrock-50** 160-6 Meter 50 W Amplifier Kit
- **MFJ-4403 Transceiver Voltage Conditioner**

Holiday Gift Guide
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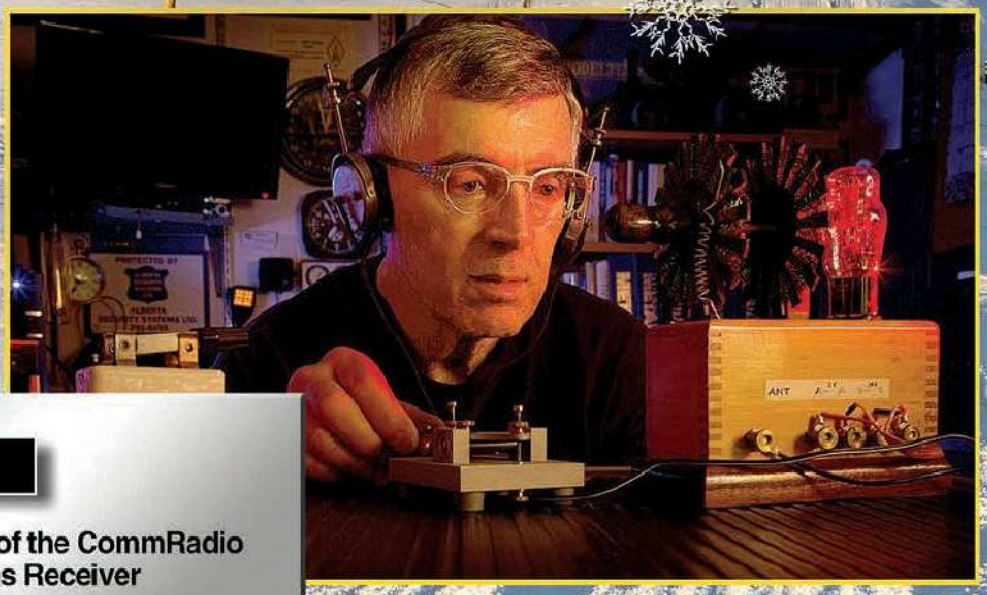
ARRL 100 YEARS



DIGITAL FEATURE

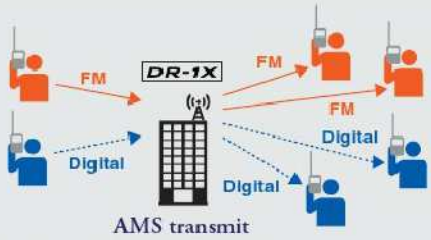
System Fusion

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 Digital Clear Voice
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

Exciting New Amateur Digital Transceiver

C4FM Digital Clear Voice
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 Digital Clear Voice
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 Digital Clear Voice
Clear and Crisp Voice Technology

Amateur Radio Internet Linking Kit

HRI-200

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The radio

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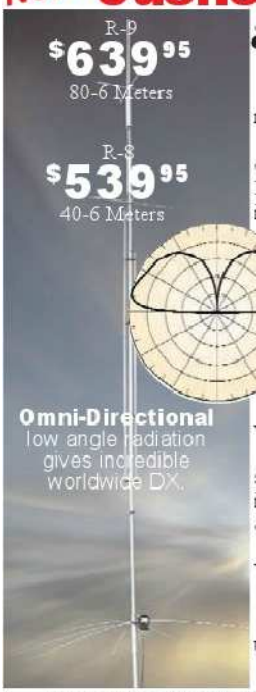
New! Cushcraft R9 . . . *80-6 Meters*



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

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

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

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

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

The R9 is super easy to assemble, installs just about anywhere, and its low profile blends inconspicuously into the background in urban and country settings alike.

Compact Footprint: Installs in an area about the size of a child's sandbox -- no ground radials to bury with all RF-energized surfaces safely out of reach.

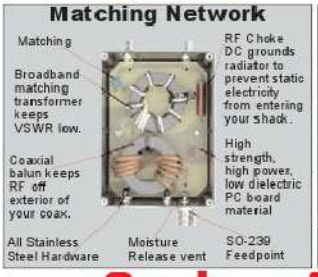
Rugged Construction: Thick fiberglass insulators, all-stainless steel hardware and 6063 aircraft-aluminum tubing is double or triple walled at key stress points to handle anything Mother Nature can dish out.

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

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

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

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



MA-5B *5-Band* Beam

Small Footprint -- Big Signal

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

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

Cushcraft 10, 15 & 20 Meter Tribander Beams

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

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

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

Cushcraft Dual Band Yagis

One Yagi for Dual-Band FM Radios

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

Cushcraft Famous *Ringo* Compact FM Verticals

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

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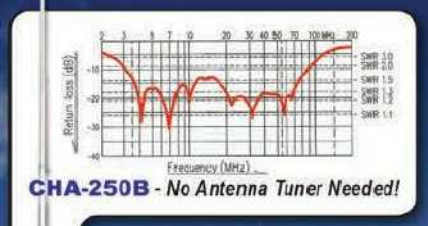

CHA-250B - *No Antenna Tuner Needed!*

Base Antennas

1 COMET CHA-250B BROADBAND 80M THROUGH 6M VERTICAL ANTENNA
A newly designed broadband vertical with NO GROUND RADIALS. EXTREMELY easy to assemble, requires no tuning or adjustments and VSWR is under 1.5:1 from 3.5-57MHz! • TX: 3.5MHz – 57MHz • RX: 2.0– 90MHz • VSWR is 1.5:1 or less, continuous • Max Power: 250W SSB/125W FM• Impedance: 50 Ohm • Length: 23' 5" • Weight: 7 lbs. 1 oz. • Conn: SO-239 • Mast Req'd: 1" – 2" dia. • Max wind speed: 67MPH

2 Maldol HVU-8 ULTRA-COMPACT 8 BAND HF/VHF/UHF VERTICAL ANTENNA
80/40/20/15/10/6/2M/70cm Only 1/2 the traditional size and weight of vertical HF antennas, and it includes 2M/70cm! Unique radial system rotates for balcony installations, the radials can all be rotated to one side. • Wavelength: HF and 6M: 1/4 wave • 2M: 1/2 wave • 70cm: Two 5/8 waves in phase • Impedance: 50 Ohm • Max Power: HF 200W SSB • 6M–70cm: 150W FM• Conn: SO-239 • Height: Only 8'6" • Weight: 5lbs. 7ozs.

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

4 COMET GP-6 DUAL-BAND 146/446MHZ BASE REPEATER ANTENNA
Wavelength: 146MHz 5/8 wave x 2 • 446MHz 5/8 wave x 5 • Max Pwr: 200W • Length: 10'2"• Weight: 3lbs. 8ozs. • Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

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

6 COMET CX-333 TRI-BAND 146/220/446MHZ BASE REPEATER ANTENNA
Wavelength: 146MHz 5/8 wave x 2 • 220MHz 5/8 wave x 3• 446MHz 5/8 wave x 5 • Max Pwr: 120W • Length: 10'2" • Weight: 3lbs. 1oz.• Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

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

CAA-500
1.8-500MHz SWR/Impedance analyzer
Simple to use and accurate, the CAA-500 displays antenna system SWR and total impedance while turning the thumb wheel to sweep though the selected frequency range.

SO-239 connector for the low range.

N-female provides stable impedance in the high range

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Our Cover
Both of the images that grace our December cover were provided by Jerry Clement, VE6AB. The snowy scene was photographed southwest of the city of Calgary, Alberta, Canada in the foothills that border the eastern slopes of the Rockies. The inset image is of Jerry himself, bathed in the warm holiday glow of his homebrew regenerative receiver.

Radiosport

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When the band is open there's no time to lose!

YOU'RE GOOD TO

It was around eight in the evening and the house was pretty quiet. The kids were finally in bed, and the XYL was working on her dissertation. I tell you, when she gets that masters in psychology I'm gonna be in a world of trouble. Anyway, I retreated to the shack and turned on the HF rig to see if there was anything left of 20 meters this late. Mostly not, but as I got down toward the low end of the phone band I heard a whole bunch of faint stations calling a VP8S. I had to look it up; it's a rare DX island in the South Atlantic. I'm thinking "Yeah right, like I can bust through a pileup and work someplace like that with 100 watts and a dipole." Just then the DX station answered someone, and he nearly woke up my kids! He was booming in 10 over 9! It was one of those flukes of propagation, and I figured it might not last long; here was my chance to work some real DX. Down that low in the band my dipole gets pretty reactive, so I ran my transceiver's built-in tuner. It went something like this:

Me: Ok radio, tune me up.
Radio: Whirrr... whirrr... Uhh, no.
Me: No? What do you mean "No"?
Radio: Dude, have you seen the SWR down there? It's like 4:1!
Me: Yeah, so?
Radio: No can do, Boss. How about the top of the band again? I'm ok up there.
Me: Not good, radio... not good at all.

Well I'm paraphrasing of course, but that was pretty much it. Ok, no worries; I have an LDG tuner too – it's good to an SWR of 10:1. I took it out of bypass mode, tuned off frequency, changed to AM mode, reduced the power, keyed down and started the tuner. I waited until it finished, un-keyed, switched back to sideband mode, reset to full power, and tuned back to the DX frequency just in time to hear: "Sorry guys, but we have to QRT. 73s, and thanks... click!" And that was it; my VP8S was gone, probably forever.

Even if you have an automatic tuner, matching a modern radio to your antenna can be a lot like playing a concerto on the piano; you have to hit half a dozen keys in just the right sequence. And if you're still using a manual tuner, like one with two knobs and a roller inductor or something, well... fuggedaboutit. And, most radio's built-in tuners are limited an SWR of 3:1 at most; my droopy old dipole is lots worse than that down at the low end of the band.

Well, there's good news. Not only do LDG tuners work automatically, with thousands of memories for instant re-tuning on previously tuned frequencies, LDG makes special models specifically designed to seamlessly integrate with Kenwood, Yaesu, Icom and Alinco transceivers. You just press the Tune button and the tuner takes over, setting mode and power, tuning and returning to the previous mode and power in seconds. And if you're re-tuning on a frequency you've used before, the tuner reads the frequency digitally from the radio, and resets from memory almost instantly, with no tuning transmission at all. It's just what you need for pouncing on that rare DX or contest station before it's gone.

LDG brand-specific tuners include custom cables to connect to your transceiver, as well as a coax jumper for RF. Most are powered by the radio itself; just plug it in and you're good to go with an integrated tuner that will match just about any coax-fed antenna at SWRs up to 10:1. LDG also sells baluns so you can easily use longwires, or antennas fed with ladder line.

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radio not included

ALL TUNERS 2000 MEMORIES

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Designed for Yaesu's FT-450, FT-450D, FT-950, FTDX-1200, FTDX-3000 and FT-2000 (non-D). Seamless integration similar to the popular YT-450. The tuner is powered by the transceiver (except the FT-2000). It has a CAT port pass-through so you can use computer control of the transceiver when using this tuner. Power and control through the provided interface cable.

Suggested Price $259.99

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.

Suggested Price $199.99

AL-100

Compatible with all Alinco radios including the new DX-SR8T (includes Alinco interface cable). The AL-100 is the definitive low cost automatic antenna tuner for the definitive low cost Amateur transceiver!

Suggested Price $149.99

IT-100

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.

Suggested Price $179.99

YT-100

For Yaesu FT-857, FT-897 and FT-100 (and all D models) an integrated tuner, powered by the interface. Press the tune button on the tuner, and everything else happens automatically.

Suggested Price $199.99

KT-100

For AT-300 compatible Kenwood transceivers (except TS-480HX). The KT-100 allows you to use the Tune button on the radio. 2,000 memories for instant recall of tuning parameters for favorite bands and frequencies.

Suggested Price $199.99

Z-817

radio not included

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.

Suggested Price $129.99

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

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YAESU
The radio

FT450D

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

Progress on 5 MHz

"Amateurs in the US and some other countries have enjoyed limited access to spectrum near 5 MHz for more than a decade. Progress toward an international allocation has been slow — but that may be changing."

When specific frequency bands were first allocated to amateurs in the 1920s, they had a harmonic relationship. Transmitters of the time had little in the way of harmonic suppression, so the idea was to keep harmonic interference within the ham bands as much as possible. As our understanding of ionospheric propagation grew, it became evident that this approach left significant gaps in propagation coverage at different times of the day, different seasons, and different levels of solar activity.

In the 1970s, our preparations for the 1979 World Administrative Radio Conference (WARC-79) were predicated on bridging those gaps. The International Amateur Radio Union, including the ARRL and its sister societies throughout the world, argued successfully for new amateur bands at 10, 18, and 24 MHz. The new bands were not as wide as we had hoped, but the increased flexibility they have afforded has been very beneficial to Amateur Radio.

In the 1990s, the IARU Administrative Council identified a band in the vicinity of 5 MHz as a long-range objective for Amateur Radio. As was the case with the upper HF bands prior to WARC-79, there are propagation coverage gaps between the 3.5 and 7 MHz bands. Atmospheric noise also becomes more of a limiting factor as one goes lower in frequency, particularly in the tropics where the Amateur Service is often called upon to respond to natural disasters.

The Administrative Council was under no illusions that it would be easy to obtain such an international allocation, even on a secondary basis. Unlike WARC-79, the World Radiocommunication Conferences (WRCs) that the International Telecommunication Union now convenes every 4 years or so have limited agendas; getting an item on the agenda is a battle in itself. Fixing 40 meters, which at the time was only 100 kHz wide in ITU Regions 1 and 3 and even in Region 2 was subjected to heavy interference from broadcasters in the upper 200 kHz, had a higher priority until the issue was addressed at WRC-03. Around that time, efforts to gain very limited access to 5 MHz on a country-by-country basis, subject to there being no harmful interference to the internationally allocated services, began to bear fruit including here in the United States. (As of now there are about 40 countries that have granted access of some kind to their amateurs.)

The agenda for WRC-07 offered the first opportunity for an international allocation. It called for a review of the allocations to all services between 4 and 10 MHz, with certain exceptions. We prepared a strong case for a 5 MHz amateur allocation based on increasing the reliability of amateur emergency and disaster relief communications and gathered some support from administrations. However, the main thrust of the agenda item was to accommodate the spectrum requirements of HF broadcasting — a service that has declined recently but was still influential at the ITU when the agenda was formulated in 2003. Broadcasters were unable to achieve any improvement in their allocations at WRC-07 and our slender hopes for an amateur allocation at 5 MHz died along with theirs.

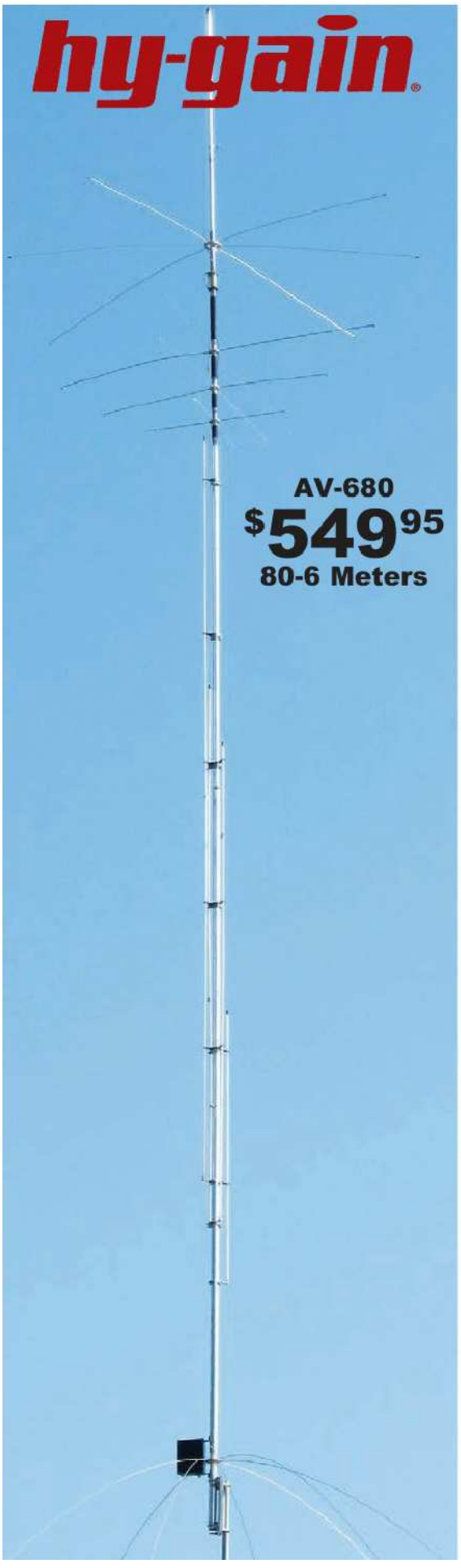
Thanks mainly to Cuba, at WRC-12 an agenda item to consider an amateur allocation on a secondary basis within the range 5250 – 5450 kHz was approved for the conference in 2015. For more than two years, a team of IARU volunteers and ARRL staff have been laboring to build upon the work done prior to WRC-07. At a series of meetings in Geneva known in ITU-speak as ITU-R Working Party 5A, representatives of the IARU and of various administrations — not all of them sympathetic — hammered out draft text for a Conference Preparatory Meeting (CPM) report that will be finalized at a meeting early next spring and will provide the technical basis for the consideration of proposals from administrations at WRC-15 in November. The representatives of administrations in WP5A included amateurs from the IARU member-societies of Australia, Canada, Germany, Japan, and the United Kingdom in addition to ARRL Chief Technology Officer Brennan Price, N4QX.

The draft CPM report text envisions four possible ways to address the agenda item positively in addition to the negative option of "no change." The positive methods include secondary allocations of 5275 – 5450 kHz and of 5350 – 5450 kHz along with two that are less specific but narrower. However, it is important to know that the CPM report is just a reference document, not a series of proposals. WRC-15 will only consider proposals that come from administrations, either directly or via regional telecommunications organizations (RTOs).

Efforts to build support for an allocation in the RTOs so far have had mixed results. In CEPT, the European organization, there is significant support for a 100-kHz allocation but not yet enough to lead to a European Common Proposal. The most encouraging development to date occurred at a committee meeting of CITEL, the RTO for the Americas, held in Mexico earlier this autumn. There, six administrations — enough for it to become an Inter American Proposal — supported a 175-kHz allocation while Canada proposed something less but still positive. This is progress, but as of yet it's far from enough.

Alas, one of the remaining stumbling blocks is here at home. While the FCC WRC-15 Advisory Committee on behalf of private sector spectrum interests has endorsed a 175-kHz allocation, as reported in "Happenings" this month we face resistance from the federal government side.

How will it turn out? We'll know next November. In the meantime, we will keep working until we prevail or the clock runs out, whichever comes first.



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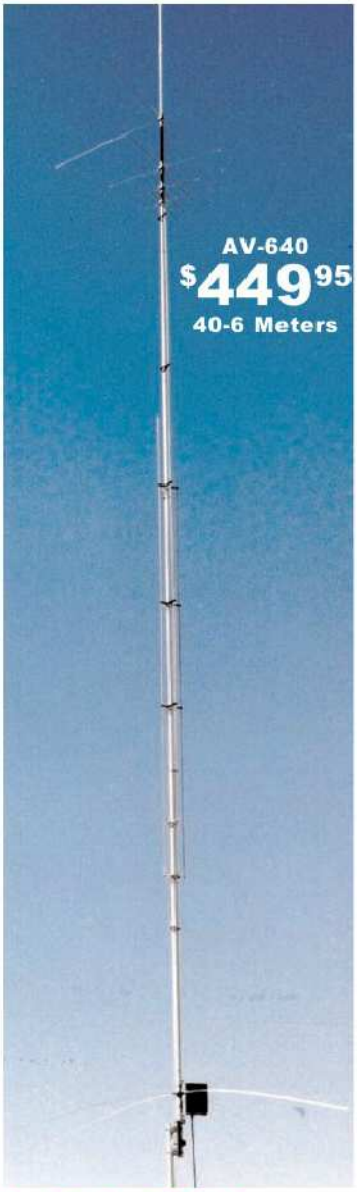

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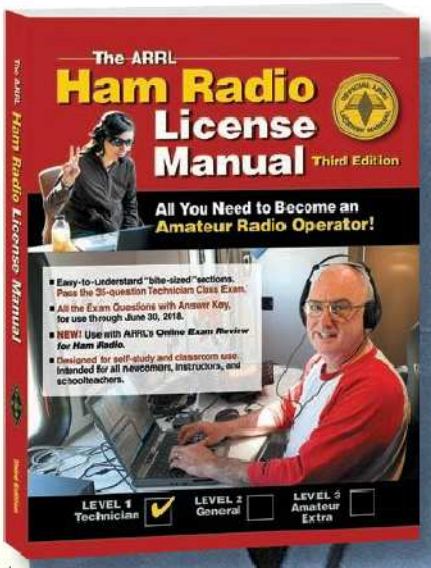

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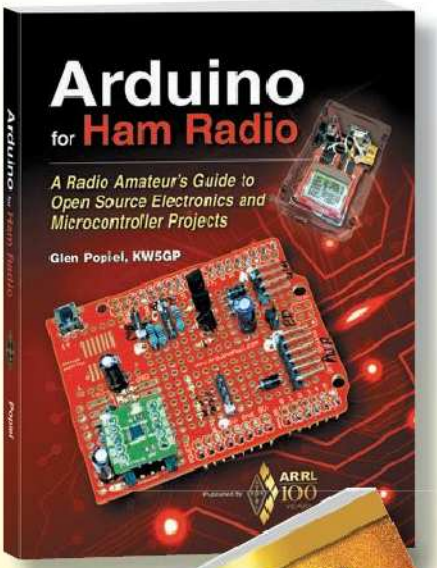

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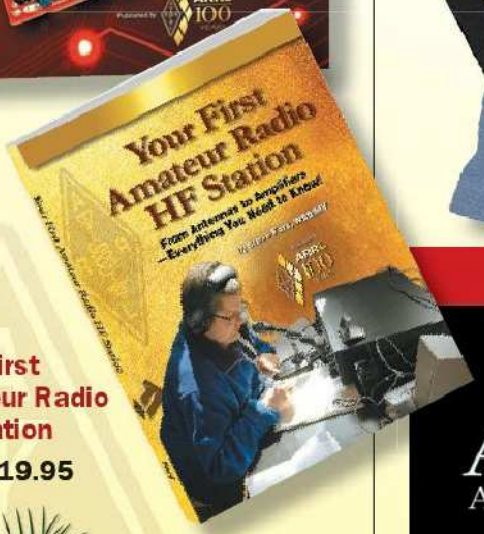

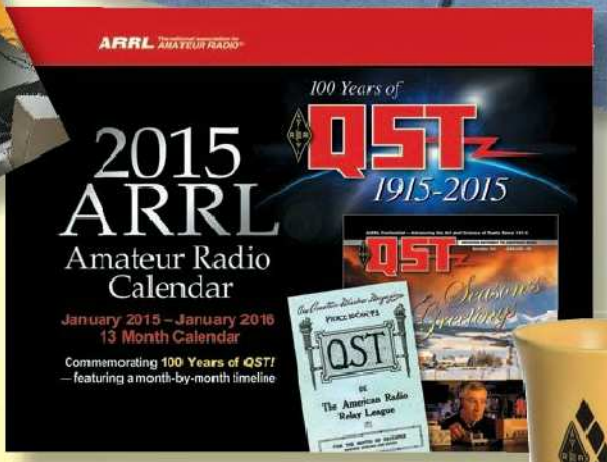

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Harold Kramer, WJ1B – hkramer@arrl.org, ARRL Chief Operating Officer/*QST* Publisher

The ARRL Laboratory Part 3 — Industry Relations

The ARRL Lab's efforts extend well beyond our Newington headquarters. Ensuring that Amateur Radio is represented nationally and internationally with regulatory agencies, standards bodies, the electronics industry, and professional associations is an important function of the ARRL Laboratory.

Much of the ARRL's industry liaison work is performed with The Institute of Electrical and Electronics Engineers (IEEE, **www.ieee.org**), the international membership organization representing electronics and computer engineers. Lab staff members are associated with the IEEE, primarily through the Electromagnetic Compatibility Society (EMC, **www.emcs.org/**) along with other IEEE Societies, including the Antennas and Propagation Society, Communications Society, and the Instrumentation and Measurement Society. The ARRL's membership in these groups assures that the ARRL staff has access to new and developing technology, particularly developments that affect Amateur Radio.

Active Participants, Real Results

ARRL's work with industry is not limited to professional society memberships. Since industry groups' decisions can profoundly affect Amateur Radio, we actively engage with them in organizations such as the ANSI C63® EMC Committee, the US EMC standards consensus body, and the IEEE EMC Society Standards Development and Education Committee (SDECom, **www.emcs.org/standards/sdecomindex.html**). The Lab staff also participates in other industry groups, such as the Electric Power Research Institute and HomePlug, a consortium of BPL manufacturers.

Participation in these organizations greatly benefits Amateur Radio. For example, in the C63® Committee, the ARRL participated in a working group that developed a scientifically based method for estimating the decay of HF signals with distance. In SDECom, we introduced an IEEE Recommended Practice to describe how electric utilities should respond to customer complaints about radio noise.

In the case of BPL, the protection that ARRL sought for Amateur Radio has been adopted by industry and included in every BPL industry specification. Protection for Amateur Radio has also been adopted internationally through the ITU-R SM.2158 report (**www.itu.int/dms_pub/itu-r/opb/rep/R-REP-SM.2158-3-2014-PDF-E.pdf**), thanks to the work of a number of IARU Societies that worked together on a worldwide standard and regulatory approach.

The ARRL staff members are not simply passive participants. They are, quite often, leaders in these endeavors. ARRL Laboratory Manager Ed Hare, W1RFI, is an elected member of the IEEE EMC Society's Board of Directors. He also served as the Secretary of SDECom; as the Vice Chair of the P1775 BPL EMC Working Group; and as the past Chair and current Vice Chair of the C63® Subcommittee 5, dealing with the EMC immunity of equipment.

These partnerships pay large dividends. When problems do arise that could affect Amateur Radio, we can build on these relationships to find a solution. For example, when the Lab recently received reports of arc-fault current interrupters (AFCIs) tripping from a low-power HF Amateur operation, they contacted the manufacturer, who already knew the ARRL. The manufacturer ultimately redesigned the circuit breakers to eliminate this problem. By maintaining effective contact with the electronics industry, the Lab staff makes ongoing, positive contributions to the development of radio technology, making certain that industry recognizes Amateur Radio as a valued participant in today's technology arena.

Technical Information Service — TIS

While I have written about it previously, I wanted to finish my series on the Lab with the ARRL Technical Information Service (TIS). This service continues to be one of the most valuable benefits that we provide for our members. Lab engineers Ed Hare, W1RFI; Zack Lau, W1VT; Mike Gruber, W1MG, and Bob Allison, WB1GCM, manage this program. Tony Nesta, AA1RZ, provides administrative support. TIS answers over 5000 technical questions from members each year on a wide range of Amateur Radio-related topics, including electronics, software, and much more. The service is available to ARRL members at no charge. While TIS does accept phone calls, the best way to contact TIS is via e-mail at **TIS@arrl.org**. For more information about the TIS, visit **www.arrl.org/technical-information-service**.

Zack Lau, W1VT, answers member questions as part of the TIS.

Finally, thanks to the Lab staff for their assistance in the preparation of this series of articles. Their experience, knowledge, and passion for Amateur Radio are, ultimately, the ARRL Laboratory's most valuable assets.

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www.arrl.org/sections

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

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Ameritron 160-6M 1.2kW FET Amplifier

1.5-54 MHz…1200 Watts PEP Output…Auto bandswitching, no tuning, no warm-up, SWR protected, Quiet Variable-Speed Cooling… Fwd/Ref PEP, PA Balance, ALC, V, I Metering

AMERITRON new ALS-1306 1.5-54 MHz solid state FET no-tune Amplifier gives you 1200 Watts PEP output on all bands, including 6-Meters. Automatic bandswitching! No tuning! No warm-up! No tubes! Quiet!

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Other amplifiers using a single power device *cannot* do this. Some power FETs are a package of several transistors in a single case and concentrate all the heat in one small area -- making them difficult to cool. If one transistor fails, they all fail.

The ALS-1306 RF deck operates at 50 Volts for efficient, low distortion linear RF power service. It's cooled by a whisper quiet fan. Fan speed is regulated by temperature sensors, assuring minimum noise.

1200 Watts PEP Output on all bands
1.5-54 MHz including 6 Meters

ALS-1306 runs up to 1200 Watts of clean SSB output power (just 100 Watts drive gives you the full rated 1200 Watts output) for *continuous* coverage between 1.5-54 MHz. 10/12 Meters is included.

This compact operator-friendly and attractive desk-top amplifier fits neatly into any station. Just 10Wx6½Hx18½D inches. Weighs only 22 pounds.

SWR Protection prevents amplifier damage if you switch to a wrong band, use the wrong antenna or have high SWR.

If forward or reflected output power exceeds a safe level then output power is automatically reduced to prevent amplifier damage by controlling ALC to exciter.

LED-illuminated Cross-Needle SWR/Wattmeter lets you read SWR, forward and reflected *peak* power simultaneously. You also get ALC, SWR, PA balance and current metering with LED backlight. An Operate/Standby switch lets you run "barefoot", but you can *instantly* switch to full power if needed.

Front-panel ALC control!

This *exclusive* Ameritron feature lets you adjust output power conveniently from the front panel.

Has bandswitch, ALC, SWR, PA and TX LED indicators.

Automatic Bandswitching!

Place your amplifier and power supply out-of-the-way and control your amplifier directly from your rig!

ALS-1306 automatic bandswitching reads band data from your transceiver and automatically changes bands as you change bands. An optional interface cable is required for your particular radio.

Clean, Modular Construction

Ameritron ALS-1306 amplifier has modular construction for *easy-servicing*, unlike other amplifiers that are so tightly packed they are un-serviceable.

ALS-1306 Power Supply

The ALS-1306 is powered by a 50 VDC switching power supply. Comes with a pre-wired cable to plug into the ALS-1306.

This *hash-free* fully regulated swtiching power supply is only 12 lbs. and measures a compact 10Wx6½Hx9½D inches. It can be placed conveniently out-of-the-way. Output is 50 VDC at 50 Amps to the ALS-1306. Wired for 220 VAC, selectable to 110 VAC. Draws less than 25 Amps at 110 VAC; 12 Amps at 220 VAC.

New! ALS-1306 **$3299** Suggested Retail

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500 Watt Mobile Amplifier

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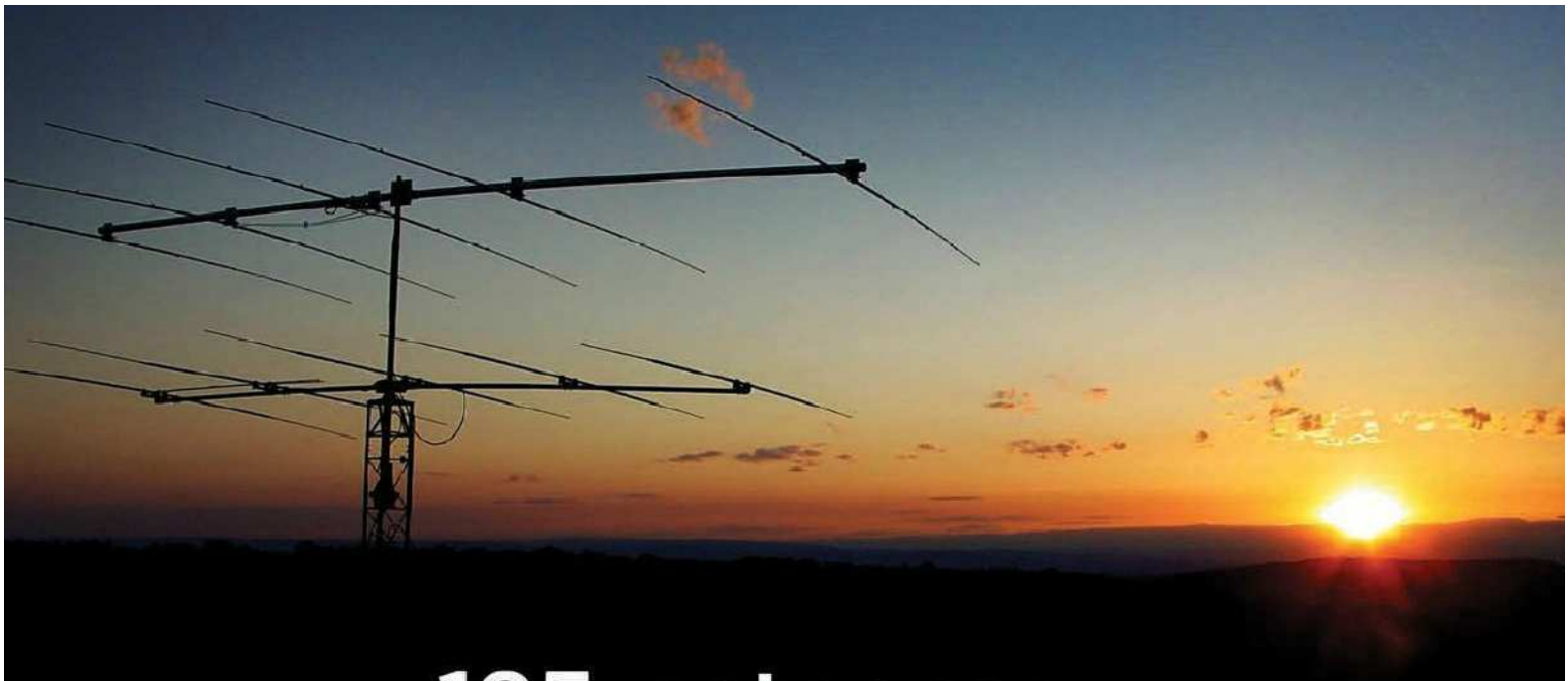

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KX3-2M/4M module adds 2 or 4 meter capability

Intended for both local emergency communications and casual all-mode use, the KX3-2M and -4M modules provide power output of 2.5 – 3 W typical at 13.8V and excellent receive sensitivity. Includes full FM/repeater support including CTCSS tones and DTMF.

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KXPA 100 Amplifier Specifications

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Steve Ford, WB8IMY, upfront@arrl.org

Field Day 2014

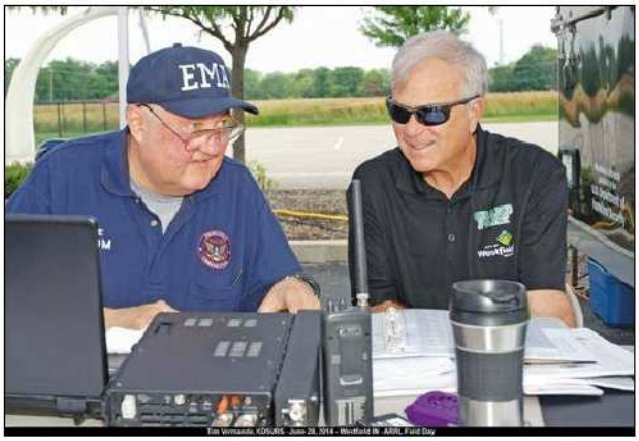
See the results in this issue!

It took two days for Bob Pfiester, KF7WOR, and his son-in-law to clear a little-used road to their Field Day site atop 6000-foot Elk Butte in north central Idaho. On the big day, Bob, KL2JY and DeAnn, KL2MA, Isenberg, drove up and assembled the first of two stations. Fog soon enveloped the site, but they went on the air regardless. A few hours later KF7WOR returned with his wife Norma and Joe Overstreet, W1YV, to put the second station on the air.

Island County Amateur Radio Club members Jon Edwards, AE7TE (right), and Wayne Jeffers, WJ7H, used hand-held antennas to successfully contact NA1SS on the International Space Station from the club's Field Day site on Whidbey Island, Washington. [Vince Bond, K7NA, photo]

Ed LaJoie, W1MA, bangs out CW contacts in the N1QP Field Day shack of the Norwood (Massachusetts) Amateur Radio Club. [Rick Booth, KM1G, photo]

Ellie Rose Tucker enjoys making a contact at the Escondido (California) Amateur Radio Society Field Day site while control operator Bud Hennessy, AE6BH, looks on. [Matthew Tucker, N6EAJ, photo]



ARRL Indiana Section Public Information Coordinator/Officer Joe March, KJ9M (left), demonstrates Amateur Radio for Westfield, Indiana Mayor Andy Cook. [Tim Vermande, KD5URS, photo]

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The K3 already gives you the competitive edge, with its optional high-performance sub receiver, roofing filters as narrow as 200 Hz, new audio peaking filter (APF), and one of the cleanest SSB signals around. Adding the P3 and KPA500 will take you, and your station, to the next level.

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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.

Hertz "Hurts"

In 1960, the General Conference on Weights and Measures honored Heinrich Hertz by designating his surname as the unit of frequency, replacing "cycles per second." As late as 1967, hams were still arguing about it in the pages of QST! *—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. I usually consider myself a liberal, willing to welcome valid innovations, but this term "Mega-Hertz" is an illogical abomination and I hope you will resist it to the last cycle per second.

H.R. Hands, VE3AOE, Hamilton, Ontario, Canada

How Channelization Came to Be

The Vintage Radio column "FM Revolution," in the October issue of *QST* didn't include anything about channelization for FM operation.

Here's how it came about. When the converted crystal-controlled commercial gear first appeared on 2 meters in the mid-to-late 1950s, localities were choosing operating frequencies at random, leaving the gear useless when traveling. In the early 1960s, several hams working for General Electric's Mobile Radio Department in Lynchburg, Virginia recognized the absurdity of this and set about to bring some standards to the frequency selection process.

A national first-frequency of 146.94, with other channels spaced multiples of 60 KHz from it and a minus 600 KHz separation for the corresponding repeater input frequency, were promoted. They chose 146.94 because it was the highest 60 KHz channel that Technician class hams could operate on at that time, as well as being closest to the original 150+ MHz operating range of the commercial gear.

The GE hams published the mimeographed "FM News," helping to spread the standards, and *QST VHF* Editor Ed Tilton soon started including a little box in his columns promoting 146.94. As FM operation spread across the country, repeaters appeared on many 60 KHz spaced channels, and soon others got involved in the standardization efforts, which evolved into the VHF/UHF band plans that we have today.

Tom McKee, K4ZAD
Cary, North Carolina

No Love for LEDs

With regard to the "Light Emitting Noisemaker" problem mentioned in "Hints & Kinks" in the October issue of *QST*, I had this problem a couple of years ago with LED screw-in bulbs from Home Depot and my RadioShack Weather Radio. The weather radio had been in service for 17 years, and one day I noticed it wasn't receiving like it used to, even though the weather service transmitter had been relocated even closer to my home. I just purchased a new Midland weather radio and thought that would be the end of it. I quickly found out that the Midland radio had the same poor receive problem. I got frustrated and left it alone for a little while. When I went back to check it out again, the radio was working fine. Then it dawned on me that the last time I'd been testing it, my nightstand light with the LED replacement lamp had been turned on. The LED lamp was emitting enough noise that it killed the receiver in my weather radio.

The antenna on my weather radio is 2½ feet tall when fully extended straight up, and the tip is about 16" from the wall-mounted nightstand light in our bedroom. I took my AVCOM Spectrum Analyzer and set its antenna right next to the weather radio to see what the signal looked like. I was pretty shocked at what I saw.

With the light off, the weather service signal was a nice clean spike in the center of the display, protruding well above the slight noise floor. When I turned the light on, the quiet noise floor burst upward, burying the weather service signal in raucous noise.

I wish I remembered the brand of LED bulb I was using at the time, but I don't. Needless to say, I removed the LED bulb and went back to the CFLs I was using.

Dan Tassell, KC5PCB
Magnolia, Texas

Returning to Radio

Because I'm retired and traveling, this past March I decided to install my 1985 generation Kenwood in my van. I tuned around on 80 meters one night and found Dave, K3TX, checking into PTN, the Pennsylvania CW Traffic Net. He was 20 over S-9, and I found that he lived just a couple of miles away from me. I had unplugged all my gear in 1993, but after a few calls to the net, I was hooked! I gradually found my equipment and put up a 80/40 meter dipole cut for the CW portions of those bands. CW itself was another matter — it was like learning all over again. I started to check into CW traffic nets and my speed came up. I still have a long way to go, but I'm enjoying myself. Thanks to everyone I've worked for their patience, and to K3TX for being my mentor this time around.

Tom Mills, AF4NC
Life Member
Yardley, Pennsylvania

A Plea for Phonetics

I would like to air my displeasure at hearing hams using their own phonetics when identifying. I even find that some hams use different phonetics in the same transmission! Just when you think you might have heard correctly the first time, two seconds later you have to try to sort it out again because the person at the other end is using different words. I find this very annoying, especially when they're in the noise. The standard phonetic alphabet was developed for a purpose. Let's stick to it.

William Sterling, K4OOO
Ruckersville, Virginia

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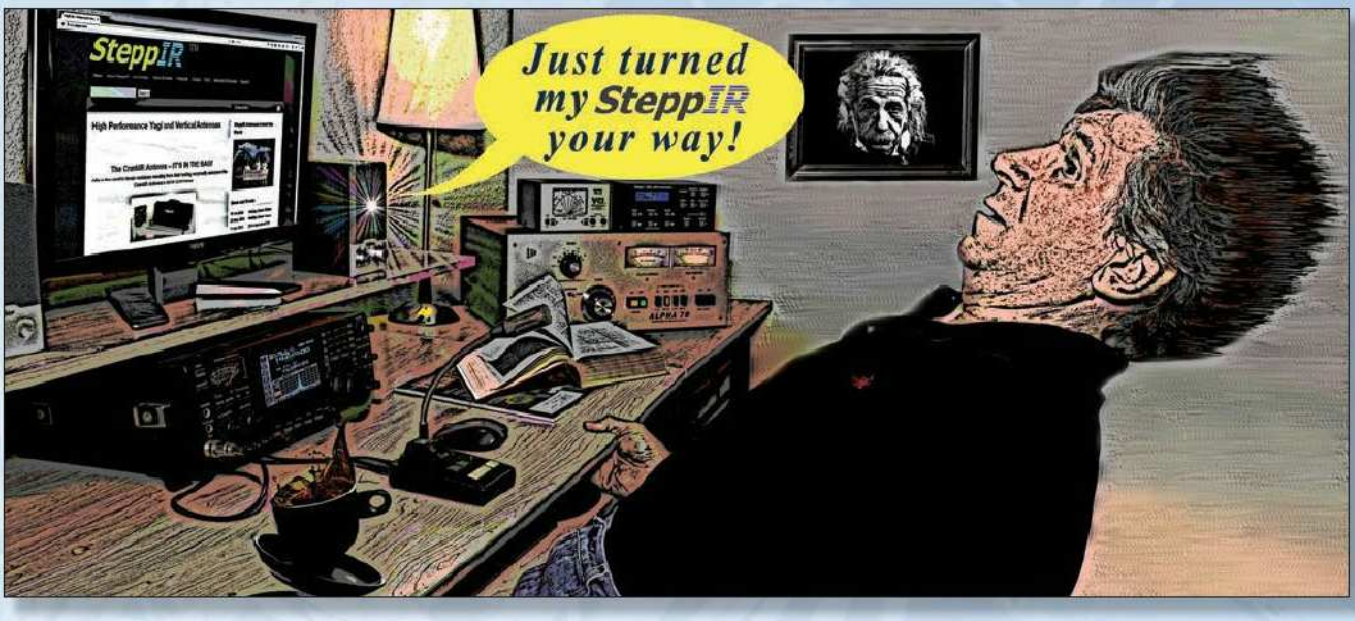

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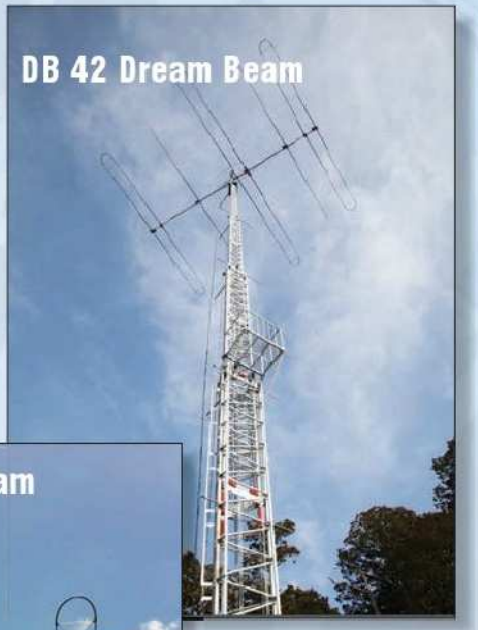

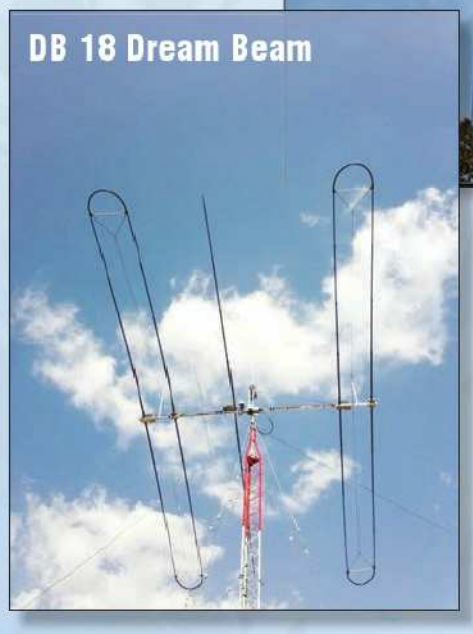

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A 1500 W Centennial Amplifier for the 80 – 6 Meter Bands

This 8877 triode-based amplifier includes technologies from a century of transmitter development.

Ralph J. Crumrine, N0KC

My goal was to homebrew a vacuum tube HF amplifier that included the 6 meter band. The project coincided with the ARRL Centennial celebration, and was meant to illustrate the advances in radio transmitter technology over this past century. To that end, it includes a laminated core transformer design dating from the start of the 20th century, a 1920s ceramic tube insulator for the plate choke, National Velvet Vernier geared dials of the 1930s, transistors and printed circuit boards of the 1950s, integrated circuits of the 1960s, external anode power triode of the 1970s with roots from the early 1900s, as well as today's 21st-century fine-line printed circuit boards with surface-mounted components. This is truly a centennial project!

I documented this project extensively, including schematics, mechanical drawings, lists of materials, a parts vendors listing, finished printed circuit board (PCB) designs, and so on, on the *QST* in Depth web page.[1] Why a tube-based amplifier? At the 1500 W level, and with 6 meters, you get the mystique of vacuum tubes as well as more bang for your buck.

Including the 6 meter band transitions the design technique from lumped to distributed elements. Components are large by design for the high power involved, so they are plagued by stray couplings. Long leads begin to look like transmission lines, and so on. Add the complexity of multiband switching at high power levels, and the design gets challenging.

Amplifier Features

This band-switched amplifier covers 80 meters to 6 meters (except 60 meters and 30 meters). It operates at the best attainable loaded Q in the output matching circuit. The input to the tube is matched with relay-switched Pi networks controlled by the front panel band switch.

RF PIN diode-switched dual inputs and relay-switched dual outputs provide convenience and flexibility. The inputs accommodate either a single transceiver with two outputs, or two separate transceivers (for which two keying inputs are provided). One output is provided for the HF bands and another is for the 6 meter band. The inputs and outputs are controlled according to the amplifier band switch and the status of the keying lines.

I used 13 separate printed circuit boards, shown in Figure 1, throughout the design. A printed circuit board assembly has proven very effective for the high voltage RF band switch function where it orga-

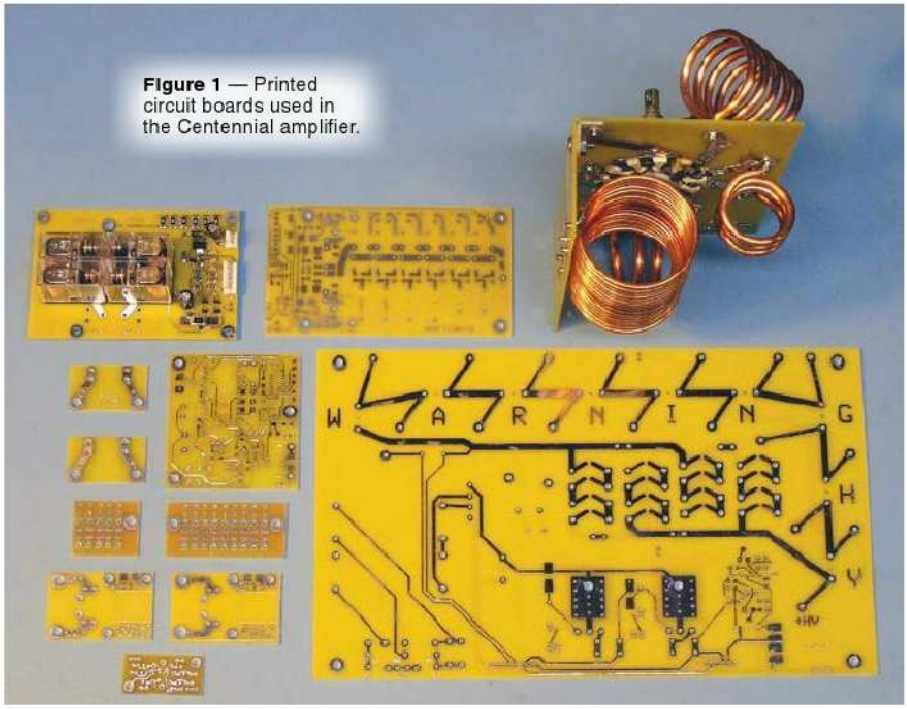


Figure 1 — Printed circuit boards used in the Centennial amplifier.

[1]Notes appear on page 35.

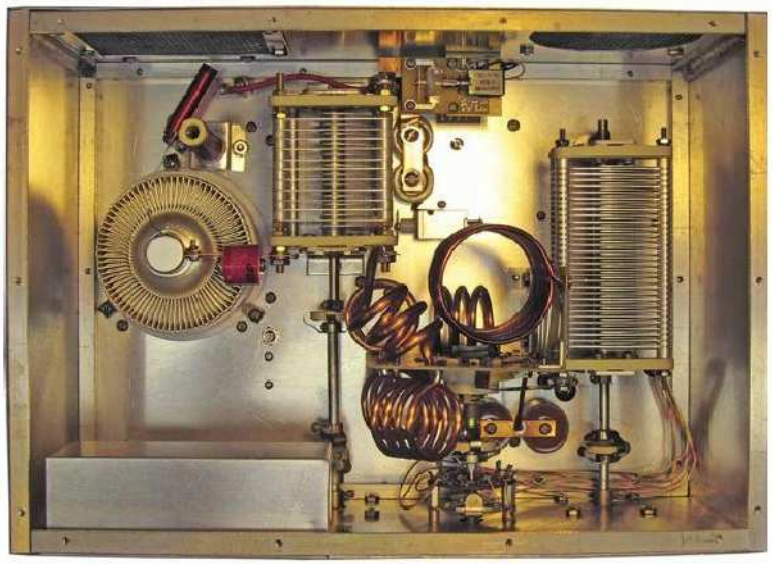


Figure 2 — Amplifier internal view from the top.

Table 1
Centennial Amplifier Measured Performance and Tuning Dial Settings

Frequency, MHz	Power In, W	Power Out, W	Tune dial setting	Load dial setting	Grid, mA	Plate, mA
3.75	45	1490	61	52	57	820
7.15	40	1475	65	79	46	770
14.18	45	1530	21	44	55	800
18.1	40	1510	19	41	62	790
21.22	35	1480	13	36	48	770
24.9	35	1480	12	32	52	770
28.5	40	1480	12	31	54	790
52	65	1560	11	20	50	1150
52	45	1250	11	21	46	950

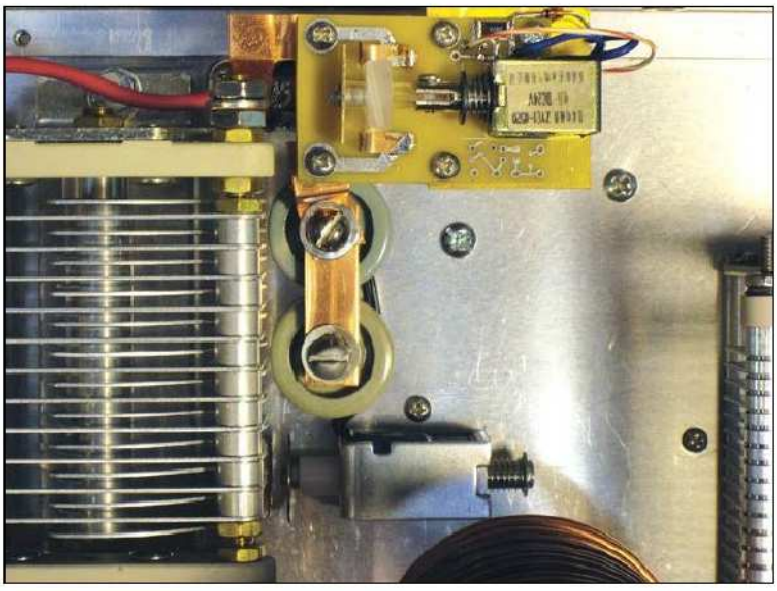


Figure 3 — Detail view of capacitor switching solenoids.

nizes and connects large coils with minimum lead length. The design includes a high speed over-current shutdown. An optical isolator, capable of switching in milliseconds, monitors the tube anode current. I employed computer aided design (CAD) techniques for amplifier stabilization.

A tube warm-up timer, one of the several control board functions, flashes a yellow LED during warm-up. High voltage may be applied to the tube only after the timer times out. A dc voltage watchdog monitor circuit at the antenna output connection will shut down the amplifier if it senses a dc voltage in excess of about 50 V, to guard against insulation failure of the plate coupling capacitor. This circuit still allows using the transmission line for remote dc supply or controlling purposes as long as these functions apply less than 50 V on the RF transmission line.

An external ac squirrel cage blower provides primary cooling air. The air duct connects by a 2-inch flange in the input compartment. It idles silently with enough airflow to remove heat from the filament, and the blower switches to full speed with application of the transmitter keying input. I also made a provision for controlling a 24 V dc box fan mounted on the rear of the unit. The box fan moves air throughout the remote reaches of the chassis, ensuring uniform cooling in the amplifier compartment. The box fan is not intended as a primary means of cooling.

The AM type National Velvet Vernier tuning dials, available from time to time on eBay, allow for precise tuning settings that can be recorded for any given set of loads, such as those shown in Table 1.

The novel high power RF relays (see Figure 2, and the detail in Figure 3) switch in fixed capacitors at both 80 meters and 6 meters. I designed the relays using hobby solenoids and built them expressly for switching high current, high RF voltage signals.

Electrical Design

The ARRL Handbook and the *QST* archives are good information sources for the design of high-power amplifiers.[2, 3, 4] Figure 4 shows a partial schematic that describes the RF signal flow through the amplifier. Eight schematics that completely describe the wiring for the amplifier, and the complete bill of materials including

vendors and parts numbers, are on the *QST* in Depth web page. The schematic for the power supply pictured in Figure 5 is also included in the package.

I used CAD to incorporate strays and parasitic couplings for a more precise understanding of the output circuit, especially at 6 meters. I settled on the basic Pi circuit, where losses were lower than in a Pi-L design.

The input switching and cathode matching circuitry are gathered together on a single printed circuit board. PIN diodes switch and select between two inputs according to the mode of operation on transmit or receive. In RECEIVE mode the amplifier is bypassed. In the STANDBY mode the amplifier is bypassed when the TX key is active. In the OPERATE mode with the TX key active, the amplifier is in the transmit path. The input power passes through one of a bank of low *Q* band-pass filters. The filter is selected by a relay that is controlled by the amplifier band selector switch portion, S301B.

I selected the 8877/3CX1500A7 vacuum tube for this amplifier. It is a very high gain triode, with gain factor μ=200. A single triode has an obvious advantage in simplicity, and this tube type has been available in useable condition as a cast-off from the MRI machine applications. The tube does, however, have a large anode structure, hence a large value of fixed output capacitance (about 22 pF total capacitance in the grounded grid configuration), which pushes the 6 meter band loaded *Q* of the design to the practical limit.

The plate feed choke must be a high impedance for all the bands, and is a critical component in the overall design that includes 6 meters. My choke design takes into account the mounting location on the amplifier chassis, and uses a carefully selected form factor, diameter, winding length, and number of turns to operate on all bands. The first parallel self resonance is at 23 MHz. The first series resonance, or short circuit, is above 40 MHz. The second parallel self resonance, or open circuit, is at 52 MHz. The choke provides somewhat less inductance than normally desired at 80 m, and has some heat losses there, but

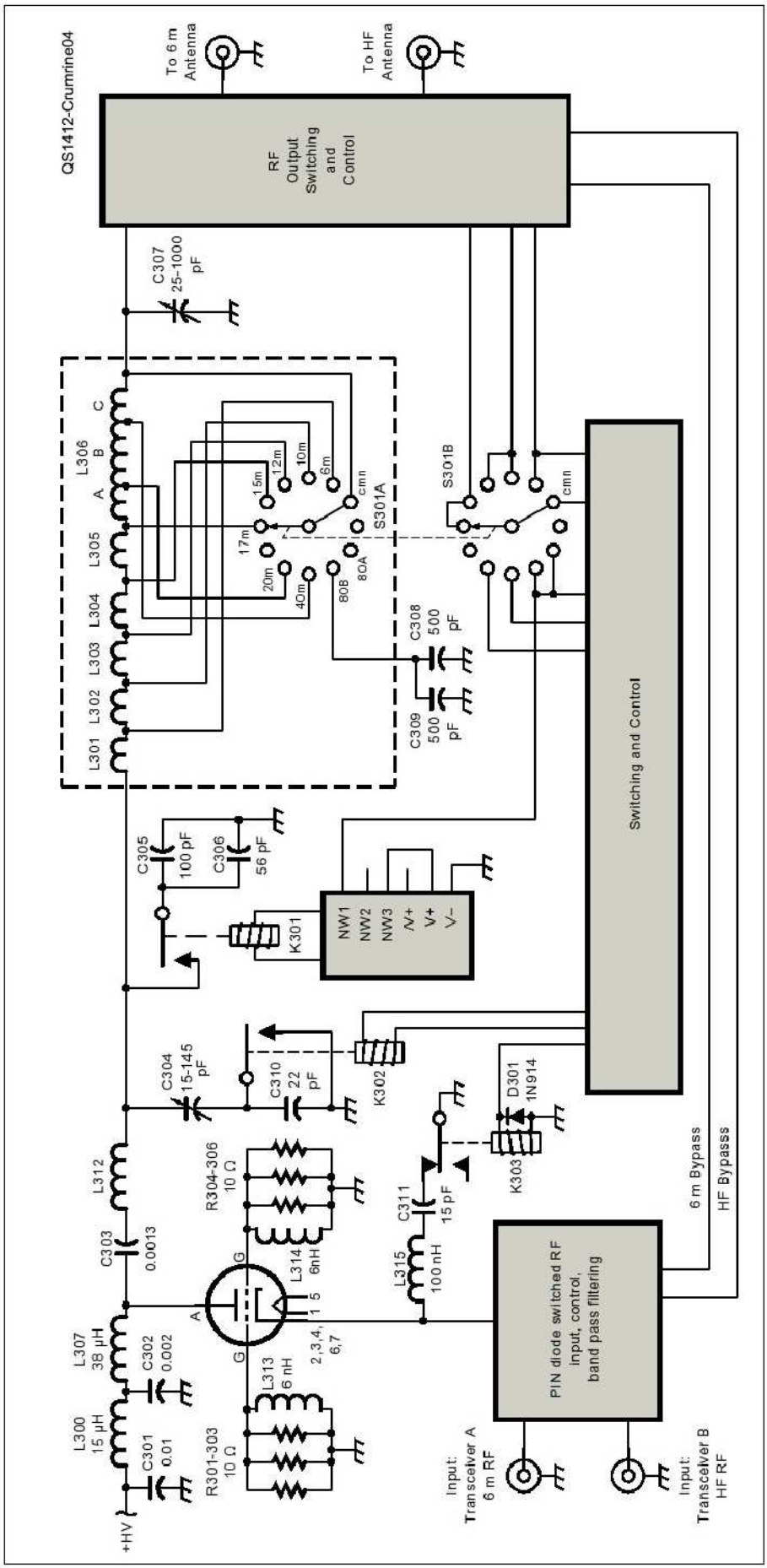


Figure 4 — Diagram of the RF flow through the amplifier.

Figure 5 — The power supply.

Figure 7 — Modified 8877 tube socket.

it is cooled by an airstream fed up through its core. That core is a 90-year-old ceramic house wiring tube, seen in Figure 6.

Stabilizing the Amplifier

Because of the extended frequency range, the problem of parasitic oscillations is greatly exacerbated. During testing (with current limiting to protect the tube), the amplifier showed a tendency to parasitic oscillations near 150 to 160 MHz with some settings of the tune and load capacitors. Modeling showed that the likely frequency for parasitic oscillation for all the HF bands was near 155 MHz, in good agreement with the tests. I connected a trap at this frequency between the cathode and ground to achieve stability on all HF bands for all combinations of the tune and load capacitor adjustments.

The likely parasitic oscillation frequency for the 6 meter band was 225 MHz. I provided stabilization using smaller component values appropriate to the VHF and UHF frequencies.[5] As shown in Figure 7, I built resistors and inductors into the standard seven-pin septar socket. I fashioned grid ring contacts from beryllium spring finger stock, and cut phenolic spacers from rod stock to accommodate the stabilization components, and to space the socket from the chassis for air circulation. As installed, the grid stabilization for 6 meters had no appreciable effect on the HF bands. For HF operation, the HF trap network is switched in with relay K303.

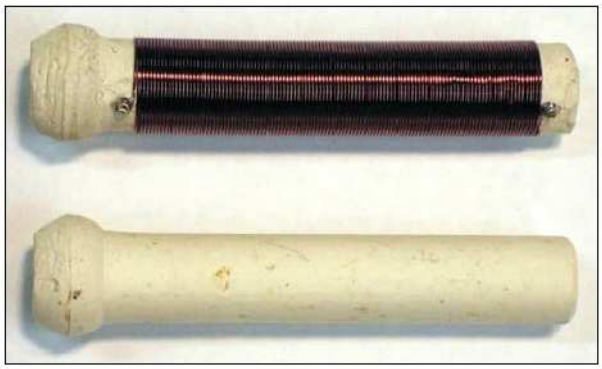


Figure 6 — Plate choke and its coil form.

Band Switching

Band switching is done with an Ohmite ceramic power tap switch, S301A, embedded in a right angle corner structure formed by two printed circuit boards (see Figures 1 and 2). This rugged assembly integrates all the individual band coils with very little stray coupling. I modeled the Pi output network using CAD to include component capacitive and inductive parasitics along with the switch stray impedance.

Band switching of high RF power at two points remote from the RF band switch is facilitated by homemade RF power relays. The relays are designed to work on the power stroke of the solenoid for affirmative contact pressure. K301 (see Figure 4) switches in padding capacitance for 80 m operation and K302 shorts out series padding capacitance for all bands other than 6 meters. The series padding capacitor C310 is a slab of ¼-inch polycarbonate that forms an insulating mounting base for the tuning capacitor C304.

All RF switching relays are closed before any RF power is applied, and opened after RF power is removed. I found it necessary to double up the output switching relays, each rated at 16 A, to minimize self-heating due to the skin effect of the relay contacts at 6 meters. I speeded up the larger output relays by using a capacitive "spiking" circuit, applying a capacitive pulse to 12 V relays from a 24 V source with a time constant of 10 ms. The tube cathode circuit is switched with time constants that ensure minimum pulse bandwidth with CW keying.

All external connections to the amplifier, exclusive of input and output coaxial connections, are made via the input compartment and the control compartment seen in Figure 8. These lines to the outside are bypassed and filtered. Internally, the interconnections that pass through the partitions from the high level RF areas in the base chassis into the control compartment are filtered with LC filters integrated into miniature printed circuit substrates.

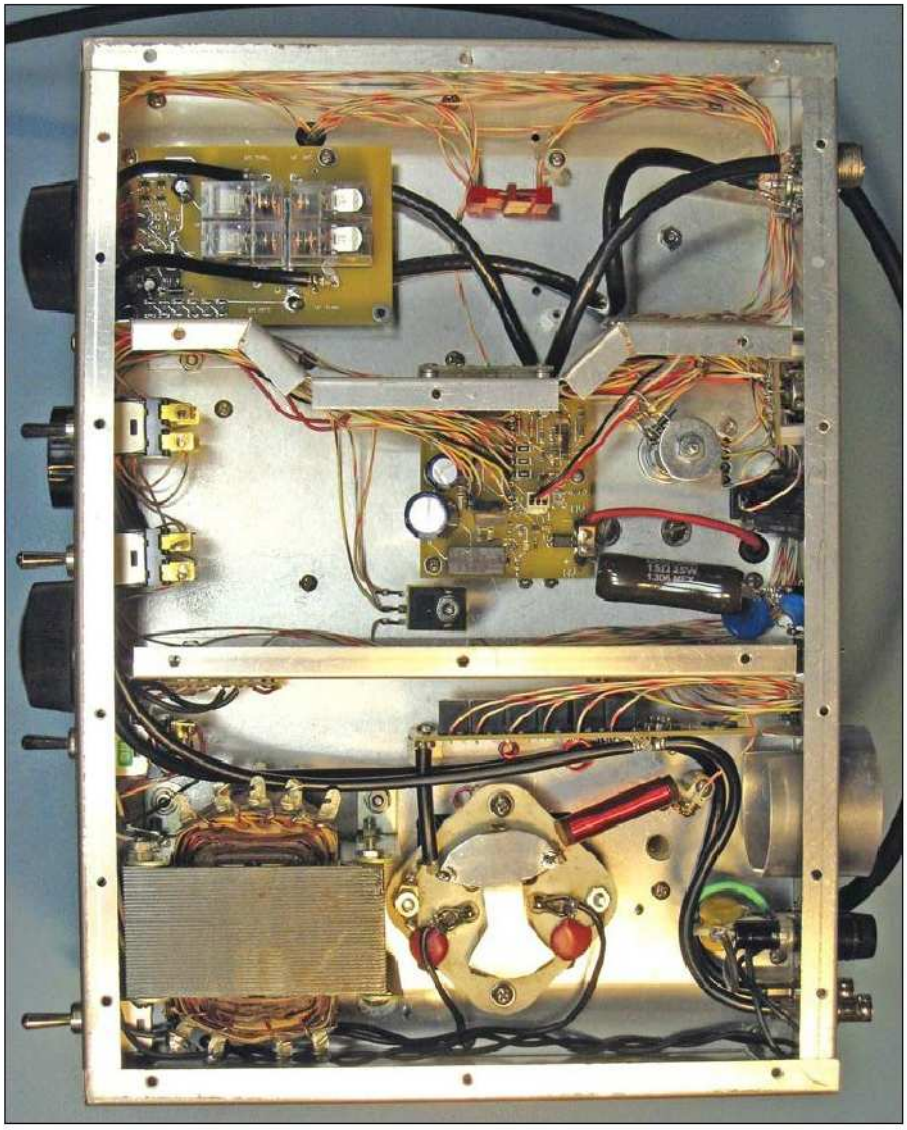


Figure 8 — View of the chassis underside shows the separate RF-isolated compartments.

Mechanical Design

The enclosure divides into several compartments with RF isolation maintained between these compartments. The enclosure foundation is a standard aluminum chassis that is 3 × 10 × 14 inches, and provides a base for the upper sheet metal sides. All the upper sheet metal enclosure surfaces can be flat rectangular pieces. The pieces are joined to form the box shape and attach to the base chassis by aluminum bar or angle stock of ⅜ inches side dimension. Cut the angle stock to length, drill and tap for 6-32 screws. Other mechanical parts are: top and bottom covers, upper back panel, two divider partitions for the chassis, a 2-inch diameter flange for the cooling air, a meter shroud to protect the plastic meters from damage, and a shield box enclosing the meters behind the front panel.

Construction

Lay out and mark all hole centers on the chassis; use the drawings available on the *QST* in Depth web page. You should keep strictly to the exact parts in the list of materials and locations (including the tube and plate choke) from the drawings to preserve the integrity of the design at 6 meters. I've allotted a 3 × 3 × 3 inch space for the 55 VA filament transformer. You can use flat pieces for the upper sides, top and back, but if you have access to a sheet metal brake, you can make the front and sides in a single U-shaped piece, as I did.

Aluminum is a notoriously poor surface for a good bond with paint because it has an affinity for grease molecules. Scrub and sand the aluminum surface with wet/dry sand paper while washing with a dishwashing liquid detergent like Dawn. It should not contain any additives such as hand lotion or aloe vera. Next, use a hot 5% vinegar bath and sand the surfaces again. Rinse with tap water, dry, and then paint. When this is done properly, the rinse water will not bead up on the prepared surface. I used a paint from a spray can labeled "Stainless." It makes a nice finish that closely matches commercial radio equipment finishes.

I prefer rub-on lettering. However, it proved to be a problem in my dry winter climate, so I used a clear tape cartridge with black letters. Even after a varnish coating, the tape is somewhat noticeable. Please see the *QST* in Depth web page for details of the amplifier assembly.

Amplifier Operation

Before applying high voltage, put the top and bottom covers in place. Contact with high voltage can be instantly lethal!

With amplifier covers in place, and without any RF input, connect a wattmeter and dummy load to the amplifier output. Connect the high voltage to the amplifier and switch S1 from the STANDBY position to OPERATE. For these first checks it is highly desirable to use some current limiting resistance in the high voltage line. When the high voltage is applied, and the cathode circuit correctly wired, and with no TX key input, there will be no plate current. By any indicator, absolutely nothing should happen regardless of band selected or position of the BIAS MODE switch, S3. These parts references are to the schematics on the *QST* in Depth web page.

Set up the transceiver to deliver 15 to 20 W of unmodulated carrier and have its TX key line connected to J1 Pin 3 or 5. For the moment, connect the transceiver RF output into a dummy load rather than into the amplifier. In the SSB BIAS mode, with the transceiver TX key line connected to the amplifier, but without any RF input, key the transceiver. Grid current should be zero. Plate zero-signal idle current should be in the 150 to 200 mA range. No RF output should be indicated on the wattmeter. Place the amplifier back in STANDBY mode.

Set the amplifier band switch to match the transceiver output. Set C304 (tune dial setting) and C307 (load dial setting) according to the values shown in Table 1. Switch the amplifier to the OPERATE mode. Key the transceiver and expect to see an output in the range of hundreds of watts. Maximize this output, first with the load control and then with the tune control. Do a back and forth touch-up of these adjustments for maximum output. Some grid current should be showing. Plate current should be somewhere in excess of the no-signal level. Proceed to increase input power and check each band for performance against the values shown in Table 1.

Duty Factor Ratings

All indications are that this amplifier will operate under Continuous Commercial Service (CCS) conditions at 1500 W on all HF bands when using a blower capable of 35 CFM and 0.4 inch column pressure differential. In the 6 meter band, the rating should be reduced to 1500 W Intermittent Commercial or Amateur Service (ICAS) using the same blower. If CCS conditions are desired at 6 meters, I would suggest limiting the power to 1250 W and using a 60 CFM blower.

Including the 6 meter band transitions the design technique from lumped to distributed elements.

Power Supply

I built a power supply especially for this amplifier. Its outputs are 3450 V dc no load, and 3000 V dc at 900 mA. There are also +14 and +24 V dc outputs. The power supply is designed so that it provides the control voltages when the supply is connected to the primary source. The high voltage is turned on only when needed in the OPERATE mode by a ground supplied from the amplifier to a relay in the power supply. Detailed information on the power supply, its components, enclosure and cooling, and schematics are on the *QST* in Depth web page.

Summary

The additional costs attributed to extending an HF linear amplifier up to the 6 meter band amounts to a couple of RF relays to remotely switch tuning capacitors, and a higher capacity blower because of lower efficiency on the 6 meter band. Heat is the enemy of reliability, so I tend to be conservative in the cooling design. I suppose you could blame the addition of the 6 meter band for the cost of the printed circuit boards used to organize the coils in an efficient band-switching arrangement. But to my mind, that is the way to go today regardless of the number of bands involved.

No corners were cut in this design. With time, effort and perseverance in building this amplifier, you will have a unit worth more in price and usefulness than the majority of commercial units presently available today. Those interested in building this amplifier should contact me about the printed circuit boards. I would order quantities of boards relative to the interest shown; this would substantially cut the individual costs. You may contact me with questions or problems.

Notes

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

[2]Chapter 17, *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**.

[3]M. B. Parten, K6DC, "Custom Design and Construction Techniques for Linear Amplifiers Using the 8877." *QST*, Sep 1971 (reproduced as EIMAC Service Letter, AS-45).

[4]F. K. Peck, K6SNO, "A Compact High-power Linear," *QST*, Jun 1961, pp 11-14.

[5]R. Crumrine, N0KC, "CAD Analysis of the Grounded Grid Amplifier Shows a Better Method for Stabilization," *QEX*, Sep/Oct 2003, pp 15-21.

All photos by the author.

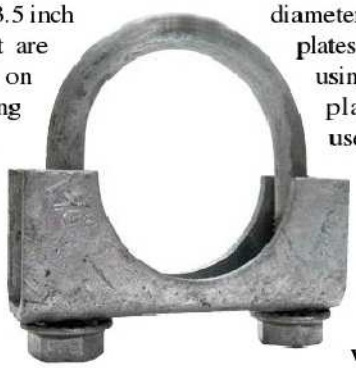
Ralph J. Crumrine, N0KC, was first licensed as a Novice in 1953 as WN3WFZ. He upgraded to General class, and finally in 1978 to Amateur Extra class. He enlisted in the USAF to work in radio and navigation equipment repair. After military service he attended Pennsylvania State University, where he earned a BSEE degree, graduating with honors. A career in the design and development of avionics equipment followed, beginning at King Radio Corporation and Honeywell Avionics Division, from which he retired. Ralph is a member of ARRL and has been an active ham in retirement, earning the WAS and DXCC awards in 2002. RF equipment and antenna design for Amateur Radio have been of particular interest in his retirement years. You can reach Ralph at **n0kc@arrl.net**.

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

New Products

Cycle 24 Saddle Clamps from DX Engineering

DX Engineering is now the exclusive source for the Cycle 24 Galvanized Economy Saddle Clamps for antenna and tower projects. Their galvanized steel saddles and U-bolts are designed to last for many years in outdoor environments. The clamps feature serrated flange nuts for locking power. Clamps with ⅜ inch diameter U-bolts have a flat surface at the top of the bolt for improved grip on the tubing. Clamps for 3 and 3.5 inch tubing have saddles that are closed and spot-welded on the ends before galvanizing to increase clamp strength and longevity. Cycle 24 Galvanized Economy Saddle Clamps are available for 1.25, 1.5, 1.75, 2, 2.25, 2.5, 3, and 3.5 inch diameter tubing. Clamps with ⅝ inch diameter U-bolts are suitable for plates up to ⅜ inch thick when using saddles, and ¼ inch thick plates if saddles are not used. Clamps with ⅜ inch diameter U-bolts will accommodate plates up to ⅝ inch thick. Prices range from $5.95 to $39.95. For more information, or to order, visit **www.dxengineering.com**.



Transceiver Power Control Accessory

Flip a switch to select power amplifier and antenna tuner drive levels for transceivers that accept external automatic level control (ALC).

Phil Salas, AD5X

This project began because of a friend's need to use a TS-520S transceiver and SB-200 amplifier with a MFJ-998RT remote antenna tuner. First he needed an easy way of reducing the transceiver output so as not to overdrive the amplifier. Then he needed an easy way of achieving 10 – 15 W output power for auto-tuner tuning. Like many older vacuum-tube or hybrid transceivers, the TS-520S doesn't have a convenient way to reduce power, especially on SSB. You can use the carrier control for CW, but you must still turn this down every time you want to adjust your external tuner. A simple power control solution that has been around for years uses a 9 V battery and potentiometer to apply an adjustable negative ALC voltage to the transceiver. I decided to expand on this idea, which resulted in an accessory that is simple to use with any transceiver or transceiver/amplifier combination that has external ALC control capability.

Circuit

Figure 1 is a schematic of the circuit that sets and selects the *negative* ALC voltages for normal transmission and antenna tuning. Note that the chassis of the unit is positive with respect to the ALC voltages and that power input jack J7 isolates the connector barrel from the chassis.

Power for the unit is provided by a wall-mounted ac adapter (often informally referred to as a "wall wart"). The unregulated power required by the unit is only several mA between 11 and 15 V dc. If you use a different ac adapter from the one suggested in the parts list, be sure that it has a 2.1 mm barrel plug that will fit the J7 1.9 mm inner contact diameter (although the sizes are specified differently, this is indeed a mating plug/jack pair) and that the center connection is positive. U1 supplies a regulated –9 V for the unit. Note that the pin assignments for the 7909 negative voltage regulator are different from a typical positive voltage regulator IC.

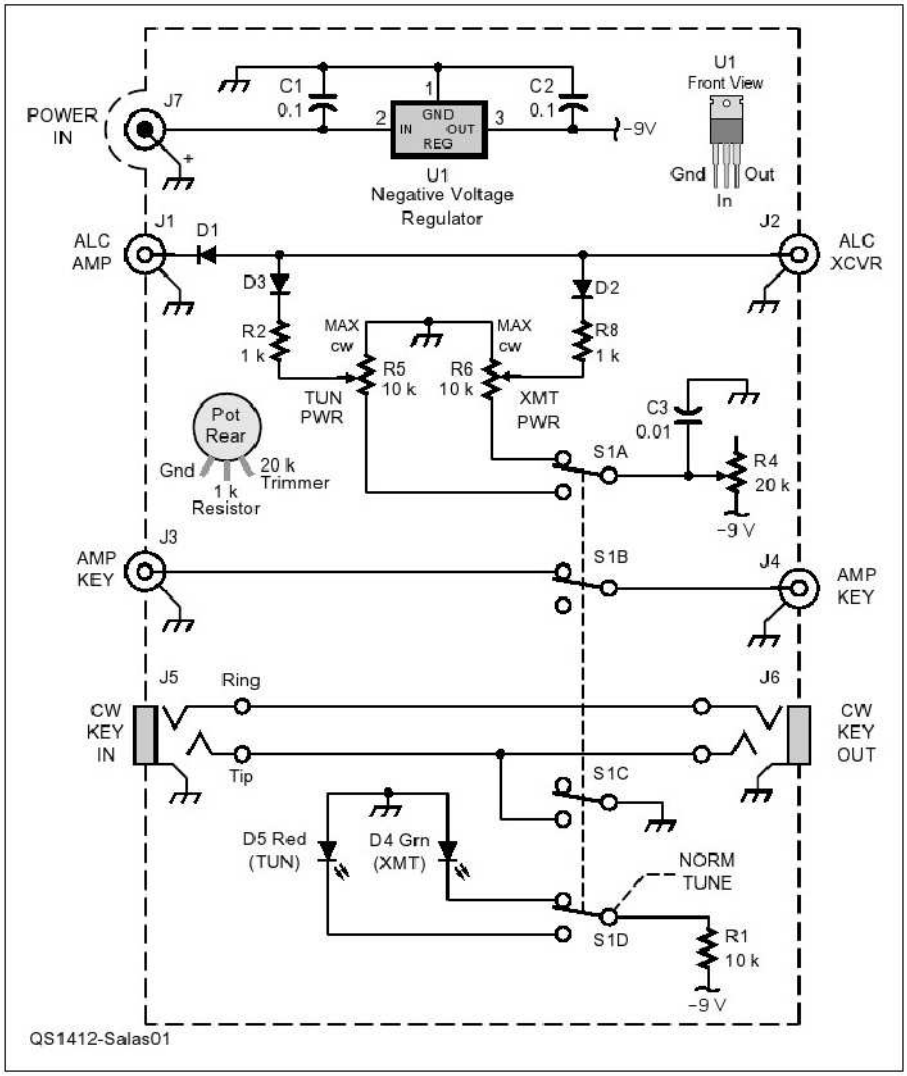


Figure 1 — Schematic diagram. Mouser part numbers in parentheses (**www.mouser.com/**).

C1, C2 — 0.1 µf ceramic capacitor (581-SR211C104K).
C3 — 0.01 µf ceramic capacitor (581-SR211C103K).
D1 – D3 — 1N5711 Schottky diode (511-1N5711).
D4 — Green high brightness 5 mm round LED (941-C503BGCNCY0C0792).
D5 — Red high brightness 5 mm round LED (941-C503BRBSCW0Z0AA2).
J1 – J4 — RCA phono jack (161-2052).
J5 – J6 — ¼" stereo jack (568-NYS230-U).
J7 — 1.9 mm × 5.7 mm dc power jack (isolated) (163-1060-EX).
R1 — 10 kΩ ¼ W resistor (71-CMF5510K000FKEK).
R2, R3 — 1 kΩ ¼ W resistor (71-CMF551K0000FKEB).
R4 — 20 kΩ ½ W trimmer potentiometer (652-3386W-1-203LF).
R5, R6 — 10 kΩ ⅛ W audio taper potentiometer (31JA401-F).
S1 — 4PDT toggle switch (108-1M41T1B1M1QE-EVX).
U1 — Negative voltage regulator, –9 V 1 A (512-LM7909CT).
1 ea — Terminal strip, 5-lug (158-1005).
2 ea — Knob, ¼" shaft (450-2034-GRX).
1 ea — Aluminum box, 4.00 × 2.13 × 1.63 inches (537-00-P).
1 ea — Wall mount ac adapter, 12 V 230 mA (552-PSM03A-120-R).

Figure 2 — Front panel view of the unit.

Figure 3 — Rear panel view of the unit.

There are two modes of operation selected by switch S1: NORM and TUNE. NORM provides a predetermined transmit power and TUNE provides a reduced power for antenna tuning while automatically keying the transmitter and disabling an amplifier (if used).

When S1 is set to NORM, S1A connects the preset maximum negative voltage from trimmer R4 to the XMT PWR control R6. The lower of the voltages presented at J1 by ALC AMP or the wiper arm of R6, the transmit power control, will result in the forward biasing of either D1 or D2 and be conducted to ALC XCVR at J2 (less a diode drop) due to the common anode connections of the two diodes. Additionally, S1B will connect AMP KEY IN at J3 to AMP KEY OUT at J4 and S1D will connect the high brightness green LED D4 associated with the XMT PWR control to –9 V through R1 (see Figure 2).

When S1 is set to TUNE, S1A connects the preset maximum negative voltage from trimmer R4 to the TUN PWR control R5. The lower of the voltages presented at J1 by ALC AMP or the wiper arm of R5 (the antenna tuning power control), will result in the forward biasing of either D1 or D3 and be conducted to ALC XCVR at J2 (minus a diode drop). This is due to the common anode connections of the two diodes. Additionally, S1B will disconnect AMP KEY IN at J3 from AMP KEY OUT at J4, S1D will connect the high brightness red LED D5 associated with the TUN PWR control to –9 V through R1 (see Figure 2), and S1C will ground the tip connections of CW KEY IN and CW KEY OUT at J5 and J6 respectively, keying the transmitter to enable antenna tuning.

Most modern transceivers require an ALC voltage of about –4 V to fully inhibit their output power, but older tube-type transceivers may require a greater negative voltage. Transceiver ALC voltage control is non-linear and I found that setting the maximum negative ALC voltage right at the radio's ALC power-off threshold with trimmer R4 and using audio-taper potentiometers for the transmit power control R6 and the tuning power control R5 makes power adjustment relatively smooth over the full output power range of any transceiver. Finally, 1 kΩ resistors R2 and R3 in series with the potentiometer wiper arms provide current limiting protection.

Construction

The unit is housed in a two-piece interlocking aluminum box with one of the longer faces serving as the front panel for the NORM/TUNE switch S1, XMT PWR control R6, and TUN PWR control R5 (see Figure 2). The opposite face serves as the rear panel where jacks J1 – J7 are mounted (see Figure 3). The interior wiring is supported by component solder lugs, augmented by a five-lug terminal strip to hold the voltage regulator chip and associated components (see Figure 4). Lettering for the front and rear panels was made with Casio 9 mm black-on-clear labeling tape.

Wiring is straightforward, but the potentiometer wiring is important as you want power to increase as you rotate the pot in the clockwise direction, as well as get the smooth power adjustment benefit of the logarithmic (audio) taper.

Figure 4 — Interior wiring and components are supported by solder lugs of panel mounted jacks and controls augmented by a five-lug terminal strip to mount the negative voltage regulator and its associated components.

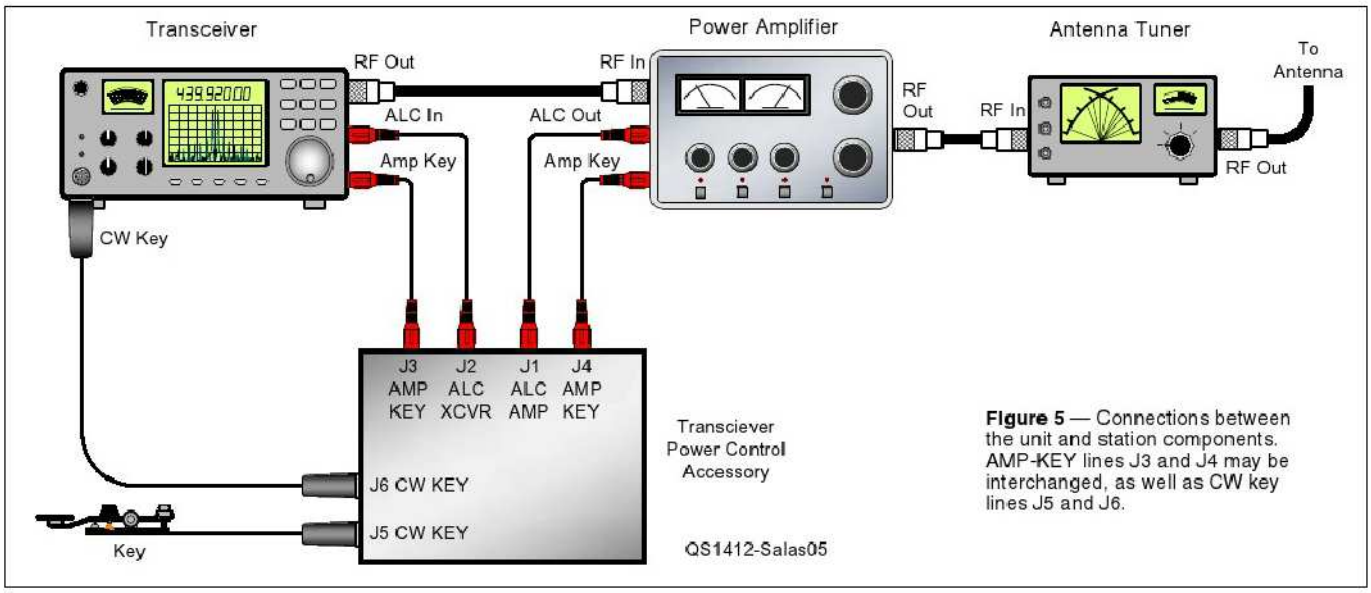


Figure 5 — Connections between the unit and station components. AMP-KEY lines J3 and J4 may be interchanged, as well as CW key lines J5 and J6.

After wiring, a few ohmmeter and voltmeter checks are in order before connecting the unit to your equipment. With the power disconnected from J7, verify that when S1 is set to NORM, AMP KEY IN is connected to AMP KEY OUT, and that the connection is broken when S1 is set to TUNE. Also with the power disconnected, verify that the ring of CW KEY IN is connected to the ring of CW KEY OUT and is isolated from the chassis. Next, confirm that the tip of CW KEY IN is connected to the tip of CW KEY OUT and that setting S1 to TUNE grounds the tip to the chassis.

Now, with the power applied to J7, verify –9 V dc at the U1 output. Then adjust trimmer R4 to its minimum resistance. The voltage on its wiper arm should be –9 V with respect to chassis ground. With S1 set to NORM, the voltage at ALC XCVR and ALC AMP should vary from close to –9 V to 0 V as the XMT PWR control is rotated from MIN to MAX. Setting S1 to TUNE should show similar results with the TUN PWR control. Finally, the LEDs above the two controls should properly indicate the switch position.

Set Up

Connect the unit as shown in Figure 5. With S1 set to NORM, set XMT PWR and TUN PWR controls fully counterclockwise to MIN and the internal trimmer to minimum resistance. Now with the transceiver in CW MODE, key the radio. The output power should be zero. Adjust the internal trimmer potentiometer until the transceiver just starts putting out power. Now rotate the XMT PWR control clockwise for the desired transmit power. Next, set S1 to TUNE and rotate the TUN PWR control for the desired tuning power when using an external antenna tuner.

Because most vintage transceivers don't have a built-in keyer, the tip connections of CW KEY IN and CW KEY OUT are automatically grounded in TUNE mode, which will cause modern transceivers with built-in keyers to send a string of dits. This is normally not a problem for manual antenna tuners. However, some automatic antenna tuners may balk, requiring the keyer input to be changed from paddle to straight key.

Operation

To transmit, set switch S1 to NORM and adjust the transceiver's output power to the desired level with the XMT PWR control. This will normally be fully clockwise to MAX when running barefoot (ie, using only the transceiver's native power) or adjusted to the proper level to drive a power amplifier. To adjust an external antenna tuner, set switch S1 to TUNE. This will key the transceiver and disable the amplifier by interrupting the amp-key line and set the power to a reduced level determined by the TUN PWR control.

Summary

This accessory is intended to simplify the operation of a transceiver driving an antenna tuner and/or power amplifier where readjusting power levels between the modes of normal transmission and antenna tuning can be inconvenient. For a transceiver with an automatic level control (ALC) input, two adjustable, switch selectable, ALC voltages are provided according to whether the station is transmitting normally or adjusting the antenna tuner. As an additional convenience factor, the transceiver is automatically keyed to aid in adjusting the antenna tuner.

Photos by the author.

Amateur Extra class license holder and ARRL Life Member Phil Salas, AD5X, has been licensed since 1964. His early Amateur Radio interests led to BSEE and MSEE degrees from Virginia Tech and Southern Methodist University respectively, followed by a 33-year career in microwave and light wave telecom design and management. Now retired, Phil, a frequent *QST* contributor, is busier than ever, tinkering with electronics, playing with his grandsons, but mostly enjoying time with his wife Debbie, N5UPT, who is also his best friend. You can reach Phil at **ad5x@arrl.net**.

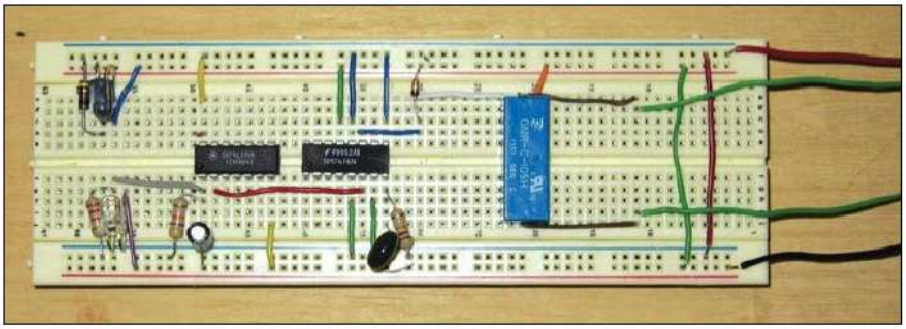
For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

Done in One:
Touch to Talk, Touch to Listen

One touch opens and closes a relay triggered by a beam of infrared light.

Paul Danzer, N1II

Years ago it was very popular to control your transmitter with a foot switch — you stomped on it to talk and took your foot off to receive. When many new rigs were equipped with VOX, foot switches seemed to disappear. But anyone who has had children running around in the background, pets barking, or just normal family noise has seen their transmitter go on due to unwanted audio sent over the airwaves. This project was designed to give the function of a foot switch without the associated mechanical problems, and the convenience of VOX without having to worry about background noise. It uses only two integrated circuits with a handful of other parts, so that it can be built and tested in just one evening.



The layout has the IR-emitting diode (top left) and the corresponding photo-transistor (bottom left). The power wires and output wires on the right. To use, place your finger between the IR diode and the transistor.

Let Your Finger Do the Walking

Although the circuit in the picture is called, "Touch To Talk," touch pads that rely on conduction between two plates by finger resistance are unreliable. They depend on the humidity and the condition of your finger — slightly oily or clean, damp or dry — to function. Instead, this circuit uses an IR (infrared) photo diode to send out an IR light beam (top left of the picture) and an IR-sensitive photo-transistor opposite it to detect the IR beam; there is no dependence on finger resistance. Turn power on (from a 5 V supply) and the relay at the right remains in the open position. Touching the area between the diode and transistor breaks the beam; do it once and the relay closes and stays closed. Touch again and the relay opens up. If you wire the relay contacts across the PTT (push-to-talk) contacts of your microphone you switch between transmitting and listening by touching the area and thus breaking the beam.

How Does It Work?

The schematic in Figure 1 has the IR-emitting diode facing the IR photo transistor. The pictorial of these two shows a flat edge on each of the cases and which lead is close to the flat edge. Breaking the IR beam sends a positive pulse to the Schmitt trigger (U1), which cleans up the pulse. The output of U1 goes to the J-K flip-flop which is wired to alternate (flip and flop) with each input pulse. Pin 11 of U2 is the flip-flop output used to control a relay. When Pin 11 is high (at +5 V) the relay is on; when it is low (near 0 V) the relay is off. R4 and C2 insure the circuit starts at power on with the relay off. The relay contacts are isolated from the circuit so it may be wired across the microphone PTT switch or any other low-voltage device.

Pin numbering of U1 and U2 is shown at the bottom of the drawing. Make sure you wire diode D1 in properly or you may blow out U2 — as I did!

Putting It Together

The photo shows the circuit built on a standard modular IC breadboard socket. This one, from RadioShack, has two bus connections on the top and bottom; thus you can connect the four buses as shown in Figure 2 and have both ground (0 V) and

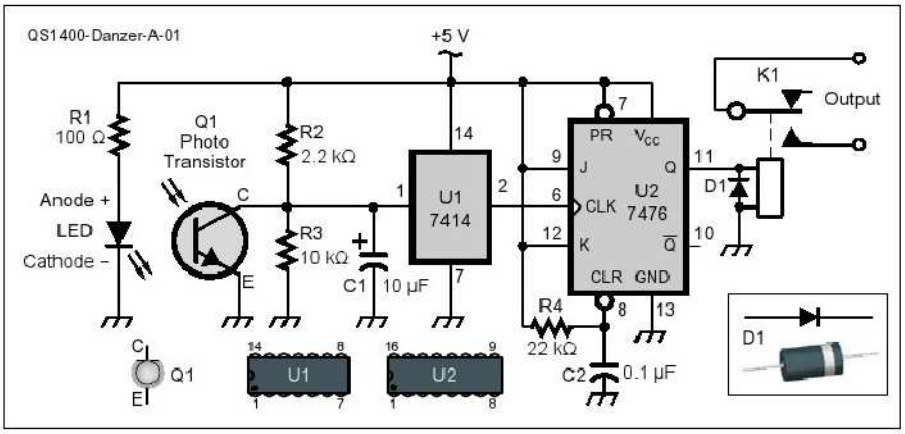


Figure 1 — In addition to the IR elements the circuit uses just two integrated circuit chips and one relay.

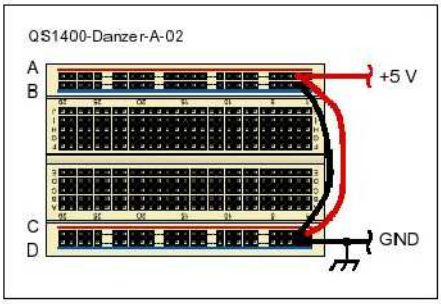


Figure 2 — The four buses are tied together so +5 and ground are available both on top and bottom of the breadboard socket.

R1 — 100 Ω ¼ W (brown black brown)
R2 — 2.2 kΩ ¼ W (red red red)
R3 — 10 kΩ ¼ W (brown black orange)
R4 — 22 kΩ ¼ (red red orange)
C1 — 10 µf 50 V dc or more
C2 — 0.1 µf 50 V dc or more
RY1 — 5 V 250Ω coil relay such as RadioShack 275-0232
LED — IR diode RadioShack 276-0143
Q1 — IR photo transistor RadioShack 276-0145
U1 — Any 7414 TTL Hex Schmitt Trigger integrated circuit such as RadioShack NTE7414 Catalog #: 55051310
U2 — Any 7476 TTL Dual J-K flip-flop such as RadioShack NTE74LS107 Catalog #: 55051045
D1 — Any low power silicon switching diode such as a 1N914 – RadioShack 276-1122
RadioShack Modular U Breadboard Socket 276-003

+5 V available on both the top and bottom. If you choose to build it more permanently on an experimenter printed circuit board such as RadioShack 276-160 you will have to run some leads and components across the board since the PC board only has one bus on top and one bus on the bottom. The red and black wires leading from the right side of the layout are the +5 and ground connections.

One caution: the relay pins may be slightly smaller than that usually needed for the holes in the modular board. Make sure the relay is firmly plugged in, perhaps by bending the four pins slightly to the sides. The circuit output from the relay contacts are the two green wires shown coming from the right side of the layout. If you have a lot of RF floating around your shack you may want to add an 0.1 µF capacitor across the relay contacts and run the output through shielded wire.

How To Use It

The contacts of the relay shown in the photo and in the parts list is rated for 0.5 A at 120 V, which should be more than enough for a push-to-talk circuit. Perhaps you will find another uses for this circuit. If so, putting 120 V on this breadboard chassis is not a safe thing to do. The relay contacts can be used to control another relay separated from the breadboard chassis. Then you can let your ham ingenuity run free!

Paul Danzer, N1II, earned his ham ticket as a teenager, which he credits as leading to a long career as an electronic engineer, designing radars and digital systems. After retiring from engineering he spent a few years in the book department of ARRL HQ, and then joined a local community college faculty as a professor of computer science. He is still doing what he did as a teenage ham — working 40 meter CW and now 30 meter CW.

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

New Books

Make Your Own Tube Testers and Electron Tube Equipment

Gary Steinbaugh, AF8L

Reviewed by Rick Lindquist, WW1ME

Even if you don't know a 2A5 from a 6F6, you may enjoy Gary Steinbaugh's *Make Your Own Tube Testers* for how he makes shine what many, if not most, of us consider bygone technology. As he says in the preface, "This is not a step-by-step instruction book; the contents are basically meant to serve as inspiration for anyone who is interested in designing and building practical tube testers and useful tube equipment." This book is less about nostalgia than an effort to promote continued use of vacuum (or "electron") tubes, which Steinbaugh believes are superior to solid state devices.

Many of us of a certain age will recall heading into the local pharmacy or radio repair shop with a handful (or an entire box) of tubes to check on the tester, which often contained a convenient supply of replacements below decks. Some of Steinbaugh's suggested designs are more complex, aimed at creating tube testers that go beyond simple leakage and emission checks, although he does show his own leakage and emission tester, a very handsome unit that bears a faint resemblance to some of the kits I built back in the day. Despite its title, though, this reference goes well beyond tube testers, covering tube architecture and operating curves, typical tube "troubles," vintage parts, high-voltage power supplies, a dual high-voltage regulator (which employs six tubes), construction techniques, and high-voltage safety. Scattered throughout are some fascinating photographs, images, and illustrations, including one photo showing ENIAC (an early, tube-type mainframe) programmers holding massive vacuum tube modules. The frontispiece is a striking Kent Leech illustration, "Electron Beams Inside a 6L6." And what radio amateur licensed longer than a couple of decades didn't put a 6L6 on the air?

Technology aside, there's more than a little bit of the touchy-feely in Steinbaugh's book. Think Zen for the MIT crowd. For example, when responding to his rhetorical question, "Why do you need a laboratory tube tester?" he allows, "I would guess that you are like me, curious about the way that the universe operates, and how nature does things behind the scenes. You want to know the reason for doing something, rather than blindly following the dictates of some musty old book." This philosophical excursion offers considerable insight into the overall tone of the book, which is also peppered with wit and wisdom of the ages — from Benjamin Franklin to Einstein to George Gobel — an early TV personality for you newcomers. (The Gobel citation: "If it weren't for electricity, we'd all be watching television by candlelight.")

Radio amateurs with an abiding interest in vacuum tube equipment may find Steinbaugh's observations and expertise valuable. He's is a pro at building gear and demonstrates the use of several types of materials! The book includes a comprehensive index.

4EA Analysis LLC, Cincinnati, Ohio, **www.4ea-analysis.com**. *ISBN 978-1-57074-089-3, softcover, 8½ × 11 in, 222 pp, illus. Available from* **Amazon.com**, *$34.98.*

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

CommRadio CR-1a Communications Receiver

A software defined receiver with no "computer" required.

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

When we think of software defined radio (SDR), among the first images that appear in our imaginations are wide flat-screen monitors. If you go to a hamfest and visit an SDR exhibit, that's what you'll see: large computer monitors displaying SDR software. Signal waveforms pulse and dance; filter windows expand and contract. It is all quite impressive and very "21st century."

SDR performance is every bit as impressive as it looks, and its magic begins at (or near) the receiver's antenna terminals. A signal arriving at an SDR receiver is, by its very nature, analog, but it doesn't remain that way for long. Within microseconds it is "sampled" — chopped to bits at an extremely high rate by an analog-to-digital converter (ADC). The data from the ADC is processed into *in-phase* and *quadrature* components, or *I/Q* for short. Once you have rendered the signal to I/Q information, you can use software to demodulate whatever is contained within.

At the center of all this wondrous work is a computer. Without a computer and software, a software defined radio is useless; it is nothing more than a sophisticated piece of hardware spewing data that goes unprocessed and unheard. That's why images of monitors have become so iconic in the SDR universe. They represent the computer connection that is critical to software defined radio.

SDR computers don't have to be tablets, laptops, or desktops, though. They can also be arrays of microprocessors hidden away in nondescript enclosures. If you can communicate with those microprocessors through a set of buttons and a functional display of some sort, you can easily dispense with the bulky monitors and keyboards.

Which brings us to the CommRadio CR-1a receiver.

SDR Without a "Computer"

The CommRadio CR-1a is most definitely an SDR, and it incorporates the requisite computer, too. But instead of depending on extra pieces of hardware external to the radio itself — what we normally think of as a "computer" — the CR-1a combines everything, including powerful microprocessors, into a single metal enclosure that is just 5.6 inches wide, 2.4 inches high and 6.1 inches deep and weighs less than 2 pounds. Instead of a monitor and keyboard, you interact with this SDR through a collection of buttons, two knobs and a crisp organic LED (OLED) display.

The CR-1a is among the first SDRs designed to be completely portable. The radio features a bottom-firing speaker, which is the reason for its unusual elevated stance. The CR-1a includes a rechargeable lithium-ion battery, although it can also be powered from a USB port or an external 6 – 18 V dc source. The powder-coated steel case and machined aluminum knobs give the CR-1a a nice feel.

Since the CR-1a looks and acts like a conventional receiver, it's fair to ask why its SDR architecture deserves discussion. The answer is that one of the most attractive aspects of any SDR is the ability to make huge changes to the way the radio functions by simply installing new software. In the CR-1a, the software resides in nonvolatile memory and can be changed at any time. If CommRadio wants to add new features to the CR-1a, such as synchronous AM reception, for instance, they can do so by offering revised software that you download from their website and then upload to the radio. So, unlike conventional receivers, the CR-1a can "evolve" over time, at least within the limitations of its hardware.

In addition, if you want to use the CR-1a as a "typical" SDR with an external computer and software, you can do so. There is a USB port on the rear panel that is normally used to recharge the internal battery. The CR-1a makes I/Q data available at this port, which you can subsequently feed to a computer and software of your choosing.

Bottom Line

The CR-1a is a portable, battery operated, wideband receiver that uses software defined radio technology to receive a variety of modes on select frequency segments from 500 kHz through 512 MHz.

When this review was conducted, Comm Radio offered a free piece of software that allowed users to access the I/Q data and control the radio to a limited extent (see Figure 1). The software was in beta testing at the time, so improved and expanded versions will probably be showing up soon. As the CR-1a becomes more commonplace, I'd expect to see compatible third-party software as well.

Broad Coverage, Filters, and More

The CR-1a's coverage spans 500 kHz to 30 MHz; 64 to 260 MHz and 437 to 512 MHz in AM, SSB, CW, WBFM, NBFM. Wideband FM is the default when tuning through the FM broadcast band (monaural only — at least with the current software). The CR-1a will also receive long wave (LW) from 150 to 500 kHz, but with reduced performance due to the lack of a dedicated front-end preselector for those frequencies.

Interestingly, the CR-1a has what you might call a "split" receiver architecture, which you notice right away when you examine the rear panel shown in Figure 2. There are two BNC jacks: one for LW through 30 MHz and the other for 64 MHz and above. The review radio also has a separate 3.5 mm jack for a long wave or AM antenna, but this was eliminated in later production runs (s/n 750 and higher). For reception below 30 MHz, the CR-1a uses a dual conversion approach to providing a lower-frequency IF signal for the ADC. For 64 MHz and up, however, it makes the jump to the IF frequency in a single step.

Tuning is not continuous from long wave to VHF or UHF. To switch from HF to VHF or UHF you must enter the menu system and select the frequency group. Once you've made your selection, you punch the user configurable BAND key to step from one band to another, or simply select the tuning step you desire and spin the tuning knob. A nice touch: you can configure the BAND key to limit choices to the 160 – 10 meter amateur bands or the 120 – 11 meter shortwave broadcast bands.

While in the menu, you'll also find a squelch adjustment. Actually, there are two separate squelches: one for HF and the other for VHF/UHF.

If you have the CR-1a in AUTOMATIC mode, the radio will automatically select the proper mode and filter as you tune. When you tune into the 40 meter Amateur

Table 1
CommRadio CR-1a, serial number 0629

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: Receive only, 0.5 – 30, 64 – 260, 437 – 512 MHz.	As specified; 150 – 500 kHz also provided for experimental purposes.
Power requirement: 5 V dc via USB jack, or 6 – 18 V dc to charge 3.7 V dc internal Li-ion battery.	3 W maximum at 120 V ac for wall charger.
Modes of operation: SSB, CW, AM, wideband FM (FM Broadcast band only).	As specified.
Receiver	**Receiver Dynamic Testing**
Sensitivity: –130 dBm (71 nV) nominal at 500 Hz bandwidth (0.5-30) MHz.	Noise floor (MDS), 3 kHz filter: 3.5 MHz –125 dBm 14 MHz –122 dBm 70 MHz –130 dBm 144 MHz –126 dBm 440 MHz –113 dBm
AM sensitivity: Not specified.	10 dB (S+N)/N, 1 kHz, 30% modulation, 6 kHz BW: 1.020 MHz 3.23 µV 3.8 MHz 2.04 µV 29 MHz 3.16 µV 120 MHz 1.12 µV 144 MHz 1.30 µV 440 MHz 9.43 µV
FM sensitivity: For 12 SINAD, –98 dBm (2.9 µV) VHF, –86 to –98 dBm (11.5-2.9 µV), UHF.	For 12 dB SINAD, 15 kHz BW: 29.6 MHz 1.29 µV 70 MHz 2.09 µV 146 MHz 0.83 µV 162 MHz 1.05 µV 223 MHz 0.76 µV 440 MHz 3.75 µV
IF and image rejection: Not specified.	IF rejection, 115 dB; image rejection, >132 dB.
Receiver audio output: Not specified.	0.3 W at 10% THD into 8 Ω. THD at 0.85 V RMS, 6.3%.
IF/audio response: Not specified.	Range at –6 dB points, (bandwidth) CW (500 Hz): 350-1135 Hz (785 Hz) SSB (2.6 kHz): 140-3000 Hz (2860 Hz) AM (7.5 kHz): 2 Hz-3830 Hz (7660 Hz)

Size (height, width, depth): 2.4 × 5.6 × 6.1 inches (including protrusions); weight, 1.5 lb.

Price: $599.99.

Note: The AGC could not be defeated, so blocking gain compression, reciprocal mixing and IMD dynamic range tests could not be performed.

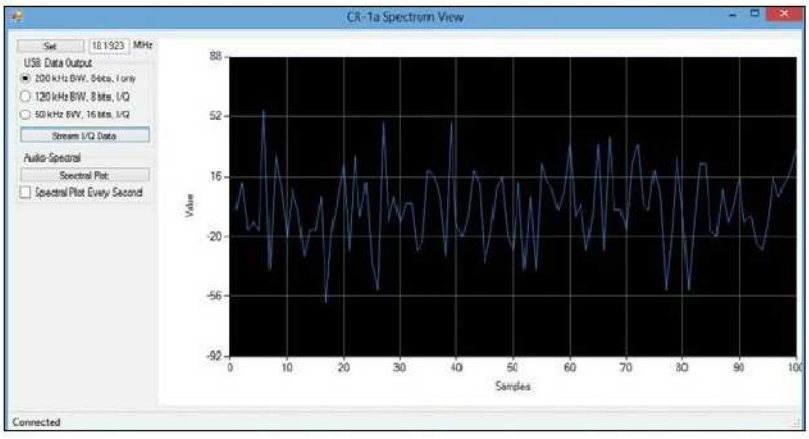


Figure 1 — The beta version of CommRadio's *Spectrum View* software.

Radio phone band, for example, the CR-1a automatically selects lower sideband. The CR-1a offers a variety of filter bandwidths — 500 Hz, 1.0, 1.8, 2.2, and 2.6 kHz on CW; 1.8, 2.2, and 2.6 kHz on SSB; 2.6, 5, 7.5, and 15 kHz on AM; and 15 and 25 kHz on NBFM. Unlike SDR receivers controlled by external software, you don't have the ability to create continuously variable filters on the fly. That said, with compatible software and an external computer you could connect the CR-1a and have the full SDR flexibility.

Like a conventional receiver, the CR-1a provides 64 memory slots to store your favorite frequencies for easy access. Scanning functions are available, but on HF only.

The CR-1a display includes a numeric S meter in the lower left corner. The S meter functions for all modes when you select the HF frequency range, but only operates while in the AM mode on VHF or UHF.

Last, but hardly least, the CR-1a can decode CW! Watch the video to see it in action.

Hands On with the CR-1a

I found the CR-1a easy to navigate once I became used to its menu system. The manual includes clear instructions and many illustrations to help with the learning curve. As I mentioned earlier, you must access the menus to switch from VHF to HF coverage, and to change filter bandwidths (if necessary).

The radio turns on with a momentary push on the VOLUME control and the amber display springs to life after a brief sign-on message. The 2.5-inch bottom-mounted speaker has plenty of power, so much that I rarely needed to advance the VOLUME knob past 11 o'clock in any listening environment. There is also a ⅛-inch jack on the front panel for headphones.

Bob Allison, WB1GCM, our ARRL Laboratory Test Engineer, measured substantial audio distortion during his tests with the VOLUME control set at low levels. Not that I doubt Bob's instruments, but I could not hear the distortion when using the external speaker. With headphones it was audible, but I didn't find it at all objectionable. Oddly enough, both Bob and I noticed that the distortion *decreased* with increasing audio volume. Speaking of unusual sounds, it is also worth mentioning that the CR-1a made a slight ticking or popping noise when stepping from one frequency to another.

Figure 2 — The CR-1a has separate jacks for MF/HF and VHF/UHF operation The AM/HF antenna jack is eliminated on current production units. The USB jack can be use to power the receiver and charge the internal Li-ion battery or for connection to an external computer.

The CR-1a's AGC performance is selectable — FAST, MEDIUM, and SLOW — but cannot be turned off, and so the Lab could not perform the usual dynamic range tests (which require AGC be turned off). The AGC is sensitive and starts to reduce the audio output levels when encountering signals as weak as –68 dBm at 20 kHz from the selected frequency. This would occasionally manifest as significant "pumping" when a strong signal was within range. This AGC behavior may also have something to do with the popping sound heard when changing frequencies.

Other than the difficulty of working the buttons with my oversized fingers, the CR-1a was a pleasure to operate. I had no difficulty listening to everything from CW, to single sideband, to FM. The CR-1a was more than sensitive enough for casual listening, including eavesdropping on Amateur Radio activity. It did double duty as a convenient test receiver and I even put it to work as a JT65 monitor by feeding the audio from the headphone jack to my station computer, which was running *JT65-HF* software.

When it comes to ham uses, the only notable limitation of the CR-1a is its inability to tune at VHF or UHF in less than 5 kHz steps. This presents issues when trying to monitor SSB or CW on these bands, although channelized FM operation is no problem. SDR being what it is, however, it is always possible that this may change with a new software release.

Manufacturer: CommRadio, a division of AeroStream Communications, 24658 Foothills Dr N, Golden, CO 80401; tel 303-279-3671; **www.commradio.com**; **info@commradio.com**.

See the Digital Edition of *QST* for a video overview of the CommRadio CR-1a Communications Receiver.

HobbyPCB Hardrock-50 160 – 6 Meter 50 W Amplifier Kit

Reviewed by Phil Salas, AD5X
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In the August 2010 issue of *QST*, Jim Veatch, WA2EUJ, detailed a 40 – 15 meter amplifier designed for QRP transceivers. Jim has since evolved that design into the Hardrock-50 now offered by HobbyPCB. The HR-50 provides 50 W output power with a drive level of 5 W or less on 160 – 10 meters, and 35 W on 6 meters. It is supplied only in kit form and is housed in a rugged aluminum enclosure. Available options include a PIN-diode QSK switch, a low-level preamplifier that permits full output from 0.5 W drive, and an internal automatic antenna tuner (not yet available during the review period). However, you cannot include both the automatic antenna tuner and the low-level preamplifier. The QSK option (available for SN1200 and above) fits with either option. The Hardrock-50 reviewed here is the standard relay-switched version with no options installed.

Putting It Together

The HR-50 arrived in a small box containing the main chassis/heat-sink, and a smaller box with the amplifier parts. This includes front and rear panels, three printed circuit (PC) boards with pre-installed surface-mounted (SMD) components, and the connectors, wire, ferrites, toroids, and hardware. See Figure 3.

No documentation is included in the box, so you must download the assembly manual from **www.hobbypcb.com**. You can print out the assembly manual, though I found it convenient to display the pages on a laptop computer adjacent to my assembly area. A printed manual would be convenient for checking off each assembly step. However it is difficult to miss a step because all SMD components are pre-mounted and so assembly consists of adding large connectors, relays, inductors, and transformers.

I built the HR-50 over 3 days and I'd estimate that the full assembly took me about 8 – 10 hours. I was missing two ferrites and a connector. I emailed HobbyPCB and received an answer within minutes — and this was on a Saturday afternoon. It seems they had identified a run of amplifiers where these parts had not been included. The replacement parts were quickly received and I continued with the assembly.

Small PC boards with display and control circuitry attach to the front and rear panels. All that was required was soldering connectors to the PC boards and then mounting the boards to the panels.

For me, the most time-consuming part was soldering in the 15 relays, followed by winding and installing the inductors and transformers. While the inductor/transformer winding process is not difficult due to the clear instructions and color illustrations, you can purchase them pre-wound from **toroidguy@earthlink.net** for $35. The as-delivered amplifier PC board with SMD parts mounted is shown in Figure 4, along with the finished inductors and transformers.

Figure 5 shows the completed amplifier just before attaching the cover. There was excess ribbon cable length, so I folded it and tie-wrapped it to the dc power cable just to keep things neat. When the amplifier is complete, only five adjustments are needed. A single-turn potentiometer sets the display contrast, and four multiturn potentiometers set the four FET gate bias voltages (for this adjustment you'll need a digital multimeter). If you cannot get your Hardrock-50 to work properly, HobbyPCB provides excellent technical support via e-mail as well as through a user forum on their website. And if all else fails, you can ship your HR-50 to HobbyPCB and they will fix it. HobbyPCB guarantees everyone will have a working amp at the end of the build.

Bottom Line

The Hardrock-50 is a compact 50 W amplifier designed to work with any QRP transceiver. Silent QSK operation may be added as an option.

Technical Details

The HR-50 dc input is an Anderson Powerpole connector. You will need a 13.8 V dc power supply capable of at least 12 A continuous current. As the amplifier is not fused, a fused (15 A) dc input cable is recommended. The large heatsink provides

Figure 3 — The Hardrock-50 arrives!

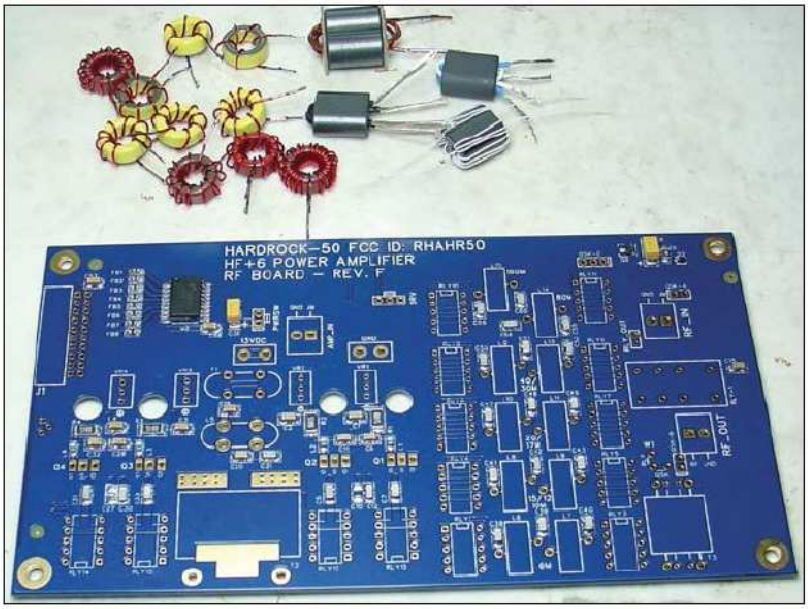

Figure 4 — As delivered, SMD parts are already mounted on the amplifier pc board. The author wound the inductors and transformers shown at the top.

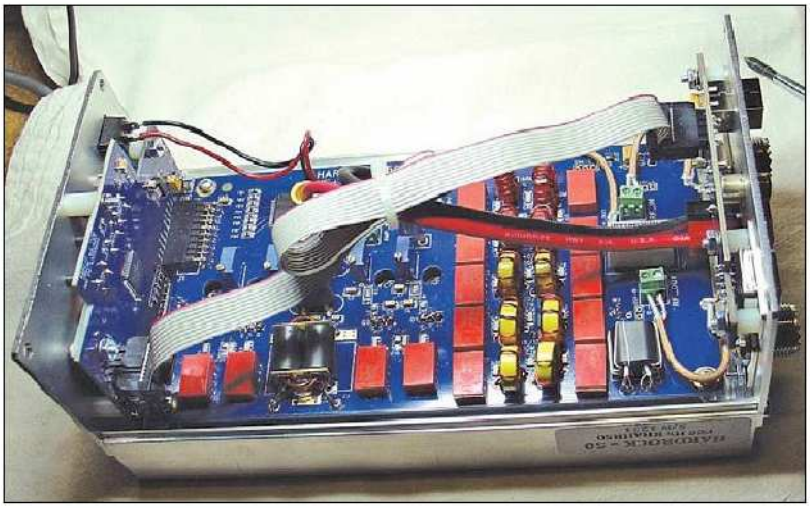

Figure 5 — Completed Hardrock-50 amplifier.

the necessary thermal dissipation — no fan is needed.

Power output is 50 W from 160 – 10 meters with 5 W maximum drive (typically 3 – 4 W is enough) using four RH16HHF1 MOSFETs. Power on 6 meters is specified at 35 W, though most amplifiers will exceed 40 W on this band. TR switching is handled by a relay or an optional PIN-diode switch. The relay 6 ms/4 ms maximum specified operate/release time is fast enough to prevent hot switching when used with most transceiver amplifier keying outputs. The optional PIN-diode QSK switch assembly switches in less than 140 µs, but there is a trade-off. The QSK switch has 0.25 dB loss in both the transmit and receive path on 160 – 10 meters (typically 3 W transmit loss). The loss increases to about 0.5 dB on 6 meters (typically 5 W transmit loss).

No automatic fault protection is included — nor is it needed! The RH16HHF1 MOSFETs are rated to operate at 16 V dc into a 20:1 SWR at any phase angle. An open or short on the output (so only the low pass filters are inline) results in a worst case SWR of 18:1 to the FETs. About the only way the FETs can be damaged is by overheating due to insufficient contact with the heatsink. The FET mounting instructions are well written and should preclude this from occurring.

Finally, the HR-50 supports automatic band tracking with the Elecraft KX3, the Flex-1500 and any of the low power software defined radios (SDRs) that use *PowerSDR* software (for example, Softrock, Peaberry, or G10 SDRs). As the HR-50 supports the Kenwood CAT command set, other SDR programs may support automatic band tracking as well. Firmware updates are easy (a USB A/B cable is required) — just follow the detailed instructions given in the assembly manual.

Display and Control

When the unit is powered on, there is a 5 – 10 second boot process during which the amplifier firmware revision is shown. The amplifier then displays mode, band, temperature and voltage. When the HR-50 is keyed, the display changes to TX mode where a top bar graph shows average forward power, and the bottom display shows calculated SWR and peak power.

There are only three control buttons — up/

Table 2
Hardrock-50, serial number 1251

Manufacturer's Specifications	Measured Performance
Frequency range: All ham bands from 1.8 – 54 MHz except 60 meters.	As specified. The optional antenna tuner includes additional filtering to allow 60 meter operation.
Power requirements: 11 – 16 V dc (13.8 V nominal), 10 A typical, 12 A peak.	See Table 3.
Input SWR: Not specified	See Table 3.
Drive power: 2.5 – 3 W typ, 5 W maximum.*	See Table 3.
Output power: 50 W typical at 13.8 V dc, 1.8-30 MHz; 35 W at 50 MHz.**	See Table 3.
Internal power meter accuracy ±5 W @ 50 Ω	As specified.
Harmonic and spurious suppression: Not specified.	HF, 48 dB (worst case, 1.8 MHz band), typically 64 dB; 50 MHz, 60 dB. Complies with FCC requirements.
Intermodulation distortion (IMD) products: Not specified.	3rd/5th/7th/9th order IMD products: 14 MHz: 38/33/38/46 dB below PEP. 50 MHz: 33/32/42/60 dB below PEP.
Key in: Receive, +5 V dc open circuit, ground to transmit, 10 mA maximum.†	As specified.
Amplifier TR relay transition time: Not specified.	PTT mode: Amplifier key to RF output, 3.2 ms; amplifier un-key to RF power off: 3.8 ms. Carrier operated mode, 12 ms for 0.4 W to max drive power.

Size (height, width, depth): 3.5 x 4.25 x 7.5 inches; weight: 3 lb.

Price: Hardrock-50 $299; QSK option, $49; 0.5 – 5 W preamp, $35; internal ATU, $179.

*The HR-50 will tolerate 10 W of drive for a short time without damage.
**Exceeding rated output may result in signal distortion. If the PIN-diode QSK option is installed, output power should be reduced 3 W on HF and 5 W on 6 meters.
†The PTT line is diode protected for externally applied voltages from –24 to +24 V.

Table 3
Hardrock-50 Operating Conditions

13.8 V dc key-down voltage; standby 0.1 A; operate, no drive, 0.3 A.

Band (m)	Drive (W)	Input SWR*	Power Output** (W)	DC Current (A)
160	4.0	1.29:1	50	9.8
80	2.4	1.21:1	50	7.8
40	3.6	1.20:1	50	8.3
30	5.0	1.23:1	49	9.9
20	4.0	1.25:1	50	9.8
17	2.7	1.30:1	50	7.3
15	2.8	1.41:1	50	7.2
12	3.0	1.48:1	50	8.0
10	2.9	1.52:1	50	9.0
6†	3.0	1.41:1	40	6.3

*Bypass SWR was 1.1:1 or less except 6 meters which was 1.4:1
**Measured with Mini-Circuits PWR-6GHS+ power sensor and calibrated attenuators.
†The 6 meter output power specification is 35 W for best IMD.

down BAND SELECT buttons and a KEY MODE button. The BAND SELECT buttons only operate during receive, and the band setting is retained when the HR-50 is powered off.

Tapping the KEY MODE button toggles between OFF (standby), PTT (push-to-talk where grounding the PTT line keys the amplifier), COR (RF carrier detect keys the amplifier), and QRP (to follow the optional antenna tuner to be used with the exciter only). The COR mode is provided as many QRP radios don't have an amp-key output. However, you *will* hot switch your driving transmitter's output as you can't sense RF and switch instantly. When added to the relay operation time, the RF sense circuitry time constant will result in RF being present for 10 – 12 ms before switching completes. Even when the QSK option is used, RF will be present for 5 – 7 ms before PIN-diode switching occurs. So if possible, use the PTT input for amplifier keying. The PTT interface is compatible with all transceivers that have an amp-key output, including the +8 V dc/0 V dc HSEND output of the Icom IC-703 transceiver.

A 3-second push of the KEY MODE button also provides access to some internal menus for other custom settings. The up/down buttons provide scrolling through the menus and changing the settings. Currently the menus include: Accessory Baud Rate, USB Baud Rate, KX3 Serial On/Off, Temperature Display (°F/°C), Watt Meter Adjust, COR Hang Time, Key-up Delay and FT-817 Mode.

Performance Measurements

I have a KX3, so I built an interface cable (shown in Figure 6), which plugs into the ACC jack on the rear panel (Figure 7). The automatic band tracking worked great. It simplified testing as my KX3 was used as the signal source for much of my work.

Table 2 summarizes the measured amplifier performance. Spurious and harmonic distortion and IMD products, and the TR relay timing were measured in the ARRL Lab.

During my initial tests I measured a high input SWR on 6 meters (about 4:1). This has been a known problem with the HR-50, but I was able to determine the cause and came up with a simple fix. The rework has been incorporated into amplifier boards above serial number 1399. For those with Rev F amplifier boards below this serial number, simply insert 33 pF/100 V capacitors into the RF-IN and AMP-IN connectors. Contact HobbyPCB for the rework necessary on earlier amplifier boards.

During the ARRL Lab testing, a spurious out-of-spec half-frequency signal was found when driving the amplifier on 6 meters. HobbyPCB determined that this was due to a change in the manufacturer of four SMD inductors (L1 – L4) and only affects Revision F amplifier boards from serial number 1200 to 1399. If your HR-50 falls into the affected serial number range and you operate 6 meters, you can either replace the inductors yourself (HobbyPCB will send you replacement inductors), or you can return your amplifier for the update. While these are SMD parts, I easily removed them by placing a soldering iron across each inductor and picking them off with tweezers. Next I added a small blob of solder to one pad end for each inductor, and used a piece of copper braid to wick

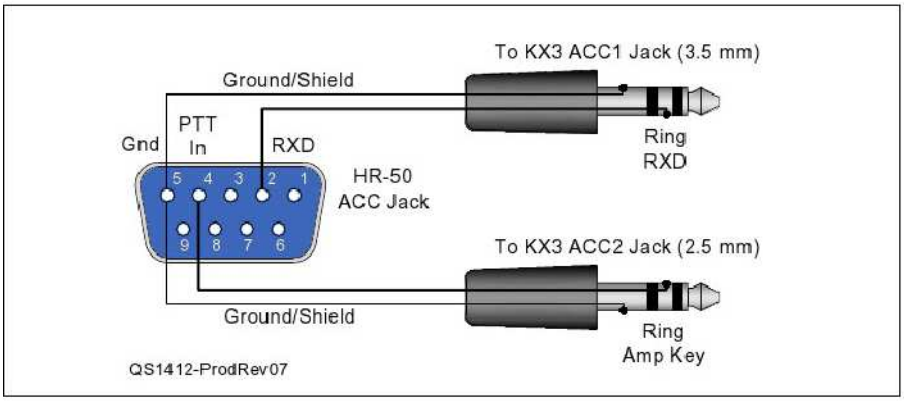

Figure 6 — The author made this cable for interfacing the HR-50 with an Elecraft KX3. The DB-9P connections are shown from the solder-cup side of the connector. I purchased the connectors from **www.mouser.com**. The 3.5 mm and 2.5 mm right-angle plugs are part numbers 171-3308-EX and 171-3325-EX, respectively. The DB-9P and hood are part numbers 156-1209T-E and 156-2009-EX, respectively. A 3-foot section of dual shielded cable connects the DB-9P and the two KX3 accessory plugs.

Figure 7 — Hardrock-50 rear panel. The USB port is used for firmware updates and the ACC jack may be used for automatic band switching from a compatible transceiver.

off excess solder on the other pad end. Then I held each inductor in place with tweezers and heated the solder blob end of the pad. This soldered one end of each inductor, and permitted the inductor to lie flat on the PC board. Then I soldered the other end of each inductor to the opposite pad.

Table 3 documents bypass and amplifier input SWR, required drive for 50 W output (or 5 W maximum drive), and +13.8 V dc current at rated output. Power was measured with a NIST-traceable Mini-Circuits PWR-6GHS+ sensor and calibrated attenuators (±3% accuracy). Input SWR was measured with an Array Solutions PowerMaster, and input dc current was measured with an AEMC 514 Hall-effect clamp-on DMM.

The HR-50 power detector has a very flat frequency response. The power read about 12% high when first tested (better a high reading than a low reading to ensure no signal distortion). Some inaccuracy is expected due to variations in the power coupler's ferrite tolerance, and primary/secondary winding symmetry and positioning. However, a menu selection permits adjusting the power reading. I put in –13% (the factory default was –1%) and achieved readings within 1 W of my PWR-6GHS+ test setup. If you have access to an accurate wattmeter, you can achieve excellent HR-50 displayed-power accuracy. Finally, don't forget to back down the output power by 3 W on HF and 5 W on 6 meters if you have the PIN-diode QSK option installed.

Conclusion

The Hardrock-50 is a compact, rugged amplifier that integrates perfectly with any QRP transceiver. It is reasonably priced and the kit is easy to build for those hams with some prior soldering experience. If you occasionally need to boost your QRP signal by an S unit or two, the Hardrock-50 is certainly worth considering.

Manufacturer: HobbyPCB, tel 646-580-4722; **www.hobbypcb.com**.

See the Digital Edition of *QST* for a video overview of the HobbyPCB Hardrock-50 160 – 6 meter 50 W amplifier kit.

MFJ-4403 Transceiver Voltage Conditioner

Reviewed by Phil Salas, AD5X
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We can't always count on a transceiver's dc voltage source to be clean. In particular, noisy power sources are probably more prevalent during portable operations such as Field Day and DXpeditions, and in automotive (mobile) environments. The MFJ-4403 Transceiver Voltage Conditioner was designed to provide dc voltage protection for transceivers subjected to virtually any dc power situation.

Features

The MFJ-4403 draws its own power from the dc voltage source. Normal dc operating current is 250 mA. Key features include:

- Reverse polarity protection — A reverse voltage input is blocked from the MFJ-4403 output.
- Transient suppression — Voltage transients are clamped at 15 V dc maximum with a 75 A transient suppressor. Long duration high voltage transients will cause the MFJ-4403 input fuse to blow.
- Short circuit protection — Internal automotive fuses protect both the source and connected equipment.
- Noise and ripple filtering — A 4 F (yes, 4 farad) super-capacitor bank made from six 25-farad series-connected capacitors, in conjunction with traditional high frequency filter capacitors, ensures that the cleanest possible dc voltage is applied to your equipment.
- Input and output dc connections are Anderson Powerpole connectors (Figure 8).

A 15 A input fuse provides protection for less-than-adequate power sources and wiring when operating low-current, or high-peak-current, low-duty-cycle, modes. For high-duty-cycle modes and a properly sized power supply, the 15 A input fuse should be replaced with a 25 A fuse. As the MFJ-4403 includes a 4 F capacitor bank, you could conceivably see currents in the hundreds of amps for a few milliseconds if you accidentally short circuit the output. The 25 A output fuse protects a short from causing serious damage.

A power resistor is used both for current limiting during the charging of the capacitor bank, and for discharging the capacitor bank when the MFJ-4403 is turned off. The discharge function is provided because the charged capacitor bank can provide a *huge* amount of energy should it be shorted inadvertently when you think everything is off.

Reverse-voltage protection is provided by a combination of a relay and a reverse protection diode. If a negative voltage is applied to the input, the relay cannot operate, and so no reverse voltage can appear across the capacitor bank or the output. The REVERSE POLARITY LED indicates a negative input voltage condition.

Damaging voltage spikes can occur in automotive environments, and with dirty or failing power supplies. A high-current clamping diode limits any spike to 15 V dc (nominal), and blows the input fuse if the clamped overvoltage persists for a few seconds. The 15 V clamping diode can handle 70 A without damage. Of course, the capacitor bank also serves to momentarily clamp any overvoltage condition because a sudden voltage change over a short period of time results in a high current pulse that can also blow the input fuse.

And finally, the super-capacitor bank provides outstanding filtering of any noise or ripple on the dc input. Smaller value capacitors take care of any high frequency noise that might make it by the super-capacitors. An interesting side effect of this capacitor bank is that you can power a 100 W SSB transceiver from an automotive accessory socket (what we used to call a cigarette lighter socket). We will look at this in more detail a little later.

Bottom Line

If you are ever concerned about the "cleanliness" of a power supply feeding your transceiver, or if you want to ensure that your mobile dc-power source is perfectly filtered, the MFJ-4403 may be just what you are looking for.

Operation

After connecting your dc source to the dc input connector and turning off any connected equipment, push the ON button. The CHARGING and POWER LEDs light and a current-limited charge of the capacitor bank begins. The high value of the MFJ-4403 capacitor bank requires that the capacitors must be pre-charged before you can operate any equipment — connecting a dc source directly to a discharged capacitor bank of this value will short the power supply output! After about one minute the current limiting resistor is shorted by the relay, the CHARGING LED extinguishes, and your connected equipment can be turned on. Incidentally, if any connected equipment is turned on during the pre-charge cycle, the pre-charge cycle will not complete and little voltage will be available for the equipment. A high-current diode in series with the pre-charging resistor keeps reverse voltage from finding its way to the output via the pre-charging circuit.

Figure 8 — MFJ-4403 input/output connections.

When you want to cease operation, turn off any connected equipment and push the ON/OFF pushbutton on the MFJ-4403. The internal power resistor is connected across the capacitor bank and discharges the capacitors in about one minute.

Performance

There is a pre-charge timing strap option on the printed circuit board, but it isn't mentioned in the manual. You should connect across these pins if you have an input voltage less than about 13.25 V dc. Normally the pins should not be strapped as you want the capacitor bank charged as close to the input voltage as possible before operating. With the timing pins strapped, the pre-charge worked well down to 12.25 V dc.

I first looked at pre-charge times. With the timing pins unstrapped, the pre-charge time was 55 seconds at 14.2 V dc, 65 seconds at 13.8 V dc, approximately 2 minutes at 13.5 V dc, and 3.5 minutes at 13.25 V dc. The pre-charge would not reliably complete below 13.25 V dc unless the pre-charge pins are strapped.

I next connected reverse voltage to the dc input. The REVERSE VOLTAGE LED lit immediately, and no negative voltage appeared at the output regardless of the position of the ON/OFF switch. When the reverse-voltage condition was corrected, the MFJ-4403 automatically reverted to normal operation.

Next I tested the input voltage clamping level. I connected a variable voltage power supply across the input and increased the voltage. I had to increase the input voltage very slowly as the capacitor bank does an outstanding job of trying to hold the voltage constant, resulting in power supply current limiting if the voltage is adjusted too rapidly. This is a desired characteristic that provides both filtering and impulse protection. With a little care, I found that clamping occurred at 15.5 V dc.

Finally I looked at power supply filtering. I previously reviewed a battery boost regulator that had ripple and noise so bad that I was afraid to connect it to my transceiver. I couldn't think of a better "dirty" voltage source for testing the MFJ-4403. First I connected the boost regulator directly to a 10 A resistive load with the input voltage set to 11 V dc, and the output set to 13.8 V dc. Figure 9 is an oscilloscope trace of the ac-coupled 13.8 V dc output across the load. As you can see, it is a pretty nasty signal. The amplitude of the ripple and noise is about 6 Vp-p! After connecting the MFJ-4403 between the boost regulator and the 10 A load, I could see absolutely no ripple or noise. The MFJ-4403 definitely does its job!

What About That Auto Accessory Connector?

This is where I really had fun with this review. We've all been told to never power high-power ham equipment from an automobile accessory socket. MFJ states that the MFJ-4403 may be used to power a 100 W output SSB transceiver (75 W output for CW) from an accessory socket for temporary operations. The reason is that the accessory socket should be able to supply the average current required by the equipment, and the MFJ-4403 super-capacitor bank will provide the peak current necessary for low duty cycle transceiver operation. SSB and CW modes permit power from the auto accessory socket to recharge the capacitor bank during speech pauses or gaps between CW characters. MFJ does recommend making a direct connection to the car's battery for normal operation, along with the MFJ-4403 for voltage transient and filtering.

Let's look at the accessory socket possibility for powering a typical SSB/CW transceiver. *UL2089 Vehicle Battery Adapters* is the standard for low-voltage power ports. This standard limits accessory outlets to 20 A, and also states that a minimum of #12 AWG copper wire is required for 20 A. But that is the maximum current permissible, and is not necessarily what is available in most cars. I've spent quite a bit of time looking into this and have found accessory socket ratings varying from 10 to 15 A, and/or 150 to 180 W, continuous, in manuals or printed on the covers of some accessory sockets. You can also get an idea of the

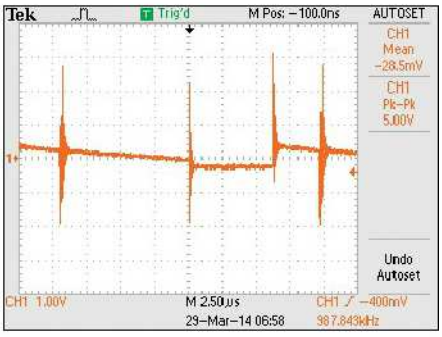


Figure 9 — Battery boost regulator 13.8 V dc output feeding a 10 A load. The amplitude of the ripple and noise is about 6 V p-p. After connecting the MFJ-4403, the ripple and noise vanished.

accessory socket current rating by looking at inverters and tire inflators that are available for use with these accessory sockets.

Based on my research, I think that a 10 A continuous rating is probably reasonable, but you should determine this for your own vehicle. However, 10 A is much less than the peak current required by most 100 W mobile transceivers (often 20 A or so). Further, the mating accessory plug is a spring-loaded pressure contact that doesn't provide the best electrical contact for the high peak current requirement.

I tested three external accessory sockets connected to the high current output of my MFJ-4245 power supply, as well as the 7 A rated MFJ-4245 internal accessory socket. I also tested two different RadioShack cigarette lighter plugs (10 A rating) with each of these sockets (see Figure 10). The upper plug is not fused, while the lower plug includes an internal 10 A fuse.

With a 10 A load connected, I found a very consistent 0.08 Ω resistive loss (measured as 0.8 V drop) with the unfused plug/sockets, and 0.10 Ω resistive loss (measured as 1.0 V drop) with the fused plug/sockets. Then I subjected the connector pairs to a continuous 10 A current for 5 minutes. All socket and plug combinations felt cool. And all socket pins were cool to the touch. However, I found that the center pin of the fused (lower) plug was quite warm after 5 minutes. Based on my resistive loss measurements, this plug is dissipating 2 W more than the unfused plug, probably all in the extra center pin pressure contact and the fuse.

Next I evaluated my IC-706MKIIG current requirements. This radio draws the most

Table 4
IC-706MKIIG CW Transmitting Current Measurements

Output (W)	I-pk (A)	I key-up (A)	I avg (50% duty cycle) (A)	I avg (44% duty cycle) (A)
100	18.6	4.5 (semi break-in)	11.6	10.7
100	18.6	1.4 (QSK)	10.0	9.0
75	16.5	4.5 (semi break-in)	10.5	9.8
75	16.5	1.4 (QSK)	8.9	8.0

Table 5
IC-706MKIIG Peak Current Measurements with MFJ-4403

Output (W)	I-pk Input (Pwr Supply) (A)	I-pk Input (Acc Socket) (A)	I-pk Input (0.1 Ω) (A)	I-pk Input (0.2 Ω) (A)	I-pk Output (A)
100	15.9	11.2	10.2	7.3	18.6
75	14.3	10.2	9.5	6.8	16.5

Figure 10 — The reviewer's automobile accessory connectors, described in the text.

current on 20 meters (18.6 A at 100 W output), so I used this band for testing. I used CW for my tests since CW has a higher duty cycle than SSB (44% PARIS standard CW duty cycle vs 20 – 30% SSB duty cycle). Table 4 shows my measurements for key-down and a string of dits (50% duty cycle), and the estimated average current based on the PARIS standard.

As you can see, about 10 A is a good average current drain that you might see when transmitting. However, we don't want to subject the accessory socket to the 18 – 19 A peak current that is drawn on every "dit." And this high peak current will also result in a peak voltage drop of 1 – 2 V dc.

I connected the MFJ-4403 between my MFJ-4245 power supply high-current output and the transceiver and measured the input and output dc current peaks while transmitting (receive current drain is well within any accessory socket current rating and so the MFJ-4403 just provides filtering and transient protection). I used an AEMC 514 digital Hall-effect clamp-on meter for peak and average dc current readings.

Initially I was surprised to see a high MFJ-4403 input spike of almost 16 A (corresponding to the 18.6 A peak current output). Then I used an accessory plug/cable between the MFJ-4245 power supply and the MFJ-4403 dc input and saw the MFJ-4403 input current spike drop to 11.2 A. After thinking about this I realized that in a perfectly lossless system, any discharge of the capacitors will be instantly recharged by the sourcing power supply, resulting in the same input and output current. However, if there is any loss from the input dc source, the recharge current is spread out over the RC time constant due to the dc-line loss and the total capacitance. With a 4 F capacitor, even a 0.08 Ω loss results in a time constant of about ½ second. My bench tests are probably as close to ideal as possible, and accessory sockets and wiring in most cars probably have more loss. Therefore I ran some additional tests showing the effect of adding in very low resistive losses. The results are shown in Table 5.

From Table 5 you can see that the accessory socket output current measurements are very similar to the IC-706MKIIG average current requirements when there is just a little loss in the system. In other words, you limit peak current when using an accessory socket to power a 100 W SSB/CW transceiver because the accessory socket and associated wiring is not lossless!

So — is it safe to use an auto accessory socket to power a MFJ-4403 connected to a 100 W SSB transceiver? I will leave this decision up to you. My measurements indicate that this is viable. And I did connect my IC-706MKIIG this way to my wife's 1997 Mustang. I used a high-power dummy load and a peak-reading Bird wattmeter and verified that the transceiver put out full power on SSB.

I do have a few recommendations. First, if you build your own cable, make sure you use a quality accessory plug that is rated for at least 10 A. The plug should have two ground "ears," and it should fit firmly into the accessory socket. You should also use #14 AWG wire minimum, and preferably #12 AWG. (MFJ sells an accessory-plug-to-Powerpole cable (MFJ-5515M) with a 3 foot flexible #12 AWG cable.) Finally, you should consider this as a temporary mobile solution. For permanent solutions, connect the input to the MFJ-4403 directly to the battery.

Conclusion

The MFJ-4403 is a very robust dc filtering and transient protection device. It is certainly something to think about adding to your mobile power supply line, and any place where there is concern about power supply cleanliness. It is even at home in your main station should you have any concerns about your power supply failing and causing a problem. My only complaint is that it does not include a ground stud. Of course, a ground stud is easy to add, and maybe MFJ will add one in the future.

Manufacturer: MFJ Enterprises, PO Box 494, Mississippi State, MS 39762, tel 800-647-1800; **www.mfjenterprises.com**. Price: MFJ-4403, $119.95. MFJ-5515M cable, $19.95.

New Books

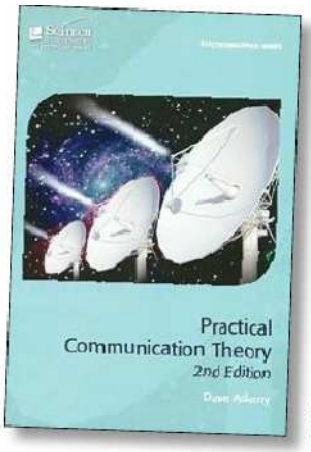
Practical Communication Theory, 2nd Edition

by Dave Adamy

Reviewed by Joel R. Hallas, W1ZR

There are a number of possible directions for a book with this title to head, and I must say that I was somewhat relieved to find that it didn't replicate some of the texts on statistical communications theory that I encountered as a graduate student. Instead, this book focuses on the elements of communications systems and how to quantify the properties of each in a very straightforward and deterministic way.

In this approach, mathematic formulations are frequently shown, but don't get far beyond decibel and relative area calculations — no understanding of calculus is required to follow along. If you're not comfortable with that level of operation, many significant calculations are also shown as nomographs or plots. In addition a handy antenna and propagation slide rule is provided that can painlessly provide free-space attenuation, parabolic antenna gain and beamwidth, and Fresnel zone width.



This book covers the whole process required to lay out a point-to-point radio communications system, or analyze the capabilities of one that is being fielded, in a systematic, straightforward and easy to understand way. Note that in this context, by point-to-point I am excluding HF ionospheric propagation, which is beyond the scope of this book — think VHF through microwave systems here, although near-Earth HF communications are not excluded.

The focus on "The Link Equation," with a dedicated chapter, is appropriate in my view. The author helps the link designer answer the key questions — how much power do I need to get the needed signal strength at the far end, what receiver sensitivity is required and what antenna gain is needed. Obviously, each of these parameters is closely related and the trade between them is often a financial one that the designer can adjust based on individual constraints. The author provides examples of determining the link design using his provided slide rule.

The next chapter gets to the heart of the matter — how much signal-to-noise ratio is required to adequately receive signals sufficient to be detected and processed as a function of the information, including the digital encoding that is generally employed.

In summary, this book very nicely covers the design and analysis of real-life radio point-to-point communications in an easy to understand, but very practical (as promised by the title) way, that will make sense to most *QST* readers.

Scitech Publishing, Edison, New Jersey. ISBN 978-1-61353-186, hardcover, 6.5 × 9.5 inches, 161 pp. Available from **Amazon.com** *for $60.52.*

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

What's the Gain of a ¼-Wave Monopole?

Q Dave, W4EJ, asks: I was recently in a conversation with a relatively new ham regarding the gain of a ¼-wave monopole antenna compared to an isotropic antenna in free space. While the gain of a dipole is commonly specified as 2.15 dBi, I noted that I had never seen a ¼ wave monopole described in this way. I researched the issue in some antenna engineering textbooks and also articles on the Internet and found gains specified from +5.17 to –0.85 dBi, depending on the author. There seems to be a lot of confusion on this subject. This is an example of something I thought I was informed about, only to find out with further study, that this was not the case. Can you provide some clarification?

A This is an interesting question, and one that requires a lot of reading of the fine print! Some key points:

- Isotropic antennas can only exist in free space, or very far from ground.
- The 2.15 dB gain of a dipole over an isotropic antenna also assumes that they are both in free space. That figure only takes into account the redistribution of the energy from the ends of the dipole toward the main lobe, which in free space for a horizontal antenna, is the same at all elevation angles.
- For horizontally polarized antennas, except for those in aircraft or space applications, the effect of ground reflections is generally more significant than the gain described above.

Note that the ground reflection of a horizontal antenna is out of phase towards the horizon (0° elevation). For a horizontal antenna, the reflection from the ground will be in-phase at elevation angles at which the path length from the antenna itself and the ground reflection are different by ½ wavelength or odd multiples (see Figure 1). While the peak angle will be different for different heights as shown in Table 1 (based on modeled results using *EZNEC* antenna analysis software), the typical increase at the peak will be about 6 dB, depending on ground conditions.[1]

As you can see the ground reflection is more significant than the increase from the end redistribution. Note that the values in Table 1 are based on "typical" ground (conductivity, 0.005 S/m; dielectric constant 13). Also, the patterns for horizontal antennas at heights above half a wavelength tend to have multiple lobes which carry additional energy.

- Unlike the horizontal antenna, the ground reflection of a vertical antenna over perfect ground is in phase at 0° elevation. Over real ground, however, the energy that would be propagating along the Earth's surface will be absorbed by ground losses, resulting in an effective null at the horizon beyond the effective distance of the ground wave, usually in the tens of miles, depending on ground conductivity. Thus long distance low angle radiation is much less than predicted by the perfect ground model.

The result is that what should be a large amount of useful radiation at low angles

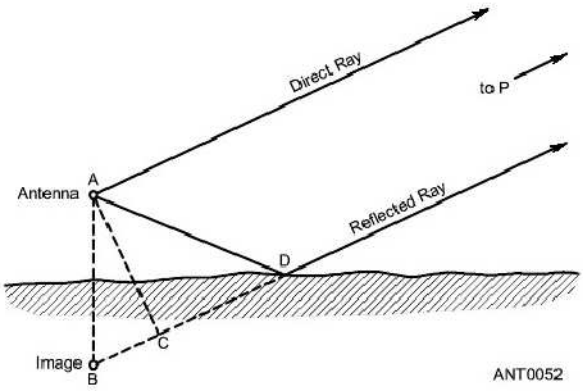


Figure 1 — Diagram illustrating the difference in path length between a direct wave and that from its ground reflection. To consider the geometry, imagine an antenna the same distance below ground B as the real one A is above. The difference in path length is then equal to the length from B to C. For a horizontal antenna, the two will be in phase (additive) at the angles for which the difference is an odd multiple of a half wavelength.

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

Table 1
Elevation Angle of First Lobe and Peak Gain as a Function of Horizontal Antenna Height

Height (λ)	Angle of First Lobe (°)	Peak Gain (dBi)
0.25	63	5.72
0.5	28	7.25
0.75	19	7.24
1.0	14	7.61

Table 2
Elevation Characteristics of Vertical Monopoles as a Function of Configuration

Monopole Length (λ)	Condition	Angle of First Lobe (°)	Peak Gain (dBi)
0.5	Free Space	0	2.1
0.25	Free Space	0	1.22
0.25	Ground Plane Over Typical Ground	27	–0.17
0.25	Above Ground Plane at 10° elevation		–2.9

doesn't make it very far, at least over typical ground. The exception is propagation over sea water, approximating a lossless perfect ground, at least toward destinations over the water.

Table 2 provides some examples of the performance of ground mounted monopoles. The last entry in Table 2 may be of interest because, while the gain of the ground plane doesn't seem so large at 10° elevation, a horizontal dipole has the be up at least 0.3 wavelengths above typical ground to have the same energy at 10° elevation. That's why verticals can work better than horizontals on the lower frequencies, where it is often difficult to get horizontal antennas high enough to be effective at low angles.

Q Bruce, N1EQG, asks: I find my new antenna analyzer a valuable tool, but I haven't yet found a way to use it to measure transmission line loss. Can this be accomplished with my analyzer?

A I can think of two ways to use an antenna analyzer to determine the loss in transmission lines. If you wish to determine the loss in a line feeding an antenna, you can do so by measuring the SWR — or better, the impedance — at the radio end of the line while it is connected to the antenna on one or more frequencies that are of interest. This also requires that you know the length and type of the transmission line, but an approximate length will yield an approximate line loss — frequently close enough for our purposes.

Open the program *Transmission Line for Windows* (*TLW*) that comes on the CD-ROM supplied with any recent *ARRL Antenna Book*.[2,3,4] By entering the line type from the pull-down box, the frequency and the length, and then the measured impedance in the box provided, you have it set up to tell you the loss — click the INPUT button near the impedance data and read the loss as well as the actual line SWR (it is always higher than it reads at the bottom, due to line loss).

If your antenna analyzer only provides the SWR, rather than the actual impedance, all is not lost. Set the reactance to 0, and for the resistance put in Z_0/SWR, where Z_0 is the characteristic impedance of the transmission line and SWR is your measured SWR, and note the loss. Then put in $Z_0 \times$ SWR and note the loss. The two values of impedance are the two easiest to calculate impedances that yield the measured SWR and should give an idea of the approximate cable loss and the range of uncertainty.

The other method to estimate line loss from measured SWR is to measure it with the far end of the line open or shorted. This is not a good idea with the SWR indicator in a transmitter, since it is not generally safe to transmit into a high SWR and many radios will shut down if this is attempted.

If the line has no loss, the SWR will be infinite, since all power will be reflected and returned to the analyzer. If the line has high loss, the SWR will be low, indicating that little power is coming back. Of course, it is the intermediate cases that we are most interested in.

An alternate parameter used in some fields to specify mismatch is called *return loss*, usually measured in decibels (dB). This is a measure of how much power is returned to the source and, as noted above, a high return loss equates to a low SWR and vise-versa. Some SWR analyzers provide this as an optional output, but most don't.

The punchline is that the return loss with an open ended or shorted cable is the two way loss on the cable at the measurement frequency — so dividing it by 2 gives the cable loss you are looking for. If the return loss is not directly available, it can be easily calculated from the SWR, as follows:

$$L_R = 20 \times \text{Log}_{10}\,[(\text{SWR}-1)/(\text{SWR}+1)] \qquad \text{Eq 1}$$

Where L_R is the return loss in decibels.

Alternately, Table 3 may be usable as a look-up table. Note that a limitation of this method is than many SWR indicators are progressively less accurate as the indicated SWR increases, so use caution if the measured SWR is high. Table 3 provides data for SWR up to 10:1, but many indicators do not even have calibration above 5 or 7:1, so apply appropriate levels of salt.

Table 3
Return Loss and Cable Loss for Various Values of SWR

SWR	Return Loss (dB)	Cable Loss (dB)
1.05	32.26	16.13
1.1	26.44	13.22
1.2	20.83	10.41
1.5	13.98	6.99
1.7	11.73	5.86
2.0	9.54	4.77
2.5	7.36	3.68
3.0	6.02	3.01
3.5	5.11	2.55
4.0	4.44	2.22
4.5	3.93	1.96
5.0	3.52	1.76
7.0	2.50	1.25
10.0	1.74	0.87

Ruddy Ellis, W4LNG, provides some cautionary insight regarding the dimming of lights under load, such as while keying an amplifier, as discussed in the August 2014 column. Ruddy suggests that, while it could be an indication of excessive drop in the circuit feeding the amplifier, as mentioned, there is another possibility. That is a poor connection of the neutral line from the pole to the ground at the service entrance.

If the problem is the neutral connection, whenever there is a heavy load on one side of the 240 V line (one 120 V "leg"), the voltage on that side will go down while the voltage on the other leg goes up. Only if the loads on the two legs are equal will each voltage be 120 V. Ruddy experienced this at one house to the extent that the lightly loaded leg voltage went high enough to burn out some appliances.

Ruddy has experienced this in multiple houses. One was caused by rodent damage, one by salt-air corrosion. So if some lights get bright, while others go dim with changing load — make sure that your neutral line is well grounded to the service entrance box. If in doubt, call your electrician.

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**.

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

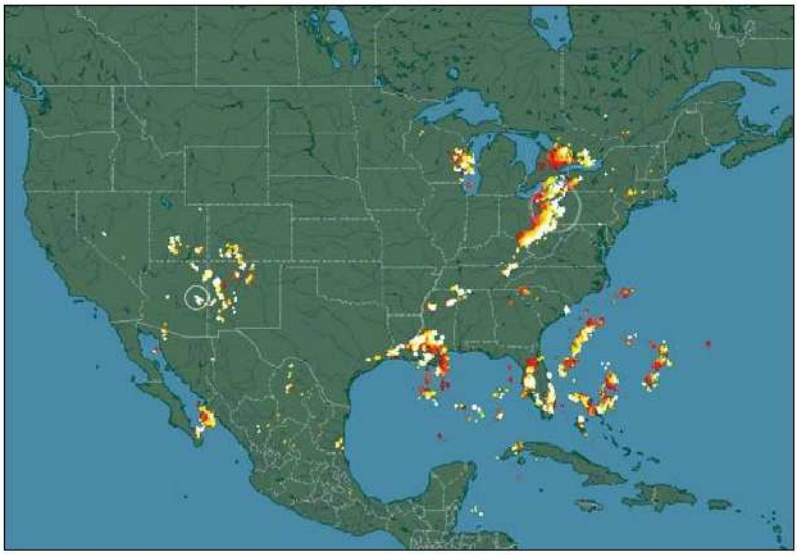
[3] While early versions of *TLW* provided accurate results with coaxial cable, they were optimistic on their loss predictions with balanced transmission lines. A new version is described in the *QST* article of reference 4, along with a pointer to the revised program file.

[4] J. Hallas, W1ZR, "Introducing an Improved Version of Transmission Line for Windows Software," *QST*, June 2014, pp 38-40.

Steve Ford, WB8IMY, wb8imy@arrl.org

Listening for Lightning at VLF

If you're looking for a way to instantly share information among large groups of people in far-flung locations, it is hard to beat the Internet. For years amateurs have exploited its ability to combine or *aggregate* disparate streams of data from throughout the world. Internet-based DX clusters combine spotting reports from amateurs on almost every continent. The constantly changing nature of radio propagation is revealed through reports fed automatically from JT65 operators to websites such as PSKReporter (**pskreporter.info**), or by reports from WSPR operators aggregated at **wsprnet.org**. And then there is the Reverse Beacon Network (**www.reversebeacon.net**) and many similar sites.



A map of reported lightning strikes in North America as seen at the Blitzortung website at **www.blitzortung.org.**

With this aggregation capability well in mind, Greg Smith, KK4AAG, passed along news of a fascinating online collaboration between Very Low Frequency (VLF) hobbyists, amateurs, and weather enthusiasts. The non-profit group calls itself *Blitzortung* (from the German for "lightning location"). It is a global network of VLF receivers that listens for the characteristic signals of lightning strikes between 3 and 30 kHz. When a receiving station detects a lightning signal, it uploads the information to the Blitzortung website for analysis and sharing.

Although this group originated in Germany, they've gathered participants from many nations, including the US and Canada. At the time this column was written, there were more than 60 participants in the United States alone.

The Blitzortung website software analyzes the incoming reports and calculates the approximate locations of lightning strikes through the use of a Time Of Arrival (TOA) technique. Think of it as a form of foxhunting at VLF frequencies, except that this fox is hotter than the surface of the Sun!

For TOA analysis to work accurately, each participating station must upload information about the lightning signal, including the precise time when the signal was detected. The network relies on Global Positioning System (GPS) time synchronization, which means that each station must also have the ability to receive and decode GPS signals. GPS reception also allows stations to accurately report their positions.

The Blitzortung group offers a station starter kit that sells for less than $270. It consists of a couple of ferrite antennas, a VLF receiver/preamplifier and a controller board. You have to add a GPS receiver module, but note that the controller board supports only those using MediaTek MT3339 and SiRF chip sets. Compatible devices include the Garmin 16, Garmin 17, Garmin 35, and the EM-406A module. For more information, go to **www.blitzortung.org** and click on the COVER YOUR AREA tab along the top of the web page.

On the same page, you will find fields where you can submit order requests for the latest kits. The Blitzortung organization is a group of volunteers, not a business, so it helps to exercise patience. At press time they announced that revised kits would be available in 2015.

A New Software Defined Transmitter from Zephyr Engineering

Zephyr Engineering has announced a new software defined radio transmitter known as the SDRstick, model UDPSDR-TX2. This neat little unit for experimenters joins UDPSDR-HFx series of receivers to create complete SDR transceivers.

The UDPSDR-TX2 covers 200 kHz to 55 MHz with an output of 500 mW. That may seem like a tiny amount of RF, but nothing would prevent you from buying or building a power amplifier to boost the output to 50 W or more.

The SDRstick modules are compatible with several different FPGA development kits available from Arrow Electronics. They provide hardware front-ends to *GnuRadio* and other SDR software for a wide range of applications. You can purchase SDRstick boards from iQuadLabs at **www.iquadlabs.com** and Arrow Electronics at **components.arrow.com/part/search/udpsdr**. For more specific information, visit **www.sdrstick.com**.

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

Experiment #143

Delay Circuits

The Warner Brothers cartoon character Marvin the Martian seethes, "delays, delays!" But there is no need for a ham radio electronics designer to become "verry annngry." Not at all! Delay circuits are found in many types of ham radio gear, and might even prevent an Earth-shattering ka-boom! This month's column serves up two sample circuits to satisfy your search for spare seconds.

Pulse Stretcher

There are many applications to "stretch" a short pulse into a longer one. A circuit that detects RF might only generate a very short pulse if the incoming signal is brief or weak. That might generate a pulse too short to reliably trigger a logic circuit, be detected by a microprocessor, or light an indicator long enough to be easily seen by the naked eye. Switching or power transients are another notoriously unreliable input signal. One simple and inexpensive solution is to use a spare logic gate or two and an RC timing network, as shown in Figure 1.

Let's take the circuit in Figure 1A as an example. In its resting or *quiescent* state, the input signal is LOW, the input connected to R and C is LOW, and the output of the OR gate formed by the combined NOR gate and inverter is also LOW. As soon as the input pulse changes to HIGH, the output of the OR gate also goes high. This causes current to flow through C, creating a voltage across R. Since C is assumed to be discharged, the initial voltage across R is approximately the same as the output signal, close to V+. Then it begins to drop according to the RC circuit's time constant $\tau = RC$. In a bit more than one time constant τ the voltage will have dropped enough at the OR gate's input to be a logic-level LOW. If the input pulse has ended by then, both inputs to the OR gate will be LOW and so the output of the OR gate will return to LOW. If τ is longer than the input pulse, the output pulse has been "stretched" to approximately *RC* seconds. The output pulse will never be shorter than the input pulse. Why? (The output of the OR gate will be high as long as either input is high.)

You can follow similar steps to figure out how the circuits work in Figures 1B – 1D. In all, there are four circuits for stretching and inverting either positive- or negative-going pulses. You'll find that using an oscilloscope is the best way of watching both the input and output pulses. Use a 555 timer circuit as described in Experiment #5 as your pulse generator.[1]

The exact amount of stretching depends on the logic switching thresholds of the logic family you are using. The closer the gate switching thresholds are to V+ and ground, the more the pulse will be stretched. For example, switching thresholds for the 4000-series of CMOS logic are about 10 and 90 percent of V+. Pulses will be stretched longer for this family of logic than for a logic family with thresholds closer to ½ V+. Why? (Because the voltage across R will have to decay longer to

[1]All previous Hands-On Radio experiments are available to ARRL members at **www.arrl.org/hands-on-radio**.

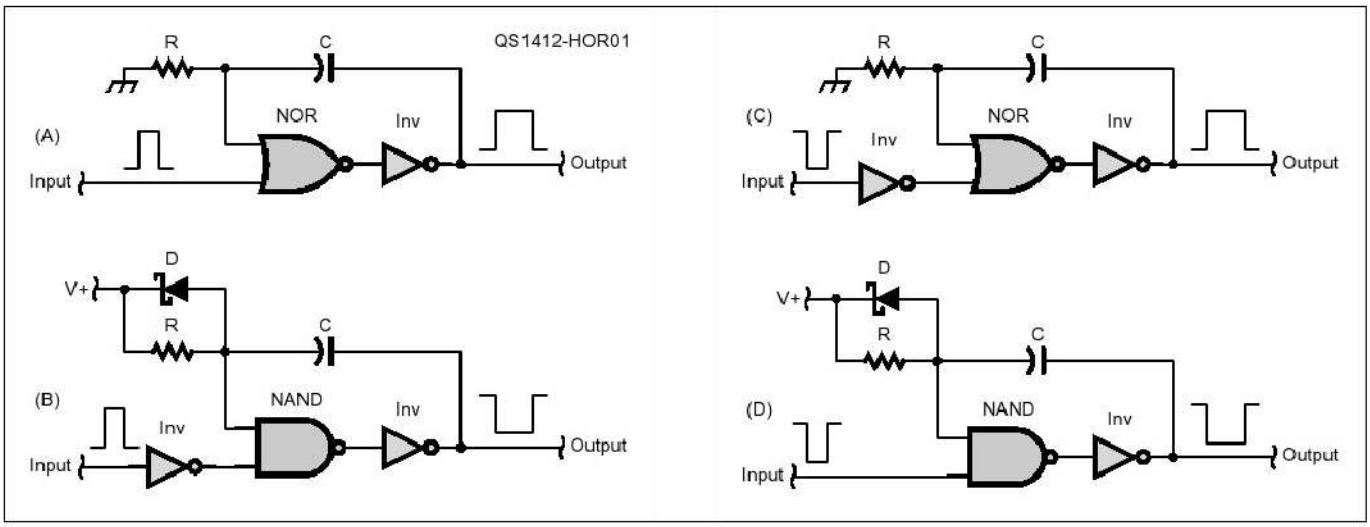


Figure 1 — Four basic pulse stretching circuits. A and D stretch the pulse without inverting it while B and C invert the input pulse. Diodes across the timing resistors prevent switching transients from exceeding the power supply voltage and possibly damaging the logic gates.

reach the lower switching threshold and that means the output pulse will stay HIGH longer.)

Soft-start Circuit

Linear amplifiers and other equipment with high-voltage (HV) power supplies need a bit of delay between the time the power switch is turned ON and the time full voltage is applied to the HV rectifiers and filter. The reason is *inrush current*. If a linear power supply's filter capacitors are discharged when power is applied, they act like a short-circuit during those first few cycles of rectified ac. This causes very high current pulses in the transformer windings and through the rectifiers as the capacitors charge up.

After a few cycles of ac and depending on the resistance of the rectifiers and transformer secondary winding, the filter capacitors are charged to near their peak value and the amount of current drops dramatically. During the charging period however, peak currents can be 10 to 20 times normal current or even higher, placing significant stress on all of the power supply components.

Circuits have been employed that slowly increase transformer input voltage with a TRIAC or other variable ac source. The *soft-start* circuit presented in Figure 2 is simpler and satisfies quite nicely the requirement to limit that surge current. It limits inrush current with a 10 Ω power resistor. Until the relay activates, the 10 Ω resistor is in series with the primary winding of the main power transformer. After a suitable delay, the relay contacts short out the 10 Ω resistor and full power is applied to the main transformer.

To power the relay, an auxiliary power supply circuit is required. A small 12 V transformer supplies a 1N4001 diode and 2200 µF in a half-wave rectifier circuit. At light loads, the filtered output voltage, V_{PS}, will be about $12 \times 1.4 - 0.7 \approx 16$ V. (V_{PS} will drop closer to 12 V when the relay coil draws current from the supply.)

The timing of when the relay switches is determined by the 33 k Ω resistor and 470 µF capacitor. When power is applied with the 470 µF capacitor completely discharged, it begins charging towards 16 V with a time constant of $\tau = RC = 33 \times 10^3 \times 470 \times 10^{-6} = 15.5$ s.

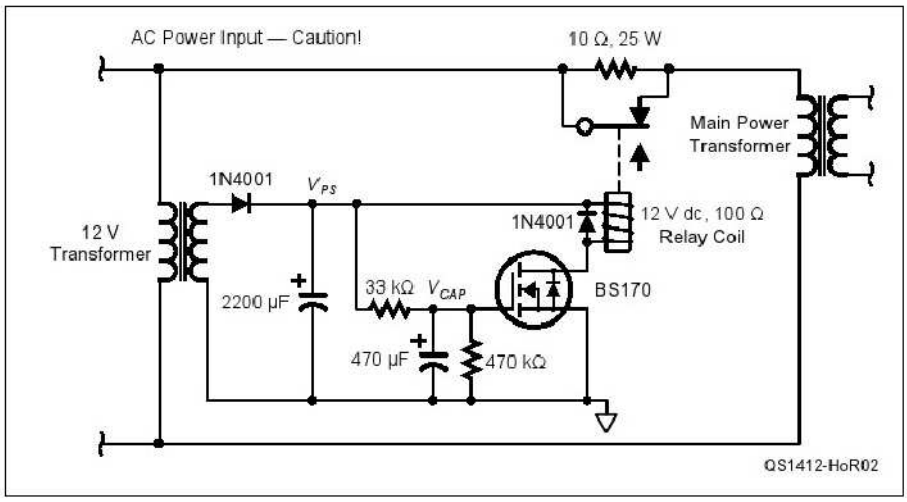


Figure 2 — A soft-start circuit reduces inrush current to the large filter capacitors in a high-voltage power supply. The 10 Ω resistor limits primary current while the capacitors charge. After a couple of seconds, the relay shorts out the resistor and applies full power to the secondary.

As the voltage across the 470 µF capacitor (V_{CAP}) increases, it approaches the *gate threshold voltage* ($V_{GS(Th)}$) of the BS170 FET. This is the point at which the FET will rapidly turn on and conduct drain current, acting more or less like a switch. How quickly the gate voltage will reach 2 V is determined by the equation:

$$t = -\tau \ln[1 - \frac{V(t)}{V_{PS}}] = -15.5 \ln[1 - \frac{2}{16}] \approx 2 \text{ s}$$

Two seconds is plenty of time for a power supply's filter capacitors to charge up. (This and similar formulas for RC timing circuits are posted on the Hands-On Radio web page for this experiment.)

Most 12 V relay coils have a resistance of around 100 Ω and so draw about 120 mA from a 12 V supply. If the *on-resistance* ($R_{DS(On)}$) of the FET is a few ohms, it will dissipate $P_D = I_D^2 \, R_{DS(On)} = 0.014 \, R_{DS(On)}$ watts, which is a minimal amount of heat. The 470 kΩ resistor discharges the timing capacitor when power is removed so that the circuit will operate properly when power is again switched on. The second 1N4001 diode clamps the coil voltage so that a nasty *inductive kickback* transient doesn't destroy the FET when the relay is turned off.

All of this is quite loosely estimated, which means there is plenty of room for experimentation by you! There is a lot of variation between relays — not only in the coil's resistance but the relay's *pull-in voltage* at which the coil will actually switch the contacts. Try changing the timing components, use different types of FETs or redesign the circuit to use an NPN transistor like the 2N4401, or maybe scrounge up some different relays and try them out. This will help you get a feel for how much variation you can expect out there in the real world.

You needn't actually apply the soft-start circuit to a high-voltage supply — it will operate just fine on its own. You can get a sense for the timing just by listening to the relay or wiring an LED circuit through the normally-open contacts. If you use this circuit on an actual ac power supply, though, please remember that the 10 Ω resistor and the relay contacts carry the full ac mains voltage. That hazard is easy to forget when working with low-voltage circuits! Make sure you keep the ac wiring insulated and well away from the low-voltage dc circuits. No surprises, please!

Feedback

In the October 2014 *QST* article "Add 40 Meters to a 24-Foot Boom Yagi" by Michael Foerster, W0IH, p 40, the first sentence of the second paragraph states that the omega match used two 200 to 250 µF variable capacitors. The unit of capacitance should have been picofarads (pF).

Steve Sant Andrea, AG1YK, hk@arrl.org

Antenna Tubing, a Homebrewed Mic Stand, and Cleaning Rotary Contacts

Mobile Antenna Carrying Case

On a trip I like to bring along several hamstick-type mobile antennas. During the day the 20 or 15 meter bands are great when they are open, and a short mobile antenna can be quite efficient on these frequencies. At night, 40 meters is my choice.

A disassembled hamstick-type antenna is a little over 4 feet long. There are two parts: the helically loaded base and a stainless steel whip. I made a tubular carrying case that will hold several such antennas. I can stow the tube with antennas underneath other luggage in my hatchback car and access an antenna easily without removing everything else.

Inexpensive mailing tubes with a 3-inch diameter are available in 3-foot lengths at any stationery store. To make my carrier, I bought two of them and cut a 16-inch section off the end of one to make an extension for the other. I butted the short piece and the full-length tube together, and wrapped a piece of cardboard about 6 inches wide around the joint to make a union, overlapping each mailing tube piece by about 3 inches. I used duct tape to hold the union together and attach it to the end of the longer tube. I then pulled out the short tube and cut two notches about an inch long into the open end so I could squeeze the short tube's end slightly, to make it easier to slide it in and out of the union attached to the long tube. I used more duct tape to permanently fasten the plastic plugs in the ends of both pieces.

Figure 1 — A couple of inexpensive mailing tubes, appropriately modified, makes a convenient way to store and transport mobile/portable antenna elements. [Al Woodhull, N1AW, photo]

This makes a good 4-foot, 4-inch storage and transportation container that can hold as many as five antennas in their plastic sleeves. The sleeves keep the bases and the whips for each band together. I label each sleeve with a marker to identify its band. Referring to Figure 1, you can see that I have also used a marker to make a 120 centimeter ruler on the backs of some of the plastic sleeves. This is to measure the extension of the whip so I can quickly readjust the frequency from the CW to the SSB end of a band.

My antenna case is easy to handle. This is not something rugged enough for checked luggage on a plane, but it is a handy way to carry a set of antennas in a car. In my old Civic wagon I was able to use bungee cords to fasten the antenna tube to the front seat overhead grab handle and the rear seat coat hanger hook. In my current car, that doesn't work but I can put the antenna tube under my luggage and access it from the rear hatch. — *73, Al Woodhull, N1AW, 199 Eden Tr, Leyden, MA 01337*, **n1aw@arrl.net**

Homebrew Microphone Stand

Desk microphones are very handy while taking traffic or filling in log sheets (for us non-computer types). But they can be very expensive and lack the useful control buttons often incorporated in the factory-provided ones.

While taking traffic on the Wyoming Cowboy Net, I found myself holding down paper with an elbow while trying to write. This was hardly efficient or comfortable. It occurred to me that the factory mic had a built-in holder on the back. If I could mount it on a stand then, using VOX, both hands would be free. The result was the mic stand shown in Figure 2.

Figure 2 — This homebrewed stand allows the typical factory hand microphone to double as a desk mic. [Leonard Gordon, KD7CLO, photo]

I have access to welding and cutting equipment so I made mine out of steel. But the same result could be done with a variety of materials, such as a tuna tin filled with plaster, with wood for the upright.

Referring to Figure 3, the bottom is a piece of 1 × 2½ × 3 inch steel drilled for a ⅜-inch round rod, 7 inches long, for the upright. The upright height can be any length to match the needs of the individual. The base is drilled and tapped for a set screw to hold the upright rod. A 3-inch piece of ⅜-inch rod was welded at a 90° angle to the upright. A piece of ½-inch square tube 2 inches long with a set screw is placed over this piece of ⅜ inch rod.

A simple tab is welded and drilled to this square tube to accommodate the screws for the microphone mounting clip. A bit of

Figure 3 — While this stand is made from steel, wood could be used for simpler construction and a more pleasing look. [Leonard Gordon, KD7CLO, photo]

Figure 5 — With the addition of some short "legs," the power supply meters are now much more visible and more cooling air can flow underneath. [Richard Russo, KB3VZL, photo]

spray paint was applied for a professional appearance. Finally, I glued a piece of craft rubber on the bottom to prevent slipping and possible scratches on the desk. Slip the microphone into the clip and you have a desk mic with full features. The total height of my stand is 9¼ inches, but it can be whatever meets your individual needs.

As a bonus, when we have one of our numerous summer afternoon thunderstorms, I simply lay the mic on the desk to indicate that the antennas are grounded. When I return to the shack there is no possibility of forgetting to reconnect the antennas because the mic on the desk is a visual reminder. — *73, Leonard Gordon, KD7CLO, 2112 Rooks Ave, Cheyenne, WY 82007*, **samicat@bresnan.net**

Cleaning Rotary Switch Contacts

My old Heath V-7A vacuum tube voltmeter (VTVM) had stopped working due to intermittent rotary switches. I fixed it by applying Noalox Anti-Oxidant Compound (**www.idealindustries.com**) to the contacts with a toothpick. Noalox is a blue, thick semi-liquid suspension of zinc particles that will remove corrosion from the switch contacts. It's available at home improvement centers and electrical/commercial supply companies.

To clean the switch, I first removed the front and rear pieces of the V-7A VTVM cabinet to give me access to the two front panel switches. I removed the nozzle on the Noalox bottle and inserted a long screwdriver into it. I stirred the contents for a few minutes, as the suspension tends to separate over time.

I reattached the nozzle, which allows a measured amount of the Noalox to be dispensed from the bottle, and put about a half teaspoon of the Noalox into a clean saucer.

Using a toothpick, I applied the Noalox to the contacts, turning the shaft to make sure all of the parts had a thin coating. When I finished, I rotated both switch shafts several times to make sure the coverage was complete.

Note: When using Noalox on switches in an RF circuit, apply it sparingly. The Noalox runs and can detune a circuit. — *73, Thomas Webb, W4YOK, 3533 Teakwood Ln, Plano, TX 75075*, **sam9lives1@verizon.net**

Tilt-up Feet

Most transceivers and other ham equipment have a tilt-up leg feature to improve the viewing angle of the controls and meters. I purchased a new power supply and discovered that it didn't have this feature. To adjust the viewing angle I created front leg extensions from a few parts and pieces I had in the workshop.

First, unscrew the two front rubber feet. Drill a center hole in two ½-inch electric box plugs, to accept the rubber foot's mounting screw. Now attach the box plug to the bottom with the flat side to the bottom of the equipment case using the original screws from the removed feet (see Figure 4). To finish the modification, screw on two ½-inch plastic threaded electrical tubing adapters. You now have front feet extensions about an inch and a half long (see Figure 5). The viewing angle is similar to that of the other equipment and, for equipment with cooling vents underneath it also allows extra cooling air in. I spray painted mine flat black to improve their appearance. The total cost of parts is less than $3. — *73, Richard Russo, KB3VZL, 105 Colonial Ave, Norristown, PA 19403*, **kb3vzl@arrl.net**

Figure 4 — A few inexpensive components can replace the low feet of a piece of equipment to allow for easier viewing. [Richard Russo, KB3VZL, photo]

Code Key Covers

For an inexpensive way to display or keep the dust off of your shiny code key, consider picking up a clear plastic "model car" display case from your local hobby shop. They can be had for under $10 and come in different sizes ranging from those suitable for the larger mechanical "bugs" down to the smaller electronic keyer paddles. If you like, you can use the shaft of a soldering pencil to easily melt a slot in the lower back wall of these cases to accommodate wiring. — *73, Joe Morse, AD4W, 317 Westlawn Rd, Columbia, SC 29210-5622*, **ad4w@sc.rr.com**

"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.

Special Veteran, Special Radio, Special Event

A Navajo Code Talker — and the radio he used — put the Navajo code on the air again.

Richard Corrigan, N0RMC

On April 4, 2014, the culmination of more than a year of research, coordination, and testing brought together the last living member of the first platoon of Marine Navajo Code Talkers, a World War II TBX-6 transceiver, and the Marines of the Marine Corps Network Operations and Security Command (MCNOSC). The purpose of this unusual reunion was to dedicate Platoon 382 Hall, the new annex to Code Talkers Hall, which is home to the MCNOSC at the Marine Corps Base in Quantico, Virginia. Platoon 382 Hall is named after the first platoon of Navajo Code Talkers who came together in 1942 to aid the US Marines in the Pacific Theater. Members of the Stafford Area Repeater Association (SARA) and the Marine Corps Amateur Radio Club (MCARC) had the pleasure and honor of participating in this historic event.

Colonel David McMorries, the commanding officer of the MCNOSC, tasked 2nd Lt Procter, a young Marine officer, to locate any pieces of history relevant to the Marine Navajo Code Talkers that could be displayed at the entrance to Platoon 382 Hall. Second Lt Procter was able to track down an operational TBX-6 radio that was in the collection of New Jersey ham Rob Flory, K2WI. Rob, who has an impressive collection of vintage naval radio equipment, agreed to part with his TBX-6, which was instrumental in making the event an overwhelming success. MCNOSC Operations Chief Robert Gibbons procured the TBX-6 from Rob for display at the entrance to the facility.

Bob Gibbons and 2nd Lt Procter joined the members of SARA on a Saturday morning in July 2013 to determine if there were any members who had experience operating and maintaining radio equipment like the TBX-6, which they brought for everyone to view. Bob went on to explain what was planned for the dedication, and the desire to have an operational radio available as well as the last remaining Code Talker present for the dedication.

This historic transceiver and the prospect of actually operating it in the presence of a living part of the radio's history were too much for members of SARA to pass up! Ron Startzel, KB5LNC, the current president of SARA, took on the task of making sure the radio and the volunteer operators were brought up to speed in time for the dedication ceremony.

Logistics

Between October 2013 and the April 2014 ceremony, Marines from the Quantico Communications School, members of SARA and MCARC, Rob Flory, and the Pentagon Amateur Radio Club conducted several tests with varying degrees of success. In its original configuration, the TBX-6 transceiver consisted of four components — the transmitter/receiver in one

Chester Nez — Code Talker

Chester Nez (January 23, 1921 – June 4, 2014) was the last original Navajo Code Talker who served in the United States Marine Corps during World War II. He was born in Chi Chil Tah, New Mexico, to the Navajo Black Sheep Clan of the Sleeping Rock People. He was raised during a time when there were difficult relations between the US government and the Navajo Nation. Nez recalled children often being taken from reservations, sent to boarding schools, and told not to speak the Navajo language. It was from one of these schools, in Tuba City, Arizona, that Nez was recruited into the Marine Corps.

Upon enlistment he was assigned to the 382nd Infantry Regiment at Camp Pendleton, where he joined a group of 28 other Navajo who were assigned to create a code. The Navajo language was chosen because its syntax and tonal qualities were nearly impossible for a non-Navajo to learn.

Nez related that they developed the code by using everyday words, which made remembering the code words much easier. For example, the Navajo word for "shark" was used in code to mean "destroyer."

In 1942, he was among the Code Talkers to be shipped out to Guadalcanal, where they worked in teams of two — one to send and receive, the other to operate the radio and listen for errors. He was honorably discharged as a private first class in 1945 and returned to serve stateside in the Korean War, afterward being discharged as a corporal.

In 2001, Nez was one of five Code Talkers who received the Congressional Gold Medal from President George W. Bush in recognition of the unique importance of their service to the Allied cause.

Corporal Chester Nez (seated) signs copies of his book, *Code Talker*, as Colonel David McMorries looks on.

This is the transmitter/receiver part of the TBX-6 radio used by the Code Talkers. The transmitter portion is on the left and the receiver portion on the right. [Antonio Fucci, I8000PU SWL, **www.radiomilitari.com**, photo]

Lance Corporal Tiffany Boyd shows Mr Latham Nez (standing) and Corporal Chester Nez a copy of Corporal Nez's 1942 platoon photo featuring the original 29 Navajo Code Talkers.

box, a hand-cranked generator, an accessory case, and the antenna. The receiver was powered by batteries and the hand-cranked generator provided +500 V plate voltage and filament voltage for the transmitter.

After overcoming hardware issues, propagation, and weather challenges, they began to make reliable contacts, initially using a G5RV antenna and then an AS-2259 NVIS (Near Vertical Incidence Skywave) antenna, all of which allowed successful contacts on 3885 kHz AM to local hams assisting in the test.

After coordinating with Colonel McMorries and Chief Gibbons, a request for the special event call sign N4C, for "Navajo 4 Code Talker," was processed by the outstanding ARRL® staff. For the event, SARA and MCARC would have the TBX-6 transceiver operating on 3885 kHz AM. The special event station also employed an Icom IC-7100 on 20 meters and an Icom IC-880 operating through Reflector 025 on D-STAR. The N4C operators included Ron, KB5LNC, a retired Marine CH-46 pilot; Larry, W4OPA, a retired Marine Communicator; Cameron, K6CLM, Active Duty Air Force, and Rich, N0RMC, a retired Marine Communicator and the author of this article.

A Special Guest

Though the dedication ceremony was initially planned for October 2013, various events delayed the activity. Finally, in April 2014, the event's guest of honor, Corporal Chester Nez, along with his grandson, Latham Nez, made the trip from their home in Albuquerque, New Mexico to Quantico. Born in 1921, Corporal Nez was a veteran of the Battles of Guadalcanal, Bougainville, Guam, Peleliu, and Angaur, and was, at the time, the last living member of Platoon 382 (Corporal Nez passed away in June; see the sidebar, "Chester Nez — Code Talker"). Upon arriving at the MCNOSC, Corporal Nez and his grandson were welcomed by the Marines, who were then treated to an ad hoc history lesson from Corporal Nez. He related how the Navajo code was developed by his platoon, and went on to relate some of his experiences during the World War II Island Hopping Campaign. When the subject of the TBX-6 arose, he was asked how long a Marine had to crank the generator. Corporal Nez quickly responded — "All day!"

During the ceremony, Corporal Nez took microphone in hand and, in the Navajo code, transmitted his first transmission on Guadalcanal, 71 years earlier: "Enemy machine gun nest on your right flank — destroy." This was probably the last time one of the original Navajo Marines would transmit the code, which was never broken by the Japanese, and he did it on a TBX-6 radio!

The Navajo Marines of Platoon 382 developed the code from the unwritten language spoken only by the Navajo People. There were a total of 421 Navajo Code Talkers during World War II who gave their solemn oath to protect the code they developed. The Navajo Code Talker program was declassified in 1968, and in 2000 President George W. Bush awarded Congressional Gold Medals to the five remaining Marines of the original 29 who formed the basis of Platoon 382.

The TBX-6 Transceiver

The TBX-6 as fielded was a portable tactical HF transceiver operated by three Marines. The transmitter is capable of 9 W on CW or 3 W on AM from a one tube 837 pentode final and is crystal or master-oscillator controlled. Though the TBX-6 is a transmitter/receiver, the transmitter portion and the receiver portion are powered separately. A hand-cranked generator, gasoline engine generator, or a dynamotor powers the transmitter while batteries or a rectifier powers the receiver.

The transceiver was carried by one of the Marines. A second Marine carried the battery and accessory box (headset, microphone, key, receiver cable, and spare tubes) in another canvas bag, while the third Marine carried the generator and antenna. The antenna is a 24-foot guyed whip with a unique connection that is rarely seen by today's amateurs. The feed line is connected to the transceiver by what today resembles an automotive spark plug connector.

You can download a video of the dedication from the *QST* in Depth web page at **www.arrl.org/qst-in-depth**.

Photos courtesy of Todd Headington.

Richard Corrigan, N0RMC, an ARRL member, is a retired Marine Corps communicator. He has been a ham for 25 years and holds an Amateur Extra class license. When he was stationed in Japan, he held the call sign 7J6CEE; when in Australia, he had the call sign VK8CN.

Today, Richard is president of the Marine Corps Amateur Radio Club, WU5MC, and technical director for Stafford Area Radio Association, WS4VA. Richard has a master's degree in engineering from George Washington University and is employed as a satellite communications subject matter expert for HQMC Director Command, Control, Communications, and Computers (C4) at the Pentagon. He can be reached at 12 Maggie Ct, Fredericksburg, VA 22406, **n0rmc2651@gmail.com**.

Youngsters On The Air — YOTA 2014

If you've been wondering where all the young hams are, this year the answer is Finland!

Ward Silver, N0AX

The Youngsters On The Air (YOTA) event is held every year in different European Union (EU) countries under EU and International Amateur Radio Union (IARU) sponsorship. The aim of YOTA (**www.ham-yota.eu**) is to bring young people — under the age of 25 — together in the spirit of cultural exchange. The YOTA event fosters collaborative learning in all segments of Amateur Radio, science, and electronics. The events of 2014 were the third year for YOTA, and 15 EU countries were represented by 75 young attendees who traveled to Virrat, Finland from July 15 – 20.

No doubt everyone had an unforgettable week, learned a lot, and made many new friends! You may have worked them on the air as OH2YOTA. This was a temporary two-tower station assembled and installed on-site by the YOTA organizers, who were led by Vili, OH5GE. YOTA attendees took part in several Amateur Radio activities, such as making contacts, testing their Amateur Radio Direction Finding (ADRF) skills, and building and testing electronic kits. Besides ham radio, they worked hard on improving their language skills and discussing issues related to cultural awareness, which is an important part of Amateur Radio's ability to foster international goodwill.

Everyone arrived in Finland on July 15. YOTA 2014 got under way the next day with presentations, energizing games, and team-building exercises. Lisa, PA2LS; Tommy, ON3TD, and Mattias, SE0M, gave a presentation describing the YOTA event in December 2013, which included awards as well as changes to the YOTA website. Johan, SM5F, gave a presentation about the CQ WPX award activities at SH3Y (2012) and SK3W (2013) in Sweden, where a young team of YOTA operators smashed the existing Swedish records. Jari, OH6BG, discussed the online version of VOACAP (**www.voacap.com/prediction.html**), a tool for predicting propagation that is helpful in planning operations. Concluding the day with an international evening, the teams presented the best food and drink from their respective countries for all to sample.

The events of 2014 were the third year for YOTA, and 15 EU countries were represented by 75 young attendees...

In the following days, the LZ team, with the help of some OH hams, gave a short introduction on ARDF (**www.ardf-r1.org**) and the use of 80 meter ARDF handheld direction finders. Meanwhile other groups built a "Slim-Jim" antenna and Morse code sounder. Some teams participated in a SOTA (**www.sota.org.uk**) activation as OG3X/p from OH/JS-016, while others traveled to Aland Island to operate as OG0A. Everyone enjoyed the experience of a traditional Finnish sauna, as well!

Seventy-five attendees from all over Europe gathered in Virrat, Finland from July 15 – 20 to take part in competitions, games, exercises, electronics training, and to enjoy each other's company during Youngsters On The Air (YOTA). [Lisa Leenders, PA2LS, photo]

This photo shows the Bronze medalists (seated, from left) Keijo, ES1XQ; Tauri, ES5HTA, and Keven, ES6AXS. Team Lithuania captain Simonas, LY2EN (foreground), and Linas, LY5AT (background), are leaning in to get a better view of the action. Contesting thrives in Estonia, and I'm sure we will find these operators represented in future results. The new nation of Estonia is largely in the hands of young people, and so is its Amateur Radio. [Martti Laine, OH2BH, photo]

December 2014 is YOTA Month

During the entire month of December, stations in several countries will be on the air seeking contacts using "YOTA" as their call sign suffix. YOTA is growing fast, and every week more youngsters are asking to participate. By making YOTA popular we can all help to get youngsters active in ham radio. YOTA stations will be trying to make lots of contacts, so take this opportunity to connect young operators in their teens and 20s with their peers on the air. YOTA month is not limited to European countries only — this will be the first worldwide YOTA event. Watch the YOTA website (**ham-yota.org**) for information about YOTA awards and QSL information. — *Thanks to Tommy, ON2TD, and Lisa, PA2LS, for this information.*

YOTA has its own Facebook page (**www.facebook.com/groups/youngstersontheair**) with hundreds of members. Some of YOTA 2014's attendees have published photo albums of the various events, such as European Radiosport Team Championship (ERTC) gold medalist, Sarka Vavrova, OK2SVA (**chery.zonerama.com/Profile/22194/43817**), and silver medalist Gabry Iuliani, IT9RGY.

European Radiosport Team Championship

YOTA 2014 concluded on July 19 with the European Radiosport Team Championship (ERTC) — a 6-hour contest held on the virtual Amateur Radio simulator, *HamSphere*. (**www.hamsphere.com**) During ERTC, 15 three-person youth teams were seated in one room with their computers. They competed in an environment similar to online gaming, a format familiar to most of the YOTA attendees. Once again, the latest technology was utilized in Amateur Radio for the benefit of Amateur Radio's future and by Amateur Radio operators themselves.

Besides ham radio, they worked hard on improving their language skills and discussing issues related to cultural awareness, which is an important part of Amateur Radio's ability to foster international goodwill.

ERTC 2014 included contacts between hundreds of young people and licensed radio amateurs from 44 participating countries in the spirit of international Amateur Radio. Murphy visited in virtual reality too, as a thunderstorm switched off electricity in the area; power was restored only 5 minutes prior to the start of the contest!

Miguel, EC1DJ, a member of the Spanish team, made a short movie (**www.youtube.com/watch?v=i3Wp8gp2oSQ&feature=youtu.be**) of the teams as they competed. He explains the online nature of ERTC: "*HamSphere* is a software simulation of the amateur bands, which gives the opportunity for young people interested in the world of Amateur Radio to experience — very realistically — competitions taking place on the air, without a need to pass exams. The only requirement is to have a computer, an Internet connection, and a headset with microphone." This type of online event certainly opens doors for Amateur Radio!

ERTC 2014 was a mammoth job for the young organizers who worked with limited resources under the guidance of Mari, OH2FPK; Kati, OH2FKX, and Lisa, PA2LS. ERTC 2014 was also honored to have Professor Rumen Gechev, LZ1MS, as patron of this first-ever World Radiosport Team Championship (WRTC) simulation over the Internet. Rumen himself finished 4th in 1990 at the first WRTC held in Seattle, Washington. Complete results can be found on the YOTA website (**www.ham-yota.eu/news**), but here are the medal winners (with their ages in parentheses):

Gold: Czech Republic — Sarka Vavrova, OK2SVA (21); Jindrich Kostal, OK1NOR (24), and Jan "Honza" Dohnalek, OK1JD (20).

Silver: Italy — Nicola Tonci, IZ6TSA (20); Gabry Iuliani, IT9RGY (26), and Orazio Intagliata, IT9DBF (25).

Bronze: Estonia — Keijo Kapp, ES1XQ (17); Tauri Helimets, ES5HTA (18), and Keven Mekk, ES6AXS (18).

YOTA and the Future

Following his return to Scotland, the UK's *TX Factor* program did an audio interview (**www.txfilms.co.uk/txfactor/adam_yota.mp3**) with Adam Hutchinson, MM0KFX, one of the five UK team members. Adam had an interesting response to the question of whether ham radio is becoming an old person's hobby — "Is it?" Adam likes having a mix of young and experienced people in Amateur Radio. He thinks YOTA and similar events will attract more interest among young people of all types and interests, especially those who are technically minded and interested in competing. These young people will take the hobby into the future. Perhaps a future YOTA will be held in North America.

Ward Silver, N0AX, is a contributing editor for *QST*. He can be reached at **hwardsil@gmail.com**.

Rick Lindquist, WW1ME, ww1me@arrl.org

ARRL Again Asks FCC to Elevate Amateur Service to Primary on 2300 – 2305 MHz

AT&T Petition threatens amateur usage in this band segment.

The ARRL has once again asked the FCC to elevate the Amateur Service allocation at 2300 – 2305 MHz from secondary to primary. The request came in comments responding to an AT&T Mobility *Petition for Rule Making* seeking a new air-to-ground communications system on 2.3 GHz Wireless Communications Service (WCS) spectrum. The *Petition* (RM-11731) asked the Commission to authorize an LTE-based in-flight connectivity service in the WCS "C" and "D" blocks (2305 – 2315 MHz and 2350 – 2360 MHz, respectively) for airlines and airline passengers. AT&T has asserted that restrictions on out-of-band emission and power limits to protect adjacent-band users make the use of the C and D blocks problematic. The wireless provider asked the FCC for rule changes to permit deployment of its service "using currently fallow spectrum" while also "preserving adequate interference protection to users of adjacent bands."

"Notwithstanding this broad and nebulous claim, there is no showing anywhere in the four corners of the *Petition* that the proposed rule changes would permit *any* continued Amateur Radio operations on a secondary basis in the shared A block (2305 – 2310 MHz)," the ARRL commented on September 22. More to the point, the League said, there is no showing in the *Petition* that Amateur Radio operations in the adjacent 2300 – 2305 MHz band would be protected from increased out-of-band emissions, if the FCC were to adopt the requested changes.

According to the League, the FCC has, to date, "failed to protect Amateur Radio operations at 2300 – 2305 MHz from WCS out-of-band emissions." The ARRL said the band is "regularly and substantially utilized by radio amateurs" for weak-signal, long-distance communication and, only by circumstances — a lack of a primary occupant — has it been able to enjoy that segment as a *de facto* primary user.

"It is obvious that the result of the AT&T *Petition* will be a virtual preclusion of amateur access to the 2305 – 2310 MHz segment," the ARRL's comments continued. "A ubiquitous air-to-ground system which operates at and above 2305 MHz will clearly render the secondary allocation status of that segment a virtual nullity."

The ARRL asked the FCC to recognize Amateur Radio's "*de facto* primary status" at 2300 – 2305 MHz and to elevate that segment from secondary to primary for amateurs. It further called on the Commission to "clarify the obligation of WCS licensees in all contexts to protect the adjacent-band Amateur Service operations at 2300 – 2305 MHz from harmful interference." The League requested that AT&T provide "a complete technical compatibility showing and interference analysis" that would demonstrate compatibility between its proposed service and amateur operations at 2300 – 2305 MHz.

ARRL Takes Issue with NTIA's WRC-15 Proposal for 5 MHz

The ARRL has taken issue with the World Radiocommunication Conference 2015 (WRC-15) stance of the National Telecommunications and Information Administration (NTIA) with respect to an international 60 meter Amateur Radio allocation. In response to WRC-15 agenda item 1.4, the NTIA has called for no change at 5250 – 5450 kHz. The League said in comments filed September 24 in IB Docket 04-286 that while it concurs with the NTIA's view regarding 5250 to 5275 kHz — allocated to the radiolocation service for oceanographic applications at WRC-12 — the rest of the agency's proposal is "unsupportable in light of actual domestic and international practice and contains assertions of incompatibility that are demonstrably not correct." The US has authorized Amateur Radio secondary operation on five discrete channels in the 5275 – 5450 kHz range for more than a decade, the ARRL pointed out, with no instances of unresolved interference to primary users.

"Against this backdrop, the stated reason for the no-change proposal — that '[e]xperience has shown that sharing is not possible between the Amateur Service and the fixed and mobile service' — fails the straight-face test," the ARRL said.

The NTIA's position is at odds with the proposal for agenda item 1.4 previously adopted by the FCC's WRC-15 Advisory Committee (WAC). In January, the WAC recommended a secondary amateur allocation from 5275 – 5450 kHz, and the FCC has indicated that it could generally support this recommendation.

The League called the NTIA's position "particularly puzzling" given the position of federal agencies, for which the NTIA manages spectrum, to allow what the ARRL called, "*a more disruptive service* (radiolocation) in the *identical* frequency range under consideration here *less than three years ago*."

"Neither NTIA nor its constituent federal agencies have credibly or persuasively articulated why fixed and mobile systems in the 5250 – 5450 kHz range can withstand the demonstrated potential for interference from automated, wideband, HF oceanographic radars, but cannot withstand operation by trained, licensed operators using smaller bandwidths, actually monitoring

the spectrum to be used before and during a transmission, and with the capability to shift frequency immediately to avoid incidents of interference with a primary service," the ARRL commented.

The League asserted that the Amateur Service deserves "the same treatment" that NTIA proposed for HF radiolocation less than 3 years ago. "Proponents of a different treatment, particularly a channelized treatment or a no-change approach, have still not presented a compelling distinction between amateur operation and radiolocation that would justify a departure from the general policy followed by the United States at WRC-12," the ARRL concluded.

FCC Turns Down Petition to Create a 4 Meter Band in the US

US radio amateurs will not be gaining a new band at 70 MHz any time soon. The FCC has denied a *Petition for Rule Making* seeking to add a 4 meter band to Amateur Radio's inventory of VHF allocations. Last May Glen E. Zook, K9STH, of Richardson, Texas, asked the Commission to allocate 70.0 to 70.5 MHz to Amateur Radio because, his *Petition* asserted, "the recent migration of broadcast television stations to primarily UHF frequencies basically eliminates any probable interference to television channels 4 or 5." VHF TV channel 4 occupies 66 to 72 MHz. Not quite, the FCC said.

"Because the Zook *Petition* is based on a faulty premise — that broadcasting use within the 70.0 – 70.5 MHz band will diminish or cease — its argument that amateur band users could operate without causing harmful interference to any existing service lacks sufficient support to warrant our further consideration, The FCC said in a September 17 *Order* denying the *Petition*. The FCC pointed out that three full-power TV stations, 110 low-power TV stations and translators, and six Class A TV stations now occupy channel 4 in the US.

ARRL Presents Barry Goldwater, K7UGA, Achievement Award to Rep Greg Walden, W7EQI

The ARRL has conferred the first Barry Goldwater, K7UGA, Achievement Award upon US Rep Greg Walden, W7EQI, (OR-2), "in recognition of many years of exceptional contributions to the strength and vitality of the Amateur Radio Service in the United States."

ARRL President Craigie presents the Barry Goldwater, K7UGA, Achievement Award to US Rep Greg Walden, W7EQI (OR-2). [Photo courtesy of Kay Craigie, N3KN]

ARRL President Kay Craigie, N3KN; Hudson Division Director Mike Lisenco, N2YBB, and General Counsel Chris Imlay, W3KD, presented the award to Walden in Washington on September 18. In a letter accompanying the award, President Craigie wrote, "Your understanding of the importance of Amateur Radio to the public interest and to the pursuit of scientific and technical knowledge has led you to act in the spirit of Sen Goldwater, whose exemplary support for Amateur Radio in Washington caused the ARRL Board to name this award in his honor."

President Craigie called Walden "a great friend to Amateur Radio over the last 12 years with regard to key issues including spectrum protection." Walden chairs the House Subcommittee on Communications and Technology, the panel to which "The Amateur Radio Parity Act of 2014" (H.R. 4969) was referred for consideration.

In 2002 Walden was an original co-sponsor of H.R. 4720, the Amateur Radio Emergency Communications Consistency Act, and sought additional cosponsors. In 2003 he co-sponsored H.R. 713, the Amateur Radio Spectrum Protection Act. During a hearing on the bill, Walden called for a halt to the "astonishing" erosion of Amateur Radio spectrum.

In 2004, Walden wrote the FCC chairman seeking to have the Commission defer action on the BPL rulemaking until the release of an NTIA study and an opportunity for public comment. That same year, during a hearing on telecom convergence, Walden grilled a BPL industry representative about interference.

In 2010 Walden co-sponsored H.R. 2160, the Amateur Radio Emergency Communications Enhancement Act. In May 2011, the ARRL was invited to testify before Walden's subcommittee on "Creating an Interoperable Public Safety Network," offering an opportunity to defend 420 – 440 MHz against reallocation.

"Senator Goldwater was a statesman for Amateur Radio," President Craigie told Walden, "and so are you."

Actor Tim Allen Gets His Ham Ticket

Newly licensed radio amateur Tim Allen. [Photo courtesy of John Amodeo, NN6JA]

Actor and comedian Tim Allen now not only plays an Amateur Radio operator on television, he *is* one! Allen got his Technician ticket on September 4. In his weekly ABC comedy TV show "Last Man Standing," Allen plays Mike Baxter, KA0XTT, and the show has featured ham radio in some episodes. Allen requested that media not make his call sign public, but it has been disclosed elsewhere.

"The Amateur Radio operators on the crew of 'Last Man Standing' are delighted that Tim has taken and passed his Technician exam and received his own real call sign," said program co-producer John Amodeo, NN6JA. "It took more than 3 years to make it happen, and it started with Tim's personal interest in radio technology and his request to make the Mike Baxter character an Amateur Radio operator." The ham shack on the set is a working station.

More than 2 dozen members of the "Last Man Standing" crew — and now Allen, its star — have been inspired by the show's Amateur Radio component to get licensed.

Radio Amateur is Among Nobel Prize in Chemistry Winners

A California radio amateur and ARRL member was among the three winners of the Nobel Prize in chemistry. William Moerner, WN6I, of Los Altos, a chemistry professor at Stanford University, will share the prestigious award equally with two other researchers — Eric Betzig and Stefan

Hell —for their work in high-resolution microscopy, or nanoscopy. For many years scientists had believed that an optical microscope could never yield greater than 0.2 micrometer resolution. The three scientists overcame that limitation through what the Nobel panel called "the development of super-resolved fluorescence microscopy."

William Moerner, WN6I. [Stanford University photo by L.A. Cicero]

"I'm incredibly happy about the recognition of the field, especially of all the workers and all the scientists at many places around the world who have contributed to the effort," Moerner said when notified of the award.

As a Stanford University news release explained, "Optical microscopy was long limited by the presumption that it could never obtain a better resolution than half the wavelength of light. Moerner, Betzig, and Hell circumvented this limitation through the clever implementation of fluorescent molecules, which made it possible for optical microscopes to operate at the nanoscale and visualize individual molecules moving within cells."

Wisconsin Ham Dies in Fall from Tower

A Wisconsin radio amateur lost his life on September 16 as he was performing maintenance on the 100 foot tower of a fellow ham. Killed in the fall was 59-year-old James G. Linstedt, W9ZUC, of Eau Claire, who died after falling 95 feet from a tower owned by Ronald Anderson, W9RMA, in Eagle Point, just outside of Chippewa Falls.

Chippewa County Sheriff James Kowalczyk told the *Leader-Telegram* newspaper that Linstedt was wearing safety equipment, but did not use it. Kowalczyk said Linstedt had been strapped in before moving 10 feet up the tower, apparently without securing himself. — *Thanks to John Bigley, N7UR*/Nevada Amateur Radio Newswire; media accounts

Silent Keys

ARRL Vice Director Candidate Steve Putman, N8ZR

Steve Putman, N8ZR.

Steve Putman, N8ZR, of Fairborn, Ohio, one of the candidates for the Great Lakes Division Vice Director's chair, died unexpectedly on October 5. He was 58 and an ARRL Life Member. At the time of Putman's death, balloting was already underway for the Great Lakes Vice Director position, currently held by Tom Delaney, W8WTD, the only other candidate. The ARRL Ethics and Elections Committee determined that all votes cast by members in the Great Lakes Division will still be counted. If Putman were to receive the most votes, a vacancy would be declared that ARRL President Kay Craigie, N3KN, would fill by appointment.

Licensed in 1972 while living in Alabama, he became an ARRL VEC volunteer examiner in 1985, in the early years of the VE program. He also served as an ARRL Volunteer Consulting Engineer. Putman belonged to the Dayton Amateur Radio Association and was a volunteer at Dayton Hamvention®. He founded the Antioch Shrine ARC and served as trustee of its club station, N8FEZ. The family invited memorial donations to the Shriners Hospitals for Children.

Past SCM, SM, Pacific Vice Director Jettie B. Hill, W6RFF

Long-time ARRL Field Organization volunteer Jettie B. Hill, W6RFF, of Roseville, California, died September 21. He was 93. An ARRL Life Member, Hill served as ARRL Santa Clara Valley Section Communications Manager (later "Section Manager") from 1978 until 1982. He was the ARRL Pacific Division Vice Director in 1982 and 1983. Following his 1984 retirement, he relocated to Roseville and subsequently served as Sacramento Valley Section Manager from 1989 until 2000 and again from 2002 until 2006.

Marte Wessel, K0EPE, and Pete Wessel, W0CM

A well-known Kansas Amateur Radio couple has passed on. Martha "Marte" Wessel, K0EPE, of Liberal, Kansas, died September 23. She was 89. Her husband Walter "Pete" Wessel, W0CM, died 6 days later on September 29 at age 101. Both were ARRL members.

Marte oversaw the annual scholarship drive for the Young Ladies Radio League (YLRL), and the YLRL invited donations in her memory to its scholarship fund c/o Linda Hynan, AC5QQ, 1312 Western Ridge Dr, Waco TX 76712.

Pete Wessel, a Nebraska native, was well-known as a low-band DXer. A US Navy veteran, he was licensed in 1928 as 9EYE. Pete and Marte Wessel were married for 69 years.

Past Western New York SM, Atlantic Division Assistant Director Steve Ryan, N2ITF

Past ARRL Western New York Section Manager Stephen M. "Steve" Ryan, N2ITF, died on October 3. He was 62. Ryan, an ARRL member, was appointed SM in November 2010, to serve the remaining term of Scott Bauer, W2LC, who had resigned. Ryan lost his 2012 bid for election as SM, and ARRL Atlantic Division Director Bill Edgar, N3LLR, appointed Ryan as an Assistant Director.

Adaptive Technology Pioneer Fred Gissoni, K4JLX

Fred L. Gissoni, K4JLX, of Louisville, Kentucky, died September 21. He was 84. Born blind, Gissoni was the co-developer of the Porta-Braille and Pocket-Braille note-taking devices as well as other adaptive technology. He also authored a popular instruction manual, "Using the Cranmer Abacus." Gissoni retired in 2011 after 23 years with the American Printing House (APH) for the Blind.

Public Service

Rick Palm, K1CE, k1ce@arrl.org

ARRL Centennial Year in Review

2014, with its celebrations, nostalgia, and preparations for the future, was a year for the history books.

The League's centennial year was marked with celebrations across the country and capped by the fantastic ARRL® National Centennial Convention in July. FEMA Administrator Craig Fugate, KK4INZ, was keynote speaker at the convention banquet. There were also many significant events on the public service and ARES dockets this past year, starting with a major new FEMA/ARRL formal agreement. Let's recap this memorable year.

New FEMA/ARRL MoA Ushers in New Era for Partners

The new agreement was signed July 18 during the National Centennial Convention in Hartford, Connecticut, by Administrator Fugate and ARRL President Kay Craigie, N3KN. Fugate said, "Radio is one of the most resilient communications technologies we have," and "when the power is out and telecommunications are down, the Amateur Radio community can serve as a vital resource in support of emergency responders and survivors during a disaster. This MOA will strengthen FEMA's partnership with ARRL and build upon our work to expand emergency communications capabilities and the use of Amateur Radio in emergency management."

FEMA Administrator Craig Fugate, KK4INZ, and ARRL President Kay Craigie, N3KN, signed a new MoA between FEMA and the ARRL at the ARRL's National Centennial Convention in Hartford, Connecticut this past July. [Rick Lindquist, WW1ME, photo]

GAREC-2014: International Cooperation

The application of advanced technologies in emergency communication was a major theme of the 2014 Global Amateur Radio Emergency Communications Conference (GAREC), held August 14 – 15 in Huntsville, Alabama, and hosted by the ARRL Alabama Section and the Huntsville Hamfest. In 2005, the first GAREC was organized in Tampere, Finland. Following the success of this event and the increased interest in international and regional cooperation on emergency communications, the GAREC was established as an annual event (**www.iaru.org/garec.html**). ARRL Regulatory Information Manager Dan Henderson, N1ND, represented the ARRL Headquarters at the conference.

The relationship between the ARRL, US radio amateurs, and other organizations around the globe, especially IARU Member-Societies, is critical to meeting the goal of rapid disaster response and assistance here and abroad. The networking among these entities' representatives on a face-to-face basis at conferences like GAREC goes a long way toward enhancing these relationships. International understanding of the natural and manmade risks that are prevalent in certain areas of the world is also critically important and a focus of these conferences.

ARRL Centennial QSO Party as Training

Mike Corey, KI1U, led off the year with a call for amateurs to get on the air as a primary method of training for public service communications. He cited the "importance of putting your license to use through on air activity, and for those interested in public service communications, this is our first level of training." Corey touted the ARRL Centennial QSO Party, which has been running every day this year, as a great opportunity for ARES groups "to get new hams on the air and for seasoned veterans to be Elmers." Corey said the special QSO party was a good chance for operators to try out new modes and bands, and improve operating skill and public service communications acumen.

Fldigi Suite Developer David Freese, W1HKJ, Dayton Hamvention® Award Winner

2014 Dayton Hamvention® Technical Excellence Award winner David Freese, W1HKJ, was recognized for his development and distribution of the Fast Light Digital Modem Application (*Fldigi*) family of programs for use in amateur and public communications. *Fldigi* is an easy-to-use, free and open-source, multi-platform digital computer sound card modem program for Amateur Radio. The suite of programs is very popular with ARES and other public service communicators.

Service Excellence: 2014 Activations in Review

By no means an exhaustive list, the following is a summary of some of the centennial year's notable activations, often employing innovative ideas and techniques, from around the country and world.

Winter storms may be rare in Florida, but icy conditions in late January caused Escambia County Emergency Management to activate its EOC, with ARES being called out and activated until January 30. Two shelters were opened, and an EMS need request was handled via Amateur Radio, along with reports on weather and road conditions being sent in by operators in the affected area. Sunshine State operators rose to the unusual challenge!

In the Pacific Northwest, members of the Lane County (Oregon) Sheriff's Amateur Radio Operators — an ARRL-Affiliated Club — used radio direction-finding techniques to locate a 78-year-old Eugene, Oregon, man suffering from dementia, who

had gone missing, but who was wearing a lifesaver radio direction finding (RDF) bracelet. As a result, the specially trained hams in the sheriff's department were able to locate the missing person.

The Delaware State Police this year partnered with Sussex County ARES for backup communication service. When ARES is activated, the State Police will assign ARES stations to set up at specific locations. ARES members will send and receive traffic as part of this State Police backup network. The partnership is testament to the viability of Amateur Radio as a key ancillary communications service for the state police in times of emergency and disaster.

Amateur Radio operators and federal government stations engaged in a 12-day nationwide test of their capability to communicate with each other on HF in the event of an emergency or disaster. The *High Frequency Interoperability Exercise 2014* activity took place on two of the five 60 meter channels. Participants used Automatic Link Establishment, a standardized digital selective calling protocol, to establish communication between stations. A Special Temporary Authorization (STA) was granted, giving permission for the radio amateurs to communicate with federal government stations for the duration of the exercise.

Amateur Radio volunteers manned the Snohomish County, Washington, EOC and provided communication with American Red Cross shelters that were set up in the aftermath of the mammoth and tragic landslide on March 22 near Oso. The ARC had established shelters for displaced residents in Arlington and Darrington. "From the time the landslide occurred on March 22, Amateur Radio volunteers staffed some 160 shifts in the EOC and command vehicle," Snohomish County Auxiliary Communications Service Radio Officer Scott Honaker, N7SS, reported.

A magnitude 8.2 earthquake occurred off Northern Chile on April 1, and a powerful 7.6 magnitude aftershock hit the area on April 3. After the initial shock, the Radio Club de Chile activated with amateurs establishing an emergency communication net on 7.050 and 14.255 MHz. .

Amateur Radio volunteers in Hawaii opened a tsunami radio watch net on the linked statewide State Civil Defense RACES/Oahu Department of Emergency Management VHF/UHF repeaters. The net carried periodic announcements from the Pacific Tsunami Warning Center in Ewa Beach, said ARRL EC and RACES Coordinator Ron Hashiro, AH6RH.

More than 300 Amateur Radio volunteers supported the 2014 Boston Marathon, April 21, a year after the tragic bombings. The Marathon is a major public service event for the region's Amateur Radio volunteers.

ARES and SKYWARN teams activated in late April to provide ground truth and damage reports during severe weather, including devastating tornadoes, in the Deep South and Midwest. On April 28, tornadoes hit Mississippi, Alabama, Arkansas, Missouri, and other states. Upward of three dozen people died. The value of such reporting and traffic handling by amateurs is recognized by emergency management professionals as indicated by the next story.

Okmulgee County, Oklahoma, Emergency Management was awarded a grant of nearly $3700 that will allow the agency to purchase an Amateur Radio-based location-tracking system for SKYWARN storm spotters. The grant will allow installation of an Automatic Packet Reporting System (APRS).

Amateur Radio volunteers in California's Tuolumne County assisted local emergency managers and the American Red Cross by supporting communication at a shelter in Groveland, set up in the wake of the El Portal Fire in Yosemite National Park. The National Park Service reported that the fire got its start in the community of El Portal on July 26. Evacuations were ordered for Foresta and Old El Portal, while area campgrounds were emptied, and roads closed. A UHF and a VHF repeater were cross-banded to cover the necessary expanse between Fresno, site of the Red Cross Headquarters, and the shelter site in Groveland.

As this is written, ARRL Headquarters under the direction of ARRL Emergency Preparedness Manager Mike Corey, KI1U, is deploying Ham Aid kits to Hawaii as ARES volunteers stand ready to activate for the Puna volcanic lava flow situation. Corey said the Ham Aid kits going to Hawaii include HF gear as well as VHF and UHF equipment.

Also as this written, US Army and Air Force Military Auxiliary Radio Service (MARS) stations are preparing to participate in a 48-hour nationwide contingency communication exercise on October 27 and 28 as part of an effort to develop greater cooperation between the Department of Defense (DoD) sponsored MARS program and the ARRL ARES program. MARS is encouraging its members to discuss communication interoperability in advance of the exercise with their ARES section and district or local emergency coordinators.

International Excellence in Service Recognized by ITU

The IARU Region 1 General Conference held in Bulgaria, September 21–26, was the scene of some remarkable comments by two high-level officials, which were more evidence of the value of Amateur Radio as a non-commercial, volunteer radio communications service on a global level. European Commissioner for International Cooperation, Humanitarian Aid and Crisis Response Kristalina Georgieva told delegates in a statement that Amateur Radio is a reliable information tool that can save lives in disasters. "The radio amateurs [are] the people who are the eyes and the ears of the world in time when all other information channels are silent," she said.

International Telecommunication Union (ITU) Secretary General Hamadoun Touré, HB9EHT, extended his wishes for "every success" to the conferees. Touré said he appreciated the work of the IARU and for its support of ITU Headquarters station 4U1ITU. "I can assure you that IARU is a valuable member of the ITU family, and this relationship will be nurtured in the years to come," said Touré, who called Amateur Radio "a very important public service."

Closing to an Incredible Year, and Call to the Future

The highlight of the year for me in a highlight-filled year was attending the ARRL National Centennial Convention in July at Hartford, Connecticut, the site of the founding of the ARRL.

It was a great pleasure and privilege to attend the show, marking the first hundred years of ARRL. Kudos to all who were involved in planning and executing it for the benefit of the rest of us. What will the National Bicentennial Convention be like? It's exciting to ponder the possibilities, but let me end this column on the following note: Let's start imagining and engaging the developments today that will be the focal points of discussion, reflection, and pride at the convention a hundred years from now!

Contest Corral — December 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				Bands HF / VHF+	Contest Title	Mode	Exchange	Sponsor's Website
3	1300Z	4	See website	1.8-28 / -	CWOps Weekly Mini-CWT Tests	CW	Name and member number or S/P/C	www.cwops.org
5	2200Z	7	1600Z	1.8 / -	ARRL 160 Meter Contest	CW	RST and ARRL/RAC section if US/VE	www.arrl.org/contests
6	0000Z	7	2359Z	- / 50-1296	ARRL EME Contest	Ph CW Dig	Call signs, sig rpt, acknowledgment	www.arrl.org/contests
6	0000Z	6	2359Z	1.8-28 / -	TARA RTTY Mêlée	Dig	RST and State/Province or serial	www.n2ty.org
6	1200Z	7	1200Z	3.5-28 / -	VU International DX Contest	Ph CW	RS(T) and Indian state or prefix	www.arsi.info/contests/international
6	1600Z	7	1559Z	3.5-28 / -	Top Operators Activity Contest	CW	RST, serial, and TOPS/PRO number	www.procwclub.ro/TAC%20Rules.html
6	2300Z	7	See website	3.5, 7 / -	AWA Bruce Kelly QSO Party	CW	RST, Xmtr type, power, name	www.antiquewireless.org
7	0000Z	7	2359Z	28 / -	Ten Meter RTTY Contest	Dig	RST and state or province or serial	www.rttycontesting.com
7	1200Z	7	2359Z	3.5-28 / -	Straight Key Weekend Sprintathon	CW	RST, S/P/C, SKCC nr or power	www.skccgroup.com
7	1300Z	7	1600Z	3.5-14 / -	SARL Digital Contest	Dig	RST and serial	www.sarl.org.za
7	2100Z	7	2259Z	14 / -	Great Colorado Snowshoe Run	CW	RST, S/P/C, class, CQC number or power	www.cqc.org/contests
8	1630Z	8	See website	3.5, 7 / -	OK1WC Memorial Contest	Ph CW	RS(T) and serial	www.memorial-ok1wc.cz
9	0200Z	9	0400Z	3.5-28 / -	ARS Spartan Sprint	CW	RST, S/P/C, and power	www.arsqrp.blogspot.com
10	0130Z	10	0330Z	3.5-14 / -	NAQCC Monthly QRP Sprint	CW	RST, S/P/C, and NAQCC mbr nr or power	naqcc.info
12	0145Z	12	0215Z	3.5-21 / -	NS Weekly RTTY Sprint	Dig	Serial, name, and S/P/C	www.ncccsprint.com
12	0230Z	12	0300Z	1.8-14 / -	NS Weekly Sprint	CW	Serial, name, and S/P/C	www.ncccsprint.com
13	0000Z	14	2359Z	28 / -	28 MHz SWL Contest	Ph CW	Log ARRL 10 Meter Contest QSOs	swl.veron.nl/swlcontest.htm
13	0000Z	14	2359Z	28 / -	ARRL 10 Meter Contest	Ph CW	RS(T) and US or XE State/Prov or serial	www.arrl.org/contests
13	1700Z	14	See website	1.8-7 / -	UBA Winter Contest	Ph CW Dig	RS(T) and UBA section or serial	www.uba.be/en/hf/contest-rules
14	2000Z	14	2359Z	1.8-28 / -	Holiday Spirits Homebrew Sprint	CW	RST, S/P/C, ARCI number or power	www.qrparci.org/contests
15	0200Z	15	0400Z	1.8-28 / -	Run For the Bacon	CW	RST, S/P/C, Flying Pig nr or power	www.fpqrp.org
17	0130Z	17	0330Z	3.5-14 / -	NAQCC Milliwatt Sprint	CW	RST, S/P/C, and NAQCC mbr nr or power	naqcc.info
18	2100Z	18	2300Z	1.8 / -	Russian 160 Meter Contest	Ph CW	RS(T), serial, square ID (see website)	www.radio.ru/cq
20	0000Z	20	2400Z	3.5-28 / -	Feld-Hell Rudolf Hell Sprint	Dig	RST, S/P/C, Feld-Hell member nr	www.feldhellclub.org
20	0000Z	21	2400Z	3.5-28 / -	OK DX RTTY Contest	Dig	RST and CQ Zone	www.crk.cz/ENG/DXCONTE.HTM
20	0001Z	Jan 4	2359Z	1.8-28 / 50-440	Lighthouse Christmas Lights QSO Party	Ph CW Dig	Serial or ARLHS number	nllw.net
20	1400Z	21	1400Z	1.8-28 / -	Croatian CW Contest	CW	RST and serial	www.9acw.org
21	1800Z	21	2359Z	3.5-28 / -	ARRL Rookie Roundup	CW	Both calls, name, check, S/P/XE or "DX"	www.arrl.org/contests
24	0000Z	24	0200Z	1.8-28 / 50	SKCC Straight Key Sprint	CW	RST, S/P/C, name, SKCC nr or power	www.skccgroup.com
26	0830Z	26	1059Z	3.5-7 / -	DARC XMAS Contest	Ph CW	RS(T) and DOK or special station code	www.darc.de/referate/dx/contest/xmas/en
27	0000Z	27	2359Z	1.8-28 / 50,144	RAC Winter Contest	Ph CW	RS(T) and province or serial	www.rac.ca/en/rac/programmes/contests
27	1200Z	28	1159Z	3.5-28 / -	Iron Ham Contest	Ph CW Dig	RS(T) and CQ zone	www.araucariadx.com
27	1500Z	28	1500Z	1.8 / -	Stew Perry Top Band Distance Challenge	CW	4-char grid square	www.kkn.net/stew
27	1500Z	28	1500Z	3.5-14 / -	Original QRP Contest	CW	RST, serial, and category	www.qrpcc.de
28	0000Z	28	1200Z	3.5-28 / -	RAEM Contest	CW	Serial and lat/long in degrees	raem.srr.ru
1	0000Z	1	2359Z	3.5-28 / 50+	ARRL Straight Key Night	CW	General QSO information	www.arrl.org/straight-key-night

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.

2014 ARRL June VHF Contest Results

Propagation was below average but way better than last year!

Bob Striegl, K2DRH, k2drh@arrl.net

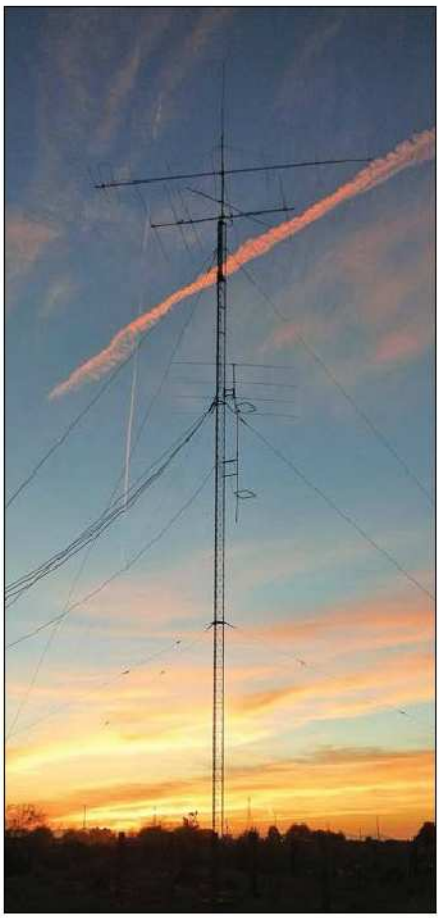
Good news — the June 2013 contest propagation was much better on June 21 – 23 than it was last year. Bad news — it was still below average even in the best places and really slow in others, such as the whole western half of the country. Better news — at least it seems to be trending back up! Conditions were not especially good, but for the majority of participants it was not totally dismal either. In the Midwest, 6 meters produced only a few scattered sporadic E (E_s) openings that were relatively short and narrowly focused. A few sweet spots in Texas and Florida seemed to fare pretty well.

Many of the Top Ten scores were at least half again higher than last year's, with some doubling their score. Once again, tropospheric ducting or other enhanced modes on 2 meters and above did not seem to play a major role for the majority of stations. While there was some excellent enhancement reported from FM grid mountaintop stations in the FM grid well into the EM and EN grids, in fact, most parts of the country experienced average-to-poor conditions.

Tuning Around the Bands

Despite the majority of stations experiencing only short E_s openings with sharply defined footprints, some sections had much better 6 meter propagation, notably in Florida and Texas. In the past, 6 meter QSO and grid totals have played a large role in the scores of the top stations in these areas, and this year was kind to them again. Unlike 2013 when there were no stations over 1000 QSOs, Chuck, W5PR (EL29), and Marshall, K5QE's Limited Multiop team in STX (EM31) both broke that barrier with grid multiplier totals well over 200. Also noteworthy, George, K5TR (EM00), had a multiplier total in the 200s. Tom, WD5K (EM12); Mike, AE5EB (EL09), and Dick, K5AND (EM00), posted good 6 meter results, too. Once again, Marshall, K5QE, was able to log more 6 meter multipliers than any other station.

Eleven stations made it over the 500-QSO mark, including the Multiops at W2SZ, W3CCX, N0SZ, and Limited Multiops W5ZN and W4IY. This was achieved despite a shortage of sustained E_s propagation apparent in lower grid counts. Notable 6 meter totals over 500 QSOs were also logged by Florida stations Dan, K1TO (EL87); Bobby, N3LL (EL86); Austin, N4WW (EL98), and Bob, N4BP (EL96). Tom, K4PI, in EM73 (GA) also managed to rack up a 500-plus total. The Limited Multiop teams at W5ZN in EM45 (AR) and W4IY in FM08 (VA) round out the list. But unlike 2013, the Colorado, New Mexico, and Arizona stations didn't seem to have as much in the way of 6 meter openings.



Hector, XE2K, used this eight-element Loop-Fed Array on 6 meters. [Hector Garcia, XE2K, photo]

The 2 meter band is often a starting point for "band running" (moving a station from band to band), because most stations are best equipped for tropospheric propagation (tropo) on 2 meters. The number of stations working more than 100 QSOs on 2 meters increased slightly to 35, from 27 in 2013 and 29 in 2012. Even with essentially flat propagation for most of us, the mountaintop multi-ops and rovers were able to take advantage of their favorable elevations. They caught whatever limited enhancement opportunities existed and some worked over 200 QSOs on 2 meters. W4IY in FM08 reported working all the way from Canada down to Cuba and the Cayman Island.

In any given contest, 222 MHz has as good or better propagation than 2 meters and lower environmental noise. Often, stations are significantly louder on 222 than they are on 2 meters. In all the ARRL VHF contests, QSOs on 222 score the same higher point value as on 432, and provide multipliers that significantly enhance scores. It's a must-have band for competitive multiops, rovers, and single ops. Five stations in the June VHF contest had 100 or more QSOs on 222; three multiops, K8GP/R, and Jeff, K1TEO.

While more commercial multiband rigs include 432 MHz, propagation on the band is generally more difficult and requires mast-mounted preamps to be truly effective because coax loss can be a significant factor. Often, propagation falls off rapidly and stations are much weaker or unworkable on 432. However, given a little tropo enhancement, stations that are workable on 2 and 222 may actually be as strong or stronger on 432, since practically sized beams are available with more gain than at lower frequencies. Eight stations in the June contest had 432 QSO totals over 100; five multiops, K8GP/R, AC0RA/R, and once again, Jeff, K1TEO.

Single Operator

The majority of contest activity originates with the single-op entrants who build stations

Affiliated Club Competition

Unlimited Club Category		
Society of Midwest Contesters	57	579,810
Medium Club Category		
Potomac Valley Radio Club	31	1,319,404
North East Weak Signal Group	16	986,314
Mt Airy VHF Radio Club	18	891,437
Florida Contest Group	16	717,585
Central Texas DX and Contest Club	7	648,691
Southern California Contest Club	23	459,242
Contest Club Ontario	21	395,444
Grand Mesa Contesters of Colorado	9	299,276
Carolina DX Association	4	239,346
Northern Lights Radio Society	17	213,535
Yankee Clipper Contest Club	19	213,092
DFW Contest Club	12	208,427
Badger Contesters	8	208,390
Pacific Northwest VHF Society	29	207,744
Arizona Outlaws Contest Club	23	200,670
Florida Weak Signal Society	9	173,957
Frankford Radio Club	8	141,195
Northern California Contest Club	19	136,268
North Texas Contest Club	3	125,190
Tennessee Contest Group	7	122,621
Alabama Contest Group	11	106,589
South East Contest Club	6	69,359
Bergen ARA	3	57,431
Cold Brook Contest Club	4	52,429
Utah DX Assn	3	41,704
Mad River Radio Club	6	39,431
CTRI Contest Group	3	34,573
Georgia Contest Group	5	34,328
North Coast Contesters	3	34,312
Louisiana Contest Club	4	33,409
Roadrunners Microwave Group	3	33,135
Western Washington DX Club	4	19,330
Willamette Valley DX Club	5	14,963
Bristol (TN) ARC	5	10,267
Rochester VHF Group	5	9,973
Hudson Valley Contesters and DXers	3	2,976
Minnesota Wireless Assn	3	2,376
Local Club Category		
Clovis Amateur Radio Pioneers	3	82,516
Chippewa Valley VHF Contesters	3	49,001
Eastern Connecticut ARA	3	28,849
Rappahannock ARA	3	24,966
Portage County Amateur Radio Service	4	8,047
Ventura County Amateur Radio Society	4	6,824
Burlington County Radio Club	3	5,637
Meriden ARC	3	3,490
Contoocook Valley Radio Club	4	3,126
Raritan Bay Radio Amateurs	3	1,557
Radiosport Manitoba	3	366

Top Ten

Single Operator, Low Power

K2DRH	241,450
WB1GQR (W1SJ, op)	138,171
N3LL	135,975
N3RG	119,314
N4QWZ	115,322
AF1T	81,900
W9GA	81,738
N0LL	80,698
K1KG	71,020

Single Operator, High Power

K1TEO	415,336
K5TR	281,796
K1RZ	258,272
W5PR	235,840
K5AND	143,200
WD5K	122,574
W3PAW	115,404
W4ZRZ	113,231
W9RM	102,912

Single Operator Portable

W1MR	23,310
N4OGW	14,673
KB5WIA	10,291
W9SZ	5,763
W0PV	4,895
AF6RR	4,743
NV4B/5	3,381
WB2AMU	2,730
N2SPI	2,320
KG2A	2,160

Single Operator Three Band

AB5EB	138,891
K1TO	105,376
AA5AM	94,080
N3RN	56,048
KI5YG	51,198
KG6IYN	50,304
K4UB	45,047
KO9A	40,810
K9MU	33,880
KM4ID	27,768

Single Operator FM-Only

W2EV	1,650
KI6JJW	616
N9VM (N1VM, op)	510
KB1YSK	423
W7AIT	418
W2EBB	216
N2PEQ	203
KA6AMB	200
N1LF	176

Limited Multioperator

K5QE	483,448
W4IY	466,880
W3SO	411,554
K2LIM	294,756
W5ZN	269,028
AA4ZZ	217,074
W2LV	133,224
N2NT	113,687
N8ZM	95,632
W4NH	61,480

Multioperator

W2SZ	1,093,902
W3GCX	521,260
K1WHS	257,570
KB0HH	136,960
N0SZ	109,392
W6TE	88,328
WE1P	87,176
W6TV	82,176
AD4ES	80,808
N7CW	58,656

Rover

K8GP	295,317
VE3SMA/R	127,641
VE3OIL/R	125,704
W6TTF	70,416
WA3PTV	50,676
K4SME/R	45,652
AG4V/R	43,888
NN3Q/R	42,186
VE3WJ	41,107
W9SNR/R	32,307

Limited Rover

AC0RA/R	146,692
WW7D/R	40,140
K2QO/R	39,624
AL1VE/R	32,120
N6GP	29,625
KD5EUO/R	27,972
W9YOY/R	27,664
K9PW/R	12,648
N2ZBH/R	11,628
KE7IHG/R	10,350

Unlimited Rover

W3HMS	18,678
K6EU/R	15,768
AF5Q	10,375
N2QIP/R	2,046
K8DOG/R	1,813
WA5KBH/R	756

that range from a single band with a modest antenna to a multi-band powerhouse with stacked arrays. These stations have been the backbone of VHF+ contesting — even the modest single-band stations make an essential contribution to the winner's success. These stations allow others to enjoy the bands by providing a lot more stations to work.

Low power stations with 100 – 200 W amplifiers have always been the mainstay of contest activity since well before the category was established, so it's no surprise that the Single Op, Low Power (SOLP) category proved to be the most popular. The Overall SOLP W3ZZ First Log Award — Memorial has been sponsored by Tim, K3LR, and Dave, W9PA, for the third year and goes to Dale Porterfield, KJ4ZYB. Good job and welcome to the ranks of SOLP VHF+ contesting!

This article's author, Bob, K2DRH, in EN41 (Illinois) took first place in SOLP with a score of 241K using eight bands through 3456 MHz. His overall multiplier total was augmented by working a lot of weak 6 meter stations while being on the fringe of the real 6 meter E_s openings. Frequent Top Ten finisher WB1GQR, manned by Mitch, W1SJ, moved up to second with 138K, also using eight bands through 3456. While he had 94 fewer QSOs and 16 fewer grids, it was the higher point values on 222 and above that gave Mitch the edge over 3rd place finisher N3LL.

The Single Op, High Power (SOHP) category is where big guns of the VHF+ contesting world really get to play. Jeff, K1TEO, in FN31 (Connecticut) with his 10-band station took top honors with 415K, despite few E_s opportunities, flat tropo conditions, major tower repair, equipment troubleshooting work before the contest, and suddenly losing 5 and 10 GHz capability toward the end. When the desire to excel kicks in, getting down and doing all the hard work it takes to get things back up and working after a disaster really separates the leaders from the followers.

The Single Operator Portable category limits station to 10 W, making it 10 – 20 dB more difficult to be heard on the bottom four bands and a few opt to run amps and enter as single op low power instead. Chris, W1MR, from FN43gd (New Hampshire) moved up from 3rd to 1st place this time with his eight-band station, scoring 23K. Tor, N4OGW, is a newcomer to VHF+ contesting who really made a big splash his first time out from Little Mountain with a five-element, 6 meter Yagi hanging from a tree and a 2 meter, nine-element beam. He took 2nd place with 14K and made a new Mississippi Section record.

This is the second year for the two new single-operator categories. Single Op, 3-Band (SO3B) is clearly a popular choice with 118 entries, defecting mostly from the SOLP category. Single Op, FM-Only (SOFM) almost doubled in size, with 17 log submissions. As expected, many of these set new section, division, and overall records.

Sporadic E made SO3B a faceoff between Texas and Florida for the top spot. Mike, AB5EB, used his EL09 (STX) sweet spot with another 49 contacts on 2 meters and 432 to vault himself into 1st place. Entries in the SOFM category spanned both coasts and many included QSOs on all of the bottom four bands. The top score in the SOFM category was logged by Ev, W2EV, of FN03 in WNY. Ev doubled last year's first-place effort with 54 contacts and 22 grids on four bands for 1650 points, the first to crack the 1000-point mark in this new category.

Multioperators

While some of these are fixed stations maintained by generous hosts who love the camaraderie and competition, others take an expeditionary outlook to find just the right mountaintop spot from which to operate. They lug huge amounts of stuff up bad roads to sit in trailers, trucks, and tents, often enduring the wind and cold in their remote locations. Having done this many years ago from Wayah Bald in North Carolina with the Fourlanders as W4AQL and operating inside the box of a rental truck during a driving rainstorm, the author can tell you first hand that it takes a lot of desire and determination.

Regional Leaders

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

WB1GQR (W1SJ, op)	138,171	LP
N3RG	119,314	LP
AF1T	81,900	LP
K1KG	71,020	LP
K2KIB	42,672	LP
K1TEO	415,336	HP
K1RZ	258,272	HP
W3PAW	115,404	HP
WZ1V	71,694	HP
K1TR	64,821	HP
W1MR	23,310	QRP
WB2AMU	2,730	QRP
N2SPI	2,320	QRP
N3KCM	1,600	QRP
KF2MR	1,560	QRP
N3RN	56,048	3B
N1IBM	16,728	3B
K3UHU	8,000	3B
W1DYJ	5,796	3B
N1JD	4,324	3B
W2EV	1,650	FM
KB1YSK	423	FM
N2PEQ	203	FM
KD2DLL	156	FM
W3SO	411,554	LM
K2LIM	294,756	LM
W2LV	133,224	LM
N2NT	113,687	LM
K2BAR	53,390	LM
W2SZ	1,093,902	UM
W3CCX	521,260	UM
K1WHS	257,570	UM
WE1P	87,176	UM
KE1LI	23,025	UM
WA3PTV	50,676	R
NN3Q/R	42,186	R
K1DS/R	28,152	R
NJ1F	19,665	R
AA1I/R	10,950	R
K2QO/R	39,624	RL
N2ZBH/R	11,628	RL
WB2SIH/R	4,773	RL
W1PL	4,040	RL
AB2YI/R	3,813	RL
W3HMS	18,678	UL
N2QIP/R	2,046	UL

Southeast Region
(Delta, Roanoke and Southeastern Divisions)

N3LL	135,975	LP
N4QWZ	115,322	LP
K2PS	67,734	LP
N4BP	66,944	LP
N4TWX	46,750	LP
W4ZRZ	113,231	HP
N4WW	90,117	HP
W3IP	84,480	HP
K4PI	64,640	HP
W5MRB	56,772	HP
N4OGW	14,673	QRP
W0PV	4,895	QRP
NV4B/5	3,381	QRP
KG2A	2,160	QRP
WA5ZEK	1,333	QRP
K1TO	105,376	3B
K4UB	45,047	3B
KM4ID	27,768	3B
KD4AA	12,084	3B
KD5CKP	10,660	3B
W2EBB	216	FM
N1LF	176	FM
W4IY	466,880	LM
W5ZN	269,028	LM
AA4ZZ	217,074	LM
W4NH	61,480	LM
N3MK	61,320	LM
AD4ES	80,808	UM
K4MM	55,080	UM
N4OX	41,778	UM
W4COV	30,624	UM
W4UAL	28,122	UM
K8GP	295,317	R
K4SME/R	45,652	R
AG4V/R	43,888	R
KS4YX	858	R
W3TMZ/R	60	R
WB4OMG	1,904	RL
WB0POH	1,196	RL
N4TZH/R	910	RL
K6PFA/R	589	RL
WA5KBH/R	756	RU

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

KL2DRH	241,450	LP
W9GA	81,738	LP
N9DG	65,836	LP
VA3ZV	38,896	LP
WZ8T	31,297	LP
W0UC	95,226	HP
K9EA	73,320	HP
K9CT	61,304	HP
WA8RJF	50,020	HP
K8TQK	48,723	HP
W9SZ	5,763	QRP
WF0T	6	QRP
KX7L/8	3	QRP
KO9A	40,810	3B
K9MU	33,880	3B
N9TF	17,500	3B
KB8U	14,418	3B
AC8HU	11,730	3B
WB8RFB	4	FM
N8ZM	95,632	LM
W9RVG	24,633	LM
N8BI	23,594	LM
KC8AAV	4,233	LM
VE3RB	2,368	LM
N2BJ	30,212	UM
VE3WCC	27,636	UM
AJ9C	13,510	UM
KF8A	9,782	UM
K9ZM	6,076	UM
VE3SMA/R	127,641	R
VE3OIL/R	125,704	R
VE3WJ	41,107	R
W9SNR/R	32,307	R
K0PG/R	7,348	R
AC0RA/R	146,692	RL
W9YOY/R	27,664	RL
K9PW/R	12,648	RL
K9ILT/R	6,536	RL
K8WTF/R	5,292	RL
K8DOG/R	1,813	RUU

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

N0LL	80,698	LP
W5SXD	48,416	LP
N0POH	33,276	LP
KK0Q	31,944	LP
WA8ZBT	23,587	LP
K5TR	281,796	HP
W5PR	235,840	HP
K5AND	143,200	HP
WD5K	122,574	HP
W9RM	102,912	HP
WD0BGZ	66	QRP
KK6MC	42	QRP
N0JK	9	QRP
AB5EB	138,891	3B
AA5AM	94,080	3B
KI5YG	51,198	3B
K0NR	22,841	3B
K5KBV	5,668	3B
K5QE	483,448	LM
N5RZ	49,842	LM
NR7T	23,108	LM
K5LRW	11,900	LM
N0EO	11,880	LM
KB0HH	136,960	UM
N0SZ	109,392	UM
K5NZ	56,056	UM
WQ0P	41,021	UM
KC5MVZ	12,789	UM
K5GJ/R	27,540	R
W0ETT	12,636	R
K0AXX/R	5,700	R
W7QQ/R	5,499	R
KC0P/R	4,564	R
AL1VE/R	32,120	RL
KD5EUO/R	27,972	RL
K0BBC/R	8,976	RL
KC0SKM/R	8,924	RL
W3DHJ/R	7,134	RL
AF5Q	10,375	RU

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

WJ0F	35,695	LP
NQ7R	24,644	LP
WA6OSX	23,700	LP
K2GMY	21,692	LP
N7AT (K8IA, op)	21,112	LP
N6MU	82,128	HP
K6KLY	52,528	HP
N6VI	34,686	HP
N6KN	34,056	HP
N7EPD	27,448	HP
KB5WIA	10,291	QRP
AF6RR	4,743	QRP
KE7UQL	1,938	QRP
KD7WPJ	1,624	QRP
N6LB	728	QRP
KG6IYN	50,304	3B
N7IR	26,001	3B
N6KZ	7,772	3B
VE7DAY	7,208	3B
N7RK	6,930	3B
KI6JJW	616	FM
N9VM (N1VM, op)	510	FM
W7AIT	418	FM
KA6AMB	200	FM
KK6DCM	126	FM
WA7JTM	35,154	UL
K7UI	26,910	UL
N5CR	17,514	UL
NI6E	15,624	UL
AA7A	8,375	UL
W6TE	88,328	UM
W6TV	82,176	UM
N7CW	58,656	UM
KB0ZO	55,198	UM
KE7SW	19,520	UM
W6TTF	70,416	R
N6ORB/R	16,830	R
N6TEB/R	13,130	R
KE6QR	12,160	R
N6TR/R	2,835	R
WW7D/R	40,140	RL
N6GP	29,625	RL
KE7IHG/R	10,350	RL
K7ATN/R	5,340	RL
AF6AV/R	3,825	RL
K6EU/R	15,768	RU

Categories: LP — Single Operator, Low Power; HP — Single Operator, High Power; QRP — Single Operator, Portable; 3B — Single Operator, Three Band; FM - Single Operator, FM Only; UM — Unlimited Multioperator; LM — Limited Multioperator; R — (Classic) Rover; RL — Limited Rover; RU — Unlimited Rover

When 6 meters opened to EU with a huge pileup, though, all the work suddenly became worth it. Multiop stations are on the air all the time, establishing the limits of what's possible for VHF+ contesting.

K5QE posted a score of 483K from the STX flatlands to win the Limited Multioperator category, but not without a fight to retain their crown. Being in a 6 meter sweet spot and having the best overall 6 meter numbers of any station boosted their bottom line. Despite a close encounter with a black bear, the W4IY team at their mountaintop FM08 location did better on the other three bands due to some of the few tropo enhancement opportunities reported in this contest.

It's almost a cliché to report that the crew at W2SZ, the Mt Greylock Expeditionary Force, posted another win in the Unlimited Multioperator category. Solid performance on 6 and 2 meters as well as outstanding numbers on the higher bands really set this group apart from the others — their score was double that of the closest competitor at 1093K, the only score over the million mark. 2014 marks their 24th time winning the June VHF Contest.

Rovers

Rovers really enhance everyone's ability to work grids that are under-represented, providing additional QSOs and needed mults for the fixed and portable stations on multiple bands, as well as with other rovers. When the author first came to Illinois and didn't yet have any towers planted, roving with some new friends around the local grids was found to be a difficult yet rewarding experience. The increase in the Classic Rovers and the steady numbers of Limited Rovers are a hopeful sign that more will continue to join their ranks. Here in the Midwest they often offer the only opportunity to work grids in western Great Plains states that have few or no VHF+ operators. 2014 was really great for the rovers — they posted some amazing scores.

In the Limited Rover category, Wyatt, AC0RA/R, really burst onto the scene by winning his inaugural June VHF Contest. In only his second serious rover outing (he took 2nd in January) he's established himself as one of the top young guns. His 147K score from 10 different grids in IL, IA and WI blew away the 2013 Central Division record from W9YOY/R.

Working Grids on 2 Meters

Curt Roseman, K9AKS

The 86 grids worked on 2 meters by multiop station W4IY in Virginia is quite a good total. However, it is not among the very highest in the history of the contest (going back to 1985 when grids were introduced as multipliers). The accompanying table shows the top 16 totals over the years. In the 1980s some really good conditions, especially the tropo in 1985, led to several totals over 100. Other high 2 meter grid totals were common in that era, when everyday activity on the band was high in many areas of the country. Over the years, however, activity declined and 2 meters became relatively less important as a contributor to multiband scores in the June contest. Indeed, none of the top 16 totals are from the 1990s.

Something of a resurgence, however, occurred in the new millennium. In recent years, some multiop stations (K5QE, K8GP, and K9NS) racked up large numbers of grids. Even though relatively low levels of everyday activity persists, their totals were probably increased by working grids using digital modes on meteor scatter, via moonbounce, and by taking advantage of rovers who cover numerous grids where activity is low or nonexistent. Back in the 1980s, a station could dredge up large number of grids when conditions were enhanced by working home stations and portables on SSB or CW. Digital modes were not available and rovers were rare, but activity levels were high.

ARRL JUNE VHF CONTEST

All-Time High Number of of Grids Worked on 2 Meters

Grids	Call	Category	Section	Year
121	W8VP	M	OH	1985
116	W9UD	M	IL	1985
110	AA9D	M	IL	1987
108	WD8ISK	M	OH	1985
105	N8FMD	M	WV	1989
102	K5QE	L	STX	2013
99	N4AR	S	KY	1985
98	K5QE	M	STX	2011
96	W8VP	M	OH	1987
96	K9NS	L	IL	2005
95	K5QE	M	STX	2009
94	K5QE	M	STX	2012
94	K5QE	M	STX	2010
92	K8GP	L	WV	2002
89	K8GP	M	WV	2001
89	AA9D	M	IL	1989

Sponsored Plaque Winners

Plaque Category	Plaque Sponsor	Winner
Overall Single Operator Low Power	Society of Midwest Contesters	K2DRH
Overall Single Operator, 3-Band	Northern Lights Radio Society	AB5EB
Overall Single Op, Low Power, Rookie	W3ZZ First Log Award — Memorial by Tim, K3LR, and Dave, W9PA,	KJ4ZYB
Overall Limited Multioperator	Gene Zimmerman, W3ZZ Memorial — ARRL Contest Branch	K5QE
Overall Rover	73 Tim KE3HT/SK, Microwave DX Addict	K8GP
Atlantic Division Rover	Potomac Valley Radio Club	WA3PTV
Dakota Division Single Operator Low Power	Northern Lights Radio Society	WB0HHM
Hudson Division Single Operator Low Power	NY2NY — In Memory of W2GFF & W2HBA	K2KIB
Northwestern Division Multioperator	Randy Stegemeyer, W7HR	KE7SW
Roanoke Division Rover	Potomac Valley Radio Club	K8GP
Southwestern Division Single Operator Low Power	Bud Semon, N7CW	WJ0F
Canada Single Operator Low Power	Northern Lights Radio Society	VA3ZV
Northwestern Single Operator, 3-Band	Pacific Northwest VHF Society	WB7FJG

In the Classic Rover category, Andy, K1RA, and Terry, W8ZN, raised the Grid Pirate flag and did a 10-band, five-grid rove through the high spots of the Roanoke Division in the tradition of the W3IY/R Intergalactic Roving Battle Jitney. Their web page at **www.k1ra.us/roving/k1ra-k8gp-rover-arrl-june-vhf-2014** is beautifully done and well worth visiting.

Steve, VE3SMA/R, and Russ, VE3OIL/R, locked horns in an unusual battle for second in another close rover finish. In the claimed scores it initially looked as if Russ had beaten Steve, but in a rare reversal of fortune, Steve lost fewer points to log checking deductions, edging out Russ with an 11-band, seven-grid effort of 128K that included seven laser contacts. In 4th place, Carole, W6TTF/R, took her 10-band rover through nine grids in the Pacific Division areas of southern California and logged a score of 70K.

In the Unlimited Rover Category, John, W3HMS, mounted a 10-band, three-grid rove in PA to garner 19K for the win. Tom, K6EU/R, visited 3 grids in Southern California while operating the bottom four bands for a 16K, 2nd place finish. Ron, AF5Q/R, hit six grids in the West Gulf Division around Oklahoma with the bottom four bands to take 3rd with 10K.

Logging Accuracy

We all make a few logging errors from time to time. While call and grid logging errors are all my own, in my contest Log Checking Reports (LCR), I have noticed losing a fair chunk of my score to Not In Log (NIL) reports. Almost invariably these are QSOs that I'm 100 percent sure that I worked when moving a station from band-to-band. Apparently, in the rush to get back to 6 meters during an opening or to find the next station, the other station forgot to log the Q or accidentally logged me on a different band. This really hurts because the "bad" QSO is often on a band worth higher points and on which I have few QSOs and mults. The deduction results in the loss of both that QSO (including any multiplier credit) plus an equivalent number QSO points, so the result is the loss of a lot of score. From talking to other operators and comparing claimed scores to adjusted scores it's evident this has affected others, too. This is especially noticeable when the score on a microwave band is a negative number because of a single QSO made and lost on that band. This can't be fixed in log checking — please make sure you log accurately to avoid inadvertently penalizing someone else. It could make all the difference in a close finish.

Epilogue

To sum up the 2014 June contest; here in the Midwest and in many parts of the country, it was a slogfest with E_s and tropo opportunities few and far between for most stations. When the band was not open (which was most of the time) you had to keep your butt glued to the seat or you would miss a contact — pretty true of VHF+ contesting in general. To wring out every possible contact you have to sit there though the slow hours, track the local rovers, and be ready to pounce on and run the bands with anyone and everyone who turns on a radio just to see if anyone's around or has a few minutes to spare to "check out the contest." This is true even when you're sorely tempted to pull your headphones off your aching ears and take a nap. We'll see you on June 20 – 22 of 2014 to wring out a few QSOs!

Full Results Online

The complete results of the June VHF Contest are available at **www.arrl.org/contest-results-articles**. You'll find more tables and tales including band-by-band QSOs and multiplier leaders, details of the competition, and notes about propagation.

2014 Field Day Results

In this year's event, 47,428 participants made over 1.2 million contacts.

Matt Wilhelm, W1MSW, w1msw@arrl.org

Operating from mountaintops, parks, emergency operation centers, and homes across North America, 47,428 operators participated in the 81st annual ARRL Field Day. Always the fourth full weekend in June, Field Day provides an opportunity to showcase Amateur Radio to the public, while practicing the skills necessary to deploy and operate portable stations. An event that is never short on challenges, participants put their knowledge and equipment together to make as many contacts as possible, while attempting to circumvent the many challenges that Mother Nature and Murphy regularly present over the weekend. Though it is not a contest, Field Day does provide a point-based scoring system to make it easier for participants to evaluate their efforts each year.

The Best-Laid Plans

Field Day operations are over the course of a weekend, but preparation for the event begins weeks and sometimes months in advance. Site planning, testing and inventory of equipment, press releases to local media outlets, and invitations to elected and agency officials are all important elements of a successful operation and must be executed long before the first exchange is made. For the 2093 stations that reported operating using only emergency power, careful consideration had to be given to the amount of power used to transmit signals and conservation of fuel to ensure stations would remain on the air throughout the event. Safety is also an important part of Field Day planning, and because the majority of operations are outdoors, sites must prepare for the constantly changing conditions.

Even the most thoroughly prepared stations can be challenged by the weather. June provides the Northern Hemisphere with shelter from the cold, but it also exposes us to the elements associated with summer in North America. This year, a large band of precipitation was recorded from the far reaches of the Northwest all the way down to Florida, and many Field Day stations reported heavy rain at their sites. Ed, KF8PD, from Chickasaw Amateur Radio Association wrote that it was one of the wettest Field Day events he had ever attended, but pointed out, "How many emergencies happen during perfect weather conditions?" High temperatures throughout the weekend were in the 100s across the south and southwest and gradually faded into the 80s to the north. These conditions tested the will and stamina of operators to assemble their stations and operate continuously throughout the weekend.

Top 10 Claimed

Call Sign	Score	Class
W1AW/3	36,730	28
W6YX	21,840	10
K6EI	20,125	6
K4LRG	19,028	5
W4IY	18,224	10
W6ZE	17,970	7
W4EZ	17,440	9
K4FC	16,934	7
K4BFT	16,370	4
W5YA	15,775	3

Conditions and Demographics

Although we will be moving past the peak of Solar Cycle 24, solar conditions were similar to last year, with almost identical solar indices. Participants reported that contacts were made on 10 meters, but that conditions were not optimal. In contrast, activity on 15 meters and below was very good across all regions. Total QSOs reported this year were down just slightly, despite an increase in the number of participants. We also saw a decrease in the number of phone QSOs, but an increase in both CW and digital contacts. Station demographics from this year showed that small club efforts are still the most common entry. However, not

In a remote desert location in Utah's San Rafael Swell, Jim Olsen's, K7JEO, 1B1 station operated using 100% solar power. [Jim Olsen, K7JEO, photo]

all Field Day sites are hosted by clubs. Some participants enjoyed setting up a single station all to themselves, while others took the opportunity to get together with a few friends to operate over the weekend. We received summaries from stations operating in remote locations and others that made it as far as their backyard. We also saw a sharp increase in the number of single transmitter home entries, which may have been in part due to heavy precipitation that many areas experienced.

QSOs with the ISS and W1AW

One highlight for many Field Day participants this year was a contact with Commander Reid Wiseman, operating as NA1SS onboard the International Space Station. The astronaut made an extraordinary and successful effort to contact as many amateurs as possible during several North American passes. We would like to thank Commander Wiseman for taking the time out of his busy schedule to participate, as well as ARISS and NASA for helping coordinate the operation. If you worked NA1SS, don't forget to send in your request to receive an ISS QSL card documenting the contact.

Members of the Navarre CERT ARC prepare to launch a tethered weather balloon that supported a long wire antenna. While providing an excellent method of antenna support, the balloon also served to bring curious visitors to the site. [Steve Van Den Akker, W4SJV, photo]

As we celebrate our 100th anniversary with the Centennial QSO Party, operators around the world attempt to make as many contacts as possible with W1AW portable. Field Day weekend was no exception. This year the Columbia Amateur Radio Association and the Potomac Valley Radio Club were back again as a 28A and operated under the call sign W1AW/3. Diane, KE3TT, blogged about the event and titled her post, "Yes, OM, That's Two Eight Alpha." That was surely a phrase heard many times over the weekend as they made over 11,000 contacts.

Time Well Spent

On Sunday afternoon, after operating came to an end, tired participants knew that there was still work to be done. The breakdown of the sites began and with the help of gravity, things always seem to come down much more quickly than they go up. Logs were collected, coax was coiled, radios were carefully packed away, and sites were cleaned of any remaining items to ensure hosts would welcome us back. Reading through the soapbox comments, e-mails and notes scribbled on paper Field Day summary sheets, there is a recurring theme. No matter how difficult the challenges were over the weekend, the majority of participants noted how much they are looking forward to Field Day next year. This reflects the important role of Field Day in both maintaining the enthusiasm of existing participants while providing a valuable context for bringing new amateurs into the hobby. We look forward to working you from the field again next year, on June 27 and 28, 2015.

Entries by Class

1A	121	1B1	104	5F	9
2A	392	1B1B	140	6F	2
3A	316	1B1C	15	7F	3
4A	150	1B2	38	9F	1
5A	87	2B2	18	10F	1
6A	29	1B2B	24	12F	1
7A	17	2B2B	10	3D	6
8A	11	1B2C	2	4D	2
9A	5	2B2C	2	7D	1
10A	5	1C	38	27D	1
12A	1	2C	2	1E	276
16A	1	1D	450	2E	36
28A	1	2D	23	3E	16
1AB	25	3D	6	4E	7
2AB	17	4D	2	5E	2
3AB	9	7D	1	7E	2
4AB	10	27D	1	1F	28
5AB	1	1E	276	2F	67
6AB	2	2E	36	3F	49
7AB	1	3E	16	4F	23
9AB	1	4E	7	5F	9
10AB	1	5E	2	6F	2
1AC	10	7E	2	7F	3
2AC	29	1F	28	9F	1
3AC	28	2F	67	10F	1
4AC	14	3F	49	12F	1
5AC	3	4F	23		

Important Field Day Statistics

Total CW QSOs	555,912
Total Digital QSOs	54,549
Total Phone QSOs	675,128
Total QSOs	1,285,589
Number of People	37,428
Entries Active	2686

Scores

Score listings are grouped according to the number of transmitters in simultaneous operation and their entry class. The listings show club or group name, call sign(s) used, total number of QSOs, number indicating power output used (5 is less than 5 W, 2 is less than 150 W, 1 is more than 150 W), number of participants and total score including bonus points and ARRL section. Entries are listed from highest to lowest claimed score in each class. Class A stations are clubs or groups portable with 3 or more participants Class B stations are portables with one or two participants. When there are two operators, the other operator's call is listed in parentheses, if it is known. Class C stations are mobiles. Class D stations are home stations using commercial power. Class E stations are home stations using emergency power. Class F stations are EOC stations.

1A

Tilson CC					
K5WA	2440	2	8	9,102	STX
Kathrine Fisher's RC					
W0FD	1830	2	11	6,412	CO
Case ARC					
W8EDU	1586	2	3	6,410	OH
Friends and Alumni Under LT					
K1LT	1423	2	3	5,842	OH
Boomer Contest Club					
K5PX	1313	2	5	5,552	OK
Wayne ARC					
W8AV	1470	2	8	5,550	OH
Lafayette DX Assn					
W9LDX	1472	2	12	5,302	IN
Murphy's Law Radio Group					
K5QY	1591	2	7	5,238	NTX
Page Valley ARC					
K4PMH	1434	2	18	5,096	VA
Dr Loomis Memorial Jr Mechanics League					
W3KDR	1459	2	12	5,086	MDC
Federation of AR Ops					
K9ZA	1197	2	3	4,752	IL
Portland Radio CC					
KK7PR	1482	2	15	4,528	OR
Union Metropolitaine des Sans-Filistes de Montreal					
VE2UMS	875	2	30	3,676	QC
Big Lake AR Enthusiasts					
W0G	1564	2	4	3,378	MN
Jefferson Cty ARC & Ancient Modulators					
KB0TLL	1252	2	25	3,324	MO
N4CWZ	1014	2	3	3,316	NC
Berwick Contest Team					
AK3V	1094	2	4	3,312	EPA
Athens Cty ARA					
W8MHV	604	2	16	3,152	OH
Patrick Henry ARA					
K4MVA	829	2	15	3,116	VA
McHenry Cty Wireless Assoc					
K9RN	730	2	15	3,112	IL
Neurosa Gopher Munchers					
AE6C	608	2	3	2,932	SV
South Georgian Bay ARC					
VE3SGB	907	2	6	2,864	ONS
Wasteland Comm Corp					
K6WCC	809	2	4	2,818	SB

AVRA Valley Coyote Group
WA7NB 1206 2 3 2,762 AZ
West Island ARC / Montreal ARC
VE2ARC 561 2 20 2,604 QC
AL Contest Group
K4ZGB 601 2 3 2,532 AL
Illinois Valley RA
K9AVE
(+W9SP) 631 2 8 2,528 IL
N5JB 539 2 4 2,476 NTX
Bass Hill Repeater Group
W1KX 547 2 10 2,426 ME
Harris-Intersil ARC
K4HRS 454 2 9 2,406 SFL
Sam Houston ARK
AI5M 503 2 20 2,318 STX
Salted Hams Club
N5PJ 452 2 3 2,258 OK
W5WQ 629 2 17 2,208 MS
Souris Valley ARC
K0AJW 481 2 10 2,190 ND
Why Gee AR Group
K2YG 507 2 5 2,190 NNJ
Benton ARS
K5NE 591 2 19 2,152 AR
WPPS RC
W7POE 406 2 3 2,074 WWA
Club Radio Amateur Saguenay Lac St-Jean
VE2CRS 377 2 5 2,000 QC
RBD Group
N1VF 661 2 3 1,982 SCV
Associated Radio Amateurs of So New England
W1AQ 586 2 10 1,934 RI
Central WA ARC
W7TT 409 2 28 1,906 EWA
Halton ARC
VE3CD 336 2 8 1,900 GTA
Fort Saskatchewan ARC
VE6CJ 662 2 4 1,874 AB
Red Ant Annihilators / SCAN
WB6QND 837 2 7 1,826 LAX
Juneau ARC
KL7JRC 287 2 47 1,770 AK
First State ARC
K3QBD 387 2 15 1,768 DE
Richardson Wireless Klub
K5RWK 494 2 33 1,754 NTX
Nashoba Valley ARC
N1NC 500 2 12 1,702 EMA
Marshall Cty ARC
W0GCJ 404 2 8 1,588 KS
WA1QCA Repeater Group
W1KDA 444 2 20 1,488 RI
Covet Hill ARC
VE2CYH 283 2 20 1,438 QC
Peruvian-American RC
W0PNA 352 2 3 1,434 MN
AB2YI 511 2 7 1,424 WNY
Jemez Hams
W5WHN 236 2 3 1,400 NM
K4DAE 620 2 3 1,390 NFL
Dillman's AR Experimenters
KO9F 390 2 7 1,346 IN
W0LI 130 2 3 1,288 CO
Hamilton Cty ARA
K0KWO 180 2 8 1,282 IA
Heart Of TX Ham Op Group
WA5HOT 207 2 7 1,264 STX
K5GOE 300 2 14 1,250 AR
Hanburger's Helpers ARC
K3HH 228 2 5 1,230 MDC
Parma Radio Club
W8PRC 228 2 26 1,224 OH
TERAC
K7AUO 451 2 4 1,186 OR
Hot Springs Village ARC
K5ID 199 2 7 1,158 AR
Flathead Valley ARC
K7LYY 375 2 24 1,150 MT
Blue Ridge Wireless ARC
K4BRW 241 2 9 1,132 VA
Theodore Roosevelt ARC
K0ND 306 2 9 1,062 ND
K5BS 42 2 15 982 STX
Tioga Wireless Club
W4TWC 230 2 14 968 NFL
Wireless Assoc of South Hills
N3SH 224 2 20 900 WPA
Tuscarora Mtn Group
KB3GDG 361 2 4 892 WPA
Middle Peninsula ARC
W4HZL 162 2 15 874 VA
Tusco ARC
W8ZX 153 2 8 858 OH
Woodchuck ARC
WA8Q 201 2 14 852 OH
Portland Amateur Wireless Assn
W1KVI 110 2 9 848 ME
Local Emerg Field Radio Op Group
W9FRG 240 2 7 830 WI
No Name Radio Gang
WA1HRE 251 2 10 826 CT
Ocean State ARG
K1OS 214 2 6 818 RI
Sportsman's Paradise ARC
K4WAK 68 2 4 794 NFL
MN ARTS
AA0MN 145 2 8 792 MN
Kings Cty RC
KC2RC 205 2 8 778 NLI
Watertown ARC
N9HR 181 2 9 766 WI
Vicksburg AR Club
K5XRO 197 2 6 744 MS
Vicksburg ARC
K5ZRO 197 2 6 744 MS
Yellow Thunder ARC
WB9FDZ 183 2 25 736 WI
Maury River Rats
WD8MQN 133 2 12 716 VA
Scott Cty ARES
NE4ST 20 2 7 710 KY
Big Island ARC
KH6EJ 59 2 29 700 PAC
AR Diamond
KE5FSY 22 2 9 694 AR
North Okanagan RA Club
VE7NOR 152 2 6 692 BC
Mason Cty Amateur Club
N7SK 89 2 21 678 WWA
Zoo Crew 147.120 Repeater Group
K8LBH 251 2 8 652 NFL
Naturist ARC
NU5DE 201 2 3 652 STX
Renfrew Cty ARC
VA3NRR 193 2 20 636 ONE
4x4 Ham
W7AZO 181 2 35 612 AZ
Bartow Co ARES
N4QET 137 2 12 574 GA
Hams & Eggs
WE8T 55 2 4 570 OH
Au Sable RC
N8KV 120 2 3 570 MI
K9KEW 97 2 4 544 WI
MARA Net
AC7R 44 2 4 538 AZ
NoviARC
N8OVI 101 2 4 518 MI
Baccalieu Amateur Radio Klub
VO1BRK 109 2 10 518 NL
Picorams
K9IYP 73 2 8 516 IL
Desert Circle ARC
NU7DE 56 2 3 516 NM
VE1UW 98 2 7 502 MAR
South Peninsula ARC
KL7NWR 11 2 15 476 AK
W5UGD 160 2 4 470 SC
Argonne ARC
W9ANL 89 2 3 428 IL
WB2IDV 139 2 4 428 NNJ
SCVRA
W9JET 13 2 10 376 WI
Hualapai ARC
WB6RER 62 2 10 374 AZ
Maverick Radio Mentors
K5UTA 62 2 3 374 WTX
AA3TL 91 2 4 364 EPA
N3FYD 56 2 3 362 WPA
LBCECG
N3RAY 77 2 3 354 EPA
St. Marys ARC
VE3SDF 27 2 6 354 ONS
Niag ARA / Peninsula RC
VE3DZ 74 2 3 346 ONS
Waltham ARA
W1MHL 31 2 3 326 EMA
Tuscarora ARA
K3TAR 100 2 4 250 EPA
N5VMO 21 2 3 234 AR
W7HBP 23 2 3 216 EWA

2A

Radio Amateurs of No VT
W1NVT
(+W1PU) 4548 2 27 14,018 VT
Batesville ARC
K5UZ
(+K5NES) 4076 2 22 13,444 AR
Newport Cty RC / Sakonnet 49'ers
W1LY
(+W1SYE) 2815 2 71 10,940 RI
Kansas City CC
KS0MO
(+KC0MO) 2425 2 10 10,276 KS
Randallstown ARC
N3IC
(+K3MZ) 2853 2 22 9,640 MDC
Big Bend ARC
K5FD
(+AD5BB) 2979 2 22 9,560 WTX
W4NT
(+W4IZT) 2819 2 10 9,548 NC
MARC
K5CM
(+NN5Q) 2492 2 11 9,232 OK
Tampa ARC
N4TP
(+N4SEX) 2629 2 45 9,198 WCF
REDXA / MARS
W6SG
(+W6KB) 2738 2 30 9,040 SF
Midland ARC
KD5C 2335 2 25 8,930 WTX
Providence RA
W1OP
(+W1PRA) 2577 2 14 8,628 RI
Falmouth ARA
K1RK
(+W1NOB) 2335 2 41 8,442 EMA
NA9U
(+KD9AGJ) 2318 2 20 8,366 IN
Schaumburg ARC
N9RJV
(+KC9NZP) 2333 2 80 8,330 IL
Lakes Region Rep Assn
W1UR
(+W1BST) 2275 2 53 8,230 NH
Pacific Cty ARC
W7R
(+W7Y) 2035 2 23 8,172 WWA
Williamson Cty ARC
N5TT
(+N5TW) 2133 2 60 8,050 STX
ARC of Greater Milwaukee
N9AW 2249 2 13 7,948 WI
Valley and Massanutten ARA
W4XD 2310 2 56 7,802 VA
Fauquier ARA
W4VA
(+KW4VA) 1963 2 16 7,692 VA
Northern OH DX Assoc
W8DXA 2215 2 25 7,306 OH
Prairie Dog ARC
W0OJY
(+W0EJ) 1594 2 20 7,290 SD
Halifax ARC
VE1FO
(+VE1QD) 1997 2 37 7,218 MAR
W9JP
(+W9RCA) 2113 2 35 7,204 IN
PR ARL
KP4ES 1964 2 9 7,000 PR
Victor Zulu Group
N3VZ 1970 2 5 6,986 EPA
Williamsburg Area ARC
K4RC
(+N4DJ) 1989 2 58 6,904 VA
NHC Emergency Prep Group
NC4NH
(+WA4CR) 1563 2 50 6,738 NC
Mining ARC & St. Paul RC
W0MR
(+K0AGF) 1883 2 55 6,698 MN
Coconino ARC & No AZ DX Assn
W7TB
(+KC7KCN) 1713 2 77 6,624 AZ
Arrow/UM ARC FD Team
W8UM
(+W8PGW) 1794 2 23 6,618 MI
Monroe Cty Radio Comm Assoc
W8PI
(+W8DWL) 2011 2 17 6,532 MI
K6AA
(+K6ZNL) 1482 2 30 6,518 LAX
S ARC/SEPAR
VE7SAR
(+VE7HME) 1541 2 30 6,256 BC
SURREY ARC
VA7SAR
(+VA7HME) 1541 2 30 6,256 BC
K0LIR 1556 2 17 6,130 MO
Oakville ARC
VE3HB
(+VE3OAK) 1597 2 21 6,108 GTA
Muncie Area ARC
K9NN
(+W9DUK) 1474 2 25 6,088 IN
Radio Farm
N0MA
(+N0MMA) 1804 2 15 5,972 IA
Pleasant Hill / Martinez ARC
N6VV 1798 2 30 5,896 EB
Radio Club of Redmond
N7KE 1637 2 15 5,770 WWA
Mountaineer ARA
W8SP 1570 2 18 5,748 WV
Lynchburg ARC
K4CQ
(+W3CQ) 1394 2 47 5,732 VA
Oakland Cty ARS
W8TNO
(+W8A) 1668 2 20 5,720 MI
Platinum Coast ARS
W4MLB
(+AF4Z) 1427 2 30 5,674 SFL
Free Radicals
KE2D 1695 2 5 5,662 SNJ
W1NRG 1345 2 37 5,528 CT
Crawford ARS
W3MIE
(+N3QQH) 1299 2 28 5,484 WPA
Philips ARC / Pentucket RA
W1HP
(+KD1NA) 1379 2 18 5,462 EMA
Centrail OR DX Club
N7LE 3146 1 12 5,440 OR
Trojan ARC
NW0K 1329 2 6 5,340 KS
Boulder ARC
W0DK
(+KH6HTV) 1724 2 23 5,270 CO
Explorer Post 599
WA2DFI
(+W7BSA) 1423 2 27 5,244 AZ
Cape Fear ARS
K4MN 1137 2 20 5,112 NC
Anderson RC
N4AW
(+N4SBA) 1109 2 12 5,062 SC
Brandon ARS
K4TN
(+KC4MMR) 1247 2 36 5,054 WCF
Montrose ARC
K0IIT
(+KC0QXX) 1254 2 55 5,054 CO
Schuylkill Am Rep Assoc
W3SC
(+W3SX) 1143 2 24 4,996 EPA
Oconee District 17 RC
N4S 1212 2 21 4,954 SC
San Mateo RC
W6UQ
(+K6VJ) 1294 2 30 4,940 SCV
Palos Verdes ARC
K6PV
(+KA6WNK) 1357 2 41 4,932 LAX
K4OO 1254 2 8 4,904 NC
Escondido ARS
N6SD
(+N6WB) 1372 2 72 4,896 SDG
KH6J 1350 2 45 4,814 PAC
Motorola ARC
K9MOT
(+N9EP) 1412 2 18 4,812 IL
Marietta ARC
W8HH 1221 2 8 4,808 OH
Tallahassee ARS
K4TLH
(+N4IPH) 1268 2 43 4,786 NFL
1900 CLUB
W3QJ
(+K3PT) 1139 2 17 4,746 DE
Hellgate ARC
W7PX 1081 2 11 4,668 MT
Cabarrus ARS
K4WC 1249 2 36 4,542 NC
Franklin Cty ARC
AC1L
(+KB1MSU) 1098 2 33 4,510 WMA
RF Wireless ARC Of Burley
W7JQ
(+W7BRC) 982 2 27 4,466 WWA
TN Valley DX Assn
W4PL 1100 2 25 4,456 TN
High Desert ARC of NM
NM5HD 1155 2 29 4,452 NM
Palatine AUXCOMM / ARES / RACES
W9P
(+WX9PAL) 1074 2 107 4,406 IL
Wilderness Road ARC
W4CDA
(+WQ4Z) 944 2 27 4,354 KY
Tri Cty ARC
W9MQB
(+W9CYA) 904 2 15 4,338 WI
Ellsworth AWA
W1TU
(+N1MEA) 976 2 18 4,334 ME
Mills Cty ARC
K5TRO
(+N5QBU) 1174 2 20 4,210 NTX
New Providence ARC
N2XJ
(+W2FMI) 1287 2 36 4,114 NNJ
Sandia National Lab ARC
W5MPZ 1023 2 23 3,990 NM
Grand Rapids ARA
W8DC
(+W8GVU) 1014 2 25 3,974 MI
York Cty ARS
K4YTZ
(+W4KMT) 864 2 25 3,972 SC
Rice Family
NX8Y
(+AB8FE) 917 2 3 3,910 OH
South Lyon Area ARC
N8SL
(+N8AR) 1132 2 30 3,900 MI
Arrowhead RAC
W0GKP
(+K0NWS) 935 2 40 3,868 MN
Irvine Disaster Em Com
N6IPD
(+K6PB) 969 2 40 3,772 ORG
VE3ORF3730 ARG
VE3ORF
(+VE3KY) 1076 2 20 3,772 ONE
Massillon ARC
W8NP
(+W8DEA) 938 2 35 3,724 OH
Twin City Ham Club
W5EA
(+WA5WX) 842 2 17 3,702 LA
Heart 'O Texas ARC
W5ZDN
(+W5TSA) 722 2 47 3,680 NTX

Motor City Radio Club
W8MRM
(+W8GTZ) 976 2 41 3,580 MI
Sioux Empire ARC
W0ZWY
(+W0FSD) 814 2 19 3,552 SD
MARCA
W7MOT 1105 2 15 3,544 AZ
EPCOM
VE7PCE 1215 2 25 3,540 BC
Ft Madison ARC
WF0RT
(+NF5B) 714 2 20 3,518 IA
Ottawa ARC
VE3RIC
(+VE3NCR) 746 2 50 3,480 ONE
Hospital Disaster Support Com System
N6NH
(+W6KOS) 732 2 48 3,472 ORG
Larkfield ARC
W2LRC
(+KC2TAF) 863 2 40 3,470 NLI
Bonac ARC
K2EC 1368 2 16 3,468 NLI
W0LS 834 2 10 3,466 MN
Radio Operadores Del Este
KP3RE 1126 2 25 3,426 PR
Carbon ARC
W3HA 816 2 6 3,424 EPA
South Kitsap ARC
N7IG 683 2 10 3,410 WWA
North Shore ARC
VE7NSR
(+VE7EMR) 847 2 40 3,382 BC
The Villages ARC
K4VRC
(+N4FP) 1765 1 45 3,315 NFL
Twin City FM Club
W0EF 754 2 26 3,298 MN
Raytown ARC
WW1USA
(+K0GQ) 878 2 200 3,266 MO
Hancock Cty ARC
W9ATG
(+N9TT) 718 2 29 3,240 IN
Garland ARC
K5QHD
(+KG5OO) 611 2 69 3,230 NTX
Candlewood ARA
W1QI
(+W1QK) 710 2 25 3,214 CT
Littleton Radio Amateurs
K0AE 894 2 10 3,150 CO
Valencia Cty ARA
K5OUR 743 2 73 3,134 NM
Clearwater ARS
WE4TT 1259 2 25 3,112 WCF
Gold Coast ARA
N4FL 772 2 54 3,090 SFL
Mid-MO ARC
N0SS 584 2 37 3,082 MO
Caribbean ARG
WP4CRG
(+KP4FIE) 1017 2 21 3,044 PR
Port Lavaca ARC
W5KTC 701 2 9 3,012 STX
Clinton Cty ARC
W9PC 566 2 18 2,994 IN
Martin Cty Ares/Races
K4ZK
(+WX4MC) 819 2 30 2,980 SFL
Southern Okla DX Club
W5CSC 862 2 12 2,968 OK
Paso Robles ARC
W6R
(+N6KKS) 1290 1 25 2,965 SB
Samuel F Morse ARC
W6SFM 521 2 21 2,954 SV
Mich-A-Con ARC
KC8VC
(+W8JWN) 676 2 18 2,952 MI
ARC Em Com Serv
WB2QBP
(+K2ARC) 1032 2 15 2,922 NLI
Orca DX & Contest Club
VA7ODX 597 2 9 2,874 BC
Naval Postgraduate School
K6LY
(+K6NPS) 791 2 18 2,860 SCV
Ashe Cty ARC
W4FD
(+W4APP) 660 2 30 2,860 NC
Cochise ARA
K7RDG
(+W7SVD) 657 2 24 2,844 AZ
Morris RC
W2YD 683 2 6 2,820 NNJ
Half Moon Bay ARC
WR6HMB 638 2 10 2,818 SCV
Palms West ARC
W4SS 699 2 33 2,804 SFL
Pueblo West ARC
NA0PW
(+KD0MBL) 537 2 7 2,792 CO
Coastside ARC
WA6TOW 744 2 13 2,752 SCV
Los Angeles ARES NW District
WA6P 619 2 40 2,744 LAX
Goochland Cty ARES / Virginia Capital District 6 ARES
N4MI
(+N4HOK) 477 2 50 2,714 VA
VE7VCC 517 2 9 2,694 BC
Carteret Cty ARS
W4YMI
(+K4TRP) 737 2 30 2,674 NC
Sierra Blanca ARC
KR5NM
(+K5RIC) 687 2 12 2,668 NM
Green Valley ARC
WE7GV 696 2 45 2,644 AZ
Laguna Mtn WFD
KK6I
(+W6BAF) 550 2 9 2,638 SDG
Ole VA Hams
W4OVH
(+N4H) 479 2 15 2,636 VA
VE3SOO 682 2 12 2,588 ONN
Blackstone Valley ARC
W1DDD
(+W1TBR) 542 2 43 2,562 RI
Moosehorn ARC
KL7AN 730 2 29 2,558 AK
PSRG Seattle ACS / WSARC Joint Team
W7ACS
(+W7AW) 617 2 109 2,550 WWA
Tesla ARC
K4XX 727 2 4 2,546 AL
Southwest LA Am Rep Club
W5BII
(+KF5HDM) 778 2 33 2,544 LA
West Allis RAC
W9FK 691 2 20 2,472 WI
Littleton Area Radio Klub
K1EME
(+KC1BLE) 379 2 14 2,470 NH
Peekskill / Cortlandt ARA
W2NYW 722 2 16 2,460 ENY
The Happy Hams
K2DXU 726 2 4 2,460 ENY
ARC of Amite Cty
W5CCW 554 2 8 2,454 MS
Guilford Cty ARES / Greensboro ARA
NA4GC
(+W4GSO) 961 2 28 2,448 NC
Minden ARA
N5RD
(+KA5KBP) 660 2 22 2,394 LA
Decatur ARC
W4ATD
(+KB4CAY) 631 2 27 2,388 AL
Butts Cty Em Com Aux
WX4BCA 657 2 20 2,384 GA
The FPL Group
K8ESQ 557 2 4 2,364 MI
Santa Cl ARA Cty AR Assn
W6UW
(+W6UU) 605 2 49 2,364 SCV
Tuscaloosa ARC
W4XI 652 2 30 2,312 AL
St Lucie Cty AR Em Serv
W4SLC
(+KK4WCA) 608 2 32 2,286 SFL
Pamlico ARS
N4PRS
(+AI4WL) 519 2 46 2,278 NC
Sacramento Mtns RC
KE5MIQ 384 2 16 2,242 NM
Corona PD CSV Team
W6CPD 491 2 40 2,234 ORG
Emerald ARS
WA7FQD 452 2 34 2,234 OR
Blossomland ARA
W8MAI
(+W8KIT) 507 2 25 2,234 MI
Central MS ARA
WX5H
(+N5DU) 357 2 34 2,226 MS
Oak Grove Hamsters
KB0NHW
(+N0PVZ) 334 2 5 2,226 MO
Parker Radio Assoc
K0PRA
(+K0PRA) 664 2 30 2,216 CO
Union Cty ARS
NC4UC 714 2 17 2,214 NC
Pacific NW QRP Group
K7W 579 2 4 2,198 WWA
Nittant ARC
W3YA 1170 1 37 2,164 WPA
Wellington RC
K4WRC
(+AJ1Q) 752 2 60 2,154 SFL
Laurel ARC
W3LRC 554 2 10 2,146 MDC
Jasper Radio Club/Cherokee ARS
K4ACW
(+KJ4PQX) 366 2 32 2,138 GA
Gallatin Ham RC
W7ED 737 2 20 2,132 MT
Olive Branch ARC
W5OBM
(+KD5IWH) 472 2 16 2,126 MS
Sonoma Cty Rad Arms
K6SON
(+W6SON) 385 2 50 2,110 SF
McDowell Cty ARC
WV8ED 274 2 16 2,106 WV
Mtn ARC
NX0G 437 2 3 2,088 CO
Twin Cities Rep Club
W0BU
(+WB0JMG) 417 2 12 2,076 MN
Pine State ARC
N1ME 778 2 26 2,066 ME
Mountain State Transmitters
K8VNQ
(+KD8MIV) 292 2 5 2,050 WV
Bloomington ARC
K9DIY
(+K9SOU) 358 2 62 2,032 IN
Club Radio Amateur de Quebec
VE2CQ
(+VE2CDX) 408 2 58 2,022 QC
Los Alamos ARC
W5PDO 420 2 15 1,990 NM
San Jose ARES/RACES/ACS
W6SJC
(+KF6IIY) 239 2 40 1,988 SCV
Panhandle ARC
W5WX
(+KC5OMK) 606 2 22 1,982 WTX
Winona ARC
W0NE 324 2 24 1,966 MN
Mid-Atlantic ARC
W3NWA
(+WB3JOE) 432 2 58 1,950 EPA
Wayne Cty Renegades
N8IW 445 2 3 1,944 OH
W5PFC 336 2 15 1,936 MS
TRI-County ARA
K6AGF 586 2 12 1,932 ORG
Queen Creek ARC
N7Q
(+KF7RYX) 452 2 13 1,922 AZ
Penn-Mar Radio Club
W3MUM
(+KB3DSR) 514 2 26 1,892 EPA
Cowichan Valley Amater Radio Soc
VE7CVA 604 2 21 1,884 BC
DeKalb Cty ARC
W4GBR 623 2 35 1,876 AL
Big Sandy ARC
KD0TOS 256 2 10 1,868 CO
Newport Beach Repeater Club
K6NBR 492 2 11 1,866 ORG
Dog Hollow Contest Group
AK9D 373 2 5 1,806 MO
Ridgeville & District ARS
N4R
(+W4QYV) 502 2 9 1,804 SC
W7BI 293 2 22 1,794 WWA
Bryan ARC
W5BCS 340 2 49 1,782 STX
NA1RL 428 2 32 1,772 CT
South Canadian ARS
W5NOR
(+WB5ULK) 318 2 35 1,758 OK
Mountain ARC
W6BW
(+KJ6JZU) 384 2 17 1,756 SJV
Pine Ridge ARC
W0FLO 348 2 20 1,750 NE
Greater NE ARL
K0GNE 524 2 13 1,748 NE
California City ARC
KE6RN 202 2 19 1,740 SJV
Douglas Cty ARC
W0UK
(+K0TOY) 475 2 20 1,734 KS
M&M ARC
W8PIF 990 1 56 1,728 MI
Six Meter Club of Chicago
K9ONA 376 2 24 1,724 IL
Charleston ARS
WA4USN 635 2 15 1,720 SC
Lauderdale-Clarke Counties ARES
WX5MEI 194 2 26 1,714 MS
VE7SCC
(+VA7BHA) 295 2 15 1,712 BC
Pamlico ARC
K4BCH 378 2 12 1,710 NC
Eastern Shore ARC
K4BW 408 2 16 1,706 VA
Vashon Maury Island RC
W7VMI
(+W7OZT) 209 2 48 1,706 WWA
South Bay ARC
W6SBA 289 2 24 1,678 LAX
Kamloops ARC
VE7UT 251 2 31 1,664 BC
Socorro ARA
W5AQA 330 2 22 1,658 NM
Citrus Cty ARC
W4CRA
(+W4R) 298 2 25 1,646 NFL
Ellis Cty ARC
WD5DDH 303 2 25 1,626 NTX
Crown Radio Group
W3RP 302 2 13 1,622 WPA
Triple A ARA
N3TN 450 2 18 1,614 WPA
Bladen ARS
W4BLA 581 2 7 1,612 NC
Maple Valley ARC
KC7KEY 339 2 32 1,612 WWA
Barrie ARC
VE3GCB
(+VE3RAG) 249 2 14 1,612 ONS
Estes Valley ARC
N0FH 322 2 30 1,604 CO
W5AUU
(+N5RYG) 447 2 40 1,598 AR
Two Rvers ARC
W3OC
(+KB3JLT) 399 2 24 1,594 WPA
Centralia Wireless Assn
W9CWA
(+NV9S) 220 2 60 1,592 IL
SC4ARC
W6SCF 144 2 25 1,592 SCV
VO1AA 152 2 9 1,588 NL
Hiawatha Valley ARC
N0DH 386 2 20 1,586 MN
St Albans ARC
N1STA 341 2 10 1,574 VT
Sachse ARA
K5S 308 2 48 1,572 NTX
Matagorda Cty ARC
W5WTM
(+KA5KTF) 329 2 34 1,544 STX
NB6GC
(+W6POC) 263 2 12 1,518 EB
Billerica ARS
W1HH 355 2 18 1,518 EMA
Hamilton ARC
W8AJT 382 2 18 1,514 OH
Washington Area ARC
W0ARC
(+AB0DX) 293 2 21 1,508 IA
London Bridge ARA
K7LHC 349 2 9 1,498 AZ
K4GNV 333 2 48 1,492 NFL
Coal Country ARC
WV8CCC 321 2 6 1,492 WV
Colquitt Cty Ham Radio Soc
AA4P 200 2 34 1,490 GA
Stillwater ARA
W0JH 226 2 30 1,484 MN
Rappahannock ARA
W4NNK 345 2 13 1,466 VA
York Pirates
NN9L/8 538 2 8 1,460 MI
W8BNZ 555 2 12 1,452 MI
Coastline ARA
N1EG 352 2 50 1,448 CT
Yellowhead ARA
VE6YAC 386 2 7 1,410 AB
Low Country CC
NA4U 296 2 5 1,400 NC
Riverside Cty ARA
W6TJ 264 2 39 1,378 ORG
South AL RC
WC4M 194 2 7 1,376 AL
Yellowstone RC
W7A
(+WN7Y) 450 1 60 1,366 MT
Cleveland Cty ARS
NA4CC
(+KK4SMV) 201 2 11 1,352 NC
Manotick AR Group
VE3AIR
(+VA3ZUO) 241 2 4 1,352 ONE
Huron ARA, INC.
W0NOZ 449 2 9 1,348 SD
W9FEZ 317 2 8 1,330 IN
Highline ARC
NC7G
(+WA7ST) 276 2 15 1,330 WWA
Saskatoon ARC Inc.
VE5AA 232 2 16 1,328 SK
Marion Cty ARS
WA9MC 224 2 11 1,308 IN
South Halton ARES
VE3OKV 176 2 8 1,294 GTA
3 Rivers Am Transmitting Soc
NC4Q 270 2 14 1,290 TN
Trident ARC
N4EE 260 2 11 1,286 SC
Southern KY Am Transmitting Soc
KY4AR 245 2 11 1,260 KY
Playground ARC
W4ZBB 234 2 14 1,250 NFL
ROARS
KK6IL
(+KF6AUP) 150 2 45 1,250 SDG
Auxiliary Com Service
K6RCR
(+KA6D) 169 2 17 1,248 ORG
Lake of the Ozarks ARC
N0ZS 287 2 20 1,242 MO
NE WA ARC / Panoramaland ARC
W7GHJ 172 2 25 1,234 EWA
Clarksville Am Transmitting Soc
KF4L 240 2 30 1,220 TN

North Franklin ARS
N2NNY 207 2 21 1,214 NNY
Saint Cloud ARC
W0SV 220 2 21 1,206 MN
Victoria Haliburton ARA
VA3LNZ 400 2 10 1,200 ONE
Callaway ARL
KS0B 280 2 13 1,192 MO
GARC ARC
W8STZ 261 2 17 1,186 OH
Tri-States ARC
W4GTA 177 2 5 1,174 GA
Sunnyvale ARES
K6SNY 116 2 52 1,172 SCV
Sturdy Memorial Hospital ARC
W1SMH 208 2 17 1,166 EMA
KS Antenna Club – Johnson Cty
K0ANT
(+KD0DWV) 219 2 15 1,154 KS
OARS
KD8SQ 400 2 8 1,150 OH
W8MLS
(+KD8WSP) 342 2 5 1,146 WV
HACDCARC
W3HAC 116 2 23 1,138 MDC
Gulf Coast ARC
WA4GDN 184 2 36 1,138 WCF
NT9E 199 2 50 1,130 IL
Westside ARC
W5ABD 130 2 9 1,110 LA
ARC at UCF
K4UCF
(+KG4YDW) 156 2 12 1,104 NFL
Arkansas Radio Emerg Services/Central Arkansas VHF
N5AT
(+NX5MK) 102 2 32 1,104 AR
Edison AR Network
W6SCE 208 2 4 1,100 LAX
Siouxland ARA
K0TFT 204 2 24 1,064 IA
KL7AIR 97 2 5 1,044 AK
Apple City ARC
W7TD 176 2 26 1,042 EWA
Phillips Cty ARC
W0ZXN 316 2 9 1,032 KS
BSA Venturing Crew 80
W3BSA 267 2 7 1,024 VA
LaPorte Cty ARC
W9LY 181 2 23 1,020 IN
Crescenta Valley RC and GEARS
AD6IZ 185 2 16 1,020 LAX
Stockton-Delta ARC
W6SF
(+W6INP) 258 2 14 1,018 SJV
Metuchen RC
K2YNT 262 2 9 1,006 NNJ
Ogden ARC
W7SU 274 2 45 1,006 UT
Utica ARC
K2IQ 119 2 10 998 WNY
Kauai ARC
KH6E 141 1 12 991 PAC
NorthEast WY ARA
NE7WY
(+WY7CAM) 214 2 17 986 WY
Valley Center ARC
N0V 260 2 25 986 KS
Nanaimo ARA
VE7NA 145 2 20 986 BC
Portland Internet Radio Group
N7PIR 309 2 7 982 OR
Hamilton Cty ARES Club
N9EOC 55 2 15 980 IN
Greenwood ARC
VE1ARC 228 2 18 976 MAR
Monroe ARC
WZ4V
(+W4YJ) 121 2 32 970 TN
Great River ARC
W0DBQ 149 2 12 968 IA
Wexaukee ARC
K8CAD 170 2 15 960 MI
Coronado Em Radio Ops
W6MLI 99 2 71 948 SDG
Eatonville RC
W7EAT 127 2 4 944 WWA
K9HD 228 2 11 924 IN
W Rockingham Cty ARES
K1WRK 37 2 7 924 NH
Owen Cty ARA
K9QZX 36 2 6 922 IN
Piedmont ARES
K4PAR 82 2 12 916 GA
San Gabriel Valley RC
W6QFK 83 2 19 916 LAX
Independent RC
WA6IRC 231 2 25 912 ORG
Palestine/Anderson Cty ARC
K5PAL 152 2 15 904 NTX
Stanly Cty ARC
K4OGB 55 2 22 900 NC
MARS
NC4MC 173 2 9 896 NC
STARS ARC
W9SRC
(+AB9JW) 103 2 19 896 IL
W0YFZ
(+AE0AL) 167 2 15 890 MN
Sky Valley ARC
W7SKY 41 2 9 886 WWA
Mayerthorpe Flying Tigers
VE6FT 325 1 14 883 AB
Manhattan Area ARS
K5OMAN 189 2 3 878 KS
Westminster RACES
AF6II 47 2 8 878 ORG
Eastern MI ARC
K8EPV
(+W8GWS) 213 2 16 874 MI
Northwest Ohio ARC
W8EQ 188 2 8 874 OH
NW ARS
W5NC
(+KF5LMJ) 97 2 58 864 STX
Huntington Cty ARS
K9HC 172 2 13 844 IN
Red Oak Soc
K2OAK 216 2 7 826 NNJ
Hog Camp Gap Pirates
W4QQI 159 2 3 826 VA
KB0VAC 181 2 10 812 KS
Ouachita ARA
W5HUM 123 2 21 796 AR
Freeborn Cty Hams
NX0P 249 2 6 796 MN
Laguna Beach EmCom Team
N6L
(+WO1S) 50 2 50 790 ORG
Woodford Cty ARC
KY4WC 119 2 25 788 KY
Starke Cty ARC
W9JOZ 16 2 17 786 IN
K0PL 260 2 4 770 MO
WD4NHW 125 2 3 770 GA
W4POX 197 2 20 764 VA
Citrus Cty CERT
K4RLK 104 2 15 758 NFL
Valley ARA
W1VAR 194 2 7 758 CT
Humboldt Cty ARES
W7TKO 253 2 3 756 NV
CRAHM
VA2HMC 245 2 8 740 QC
Mid Island Radio Assoc
VE7MIR 74 2 18 730 BC
Hood Cty ARC
W5HCT
(+KC9EHQ) 67 2 32 724 NTX
Kent Cty ARC
KC3ARC
(+WB3JUV) 135 2 14 714 DE
Scott Cty ARES
N0BHC 68 2 5 712 MN
Eastern NM ARC
KA5B 169 2 15 708 NM
Ozark ARC
K5BAX 96 2 15 704 AR
Radops of El Jebel Shrine
K0FEZ 97 2 7 684 CO
University ARC
N7UW 65 2 28 680 WY
Cold Lake ARS
VE6YOD 50 2 12 670 AB
Sierra Intermountain Emergency RA
NV7CV 82 2 12 666 NV
Atchison Cty AR Serv
K0HK 81 2 15 662 KS
Spalding Co ARC
K4CXS 45 2 8 640 GA
Capital City ARC
W7TCK 86 2 20 622 MT
Pearland ARC
K5PLD 73 2 11 614 STX
WA2SVM 31 2 5 612 NNJ
Rich & Ron's Field Day
KJ6HRO 194 2 3 588 SV
West Cty ARA
KB3PSL
(+WB3CNJ) 12 2 4 582 WPA
Huber Heights ARC
NO8I 11 2 11 582 OH
Renton Em Com Service
K7FDF 47 2 13 570 WWA
Digital Connections ARC
N0W 108 2 3 566 MO
World Wide ARG
KF7CIA 157 2 8 564 WWA
Mohawk Valley ARA
KC2AUO 125 2 5 560 NNY
Thunderbolt AR Assn
KJ0T 26 2 10 522 CO
Monterey Bay ARA
N6IJ 53 2 3 512 SCV
Federal Way ARC
WA7FW
(+WA7DR) 61 2 13 472 WWA
W2ZQ 4 2 14 458 SNJ
Em Radio Response Team
K6S 4 2 4 458 SF
Becar Family Hams
KI6OSS 75 2 6 450 ORG
Big Horn Basin ARC
KI7W 80 2 9 450 WY
Glendora Em Radio Com
AG6VH 34 2 4 432 LAX
Calgary ARA / Calgry Reginal ARES
VE6NQ 36 2 22 422 AB
Houston Cty ARC
WA5EC 79 2 4 408 STX
ARS of South Jersey
KD2GCW 102 2 4 404 SNJ
Disaster Response Com RC
N1DRC 76 2 26 402 MN
OSU RC
W8LT 17 2 5 384 OH
Carolina ARES
WX4SC 11 2 5 322 SC
Aerospace Employees Assn ARC
W6AGO 30 2 5 310 LAX
Rossmoor ARC
KK6MRL 5 2 3 310 EB
KJ6ANT 28 2 6 306 SV
Poor Busters
N0ADF 23 2 3 304 SFL
N4GM 66 2 10 286 NC
NQ6R 104 2 4 258 SJV

3A

Rochester DX Assn
W2RDX
(+W2AN) 4068 2 30 14,340 WNY
North Shore RC
K9OR
(+K9RST) 3552 2 130 13,112 IL
PVRC
N4C 4000 2 8 12,912 NC
North Shore Radio Assn
NS1RA
(+KB1PAL) 3453 2 40 12,338 EMA
North Fulton ARL
K4JJ
(+NF4GA) 3585 2 256 12,300 GA
Albuquerque DX Assn
W5UR 3892 2 14 11,536 NM
Stamford ARA
W1EE
(+K1FC) 3750 2 63 11,334 CT
W0BM
(+W0MXW) 2602 2 30 10,020 MN
Port City ARC
K1R 3345 2 25 9,964 NH
Great Southern DX Assoc
K5GDX 2753 2 16 9,542 MS
San Lorenzo Valley ARC
K6MMM
(+N6OTA) 2078 2 82 8,504 SCV
Greater Norwalk AR Corp
N1EV
(+W1NLK) 2410 2 35 8,306 CT
Suncoast ARS / Sarasota Cty ACS
WC4EM 2371 2 14 7,890 WCF
ARVARF
K5PXP
(+KG5ABC) 2021 2 28 7,726 AR
Mississippi Valley ARA
W9MVA
(+W9FCC) 2109 2 16 7,594 WI
QST Society
K2QS
(+WK2T) 1578 2 19 7,096 ENY
Albany ARA
K2CT
(+KC1NN) 2054 2 50 7,016 ENY
Bishop ARC
N6CV
(+W6TD) 1729 2 27 6,778 ORG
Edmond ARS
K5EOK
(+AE5RP) 1676 2 69 6,716 OK
Montgomery ARC
W4AP
(+K4PO) 1591 2 53 6,668 AL
South Orange ARA
K6SOA
(+K6WO) 1806 2 141 6,614 ORG
Barnstable ARC
K1UI
(+K1PBO) 1844 2 31 6,564 EMA
Ski Country ARC
K0RV
(+KQ0C) 1669 2 54 6,456 CO
San Andreas Faultline Survivors
W6SW
(+K6F) 2076 2 11 6,400 SJV
PART of Westford MA
W1IS 1670 2 40 6,212 EMA
K3YTL
(+W3MTP) 1671 2 27 6,188 EPA
Baton Rouge ARC
W5GIX
(+K5LSU) 1548 2 45 6,176 LA
Oh-Ky-In ARS
K8SCH
(+W1SCR) 1720 2 30 6,082 OH
Jefferson Cty ARC
W7JCR 1294 2 19 6,058 WWA
Dial Radio Club
K8PI
(+W8BLV) 1696 2 35 6,046 OH
W4VIY 1301 2 12 5,754 NFL
Sterling Park ARC
K4NVA
(+NQ4K) 1447 2 20 5,712 VA
Paducah ARA
W4NJA
(+KK4RGM) 1375 2 25 5,698 KY
West TN MARS
W4ODR 1884 2 10 5,616 TN
Colorado ARES – Douglas & Elbert Cty
WA0DE
(+W0RDR) 1442 2 41 5,564 CO
Kaw Valley ARC
W0CET 1469 2 30 5,520 KS
Hughes Aircraft ARC
W6HA
(+WB6MMQ) 1939 2 34 5,368 LAX
Jefferson ARC
W5GAD 1199 2 24 5,204 LA
Utah ARC
W7SP
(+K7LO) 1745 2 87 5,166 UT
St Charles ARC
KC0A
(+WB0HSI) 1346 2 120 5,100 MO
DE Lehigh ARC
W3OK
(+NT3P) 1349 2 43 5,044 EPA
CRES ARC
W8ZPF 1257 2 38 5,044 OH
Bristol ARC
W4UD 1200 2 56 5,016 TN
Central IL RC
W9EX 1445 2 32 4,988 IL
Wireless Soc of Southern ME
WS1SM
(+KB1YYC) 1052 2 33 4,910 ME
Reelfoot ARC
K4RFT
(+N4MJ) 907 2 15 4,814 TN
Manitoba ARC
VE4BB
(+VE4VZ) 1049 2 73 4,798 MB
Alliance ARC
W8LKY
(+KB8VVL) 1282 2 24 4,690 OH
Fond Du Lac ARC
W9EBV 1267 2 37 4,668 WI
W6QET 1249 2 25 4,570 LAX
Alpha 3
W1PBR
(+NY1B) 840 2 15 4,508 ME
Foothills ARS
K6YA
(+N6DQ) 1283 2 25 4,468 SCV
Fluvanna ARES Group
W4XR 1304 2 12 4,420 VA
Utah DX Assoc
K7UM 1337 2 19 4,420 UT
Ashtabula Cty ARC
K8CY
(+KD8WJL) 1410 2 25 4,414 OH
Boeing Employees' ARS
W0MA
(+N0SO) 1338 2 20 4,410 MO
White MTN ARC
W1MWV 1097 2 25 4,408 NH
Chattanooga ARC
W4AM 1255 2 27 4,382 TN
Freescale ARS
W7FSL 1294 2 6 4,374 AZ
Cumberland Plateau ARC
WW4TN
(+NV1T) 879 2 57 4,348 TN
VE3SAR
(+VE3CGC) 915 2 22 4,342 ONS
McKinney ARC
W5MRC 1023 2 74 4,328 NTX
N4UH
(+W4EXU) 913 2 31 4,324 NC
Cuyahoga Falls ARC
W8VPV 1294 2 24 4,324 OH
Mecklenburg ARS
W4BFB
(+NC4DP) 1026 2 45 4,300 NC
BRARC
W4YK
(+NA4X) 940 2 47 4,274 NC
Boeing Employees ARS & Mercer Island Radio Ops
K7NWS
(+W7MIR) 857 2 44 4,232 WWA
Milford ARC
W8MRC
(+KD8OUT) 899 2 51 4,174 OH
Maui ARC
KH6RS 2438 1 20 4,172 PAC
Roanoke Valley ARC
W4CA
(+AK4DV) 1002 2 16 4,088 VA
Central MI ARC
W8MAA
(+KD8ONC) 810 2 26 4,032 MI
Murray State Univ ARC
K4MSU
(+W4GX) 832 2 27 4,014 KY

BEARONS
W7FLY 970 2 10 3,990 WWA
Xerox ARC
W2XRX
(+KD2FET) 1062 2 21 3,930 WNY
K5TYR 1004 2 62 3,910 NTX
Albemarle ARC
W4DO
(+WA4TFZ) 931 2 18 3,838 VA
Mohawk ARC
N1WW 1027 2 30 3,834 WMA
Austin TX ARC
W5KA
(+K5LBJ) 759 2 54 3,834 STX
FORX ARC
N0GF 1026 2 19 3,824 ND
Saratoga Cty ARA
K2DLL
(+N2MBX) 956 2 25 3,808 ENY
Derangers
N6MI 2209 1 8 3,808 SCV
Rogue Valley ARC
W7DTA
(+K7TFC) 1167 2 19 3,786 OR
TriState ARS
W9OG
(+WA9C) 860 2 32 3,772 IN
Fox Cities ARC
W9ZL 917 2 48 3,762 WI
Fresno ARC
W6TO 862 2 20 3,744 SJV
Muscatine ARC
N2AM
(+KV1E) 1015 2 14 3,666 IA
Tri-Cty Field Day
W4C
(+KI4OAS) 771 2 20 3,624 TN
KM5PS 744 2 40 3,584 AR
Stonewall Jackson ARA
K8DF
(+K8TPH) 986 2 9 3,582 WV
Richmond Multi-Club Field Day Party
W4RAT 1079 2 50 3,578 VA
Clay Center ARC
W1CLA
(+WX1CLA) 1112 2 42 3,512 EMA
Boca Raton ARA
N4BRF 882 2 7 3,474 SFL
Lenoir ARC / Caldwell ARES
N4LNR
(+KF4FLY) 870 2 15 3,470 NC
Hambuds
KK5TRE
(+K5KTF) 769 2 34 3,454 STX
Yonkers ARC
W2YRC
(+KF2FK) 766 2 48 3,450 ENY
Rip Van Winkle ARS
WD2K
(+K2RVW) 691 2 20 3,396 ENY
Geezer Natomas ARC
N6FR 928 2 25 3,382 SV
L'anse Creuse ARC
N8LC
(+KC8WNK) 1026 2 15 3,372 MI
New River Valley ARC
N4NRV 791 2 21 3,370 VA
Bella Vista Rep Group
K0SNG
(+KD5UFY) 689 2 12 3,370 AR
NW FL ARC
KE4FD
(+N4HHM) 842 2 7 3,334 NFL
Royal Gorge ARC
NC0A
(+KB0TUC) 677 2 18 3,332 CO
JAWS
K4HH 677 2 15 3,244 KY
San Joaquin Valley ARS
W6V
(+W6TTF) 672 2 25 3,234 SJV
Jupiter Tequesta Rep Group
W4J 1025 2 45 3,228 SFL
Valley of the Moon ARC
W6AJF 641 2 10 3,218 SF
Downey ARC
W6TOI 1323 2 25 3,196 LAX
Not Quite Workable FD Group
AA8BV
(+WB8DC) 929 2 11 3,188 OH
Seneca RC
W8ID 614 2 22 3,186 OH
Boston ARC
W1BOS 658 2 23 3,138 EMA
Middle East TN Em Rad Serv
KC4EM
(+KJ4SVB) 553 2 46 3,134 TN
Hernando Cty ARA
K4BKV 488 2 11 3,128 NFL
Easton ARS
K3EMD
(+KC3DAL) 719 2 41 3,086 MDC
Parkersburg ARK
W8PAR 894 2 36 3,072 WV
High Sierra FD Group
N6OI 1094 2 7 2,982 SV
Birmingham ARC
W4CUE
(+KA4ZQA) 692 2 25 2,952 AL
Cape Ann ARA
W1GLO 591 2 65 2,928 EMA
Randolph Cty Em RC
K4RAN 863 2 10 2,926 AL
Kankakee Area Radio Soc
W9AZ
(+N9FD) 713 2 8 2,924 IL
Association Radioamateur de Portneuf
VE2CSP 568 2 18 2,906 QC
N8QA 812 2 20 2,876 OH
Southern VT ARC
K1SV
(+WT1B) 714 2 21 2,866 VT
Great Bay Rad Assn
W1FZ 535 2 17 2,858 NH
Bitterroot ARC
W7FTX
(+W7FTX) 566 2 20 2,848 MT
Okaw Valley ARC
KK9N
(+AD9RR) 613 2 42 2,838 IL
YARS /Yolo ARES / UCDARC
W6YAR 711 2 38 2,824 SV
Club Radioamateur de la valle du Richelieu
VE2CVR 632 2 21 2,816 QC
WC2FD 549 2 40 2,744 NNJ
Tri-Cty ARC
WX4TC 569 2 26 2,724 GA
Montachusett ARA
W1GZ
(+KB1YRS) 544 2 13 2,716 WMA
Macoupin Cty ARC
K9MCE
(+KC9ZMD) 548 2 7 2,690 IL
Oakland Radio Com Assn
WW6OR 774 2 70 2,680 EB
Cape May Cty ARC
N2CMC
(+W2CMC) 729 2 35 2,674 SNJ
Cowtown ARC
K5COW 522 2 51 2,674 NTX
VE3RL 550 2 21 2,648 ONE
Rolla Regional ARS
W0GS 435 2 39 2,642 MO
Santa Clarita ARC
W6JW 490 2 35 2,640 LAX
K5MW 522 2 51 2,574 NTX
VECTOR
VE7VCT
(+VA7VCT) 436 2 40 2,568 BC
Shelby ARC / ARES of Cleveland Cty
KM4C 630 2 18 2,536 NC
Michigan AR Alliance
W8USA 661 2 8 2,530 MI
Owensboro ARC
K4HY 637 2 21 2,530 KY
Boro of Barrington, NJ OEM
WA2WUN 647 2 41 2,494 SNJ
San Fernando Valley ARC
W6SD 523 2 30 2,470 LAX
Nashville ARCInc
K4CPO
(+WA4VGZ) 387 2 72 2,452 TN
Cuyahoga ARS
W8BM 687 2 14 2,450 OH
Overlook ARC
N2LL 729 2 13 2,422 ENY
Newton / McPherson ARC
N0NK 503 2 14 2,416 KS
Irving ARC
N5BB 445 2 20 2,410 NTX
Olympia ARS
NT7H 364 2 50 2,368 WWA
NE4GA 418 2 16 2,364 GA
Kennehoochee ARC
W4BTI
(+W4S) 429 2 68 2,350 GA
Coos Cty RC
K7CCH 421 2 30 2,342 OR
Blue Ridge ARS
W4NYK 517 2 27 2,336 SC
Lakeway ARC – JCARES
W2IQ 484 2 13 2,328 TN
Moore Cty ARS
NC4ML
(+N4BRD) 447 2 49 2,300 NC
Holmesburg ARC
K3FI 470 2 12 2,292 EPA
Wyandot Area Ham Ops Organization
KD8BNV
(+KD8FLT) 389 2 10 2,284 OH
W3CDI 533 2 8 2,256 MDC
Monessen ARC
W3CSL 534 2 23 2,244 WPA
HamVaders
AG9D 607 2 10 2,236 WI
North Port ARC
W4NPT 416 2 15 2,220 WCF
Palouse Hills ARC
KD7PH
(+W7YH) 343 2 26 2,204 ID
Calhoun Cty ARA
WB4GNA 518 2 33 2,198 AL
W6VVR 641 2 27 2,192 EB
Island Cty ARC
W7AVM
(+N7AXJ) 469 2 42 2,184 WWA
Red Daemon Contest Team
N5T 746 2 4 2,156 STX
Ramapo Mtn ARC
WA2SNA 637 2 7 2,132 NNJ
Regina ARA
VE5NN 444 2 20 2,126 SK
San Francisco RC
W6PW 760 2 10 2,096 SF
Hurst ARC
W5HRC
(+N5LNX) 380 2 29 2,092 NTX
CBRA-SLRC
K3CF
(+KB3ZIJ) 405 2 41 2,090 MDC
Central OR Coast ARC
W7L
(+W7FLO) 294 2 50 2,090 OR
Chicago Suburban RA
N9BAT 466 2 23 2,084 IL
Delta ARC / Mid-South ARA / Tri-State
Repeater Assoc
W4BS 372 2 110 2,082 TN
Chesapeake AR Serv
W4CAR
(+K4AMG) 661 2 25 2,054 VA
Gaston Cty ARS
N4GAS 331 2 35 2,052 NC
Butler Cty ARA
W8WRK 412 2 35 2,038 OH
Reading RC
W3BN 391 2 33 2,036 EPA
Jupiter Lighthouse Radio Group
W4L 427 2 15 2,024 SFL
W2AMC 458 2 29 2,020 NLI
Harrisburg Radio Am Club
W3UU 504 2 21 2,018 EPA
W0PIR 395 2 8 2,016 SD
W5KS
(+KO5OK) 181 2 41 1,984 OK
Delaware Valley ARA
KC3AM 559 2 15 1,962 DE
Federacion de Radioaficionados de PR
KP4FRA 471 2 10 1,954 PR
San Angelo ARC
W5QX
(+KC5NPC) 294 2 51 1,946 WTX
West AL ARC
KC4UG 498 2 15 1,946 AL
Scranton-Pocono AR Klub
K3CSG 298 2 50 1,946 EPA
North West Illinois ARC
W9F
(+N9WN) 391 2 21 1,930 IL
Unallocated Space
W3UAS 510 2 10 1,926 MDC
Rio Hondo ARC
W6GNS
(+KX6D) 470 2 12 1,916 LAX
Arlington ARC
K5SLD
(+N5ACK) 260 2 81 1,914 NTX
Grande Ronde Radio Am
W7GRA 474 2 5 1,894 OR
Ellijay ARS
KK4AFG 406 2 11 1,890 GA
VE9ND 272 2 20 1,868 MAR
Bedford ARC
K5BED 353 2 25 1,854 NTX
N3IS
(+W3PRK) 310 2 9 1,852 EPA
Cherokee Cty ARES
W4TEB 364 2 13 1,840 NC
Midwest ARS
W9MAR 347 2 10 1,808 IN
Fallbrook ARC
N6FQ 540 2 52 1,794 SDG
Jefferson Cty ARC
W7PT 301 2 17 1,788 WWA
Emporia ARS
KB0SSR 301 2 39 1,772 KS
Dubois Cty ARG
N9NAU 312 2 26 1,766 IN
Kishwaukee ARC
WA9CJN 595 2 11 1,760 IL
Aeronautical Center ARC
W5PAA 395 2 15 1,736 OK
Mt Magazine ARC
W5MAG 403 2 10 1,734 AR
Lake Erie ARA
WB8CQR 266 2 24 1,730 OH
Springhill Amateur Club
N5II 561 2 10 1,728 LA
Coachella Valley ARC
NR6P 320 2 28 1,714 ORG
Cumberland Valley ARC
W3ACH 344 2 28 1,696 WPA
Longmont ARC
W0ENO 477 2 15 1,680 CO
3 Rivers ARC
KK3ARC
(+KF7YKM) 257 2 37 1,664 ID

San Fraser, W6RRR, making contacts at the San Lorenzo Valley ARC GOTA station. San is one of the few operators who is eligible to operate the GOTA station and qualified to coach it! [Bob Wolbert, K6XX, photo]

Lowell ARC
W8LRC
(+WX8GRN) 575 2 15 1,660 MI
Greater Wichita Area FD
WoN 292 2 34 1,650 KS
Four States ARC
KD5RCA 350 2 32 1,636 NTX
Joplin ARC
WOIN 379 2 12 1,628 MO
Southern Berkshire ARC
W1BAA
(+K1LEE) 244 2 24 1,612 ENY
Hall of Science ARC
WB2JSM 353 2 31 1,592 NLI
W4KBL 208 2 12 1,588 KY
Peace River RA
W4DUX
(+WB2YKY) 303 2 10 1,586 WCF
Orange Cty RACES
W6ACS 443 2 18 1,580 ORG
Elko ARC
W7V 280 2 10 1,580 NV
Convair 220 Club
W6UUS 193 2 47 1,578 SDG
Brownwood ARC
K5BWD
(+KE5UDM) 132 2 16 1,572 NTX
Christian Cty ARES
WA6JGM 351 2 3 1,572 MO
The East Pasco ARS
K4EX 273 2 30 1,554 WCF
Westmoreland ARC
NN4VA
(+W4GMF) 269 2 12 1,536 VA
West River RC
WR1VT 371 2 15 1,534 VT
Genesis ARS
N1ZIZ
(+KB1EVY) 168 2 30 1,520 EMA
Thousand Islands Rep Club
KD2CPX 354 2 26 1,518 NNY
Lee de Forest ARC
KK6JUV
(+WA6SUD) 100 2 42 1,510 ORG
Mt Diablo ARC
W6CX 177 2 50 1,504 EB
St. Marys Cty ARA
K3NHK 433 2 15 1,500 MDC
Moreno Valley ARA
AB6MV
(+KK6IGU) 405 2 13 1,500 ORG
Hiawatha ARC
KD0NEB
(+KD0BR) 224 2 48 1,498 IA
The Green Bay Mike & Key Club
K9EAM 153 2 15 1,454 WI
Peoria Area ARC
K9S
(+W9PIA) 155 2 26 1,440 IL
Will Cty ARES
W9W 317 2 5 1,436 IL
Orange ARC
W5ND 337 2 13 1,434 STX
Clark Cty ARC
W9WWI 287 2 58 1,398 IN
Lake Area AR Klub
K5LRK 272 2 22 1,396 NTX
KA3PMW 506 2 5 1,382 WPA
Lake Oswego ARES
WA7LO
(+WA7LO) 234 2 11 1,378 OR
Aroostook ARA
K1FS 249 2 31 1,350 ME
Musselshell ARC
KF7ELT 244 2 5 1,336 MT

Rose Tech RC
W9NAA 412 2 20 1,332 IN
Redmond ARES
K7REM 220 2 20 1,330 WWA
Shoreline ACS
W7AUX 269 2 12 1,316 WWA
N4NPS 202 2 26 1,306 VA
TCARA/ARES FD Group
KC8CNN 348 2 9 1,296 MI
Charles Cty ARC
K3SMD 155 2 19 1,296 MDC
Hopkins Cty ARC / Rains ARA
K5SST 178 2 22 1,286 NTX
Lockport ARA
W2RUI 219 2 30 1,284 WNY
Road Show ARC
WA4TRS
(+NU4U) 142 2 20 1,276 NC
Georgian Bay ARC
VE3OSR 178 2 18 1,260 ONS
Rome RC
W2OFQ 402 2 7 1,254 WNY
Dixie ARC
W7DRC
(+N0UZ) 469 2 60 1,230 UT
Metropolitan ARC
K8NOW 246 2 5 1,214 MI
WX4ET 243 2 3 1,214 TN
Wood Cty ARES
W9DQA 197 2 11 1,210 WI
Santa Fe Trails ARC
KS0KS
(+KU0RTZ) 208 2 10 1,190 KS
Benton Cty Radio Ops
WX5BC 140 2 15 1,180 AR
Pioneer AR Fellowship
W8CTT 227 2 6 1,152 OH
Thunder Bay ARC
K8PA 202 2 20 1,150 MI
West Santa Barb ARA Cty ARES
W9EC 244 2 15 1,138 SB
Nortown ARC
VE3NAR 342 2 7 1,124 ONS
SEMO ARC
W0QMF
(+W0QMF) 183 2 17 1,116 MO
Chelsea ARC
WD8IEL 88 2 12 1,108 MI
AA0NC
(+KL7QW) 101 2 10 1,092 MO
W3YXE 107 2 24 1,078 WPA
Hocking Valley ARC
K8LGN 207 2 15 1,064 OH
Chisolm Trail ARC
WD5IYF 96 2 24 1,042 OK
Ozark Mtn ARC
N0NTC
(+KE0ARL) 72 2 17 1,038 MO
Yarmouth ARC
VE1GX 268 2 15 1,028 MAR
Madison-Oneida ARC
W2MO 120 2 10 1,006 WNY
Mile High RC
KD6OI 38 2 20 1,002 ORG
Shore Points ARC
K2BAW2HRW 137 2 25 990 SNJ
Atlanta IBM ARC
W4IBM 300 2 8 990 GA
Acton-Agua Dulce ARC
KK6MTQ 68 2 31 986 PAC
Murray Cty ARC
KD0MC 168 2 4 986 MN
Charter Oak Radio Soc
N1CRS 159 2 12 976 CT
Bluegrass ARS
K4KJQ
(+KE6IVK) 207 2 53 976 KY
Clay Cty ARC
W0TE 237 2 10 958 MO
Ankeny Centennial High School ARC
AC0HS 93 2 11 956 IA
VE5MA 124 2 9 946 SK
Sacramento ARC
W6AK 236 2 8 942 SV
Victoria ARC / Coloto Creek ARC
W5DSC 85 2 13 920 STX
Mystic Valley ARG
N1MV 29 2 30 908 EMA
Bayfield Area Radio Ops
VE3CV 193 2 5 902 ONS
Club RadioAmateur VE2CWQ
VE2CWQ 272 2 13 894 QC
Worldwide ARC
WE1SPN 358 2 10 888 CT
Waukesha Cty ARES/RACES
W9AUK 67 2 6 814 WI
West Central Ohio ARA
WC8OH 82 2 17 814 OH
Mendocino Cty AR Com Service
NC6MC 160 2 19 804 SF
Golden Empire ARS
W6RHC 106 2 26 802 SV
Walton Cty Em RC
WE4RC
(+K4LAM) 227 1 22 797 GA
Henderson Cty RC
W4KVK 38 2 9 780 KY
AR Caravan Club
W5GSY 16 2 44 766 NM
Sequoia AR Group
N6KRV 56 2 5 762 SJV
Ellington CERT Team
K1ECT
(+W1HEN) 89 2 8 760 CT
Kansas-Nebraska RC
K0KSN 54 2 12 760 KS
Elliot Lake ARC
VA3TOP 29 2 10 758 ONN
Northern Lakes ARC
K0GPZ 177 2 23 754 MN
Indy Midtown ARC
NE9T
(+NE9T) 125 2 10 736 IN
AmateurLogic.TV
W5JDX 131 2 3 726 MS
Northeast Iowa Radio Amateur Assn
W0MG 68 2 12 724 IA
W8WSL 131 2 3 712 WV
VE8AU 119 2 6 690 NWT
SE WI FM Am Rep Soc
K9BIZ 148 2 8 688 WI
NEMO ARC
W0CBL 51 2 8 652 MO
North Georgia Tri State ARC
W4NGT 131 2 15 588 GA
Pioneer Radio Operators
K2PRO 33 2 6 566 WNY
Ozone ARC
W5SLA 88 2 28 546 LA
DCT ARC
WA5DCT 35 2 7 450 NTX

4A

Huntsville ARC
K4BFT
(+N7KDT) 4928 2 75 16,370 AL
Palo Alto ARA
W6ARA
(+K6OTA) 4648 2 112 15,716 SCV
DE ARA
K8ES
(+W8JK) 4086 2 101 14,456 OH
Vienna Wireless Soc
K4XY
(+K4HTA) 3191 2 106 10,954 VA
Portage Cty AR Serv
K8BF
(+WB8LCD) 3147 2 115 9,520 OH
Lighthouse AR Alliance
K4LM 2753 2 20 9,374 SFL
K2VN 2470 2 36 8,952 NLI
Palom AR ARC
W6NWG
(+WD6FWE) 2296 2 250 8,946 SDG
Lake Monroe ARS
N4EH
(+KK4RYN) 2646 2 81 8,742 NFL
Old Barney ARC
N2OB
(+N2CW) 2414 2 65 8,670 SNJ
Bill Gremillion Mem RC
K4NRC 2397 2 60 8,630 GA
LARC-FARL
K8UNS 2714 2 47 8,440 MI
Ozaukee RC
W9LO
(+AA9W) 2510 2 35 8,284 WI
VBARC and VADXCC
W4UG 1982 2 45 7,724 VA
Peel ARC
VE3XR
(+VE3AZA) 1857 2 35 7,348 GTA
Westchester Em Com Assn
N2SF
(+KC2ZSL) 1634 2 25 6,968 ENY
Franklin Cty ARC
W4FGR 1506 2 9 6,864 VA
Johnson Cty Radio Am Club
W0ERH
(+W0AR) 1738 2 55 6,792 KS
Saint Petersburg ARC
W4TA
(+W4GAC) 1596 2 40 6,324 WCF
W4OLB 1848 2 33 6,292 TN
Columbus ARC
W4CVY 1459 2 35 6,130 GA
Southern PA ARC
K3IR
(+KN3A) 1237 2 12 5,816 EPA
Eastern Connecticut ARA
KZ1M
(+K1MUJ) 1417 2 30 5,774 CT
Des Moines Radio Amateurs Assn
W0AK 1300 2 41 5,742 IA
Mt Vernon ARC
K8EEN 1553 2 35 5,666 OH
OR Tualatin Valley ARC
W7OTV 1349 2 80 5,564 OR
Kitsap Cty ARC
KC7Z
(+KX7DX) 1652 2 39 5,546 WWA
Contoocook Valley RC
K1BKE
(+K1DFQ) 1957 2 32 5,474 NH
WK7B 1323 2 20 5,472 AZ
Lincoln ARC
K0KKV
(+KC0WWR) 1477 2 65 5,364 NE
ALL ARC
W7PU 1138 2 8 5,252 WWA
Northern Berkshire ARC
N1WM
(+KB1DMR) 1259 2 30 5,152 WMA
Kanawha ARC
W8GK 1274 2 30 4,832 WV
Green Mtn Wireless Soc
N1VT
(+WA1VT) 1354 2 20 4,824 VT
Medina 2 Meter Group
W8HN
(+W8EOC) 1274 2 19 4,760 OH
North Augusta-Belvedere RC
K4NAB
(+KK4AMJ) 1230 2 34 4,754 SC
Garrett Cty ARES
K3EE 1256 2 21 4,642 MDC
Peterborough ARC
VE3RB
(+VE3KRG) 1189 2 25 4,616 ONE
Lakeland ARC
K4LKL
(+K1DU) 1098 2 64 4,608 WCF
Cambridge ARA
W8VP 959 2 29 4,606 OH
Hamfesters RC
W9AA
(+K9MS) 936 2 52 4,504 IL
Hamilton ARC
VE3DC 1360 2 97 4,460 ONS
Lake Area Radio Klub
W0WTN 883 2 30 4,250 SD
Orange Park ARC
K4BT 1020 2 46 4,168 NFL
Clark Cty ARC
W7AIA
(+K7JAQ) 1061 2 200 4,050 WWA
Phil-Mont Mobile RC
W3EM
(+W3PSH) 1045 2 40 4,000 EPA
Granite State ARA
N1QC
(+KB1NH) 1034 2 28 3,976 NH
Peninsula ARC
W4MT 1185 2 67 3,848 VA
Sierra Foothills ARC
W6EK
(+K6UDA) 1003 2 40 3,826 SV
St Croix Valley ARC
WW1E
(+K1BSA) 707 2 25 3,756 ME
Alford Memorial RC
W4BOC
(+KM4BHK) 724 2 89 3,692 GA
Skyline ARC
K2IWR 1275 2 26 3,652 WNY
Southern PA Com Group
K3AE 961 2 40 3,608 EPA
Western Tidewater Radio Assoc
WT4RA 1171 2 11 3,562 VA
Carroll Cty ARC
K3PZN 790 2 15 3,550 MDC
Twin City ARC
K9CU 825 2 20 3,458 IL
Snohomish Cty Hams Club
WA7LAW
(+N7PKK) 610 2 92 3,434 WWA
AERO ARC
W3PGA 813 2 19 3,420 MDC
Columbia-Montour ARC
WC3A
(+K3BD) 636 2 15 3,394 EPA
InterCity ARC
W8WE 813 2 7 3,364 OH
Radio Amateurs of Greater Syracuse
W2AE 632 2 30 3,348 WNY
North Richland Hills ARC
K5NRH
(+W5HP) 773 2 48 3,298 NTX
Milwaukee RAC/MA ARS/Gateway Tech Coll
W9RH
(+N9GTC) 759 2 15 3,262 WI
Maryland Mobileers ARC
W3CU 628 2 39 3,200 MDC
Liverpool Am Rep Club
W2CM 759 2 25 3,162 WNY
Plano ARK
K5PRK
(+K5F) 613 2 30 3,162 NTX
W3M
(+KV3B) 650 2 45 3,140 MDC
South Bay ARA
KU6S
(+AE6YN) 1881 1 47 3,125 EB
K9BAR 708 2 32 3,076 IL
OK City Auto-Patch Assn
W5MEL
(+W5TJS) 702 2 23 3,074 OK
ID DX Assoc
NI7DX 661 2 30 3,062 ID
Antelope Valley ARC
K6OX
(+K6A) 613 2 74 3,062 LAX
World RC
W3WRC 759 2 6 3,020 SV
Central NY Contesters
KD2ETT 556 2 31 2,974 WNY
Tipp City AR Group
K8ZC 587 2 12 2,924 OH
Cleveland ARC
W4GZX 519 2 68 2,824 TN
K4WO 685 2 33 2,786 NC
Silvercreek ARA
W8WKY 656 2 10 2,722 OH
Dallas ARC
W5FC 567 2 100 2,702 NTX
North Ottawa ARC14
W8CSO
(+KC8UNY) 436 2 14 2,688 MI
Alexandria RC
W4HFH 763 2 30 2,662 VA
Plattsmouth ARC
KB0SMX 402 2 24 2,584 NE
RA of Erie
W3GV 852 2 23 2,512 WPA
Navarre CERT ARC
KC4ERT 452 2 15 2,504 NFL
Calvert ARA
K3CAL 558 2 18 2,502 MDC
North Shore ARC
VE3NSR
(+VE3QG) 505 2 25 2,500 GTA
Meeker Cty ARC
K0MCR 674 2 12 2,480 MN
W4DV 594 2 50 2,478 GA
Binghamton ARA
W2OW
(+K2ZRO) 440 2 54 2,426 WNY
Sun Country ARS
W4CW 469 2 19 2,378 NFL
Beaver Valley ARA
W3SGJ 758 2 20 2,366 WPA
Schenectady Museum ARA
W2IR
(+KD2GQV) 467 2 24 2,354 ENY
Middlesex ARS
W1EDH 409 2 12 2,292 CT
Brightleaf ARC
W4AMC 549 2 30 2,178 NC
Eastern AZ ARS
K7EAR 399 2 12 2,176 AZ
Radio Operators Assoc of Dallas
W7ORE 388 2 20 2,148 OR
Lincoln Cty Vol Com / Carolina ARC
NC4LC 299 2 57 2,126 NC
Middle Tennessee – MTARS-BARS-SMRC
K4T
(+KI4RQK) 298 2 60 2,118 TN
Borderline ARC
W7BAR 466 2 41 2,082 UT
KK4BQ 318 2 30 2,032 SC
Triangle ARC
K8BLP 419 2 10 1,994 OH
K4HJ 362 2 10 1,956 KY
W2CRA
(+KD2GRL) 265 2 24 1,946 NNJ
Kent Com Support Team
K7CST
(+N7MU) 332 2 24 1,942 WWA
Troy AR Assn
NY2U 383 2 31 1,922 ENY
San Gorgonio Pass RC
W6PRC 191 2 22 1,856 ORG
Delta Cty ARS
K8PL 410 2 20 1,846 MI
Hendricks Cty ARS
N9HC
(+N9CQ) 345 2 73 1,840 IN
King George AR Operators
K4GVA
(+KK4VR) 276 2 11 1,828 VA
Brush Prairie Hams
N7WO 606 2 25 1,796 WWA
Black River ARC
K8BRC 344 2 12 1,786 MI
Fulton Cty ARC
K9I 501 2 24 1,786 IL
Cherokee Capital ARS
K4WOC
(+AA4KX) 339 2 16 1,782 GA
Susquehanna Cty ARC
N3SRC 425 2 25 1,752 EPA
RAC of Knoxville
W4BBB 278 2 43 1,672 TN
Lincoln Cty ARC
N7OY
(+N7HT) 238 2 14 1,670 OR
DBARA/VARES
K4BV 245 2 35 1,630 NFL
Skyview ARS
WX3SKY 248 2 16 1,618 WPA
Honeywell-Glendale ARC
K7HON 387 2 20 1,612 AZ
Roane Cty ARC
KE4RX 300 2 25 1,602 TN
Meewasin ARS
VA5DR 209 2 20 1,582 SK
Northwoods AR Group
N0I 209 2 8 1,580 MN
Northern OH ARS
K8KRG 265 2 32 1,562 OH

Sierra ARC
K6P 242 2 12 1,536 ORG
Newark ARA
N8ARA 245 2 40 1,532 OH
Insurance City Rep Club
K1CRC 364 2 15 1,478 CT
Western Reserve ARC
W8WRC 173 2 60 1,424 OH
Orange Cty ARC
KB9OHY 218 2 11 1,386 IN
Five Flags ARA
W4UC 145 2 38 1,302 NFL
North Hills ARC
WV3E 155 2 24 1,294 WPA
Lancaster & Fairfield Cty ARC
K8QIK 200 2 19 1,260 OH
Lamorinda Area Rad Interest Group
K6ORI 187 2 19 1,224 EB
Alphalpha Rep Group
W4A 148 2 16 1,152 WCF
Maple Ridge ARC
VE7CMR 300 2 16 1,150 BC
K0SEK 113 2 13 1,134 KS
Isothermal ARC
K4F 260 2 15 1,128 NC
High Desert ARG
W7JVO
(+N7VME) 296 2 8 1,126 OR
DE Valley Ragchew Club
N2HQX 67 2 12 1,092 SNJ
Yadkin Valley ARC
KE4YVF 164 2 5 1,054 NC
Brookings Radio Rese ARC
W0BXO 233 2 15 1,016 SD
Pine Mtn ARC
W6P 171 2 35 992 SJV
Mercury Northwest
W7MNW
(+Y7YON) 35 2 30 982 WWA
Oak Forest ARC
KE5TRB 145 2 8 962 STX
Elk Grove Florin ARC
W6EGF 139 2 12 928 SV
Pioneer ARC
K0JFN 161 2 40 834 NE
Brantford ARC
VE3BA 166 2 6 832 ONS
220 Mhz Guys.
WM9W
(+KD8TUT) 142 2 20 754 IL
W0EMZ 40 2 8 630 MN
Allegan Co ARC
AC8RC 57 2 26 606 MI
Regional EmComm & Weather Assn
WW2FD 98 2 6 496 ENY

5A

Loudoun AR Group
K4LRG
(+N3FQ) 6002 2 63 19,028 VA
Andrew Johnson ARC
W4WC 2592 2 23 9,994 TN
Sussex Cty ARC
W2LV 2550 2 25 9,356 NNJ
WA Amateur Com
WA3COM
(+KC3HW) 1880 2 18 7,472 WPA
Rappahannock Valley ARC
K4TS
(+W4IM) 1860 2 25 7,442 VA
Central KY ARS
AJ4A 2177 2 18 7,264 KY
Bergen ARA
K2BAR
(+KD2GPT) 2219 2 56 7,218 NNJ
LIM ARC
W2VL
(+WV2LI) 2008 2 85 6,986 NLI
Fountain Valley Am Com team & West Coast ARC
WA6FV 2036 2 20 6,654 ORG
Lorain Co Wireless Operators
NW8S 1736 2 21 6,394 OH
Kilocycle ARC
W5SH 1441 2 20 6,144 NTX
Niagara Peninsula ARC, Inc.
VE3VM
(+VA3ROW) 1626 2 35 6,128 ONS
Cheshire Cty DX ARC
AD1T 1817 2 25 5,958 NH
Hazel Park ARC
W8HP
(+W8JXU) 1390 2 20 4,818 MI
York Region ARC
VE3YRA
(+VE3YRK) 1177 2 61 4,588 GTA
Marple Newtown ARC & Mobile Sixers RC
N3NZ
(+W3AWA) 1031 2 44 4,566 EPA
Lancaster ARC
W2SO 1163 2 25 4,508 WNY
Warminster ARC
K3DN 1404 2 35 4,478 EPA
Butler Cty AR Assn
W3UDX
(+AA3YW) 1027 2 5 4,446 WPA
Androscoggin ARC & Oxford Cty CERT
K1P
(+W1OCA) 952 2 40 4,286 ME
BCRC / SPR ARC
VE3OW 1399 2 25 4,204 ONS
Orange Cty ARC
W2HO 1055 2 88 4,152 ENY
LaGrange ARC
AB4KE
(+AD4GS) 863 2 40 4,146 GA
Wayne Cty ARA
W4HS
(+W4GOL) 794 2 49 4,112 NC
Iredell Cty ARS
W4SNC 1122 2 17 4,104 NC
Holland ARC
K8DAA 1001 2 25 4,028 MI
South Waterloo ARC
VE3SWA 920 2 5 3,998 ONS
Goshen ARC
N9HZ 820 2 9 3,996 IN
Sierra Nevada ARS
W7TA
(+KG7HBY) 809 2 13 3,952 NV
Clinton Cty ARA & Highland ARA
W8O
(+W8GO) 992 2 43 3,884 OH
W7SST 946 2 10 3,830 OR
Shenandoah Valley ARC
W4RKC 876 2 16 3,782 VA
Penn Wireless Assn
W3SK 945 2 22 3,582 EPA
Owatonna Steele Cty ARC
N0UW 820 2 47 3,564 MN
Chenango Valley ARA
W2RME
(+N2YP) 704 2 41 3,486 WNY
Tryon ARC
K2JJI
(+K2ALS) 586 2 20 3,428 NNY
Ft Myers ARC
W4LX
(+KM4CGS) 704 2 22 3,422 SFL
RF Hill ARC
W3AI 883 2 20 3,210 EPA
Saginaw Valley ARA
K8DAC 773 2 15 3,098 MI
Mohave ARC
K7MPR 604 2 20 2,874 AZ
Morongo Basin ARC
W6BA
(+K7RBD) 659 2 89 2,866 ORG
MGRA / CGARC
K4B
(+WR4MG) 738 2 60 2,860 GA
Genesee Cty RC
W8AGW
(+WA8MY) 593 2 19 2,688 MI
Garden City ARC
K8GC 537 2 48 2,664 MI
Broken Arrow ARC
W5DRZ
(+KG5AUN) 442 2 75 2,604 OK
River City AR Com Soc
N6NA 670 2 6 2,580 SV
Tishomingo Cty ARC
W5TCR 540 2 9 2,542 MS
SCICSG
W9SCI
(+W9SIR) 323 2 22 2,488 IN
Kokomo ARC
W9GO 665 2 24 2,486 IN
San Antonio RC
W5SC 407 2 34 2,480 STX
Haywood Cty ARC
KW4P 728 2 17 2,426 NC
Toronto ARC
VE3TNC
(+VE3BGD) 531 2 20 2,404 ONS
Toledo Mob Rad Assn
W8HHF 441 2 48 2,394 OH
Bridgerland ARC
W7IVM 429 2 55 2,354 UT
W9MKS
(+K9ZQ) 360 2 50 2,308 IL
W0TX
(+W0OIU) 434 2 41 2,282 CO
Red River Radio Amateurs
W0ILO 512 2 11 2,278 ND
Wood Cty Em Com
WC8EC 289 2 34 2,272 WV
Pilot Knob ARC
KS0LV 474 2 9 2,264 KS
Radio Amateurs Skagit Cty
N7GDE 442 2 22 2,164 WWA
Schenectady ARA
K2AE
(+N2WDL) 409 2 25 2,158 ENY
Midland ARC
W8KEA 358 2 25 2,148 MI
Citrus Belt ARC
W6JBT 388 2 25 2,068 ORG
San Diego Sixshooters ARC
KI6BJN 420 2 25 2,004 SDG
Indiana Cty ARC
W3BMD 550 2 16 1,976 WPA
South TX ARC
N5CRP
(+KF5NJQ) 258 2 38 1,940 STX
Winchester Pioneer ARC
AC4YD 519 2 20 1,938 KY
Western Carolina ARS
W4MOE
(+W4MOE) 257 2 21 1,836 NC
Briarpatch ARC
W4BRC 222 2 64 1,788 VA
Fannin Cty ARC
K5FRC 245 2 13 1,760 NTX
Bluefield East River ARC
W8MOP 289 2 12 1,744 VA
CORE Group
AA4TA
(+W4CHM) 425 2 8 1,728 TN
Norfolk ARC
VE3SME 309 2 15 1,694 ONS
Wilson ARC
WC4AR 270 2 25 1,664 TN
Riverland ARC
WR9ARC 139 2 22 1,568 WI
TCARES
K6TUO 290 2 20 1,552 SJV
Toothless Talkers
N8IVE 438 2 12 1,526 OH
Somerset Cty ARC
K3SMT 442 2 36 1,524 WPA
South East Metro ARC
W0CGM 380 2 8 1,522 MN
Jonestown Mtn Rep Assoc
N3CSE 311 2 16 1,516 EPA
San Juan Cty ARS
N7JN 152 2 33 1,434 WWA
Magic Valley ARC
K7MVA 351 2 17 1,414 ID
Huntington Beach RACES
W6O 94 2 15 1,342 ORG
Ottawa Valley Mobile Radio
VE3RAM
(+VA3CUA) 175 2 12 1,312 ONE
K7ECI 200 2 15 1,250 ID
Elk Cty ARA
N3NIA 200 2 12 1,150 WPA
St Joe Cty ARES/RACES
AD8W 99 2 9 572 MI

6A

South Jersey Radio Assn
K2AA
(+W2EA) 4304 2 48 13,572 SNJ
Hampden Cty RA
W1NY 3789 2 60 12,558 WMA
N4N
(+N4G) 3089 2 16 11,806 GA
Stanwood Camano ARC
W7PIG
(+K7UDG) 2546 2 89 9,310 WWA
Culpeper ARA
W4CUL
(+KC4QP) 2018 2 50 9,044 VA
Fox River Radio League
W9NE
(+W9CEQ) 2533 2 57 8,914 IL
Central MA ARA
W1BIM 1532 2 24 6,592 WMA
Ft Wayne RC
W9TE
(+KB9DOT) 1522 2 62 6,494 IN
Catalina RC
W7SA 1749 2 25 5,744 AZ
Du Page ARC
W9DUP
(+KD9AUM) 1244 2 60 5,454 IL
Bellbrook ARC
W8DGN 1015 2 69 4,858 OH
20/9 Radio Club
K8TKA 1090 2 45 4,756 OH
Pasadena RC
W6KA 1021 2 76 4,370 LAX
RASON
N1NW 875 2 24 4,110 CT
Fulton Cty ARC
K8BXQ
(+K8LI) 799 2 12 3,846 OH
Northern KY ARC
K4CO
(+KY4DH) 731 2 30 3,566 KY
Antietam Radio Assoc
W3CWC
(+W3HAG) 587 2 58 3,474 MDC
Assn Radio Am of Long Beach
W6RO
(+NA6XR) 803 2 85 3,386 LAX
Kalamazoo ARC
W8VY 893 2 30 3,384 MI
Copper Country RA Assoc & Keweenaw Cty Rep Assoc
W8CDZ 534 2 15 2,778 MI
Lodi ARC
N6SJV 488 2 25 2,398 SJV
Kern Cty Central Valley ARC
W6LIE 604 2 35 2,320 SJV
Western Placer ARC
K6PAC 457 2 37 2,288 SV
SARS
W6CO 517 2 18 2,258 EB
Ft. Venango Mike & Key Club
W3ZIC 456 2 6 2,124 WPA
Warrensburg Area ARC
W0AU 395 2 9 2,012 MO
Silver Springs RC
K4GSO
(+KK4JIV) 355 2 11 1,880 NFL
Enid ARC
W5HTK 196 2 10 1,274 OK
Radio Adventurers of ME
K1B 94 2 6 1,066 ME

7A

OCARC Orange Cty ARC
W6ZE
(+W6ETC) 5419 2 108 17,970 ORG
Lake ARA
K4FC
(+KT4Q) 5071 2 31 16,934 NFL
599 DX Assn
NA5NN
(+KZ5DX) 3605 2 39 13,090 MS
Lake Cty ARA
N8BC 2226 2 40 8,794 OH
Big Bear ARC
K6BB 1664 2 20 6,592 ORG
W6TRW ARA
W6TRW
(+KE6YEX) 2341 2 24 6,434 LAX
Calaveras ARS
N6FRG
(+NV6V) 805 2 15 4,132 SJV
Ak-Sar-Ben ARC
K0USA 1000 2 30 4,092 NE
AG6AU 1036 2 50 3,978 SV
Coastal ARS
W4HLS 1166 2 34 3,632 GA
Delta ARS
VE7SUN
(+VE7LEE) 570 2 40 3,230 BC
Kent ARS
K3ARS 416 2 10 2,890 MDC
Whitman ARC
W1AY 537 2 35 2,514 EMA
North Bay ARA
K6LI 367 2 20 2,404 EB
Crawford Cty ARC
W8BAE 580 2 14 2,162 OH
South Wake ARC
NE4DX
(+N4SWC) 336 2 50 2,038 NC
Kitchener Waterloo ARC
VE3IC 370 2 18 2,004 ONS

8A

Brazos Valley ARC
KK5W 3763 2 68 14,924 STX
Gwinnett ARS/ Gwinnett ARES
W4GR
(+K4YDB) 2982 2 119 10,570 GA
Mahoning Valley ARA
W8QLY
(+KD8NZF) 2167 2 59 8,072 OH
Nashua Area RC
N1FD 2109 2 30 7,930 NH
Raleigh ARS
W4DW
(+N4RAL) 2374 2 65 7,790 NC
Ft Smith ARC
W5ANR 1907 2 25 7,258 AR
Ventura Cty ARS / Simi Settlers ARC
N6R 1824 2 40 5,448 SB
Wabash Valley ARA
W9UUU
(+K9CAT) 953 2 25 4,474 IN
KB5TX 1037 2 35 4,468 STX
Sangamon Valley RC
W9DUA 403 2 10 2,202 IL
Peak Radio Assoc
W7PRA 469 2 20 2,114 OR

9A

W4B
(+W4SVI) 835 2 30 4,482 SFL
Forsyth ARC
W4NC
(+W4WS) 1069 2 43 4,408 NC
Ventura Cty ARC
K6MEP 716 2 17 3,100 SB
Barry Cty ARC
K8BMI 323 2 20 2,286 MI
Stanislaus ARA
W6ERE
(+K6JRO) 393 2 27 1,996 SJV

10A

Woodbridge Wireless
W4IY
(+W4PIO) 5274 2 35 18,224 VA
VE3MIS
(+VE3RCX) 2043 2 44 7,818 GTA
Anne Arundel RC
W3VPR 1152 2 114 5,540 MDC

HP Boise ARC / Voice of Idaho
AB7HP (+W7VOI) 557 2 30 3,262 ID
South Bay ARS
K6QM 420 2 30 2,626 SDG

12A

W2MMD (+KC2SJ) 2574 2 29 10,826 SNJ

16A

Conejo Valley ARC
AA6CV (+K6KY) 1292 2 102 6,216 SB

28A

W1AW/3 (+W3AO) 11233 2 80 36,730 MDC

1A Battery

CO QRP Club
W0CQC 1186 5 7 12,290 CO
Chew's Ridge Gang
K6MI 1051 5 8 11,400 SCV
Hunters Ridge Hams
NK9R 411 5 6 5,060 GA
Island Contesters
VE7QF 420 5 5 4,630 BC
New England QRP Group
K1DFT 410 5 5 4,395 ME
New England Radio Discussion Soc
K1A 297 5 16 3,270 ME
PA Knightlites
KA2QPG 265 5 9 2,805 WPA
Elk Neck Canoes
AC3V 280 5 6 2,625 MDC
Jacksonville Chiggers
AA5TB 209 5 6 2,365 NTX
Club Radio Amateur Sorel Tracy
VE2CBS 190 5 8 2,365 QC
Prairie Contesters
N0UD 201 5 3 2,260 ND
Wolf Creek Crazies
K7UT 236 5 3 2,190 UT
Hiawatha ARC
WA0W 197 5 10 1,945 KS
Los Chupacabraderos
K5AXW 150 5 6 1,755 STX
Cranes View Lodge ARC
N4CVL 91 5 6 1,705 NFL
Reno Cty ARA
W0WR 119 5 25 1,545 KS
Club Radio Amateur Maskoutains
VE2CAM 93 5 3 1,430 QC
N0SFF 168 5 9 1,280 IA
Northern Vermont QRP Soc
N1QS 159 5 6 1,045 VT
Tick Bite Trio
K4RET 131 5 3 980 VA
K2QR 38 5 4 830 WNY
Palo Cedro Ham Radio Club
N6VLH 55 5 3 725 SV
Yarmouth RC
W1YAR 50 5 5 700 ME
Marconi ARC of Newfoundland / Signal Hill Splinter Group
VO1MRC 6 5 11 510 NL
OMARC Lite
KC2SVS 18 5 4 390 NNJ

2A Battery

Explorers Radio Club
NA3DX (+K3NDM) 725 5 12 8,080 MDC
Wireless Assoc of South Hills
WA3SH 355 5 5 4,100 WPA
South Plainfield ARC
NJ2SP 373 5 11 4,080 NNJ
West Park Radiops
W8VM 362 5 25 3,630 OH
Central OH Operator Klub Extra – Novice
W8FD 328 5 19 3,480 OH
3 Old Guys
N0YJ 250 5 3 2,900 KS
Walton Radio Assoc
W2LZ 211 5 8 2,560 WNY
WB4AWM Memorial QRP Soc
W4DGH 219 5 35 2,530 AL
3 Y's Guys
W0UV 182 5 3 2,135 KS
East Greenbush ARA
W2EGB 525 2 17 1850 ENY
Boschveldt QRP Club
W3BQC 193 5 4 1,825 EPA
Ottawa Valley QRP Soc
VA3OVQ 89 5 3 1,555 ONE
Yellowknife ARS
VE8YK 70 5 5 1,430 NWT
Pearl River Cty Ameteur RC
W5PMS 86 5 20 1,180 MS
North TX Antenna Design Consortium
N5ANT 92 5 3 810 NTX
Shanley High School ARC
KD0TCP 89 5 4 785 MN
U of UT Amateur Radio
KB0LQJ (+W7YMG) 9 5 3 735 UT
Hat Creek Ham RC
K6SDX 6 5 3 680 SV

3A Battery

Club SOTA
W5YA 1555 5 8 15,775 NM
Reno QRP Group
W7FST 363 5 12 4,510 NV
Salem ARC
W7SAA (+W7SDP) 424 5 30 4,475 OR
Gateway ARC
K4GAR 157 5 125 2,165 GA
Scotty's Nevada Pine Nuts
N7QC 181 5 6 1,790 NV
Barstow ARC
WA6TST (+KC6IIH) 170 5 35 1,675 ORG
ARC of Alameda
K6QLF 59 5 15 1,310 EB
Lonesome Lark Radio
K5LLR 59 5 4 1,045 STX
N8B 40 5 3 1,015 OH

4A Battery

KnightLites QRP Assoc
WQ4RP 972 5 12 9,945 NC
Zuni Loop Mtn Expeditionary Force
K6Z 906 5 7 9,305 LAX
Colorado QRP Club
N0CQC 249 5 26 3,270 CO
Southern MI ARS
W8DF 377 5 59 2,975 MI
Portland ARC
W7LT 242 5 11 2,850 OR
Elgin ARS
VE3RSE 197 5 10 2,455 ONS
Houston QRP Club
W5MSQ 193 5 14 2,430 STX
St Louis QRP Soc
NF0R 95 5 12 2,095 MO
McMinnville ARC
W7G (+W7YAM) 120 5 75 1,945 OR
Snake River ARC
K7SI 107 5 4 1,625 ID

5A Battery

North Coast ARC
N8NC 213 5 25 2,055 OH

6A Battery

West Valley Amateur Radio Assoc
K6EI (+W6ZZZ) 2091 5 25 20,125 SCV
Durham Region QRP Club
VE3QDR 640 5 6 7,055 ONE

7A Battery

David Sarnoff ARC
N2RE 412 5 51 5,115 SNJ

9A Battery

Orange Cty Radio Amateurs / Durham FM Assn
W4EZ 1890 5 46 17,440 NC

10A Battery

Utica Shelby Em Com Assoc
K8UO 1174 5 53 11,390 MI

1A Commercial

Pathfinders ARC
VA4PAR 705 2 10 1,760 MB
Camping with Radios
N6M 357 2 6 1,430 SDG
Southern MS YL
KB5MZ 67 2 5 790 MS
Steve Lewis ARC
W8C 178 2 3 606 OH
KB7PJH 92 2 4 436 MT
Chicago FM Club
WA9ORC 125 2 20 400 IL
K4NGA 113 2 8 348 GA
South Tidewater ARK
W4HDW 142 2 6 334 VA
Williams Cty ARA
W8JDM 11 2 5 72 OH
W3WFI 23 2 3 46 MDC

2A Commercial

Radio Central ARC / Order of Boiled Owls of NY
W2RC (+KW2O) 1780 2 22 6,470 NLI
KS State Alumni Radio Team
K0DNG (+W0RPZ) 838 2 4 3,152 MO
Spartanburg ARC
K4II (+K4JLA) 876 2 25 3,146 SC
Henry Cty ARC
W9OB 1026 2 10 2,522 IN
Barnstormers Contest Group
NZ1U 624 2 4 2,520 CT
San Diego ARES
KG6IYN 1076 2 3 2,452 SDG
Lewes ARS & Sussex ARA
W3LRS 406 2 5 1,724 DE
Mora Open Rep Assn
KJ9W 303 2 6 1,652 MN
Ottumwa ARC
WA0DX 465 2 6 1,446 IA
WA2LQO 469 2 15 1,372 NLI
Skyline Tower ARC
W7DTV 647 2 5 1,344 OR
Milledgeville ARC
W4M 297 2 19 1,314 GA
West Morris ARC
KD2GLZ (+KB2UNZ) 262 2 7 1,014 NNJ
Daviess Cty ARC
KC9SFL 141 2 15 1,014 IN
Benton Cty ARC
K0KBX 262 2 30 964 IA
Coon Valley ARC
N0NAF 203 2 3 890 IA
Cascade RC
W7EK 272 2 22 890 WWA
Wantagh ARC
W2VA 82 2 11 762 NLI
Arlington ARC
W4WVP 193 2 14 756 VA
Chautauqua AR Serv
N2MQ 242 2 15 654 WNY
Valley RC
W7PXL (+KG7MQD) 171 2 15 616 OR
Champaign Cty ARES
WB8UCD 113 2 9 448 OH
Janet Club
KK6JA 74 2 7 388 SCV
Polk Cty ARA
N9XH 121 2 7 352 WI
Coyote ARC
KN5S 100 2 4 350 STX
W4FAR 91 2 6 332 NC
N8USK 85 2 3 324 OH
Hilton Head Island AR
W4IAR 48 2 10 184 SC
Mackenzie Regional RC
VE6MRF 61 1 10 117 AB

3A Commercial

Zamora RC
W4ZHR (+N4JF) 1548 2 23 6,266 AL
ARK of the AR Northwest
AA5AR (+N5NTI) 1507 2 28 6,178 AR
Splitrock ARA
K2GG 1868 2 20 5,960 NNJ
Southwest Dallas Cty ARC
W5WB (+W5AUY) 1391 2 87 5,832 NTX
Pottstown Area ARC
W3T (+K3ZMC) 1294 2 45 5,266 EPA
Macon Cty ARC
N0PR (+AB0C) 1004 2 14 4,138 MO
Fayette Cty ARC
KK4GQ 822 2 20 3,240 GA
Coshocton Cty ARA
W8CCA 552 2 14 2,650 OH
Kootenai ARS
K7ID 511 2 47 2,308 ID
N5BTC 456 2 26 2,102 STX
South Baldwin ARC & Lillian ARG
AF4I 415 2 35 2,020 AL
Radio Assoc of Western NY
W2PE 562 2 23 1,908 WNY
High Point ARC
W4UA (+KI4JWG) 673 2 18 1,856 NC
Drake RC
K8UU 612 2 12 1,616 OH
Flagler Palm Coast ARC
W4FPC 305 2 14 1,462 NFL
Hillsdale Cty ARC
K8HRC (+KB9YJH) 288 2 23 1,360 MI
K5RKW 342 2 26 1,298 NTX
Magnolia DX Assoc
K5MDX 322 2 16 1,292 MS
Talladega ARC
N4WNL 481 2 5 1,232 AL
Lakes Area ARC
W5JAS 190 2 15 1,220 STX
Camden Cty ARS
KB4CC 317 2 10 1,056 GA
Tompkins Cty ARA
AF2A 305 2 9 1,044 WNY
Bankhead ARC
N4IDX 373 2 16 1,006 AL
Worthington ARC
K0QBI 158 2 5 796 MN
Wellesley ARS
W1TKZ 132 2 26 790 EMA
Prince Georges Cty ARES
K3ERA 146 2 4 550 MDC
Katy ARS
KT5TX 208 2 10 416 STX
Berks ARC
K3TI 62 2 14 124 EPA

4A Commercial

Sawnee ARA
N4NE 1848 2 54 6,584 GA
Cumberland ARC
K3IEC 531 2 26 1,874 EPA
Mississippi Coast ARA
W5SGL 375 2 34 1,658 MS
K0DCA 244 2 31 1,214 MO
Bear Bait RC
KC2ZZO 493 1 10 1,204 NNY
West Fork ARC
WQ5A 540 2 8 1,130 NTX
Tri-Cty Amateurs
KC9OLF 218 2 15 1,032 IN
Black Diamond ARC
WV8BD 236 2 15 922 WV
Mayes Cty ARC / Rogers Cty Wireless Assn
WX5RC 113 2 22 726 OK
Black Diamond Radio Group
WI9BD 308 2 10 664 WI
K7BD 187 2 30 604 WWA
BOARS
KE8CU 136 2 4 534 MI
Lawrence Cty ARC
W5WRA 24 2 10 406 AR
Grayson Cty ARC
K5GCC 53 2 27 342 NTX

5A Commercial

Frontenac Radio Group
VE3FRG 1423 2 6 3,556 ONE
W9CQ 480 2 8 1,970 WI
NE AR RC
K5NEA 272 2 18 1,812 AR

1B-1 Op

N7OU	1538	2	1	6,402	WWA
KJ6YAQ	1168	2	1	4,844	SDG
N6RK	1083	2	1	4,458	SV
K1BG	1231	2	1	4,416	WMA
AB9CA/4	665	2	1	2,910	AL
N5OE	654	2	1	2,866	NTX
KA2OUO	638	2	1	2,496	MDC
KM5VI	2256	1	1	2,406	STX
K8ER	481	2	1	2,074	MI
WO9Z	880	2	1	2,010	IN
N4UF	461	2	1	1,994	NFL
N7DLV	571	2	1	1,692	WWA
VE7JKZ	366	2	1	1,614	BC
W0XR	365	2	1	1,610	CO
N0UY	344	2	1	1,526	MN
WJ2D	366	2	1	1,478	NC
KE2WY	366	2	1	1,452	WNY
WA9STI	398	2	1	1,440	SJV
KB8UHN	615	2	1	1,430	OH
K7JEO	572	2	1	1,394	UT
W9WI	298	2	1	1,356	TN
C6AGU	250	2	1	1,250	DX
W5JMW	233	2	1	1,238	WTX
W9KHH	207	2	1	1,178	WI
N8TD	204	2	1	1,166	OH
WB0SMX	197	2	1	1,138	AZ
K0VK	411	2	1	1,122	CO
AB6GS	400	2	1	1,050	SJV
K7YB	240	2	1	992	MT
N3ZP	226	2	1	962	EPA
KU7K	214	2	1	952	OR
AA1PL	209	2	1	942	ME
AD7DD	78	2	1	942	EWA
W0RX	192	2	1	910	MN
AG4P	200	2	1	786	TN
K0ADL	265	2	1	780	CO
KC7O	277	2	1	754	ORG
AA7AD	50	2	1	650	EWA
K2HT	125	2	1	650	MO
KA0REN	118	2	1	622	MO
W0KIE	34	2	1	618	OK
WA1AR	113	2	1	602	EMA
KD5BBR	150	2	1	600	OK
K6PVA	212	2	1	574	SV
AH6KO	78	2	1	550	PAC
K6KS	100	2	1	550	SV
K6PDQ	95	2	1	540	SB
K7DNH	144	2	1	538	NV
N5DD	134	2	1	520	NTX
WB9WHG	41	2	1	514	WI
WB5LRP	90	2	1	514	STX
K4PP	109	2	1	512	AL
KA2OEE	180	2	1	510	AR
AC7CJ	22	2	1	494	EWA
VE8GER	166	2	1	482	NWT
AK4OH	111	2	1	472	VA
KA1QYP	110	2	1	470	RI
WA4RG	67	2	1	462	GA
KL7WP	88	2	1	452	EWA
WB1FAW	149	2	1	448	EMA
KX7L	99	2	1	446	OH
N6AE	48	2	1	446	SV
VE7HLW	148	2	1	446	BC
N6IV	117	2	1	416	SJV
WB9QAF	27	2	1	412	NE
W6PZA	70	2	1	390	SV
KD8UXB	33	2	1	382	OH
K9ZXO	49	2	1	382	IL

KA2REY	56	2	1	374	ENY
VE7GYR	110	2	1	370	BC
W2SST (AA1SB,op)	65	2	1	360	NNY
N1EK	104	2	1	358	MDC
KB7RGX	48	2	1	346	OR
WA7BME	23	2	1	342	UT
AD7BF	36	2	1	334	WWA
N6KIA	88	2	1	326	ORG
KF5RGU	8	2	1	316	NM
N7CFO	103	2	1	306	EWA
KB3BYA	24	2	1	298	WPA
N8JAX	116	2	1	282	WCF
W3XG	41	2	1	274	MDC
KB0YTO	10	2	1	270	NE
KJ6JO	54	2	1	260	ORG
KM5VZ	4	2	1	258	NTX
KD5DLZ	51	2	1	252	OK
W5BI	101	2	1	252	NM
AG6RX	36	2	1	246	SJV
N1ORK	16	2	1	232	NH
N6FC	40	2	1	230	SV
KK7OQ	35	2	1	220	OR
N8ZKT	21	2	1	192	OH
NK0E	10	2	1	188	CO
AD5SR	41	2	1	182	OK
WA1LEI	39	2	1	178	NH
K7RQN/7	34	2	1	168	ID
N8HM	6	2	1	162	MDC
KC2NEO	4	2	1	158	NNJ
W9VQ	29	2	1	146	MI
VA2NU	40	2	1	130	QC
N0WRK	32	2	1	114	CO
WA7TPB	5	2	1	110	WWA
K6MLE	1	2	1	102	SF
W0SG	11	2	1	74	CO
KC0TXV	14	1	1	14	CO

1B-1 Op Battery

KW8N	947	5	1	9,865	OH
W3TS	596	5	1	6,410	EPA
KX0R	569	5	1	6,040	WY
N1KW	568	5	1	6,030	IL
K0MF	506	5	1	5,360	CO
K5AB	520	5	1	5,350	NTX
K7IA	487	5	1	5,220	NM
K5WNH	460	5	1	4,850	NTX
KE0G	439	5	1	4,490	MN
N0EVH	351	5	1	3,860	MO
NZ5A	314	5	1	3,490	STX
NQ2W	323	5	1	3,480	ENY
NN2L	306	5	1	3,460	NNY
KA5CJJ	310	5	1	3,050	NTX
N3CU	278	5	1	3,030	WPA
WA7NCL	267	5	1	3,020	EWA
W5ODS	280	5	1	3,015	OK
AA5CK	270	5	1	2,900	OK
AC7A	263	5	1	2,780	AZ
NR8Z	233	5	1	2,770	OH
W3NCR	231	5	1	2,740	MDC
WA8PGE	222	5	1	2,570	OH
W6UB	219	5	1	2,340	TN
N1BYT	205	5	1	2,300	EMA
K8ZT	200	5	1	2,160	OH
N0FKC	141	5	1	2,160	MN
N3AB	194	5	1	2,090	EPA
W3WT	171	5	1	2,060	EPA
WW6M	196	5	1	2,060	SV
WA4DOX	185	5	1	2,000	VA
K1PDY	153	5	1	1,880	NH
KA1SG	160	5	1	1,850	ME
AK4BH	156	5	1	1,710	SC
W5ETZ	155	5	1	1,675	MS
K2YY	154	5	1	1,665	EMA
VE3EDX	139	5	1	1,640	ONN
W0CZ	118	5	1	1,630	ND
K0ALN	134	5	1	1,600	CO
VE3UZ	135	5	1	1,600	ONS
W7JEX	152	5	1	1,570	UT
K8EG	131	5	1	1,560	OH
WC7S	127	5	1	1,540	WY
W9OV/P	126	5	1	1,510	NFL
W7BV	141	5	1	1,510	AZ
WA7ZZB	84	5	1	1,490	EWA
N6CMF	130	5	1	1,450	ORG
W9FHA	111	5	1	1,360	IN
WF2V	124	5	1	1,310	WNY
K2SH	102	5	1	1,270	WNY
KB2OBQ	101	5	1	1,260	NFL
KB5FIO	77	5	1	1,220	STX
W6GF/0	163	5	1	1,215	SD
AC8GS	193	5	1	1,215	OH
W1ZU	107	5	1	1,210	VT
WB3CEG	95	5	1	1,200	STX
WG5F	91	5	1	1,160	OK
K5WI	81	5	1	1,160	NTX
K0CD	100	5	1	1,150	WI
W6UR	99	5	1	1,140	SJV
AB4EL	100	5	1	1,115	NC
WU0L	84	5	1	1,090	MT
VA3PAW	82	5	1	1,070	ONE
KJ4RGH	100	5	1	1,050	VA
K0RGI	69	5	1	1,040	WI
AB8DF	89	5	1	1,040	MI
NC4RT	75	5	1	1,000	NC
W1MJ	66	5	1	910	EMA
K3TW	45	5	1	900	NFL
VE3IGJ	83	5	1	880	ONE
AC2HJ	63	5	1	880	WNY
WA6CAL	60	5	1	850	SV
K3RLL	80	5	1	850	WPA
W4DIT (K4KO,op)	64	5	1	840	TN
WA9YEE	75	5	1	800	IL
WQ3RP	53	5	1	780	DE
K2BCM	52	5	1	770	WNY
KF0XV	62	5	1	770	KS
WA4MXF	55	5	1	750	TN
K4CHE	49	5	1	740	DE
N1LT	49	5	1	735	NH
AC8OY	63	5	1	730	OH
AC0GP	85	5	1	725	MO
KK6RF	94	5	1	720	ORG
AF4LB	45	5	1	700	VA
W8NNC	64	5	1	690	OH
WA6CWM/7	50	5	1	650	ID
NU0T	67	5	1	635	CO
AG6RB/0	31	5	1	635	MN
N1DN	46	5	1	610	CT
KC1SS	64	5	1	570	VT
W7SAG	49	5	1	540	ID
AD0BI	37	5	1	520	MO
W4NE	35	5	1	500	SC
KC8SQC	14	5	1	490	NV
VE3LVW	28	5	1	490	ONS
KD7OED	44	5	1	480	AZ
VE6ZC	19	5	1	465	AB
N8XMS	30	5	1	450	MI
VE3AIH	22	5	1	420	ONE
KA2ZEY	26	5	1	410	NLI
WB6PWD	10	5	1	400	LAX
NJ7Z	35	5	1	400	TN
WB6HVH	23	5	1	380	SJV
AJ4EY	5	5	1	380	VA
KC9CSH	5	5	1	375	IL
W5GAI	23	5	1	370	MS
KC7WZL	63	5	1	365	ID
KC2LZO	1	5	1	355	MDC
W6RTI	9	5	1	350	EB
WD9EWK	16	5	1	330	AZ
KB1WXC	7	5	1	320	EMA
K2DEP	17	5	1	320	MDC
AA5CO	22	5	1	320	OK
N6NKO/9	6	5	1	310	WI
AD5QA	31	5	1	305	VA
VA3TPV	10	5	1	300	ONE
W6VAR	25	5	1	300	EB
KK6BXR	10	5	1	300	EB
AG6QR	7	5	1	285	SV
NS3C	12	5	1	270	ORG
N9JPV	2	5	1	260	IL
KB9UIY	22	5	1	260	OH
N4IX	40	5	1	250	GA
VA3PGJ	9	5	1	240	ONE
WA4HWT	37	5	1	235	GA
KF7WGL	14	5	1	220	UT
N2JFS	7	5	1	220	NH
KB3YOT	8	5	1	190	NC
KC2JRQ	7	5	1	185	NLI
K2QPN	3	5	1	180	NFL
WB2TVB/9	5	5	1	175	IL
VE3SHO/W4	24	5	1	170	WCF
KC2KME	6	5	1	160	WNY
KT6L	1	5	1	160	SDG
K4UB	19	5	1	145	GA
W1LVT	7	5	1	120	VT
WA7UJR	1	5	1	105	WWA
KD0XT	5	5	1	75	MN
KG7FDK	2	5	1	60	EWA
AI6PG	1	5	1	55	SB

1B-1 Op

N8KD	696	2	1	2,934	MI
WE8R	235	2	1	1,090	OH
VE3RCN	202	2	1	794	ONS
N3JJT	108	2	1	732	OH
KJ4LQX	101	2	1	726	SFL
N9EAX	235	2	1	694	WI
NM9W	156	2	1	672	SC
WA9PYH	124	2	1	546	IN
K7MK	181	2	1	422	ID
N0KEN	90	2	1	330	MN
N4QX	40	2	1	310	ORG
K5KMS	108	2	1	266	NTX
K0VG	12	2	1	196	MN
VA3KHH	24	2	1	98	ONS
KC8FOV	18	2	1	86	OH

1B-2 Op

AA5B	1539	2	2	6,406	NM
VE6KZ	1102	2	2	4,658	AB
K7A	780	2	2	3,748	MT
N7QT	823	2	2	3,642	EWA
K5MXG	1009	2	2	3,560	STX
K7GGG	1002	2	2	3,444	AZ
W1LN	1513	2	2	3,276	ME
VE3EY	1387	1	2	2,330	GTA
W8AWE	421	2	2	1,824	MI
KI0F	411	2	2	1,486	MN
K4AEN	261	2	2	1,190	VA
K9KD	226	2	2	1,184	IN
W7IWW	511	2	2	1,174	MT
KA9P	253	2	2	1,074	IL
K6TY	158	2	2	930	SJV
KA2DDO	120	2	2	890	EPA
W6PS	177	2	2	862	SV
W7WSV	137	2	2	798	AZ
W7CH	200	2	2	650	EWA
N6KD	175	2	2	566	SF
WR1B	50	2	2	534	DE
KA2BEO	42	2	2	506	SNJ
K8UDZ	138	2	2	426	MI
NM0S (+KB9TXH)	7	2	2	416	IA
KC9ILS	131	2	2	412	IL
W4BFL	77	2	2	404	SFL
KC2JAV (+KA8HUZ)	75	2	2	400	OH
KD0IOE	62	2	2	396	ND
KQ4K	83	2	2	324	NC
WA2EZG	83	2	2	316	NNJ
KK4DDF	73	2	2	296	VA
WB4ZTF	10	2	2	292	NC
AC7SR	55	2	2	260	WWA
N0PTN	50	2	2	250	MO
N2VR	48	2	2	246	WNY
KC0VRV	19	2	2	188	MN
WA9LKZ	9	2	2	186	IL
WA3WSB	60	2	2	170	VA

2B-2 Op

K8MU	721	2	2	3,042	MI
NE3MD	742	2	2	2,846	EPA
WR7Q	580	2	2	1,756	UT
K9SRS	322	2	2	1,576	IL
W0NA	385	2	2	1,536	WPA
N2BC	366	2	2	1,368	WNY
K0ZS	554	2	2	1,358	MO
K7PX	178	2	2	960	MT
K6VRS	105	2	2	770	SDG
KE6F	261	2	2	712	SV
AF5FB	164	2	2	592	NTX
NL7FX	90	2	2	530	WWA
K8VEB	118	2	2	494	MI
KC0LMX	70	2	2	490	ND
W3LP	103	2	2	478	EPA
KD6CP	146	2	2	362	SD
K5JTB	14	2	2	298	AR
AC9FY (+NF9P)	19	2	2	140	WI

1B-2 Op Battery

N4DD	840	5	2	8,550	VA
VA3DF	517	5	2	5,320	ONS
VA3YV	358	5	2	3,500	ONS
W2JLK	292	5	2	3,270	SNJ
N4RE	275	5	2	3,000	NC
N0FP	227	5	2	2,620	MN
W1KMG	134	5	2	1,820	ME
K9F	161	5	2	1,760	WI
K0G	135	5	2	1,700	CO
VE9AA	153	5	2	1,665	MAR
NG0R	100	5	2	1,540	MT
NK8I	109	5	2	1,340	OH
WE8E	120	5	2	1,320	MI
NR5ON	71	5	2	1,060	NM
W3SW	54	5	2	890	WNY
W9JFK	68	5	2	870	WV
AI2T (+AC2MZ)	44	5	2	740	WNY
AE5DD	52	5	2	510	NTX
N6MDV	13	5	2	450	LAX
N1BFK (+KA1JDH)	9	5	2	445	NH
WB0RMK	17	5	2	435	MN
NA0Q	31	5	2	360	MO
W1QWT	21	5	2	355	EMA
N3OFR	20	5	2	350	EPA

2B-2 Op Battery

K3ZZ	1369	5	2	11,050	MDC
N3AQC	288	5	2	3,130	WPA
NU0P	284	5	2	3,090	WY
KS8M	200	5	2	2,295	OH
WR8S	209	5	2	2,115	WV
K1SWL	116	5	2	1,710	NH
W7JWT	204	5	2	1,570	EWA
W6JFE (+K6RHB)	163	5	2	1,315	SB
W9EWW	79	5	2	1,105	WI
N2FWB	84	5	2	920	ENY

1B-2 Op

NW3H	435	2	2	1,688	EPA
W5RAW/0	219	2	2	488	SD

2B-2 Op

NE7D	917	2	2	3,718	OR
K7QFE (+K7RPX)	82	2	2	164	OR

Mobile Stations

1C

N6VW	431	5	4	4,660	LAX
K5YAA/M	1236	1	1	2,380	OK
W3PP	544	2	2	2,296	DE
WU3U	377	2	1	2,056	SNJ
W8UE	396	2	1	1,834	OH
W1JCW	620	2	8	1,690	OK
W3US	413	2	1	1,634	NC
K1GGI	224	2	1	1,046	EMA
K2NV/VE3	171	2	1	734	ONS
NA1GB	137	2	2	654	RI
W7CGA	96	2	1	634	EWA
WA1QZK	38	2	1	596	EMA
KN4Y	93	2	1	422	NFL
WB0POH	52	2	1	358	VA
W0SEB	100	2	1	350	SD
K0NE	62	2	1	298	NE
W7VN	73	2	1	290	OR
KC2UGV/P	34	2	1	286	WNY
WA4CHJ	66	2	1	282	NC
AA6DP	56	2	1	274	LAX
N8TFD	75	2	1	274	OH
KB7EWA	7	2	1	264	ID
W4ZPR	5	2	1	220	VA
KC0RPS	23	2	1	196	WY
KA3KSP	46	2	1	192	WPA
KD0YNH	61	1	2	161	MN
KF4KI/VE3	5	2	1	160	ONS
KD4BTD	1	2	1	152	SFL
KC9HZC	31	1	1	131	IL
K5VHH	19	2	1	88	STX
K7BEN	15	2	1	80	NFL
WE8DX/M	11	2	1	72	OH
VA7RU	10	2	1	70	BC
KU6T	10	2	1	70	LAX
N2CEC	9	2	1	68	NNJ
KB3JHC	6	2	1	62	NC
KC3BKR	5	2	1	60	NC
KD0BSS	1	2	1	52	KS

2C

AB7AA	290	2	2	1,660	AZ
AB7AA/M	290	2	2	1,660	AZ

Home Stations Commercial Power

1D

N4BP	1600	2	2	5,008	SFL
W7YAQ	945	2	1	3,652	OR
AA2BJ	953	2	2	3,418	EPA
K9CJ	531	2	1	2,274	IL
K9UQN	523	2	1	2,186	TN
N0EF	487	2	1	1,998	MT
W6AEA/7	905	1	1	1,860	EWA
N6JF	375	2	2	1,600	ID
KB3LIX	354	2	1	1,492	WPA
N3CZ	335	2	1	1,390	NC
N9OF	323	2	1	1,342	STX
N3KR	322	2	1	1,338	EPA
VA3ATT	312	2	1	1,298	ONS
WA0BJR	337	2	3	1,252	MO
W5JDP	273	2	2	1,242	NTX
NW0M	301	2	1	1,242	MO
K3ATO	607	1	1	1,214	EPA
WB3ESR	295	2	1	1,212	EPA
K2MK	605	1	1	1,181	SNJ
KS4YX	310	2	1	1,180	SC
N9NM	272	2	1	1,138	STX
K4DJ	272	2	1	1,138	NC
WOGN	271	2	1	1,134	IA
VE2FK	264	2	1	1,106	QC
N4UEZ	267	2	1	1,086	NC
N4NA	255	2	1	1,070	TN
K4GU	262	2	2	1,056	AL
K2CYE	251	2	1	1,052	ENY
W9A	420	2	1	1,048	IL
W7LKG	260	2	1	1,020	WWA
KC8KE	402	2	1	1,020	MI
N6PN	250	2	1	986	EB
WM2W	819	1	2	957	NFL
WA4YHA	235	2	1	954	VA
WZ8T	449	2	1	948	MI
K9GDF	222	2	1	938	WI
VE2BWL	230	2	1	938	QC
K4RDU	206	2	1	924	VA
K6KQV	216	2	1	920	SCV
KL7AA	331	1	4	889	AK
W5PQ	207	2	1	878	LA
W0NH	204	2	5	876	MO
W7QN	206	2	1	874	WWA
KI7M	871	1	1	871	OR
WB8YLO	156	2	2	858	OH
W4YS	402	2	1	854	SJV
WA4AOS	194	2	1	826	SC
K6SEA	413	1	12	809	OR
W0YHE	204	2	1	808	AZ
NF8J	274	2	1	806	MI
N6NC	377	1	1	804	SDG
KD7MSC	232	2	1	794	OR
NJ1K	731	1	1	781	VA
N0FU	180	2	1	770	SDG
KP4CPC	179	2	1	766	PR
VA3FN	175	2	1	750	ONS
VA7JC	142	2	4	748	BC
K0JPL	183	2	1	728	MO
W0PV	167	2	1	696	WCF
N3GGT	160	2	1	690	EPA
N1ZX	160	2	1	690	SFL
KB5ENP	140	2	2	686	MO
AE4VJ	251	2	1	678	SC
NR9A	195	2	1	678	MO
K9SG	599	1	1	674	IN
W8PNA	152	2	1	658	MI

After completing a Summits on the Air activation on Frazier Peak, Scott Hanley, WA9STI, operates 1B1 from his campsite at 7400' in the Los Padres National Forest. [Scott Hanley, WA9STI, photo]

WX9DX	618	1	5	658	IL
K7TR	236	2	1	652	AZ
AK2U	162	2	1	648	WV
W4EE	184	2	1	636	MDC
WA4ZPZ	146	2	1	634	AL
N4OTR	156	2	2	634	OH
K2UGH	258	2	2	630	SFL
K4IU	144	2	1	626	MN
W9RF	155	2	1	622	IL
WO8L	157	2	1	618	NC
ND4Y	198	2	2	602	KY
N4UOH	150	2	1	600	NC
KM4I	275	2	2	600	TN
N9WKW	136	2	1	594	IN
KM4FO	134	2	1	586	KY
KC1V	131	2	1	574	CT
WK4AA	130	2	1	570	KY
WA9LEY	141	2	1	564	IL
W4XK	126	2	1	554	TN
KB6A	125	2	1	550	ORG
WBoN	125	2	1	550	MN
NE8J	124	2	1	546	MI
KE3X	127	2	1	538	MDC
WA3AAN	243	1	1	536	EPA
WA3SOR	95	2	1	530	EPA
W4VIC	131	2	1	524	VA
K3URT	149	2	1	512	EPA
VE3SSB	125	2	2	508	GTA
WA3IVV	127	2	1	508	WPA
WO3T	175	2	2	500	WPA
AC6ZM	133	2	1	498	OH
K4YYL	120	2	1	480	SC
KN4DS	72	2	1	480	GA
WA8JHH	135	2	1	478	MI
K3WGR	88	2	1	470	EPA
WB9HFK	129	2	1	460	IL
WB4RRD	96	2	3	454	GA
W5EW	101	2	1	454	LA
K8OT	101	2	1	450	MI
KK4DZP	88	2	1	450	NFL
W2ORO	144	2	2	444	KY
WBoSOK	118	2	1	440	MN
ND3R	122	2	1	440	WPA
W7QHZ	186	2	1	422	AZ
N3VYZ	208	2	4	416	WPA
N6MSY	90	2	1	410	EB
KI7I	204	2	1	408	ID
AK3G	179	2	1	408	WPA
WA5LOU	140	1	1	401	IN
N2BEF	100	2	1	400	ENY
K6GSL	102	2	1	400	SJV
W3SFG	92	2	1	398	MDC
AA6EE	99	2	1	396	SDG
N7IXI	172	2	2	394	OR
KF7VSL	169	2	1	388	EWA
VE3FJ	84	2	1	386	GTA
KE5UES	42	2	4	384	NTX
K2DLS	116	2	1	382	NNJ
N8CWU	165	2	1	380	OH
W6RGS	165	2	1	380	SDG
N1KRT	161	2	1	372	EMA
K2NV	158	1	1	366	WNY
AC8GU	156	2	1	362	OH
K9UT	78	2	1	362	IN
KSOM	77	2	1	358	MO
NT9M	100	2	1	356	IN
AA7L	99	2	1	356	WWA
W4BO	76	2	1	354	NC
KG6AF	75	2	1	350	SCV
W9AVM	90	2	1	350	WI
K3SV	95	2	1	342	WCF
WA7YNU	57	2	1	342	MT
WA8RSA	171	2	1	342	MI
WA5RML	85	2	1	340	NTX
WE7H	91	2	1	340	AZ
N2QGV	47	2	1	338	NFL
AD7L	72	2	1	338	OR
KA5NDH	104	2	1	330	NFL
W7RTX	127	2	1	324	AZ
K7LOP	135	2	1	320	NV
KE5IRK	67	2	1	318	OK
KB3IRR	132	2	1	314	EPA
KoLAR	66	2	1	314	MN
WX6SGX	131	2	2	312	SDG
KK4YEL	124	2	1	310	SFL
NA0BR	64	2	1	306	CO
KE4ZDJ	74	2	1	298	KY
N2ASD	48	2	1	298	NNY
KF5SYB	138	2	3	296	STX
N7FG	68	2	1	296	AZ
WT3O	122	2	1	294	MDC
W4BWQ	110	2	1	294	NFL
WA3KOI	51	2	3	292	WPA
WA2BMH	74	2	1	292	NNJ
AA5BE	121	2	1	292	AR
W6NS	105	2	1	290	SB
N6RLS	45	2	1	286	EB
W1WIU	202	1	1	285	RI
N4MBI	116	2	1	282	NC
K7WLF	65	2	1	282	AZ
KC5YWN	115	2	1	280	AR
N3KN	114	1	1	278	VA
K4AMQ	67	2	1	276	TN
K4EET	111	2	1	272	MDC
KJ4WD	63	2	1	272	NC
KC8IKK	135	2	1	270	OH
AF6VN	30	2	1	270	MI
WE1CT	109	2	5	268	WMA
KB7HDX	108	2	1	266	EWA
WB4KFO	108	2	1	266	VA
N6BHX	56	2	1	266	EB
WD1H	132	1	1	264	EMA
N5TOL	106	2	1	262	WTX
KK4PGC	106	2	1	262	NC
WB3CJU	130	2	1	260	EPA
KB7YSY	105	2	1	260	AZ
WBoNRE	47	2	1	258	ORG
KD2EOM	72	2	2	258	ENY
N5RGV	103	2	1	256	STX
K2CDX	51	2	1	254	WNY
W8NOR	51	2	1	254	AZ
KC2MBV	61	2	1	254	NLI
N1NN	101	1	1	252	EMA
NF9D	50	2	1	250	IL
K7ZYV	50	2	1	250	MS
KI6ORO	197	1	2	247	SF
KZ5OM	49	2	1	246	SV
VE9LMN	96	2	3	242	MAR
JO7KMB	100	1	1	239	DX
NM4SH	47	2	1	238	VA
KC2WUF	26	2	1	238	NNJ
K6SYU	46	2	3	234	ORG
WoMDT	149	1	2	234	MN
AE1D	58	2	1	230	NH
N3IJW	45	2	1	230	VA
NoNA	89	2	1	228	WWA
W4WLC	43	2	1	222	NFL
KA7NWF	86	2	1	222	WWA
WD8JPX	110	2	1	220	SFL
N2SE	34	2	4	218	NNJ
K6LMN	32	2	1	214	LAX
WA0RKQ	98	2	1	214	KS
K8BHK	44	2	1	214	MI
NoGOS	53	2	1	212	CO
WO8M	54	2	2	210	MI
K2VK	30	2	4	210	NNJ
W1HFG	65	2	1	210	EMA
AH6EZ/W7	99	1	1	209	WWA
AA4LR	52	2	1	208	GA
WA6URY	140	1	1	208	LAX
KC7CUE	78	2	1	206	MT
W8FO	103	2	1	206	OH
WE6EZ	101	2	1	202	STX
WD8LYB	99	2	1	198	MI
KF6FIX	24	2	1	196	ORG
KM5ART	73	2	1	196	NTX
KB9TYT	80	1	1	196	IL
NoKOE	36	2	1	194	NC
KBoUBZ	72	2	1	194	CO
W2GHD	36	2	1	194	WNY
N5WSS	62	2	2	194	AR
NE9O	96	2	1	192	NFL
N4OLN	71	2	1	192	GA
N7JI	35	2	1	190	OR
N3JNX	43	2	1	188	EPA
VY2DIM	47	2	1	186	MAR
K9IDQ	137	1	1	187	IL
N7TMS	55	2	1	186	ID
W1WAB	9	2	1	184	WCF
ND2Z	66	2	1	182	SC
KC2LWD	16	2	2	182	EPA
VE3NDI	90	2	1	180	ONN
VE3HED	130	1	1	180	ONE
KB3INE	65	2	1	180	SC
W3TZ	89	2	1	178	AR
K0UD	32	2	1	178	ND
NC4MI	32	2	1	178	NC
AD7AW	127	1	1	177	WWA
W0DHB	13	2	1	176	CO
NM3S	68	2	1	174	SV
NI4ET	62	2	1	174	TN
KI6OY	43	2	1	172	EB
AI6II	79	1	1	171	SF
W5P	15	1	1	170	NFL
KA6MLE	120	1	1	170	SB
K2FEO	85	2	1	170	WNY
NOZTO	60	2	1	170	CO
N2CJN	59	2	1	168	SCV
K6DKO	59	2	1	168	SB
W1VCM	82	2	6	164	CT
VE6VS/VE5	57	2	1	164	SK
N9SRO	6	2	1	162	SFL
KE7GKI	56	2	1	162	AZ
WA2LLN	80	2	1	160	NFL
AD4IE	40	2	1	160	NC
KB1NGQ	27	2	1	158	VT
W2LID	27	2	1	158	NNJ
W2PIP	52	2	1	154	WNY
N7RHW	50	2	1	150	EWA
KA1PPV	25	2	1	150	CT
N6BXO	49	2	1	148	CO
AD0DB	49	2	2	148	MN
WA6GFR	24	2	1	146	ORG
WA3YMM	43	2	1	146	WPA
WA1OOH	72	2	1	144	AZ
KJ1J	38	2	1	142	NH
KD8OBW	45	2	1	140	OH
KD8RUC	45	2	1	140	MI
W3BW	106	1	1	140	MDC
AG6RF	44	2	1	138	EB
W4/SV1IT	43	2	1	136	VA
NJ6W	43	2	1	136	EB
KC8YLZ	42	2	1	134	OH
AD0JA	42	2	1	134	MO
WB7BBQ	132	1	1	132	WWA
VE9FX	82	1	1	132	MAR
N2SQW	80	1	1	130	ENY
KC4UJN	40	2	1	130	KY
AC6TU	20	2	1	130	LAX
KD4QMY	39	2	1	128	GA
N4NC	32	2	1	128	NC
N5XGG	24	2	1	128	STX
KD7LEE	26	2	1	126	WWA
K3CJW	75	1	1	125	MDC
AC2EV	62	2	1	124	WNY
NO2D	31	2	1	124	CO
AC2JO	37	2	1	124	WNY
NOAXE	21	2	1	122	CO
K3STL	21	2	1	122	WPA
N8EBN	36	2	1	122	AZ
VE6SPS	43	2	1	122	AB
AI3G	36	2	1	122	DE
K7JSG	24	2	1	120	WWA
W6JWP	35	2	1	120	SB
WB4ALM	25	2	1	120	SC
KB4VL	35	2	1	120	TN
WO2N	17	2	1	118	NLI
KI6IHW	34	2	1	118	SF
KK1X	32	2	1	118	EMA
KD6ZLB	32	2	2	114	EB
VE3GF	16	2	1	114	ONE
W4SOF	32	2	1	114	NM
W8CAH	28	2	1	112	IL
W2CCR	31	2	1	112	ENY
WoKK	28	2	1	112	NE
WB8WUA	38	2	1	112	OH
WB5PPH	61	1	1	111	NTX
KDoPIO	30	2	1	110	MN
KK4BFN	20	2	1	110	NFL
K1RDX	29	2	1	108	NH
KK6CZC	15	2	1	108	LAX
WS2K	33	2	1	108	EPA
NoRZT	51	2	1	108	NE
W7KAM	54	2	1	108	MO
K5OMC	15	2	1	106	MS
N7QMT	53	2	1	106	WWA
K7JQ	56	1	1	106	AZ
KK6L	28	2	1	106	EPA
KO9A	22	2	1	106	IL
ON5WL	26	2	1	104	DX
AC8NO	27	2	1	104	MI
WQ8U	16	2	1	104	OR
KU1Q	93	1	2	103	CT
KN3D	26	2	1	102	MDC
KA1BVV	52	1	1	102	ME
WD4BMG	26	2	1	102	NC
K6DSW	26	2	1	102	LAX
W9IIX	52	1	1	102	IL
AF5BZ	100	1	1	100	AR
VE2KOT	25	2	1	100	QC
WA8FRE	50	2	1	100	MI
N2IMK	25	2	1	100	SNJ
SP5TAT	12	2	1	98	DX
JF2IWL	24	1	1	98	DX
AG6JA	24	2	1	98	SCV
KF6RXB	46	1	1	96	SF
W8CON	23	2	1	96	MI
KZ8R	24	2	1	96	NC
VK8AV	11	2	1	94	DX
WB8VBG	13	2	1	94	AZ
WB4IZC	22	2	1	94	MS
WK2P	22	2	1	94	EPA
KI4WFJ	47	2	1	94	SC
K6BSD	22	2	1	94	ORG
AB7MP	11	2	1	94	EWA
KC8RTW	46	2	1	92	MI
K4GOP	21	2	1	92	NFL
K8FZY	11	2	1	92	OH
W4CHI	21	2	1	92	NC
KG6YPH	21	2	1	92	SCV
N8BUS	91	1	1	91	OH
WA9CYG	25	1	1	90	IN
WA5LFD	80	1	1	90	NTX
NoICV	20	2	1	90	IL
K4IJK	20	2	1	90	RI
K9VS	44	2	1	88	WI
K7VBY	11	2	1	86	OR
N8DRG	43	2	1	86	OH
K2NNY	9	2	1	86	NNY
KE9F	12	2	1	86	IL
N5UVQ	14	2	1	84	NM
AD7GU	17	2	1	84	SJV
AB3CA	17	2	1	84	MDC
WA6EJO	17	2	1	84	SB
KF7WWP	17	2	1	84	AZ
N7XVQ	17	2	1	84	AZ
KK9D	10	2	1	84	WI
KG1GEM	8	2	1	82	NTX
WONFS	16	2	1	82	MO
KA1RFD	8	2	1	82	ME
K5PCA	15	2	1	80	NM
N6NFB	15	2	1	80	WWA
KC2PDO	15	2	1	80	NNJ
N4YHC	10	2	1	80	KY
KDoHBS	39	2	1	78	MO
KD5JFE	13	2	1	76	LA
K7MY	75	1	1	75	AZ
K1JNX	37	2	1	74	IN
K7JWM	37	2	1	74	WWA
KK4TGV	2	2	1	74	VA
JA3JM	6	2	1	74	DX
NJ2BB	24	1	1	74	SNJ
KK4CNJ	36	2	1	72	NFL
WX4AR	36	2	1	72	SNJ
KB3ANZ	10	2	1	70	MDC
W7JSD	6	2	1	70	AZ
WC7Q	19	2	1	70	WWA
KD2BRB	10	2	1	70	NLI
W9PGE	69	1	1	69	IL
VE3FMK	34	2	1	68	ONE
KB4RG	34	2	1	68	STX
KX1W	9	2	1	68	ENY
KC2KQH	8	2	1	66	SNJ
KA0EIC	4	2	1	66	KS
JA1YNE	4	2	1	66	DX
KD5YPH	7	2	1	64	CO
KE9SA	7	2	2	64	WI
K6GRL	6	2	1	62	SCV
K7IP	3	2	1	62	WWA
N7JB	36	1	1	62	WWA
AG6YO	5	2	1	60	SCV
N6MCM	9	1	1	59	SV
WOVB	40	1	2	58	MN
NM1A	4	2	1	58	SFL
KK4MOV	4	2	1	58	NC
K2UP	2	2	1	58	ENY
BA4TB	3	1	1	56	DX
WA7KGX	2	2	1	56	OR
KA2BPP	2	2	1	54	NLI
K8JSM	2	2	1	54	OH
KB8MRC	2	2	1	54	OH
N3GBJ	2	2	1	54	EPA
KA1RWY	2	2	1	54	CT
K9ELF	2	2	1	54	IN
KI8HF	1	2	1	52	MI
KG7MJW	1	2	3	52	AZ
W5ROE	13	2	1	52	NTX
VE2PIJ	1	2	1	52	QC
KA2ENE	25	2	1	50	WNY
K7JKM	25	2	1	50	OR
KI4EBD	18	2	1	50	NFL
WB9AA	25	2	1	50	IN
W5JBB	24	2	1	48	STX
KG4AQN	24	2	1	48	NC
K4GRE	24	2	1	48	SC
AB8OU	23	2	1	46	OH
KD4YDD	22	2	1	44	GA
KO6YG	22	2	1	44	SCV
WA3YTI	21	2	1	42	SDG
K1QED	21	2	1	42	WMA
W8BAP	21	2	1	42	OH
W3RLO	20	2	1	40	DE
WB9MII	9	2	1	36	IL
W6AAN	26	1	1	36	MDC
KV1P	16	2	1	32	NFL
WA5YNE	25	1	1	25	OK
AF9J	24	1	1	24	WI
N4MM	10	2	1	22	VA
W1CRK	8	2	1	16	EMA
KE7TM	7	2	1	14	AZ
KE4WBI	7	2	1	14	NFL
N6TCZ	8	1	1	9	LAX
WA1N	3	2	1	6	NH
NG5C	1	1	1	1	MS
NR6T	1	1	1	1	ORG

2D

W4UH	3795	2	2	10,990	SFL
W8RT	908	2	2	3,782	MI
N5KWN	805	2	2	3,266	STX

N2BJ	2169	1	3	3,102	IL
W4NUN	654	2	4	2,566	GA
KA3NZR	569	2	2	2,054	WV
KH6HME	863	1	9	1,446	PAC
WA4T	272	2	22	1,396	WCF
W2LI	254	2	9	978	NNJ
N2UC	203	2	2	862	WNY
W4UQ	710	1	5	760	GA
W5ROS	143	2	10	680	STX
N0A	151	2	5	552	MO
WA4KFZ	172	2	2	544	VA
N4EMP	172	2	2	482	AL
WB4WPF	134	2	2	338	DE
W9JXN	141	2	4	322	IL
K4TAK	51	2	1	316	TN
N9ZWY	104	2	4	258	WI
WT3C	78	2	2	230	MDC
KJ4MFJ	70	2	3	190	KY
KK6DPE	72	2	2	144	ORG
KF5WBU	42	2	2	134	OK

3D

K5SAR	1315	2	40	3,576	LA
W5RTA	662	2	7	2,262	STX
W9HW	392	2	4	834	IL
KD2AJO	149	2	3	408	WNY
AJ5Q	49	2	11	386	OK
N9QID	111	2	4	272	MI

4D

W9GUS	287	2	14	1,512	IN
K5JVL	117	2	7	456	NTX

7D

W3LIF	2797	2	30	5,942	WPA

Home Stations Emergency Power

1E

W0DLE	993	5	1	10,080	CO
AA3B	2315	2	1	9,610	EPA
W6JTI	753	5	1	7,780	SF
N4UU	1361	2	1	5,694	NFL
W9TS	460	5	1	4,850	IL
W1ECH	510	5	1	4,795	VT
K7TD	1132	2	3	4,678	CO
AE5GT	1121	2	1	4,634	STX
W8HW	450	5	1	4,570	SFL
K1EEE	1201	2	3	3,898	NH
KY7M	1212	2	1	3,786	AZ
N4CF	377	5	1	3,775	VA
WZ2T	340	5	1	3,750	NNY
N6TV	1196	2	1	3,744	SCV
N0TT	832	2	1	3,478	MO
K9OM	800	2	1	3,450	WI
W4UT	316	5	1	3,310	TN
AB5ZA/7	733	2	2	3,082	MT
W4KKN	663	2	3	2,904	VA
WA2EQF	621	2	5	2,872	NNJ
W8TM	262	5	1	2,870	OH
K2YGM	266	5	1	2,810	NLI
W3HGT	1005	2	5	2,730	NTX
E51AND	605	2	1	2,670	DX
VE3MGY	724	2	1	2,638	ONS
VE7NI	227	5	1	2,620	BC
WA1VKO	968	2	1	2,586	NH
K0MPH	628	2	1	2,562	MN
K7RF	600	2	1	2,550	OR
KU4V	877	2	1	2,506	NC
K8ET	904	2	3	2,460	MI
K4WW	900	2	1	2,450	KY
KY0Q	219	5	2	2,440	IL
WA1ENO	1039	2	2	2,328	EMA
K9JWV	217	5	1	2,320	UT
W7GB	532	2	1	2,268	WWA
W9PA	547	2	1	2,266	IN
K4BSK	490	2	2	2,202	VA
WV0H	189	5	1	2,140	CO
KS4X	206	5	1	2,110	TN
WB4MJF	1007	2	1	2,064	WNY
W1JN	188	5	1	2,060	CT
VE3PYG	177	5	1	2,030	ONE
KB9S	468	2	1	2,022	WI
W2IRT	570	2	1	2,020	NNJ
W3RMS	936	2	1	1,972	EPA
KB2MN	168	5	1	1,930	SNJ
K0MP	161	5	1	1,860	AZ
WA5TVO	422	2	1	1,850	SDG
W2DPT	165	5	1	1,850	NNJ
WA4FOM	163	5	1	1,845	NNJ
KG4W	448	2	1	1,842	VA
KB8PGW	176	5	1	1,810	MI
NY6J	523	2	1	1,790	IN
WM4AA	161	5	1	1,760	SC
K9TF	161	5	3	1,760	WI
WA2WDT	342	2	1	1,706	MDC
KU4A	168	5	1	1,705	KY
W6OGC	142	5	1	1,670	STX
WA4BPJ	755	2	5	1,660	NC
AA3CS	377	2	1	1,658	MDC
NS3L	464	2	2	1,580	EPA
W9AV	406	2	1	1,526	WI
N7NB	126	5	1	1,510	WWA
K0RFD	366	2	2	1,506	CO
AA1CA	144	5	1	1,490	NH
WW6AFA	663	2	1	1,476	LAX
WB8RFB	306	2	1	1,456	IL
KK5JY	326	2	1	1,438	OK
KA2FHN	118	5	1	1,370	WNY
K7EA	276	2	1	1,354	UT
K9NO	330	2	1	1,340	IL
VA7ST	109	5	1	1,340	BC
N8OQ	211	5	1	1,305	VA
NA7UT	209	5	2	1,295	UT
KB0YH	316	2	1	1,278	CO
AA8V	261	2	1	1,244	MDC
K2OGT	247	2	1	1,238	EPA
W7GF	241	2	1	1,214	OR
K1TKL	278	2	1	1,212	SDG
WB2RHM/4	238	2	1	1,202	NC
W1PID	93	5	1	1,180	NH
W1FM	113	5	2	1,180	EMA
W5RF	503	2	1	1,156	STX
KC0UXC	233	2	2	1,156	SD
W7CD	79	5	1	1,130	WWA
AC2DE	218	2	1	1,122	WTX
K2WO	96	5	1	1,110	NFL
AE2T	86	5	1	1,110	WNY
WG4FOC	75	5	1	1,100	NFL
NX1K	80	5	1	1,050	WI
K6AR	91	5	1	1,010	SDG
KB5EZ	65	5	1	1,000	AL
N6KZ	240	2	1	994	AZ
K2QM	235	2	1	990	SNJ
WD6BGN	75	5	1	985	MO
KE6K	143	5	1	985	AZ
KC4ZA	83	5	1	980	VA
W2SFD	243	2	3	976	ENY
K5RWP	172	2	1	938	NTX
W6BIV	172	2	1	928	LAX
W3AG	193	2	1	922	WPA
AA0TR	67	5	1	910	MN
WR2G	140	2	1	888	NNJ
AC2J	63	5	1	880	WNY
KE5RTI	156	2	1	874	STX
W3KS	350	2	1	850	DE
KF6I	395	1	4	813	ORG
N1MHC	381	2	3	812	ME
WA7PRC	212	2	1	806	WWA
N2MTG	324	2	1	798	ENY
KI6WD	226	2	4	794	ORG
K3ORS	209	2	1	768	TN
N4CYV	100	5	1	765	NM
AE0G	153	2	1	762	NE
N4HAI	152	2	1	756	OH
AB2ZO	50	5	1	750	ENY
N6NF	542	1	1	727	SCV
K3CSF	120	2	12	726	WPA
WI7J	113	5	2	715	UT
VE2AWR	155	2	1	688	QC
KF5NIX	289	2	4	678	STX
NO7DE	64	2	2	670	WWA
KE6WC	306	2	1	662	SF
W0WFX	98	2	1	642	MO
K0CQ	138	2	1	636	IA
WA7LK	140	2	1	630	WWA
WB6FDY	95	2	1	628	IL
WD5CFJ	130	2	1	610	STX
AA5UY	100	2	2	596	LA
KG6S	143	2	3	594	SV
W6IEE	82	2	1	592	LAX
KV4RH	149	2	1	584	SC
WA7PTM	26	5	1	580	WWA
NZ8D	93	2	2	576	SNJ
N7NEV	9	5	1	540	AZ
KK4RV	193	2	1	536	NC
AE7DW	116	2	1	536	AZ
AC6DN	118	2	1	536	SCV
N3FJP	243	2	2	536	MDC
N7QS	94	2	1	526	WWA
N0FUK	186	2	1	522	WI
W7WOW	186	2	1	522	NV
W7SLS	143	1	2	516	WWA
AC5O	201	2	1	516	LA
AC4RF	132	2	2	514	NC
VA3TGS	81	2	2	512	ONE
WB0IWG	92	5	1	510	ND
N2USM	205	2	1	510	ENY
K7NEW	115	2	1	510	WWA
W8BFX	88	5	1	505	WWA
WB6CZG	70	5	1	500	SV
AA3KM	37	2	1	498	STX
K6UF	112	2	1	498	SCV
W4LT	44	5	1	490	WCF
KB1HXO	70	2	1	490	WMA
W7RT	120	2	1	484	AZ
KK4VNH	67	2	1	484	NC
KQ4CI	116	2	1	482	NC
WA2JSG	38	5	1	480	SNJ
N5HRK	111	2	1	472	NTX
KX3M	92	2	1	468	EPA
KF2MR	72	2	1	464	WNY
N4MUH	150	2	1	464	NFL
KU4WD	179	2	1	458	TN
KD4BAO	102	2	2	454	SC
KS4FE	116	2	1	438	KY
N0BJF	94	2	1	438	MO
W4PGM	169	2	1	438	TN
WB6AAJ	58	2	1	432	SCV
K9SAT	88	2	1	426	AZ
VE6UX	69	2	1	426	AB
K8WTF	70	2	1	424	OH
KD0JLE	137	2	1	424	CO
W3SVJ	133	2	1	416	WPA
VE4XM	132	2	1	414	MB
KK4SUF	31	2	1	412	NC
AB5JR	80	2	1	410	NM
N6QZS	76	2	1	404	SV
W5ES	125	2	16	400	WTX
K8PXR	145	2	1	390	OH
AD7MC	7	5	1	390	WWA
KC3OQ	119	2	2	388	DE
K0NL	67	2	3	384	CO
KB8X	70	2	1	380	OH
KC5WA	45	5	1	375	LA
AD7YV	59	2	4	368	UT
KB0HLF	106	2	1	362	WI
N2GPE	53	2	1	360	NNJ
W5RUA	50	2	1	350	STX
W2MRD	47	2	1	344	ENY
N4TUU	47	2	1	344	NFL
K0MIS	48	2	1	342	CO
K0LEW	191	1	1	341	SD
K7OVG	27	2	1	340	ID
WW0SS	19	5	1	340	MN
KF4VXJ	42	2	1	334	NC
KG8YN	88	2	1	326	OH
KA7RRA	87	2	1	324	WWA
WU9Z	72	2	2	318	IN
KA3PCX	67	2	1	318	EPA
WD8RYC	60	2	1	310	TN
WA8WZG	78	2	1	306	AZ
KG6MXO	10	5	1	300	OK
VE6SKY	10	5	1	300	AB
W7JZE	20	2	3	290	SJV
K6OTT	8	2	2	286	SCV
K7VGF	32	2	1	278	WWA
K8RMM	5	5	1	275	MI
KI4TXP	85	2	1	270	DE
N5PA	80	2	1	268	MS
KA2VCW	55	2	1	260	WNY
N7HZB	1	5	1	255	UT
KB5WRK	51	2	1	254	NTX
KC0CDM	26	2	1	254	IA
KE6VUS	88	2	1	252	SV
AE7WE	100	2	2	250	MS
VE3RHE	49	2	1	248	GTA
KI6CQ	48	2	1	248	TN
WO3X	48	2	1	246	OH
KE6TIM	48	2	1	246	SCV
W7SUA	46	2	1	242	AZ
W6ZH	44	2	1	238	LAX
KG4OKG	44	2	1	238	GA
AD8B	93	2	1	236	OK
NOODK	66	2	1	232	MN
K2HVE	40	2	1	230	NNJ
KJ4VTH	39	2	1	228	VA
KB2BE	12	2	1	224	WCF
KA6PUW	34	2	1	218	ORG
KF7PCL	50	2	1	208	WWA
WB4QNG	52	2	1	204	KY
W1AAT	52	2	1	204	VT
N3MWQ	27	2	1	204	DE
KI7N	34	2	1	202	OR
W2FCP	16	2	1	200	NNY
N6CKV	22	2	1	194	SV
VE3JOG	20	2	1	190	ONS
KN7S	43	2	1	186	WWA
KD7YDL	43	2	1	186	WWA
WA7O	40	2	1	180	WWA
N8GGO	40	2	1	180	MI
KA7NPQ	39	2	1	178	AZ
VE7WNO	5	5	1	175	BC
KI4ENS	12	2	1	174	KY
N3XZX	12	2	1	174	VA
KI6WIR	10	2	1	170	LAX
KC5TGF	14	5	1	170	NTX
VE3XAM	32	2	1	164	ONE
KG6HXN	7	2	1	164	SCV
K8IJ	28	2	1	162	KY
KB3ORR	55	2	1	160	WPA
K7NJC	30	2	1	160	MT
WB8ADF	1	2	1	154	OH
WA3LGG	10	5	1	150	EPA
K3SFP	23	2	1	146	VA
KD5WBW	11	2	1	144	NTX
K1RFD	24	2	1	132	CT
N6VNO	7	2	1	128	SCV
K8WZY	11	2	1	122	OH
K4YZ	11	2	1	122	TN
AG4SO	13	1	1	113	VA
K1NPT	31	2	1	112	RI
KF7MKR	31	2	1	112	WWA
N5KH	5	2	1	110	NTX
W6VV	1	5	1	105	SF
K1XRN	25	2	1	100	EMA
KI4CVU	25	2	1	100	TN
K5ZCL	16	2	1	82	STX
N1HOB	8	2	1	78	OK
KE6DII	3	5	1	65	LAX
N3LGA	6	2	1	62	SCV
KF7WXZ	4	2	1	58	NV
AC8PO	3	2	1	56	OH
KC0IUY	1	2	1	52	KS
VA6PRC	1	2	1	52	AB

2E

W5CT	3483	2	5	11,794	STX
KF0UR	1996	2	2	6,838	CO
W6BX	566	5	1	6,010	SCV
W4DXA	1552	2	12	5,508	NC
W2MU	1364	2	3	4,822	ENY
WB2ELW	1159	2	22	4,812	WNY
W4IT	366	5	3	4,260	SC
KQ3F	953	2	6	4,008	EPA
WR5P	1464	2	6	4,008	AR
N3DUE	967	2	2	3,878	MDC
N1CC	1110	2	1	3,856	NTX
K5ER	1193	2	2	3,654	LA
WY7H	1293	2	25	3,466	AZ
W3VPJ	719	2	14	3,226	EPA
K2CK	1119	2	20	2,588	ENY
VA7MM	417	2	4	2,066	BC
K3CCR	513	2	4	2,052	MDC
W6QAR	411	2	11	1,810	SDG
NY4G	166	5	2	1,710	SC
VE6FI	1550	1	5	1,700	AB
W8DYY	916	1	16	1,677	OH
K7SEL	418	2	7	1,344	ID
WOVFW	440	2	7	1,322	KS
K7SDX	386	2	19	1,146	EWA
W6IM	683	1	3	1,122	SDG
KB2URI	85	2	1	976	WNY
AA9UF	142	2	2	918	IL
VE3LM	140	2	2	894	ONE
WB5LVI	135	2	55	826	STX
WC9AR	216	2	16	692	IN
KC9CCQ	223	1	2	493	WI
W4MHG	55	2	2	460	TN
W4TI	60	2	2	340	GA
W8WML	93	2	3	340	MI
K0F	19	2	3	328	IA
KJ6YPG	31	2	1	312	SJV

3E

NF2RS	1679	2	7	7,558	WNY
KE8M	478	5	2	4,790	OH
N1EN	817	2	3	3,844	CT
NO8N	690	2	7	2,926	OH
W9AB	623	2	17	2,754	IN
W5SSV	359	2	40	1,730	STX
W3KWH	292	2	8	1,506	WPA
W6DOJ	1204	1	4	1,345	SV
VE6FAR	298	2	10	1,226	AB
WD6RAT	295	2	15	1,220	ORG
W5RRR	138	2	26	1,090	STX
W6AB	323	2	6	956	SB
AK7AT	219	2	3	914	ID
KB6TR	198	2	3	746	SV
W5HVL	71	2	12	734	STX
K5HOU	40	2	3	654	STX

4E

K3MJW	1537	2	20	5,174	WPA
W4GJ	1274	2	5	4,964	NFL
W7DK	1247	2	45	4,342	WWA
K2USA	854	2	20	3,968	NNJ
K5WPH	816	2	40	2,942	WTX
W8WZZ	653	2	7	1,960	OH
K7LWH	197	2	10	786	WWA

5E

N4SVC	1129	2	18	3,854	NFL
NR3I	98	5	5	1,530	DE

7E

W0NT	3248	2	20	10,746	CO
WG0D	266	2	7	1,538	MN

EOC Stations

1F

Amherst Area Amateurs					
K9UW	1229	2	4	4,468	WI
West Essex ARC					
W2EF	599	2	10	2,814	NNJ
GRVARS					
K9WM	520	2	21	2,568	IL
Dickson Cty ARC					
WC4DC	516	2	10	2,232	TN
Parsippany-Troy Hills RACES					
NI2S	544	2	20	2,052	NNJ
Newton ARA					
WOWML	426	2	5	1,828	IA
Solano Cty Auxiliary Com Service					
K6SOL	509	2	9	1,688	EB
Morgan Cty ARES					
WR4MC	301	2	6	1,570	GA
Amargosa ARC					
N7A	237	2	10	1,558	NV
Montvale OEM & Montvale Emerg Management Radio Ops					
NJ2MV	238	2	9	1,414	NNJ
NASA Marshall Space Flight Center ARC					
WA4NZD	304	2	10	1,380	AL
WX5FWD SKYWARN Team					
W5W	203	2	7	1,058	NTX

Addison Cty ARES
N1NRA 190 2 3 930 VT
Metro ARC
W9LYA 191 2 15 832 IL
Spring ARC
K5VFD 320 2 2 640 STX
Bathurst Area Amateurs
VE9BPD 124 2 6 598 MAR
LaSalle Cty RACES
KC9VID 10 2 2 570 IL
CSP VFD
N7KQ 98 2 2 546 AZ
Johnson Cty ARES
KD0MVJ 216 2 7 504 IA
Ft Bend Cty EMROG
KD5HAL 13 2 5 402 STX
Old Post ARS
W9EOC 57 2 9 364 IN
Montocopa RACES ARES
NE3I 88 2 3 340 EPA
Athens ARC
K5EPH 100 2 10 300 NTX
Ft Armstrong Wireless Assoc
K3QY 105 2 1 260 WPA
Converse Cty ARC
KI0IN 85 2 2 220 WY
ECTAR
KM0OSE 43 2 6 136 SCV
Auxiliary Communications Serice – CA Office of Em Serv – Fresno
W5OES 16 2 1 82 SJV
Plaquemines Parish EOC
KA5EZQ 35 2 3 70 LA

2F

North Central AR AR Service / Small Town AR Service
W5ZN
(+N5QS) 2791 2 64 9,956 AR
Bullitt ARS
KY4KY
(+W4KBR) 1648 2 56 6,348 KY
Alamance ARC
K4EG
(+W4VGZ) 1471 2 25 5,522 NC
York RC
W9YRC
(+N9ZE) 1440 2 25 5,476 IL
Great Falls Area ARC
W7ECA 974 2 36 3,916 MT
Merrymeeting ARA
KS1R
(+N1TRC) 705 2 27 3,754 ME
Oak Ridge ARC
K4PJ 736 2 39 3,356 TN
Hannibal ARC
W0KEM
(+W0MTL) 667 2 14 3,324 MO
MOSI ARC
K2DS
(+KM0SI) 953 2 17 3,256 WCF
Western Illinois ARC
W9AWE 694 2 26 3,254 IL
Polk Cty ARES
WC4PEM 700 2 30 3,248 WCF
Shelby Cty Ohio ARES
K8EMA 889 2 8 3,178 OH
North East Tarrant Cty ARC
N5EOC 591 2 29 3,102 NTX
Turkey Heaven Mtn Rep. Repeater Assoc
N4THM
(+N4IF) 669 2 27 3,076 AL
Story Cty ARC
W0YL
(+W0ISU) 648 2 19 2,798 IA
Franklin Cty ARC
WE4A 678 2 18 2,788 NC
ARC of Centrall LA
N5I
(+KC5ZJY) 625 2 25 2,766 LA
Kings' Point ARC
W4KPR
(+W3SOB) 689 2 21 2,746 WCF
Prairie Home Fire
WA0E 663 2 4 2,684 MO
Orleans Cty ARC
W2ORC
(+WA2DQL) 600 2 25 2,540 WNY
Central IA RAS
K0MIW
(+N0MVC) 525 2 19 2,306 IA
Imperial Cty ARES / RACES
W6ICR 589 2 5 2,304 SDG
Cal Poly ARC
N6CP 974 2 13 2,202 SB
Washington Cty Oregon ARES
W7BVT 227 2 29 2,092 OR
Piscataquis ARC
K1PQ
(+WA1JMM) 301 2 5 2,082 ME
Em Com Assoc
W0ECA 485 2 10 2,032 MO
Norwood Em Management
N1OP 492 2 20 1,874 EMA
Chester Cty ARES/RACES
W3EOC 502 2 14 1,872 EPA
Monroe Cty ARES/RACES
W2EOC
(+KD2DO) 389 2 22 1,830 WNY
Bayouland Emergency AR Service
W5BMC 539 2 24 1,828 LA
Benicia ARC
KB6EOC 409 2 36 1,788 EB
Marshall Cty ARA
KI4HJS
(+K9MMW) 326 2 10 1,754 KY
Thibodaux ARC
W5YL 486 2 15 1,668 LA
Fair Lawn ARC
W2NPT
(+W2TTT) 273 2 35 1,650 NNJ
Howell Cty ARC
W0HCA 277 2 5 1,576 MO
SATERN
K6CME 300 2 10 1,540 SJV
PR Field Day Group
KP4FD 551 2 4 1,506 PR
Hays/ Caldwell ARC
KE5LOT 218 2 14 1,488 STX
Lisbon Area ARA
K8GQB
(+KD8WYO) 145 2 7 1,382 OH
RCMP Group Ottawa
VE3RCMP 253 2 20 1,310 ONE
K2ZV 207 2 25 1,304 NNJ
Raritan Bay Radio Amateurs
K2GE 132 2 16 1,226 NNJ
Waterbury ARC
W1LAS 479 2 9 1,224 CT
East Central MS Chapter American Red Cross
KB5ARC 227 2 6 1,114 MS
Washington Cty Auxiliary Com Service
WC5AR 381 2 5 1,112 AR
UMBC ARC
KB3CVD 193 2 5 1,044 MDC
Tri-County ARC
NC4AR 253 2 36 1,006 NC
Huron Co AR Serv
KC8WIT 230 1 12 949 OH
NE OK Radio Amateurs
NO5RA 376 2 4 948 OK
Stone Cty ARES Group
K5STO 131 2 15 892 MS
Corona Norco RAC
W6PWT 255 2 5 880 ORG
Providence Emerg Management Agency RACES Club
KK1PMA 106 2 7 852 RI
Elk Cty Ks ARS
WX0EK
(+KC0NYK) 43 2 7 836 KS
Decatur Cty ARC
KW4DC
(+KW4DC) 184 2 7 818 TN
Northville ARA
NA1RA 203 2 25 776 CT
Anoka Cty Em Management
W0ANA 212 2 12 774 MN
Bayman RC
KP4NM 6 2 20 762 PR
Sheboygan Cty ARC
W9VCL
(+AB9HH) 212 2 10 706 WI
El Paso Cty SCU
K0EPC 15 2 15 700 CO
Red River Valley ARC
WB5RDD 144 2 16 664 NTX
Marshall ARC
KB5MAR 84 2 17 656 NTX
Club Radio Amateur de l'Estrie
VA2RUF 134 2 23 636 QC
Navarro ARC
W5NFL 82 2 12 614 NTX
AJ4IR 195 2 5 540 SFL
Ashland Area ARC
N8IHI 81 2 6 512 OH
Yavapai ARC
W7YRC 125 2 20 300 AZ
Frederick Cty Sheriff Specialized Communications Team
W4FCS 22 2 3 44 VA

3F

West Jersey DX Group
K2NJ
(+W2EN) 3169 2 26 11,330 NNJ
Williamson Cty ARES
N4FR
(+W4SQD) 2308 2 100 7,928 TN
Mansfield Johnson AR Service
K5T
(+WA5JRS) 2617 2 65 7,642 NTX
Oro Valley ARC
K7T
(+W0HF) 1539 2 50 6,510 AZ
Garden State ARA
W2GSA
(+W2XYZ) 1530 2 34 5,964 NNJ
Lake Cty RACES / ARES
K9IQP
(+W9QL) 1236 2 27 5,264 IL
McHenry Cty RACES / ARES
K9ESV 1117 2 15 4,970 IL
Southwick RACES
WC1SW 1253 2 18 4,834 WMA
Livingston ARK
W8LRK
(+N8EOC) 913 2 18 3,804 MI
Anderson RC
K4TG
(+KY4LAW) 725 2 14 3,540 KY
Tri-Cty ARC North TX
WC5C
(+W5A) 630 2 19 3,100 NTX
Calhoun Cty Em Serv
AB8I 603 2 9 2,812 MI
CARS
(Cascades ARS)
W8JXN 641 2 25 2,760 MI
Burlington ARC
W1KOO 917 2 15 2,684 VT
Burlington Cty RC
K2TD 452 2 42 2,598 SNJ
Goddard ARC
WA3NAN
(+KB3PEE) 648 2 14 2,562 MDC
Daytona Beach CERT ARC
N4DAB 286 2 9 2,432 NFL
Jackson Cty ARA
N5OS
(+W5WA) 533 2 10 2,366 MS
Rockingham Cty ARC
N4IV 398 2 19 2,362 NC
NC Four Cty ARES
NC4CA 698 2 10 2,250 NC
Cass Cty ARC
W9VMW
(+W9LVY) 414 2 14 1,756 IN
Dutch Fork AR Group
W4DFG 458 2 20 1,724 SC
Jones Cty ARC
WV5D 337 2 19 1,580 MS
Culver City AR Em Serv
K6CCR
(+W1MJH) 293 2 24 1,534 LAX
Putnam Cty RACES
WB9EOC 266 2 23 1,462 IN
Effingham Cty ARES
W4ECA 211 2 21 1,446 GA
Queen City Emergency Net
W8VVL 380 2 19 1,366 OH
South San Francisco CERT Comm Group
N6SSF 224 2 21 1,298 SCV
Adams Cty ARS
W3KGN 273 2 13 1,236 EPA
DeSoto ARC
W4MIN 223 2 11 1,220 WCF
Ft Ross Volunteer Fire Dept Station 4
K6MAP 51 2 4 1,182 SF
Virginia Mtn ARC
W4COV 531 2 6 1,124 VA
Baytown Area ARC
K5BAY 254 2 13 1,122 STX
Cupertion ARES
K6KP 27 2 73 1,024 SCV
Laguna Woods ARC
W6LY 178 2 18 1,000 ORG
San Diego / Imperial Ctys Chapter Am Red Cross
W6RDX 410 2 24 970 SDG
Manteca ARC
K6MAN 269 2 20 956 SJV
Sarasota Em RC
N4SER 256 2 13 920 WCF
Friends and AR Com Enthusiasts
KF6NNM 188 2 5 914 SV
Greater Bridgeport ARC
WA1RJI 261 2 10 910 CT
Arizona ARC
W7IO 220 2 13 898 AZ
Osceola Cty ARES
KG4EOC 59 2 19 734 SFL
Metroplex ARC
W2MPX 64 2 11 728 NNJ
Melrose Park ARES / RACES
K9VMP 60 2 4 580 IL
Clatsop Cty EOC
N7AST 65 2 5 578 OR
Defiance Cty ARC
KT8EMA 70 2 17 490 OH
Mon Wireless Assn
W8MWA 92 2 10 442 WV
Madison Cty ARC
W9VCF 142 2 10 344 IN
Hill Cpuntry ARC
N5HR 106 2 30 262 STX

4F

NE MS Rad Ams
W5NEM
(+KE5LUX) 1874 2 69 7,942 MS
MICON-DTX
K8DTX 1128 2 10 4,518 MI
Van Wert Amateur RC
W8FY 1342 2 18 3,974 OH
Southern Counties ARA
K2BR
(+AC2NJ) 822 2 30 3,724 SNJ
NOARC
W4AAZ
(+KI5FR) 933 2 24 3,624 NFL
Charlotte ARC
W4CQ 537 2 29 2,734 NC
Bedford Cty ARS
K3NQT 610 2 20 2,602 WPA
Highlands Cty ARC
K4W 408 2 13 2,366 WCF
South Mtn Radio Amateurs
N3TWT 422 2 45 2,130 EPA
Warren Cty RC
W2WCR 431 2 32 2,108 ENY
ARES Marion CTY
K7MAR 250 2 7 2,022 OR
Key City ARC
KC5OLO 516 2 40 2,020 WTX
Broken Arrow EM ARC
WX5BA 306 2 7 1,862 OK
ARA Tonawandas
W2SEX 305 2 16 1,820 WNY
Tri-Town RAC
W9VT 256 2 13 1,670 IL
XWARN /DARA
W8XRN 398 2 65 1,638 OH
TEAC
W5SI 252 2 21 1,408 STX
Orange CT CERT EmComm
NF1Y 304 2 5 1,376 CT
Madison Cty ARC
KE8RV 208 2 21 1,256 OH
Mid-State ARC
WA9RDF 287 2 25 1,206 IN
WA5CC 150 2 11 1,176 AR
Tazewell Cty ARS
W9TAZ 411 2 35 1,132 IL
Carter Cty ARA
WR4CC 201 2 21 952 TN

5F

Great South Bay ARC
W2GSB 2582 2 75 10,060 NLI
ARASWF
W5F
(+K4YHB) 1220 2 36 4,742 SFL
ARA SW FL
W4F
(+K4YHB) 1220 2 36 4,742 SFL
The Columbia ARC
W4CAE
(+W4RWL) 913 2 58 3,228 SC
Lakeside ARC
K8SEE 657 2 35 2,746 SDG
Flagler Em Com Assoc
AF2C 336 2 41 2,370 NFL
Platte Cty AR Group
WA0QFJ 373 2 29 2,072 MO
Endless Mtns ARC
N3EP
(+W3RN) 268 2 22 1,296 EPA
West GA ARS
W4FWD
(+W3RWT) 203 2 8 874 GA

6F

Centralia ARES
K7CEM 712 2 25 3,392 WWA
SIARC and Drumlins Clubs
WA2EMO 517 2 35 2,332 WNY

7F

Shelby Co ARC
W4SHL
(+NR4J) 1671 2 40 6,842 AL
Tri-State ARA
W8VA
(+W8OI) 833 2 43 3,952 WV
SATERN
N8SE
(+N8SE) 847 2 10 3,276 MI

9F

BEARS of Manchester
W1BRS 919 2 23 4,220 CT

10F

Stanford ARC
W6YX
(+K6SU) 7078 2 42 21,840 SCV

12F

Orlando ARC
K1AA
(+W1SE) 1249 2 48 5,460 NFL

The 2015 ARRL International DX Contest

CW: 0000 UTC Saturday, February 21 – 2359 UTC Sunday, February 22
SSB: 0000 UTC Saturday, March 7 – 2359 UTC Sunday, March 8

Members of the W7RN multioperator, two-transmitter team at the helm during 2014 ARRL DX CW (seated l-r) Trey Garlough, N5KO, and Ralph Bowen, N5RZ, (standing l-r) Rick Tavan, N6XI, and Bob Wilson, N6TV. [Tom Taormina, K5RC, photo]

- Join thousands of operators from around the world as they compete in this fast-paced and exciting international contest. How many different countries can you work in 48 hours?
- W/VE stations send signal report and state or province; DX stations send signal report and transmit power.
- E-mail Cabrillo-formatted logs to **dxcw@arrl.org** or **dxphone@arrl.org**; send paper logs to ARRL, DX Contest, 225 Main St, Newington, CT 06111.
- Log Submission Deadlines:
  CW: 2359 March 25
  SSB: 2359 April 8

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

The 2015 January VHF Contest

1900 UTC Saturday, January 24 – 0359 UTC Monday, January 26

In 2014, Dr Carol Milazzo, KP4MD/6, returned to the January VHF contest for the first time since 1971. This time she used software defined radios and transverters in place of low-power vacuum tube radios. [Dr Carol Milazzo, KP4MD/6, photo]

- The action returns to VHF+ for the January VHF contest. How many amateurs can you contact on 6 meters and up?
- Three new categories for 2015 — Single Operator Unlimited, High and Low Power, and Single Operator Unlimited Portable.
- Contest exchange is simply your Maidenhead grid square. More info on grid squares can be found at **www.arrl.org/grid-squares**.
- Logs must be e-mailed or postmarked no later than 0359 UTC Wednesday, February 25, 2015. Electronic Cabrillo-formatted logs are strongly preferred. E-mail Cabrillo logs to **januaryvhf@arrl.org**; paper logs should be sent to ARRL, January VHF Contest, 225 Main St, Newington, CT 06111.

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

The 2015 RTTY Roundup

1800 UTC Saturday, January 3 – 2359 UTC Sunday, January 4

- Growing in popularity each year, the RTTY Roundup is a perfect opportunity to try RTTY contesting. If you are new to RTTY, setting up your station is easier than ever before. All you need is a PC, a rig, and a sound card interface. Be sure to check out the web page of veteran contester Don Hill, AA5AU, for tips on how to get started, at **www.rttycontesting.com**.
- Don't forget, two new categories were introduced in 2014 — Single Operator Unlimited, High and Low Power.
- W/VE stations send signal report and state; DX stations send signal report and consecutive serial number starting with 001.
- All logs must be received or postmarked no later than 2359 UTC Tuesday, February 3, 2015. E-mail Cabrillo-formatted logs to **rttyru@arrl.org**. Paper logs should be sent to ARRL RTTY Roundup, 225 Main St, Newington, CT 06111.

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

Mike Jacoby, N3MA, poses for a photo before operating in the 2014 RTTY Roundup from his home in Bristow, Virginia. [Michael Jacoby, N3MA, photo]

The 2015 ARRL Straight Key Night

0000 UTC – 2359 UTC Thursday, January 1

Pictured is an antique strap key built by the Engineering Department shop at the University of Michigan. Its owner — and U of M alumnus — Paul Huff, N8XMS, operates Straight Key Night every year with this favorite key. [Paul Huff, N8XMS, photo]

- Celebrate the New Year by slowing down, connecting that favorite straight key or bug that's on your desk or shelf, and making contacts.
- Straight Key Night is not a contest; no need for quick exchanges. Take your time and enjoy a good ragchew…or several! Many hams enjoy dusting off vintage rigs for the occasion, but it isn't required.
- Send us your list of stations worked, along with your votes for Best Fist and Most Interesting QSO, to **straightkey@arrl.org** before January 31, 2015. A paper summary of your activity can be mailed to ARRL Straight Key Night, 225 Main St, Newington, CT 06111. Be sure to post your story and photos of your evening at **www.arrl.org/soapbox**; we love reading detailed stories and seeing photos!

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

January Kids Day — 2015

1800 UTC – 2359 UTC Sunday, January 4

- The first Sunday in January is the time to get youngsters on the air and share in the joys and fun that Amateur Radio can provide!
- Sponsored by the Boring (Oregon) Amateur Radio Club, this event has a simple exchange suitable for a younger operator: First name, age, location, and favorite color. After that, the contact can be as long or short as each participant likes.
- Kids Day is the perfect opportunity to open your shack doors and invite kids over to see what Amateur Radio is all about!

Complete rules and entry forms can be found at
www.arrl.org/kids-day

After watching her dad operate the radio for months, Mike's, N8MR, daughter made her first contacts during the January 2014 Kids Day event. [Photo courtesy of N8MR]

ARRL Rookie Roundup — CW December 2014

1800 UTC – 2359 UTC Sunday, December 21

- If you have been licensed 3 years or fewer, this is your chance to let your new CW skills shine! This 6-hour contest is designed to introduce Rookies to contesting and provide Elmers with an opportunity to help both in the shack and on the air.
- Rookies can work anyone, while non-Rookies work only Rookies. The exchange is your name, the last two numbers of the year you were licensed, and your state, province, or "DX" if you're outside of the US and Canada. Non-Rookies should be prepared to send slowly.
- All scores must be reported within 72 hours after the event.

Complete rules, team registration and score reporting can be found at
www.arrl.org/rookie-roundup

Jeff Howington, AD0AK, will return for his final year as a Rookie in the December Rookie Roundup — CW. [Jeff Howington, AD0AK, photo]

Bernie McClenny, W3UR, w3ur@arrl.org

New DXers and Returning Entities

Some pointers to help the many new DXers out there.

This past summer I had the pleasure of presenting as a "professor" for DX University (**www.dxuniversity.com**) at the ARRL® Centennial Convention in Hartford, Connecticut. My presentation was on Internet Resources. When doing presentations, it is always a good idea to know your audience and the material you're going to talk about. We had well over 120 attendees. Of these, more than 50% were interested in DXing and had fewer than 100 DXCC entities worked. I've helped Wayne Mills, N7NG, and the other DX University professors facilitate for several gatherings, and this gathering had, by far, the best percentage of new and interested DXers. After realizing this, I decided to change my presentation a tad by asking some questions of the audience and giving the attendees some helpful hints.

The Value of Going Digital

Yes, I told them the old proverb, "listen, listen, and listen some more before getting in the pileup." I asked how many of them had a computer in their shack. It was not a surprise that most did. I recommended they they use a computer to log all of their contacts, whether for contesting, DXing, or just plain old ragchewing. I spoke about how I wished I had had a computer when I first got licensed back in 1977. Having computerized logs really helps when searching for contacts. You can search by call, country, state, county, grid locator, CQ zone, ITU zone, date, time, band, mode, and even for a keyword in the comment field.

I advised them to remember, that when they start logging contacts in the computer, they need to maintain the files containing those prized contacts. First, it's important to back up the needed files. It's best to have a copy both in the shack and off site, in case of fire or other disaster. It's just a matter of time before we will need those backup copies. Believe me, I speak from experience!

Next, I advised the new DXers to go online and register for Logbook of The World (LoTW). Even if you don't start out seeking awards, LoTW (**www.arrl.org/logbook-of-the-world**) is free to everyone to upload logs, and it helps many people with award-hunting by confirming contacts automatically. It's also another way to retrieve your log if it's ever lost. While we're on the subject, everyone should encourage contesters to use LoTW also. After all, their contacts are already in electronic format and it is just one easy step to upload after a contest, just like submitting logs to the contest sponsor.

Delete Them All?

I've always wanted to write a "How's DX?" article entitled "Delete Them All." I'm convinced we could come up with an excuse to delete almost every ARRL DXCC Entity on the list. Every once in a while I hear someone say, "We should delete [fill in the blank] because of [fill in the blank]." My favorite excuse is the ever-present "because it hasn't been on the air in [fill in the blank] years." The DXCC rules, which began to take form in the mid 1930s, never mentioned time frame of inactivity, and hopefully never will. Believe it or not, this adds to the value of the DXCC program — just ask any old-timer.

Cases in Point

In the past we could all point to China, which, up until the 1980s, had not been on the air for almost 40 years. Then there was Albania, silent for close to 20 years. Now both are on the air — daily in the case of BY and almost daily with ZA.

But for the newer DXers out there, let's talk about E3 — Eritrea, which has not been on the air since we last heard E30OA in early December 2001. Thanks to the steadfast efforts of Zorro Miyazawa, JH1AJT, we finally heard E30FB from downtown Asmara during the period of September 17 – 25 this year, with a strong possibility of a larger scale DXpedition taking place before the end of the year, probably during November 2014. That's 12 years and 9 months of no activity. That doesn't even come close to the 40 years of no activity from China. The point is that an entity may be silent for a long time, but they have always returned to the air at some point.

There is yet another DXpedition coming up very soon that we will all be a witness to, Navassa Island (KP1). This one was last put on the bands by W5IJU, NF6S, NH2S, and KH2W, with the last contact in the log on April 2, 1993. KP1 is the most wanted DXCC Entity, probably because it's the ARRL DXCC list entity that's been inactive for the longest time. As of December 2014, it's now been 21 years and 8 months. Yes, longer than ZA, but not as long as BY. However, I believe we are soon going to hear KP1 on the bands again.

And there is another entity — I'm not at liberty to say which one, yet, — that has been off the air more than 12 years, which may return soon. I understand news of this one will soon be announced. Until then, watch your favorite DX outlet.

True-blue DXers know good things come to those who can stay in the game. The original crafters of this award never meant for the players to work them all — well, at least not very quickly. The effort required is what adds to the value of the DXCC program. If it were easy to work them all, everyone could do it, or at least not as many would try!

Chesterfield Islands 2015 DXpedition

Gene Spinelli, K5GS, issued this press release regarding a DXpedition to Chesterfield Islands:

> The Perseverance DX Group (**pdxg.net**) is pleased to announce their intention to conduct a DXpedition to the Chesterfield Islands (OC-176), currently number 25 most wanted on Club Log. Initial planning has begun for an expedition later in 2015.

The expedition yacht *Evohe* will provide transportation to the island. Subject to licensing and landing formalities, it is expected a team of up to 12 operators will be on the island for up to 12 days. The team will sail from Nouméa, New Caledonia.

Team members committed or considering their participation include: Pista, HA5AO; Les, W2LK; Heye, DJ9RR; Norbert, DJ7JC; Mike, WA6O, and Gene, K5GS. Additional team members will be added throughout the planning phase.

Our website is under construction. Watch the usual DX sources for information. We will announce additional details as they develop.

Please direct questions to Gene, K5GS, or Pista, HA5AO, at their e-mail address listed on **QRZ.com**.

73,

Team Chesterfield — 2015

PS, As most of you know, *Evohe* is out of Dunedin, New Zealand. The current plan is to load the boat in New Zealand and later meet the boat and the remainder of the team in Nouméa.

A Note from a Bureau Sorter

Bill Ellington, K4MWB, is a volunteer ARRL incoming DX QSL sorter for W4M, K4M, and N4M calls. He sends the following:

As a volunteer ARRL incoming QSL bureau sorter, I periodically try to purge my files of unclaimed incoming DX QSLs. Recently, I looked at how many of the calls who currently had unclaimed cards I could reach and who wanted the QSLs. Here are some interesting statistics:

In my files there were 390 calls with at least one unclaimed incoming DX QSL card. Of these calls, I was able to successfully contact only 34% using a valid e-mail address in **QRZ.com**. The rest had either no e-mail address or an invalid one. *Lesson 1*: Keep a valid e-mail address in **QRZ.com** for things like this.

Of the calls I was able to notify of QSLs awaiting their SASE, 6% said to discard them, 25% said they wanted the QSLs and would send an SASE right away, and 69% did not reply to my request for direction on disposal of the QSLs. *Lesson 2*: If you want incoming DX QSL cards from the bureau send your sorter SASEs.

Suggestion: If you do not accept bureau cards, notify your sorter and please make sure your **QRZ.com** profile states this. It will save much time and money for those who send cards, as well as the bureau, and sorters like me.

To contact your sorter go to **www.arrl.org/incoming-qsl-service** and look for your call prefix sorter.

DX News From Around the Globe

5R — Madagascar. Toshi, JA8BMK, has announced he is heading to Madagascar Island where he will be operating as 5R8DX in January 2015. He will be focusing on 80 and 160 meters. Details to follow. QSL via JA8BMK.

DF2WO Back to Africa. Harald, DF2WO, is planning his first stop in Ouagadougou, Burkina Faso, where he will be QRV on the HF bands on CW and SSB as XT2AW November 17 – December 2. Next, he will go to Praia, Cape Verde where he will be QRV as D44TWO. He'll be there December 12 – January 8. QSL both via M0OXO.

E6 — Niue Island. JA1XGI's next operation will be December 1 – 6 from Niue. This one used to be ZK2. He leaves Tokyo November 28 for Sydney, and then will travel to Auckland, leaving from there for Niue on the 30th. He will pick up the license at Telecom Niue on December 1. He expects to get the call sign E6XG. Once those formalities are all settled, he will be on the air, 160 – 10 meters, especially looking for Europe and North America on low bands, mostly CW, with some SSB and digital modes. Here are the target frequencies:

CW: 1815; 3525; 7025; 10,105; 14,015; 18,080; 21,015; 24,895, and 28,015 kHz

SSB: 7145; 14,175; 18,135; 21,260; 24,940, and 28,450 kHz

RTTY: 7045; 10,140; 14,088; 18,102; 21,088; 24,915, and 28,088 kHz

For E6XG, QSL direct or by the bureau to his home call; OQRS will be available too. His web page and blog are at **island.geocities.jp/niuevacation/index.htm** and **e6xg.yolasite.com**, respectively.

HK0 — San Andres and Providencia Islands. 5K0A will be QRV from San Andres Island November 26 – December 4, with operator Tim, LW9EOC. This operation will be like his previous 5J0T operation, earlier this year, on 80 – 10 meters CW, SSB, and RTTY. QSL via LW9EOC.

VK0H — Heard Island. The much anticipated Heard Island DXpedition, lead by Dr Robert Schmieder, KK6EK, has been moved up to the November/December 2015 time frame. This one hasn't been QRV since late January 1997, when Bob and the VK0IR crew were last there. Keep an eye on the VK0EK website at **vk0ek.org**.

VK0M — Macquarie Island. By the time you read this Rod Macduff, VK6MH (GM4AWB), should be on the air as VK0MH from the permanent base on Macquarie Island. He's expected to be there working and operating in his spare time until April 2015. Word has it he'll be uploading his logs to both Club Log and LoTW. Rod has not been on the air for some years but his buddy Chris, GM3WOJ, back in Scotland spent some time with him, giving him some pileup practice and coaching. Rod has been technical director of Q-Mac Radio in Perth, Australia.

Wrap Up

That's it for this month with thanks to K4MWB, KE3Q, and *The Daily DX* (**www.dailydx.com**) for helping to make this month's column possible. Please 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

Strong Tropo Heats Up the VHF Contest

Tropospheric opening boosts contest scores in the ARRL September VHF contest.

On Saturday evening and Sunday morning of the ARRL® September VHF contest, a strong tropospheric opening took place on the VHF and UHF bands across the Midwestern and Northeastern states. Sam, W8SPM, was operating low-power portable from Spruce Knob, West Virginia in FM08. He was in a prime spot to take advantage of the opening. He worked as far west as KF0M (EM17) and N0IRS (EM29) Saturday evening on 2 meters, running only 10 W. Here is his account:

> I arrived in FM08 Wednesday, September 10 around 9 PM. There were 50 – 65 mph winds all night, lasting into early the next morning. The temperature was in the high 40s. Early Thursday morning the winds died down. I started assembling antennas at 8 AM — rain started at 9 AM and it rained the entire day, making the antenna work miserable. I was soaked head to toe. The antenna work was done about 3 PM. I had to use a 24-inch pipe wrench and a screwdriver to lock down the telescoping mast pipe due to wind. Late Thursday night the weather cleared. It was a nice morning on Friday. I should have waited until Friday to put the antennas up.
>
> I woke up Saturday morning with 20 – 30 mph winds and hard rain. The peak was socked in with fog. I hoped for the weather to clear before the contest started. The pipe wrench was needed to hold the antennas in position due to the wind! The conditions were bad at contest start at 2 PM (1800Z) with a hard rain and 20 – 30 mph winds for 3 – 4 hours after the start of the contest. Then, at about 5:45 PM the rain and wind let up. I turned the antenna to the west and things began to happen. Heard N0IRS (EM29) on 2 meters with an S-9 signal. N4QWZ (EM66) stayed 10 over nearly 12 hours from 2100Z until 1000Z Sunday morning!
>
> Very slow conditions Sunday morning with more rain and wind. By the afternoon, I thought the contest was about over for me. About 0000Z Monday, the rain and wind stopped, and I turned the antenna to the Northeast. Worked N1IIG (FN31). Within 30 – 40 minutes, I logged 10 new grids including Dave, K1WHS, in Maine (FN43). That was the farthest northeast I got!
>
> I have come to this location on Spruce Knob 41 times since 1980. I have used telescoping mast pipes for many years and then about 1993 started building a 50-foot tower for contests. I worked 84 grids in the September 1986 VHF Contest running stacked 214 b Cushcraft antennas and 160 W. This is my first contest operating low power at 10 W using a single 13LB2 Yagi with a Kenwood TR-751A with two deep-cycle Crown batteries in parallel. In 34 years I have never had what I call a good opening. So many stations could not believe I was running just 10 W. I had always hoped just one time to get great conditions, and I think this was it!

Sam, W8SPM, operated the VHF contest as a low-power portable from Spruce Knob, West Virginia in FM08. He used a Kenwood TR-751A transceiver running 10 W into this single 13LB2 Yagi. [Sam Maze, W8SPM, photo]

Geminid Meteor Shower — the Radiant Effect

The annual Geminid meteor shower will grace the holidays with a spectacular celestial light show in mid-December. This year the shower peaks on December 13. Here are some tips for improving your success this year, based on observations from the Perseid shower.

The August 2014 Perseid meteor shower had some great moments. Some stations worked rare grids and new states; others had poor results. Why were some stations successful while others struggled? It could be due to the "radiant effect."

There are nuances as to the best times to operate during a meteor shower. The exact "peak time" of a meteor shower is not as important as many people think. Most showers have broad peaks of a day or more. The radiant effect is the most important. It has been found that the best radio reflections from meteors occur when the shower's radiant (the point in the sky where it appears the meteors are originating from) is at 45° elevation and an azimuth of 90° to the path between two stations. This will be the most productive time for meteor scatter contacts.

This occurred twice a day during the Perseid shower — from 0100 – 0300 midpath local time for SE – NW paths and 0900 – 1100 for NE – SW paths. The K5N Grid Expedition was loud August 13 on 6 and 2 meters to the Midwest between 9 – 10 AM CST via meteors. It was no coincidence that this was the peak time for the Perseid's NE – SW path. You will hear very few meteor reflections when the radiant is low, below the horizon, or too high in the sky. I saw people on the Ping Jockey page attempting Perseid's schedules when the radiant was in a poor location.

The velocity of meteors is important as well. The Perseid meteors are fast at 59 km/s. For 144 MHz meteor scatter — meteors slower than 50 km/s are usually inadequate. The Geminid meteors are slower at 34 km/s — but can produce strong reflections on 6 and 2 meters, making contacts possible. A tip for success in this shower — the peak path directions and times based on the Geminid shower's radiant are N – S 10 PM – local time and N – S 5 – 7 AM local time. SSB and CW contacts are possible at peak times. (A detailed discussion of these topics can be found in Chapter 3 of the *ARRL Operating Manual*).[1]

The 16th International EME Conference

Rick Rosen, K1DS, submitted a report about the 16th International EME (moonbounce) Conference. It was held in Brittany, France on August 24 – 26, 2014 at Pleumeur-Bodou, the site of the 64-meter wide radome. The radome houses the immense 340-ton antenna that captured the first live television signals broadcast from the US via Telstar satellite to France in June of 1962. More than 100 EME enthusiasts and their spouses participated in this 3-day event.

The conference had more than 23 presentations over 2 days with topics in all fields related to moonbounce activity and frequencies as high as 77 GHz. Speakers from countries all over the world contributed their experience, technical achievements, and research. The program was interspersed with workshops and demonstrations that included operation of the 144 MHz digital EME station, a 5.6 GHz CW/SSB EME station, and reception of the 10 GHz EME beacon with a small 50 centimeter dish, preamp, and downconverter. We thank Chairman Andre Gilloire; Co-chair Lucien Serrano, F1TE, and Co-chair Guy Gervais, F2CT. The 17th International EME Conference will be held in Venice, Italy in 2016.

The ARRL EME Contest will be held on the weekend of December 6 – 7. See the ARRL website for complete details.

On the Bands

50 MHz. A strong sporadic E (E_s) opening took place Labor Day weekend. In Kansas, N3MK in rare grid FM27 was strong at 0109Z September 1 for N0JK (EM28). W3UUM Texas (EL29) worked W1AW/1 ME (FN43) on double-hop E_s at 0202Z on the 2nd. An E_s-TEP opening occurred on the afternoon of September 3. Stations from New England and California worked Argentina, Brazil, Chile, and Uruguay. K1SIX and K2MUB spotted CE3SX at 2200Z and K7JA spotted CE4WJK at 2300Z. E_s was spotted from Mexico with XE1USG (EK09) by KS7S (DM41) at 2345Z.

TEP season started in the Pacific. Art, KH6SX (BK29), heard the FK8SIX/b and worked VK4WTN via TEP on the 4th at 0708Z. On the afternoon of September 5 a strong E_s-TEP opening occurred between W1, W2, W3, W4, VE2, and VE3 to CX and LU. The E_s link was shown by spots posted by N8JX for NP4A and 9Y4D, and by W1JR for HI3TEJ via E_s at ~ 2100Z.

An unusual early morning double-hop E_s opening occurred between the southern states and Puerto Rico September 7. NP4A worked as far west as N5JEH (DM65) around 1230Z. That is 6:30 AM in the morning in New Mexico! Later that afternoon, another strong E_s opening occurred from Pedro, NP4A, to the Midwest. Pedro was 20 over S-9 for over an hour here in Kansas for N0JK (EM28) and KQ0J (EN11) Nebraska at 2215Z. Later, an E_s-TEP opening occurred from the eastern and central states to CE, CX, LU, and PY. Dennis, K7BV, commented: "My ON4KST post says it all: 00:48:10 K7BV Dennis True DX piggy day here: CE-2 CO-1 CX-6 LU-7 KP2-1 KP4-5 PY-5. A fun, fun day."

In addition, Dennis "spotted many South American beacons — many heard for the first time from here. E_s was good to the west as well as throughout the entire Caribbean and then the TEP opening."

On the 10th an X-class solar flare erupted. Hopes were high for aurora and other propagation. The CME arrived on the 12th. Some aurora contacts were spotted on 6 meters along the northern tier states, but there was no F-layer enhancement. The CME sparked some E_s-TEP the Saturday afternoon of the VHF contest on the 13th. Fred, K3ZO (FM18), reports:

> It is my observation that each time the K-index reaches 4 or higher, the following day there will be a sporadic E opening on six meters to the Caribbean. So since the K index hit K = 7 on Friday night, I was fully expecting the two CO3s that I worked during the contest Saturday. I was not expecting the opening to Florida, much less the opening that we had to Uruguay and Argentina. I had worked everybody in Florida that I could hear running stations so at 2134Z Saturday, I called CQ on 50.126 MHz and was answered by KP4KD/W4 and then by KF4PFI.
>
> KF4PFI complained about splatter from 50.125. By then I could hear the splatter myself so I went over to 50.125 to see who it was. Wow! Was that fellow actually giving out the grid GF15?! It turned out to be CX2TQ and I made a quick QSO with him.

A group of EME 2014 participants setting up the 2 meter antennas used for the digital EME station at the foot of the Pleumeur-Bodou site's 13 meter dish. [Rick Rosen, K1DS, photo]

[1] M. Wilson, K1RO, Ed., *The ARRL Operating Manual for Radio Amateurs*, 10th Edition, (Newington: 2012), pp 3-10 to 3-13. Available from your ARRL dealer, or from the ARRL Store, ARRL order no. 5965. Telephone toll-free in the US 888-277-5289, or 860-594-0355, fax 860-594-0303; **www.arrl.org/shop/**; **pubsales@arrl.org**.

Alerted to the opening to southern South America — no doubt due to the mating of Sporadic E to Florida and Cuba with TEP from there to LU and CX — I went down the band where I found and worked LU9AEA in GF05 on 50.107. Then I heard Dave, K1RZ, working LU6DRV in GF05 on about 50.120 but I couldn't hear him well enough to complete a QSO with him, but I did so later at 2204Z. At 2210Z I noticed that LU9AEA was peaking over S9 so I called a brief "QRZ DX?" on 50.110 in Spanish and was rewarded with an immediate answer from LU8DWR in FF86.

N0JK/p (EM18) logged CX2TQ (GF15) at 2210Z. KB0QGT/rover (EM18) was heard calling CX2TQ. K2MUB (FN21) found LU1YT (FE49) at 2202Z. Rich, K1HTV (FM18), says:

> The first E_s started for me just before 2030Z Saturday, September 13. A number of Florida stations were worked plus stations in Cuba (CO3VR and CO3JA) and Mexico (XE3/K5ENS). Just before 2200Z, our E_s opening to the south coupled into the Florida-to-South America TEP. I had QSOs with two LU stations in GF05 (LU9AEA and LU6DRV) and two stations in GF15 (CX2TQ and CX9AU). By 2220Z Saturday the E_s and TEP disappeared.

On the 20th, W9DR (EL86) heard the ZD8VHF/b (II22) at 2330Z. KH7Y and KH6/K6MIO (BK29) worked LU and PY stations on the 23rd around 0145Z over a 12,000 kilometer path. Bob, W9EWZ, in Wisconsin worked Doug, ZP6CW, in Paraguay at 0150Z via E_s-TEP on the 28th.

144 MHz. N0IRS (EM29) worked W3IP (FM19) at 1543 kilometers and K8TQK (EM89) on tropo September 8, which had formed under a stagnant high pressure system at 0138Z. JD relates:

> I had been working the guys up into northern Illinois on 432 MHz and had the antennas parked at 52°. I left the K3 on 144.200 MHz and was working across the room when I heard an unfamiliar voice calling CQ. Managed to pick the right direction and turned the antennas due east. There was Mike, W3IP, loud and clear at S-5. He pointed out that we had worked last year on September 5, 2013. My log confirmed this. So we were within a few days of the same conditions 1 year apart.

W0VB (EN34) spotted aurora contacts on the 12th as far as NZ3M (FN10) and VE2DSB (FN35). W8IO (EN63) worked W0VB (EN34), W9EWZ (EN52), and N0KK (EN35) around 2315Z.

KF6A (EN73) worked W4NH (EM85) at 0223Z September 14. John, KF0M (EM17), and Sam, K5SW (EM25), logged W8SPM/p low-power in FM08 around 0400Z on the 14th. Rich, K1HTV (FM18), says:

> On the first night of the VHF contest, tropo conditions on 2 meters and 70 centimeters were nothing to write home about. The only decent distance on 2 meters was with VA3ST (FN03) and K2EY (FN02). I got on Sunday morning around 1320Z. By then, conditions were much improved with QSOs up with K1PXE (FN31) on 2 meters and 70 cm and K1WHS (FN43) in Maine on 6. As the evening progressed, the tropo conditions continued to improve. On both 144 and 432 MHz, QSOs were made with W2SZ (FN32), W4NH (EM85 in GA), N4QWZ (EM66 in TN), and VA3ST (FN03). On 2 meters my best DX was out to TN (N4QWZ in EM66).

Fred, K3ZO (FM18), also had great tropo conditions during the contest:

> Two meters was also a source of some pleasant surprises for me. I have found over time that the best way to pick up some distant grids on 2 meters is to call a slow CQ on CW in the vicinity of 144.200 beaming alternately NW, W, and SW. At 0104Z (9/14), Saturday night, that garnered an answer from WA9KRT in EN61 and at 0226Z (9/15) Sunday night it brought an answer from N4QWZ in EM66. At 0313Z Saturday night I worked W8SPM/8 (FM08) on 144.200 who was calling CQ. After I worked him he was called by KF4WE in EM56 and by golly I could hear KF4WE perfectly well, so while W8SPM very kindly stood by I quickly logged a QSO with EM56.

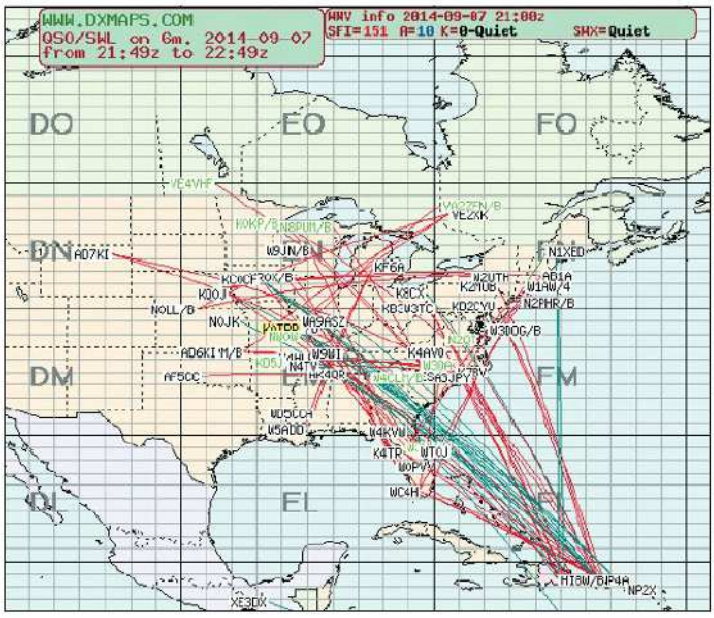
On the 20th, Ramsey, NP3XF, and KP4EIT (FK68) worked CX6DH at 2334Z via TEP.

222 MHz. On the 8th, JD, N0IRS (EM29), worked K8TQK (EM89) on tropo.

432 MHz. K8TQK (EM89) worked N0IRS (EM29) with 58 signals at 0206Z the 8th. On September 18, N0JK (EM28) contacted WB0YWW (EN22) using 10 W and a Quagi, and N0IRS (EM29) chatted with N4PZ (EN52) via tropo.

1296 MHz. N0IRS (EM29) using a single loop Yagi and 50 W logged K8TQK (EM89) at 974 kilometers on the 8th at 0506Z.

10 GHz. Herb, WA2FGK, worked K2DH (FN12) for a new state (New York) September 21 over an obstructed path. "With New York worked, I am now at 14 states and 23 grids from FN21."



An unusual double-hop E_s opening brought Puerto Rico and the southern states together, if you were up early enough, that is. [**dxmaps.com**]

Here and There

The K5N Group reported 196 contacts on 6 meters and 89 on 2 meters from DM71 in August. They also made 11 EME contacts on 6 meters.

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!

Nov 28, 1300Z – 2100Z, W1P, East Falmouth, MA. *Seehund* U-5075 Amateur Radio Association. **Steamship *Portland* Commemorative Special Event**. 21.260 14.260 7.230 3.997. QSL. Henry Brown, K1WCC, 19 Sao Paulo Dr, East Falmouth, MA 02536. **www.qrz.com/db/ww2man**

Nov 29, 1400Z – 2000Z, K4VRC, Lady Lake, FL. The Villages Amateur Radio Club. **Radio on the Square**. SSB 21.361 14.261 7.261; CW 24.291 18.091 10.121; PSK31 14.071. Certificate. Marty Brown, 2218 Margarita Dr, Lady Lake, FL 32159. **www.k4vrc.com**

Dec 5 – Dec 7, 0000Z – 2300Z, KC9HYY/MMD, Muskego, WI. KC9HYY. **Monongah Mine Disaster of 1907**. 28.365 21.265 14.265 7.165. QSL. Nathan Banks, Attn: Monongah Mine SES, PO Box 324, Muskego, WI 53150. *All QSLs need to be submitted with SASE by mail by Feb 1, 2015 to be guaranteed a QSL.* **www.qrz.com/db/kc9hyy**

Dec 6, 1400Z – 2200Z, W2HO, Newburgh, NY. Orange County Amateur Radio Club. **Santa Net**. 14.220 7.200 3.920. QSL. Orange County Amateur Radio Club, PO Box 624, Cornwall, NY 12518. *Santa will make a special trip to the Newburgh, NY area on Dec 6 to talk with good boys and girls from all over the world. We have expanded Santa Net this year for a much broader operating schedule. All children who talk with Santa will receive a QSL card from the Jolly Old Elf himself, sent to the address of the licensed ham who is using his or her station to contact Santa.* **www.ocarc-ny.org**

Dec 6, 1500Z – 2100Z, W4HZL, Hayes, VA. Middle Peninsula Amateur Radio Club. **407th Anniversary of Capture of Captain John Smith**. 14.262 7.262. QSL. QSL Manager, MPARC, PO Box 1121, Gloucester Point, VA 23062. *Capture of Captain John Smith by the Powhatan Confederacy, led by Chief Powhatan. 2014 is also the 400th anniversary of the marriage of Pocahontas to John Smith.* **www.mparc.net**

Dec 6, 1700Z – 2300Z, N0C, Saint Charles, IL. Illinois Wing Civil Air Patrol. **73rd Anniversary of Civil Air Patrol**. 18.125 14.250 7.255. QSL. Maj Ron Walerowicz, ILWG CAP, PO Box 4027, Saint Charles, IL 60174. *Frequencies will move as band conditions change; see URL.* **www.n0c.info**

Dec 6 – Dec 13, 1300Z – 2200Z, W2W, Baltimore, MD. Amateur Radio Club of the National Electronics Museum. **Pearl Harbor Commemoration**. 14.241 14.041 7.241 7.041. Certificate & QSL. W2W — Special Event Station, Box 1693, MS 4015, Baltimore, MD 21203. *Additional operation is possible Dec 8 – 13, 2014.* **ww-2.us**

Dec 6 – Jan 6, 0000Z – 0500Z, XM3G, Mississauga, ON. Robert Emerson. **200th Anniversary of the Treaty of Ghent**. 28.525 24.940 21.295 14.270. QSL. Robert Emerson VE3RHE/XM3G, 6950 Summer Heights Dr, Mississauga, ON L5N 7E9, Canada. *VE3RHE will be operating as XM3G to celebrate the 200th Anniversary of the Treaty of Ghent.* **ve3rhe.ca**

Dec 13, 1500Z – 1900Z, N4TUN, Cullman, AL. Cullman Amateur Radio Club. **50th Anniversary**. 14.220 145.310. Certificate. Mike Fromhold, 1705 Emil Dr NW, Cullman, AL 35055. **www.facebook.com/CullmanARC**

Dec 13, 1600Z – 2200Z, K9C, Rudolph, WI. Wood and Portage County ARES. **13th Annual Country Christmas in Rudolph, Wisconsin**. 14.280 14.242; 146.790 pl 114.8; 146.520 simplex; AA9US-R EchoLink node: 688418. Certificate & QSL. Paul Giannoni, 976 Falk Ct, Nekoosa, WI 54457. *SASE for Special Rudolph the Red Nosed Reindeer QSL and Certificate.* **www.qrz.com/db/k9c**

Dec 13, 1700Z – 2359Z, NI6IW, San Diego, CA. USS *Midway* (CV-41) Museum Ship. **Pearl Harbor Remembrance Special Event**. 14.320 7.250; PSK31 14.070 D-STAR REF1C. QSL. USS *Midway* (CV-41) Museum Radio Room, 910 N Harbor Dr, San Diego, CA 92101.

Dec 13 – Dec 14, 0000Z – 2200Z, K7CCH, Coos Bay, OR. Coos County Radio Club. **28th Annual Shore Acres Holiday Lights Festival**. 21.287 14.287 7.287 3.987; digital and voice. QSL. Coos County Radio Club, K7CCH, PO Box 698, Coos Bay, OR 97420. **www.coosradioclub.net**.

Dec 13 – Dec 14, 1400Z – 2200Z, WX3MAS, Nazareth, PA. Christmas City Amateur Radio Club and the Delaware/Lehigh Amateur Radio Club. **Christmas City Special Event**. 28.465 21.365 14.265 7.270 3.850; CW and PSK31 on 20 and 40 meters; possible 10 and 15 meters depending on conditions. Certificate. WX3MAS, 14 Gracedale Ave, Greystone Building, Nazareth, PA 18064. **www.dlarc.org**

Dec 13 – Dec 14, 1600Z – 0100Z, K5WPH, El Paso, TX. Sun City Amateur Radio Club. **B-36 Special Event.** 14.260 14.070 7.260. QSL. Sun City Amateur Radio Club, B-36 Special Event, 3709 Wickham, El Paso, TX 79904. *Remembering the crew of the B-36D that crashed in the El Paso, Texas, Franklin Mountains on Dec 11, 1953.* **www.k5wph.org**

Dec 15 – Dec 30, 0000Z – 2359Z, W2B, Cleburne, TX. Menasco Amateur Radio Club. **Battle of the Bulge Memorial Station.** 28.427 24.942 21.350 14.035 14.062. QSL. Menasco Radio Club, KC5NX/W2B, 9200 Summit Court W, Cleburne, TX 76033. *We will attempt to operate all bands and modes. QSL with return postage only to KC5NX or W2B.* **kc5nx.radio.club@gmail.com** *or* **www.qrz.com/db/w2b**

Dec 18 – Dec 24, 1500Z – 2300Z, KC5OUR, Peralta, NM. Valencia County Amateur Radio Association. **Christmas in Bethlehem**. 28.483 21.283 14.283 7.283. QSL.* VCARA, PO Box 268, Peralta, NM 87042. *LoTW or bureau also good.* **www.kc5our.com**

Dec 26, 1700Z – 2100Z, WE7GV, Sahuarita, AZ. Green Valley Amateur Radio Club. **Happy Holidays Special Event**. 14.246 14.244 14.242. Certificate & QSL. Green Valley Amateur Radio Club, 601 N La Canada Dr (SAV), Green Valley, AZ 85614. *Grab your new rig and contact us from the Collins discage antenna at the Titan Missile museum.* **gvarc.us**

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 x 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 **Feb** *QST* would have to be received by **Dec 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 Oct 8. You can view all received Special Events at **www.arrl.org/special-event-stations**.

Strays

A Coded Message

Raul Midon is an accomplished jazz musician. He has performed all over the world, including at Carnegie Hall. Blind since birth, he is also a Morse code enthusiast and active ham operator, licensed as KB5ZOT. In his performance of The Who's "I Can See For Miles," he introduces the song saying, "I included a little coded message at the beginning that only a few of you will get." Can you? It begins at the 1 minute, 20 second point in the online video at **www.youtube.com/watch?v=ICjINQtOvbA**. — *Fred Maas, KT5X*

Life Members

Elected October 4, 2014

Alicia W. Abell, KG6LJ
Steven R. Allen, WD4JIX
Kitty J. Allison, K5ITT
John C. Amodeo, NN6JA
Michael T. Anderson, N2TX
Paul Anderson, KC9FYD
William D. Anderson, N6KAS
William K. Arthur, WA6OPQ
Stephen M. Ater, KA9ORH
Tomas M. Bagdas, NU2I
Michael H. Barnard, N1IHL
Frank H. Bauer, KA3HDO
Jimmie D. Becraft, K4JDB
Paul W. Benfield, NB9Z
Debra K. Bennett, KD0ZJP
Christopher A. Bible, KC9ZCK
Raymond T. Bishop, NV9B
Philip J. Black, KF7WFZ
Robert E. Bliss, KE5GBQ
Harold Bodkin, K1SY
Steve Bontempo, KU4BY
Martin J. Boyle, KA2CCJ
Norman P. Bradley, K6NPB
Elaine Bradtke, KG7CME
Jeremy Brandt, AF5NS
Marc C. Breckenridge, WD8MWD
Paul M. Brooks, WB6MKS
Eric T. Budinger, N2KOJ
Lee R. Burton, N6UDP
Paul D. Cabbe, KA1ROH
Reginald L. Carter, WV3L
Ron Chambers, N5QQ
Terry J. Chontos, WB3EVZ
Thomas T. Ciciora, KA9QPN
Bruce L. Clark, KA2ODP
Darren P. Clarke, N9YLZ
Chip Cohen, W1YW
Theodore E. Collins, AL7RF
James Connors, K1SAW
John Copeland, N8DXR
William Corea, KA1EVS
Michael A. Cozzi, KD8TUT
Robert R. Creal, KG4HUF
Nicholas Curcuru, K1LFG
D. J. Czech, KV3X
Jeffrey T. Dalrymple, N5YEI
Rolf Damon, KG7MYO
Bernd Daubner, DL4MFO
Jeff L. Davis, KE9V
David J. De Vos, KF8QL
Juan C. Delgado, W6NOW
Bryan J. Delozier, N4BJD
Barry H. Dent, K6BHD
Wayne B. Dunham, NC4B
Kevin S. Early, WL7BZ
David O. Eisman, AJ1O
Sean Flippin, KK4JKW
Robbie Foust, KI4TTZ
Sonja Foust, KI4USZ
Thomas A. Foy, N4HAI
Mark E. Francis, KD2EUV
Todd J. Gahagan, WA7U
Francisco J. Garcini, N1JEU
Dennis P. Garrett, AD7VJ
David Gealt, KD2BVA
Atanas Genov, LZ1LZN
Philip J. Gladstone, N1DQ
Tommy Gober, N5DUX
J S. Goldberg, AF6GM
Catherine M. Goodrich, KK4IWN
James H. Goodrich, WA4VGZ
Brandon L. Graham, W0GPR
Nathaniel L. Graham, KD3OH
Scott M. Graham, N0NUF
Kevin E. Gray, N9VPV
Scott F. Gray, KD4VVC
William F. Guennewig, WA9WOB
Victor R. Haburchak, KJ4FOR
David Ham, KD2CDF
James A. Hamilton, NF8I
Edward A. Hanna, KF6FIR
Thomas M. Hansen, N8DGD
Todd S. Hansen, KD6YPS
Joseph A. Harris, N1QD
Gregory Hayden, KF4CYT
Howard D. Hazelrigg, W4PH
Bryan Herbert, KE6ZGP
William Hewitt, W3FRB
Carl W. Hickman, N5XE
Wolfgang Hinz, KC1ANN
Gary R. Hoffman, KB0H
Kenton A. Hoover, KC6SST
James B. Hudson, WB9QPM
Aaron M. Hulett, K8AMH
Jonathan P. Jackson, KB4JAY
Michael W. Jacobs, N3MJ
Glen H. Johnsen, KA6GMA
David P. Johnson, WK7W
Peter S. Johnson, AB9PJ
Andrew J. Joiner, KC2LPU
Jeremy D. Jones, W5JDJ
Rick Jones, W7HBP
Robert R. Jones, W8KRJ
Masafumi Kagioka, N3KW
Kevin Kane, AD5RA
Scott Kanzelmeyer, KJ6PCC
Charles H. Keeler, W7JG
Steven Keller, K2DKT
David Kelly, KB1TL
Aki H. Korhonen, KG7LYE
Ralf J. Kurzhals, AE7PH
Kusaka Hiroshi, AI6DN
James A. Kutsch, KY2D
Jansen L. Lancaster, N0MDL
Samuel A. Landau, KK6SAM
David A. Lane, KG4GIY
Scott A. Langlands, KB1SMU
Thomas Leibold, KK6FPP
Howard Lesiuk, VE3HLE
Leo S. Lesko, WW2LL
Philip W. Lindley, K9FLA
Randy L. Love, WF5X
Kennan B. Low, KE3X
William Lower, WX9RUB
Xingyu Lu, KK6ITS
Padraig Lysandrou, KC9UUS
Mark Mader, KK6KOH
Connie Mah, NR4CB
Eugene Mah, AB4UG
Mario R. Maipid, KB4SAD
Paul Mandel, W4PGM
Patrick J. Mandas, KG6JXZ
Kristie A. McCue, KJ6FZQ
Carl Meyer, WG5F
Ryan Michaelson, KB1YTR
Bret A. Miller, W9JY
Joseph B. Miller, KJ8O
Keith E. Miller, N9DGK
Vivek Misra, OZ1VI
Jeremy Mooney, KC0LDI
Jeffrey S. Moore, WA8REN
James A. Morin, KT5JM
Jo Anne Murdock, N6YLO
Andy J. Myers, NX9L
John V. Myers, WB9EWM
Ronald J. Nelson, W3RN
Derek Newbern, K3XD
Gregory Newman, AB3UN
Scott A. Nuchow, KA2ETB
Yaron Oren-Pines, K6YOP
Bradford S. Ormsby, W6VO
James A. Overman, W7JAO
John S. Pak, KB3EBN
Rita Palacios Rader, KD6BNV
David Parker, N4ASA
David H. Pascoe, KM3T
Douglas A. Payne, AC7T
Jim Perry, KA5BCM
Art Peters, K0ACP
Daniel J. Phelps, N1FUL
Bret A. Phillips, N9LPT
Michael H. Phillips, WB9SIS
Scott M. Phillips, AF6VU
Clyde D. Plunkett, KL7CP
Russell V. Plyler, AB6DS
Glen A. Powell, K9GP
Roxanne M. Powell-Baxter, AA7RX
Rod Quinn, KB1EWI
Ernie Rader, W5NH
Claudio A. Raiteri, V31CR
Don E. Reed, KI6FTV
James L. Reed, N4BFR
David D. Reynolds, KE7PGU
Nigel B. Ricards, KB4F
Dwayne A. Rich, NC4EM
Robert L. Risacher, W5BR
John Robertson, K5JMR
Scott Robinson, AG7T
Achim Rogmann, DF3EC
John R. Rudolph, N2YP
Alan D. Ruehl, KB9EQ
Wayne B. Rumley, WA5YNE
Phil T. Sadow, K6CQU
William N. Sallander, N3ETC
Robert D. Sanders, K6ON
Jesse Schonau, KE7GKG
Richard R. Schultz, KB7YBI
Neil T. Schwanitz, WD8CRT
Paul A. Scipione, AA2AV
Jeremy N. Seidler, KC9TSO
Michael Sharon, KB3ZDR
Ed Simpson, W6EDD
Kenneth W. Smalley, K1WS
Steve L. Sparks, WK5S
Joseph K. Spier, K6WAO
Jeremy D. Spranger, W7JS
David A. Stark, AB3UX
Marcus F. Steurer, KC0HWB
Brandon R. Stevens, KC9WMY
Henry D. Stewart, WA4OWG
Patrick E. Stoddard, WD9EWK
Robert W. Storey, AF5RS
John M. Struewing, KC9OQS
Rodger M. Stutes, KM4NS
Jae Stutzman, K5JAE
Marc D. Tanner, N8IV
Melinda Thomason, KE5IGK
John W. Thompson, W1EIR
Russell D. Thrall, KB3VSQ
Carole Town, AF5CT
Dale R. Town, N5VX
Matthew L. Turtenwald, KD2FME
Robert M. Urban, W9EWZ
Clyde Washburn, K2UE
Wade B. Watson, W7WBW
Susan M. Webb, KG6UIE
Richard E. Weiss, N4FKH
Matthew M. Widup, KC9UDX
Christopher G. Williams, KJ6WKH
Jonathan H. Williams, KW6AM
Mark Williams, WT5MW
Daniel Wissell, N1BYT
Willard D. Wolfshohl, KC6X
Benjamin D. Woodruff, N0BDW
Henry Wussler, KC0SDU
Linda S. Yankovich, N3LY
Matthias Zapatka, AJ4BB

New Products

Call Sign Ornaments

Almost Home Ornaments of Duxbury, Massachusetts, offers holiday ornaments customized with your call sign and a replica of your FCC license mounted on a scaled replica of a tower. These glass snow globe ornaments are hand made and 3.5 inches in diameter. Price: $36 plus shipping/handling. For more information, or to order, visit **http://almosthome.biz**.

Creative Tension

It's essential to overcome conflict between old and new.

David Sumner, K1ZZ
ARRL Chief Executive Officer

As this issue of *QST* goes to press, ARRL members are nearing the end of a memorable Centennial Year. The Centennial National and Regional Conventions are over; there are just a few more weeks of on-the-air celebration before New Year's Eve brings the Centennial QSO Party and the special W1AW Worked All States and W100AW operations to a close; and this is the final Personal Visions column before we turn the calendar to 2015.

Over the course of the year we have honored those who came before us: those who discovered and first harnessed the natural forces that make communication by radio possible and especially those who saw the need for an organization to protect and promote the role of the amateur in its development. Without the personal visions of Maxim, Tuska, and hundreds of others who are less well known, and without their hard work and sacrifice in the pursuit of that vision, Amateur Radio as we know it would not exist. They could not have known what Amateur Radio would become; they only knew that it ought to be.

We're in much the same boat today, even with a century of history and experience from which to draw. We know the technological and societal trends that will shape our immediate future, but we cannot know where they will take Amateur Radio two or three decades hence.

One thing we can predict with some certainty is that Amateur Radio will develop simultaneously in different directions, and some tension will result. That's safe to say because it's been happening all along.

From Spark to...

In the beginning there was spark, and only spark. Yet conflict soon developed between those who sought to extend their communications range and those who were content to exchange messages with their friends in the neighborhood. Each pursuit interfered with the other. Then came spark vs CW, CW vs AM, AM vs SSB on HF, and AM vs FM on VHF. Technical progress generated conflict — creative tension — between old and new. Sometimes the new replaced the old; more often they came to coexist, comfortably or otherwise. Now we see similar patterns developing on VHF between analog and digital voice and on HF between various data modes. The time may not be far off when digital voice technology will be developed to the point that it will challenge SSB for supremacy in the hostile HF environment.

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.

Shared Values

Advances in technology are by no means the only potential source of tension. Just as the neighborhood communicators and their more serious brethren ran afoul of one another in the early spark days, radio amateurs pursuing different aims within the same limited spectrum can come into conflict even if, in the words of The Amateur's Code, they "never knowingly operate in such a way as to lessen the pleasure of others."

As the scope of Amateur Radio continues to expand, we must not allow those tensions to lead to factionalism. Amateur Radio will continue to thrive only as long as we are a single community with shared values, united in the face of external threats while respecting the diversity of backgrounds and interests within our global community.

Demonstrating our Relevance

One threat is perceived irrelevance. It is in our DNA to want to put our capabilities to practical use; the ARRL was founded as a network of stations willing and able to relay messages at a time when, for most people, rapid long-distance communication was a novelty. Today we still possess a unique ability to communicate independent of any infrastructure. It may seldom be needed, but we shouldn't be defensive about that. Aren't skills at communicating by radio at least as valuable to society as are skills at throwing, kicking, and hitting balls of various sizes?

External Threats

Another threat is a rising tide of radio spectrum pollution. You might think that because access to the spectrum is worth billions of dollars at auction, there must be an army of lobbyists working to protect the value of the spectrum against interference from unintentional emitters of RF energy. There isn't. All too often the ARRL and other leading member-societies in the International Amateur Radio Union are lonely voices calling attention to inadequate standards for electromagnetic compatibility and inadequate shielding and filtering in products whose makers ought to know better.

Finally, we must resist the trend toward total commercialization of the spectrum. Here we have some natural allies: radio astronomers and other scientists, public safety services, and parts of the federal government including the military.

In short, we must continue to work together. To continue to thrive we must be willing to share our knowledge and experience with, and to learn from, one another across the imaginary boundaries of our parochial interests.

If through our example we can inspire future radio amateurs as our predecessors inspired us, the future will be even brighter than the brilliant past we have celebrated this Centennial Year.

Rick Lindquist, WW1ME, ww1me@arrl.org

ARRL Hosts 31st USTTI Amateur Radio Administration Course

Students from Asia and Africa attended the 31st United States Telecommunications Training Institute (USTTI) Amateur Radio Administration Course (ARAC) September 29 – October 3 at ARRL Headquarters. Two participants got their US Amateur Radio licenses as the course wrapped up. ARRL Chief Technology Officer Brennan Price, N4QX, administered the course, which is designed for government officials in developing countries who regulate and manage Amateur Radio.

The students and primary staff for the 31st USTTI Amateur Radio Administration Course at ARRL Headquarters: (L-R) ARRL Chief Technology Officer Brennan Price, N4QX; Virat Uansri; Annop Nittaya, HS1PLO; Peter Djakwah, KM4EQL; Oki Gari, KM4EQM, and ARRL Assistant to the Chief Executive Officer and Meeting Planner Lisa Kustosik, KA1UFZ. [Sean Kutzko, KX9X, photo]

"Our students — Annop Nittaya, HS1PLO, and Virat Uansri from Thailand, Peter Djakwah, KM4EQL, of Ghana, and Oki Gari, KM4EQM, of Papua New Guinea — were already quite knowledgeable about Amateur Radio, and are committed to the further development of Amateur Radio in their countries," Price said.

The ARAC spans a variety of topics, including licensing, spectrum, disaster communication, and antenna requirements. The curriculum also covers the International Telecommunication Union (ITU) and the 2015 World Radiocommunication Conference. Several ARRL staff members delivered classroom presentations within their areas of expertise. Students also built a 40 meter receiver kit with help from ARRL Laboratory staffers.

USTTI is a non-profit joint venture of leading US-based communications and IT corporations, and federal government officials, who collectively provide tuition-free management, policy, and technical training for talented professionals from the developing world.

Amateur Radio is "Communications Superpower," IARU Region 1 Delegates are Told

European Commissioner for International Cooperation, Humanitarian Aid and Crisis Response Kristalina Georgieva told delegates to the International Amateur Radio Union Region 1 General Conference on September 22 that Amateur Radio is a reliable information tool that can save lives in disasters. In a statement read to the conference on her behalf, Georgieva laid out a scenario in which all modern telecommunications and electrical power are knocked out, and no one can help the victims, because no one knows what has happened.

Kristalina Georgieva. [Courtesy of the European Commission]

"Luckily, there is a last resort: The radio amateurs, the people who are the eyes and the ears of the world in time when all other information channels are silent," she said. "[Y]ou are the last technical miracle…an independent, reliable information channel, which can transmit…important…news from any place in the world, anytime."

Georgieva said Amateur Radio's advantage is that it is independent of the conventional communications infrastructure. "A well-trained radioman with good equipment and ever-charged batteries can be a fantastic link between two villages, two countries, or two continents," she said. "When organized in a Union, you are a communication superpower in times of total electronic darkness."

In a video presentation, International Telecommunication Union (ITU) Secretary General Hamadoun Touré, HB9EHT, extended his wishes for success to the IARU Region 1 delegates. Touré said he appreciated the work of the IARU and for its support of ITU Headquarters station 4U1ITU. Touré called Amateur Radio, "a very important public service." Next year, the ITU will celebrate its 150th anniversary, and Touré said that the ITU club station will identify as 4U0ITU to mark the occasion. He invited the Region 1 delegates to join the World Radio Day celebration next February 13, the anniversary of the first broadcast by UN Radio in 1946.

ITU Secretary General Hamadoun Touré, HB9EHT. [ITU video]

Signal/One, Alpha, and Dick Ehrhorn

The journey to a line of classic amplifiers begins with a classic transceiver.

Joe Veras, K9OCO
k9oco@jveras.com

The headline of a 1968 Signal/One ad in *QST* asked, "What's the BIG Idea?" The ad's body copy inquired, "Why does Amateur Radio stick with the technology of the Fifties?" It went on to recount a conversation in which the manager of a big communications company posed that question to an authority on solid state devices.

Their conclusion — the "big idea" mentioned in the ad's headline — centered on organizing professional engineer/hams to develop a new generation of no-compromise amateur gear. They observed that, "Effective application of the new technology — largely a product of the aerospace industry — demanded a high degree of engineering sophistication and a variety of technical capabilities not generally found outside that industry."

The manager was Dick Ehrhorn, W4ETO, (then WA4NGO), who worked for ECI (Electronic Communications, Inc — a division of NCR). ECI primarily did contract work for the US Navy. Ehrhorn founded ECI's Signal/One division, becoming its general manager in 1967. He tasked the new division with producing state of the art amateur gear.

Signal/One's initial project was the CX-7, a *Deluxe Integrated Station*, the term preferred by the company rather than "transceiver." Their design used new devices such as MOSFETs (Metal Oxide Silicon Field-Effect Transistors) along with linear and digital ICs (Integrated Circuits). Signal/One strove to update and incorporate the best features from top-of-the-line older equipment, such as the Collins 75A-4 receiver and Central Electronics 100V transmitter, into the CX-7.

It boasted a feature set that was eye-popping for the time. Except for the transmitter's 300 W 8072 final amplifier, all electronics were solid state. With a pair of PTOs (Permeability Tuned Oscillators), the rig could transceive using either PTO, dual receive, or operate split frequencies.

Figure 1 — Signal/One set new performance and feature standards for amateur gear with the introduction of its CX-7. [Joe Veras, K9OCO, photo]

The CX-7's 16.25 × 7.25 × 14-inch box contained many more features, some of them new to the Amateur Radio market. Among the first things to catch the eye was the digital frequency readout. It employed Nixie® tubes to display frequency down to 100 Hz. The CX-7 covered all bands then in existence from 160 – 10 meters in 1 MHz ranges. Three spare band switch positions provided additional segments between 2 – 3, 4 – 7, and 8 – 14 MHz. The transmitter's broadband, no-tune circuits offered frequency agility and ease of band-hopping. Just change bands and start transmitting; commonplace today, but revolutionary in the 1960s.

Cascaded filters in the receiver's IF provided sharp selectivity and the CX-7's electronic passband tuning allowed placing that selectivity window just where it was needed. The designers paid particular attention to the MOSFET front end's performance in the presence of strong signals.

As they say on TV, "But wait — there's more!" Transmit/receive switching featured full break-in on CW and either fast-attack VOX or PTT on SSB. Additional modes included FSK and AM. The built-in 115/230 VAC power supply and final amplifier were capable of continuous duty on all modes. An IC keyer generated CW from 5 to 50 WPM and a pushbutton spotting switch aided zero beating. The RF clipping speech processor produced a pileup-penetrating phone signal. A pre-IF noise blanker and fast-attack AGC added to the receiver's arsenal. Except for the final amplifier and power supply, the CX-7 used modular construction with glass epoxy circuit boards.

The advanced-concept integrated station was a couple of years into the testing and prototyping stage when Signal/One's parent company, ECI, decided the time had come for R&D to end and production to begin. Perhaps the birth of the CX-7 was premature; a succeeding version, the CX-7A, was necessary to get everything in the initial model just right.

The CX-7's $2195 price tag relates to about $13,000 in today's dollars, somewhat above the mark commanded by all but the most expensive current transceivers. Even at that, the Signal/One's 1969 introductory price was no more than that of the desktop full of premium 1950s gear it replaced.

Not everyone shelled out nearly 2200 bucks to make a CX-7 their station's centerpiece. Take Joe Pontek, K8HKM (now K8JP), for example; he acquired his with a pair of crisp one-dollar bills. The 1969 ARRL Great Lakes Division convention in Louisville, Kentucky featured a CX-7 as the hamfest's grand prize. Pontek (then Michigan Section Communications Manager) and his family were in attendance. Just before the after-banquet prize drawing, Pontek rushed up

and purchased two $1 raffle tickets. One of them was drawn for the grand prize.

The Birth of the Alpha 70

January 1970 found Dick Ehrhorn leaving Signal/One to start his own company, Ehrhorn Technogical Operations, Inc. One might assume that he used the company's initials to choose the call sign W4ETO, but just the opposite is true. The FCC had assigned that call to him when he changed calls in 1968. Ehrhorn derived the company name by shoe-horning a new set of phonetics onto the call's suffix.

ETO's story perfectly illustrates the aphorism concerning acorns and oak trees. Recalling ETO's early days, Ehrhorn says, "The business began with no capital, occupying a pair of leased trailers on property owned by a Brooksville, Florida automobile dealer. Both amateur and commercial product lines eventually grew to attract a global customer base.

Ehrhorn formed the company to build top-of-the-line amateur linear amplifiers. Because much of his amateur activity had involved modifying existing commercial amps or homebrewing designs of his own, linear amplifiers seemed a logical first product. Ehrhorn built ETO's first amp around a power transformer designed by Harold Johnson, W4ZCB, who had worked for Dick as product line manager at Signal/One. Johnson recalls winding the first six CX-7 transformers on his kitchen table.

The amp that would become the Alpha 70 used an Eimac 3CV1500 vapor-cooled tube. Ehrhorn designed and prototyped the Alpha 70 through 77 series amps himself and Harold Johnson's transformers provided their heartbeat. The Alpha/W4ZCB collaboration proved to be long-lived, lasting until Johnson retired in 1986.

Much as he had done at Signal/One, Ehrhorn set Alpha's sights on advancing the technology used by amateurs. The company introduced its 74 series in early 1974 and with it, broad-banded, no-tune operation — the first in a legal-limit amplifier.

When ETO moved to Canyon City, Colorado in 1977, the amplifier line was making a modest profit. Ehrhorn described the new location as, "Two buildings in an industrial park located on a gravel road." That road would eventually lead to the whole world.

A Dayton Hamvention® conversation between Ehrhorn and George Johnson, W1ZT, opened the door for ETO's entry into the medical field. Johnson worked as an engineering manager for GE Medical Systems in New Berlin, Wisconsin. His responsibilities included pulling together the hardware needed to build the company's medical imaging devices. Among the hardware required was an extremely linear, high-power RF amplifier. Recalling their Hamvention® conversation, Johnson got in touch with Ehrhorn to discuss the project.

Figure 2 — Alpha amplifiers have a 40-plus year reputation for reliable performance under tough conditions. Pictured is a 1970s era Alpha 77D. [Joe Veras, K9OCO, photo]

Johnson says, "Convincing the purchasing department to go with Ehrhorn's small Colorado company as a supplier led to some challenging times." Things worked out well in the end, though. In 1983, GE Medical issued a request for proposal to ETO, inviting the company to submit a bid for supplying an amplifier to be used in GE's first Magnetic Resonance Imaging (MRI) system.

The Alpha/GE Medical story has even deeper Amateur Radio roots. George Johnson first encountered Alpha amplifiers at the contest super-station of Jim Lawson, W2PV. Lawson's station was a powerhouse in the multi-multi category from the early 1970s until his death in 1982.

Dick Ehrhorn is proud that his amplifiers so often show up in top-scoring contest stations. Chief among reasons for this is the amp's bullet-proof reputation. To illustrate this virtue, Ehrhorn once ran an Alpha at full power, around the clock, for 57 days straight. He stopped only because it made little sense to keep adding to the electric bill.

When asked to choose a favorite among his amplifier "children", Ehrhorn quickly responded, "The Alpha 87A!" Introduced in 1991, the amp featured microprocessor-controlled tuning that performed automatic band changes and tuned up in a single second. Strings of LEDs replaced function indicators and conventional meter movements.

Mergers and Acquisitions

The non-amateur side of ETO's business merged with Applied Science and Technology, Inc. in late 1995 and Ehrhorn became chairman of Alpha/Power, Inc, holding that position until 2000, although not active in daily operations. Today, Dick Ehrhorn (now W4EA) and his wife Marilyn live near Lynchburg, Virginia — their horizon defined by the Blue Ridge Mountains rather than the Rockies.

In September 2009, RF Concepts acquired the assets of Alpha Radio Products. Going forward, the company plans to create new product lines bearing the Alpha name.

What about service for older amplifiers? Parts for some legacy amps are no longer available, making factory repair economically unfeasible. The company does, however, offer free Internet support as time permits. Telephone support of out-of-warranty equipmentis available for a fee. The factory continues to service the Alpha 8100, 87A, 89, 91b, and 99 models and all current products.

Just as in Dick Ehrhorn's day, the strength of Alpha is still rooted in the people who make up the company. In addition to president Ken Long, N0QO, those involved in day-to-day operations in Longmont, Colorado include: Gordon Hardman, W0RUN; Brad Focken, K0HM; Glenn Pladsen, AE0Q; Carey Fuller, KX0R, and many others.

ARRL VEC Volunteer Examiner Honor Roll

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

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

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

Examiner	Sessions	Accreditation Date
Atlantic		
Edward Genoino, WA2NDA	246	10-Jul-85
William Effland, K2GVI	228	06-Sep-84
James McCloskey, NS3K	223	14-Nov-94
George Brechmann, N3HBT	213	01-Apr-91
Donald Wright, Jr, AA2F	186	26-Oct-84
Central		
Eldon Boehm, NK9U	239	21-Nov-86
Allan Bukowski, N9ZD	239	01-Jun-92
Donald Hlinsky, N9IZU	233	01-Mar-91
George Greene, NE9ET	229	13-Nov-00
Timothy Pechtold, AA9BV	227	01-Nov-92
Dakota		
John Schwarz, Jr, AE0AL	229	26-Oct-94
Jeffrey Goodnuff, W0KF	210	17-Jun-03
Dennis Ackerman, KB0OQQ	196	15-Jul-96
Daniel Royer, KE0OR	194	01-Jul-91
Thomas Wilson, NI0I	183	30-Jul-86
Delta		
Arthur Parry, Jr, WB4BGX	228	01-May-91
Edward Scheufele, AB5RS	220	19-Jan-94
William Easterday, KB8FU	209	01-Mar-91
Joan Thorne, KN4PM	172	01-Jan-91
Bobby Livingston, N5YLE	166	01-Apr-93
Great Lakes		
David Schmidt, KI4QH	250	15-Feb-85
Herbert Blasberg, WA8PBW	216	06-Sep-84
Charles Hall, W8HF	209	01-Jun-92
Claybourne Mitchell, W8JNZ	201	01-Sep-90
Theodore Wilson, K8TCR	201	19-Jan-90
Hudson		
Paul Maytan, AC2T	463	06-Sep-84
E. Drew Moore, W2OU	344	01-Aug-90
Gerald Miller, Jr, AA2ZJ	316	05-Dec-95
Daniel Calabrese, AA2HX	305	01-Nov-91
Stanley Rothman, WA2NRV	285	01-Mar-85
Midwest		
Harry Nordman, AB0SX	621	09-Jan-02
David Bartholomew, AB0TO	514	22-Mar-02
Kevin Naumann, N0WDG	478	17-Nov-02
Jeanette Nordman, AB0YX	438	21-Aug-03
Roland Kramer, W0RL	357	21-Jun-01
New England		
Lawrence Polowy, KU1L	292	02-Jan-85
James Mullen, KK1W	274	01-Mar-91
Stefan Rodowicz, N1SR	272	20-Nov-84
Bruce Anderson, W1LUS	270	11-Feb-88
Robert Beaudet, W1YRC	270	01-Aug-90
Northwestern		
Richard Morgan, KD7GIE	399	11-Aug-00
John Mackey, Jr, KS0F	369	01-Oct-90
Loren Hole, KK7M	314	06-Sep-84
George Ftikas, N7TQZ	254	01-Dec-92
Duane Anderson, NA7DA	241	28-Mar-00
Pacific		
Royal Metzger, K6VIP	368	29-Apr-85
Morris Jones, AD6ZH	331	27-Nov-01
Dorothy Hays, N6UDH	242	01-Sep-91
Kenneth Hall, WO6J	230	18-Mar-86
Rodney Gibson, KC6NYR	198	01-Aug-92
Roanoke		
Judy Friel, AC4RG	230	01-Feb-91
Alan Moeck, WA2RPX	203	27-Sep-94
Thomas Hill, KJ4IV	201	01-Jun-91
David Snyder, W4SAR	183	01-May-93
Sheila Frank, KT4YW	181	30-Oct-96
Rocky Mountain		
Karen Schultz, KA0CDN	404	06-Sep-84
Robert Hamilton, N0RN	315	19-May-87
Frank Goddard, W0AJY	266	01-Feb-92
Henry Luthe, Jr, W0ZU	250	01-Jan-92
David Avery, N0HEQ	240	13-Jan-88
Southeastern		
Victor Madera, KP4PQ	370	01-Mar-92
Pablo Soto, KP4SJ	300	01-May-92
Joseph Patti, N4UMB	273	01-Sep-90
Harold Prosser, III, KK1B	264	22-Jan-86
Robert Cumming, Sr, W2BZY	257	29-Jan-97
Southwestern		
Bill Martin, AI0D	553	01-Nov-84
Fred Bollinger, AB7JF	321	17-Apr-95
Steve Gurley, KY7W	290	19-Apr-96
Gary Mangels, AD6CD	286	30-Jul-97
Frankie Mangels, AD6DC	282	14-Oct-97
West Gulf		
Franz Laugermann, K3FL	554	01-Dec-91
Sammy Neal, N5AF	533	20-Nov-84
John Moore, III, KK5NU	425	21-May-95
Gerald Grant, WB5R	371	04-Jan-85
David Fanelli, KB5PGY	348	01-Oct-91

Radio Tips

Split Frequency Operation

Stations that are likely to generate a great deal of interest in the form of a pileup often choose to use Split Frequency Operation. This means that they will transmit on one frequency while listening on another. This helps the sought-after station manage the influx of calls. The desired station will usually inform the pileup that they are *working split* by saying or sending UP **1**, UP 5, or just UP. This is the station letting folks know that they are not listening on their transmitting frequency, but rather, some number of kHz higher.

To make contact with this station you need a transceiver capable of working split operation. Most modern rigs allow for this but older equipment may require the addition of an external VFO. Alternately, a separate transmitter and receiver can get the job done with an antenna switch between the two units. Your transceiver's manual should guide you through the necessary steps.

Let's say you hear a pileup on 7030 kHz. Tune down a bit to 7029 and you may hear something like CQ DE XY2XYZ UP 1. XY2XYZ is letting everyone know that they are transmitting on 7029 kHz but listening on 7030 kHz. Now you know how to set up your station to have a contact. Listen on XY2XYZ's frequency and send your call on the frequency that XY2XYZ has chosen to monitor, that is, 1 kHz up. Then, just keep an ear out for your call sign.

You may also see stations listed on DX spotting networks indicating the split operation as XY2XYZ 7.029 +1.

An old DXer's trick is to keep an ear on both frequencies. (Some modern transceivers allow you to do this with stereo earphones separating the two frequencies to your different ears.) Listen for the station coming back with a signal report to the desired station and then tune just slightly above or below that operator's frequency. It can make your signal stand out against the noise. Be patient, there a lot of folks trying to do the same thing.

Any successful split operator will tell you there is no substitute for listening. You will want to get a sense of how the station you seek is operating. Is the station taking the first call they hear or are they waiting for the noise to die down a bit before picking a contact? Timing is everything! — *73, Thomas Arey, N2EI, 104 West Franklin Ave, Edgewater Park, NJ 08010*, **tjarey@gmail.com**

Convention and Hamfest Calendar

Gail Iannone, giannone@arrl.org; www.arrl.org/hamfests-and-conventions-calendar

Abbreviations

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

Alabama (Locust Fork) — Jan 3
D F H R T V
8 AM – 1 PM. *Spr:* Blount County ARC. Locust Fork High School, 155 School Rd. *Tl:* 146.7 (91.5 Hz). *Adm:* Free. **www.freezefest.com**.

Arizona (Phoenix) — Jan 10 F H Q R T V
8 AM – noon. *Spr:* Thunderbird ARC. Northwest Community Church, 16615 N 43rd Ave. *Tl:* 446.15 (100 Hz). *Adm:* $2. **w7tbc.org**.

WEST CENTRAL FLORIDA SECTION CONVENTION

December 12 – 13, Plant City, FL
D F H Q R S T V
Friday 2 – 7 PM, Saturday 9 AM – 4 PM. *Spr:* Florida Gulf Coast AR Council. Strawberry Festival Grounds Agricultural Show Center, 2508 E Oak Ave. 39th Annual Tampa Bay Hamfest. *Tl:* 146.94 (146.2 Hz). *Adm:* advance $9, door $10. **tampabayhamfest.org**.

TECHFEST

January 10, Lawrenceville, GA
H R S T V
10 AM – 2 PM. *Spr:* Gwinnett ARS. Gwinnett Medical Resource Center, 665 Duluth Hwy (GA 120). *Tl:* 147.075 (82.5 Hz). *Adm:* Free. **www.gars.org**.

Louisiana (Minden) — Dec 20
D F H Q R S V
8:30 AM – 2 PM. *Spr:* Minden ARA. Minden Civic Center, 520 Broadway. *Tl:* 147.3. (186.2 Hz). *Adm:* $5. **n5rd.org**.

Missouri (Brighton) — Jan 3 D F H R T V
8 AM – noon. *Spr:* Ozark Mountain AR Group. Brighton Assembly of God, 5403 Hwy F. *Tl:* 147.225 (162.2 Hz). *Adm:* $5. **w0omd.org**.

New Jersey (Bergenfield) — Dec 13
D F H R S
8 AM – 4 PM. *Spr:* Boy Scout Troup 139/Venture Crew 7373. Conlon Hall, 19 N William St. *Tl:* 146.955 (141.3 Hz), 146.52. *Adm:* $2 suggested donation (under 14 free).

NEW YORK CITY/LONG ISLAND SECTION CONVENTION

January 4, Bethpage, NY
R S V
7:30 AM (doors open), 9 AM (forums start). *Spr:* Great South Bay ARC. Briarcliff College, 1055 Stewart Ave. Ham Radio University 2015, Special Event Station. *Tl:* 146.85 (136.5 Hz). *Adm:* $3 (donation). **hamradiouniversity.org/**.

Ohio (Delta) — Dec 6 D H R V
8 AM – 2 PM. *Spr:* Fulton County ARC. Delta Memorial Hall, 401 Main St. *Tl:* 147.195. *Adm:* $5. **k8bxq.org/**.

South Carolina (Greenwood) — Jan 10
D F H S V
9 AM – 3 PM. *Spr:* Greenwood ARS. Piedmont Technical College James Medford Center, 620 N Emerald Rd. *Tl:* 147.165 (107.2 Hz). *Adm:* $8. **w4gwd.org**.

Tennessee (White Pine) — Jan 3 D H R S T V
8 AM – 2 PM. *Spr:* Lakeway ARC. Walters State Great Smoky Mountains Expo Center, 1615 Pavilion Dr. *Tl:* 147.03. *Adm:* $8. **www.lakewayarc.org**.

Texas (Schertz) — Jan 10 D F H Q R S T V
8 AM – 2 PM. *Spr:* San Antonio RC. Schertz Civic Center, 1400 Schertz Pkwy. *Tl:* 146.94 (179.9 Hz). *Adm:* advance $8, door $10. **w5sc.org**.

Wisconsin (Waukesha) — Jan 10 D F H R V
8 AM – 1 PM. *Spr:* West Allis RAC. Waukesha County Expo Center Arena, 1000 Northview Rd (County Trunk FT). 43rd Annual Midwinter Ham Radio, Computer and Electronics Swapfest. *Adm:* advance $5, door $6 (free admission ticket with every two tables purchased). **www.warac.org**.

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

To All Event Sponsors

Before making a final decision on a date for your event, you are encouraged to check the Hamfest and Convention Database (**www.arrl.org/hamfests-and-conventions-calendar**) for events that may already be scheduled in your area on that date. You are also encouraged to register your event with HQ as far in advance as your planning permits. See **www.arrl.org/hamfest-convention-application** for an online registration form. Dates may be recorded up to 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 **December 1** to be listed in the **February** issue. Information in this column is accurate as of our deadline; contact the sponsor or check the sponsor's website for possible late changes, 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.**

December 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.

December Qualifying Runs will be transmitted by W1AW in Newington, Connecticut at 10 PM EST on Friday, December 5 (0300 UTC December 6) and at 9 AM EST on Tuesday, December 16, (1400 UTC) 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 K6KPH on Saturday, December 13, at 2 PM PST (2200 UTC) at 3581.5, 7047.5, 14047.5, 18097.5, and 21067.5 kHz. Unless indicated otherwise, sending speeds are from 10 to 40 WPM.

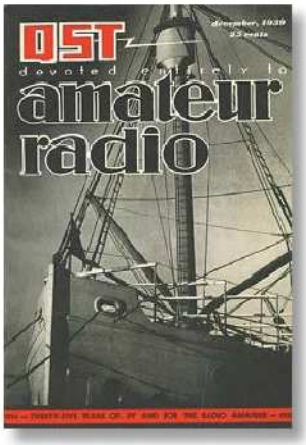
Listen for W1AW Portable Centennial QSO Party Operations in December!

December 3 – December 9	W1AW/1 W1AW/9	Maine Illinois
December 10 – December 16	W1AW/7 W1AW/9	Montana Indiana
December 17 – December 23	W1AW/3 W1AW/4 W1AW/KH6	Maryland Georgia Hawaii
December 24 – December 30	W1AW/3 W1AW/0	Pennsylvania Iowa
December 31	Red Badges on the Air	

75, 50, and 25 Years Ago

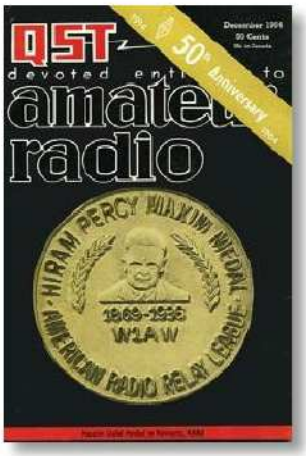
Al Brogdon, W1AB

December 1939



- The cover photo shows the bow area of a tall ship that will be part of the Byrd Expedition — and so will Amateur Radio!
- The editorial again reminds us not to discuss the European War on the air, because the US is a neutral party.
- Clinton B. DeSoto, W1CBD, reports "Byrd Antarctic Expedition to Use Amateur Radio," and provides details of the plan.
- By Goodman, W1JPE, tells about his latest project, "A Four-Tube Superheterodyne."
- E. E. Combs, ex-W6CTN, built "A Homemade Exponential Horn," resulting in better audio from the broadcast receiver.
- Don Mix, W1TS, tells us how to use "'Dish-Type' Construction for the High-Power Amplifier," to result in a smaller size unit.
- Fred Sutter, W8QBW, built "The 'Portable Five'," leaving out the power transformer and running the 5 watt rig directly off the 110 volt a.c. mains.
- In "Five Bands without Changing Coils," T. M. Ferrill, W8QBW, tells us how to use ganged L-C sections.

December 1964



- The cover photo shows the new A.R.R.L. award, the Hiram Percy Maxim Medal.
- The editorial discusses changes to the League's contests, some already made and others on the horizon.
- Henry Cross, W1OOP, tells about his new rig, in "No Tubes — Four Watts — Six Meters."
- John Raydo, K0LMZ, describes "A Low-Cost Transistor Mobile Power Supply" that will provide voltages for bias, screen, and plate circuits — with a total of 375 watts of d.c. output.
- "First Maxim Medal Awarded to Reinartz" reports on the passing of John Reinartz, K0HJ (ex-1QP/1XAM), and looks at the highlights of his amateur work, including the discovery in the early 1920s of the Heaviside Layer as being responsible for "skip" propagation.
- Robert Hanta, K8PBA, tells us how to build "The ANTALO," a 2 meter halo with parasitic elements.
- "Extending the Range of the BC-221 Frequency Meter," by Alfred Robinson, W6PM, helps us get even greater utility out of that World War II surplus unit.
- Robert Forster, W2DVG, describes "A Heterodyne-Type Transmitter for 144 Mc." that will give high frequency stability with V.F.O. control.
- In "Crystal V.F.O. with Full-Band Coverage," Frank Noble, W3QLV, tells us how his 3500 to 4000 Kc. unit uses a series of crystal-controlled oscillators and mixers to generate a rock-stable signal.

December 1989

- The cover photo shows the new W1AW building at night, with the caption "The New W1AW Really Shines!"
- The editorial reports on "Our Anniversary Year," now that the League has reached the 75-year mark.
- Jim Cain, K1TN, tells about "A Visit to W1AW," with the main photo showing the station's Chief Operator, Chuck Bender, W1WPR.
- Wes Hayward, W7ZOI, gives us Part 1 of "A QRP SSB/CW Transceiver for 14 MHz."
- Emil Pocock, W3EP, tutors us on "Auroral-E Propagation at 144 MHz," using the Great Aurora of March 1989 as an example.
- Bruce, NR5Q, gives us a nice seasonal article, "Christmas for an Elmer."
- The recent passing of Loren Windom, W8GZ, prompts Rod Newkirk, W9BRD, to reminisce about his own Windom antenna, in "A Tipsy Windom on Evans Hill."
- Jim Cain, K1TN, presents Part 4 of "Tune in to Glasnost."
- Bruce Hale, KB1MW, provides information for the Novices and other newcomers who want to step up from their labor-intensive straight keys, in "Keys, Keyers, and Keyboards."

Field Organization Reports

September 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**.

705
KB2RTZ
531
W5KAV
388
WB8RCR
339
W7PAT
267
AK1NS
260
K0IBS
245
WB8R
243
KF4DVF
240
KT5SR
225
N8SY
220
W5DY
215
N5NVP
KC5ZGG
214
WB9FHP
210
WB8TQZ
208
W4VX
190
W1KX
K7OAH
WB8YYS
187
K7RDB
185
WB9WKO
179
N8OSL
178
K8RDN
175
WA3EZN
WA4STO
170
KE5YTA
N5TMC
W7FQQ
165
KE5HYW
160
KG0GG
W8QAS

KD5RQB
N9WLW
KE4CB
W4NDA
KE4CB
VE7GN
N8FVM
WD8USA
156
N7EIE
155
WB9QPM
152
W9EEU
150
WS6P
W9BGJ
KB8QKC
N2WGF
148
KW4EMG
144
N2PQJ
140
K1PJS
WV8CH
N7CM
K7EAJ
KJ4JPE
WB4ZIQ
139
K1MLG
137
W9WXN
136
KB8VXE
135
W8DJG
W3YVQ
KC8YVF
KO4OL
WB2ZEX
130
W1INC
W0LAW
K6JT
WB2FTX
W7EKB
K4IWW
WA1STU
K2TV
129
KF4DAX
127
KB8RCR
125
KF5IOU

120
K0VTT
NN7H
AG9G
K9LGU
WK4WC
NA7G
KK3F
KB1RGQ
NM1K
KA1G
118
KA9ZGY
115
KC9UJP
W8MAL
K4VWK
WB8JSR
KA0DBK
112
KJ6PCC
KD8TTE
111
W7JSW
110
K6HTN
N9VC
NX9K
K5KV
KC5OZT
N1JX
KB2QO
KA9QWC
K4GK
N7XG
W2EAG
K1HEJ
N9MN
WS4P
108
K2KNB
N2RQ
105
KK7TN
KF7GC
KC2YDT
103
W3CB
101
NA9L
W4CPG
100
WA1MXT
K6FRG
K0PTK
N0DUX
K9JM
KA5AZK
KF5TTN
KB5SDU
KA2GQQ

N3RB
N3SW
WA4BAM
NC3F
AA2SV
WA0CGZ
WB6OTS
AK4RJ
W4TTO
WA4BAM
NC3F
KC8WH
WD8Q
WB4FDT
KB3LNM
AA3SB
WB8WKQ
AJ4TH
99
W8KWG
KD8LSM
98
KB1NMO
KJ4G
97
K6JGL
96
W8CPG
95
KC0ZDA
93
WA7PTM
AB1AV
AF7FT
91
AB9ZA
90
N2DW
WA6IAF
W0CLS
N3KB
KU6J
N5RL
W2CC
KB5KKT
KZ8Q
WB8QLT
WG8Z
KB8HJJ
WB3FTQ
K8KV
N4RNM
89
KB9KEG
KC8BW
88
KB0DTI
87
AB1ST
KJ6IJJ

K5RG
86
WB8SIQ
KJ7NO
85
KD0NJK
KA2HZP
N9EXM
83
N2RTF
W8ARR
82
WD0GUF
N2RDB
80
K0DEU
WA9QIB
N2GJ
K9DUR
KF4OCU
W8WDS
WB8YLO
WB4RJW
K8ED
79
KC5TGF
78
N8IBR
77
KC9ZDA
KC7ASA
76
W8IM
KC4YGB
WA5LOU
KM7N
75
W0PZD
74
AJ7B
N5MBQ
K5JAW
KJ4HGH
72
KC2EMW
73
AL7N
71
K6RAU
K5JAW
NI2W
70
K0RXC
KD0USN
KD7ZUP
N0DUW
N0YOL
KD0UST
KD2AKX

The following stations qualified for PSHR in previous months but have not been recognized in this column yet: (Aug) K2TV 155, N2WGF 120, WS4P, KO4OL 110, AJ4TH, N4RNM 100, KC2YDT 91, K2KNB 83, N2PQJ 75, AK1NS 72, WB2ZEX 70. (July) KK3F 165, AA3SB 160, KD8TTE 149, W3YVQ 135, N2PQJ 120, KA1G 120 [Correction], W3CB, WB4FDT, KB3LNM 100, WB3FTQ 90, W4OTN 82, NF8I 70. (June) N2PQJ 201.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AK, AL, AR, AZ, CO, CT, DE, EB, EPA, GA, IA, ID, IL, IN, KS, KY, LA, LAX, MDC, ME, MI, MN, NC, NE, NFL, NH, NLI, NM, NNJ, NTX, OH, OK, OR, ORG, SC, SD, SFL, SJV, STX, SV, TN, UT, VA, WCF, WI, WPA, WV.

Section Emergency Coordinator Reports

The following ARRL Section Emergency Coordinators reported: GA, ENY, EWA, IA, ID, IN, KS, LA, MDC, ME, MI, MN, MO, NC, ND, NLI, NM, OH, OK, SFL, SJV, SNJ, SV, WTX, WV, WWA.

Brass Pounders League

The BPL is open to all amateurs in the US, Canada and US possessions who report to their SMs a total of 500 or more points or a sum of 100 or more origination and delivery points for any calendar month. Messages must be handled on amateur radio frequencies within 48 hours of receipt in standard ARRL radiogram format. Call signs of qualifiers and their monthly BPL total points follow.

WB9FHP 1896, NX9K 1547, K6HTN 1111, WS6P 1009, WA4STO 599, K6FRG 591, KK3F 506.

BPL with Originations + Deliveries: NM1K 102.

KK3F achieved 905 BPL points in July but was not recognized in this column yet.

Silent Keys

Silent Keys Administrator, sk@arrl.org

It is with deep regret that we record the passing of these amateurs:

W1CSR **Ericksberg**, Alvah O., Ludlow, MA
K1DAD **Sawyer**, Royce N., Bradford, MA
*AA1HK **Johnstone**, Diane M., Torrington, CT
*W1IVB **London**, Frank J., Delray Beach, FL
K1JGM **Messer**, James G., Riverview, FL
WA1JTE **Johnson**, Gerald D., St. Johnsbury, VT
W1KL **Ryder**, William C., Brewster, MA
W1QIQ **Johnson**, Lee D., Portland, ME
W1QJL **Dombrowik**, Eugene S., New Britain, CT
N1RFX **Gebo**, Joseph S. Jr, Spencer, MA
*KB1T **David**, John G., Amherst, NH
KB1TJC **Butkiewicz**, Leonard A., Meriden, CT
WA1USD **Muzzulin**, Guerin V., Colchester, CT
W1VMC **Laplante**, Jean-Paul, Underhill Center, VT
K1VU **Johnson**, Robert E., West Bridgewater, MA
N1VVF **McQueeney**, Robert D., Cherryville, NC
AJ1W **Rosen**, Julius J., Millis, MA
WE1W **Campbell**, Walter W., North Kingstown, RI
W1YDK **Hughes**, Joseph J. Sr, Marlborough, MA
KA2AFC **LaBarge**, Daniel C., Saratoga Springs, NY
N2BUQ **Valentino**, Dominic J., South Plainfield, NJ
KC2C **Avery**, Peter H. Jr, Valatie, NY
W2FIX **Cole**, Bruce H., Liverpool, NY
WA2FJM **Breese**, John L., Horseheads, NY
N2GUS **Croft**, John F. Sr, Fair Haven, NJ
W2IXT **Oliveri**, Benedetto R., Lake Wylie, SC
N2JR **Harrison**, Richard J., Warrenton, VA
NJ2K **Lipkin**, Ezie, Great Neck, NY
K2KZI **Steen**, John E., Bath, NY
W2LYS **Delevante**, Harry J., Arlington, TX
N2MUH **Tooker**, Kenneth V., Pleasant Valley, NY
K2MVB **Wireback**, Herbert D. Sr, Bridgeton, NJ
AB2NC **Wachter**, Gary J., Round Top, NY
WA2NCA **Hotchin**, John, Delmar, NY
K2NDR **Ruggiano**, Nicholas D., Waterford Works, NJ
W2NTN **Bishop**, James C. Jr, Scotch Plains, NJ
W2PZT **Podgorski**, Edward M., Haddonfield, NJ
N2QC **Mason**, Howard, Egg Harbor Township, NJ
N2TEK **Tubiola**, John M., Poughkeepsie, NY
NQ2V **Myrick**, John R. Jr, Lafayette, LA
N2VDN **Schmidt**, Bernard G., Pittsford, NY
KC2VUX **Bolero**, Richard A., Andover, NY
AC2Z **Guercio**, Robert J., Neptune, NJ
KA2ZUM **Cook**, William A., Bloomingdale, GA
*W3BL **Baustert**, George J., Pinellas Park, FL
VE3EKH **Boudreau**, Donald J., Anna, TX
N3FJA **Navin**, Mike, Mountain Top, PA
W3HUE **Herschman**, Harris J., Columbia, MD
*W3JBJ **Welch**, Marshall D. Jr, Williamsport, PA
K3KEP **Beans**, George A., Lansdale, PA
W3KUA **Samson**, Joseph S., Pringle, PA
WA3LZH **Wilson**, Donald E., Brookville, PA
ex-NW3M **Curran**, William E., Colorado Springs, CO
WA3PHT **Lanahan**, James M., Wilmington, DE
W3PRG **Arnold**, Charles G. W., York, PA
K3QOD **Schapiro**, Oscar M., Pikesville, MD
WA3TUC **Bugen**, Paul, Philadelphia, PA
N3TUZ **Holsberger**, John G., Lilly, PA
N3YMZ **Kosloski**, Robert F., Luzerne, PA
K3ZIP **Bishop**, George W. Jr, Allentown, PA
KI4ABR **Mullinax**, James D., Travelers Rest, SC
W4BAL **Bayless**, Wade J., Tampa, FL
K4BCA **Dew**, Robert H., Satellite Beach, FL
WQ4C **Cagle**, Namon L., Huntsville, AL
N4CTO **Crouse**, Norman W., Brentwood, TN
N4CUZ **Nelson**, Robert C. III, Jacksonville, FL
KF4EEA **Hatmaker**, James E., Caryville, TN
W4EHR **Barrs**, Burton K. II, Santa Clara, CA
W4EIF **Clark**, Curtis M., Garner, NC
KD4EZE **Wingfield**, Earl M., Lillian, AL
KB4FFI **Stewart**, Roger P., Plant City, FL
*AA4FW **Richardson**, Wyman C., Ponte Vedra, FL
AF4GH **Hughes**, George H., Warner Robins, GA
KA4GOK **Martinez**, Osvaldo, Pompano Beach, FL
KJ4IFU **Castoran**, William M., Alexandria, VA
KI4JQM **Bell**, Monroe P., Burlington, NC
KF4KEK **Murphy**, Joseph K., Kingston, TN
AD4KH **Shaper**, H. E. "Ed" Jr, Crawfordville, FL
*K4KIY **Suchocki**, Thomas P., Los Alamos, NM
KG4KZE **Ottaviano**, Richard J., Lake Placid, FL
KD4LCY **Taylor**, Stephen G., Jacksons Gap, AL
K4LEX **Elliott**, Raymond L., Nicholasville, KY
N4LII **Johnson**, Edward T., Richland, WA
KB4LIZ **Hester**, Walter G., Leeds, AL
WB4MAR **Ballentine**, James R., Cashiers, NC
*K4MAS **Kane**, Sheldon "Ed," Margate, FL
KF4MUN **Cruse**, Lloyd L., Paducah, KY
K4MXV **Shankle**, James "Ted" D. Jr, Rome, GA
K4NR **Branch**, Thomas P., Plano, TX
AB4OC **Sicard**, Albert J., Saint Petersburg, FL
KI4OEB **Mackin**, Suzanne A., Palm Harbor, FL
W4OFU **Dewberry**, William C. Jr, Pensacola, FL
KC4OIT **Husband**, George M., Center Point, AL
WB4RMT **Autry**, John D., Dunlap, TN
NN4S **Trammell**, Donald N., Toney, AL
K4SYR **Greer**, Sam Jr, Shelby, NC
WB4SYU **Kressenberg**, Kenneth M. Jr, Chattanooga, TN
W4TU **Thompson**, Heyward C., Buchanan, VA
KJ4TVA **Grossett**, Tyler C., Granville, OH
WT4U **Edwards**, Carlton L., West Columbia, SC
KK4UFO **Jeffries**, Hugh M., Louisville, KY
AE4VV **Bridges**, Louis R., Mooresboro, NC
AB4XS **Heimel**, Roy F. II, Bradford, PA
W4YCE **Sherrill**, Bryce H., Lenoir, NC
KF4YLT **Billingsley**, Billy M., Pikeville, TN
W4YTY **Chaput**, Tarcisius A., Collinsville, VA
*K5ADQ **Boyd**, Virginia M., Los Alamos, NM
K5BFA **Lockey**, Myron W., Madison, MS
W5BTB **Blymn**, Robert S., Hobbs, NM
WA5COD **Perkins**, J. D., Orange, TX
KE5DTS **Canfield**, Carolyn E., Austin, TX
N5EGL **Waddell**, Jack L., Fort Smith, AR
KE5FF **Hicks**, Douglas J., Las Cruces, NM
W5FIH **McElhany**, James H., Norman, OK
*K5FY **Hellmann**, Bruce P., Fairfax, VA
W5HLR **Glendenning**, Franklin B., McAllen, TX
WB5JFS **Spencer**, Imogene, Visalia, CA
KK5LH **Winnard**, Toni, Oklahoma City, OK
KC5NBT **Canady**, Eugene R., Lubbock, TX
W5ODR **Wnukowski**, Charles, Ocean Springs, MS
N5ORT **Helvey**, Orin G. Jr, Wiggins, MS
KC5QCR **Simpson**, Gene "Dennis," Oklahoma City, OK
W5SNF **Harper**, John W., Fort Worth, TX
W5SPI **Myers**, Malcolm E., Hammond, LA
*W5TBQ **Rivers**, James D. Jr, Plano, TX
K5YND **Pareti**, Paul P. III, Metairie, LA
KB5ZRJ **Owens**, Rebecca L., Lake, MS
WD6BPF **Maclean**, John, Ventura, CA
KE6DDA **Collins**, John P., San Anselmo, CA
W6IRT **Lefcourt**, Norman, Woodland Hills, CA
KI6KIJ **Freeman**, Robert M., Taft, CA
*W6MZQ **Johnson**, Walter J. Jr, San Jose, CA
W6NVN **Lucchi**, George A., Phoenix, AZ
W6ODI **Lace**, Robert, Rancho Palos Verdes, CA
K6QIE **Havlina**, William C., Klamath Falls, OR
K6USI **Bradley**, Burton N., Mission Viejo, CA
N6WWY **Griffin**, Robert L., Sacramento, CA
N6XVL **Johnson**, Paul, Olivehurst, CA
*K6ZE **Mitchell**, George T., San Diego, CA
WA7ABT **Watters**, William A., Battle Ground, WA
ex-N7CIS **Wridge**, Wilbur "Bill" S., Kirkland, WA
W7DCA **Robbins**, Omer, Show Low, AZ
KA7DCQ **Smith**, Vern, Vancouver, WA
KC7DTB **Easton**, David, Forest Grove, OR
K7DYE **Dye**, Daryll A., Anaconda, MT
K7EZR **Fish**, Lewis J., Saint George, UT
K7GCD **Van Schuyler**, Philip, Boise, ID
KL7IKF **Kostlin**, Hal, Palmer, AK
AE7JL **Larsen**, Howard "Joe," Fish Haven, ID
KE7JTG **Turley**, Glenae, Holladay, UT
W7LEW **Jezso**, Lewis J., Mesa, AZ
*W7LQY **Clark**, Leonard H., Saratoga, WY
KA7MXS **Hubbard**, Elbert A., Manson, WA
KC7NIE **Farkas**, Nicholas V., Albany, LA
AE7NY **Ekelund**, Harry J., Southbury, CT
W7QCD **Seeley**, Leslie "Les" A., Hyrum, UT
N7QCO **Catterlin**, Richard L., Belgrade, MT
W7RNJ **Sorenson**, Randall E., Rigby, ID
W7RSJ **Bell**, David E., Sheridan, WY
KC7TB **Boleen**, Wallace E., Hillsboro, OR
KE7UDC **Karwhite**, Jason W., Auburn, WA
W7YEM **Triebwasser**, Warren L., Spokane, WA
KC8ALL **Torrence**, William S. Jr, Lansing, MI
W8CP **Werner**, Raymond E., Cincinnati, OH
KB8CQ **Kochevar**, Edward W., Parma, OH
KA8DFD **McGlinch**, Craig A., Greenville, OH
N8GRA **Slawson**, Raleigh A., Northwood, OH
WD8IDJ **Eikhoff**, Donald R., Portage, MI
WE8L **Zaleski**, Mark E., Holland, MI
W8MEJ **Menerick**, Virginia S., Sarasota, FL
N8PLV **Gorris**, William E., Pepper Pike, OH
KD8QCW **Shoemaker**, Lester E., Sabina, OH
*K8QGC **Davidson**, Calvin, Oberlin, OH
W8QPP **Brockmeier**, Jonathan R., Zeeland, MI
N8RTH **Roark**, Terry L., Middletown, OH
N8RUE **Gayeski**, Edward A., Chesterfield, MI
WA8TCY **Wirt**, James R., Flint, MI
W8TJK **Kelly**, Thomas J., Novelty, OH
WA8UDE **Price**, Steven D., Kentwood, MI
W8UNI **Pekrul**, Herman P., Cleveland, OH
K8YAM **Wenger**, Lyman P., Ada, MI
K8YYF **Marker**, John E., Wright, MI
K9BED **Storm**, Ralph F., Milwaukee, WI
W9CKQ **Marini**, Albert T., Racine, WI
AB9EF **Cockream**, Donald W., Elwood, IL
KR9G **Louvier**, Jim J., Waterloo, IL
*K9LAC **Wesner**, James C., Sterling, IL
N9MUJ **Brooks**, William E., Indianapolis, IN
W9NIS **Thompson**, James O., Saint Paul Park, MN
W9OWV **Kayler**, Warren F., Inverness, IL
WE9P **Szulczewski**, Patrick M., Merrill, WI
KA9PLO **Finzel**, George, Huntley, IL
N9RGE **Warke**, Wilbert R., Lebanon, IL
WB9RKK **Schmidt**, Thomas R., Cecil, WI
N9RXP **Nye**, H. Stephen, South Bend, IN
W9SUQ **Prichard**, Lawrence E., Lynn, IN
N9TXS **Weiske**, John "Jack," Fulton, MS
KB9TXX **Serchen**, Dave C., Marshfield, WI
KD9VA **Schutjer**, Johanna L., Quincy, IL
K9YBX **Resnick**, Nathan G., Indianapolis, IN
W9ZUC **Linstedt**, James G., Eau Claire, WI
KE0ABJ **Ryan**, Terry, Fort Collins, CO
WD0AYY **Adrian**, Robert S., Hastings, NE
KC0DB **Peaker**, Charles T., Omaha, NE
K0EPE **Wessel**, Martha E., Liberal, KS
W0GLT **Thye**, Gerald L., Eugene, OR
W0JW **Hilts**, George H., Kronenwetter, WI
KL0LN **Garrison**, James E., New Brockton, AL
N0LRH **Larson**, John R., Corvallis, OR
N0RHR **Rice**, Jack C., Kansas City, KS
W0UYJ **Ferrey**, Gregory M., Saint Paul, MN
W0VPH **Mulkey**, Kendall L., Las Vegas, NV
*WB0VYR **Staerkel**, Gary W., Topeka, KS
*AI0W **Finch**, Stephen C., Homosassa, FL
N0YVR **Beinke**, Myron C., Mason City, IA
*VE3BBB **Waechter**, Paul S., Breslau, ON, Canada
VE5KP **Prickett**, Don R., Saskatoon, SK, Canada
DL8MG **Kleff**, Alfred, Nidderau, Germany
VK2XAR **Moore**, Dennis R., Bathurst, New South Wales, Australia

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FTDX5000MP Limited | *200W HF + 6M Txcvr*

• Internal Power Supply • Two Totally Independent Receivers • Super Sharp "Roofing" Filters • High Performance Yaesu Custom-designed 32-bit Floating Point DSP • True Analog Meter Precision

FTDX3000 | *100W HF + 6M Transceiver*

• 100 Watt HF/6 Meters • Large and wide color LCD display • High Speed Spectrum Scope built-in • 32 bit high speed DSP /Down Conversion 1st IF **Call For Low Pricing!**

FT-991 | *HF/50MHz/2M/440 Transceiver*

• 160 M-440MHz - SSB/CW/FM/C4FM Digital/AM/RTTY/PSK • 100 W (2M/440: 50 Watts) • 3.5" TFT full-color touch panel operation • High speed spectrum scope • Roofing filers: 3kHz & 15kHz • 32-bit high speed floating point IF DSP • 160-6 meter high speed automatic antenna tuner

FTDX1200 | *100W HF + 6M Transceiver*

• Triple Conversion Receiver With 32-bit Floating Point DSP • 40 MHz 1st IF with selectable 3 kHz, 6kHz & 15 kHz Roofing Filters • Optional FFT-1 Supports AF-FFT Scope, RTTY/PSK31 Encode/Decode, CW Decode/Auto Zero-In • Full Color 4.3" TFT Display

FT-450D | *A100W HF + 6M Transceiver*

• 100W HF/6M • Auto tuner built-in • DSP built-in • 500 memories • DNR, IF Notch, IF Shift **Call For Pricing!**

FT-857D | *Ultra Compact HF/VHF/UHF*

• 100w HF/6M, 50W 2M, 20W UHF • DSP included • 32 color display • 200 mems • Detachable front panel (YSK-857 required)

Call For Our Low Price!

FT-2900R | *Heavy-Duty 75W 2M FM Transceiver*

• Massive heatsink gurantees 75 watts of solid RF power • Loud 3 watts of audio output for noisy environments • Large 6 digit backlit LCD display for excellent visibility • 200 memory channels for serious users

FT-8800R | *2M/440 Mobile*

• V+U/V+V/U+U operation • V+U full duplex • Cross Band repeater function • 50W 2M 35W UHF • 1000+ memory channels • WIRES ready **Call Now For Low Pricing!**

FTM-400DR | *2M/440 Mobile*

• Color display-green, blue, orange, purple, gray • GPS/APRS • Packet 1200/9600 bd ready • Spectrum scope • Bluetooth • MicroSD slot • 500 memory per band

FT1DR | *144/430 5W Digital Transceiver*

• C4FM/FDMA • 1200/9600bps AX.25 APRS & GPS Recvr Built-in • Dual Band Operation w/Dual Receivers (V+V/U+V/V+U) • Wideband Receive/AM Bar Antenna/Aircraft Receive • 1266 Memory Channels w/16 Char Alpha Tagging

Also Available In Silver!

VX-6R | *2M 220/440MHz HT*

• Wideband RX – 900 memories • 5W 2/440, 1.5W 220 MHz TX • Li-ION Battery - EAI system • Fully submersible to 3 ft. • CW trainer built-in

New Low Price!

VX-8DR | *50/144/220/440*

50/144/220/440 • 5W (1W 222 MHz) • Bluetooth optional • Waterproof/ submersible (3' for 30 min) • GPS APRS operation optional • Li-ion Hi-capacity battery • Wide band Rx

FT-60R | *2M/440 5W HT*

• Wide receiver coverage • AM air band receive • 1000 memory channels w/alpha labels • Huge LCD display • Rugged die-cast, water resistant case • NOAA severe weather alert with alert scan

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HAM RADIO OUTLET

PLANO TEXAS STORE COMING SOON!

IC-7850 | *HF/50MHz Transceiver*

• 1.2kHz "Optimum" roofing filter • New local oscillator design • Improved phase noise • Improved spectrum scope • Dual scope function • Enhanced mouse operation for spectrum scope • More features

IC-7700 | *HF/50MHz Transceiver*

The Contester's Rig • HF + 6m operation • +40dBm ultra high intercept point • IF DSP, user defined filters • 200W output power full duty cycle • Digital voice recorder

IC-7600 | *All Mode Transceiver*

• 100W HF/6m Transceiver, gen cov. receiver • Dual DSP 32 bit • Three roofing filters- 3, 6, 15khz • 5.8 in WQVGA TFT display • Hi-res real time spectrum scope

IC-9100 | *The All-Round Transceiver*

• HF/50MHz 144/430 (440) MHz and 1200MHz*1 coverage • 100W on HF/50/144MHz, 75W on 430 (440) MHz, 10W on 1200MHz*1 • Double superheterodyne with image rejection mixer

IC-7410 | *HF/50MHz Transceiver*

• 32-bit floating point DSP unit • Double Conversion Super-Het Receiver • Built-in 15kHz 1st IF Filter • Built-in Band Scope • Large, multi-function LCD • RTTY Demodulator/Decoder • USB for PC control

IC-7200 | *HF Transceiver*

• 160-10M • 100W • Simple & tough with IF DSP • AGC Loop Management • Digital IF Filter • Digital Twin PBT • Digital Noise Reduction • Digital Noise Blanker • USB Port for PC Control

IC-718 | *HF Transceiver*

• 160-10M* • 100W • 12V operation • Simple to use • CW Keyer Built-in • One touch band switching • Direct frequency input • VOX Built-in • Band stacking register • IF shift • 101 memories

IC-7100 | *All Mode Transceiver*

• HF/50/144/430/440 MHz Multi-band, Multi-mode, IF DSP • D-STAR DV Mode (Digital Voice + Data) • Intuitive Touch Screen Interface • Built-in RTTY Functions

IC-5100A | *VHF/UHF Dual Band Digital Transceiver*

• Analog FM/D-Star DV Mode • SD Card Slot for Voice & Data Storage • 50W Output on VHF/UHF Bands • Integrated GPS Receiver • AM Airband Dualwatch • FM Analog/DV Repeater List Function

IC-V8000 | *2M Mobile Transceiver*

• 75 watts • Dynamic Memory Scan • CTCSS/DCS encode/decode w/ tone scan • Weather alert • Weather channel scan • 200 alphanumeric memories

IC-PW1 | *HF/50 MHz Amplifier*

• Wide freq. coverage - 1 kW from 1.8 MHz to 50 MHz (amateur bands only) • Wide ALC adjustable range • Full duty cycle • Auto antenna tuner built-in • Auto AC input voltage selector is employed • Current (Ip), Voltage (Vp), temperature, SWR and output power protectors are available

IC-2300H | *VHF FM Transceiver*

• 65W RF Output Power • 4.5W Audio Output • MIL-STD 810 G Specifications • 207 alphanumeric Memory Channels • Built-in CTCSS/DTCS Encode/Decode • DMS

ID-880H | *Analog+Digital Dual Bander D-STAR*

• D-STAR DV mode operation • DR (D-STAR repeater)mode • Free software download • GPS A mode for easy D-PRS operation • One touch reply button (DV mode) • Wideband receiver D-STAR ready

IC-V80 | *HD 2 Meter FM Transceiver*

• Tough construction • 750mW loud audio • Powerful 5.5W of output power • IP54 and MIL-STD-810 rugged construction • Built-in CTCSS/DTCS • WX channel & weather alert function

IC-51A | *VHF/UHF Dual Band Transceiver*

• 5/2.5/1.0/0.5/0.1W Output • RX: 0.52–1.71, 88–174, 380-479 MHz** • AM/FM/FM-N/WFM/DV • 1304 Alphanumeric Memory Chls • Integrated GPS • D-STAR Repeater Directory • IPX7 Submersible D-STAR ready

ID-31A | *UHF Digital Transceiver*

5W Output Power • FM Analog Voice or D-STAR DV Mode • Built-in GPS Receiver • IPX7 Submersible • 1,252 Alphanumeric Memory Channels

D-STAR ready

5 Ways to Shop!

- RETAIL LOCATIONS – Store hours 10:00AM - 5:30PM - Closed Sunday
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BURBANK, CA (877) 892-1748	SAN DIEGO, CA (877) 520-9623	NEW CASTLE, DE (800) 644-4476	DENVER, CO (800) 444-9476	ATLANTA, GA (800) 444-7927	SALEM, NH (800) 444-0047	ONLINE STORE WWW.HAMRADIO.COM

*Except 60M Band. **Frequency coverage may vary. Refer to owner's manual for exact specs. *1 Optional UX-9100 required. ✦ Instant savings expire 12/31/14. Contact HRO for promotion details. OST DEC 2014. The Icom logo is a registered trademark of Icom Inc. 70048
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Special HRO Holiday Pricing!

HAM RADIO OUTLET

PLANO TEXAS STORE COMING SOON!

TS-990S | *200W HF + 6M Transceiver*

• World's first dual TFT display • 200W output on all bands • ±0.1ppm TCXO ensures both high stability and reduced power consumption • Triple 32-bit DSP's dedicated to main/sub receivers and band scope • Main receiver employs full down conversion, new mixer & narrow band roofing filters • Third order intercept point (IP3) +40dBm for highest level of RX performance (main receiver)

Call For Special Price!

TM-D710G | *2M/440 Dualband*

• V+V/V+U/U+U operation • Built-in GPS • Built-in TNC for APRS & DX-Cluster operation • 50W 2M & UHF • 1,000 memories • Dual receive • Green or amber backlight colors • Latest APRS firmware w/new features • Sky Command II remote functions

Call For Special Price!

TS-480SAT/HX | *HF + 6M Transceiver*

• 480HX 200W HF & 100W 6M (no tuner) • 480SAT 100W HF & 6M w/AT • Remotable w/front panel/speaker • DSP built-in

Call Now For Low Price!

TS-590SG | *HF/50MHz Transceiver*

• Equipped with 500 Hz/2.7 kHz roofing filter as standard • ALC derived from TS-990S eliminating spike issues • Antenna output function (shared with DRV connector) • CW - morse code decoder function • Improved 1st mixer • New PFB key with multi-function knob • New split function enabling quick setting • LED backlight with selectable color tone

TM-V71A | *2M/440 DualBand*

• High RF output (50W) • Multiple Scan • Dual receive on same band (VxV, UxU) • Echolink® memory (auto dialer) • Echolink® Sysop mode for node terminal ops • Invertible front panel • Choice of green/amber for LCD panel • 104 code digital code squelch • "Five in One" programmable memory • 1000 multifunction memory

Call Now For Your Low Price!

TH-D72A | *2M/440 HT w/extended RX*

• 5W TX, RX 118-524 MHz, VxU, VxV, UxU • APRS w/built-in 1200/9600 TNC • Built-in GPS, Built-in USB, digipeater • Echolink® compatible, • Mil-Spec STD810

Call For Special Low Price!

TS-2000/2000X | *HF/VHF/UHF Transceiver*

• 100W HF, 6M, 2M • 50W 70CM • TS-2000X 10W 1.2GHz • Built-in TNC, DX packet cluster• IF Stage DSP • Backlit front key panel

Call For Special Price!

TM-281A | *2 Mtr Mobile*

• 65 Watt • 200 Memories • CTCSS/DCS • Mil-Std specs • Hi-quality audio

Call For Special Low Price!

TH-F6A | *2M/220/440*

• Dual channel receive • .1 - 1300 MHz (cell blocked) RX • FM, AM, SSB • 5W 2M/220/440 TX, FM • 435 Memories • Li-Ion Battery

Call For Low Price!

TH-K20A | *2M Handheld*

• 2M 5.5W • VOX • CTCSS/DCS/1750 Burst built-in • Weather alert

Call For Special Low Price!

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BURBANK, CA (877) 892-1748	SAN DIEGO, CA (877) 520-9623	NEW CASTLE, DE (800) 644-4476	DENVER, CO (800) 444-9476	ATLANTA, GA (800) 444-7927	SALEM, NH (800) 444-0047	ONLINE STORE WWW.HAMRADIO.COM

✦ Kenwood coupons expire 12/31/14. Contact HRO for promotion details. Toll-free including Hawaii, Alaska and Canada. Call will be routed to the nearest store. All HRO 800-lines can assist you. If the first line you call is busy, you may call another. AZ, CA, CO, GA, VA residents add sales tax. Prices, specifications and descriptions subject to change without notice.

❄ Special HRO Holiday Pricing! ❄

HAM RADIO OUTLET

PLANO TEXAS STORE COMING SOON!

ACOM

ACOM-1000

• HF and 6 Meter 1KW Amplifier • Match 3:1 SWR with No Tuner • User Friendly QSK Operation • LCD Message Display • Single 4CX800a Tube • Vacuum Antenna Relays

Call For Additional ACOM Products!

ABR INDUSTRIES

- *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:
TS-480HX/SAT; TS-2000 (RC-2000 req'd); IC-703/Plus; IC-706 series; DX-SR8T; IC-2820H; IC-R2500

Just simply insert your control box in place of your front panel interconnect cable, place the body of the radio on the remote end and you are on the air as if you are there! Extra Controller and Remote interface units sold individually for multiple sites/users.

Now includes 12V power supply, $12.95 value!

Available exclusively from all HRO locations!

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• 40' Tubular Tower

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MA-550

• 55' Tubular Tower • Handles 10 sq. ft. at 50 mph • Pleases neighbors with tubular streamlined look

Call For Latest Pricing!

All US Towers shipped by truck; freight charges additional.

BUY FROM HRO. The World's Largest US Tower Dealer

TX-455

• 55' freestanding crank-up • Handles 18 sq. ft. @ 50 mph • No guying required • Extra-strength construction • Can add raising and motor drive accessory • Towers rated to EIA specifications • Other models available at great prices!

Revolutionary Radio Interfaces

Rig control interfaces with CAT for all popular radios. Digital modes including RTTY, PSK, CS (WinKey emulation), MFSK, MT63 SSTV, PACTOR and many more. Experience untethered connection to the computer using the new WTI-1 wireless transceiver interface.

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Great selection of antenna analyzers designed for testing, checking, tuning or repairing antennas and feedlines with frequency ranges and accuracy to meet the needs of even the most discriminating amateur radio operator.

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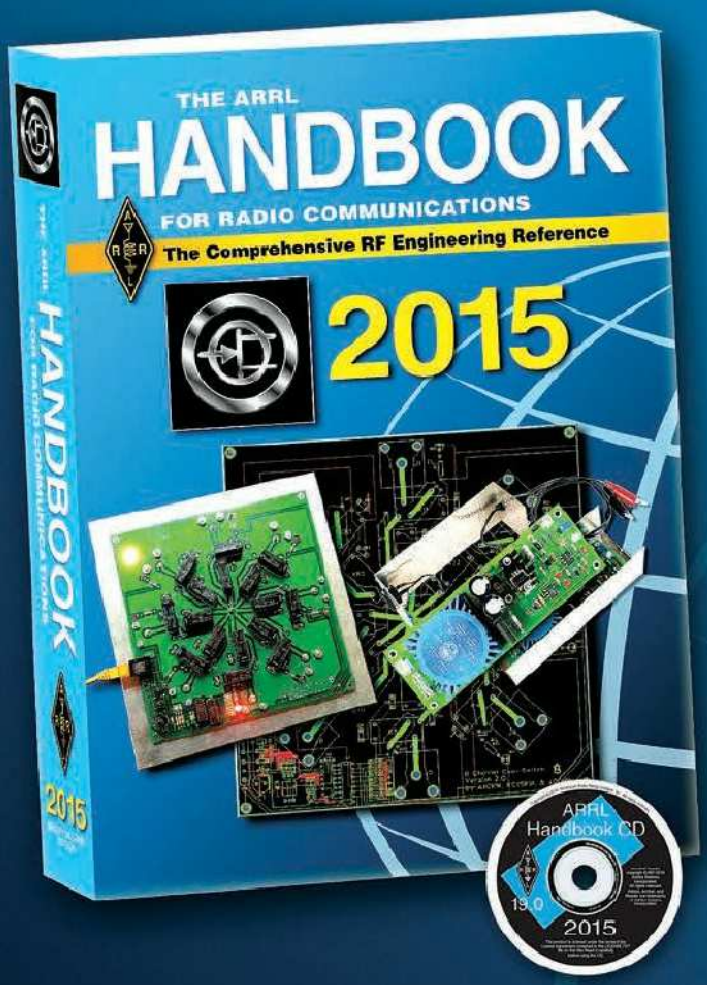
The ARRL HANDBOOK for Radio Communications

NEW!



2015 Edition

Discover the theory, practical information and construction details to expand your knowledge and skill as an Amateur Radio operator and experimenter.

This 92nd edition of ***The ARRL Handbook*** is at the forefront of the growing field of wireless telecommunications. The book covers not only the fundamentals of radio electronics—analog and digital—but also practical circuit and antenna design, computer-aided design, digital operating modes, equipment troubleshooting, and reducing RF interference. Many projects and construction articles are included to help enhance your station and expand your participation as an active radio experimenter. Practical applications and solutions make ***The Handbook*** a must-have for hobbyists and technical professionals, finding its way onto workbenches, operating desks, and into university libraries and classrooms.

Dozens of contributors help ensure that each edition is updated and revised to reflect the latest advances and technologies:

New Projects

- Simple Adjustable Tracking Power Supply
- Tri-Band Moxon Yagi Antenna
- A Legal-Limit Bias-T
- An Eight-Channel Remote Control Antenna Switch

New Information

- Updated material on the state of Solar Cycle 24
- Recommended parts for modifying circuit designs and fine-tuning performance
- A package of useful applications on CD-ROM from Tonne Software, including a new version of the ELSIE™ filter design program
- Annual transceiver model review

CD-ROM Inside

Includes the fully searchable text and illustrations in the printed book, as well as expanded supplemental content, software, PC board templates, and other support files.

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QST 12/2014

A DX Engineering Gift Card Makes a Great Stocking Stuffer.

DX ENGINEERING

New!

Receiver Guard 5000

Protect your sensitive receiver against high levels of RF from strong or nearby signals. DX Engineering's Receiver Guard 5000 is perfect if you have a receive antenna saturated with high RF levels. It is also useful for Field Day, SWL or if your neighbor generates a lot of RF.

The RG-5000's advanced design limits strong signals with minimal harmonic noise and is RF transparent at normal receiver signal levels. Designed for the world-class multi-transmitter contest station K3LR, it offers 100% protection to expensive transceiver front-ends. The RG-5000 provides performance and frequency coverage superior to other devices. At a continuous input of 10 W maximum, output is only +10 dBm (83 dB over S-9), and insertion loss is under 0.15 dB 0.5 to 50 MHz.

DXE-RG-5000 Receiver Guard 5000.....**$69.95**

New!

Copper Ground Rod Clamp

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.*

DXE-UCGC Copper Ground Rod Clamp.....**$48.95**

New!

Rotator Control Line Protector

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.

DXE-IS-RCT Rotator Control Line Protector...**$169.95**

New!

Dual Vertical Array

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.

DX BUCKS 45

The DX Engineering Dual Vertical Array systems are available for the 160, 80 and 40 meter bands. More bands are coming soon.

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**

Eligible for 45 DX Bucks, see DXEngineering.com for details.

Excellent Reception with a Small Footprint.

DX BUCKS 200

100 kHz-30 MHz Receive Four-Square Array Packages

Optimized to produce wider, deeper rear nulls and a narrower main lobe, DX Engineering's patented* receive system takes up much less space than a Beverage antenna. The system uses time delay phasing to deliver exceptional broadband performance. A superior front-to-back ratio reduces noise and unwanted signals as well.

The innovative design means you'll enjoy improved signal directivity, a better signal-to-noise ratio, and enhanced reliability. Select from one of four 90-degree spaced directions with a cleaner pattern than any other four-square array system on the market. Your receive pattern will also be less susceptible to high-angle signals when compared to flag, pennant, EWE and K9AY antennas.

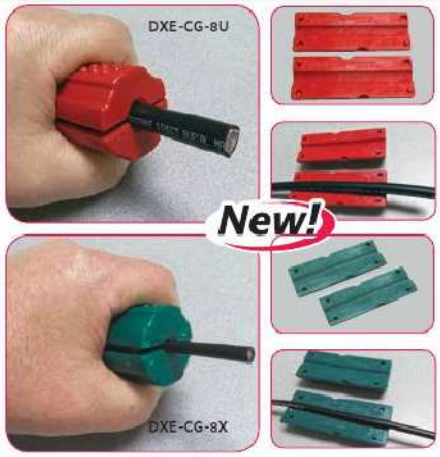
Find full details on each package at DXEngineering.com.

DXE-RFS-SYS-2P 4-Square Array, Controller and Switch Package **$419.95**

DXE-RFS-SYS-3P 4-Square Array, Electronics Package..... **$1,468.95**

DXE-RFS-SYS-4P 4-Square Array, Complete Package..... **$1,947.95**

DXE-RFS-SYS-3P 4-Square Array, Electronics Package is eligible for 200 DX Bucks, see DXEngineering.com for details.



New!

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**

DXE-CG-8X Cable Gripper for RG-8X Size Cable..... **$14.95**

M² ANTENNA SYSTEMS, INC.

DX BUCKS 500

Limited-Time Offer!

1K2 6 Meter 1,200 Watt Amplifier

This compact amp is perfect for Field Day, DXpeditions and your base station. Even with its built-in power supply, the 1K2 is the smallest 1,200 watt amplifier ever offered, weighing a mere 20 pounds. This amp features a single LDMOS FET rated at an incredible 1,250 Watts, able to handle a 65:1 SWR. It's perfect for EME (CW and JT65), SSB, CW or JT6M for meteor scatter.

M2 1K2 VHF Amplifiers are only available at DX Engineering.

MSQ-6M-1K2 6 Meter 1,200 Watt Amplifier with Power Supply.....~~$3,299.00 List~~

Limited-Time Offer $2,699.00

Eligible for 500 DX Bucks, see DXEngineering.com for details.

FREE STANDARD SHIPPING on most orders over $99!

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800-777-0703

Your #1 Source for Coaxial Cable and Cable Tools

DX ENGINEERING

DXE-UT-KIT4

Coaxial Cable Prep Tools for Solder-On Connectors

Using a two-step process, these prep tools are the ideal way to prepare your foam or solid dielectric coaxial cable for a solder-on connector. The tools' premium-quality, long-lasting blades and superior precision ensure that you won't damage the cable's conductor.

DXE-UT-8213	Cable Stripper for RG-8, RG-213, and Similar Sizes	$49.95
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

DXE-UT-KIT3 eligible for 10 DX Bucks, DXE-UT-KIT4 eligible for 20 DX Bucks, see DXEngineering.com for details.

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-UT-KIT-CRMP2 eligible for 10 DX Bucks, see DXEngineering.com for details.

DXE-PL259

DXE-PP30

DXE-UG175S

DXE-UG176S

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
AML-83-1SP	Amphenol PL-259 Connector	$4.15
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

Tigertronics
Grants Pass, Oregon

SignaLink™ USB Unit from Tigertronics

PSK-31, RTTY and more! Powered by your computer's USB port, this unit is compatible with both PCs and Macs, and works with virtually every radio. The SignaLink supports all sound card digital and voice modes. It's easy to install and set up, and software is included.

TGR-SL-USB	SignaLink™	$85.00

You'll need the right radio cable to get started. Right now, any interface cable is only **$14.95** when you buy a SignaLink.

New! Earn Rewards from Your Purchases!

DX Bucks are like gift certificates to use on future orders from DX Engineering. DX Bucks are redeemable via phone, mail, online or by presenting them at a retail location.

When you're awarded DX Bucks, you'll get a numbered certificate in the mail about two weeks after we ship your order.

DX BUCKS 25

Visit DXEngineering.com and click the "Hot Deals" button for details.

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!

Made in USA

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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Heavy-Duty 4130 Chromoly Steel Masts

Start stacking some serious antennas. These 2" and 3" O.D., 22' masts feature a 0.250" wall thickness and meet ASTM A-513 Type 5 ratings. The cold-drawn, electric-weld carbon-steel masts have a galvanized surface that creates an almost polished appearance.

- Certified yield stress rating over 100,000 psi
- Tensile strength minimum above 110,000 psi
- Stress-relieved for consistent mechanical strength
- Minimum Rockwell B hardness is 96

Use DXEngineering.com's exclusive online Mast Load Estimator to find the perfect mast for your setup.

DXE-ST200CM-22 2" O.D. Heavy Duty Mast, 22' **$399.95**
DXE-ST300CM-22 3" O.D. Heavy Duty Mast, 22' **$589.95**

Full Size 75/80 Meter Quarter-Wave Vertical Antennas

See video on how these four UNGUYED DXEngineering 80M Verticals easily withstood SuperStorm Sandy at DXEngineering.com!

These 68 foot tall, high-performance, full size antennas have rugged base sections (2", 3" or 4" diameter) made from aircraft-grade aluminum tubing. The VA-1 requires simple guying. The VA-2 and VA-3 models are very stout and don't require guying.

Using DX Engineering's innovative structural design and high strength tubing, these antennas are built to our rigid specifications for the best wind ratings in the industry. Extra strong UV-protected Extren® insulators give you high power handling ability, and each antenna is built using precise machining and uses stainless hardware for unmatched reliability. These antennas give you an incredible 2:1 bandwidth up to 500 kHz. VA-2 and VA-3 antennas also include a Heavy Duty Plus Stainless Pivot Base which lets you easily tilt your antenna up and down.

Super Duty Tilt Bases also offered separately, visit DXEngineering.com for more products and available configurations.

DXE-7580FS-VA-1 Vertical Antenna, Standard Duty, 2" O.D. Base.....**$399.95**
DXE-7580FS-VA-2 Vertical Antenna, Heavy Duty, 3" O.D. Base.....**$899.95**
DXE-7580FS-VA-3 Vertical Antenna, Super Duty, 4" O.D. Base...**$1,769.95**

Freight Talk. We've refined our shipping methods to ensure that you get your order quickly and accurately, without a huge expense or headache. That includes the big stuff, like tower sections and antenna masts. Your oversize order will ship for a flat rate, without any guesswork or additional charges. Talk to a DX Engineering advisor and we'll walk through the process together.

High Performance Easy to Install

2X Arrays

TX38 Tri-Band Yagi

Get on the 20/15/10 meter bands with an antenna that can withstand 100 mph winds. Its durability makes it ideal for permanent installations, but it's compact and light enough to be used during Field Day.

TXA-3B-8L-WRTC TX38 Yagi Antenna **$1,199.00**

DX Engineering Clamps are Specified by Scientific, Military & Government Designers, & Used by Antenna Builders: Both Commercial & Amateur.

Highest Quality—Lasting Performance!

Whether you are building a Yagi from scratch, refurbishing a well-used "old friend," or experimenting with a new antenna project, DX Engineering can supply the best hardware for your application. You can find useful tips and complete dimensions for each clamp and bracket type at DXEngineering.com.

GENERAC

Generac iX Series Portable Generator

With 2,000 watts of clean AC power in a whisper-quiet package, Generac's 5793 iX Series Portable Generator is practically tailor-made for remote Amateur Radio operations. More importantly, it is extremely lightweight with an integrated carrying handle, making it easy to haul. An ingenious "FlexPower" switch can be used to save power and further reduce engine noise.

The 1 gallon fuel tank provides about 2 hours of full-load power, and over 5 hours of power at half-load. The generator features dual 110 Vac outlets and a 12 Vdc outlet. The 5793 is 50-state legal, CARB EO number U-U-166-0036.

GNR-5793.....**$589.00**

Stainless Steel Radial Plate with Coax Attachment

Not Aluminum! Guarantees Best Radial System Conductivity Over Time

Make radial attachment a snap. This plate fits 3" pipe, 4x4 and 6x6 posts and you can use up to 120 radials. It's made from .125" thick 304 stainless steel, not cheap aluminum and uses a patented high current coax-to-radial connection. This ensures excellent, lasting radial connectivity.

DX BUCKS

DXE-RADP-3 Complete with 20 Stainless Bolt Sets **$57.95**
DXE-RADP-1HWK 20 Sets of 1/4" Stainless Hardware.....**$7.95**
DXE-SSVC-2P Stainless Saddle Clamp for to 1" to 2" O.D. Steel Tube.....**$11.95**

DXE-RADP-3 is eligible for 10 DX Bucks, see DXEngineering.com for details.

Telescoping Fiberglass Antenna Tubing Kits

These kits contain seven sections of high quality smoothly telescoping tubing from 2" to 1/2" O.D. and new DX Engineering Compression Clamps for maximum tubing grip and strength. Perfect for portable operation, camping, Field Day or experimenting, these kits are an excellent way to get your antenna wire in the air quickly.

DXE-FTK50A Fiberglass Antenna Tubing Kit, 50' Max. Length.....**$198.95**

The Best Aluminum Tubing Available

Just Add Clamps and Slide It Together for a Complete Antenna Element!

6063-T832 Aluminum Tubing

- Better than the other guys, at same price
- Order from us and the competition—We're sure that you'll send theirs back
- Smoothly telescoping pre-slit or un-slit lengths
- Custom made just for DX Engineering

3' lengths .058" wall - 3/8" to 2 1/8" O.D.
6' lengths .058" wall - 3/8" to 2 1/8" O.D.

5 Guy Rings Included

Perfect for Most Elements

6061-T8 .120" wall - 1.5" to 3" O.D. un-slit

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DXE-ATK65A Aluminum Antenna Tubing Kit, 65' Max. Length.....**$209.95**

See DXEngineering.com for specs and additional tubing. DX Engineering has All-Stainless Steel Element Clamps to fit exact tubing sizes.

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The linear amplifier OM2000+ is designed for all short wave amateur bands from 1.8 to 29 MHz (including WARC – bands) + 50 MHz and all modes. It is equipped with a ceramic tetrode FU-728F.

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- Frequency coverage: All amateur bands 1.8 – 29.7 MHz
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Rig Expert Antenna Analyzers

See the full Rig Expert line including the new AA-170 on our Webpage!

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RigExpert AA-1000 is a powerful antenna analyzer designed for testing, checking, tuning or repairing antennas and antenna feedlines.

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RigExpert IT-24 is a universal, ultra-portable device for testing, checking, tuning or repairing antennas and antenna feedlines of the 2.4 GHz ISM band (operating frequencies are 2.3 … 2.6 GHz).

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New coaxial and balanced tuners available in **800w**, **1500w** and **3000w** versions.

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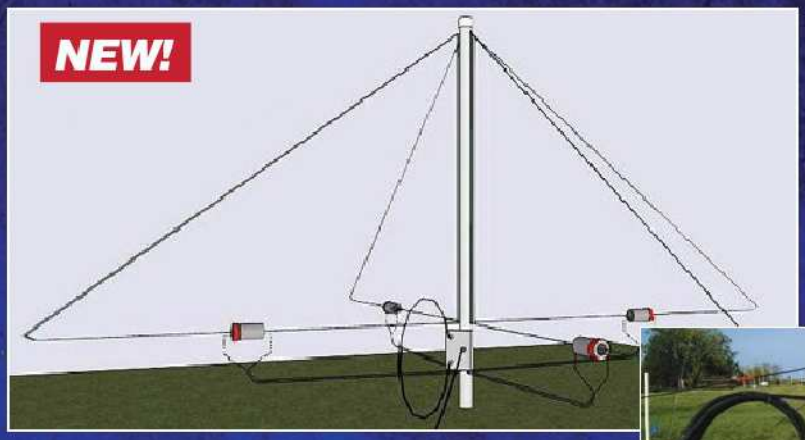

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The Shared Apex Loop Array™ is a revolutionary receiving antenna that will change the way that you listen to the radio! The patented design provides performance in a size and over a range of frequencies that will please both the rag-chewer and DXer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

Two models to chose from:

- AS-SAL-20 - optimized for VLF, BCB, Low Band DXing, shortwave to 15MHz, 20 feet tall and about 40 foot diameter
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- New Larger, Sharp & Fast LCD Display
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- New - Both 3kW and 10kW couplers on one display - switched
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Introducing the VNA *uhf* two-port Vector Network Analyzer

- Frequency range from 5 kHz to 1 GHz
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- Dual Smith charts with rotation and 20 markers

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NEW!

BEKO VHF and UHF amplifiers (2m and higher) are now available from Array Solutions. These are considered the best solid state amplifiers in their categories and we have them!

Stack Match II Plus!

Stack two yagis on any HF band or 6m and take advantage of high or low angle propagation with upper/lower/BIP/BOP without any phasing lines!

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— Yaesu System Fusion —

FT-1DRBHD 2M/440 FM HT

• TX: 2M/70cm • Wideband RX: 500kHz-999MHz (less cellular with AM/FM broadcast) • Power: 5W • Analog and Digital (12.5kHz C4FM FDMA) • Integrated GPS • CTCSS/DCS Encode & Decode • WX Receiving with WX Alert • Digital Group Monitor Function • GSM (Group Short Message) • Snapshot Function with optional Speaker Mic

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FTM-400DR 2M/440FM Transceiver

TX: 2M/70cm RX: 108-470/800-999MHz (cell blkd) • Power: 50W FM • C4FM FDMA w/GPS for APRS (1200/9600bps) • Packet Ready Color display • Spectrum scope • ARTS • Bluetooth • Twin RX• MicroSD slot • 12/30kHz filters • 500 memories/band

NEW LOW PRICE

FT-270R 2M FM HT

• TX: 144-148 • RX: 136-174 • Power: 5/2/0.5W • 200 Memories • Extra large LCD display & speaker

FT-60R 2M/440 MHz HT

•TX: 144-148, 430-450 • RX: 0.5-999 • 5 Watts RF Output • Features wideband receive from 108-520 and 700-999 MHz (Cellular Blocked) • Emergency Auto ID System • Over 1000 Memories

VX-8DR 6M/2M/440 FM HT

• TX: 50-54, 144-148, 222-225, 430-450 MHz • RX: 0.5-999 MHz (cell blocked) • 1200+ Memories • Power: 5/2.5/1/0.05W (1.5W on 220 MHz) • Optional GPS Unit FGPS-2 with either CT-136 adapter or MH-74A7A hand microphone provides APRS® data

$40 MAIL-IN REBATE

FT-2900R Heavy Duty Wide/Narrow, Deviation Section 2M FM Mobile

• TX: 144-148 MHz • RX: 136-174 MHz • Power: 75/30/10/5W • 3W of Audio for for Noisy Environments • Massive Heat Sink (No Cooling Fan Needed) • 221 Memories • Dual Watch • Versatile Scanning Capability • WX Channels with "Severe Weather" Alert • CTCSS and DCS Encode/Decode Built-in • Transmit Time-Out timer • Automatic Power Off

$50 MAIL-IN REBATE

NEW LOW PRICE

FT-450D HF/6M Transceiver

• TX: HF/6M • RX: 0.03-56 MHz • Power: 10-100W • Memories: 500 • Built-in Automatic Antenna Tuner • IF DSP • Same as the original FT-450AT with new features: Key illumination, Foot stand, Selectable 300 Hz/500 Hz/2.4 kHz CW IF Filters • Classically designed main dial and knobs • dynamic microphone

$200 MAIL-IN REBATE

FTDX-1200 HF/6M Transceiver

• TX: HF/6M • RX: 0.03-56 MHz • Triple Conversion with 32-bit floating point DSP • Power: 100W • Built-in Automatic Antenna Tuner • 40 MHz IF with selectable 3 kHz, 6kHz & 15 kHz Roofing Filters • FM & AM Wide and Narrow modes included • Optional built-in FFT UNIT supports advanced functionality including AF-FFT Scope • RTTY/PSK31 Encode/Decode • CW Decode and CW Auto Zero-in • Full Color 4.3 in. TFT Color Display • USB port

$100 MAIL-IN REBATE

FTDX-3000D HF/6M Transceiver

• TX: HF/6M • RX: 0.03-56 MHz • Power: 5-100W • Large TFT color display • High-speed spectrum scope • High end receiver based off of the FTDX-5000 • IPO • Built-in USB interface • Remote Control Capability • High-speed auto antenna tuner • RTTY/PSK31encode/decode included • 5 Digital voice messages

$400 MAIL-IN REBATE

FTDX-5000MP *Limited* HF/6M Transceiver

• TX: 1.8-29.7, 50-54 MHz Power: 10-200W on CW, SSB, FM, RTTY & PKT and 5-50W on AM • RX: 0.03-60 MHz • 99 Memories • Agressive 112dB range • +40dBm IP3 or 3rd-order Intercept Range • High stability ±0.05ppm OCXO • 32-bit Floating Point DSP • Variable CW Audio Peak Filter, and High/Low-Cut DSP filtering • 300 Hz, 600Hz, 3 kHz, 6kHz and 15 kHz Roofing Filters

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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 $2^{1}/_{16}$".

HAM-VI **$749.95** with DCU-2

HAM-VII **$799.95** *with DCU-3*

HAM IV and HAM V Rotator Specifications	
Wind Load capacity (inside tower)	15 square feet
Wind Load (w/mast adapter)	**7.5 square feet**
Turning Power	800 in.-lbs.
Brake Power	**5000 in.-lbs.**
Brake Construction	Electric Wedge
Bearing Assembly	**dual race/96 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	26 lbs.
Effective Moment (in tower)	**2800 ft.-lbs.**

TAILTWISTER SERIES II

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, $2^{1}/_{16}$" max mast. **MSHD, $109.95.** Above tower heavy duty mast support. T2X, HAM-IV, HAM-V, HAM-VI. Accepts $1^{7}/_{8}$-$2^{5}/_{8}$" OD.

TAILTWISTER Rotator Specifications	
Wind load capacity (inside tower)	20 square feet
Wind Load (w/ mast adapter)	**10 square feet**
Turning Power	1000 in.-lbs.
Brake Power	**9000** in.-lbs.
Brake Construction	Electric Wedge
Bearing Assembly	**Triple race/138 ball brngs**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	31 lbs.
Effective Moment (in tower)	**3400 ft.-lbs.**

CD-45II

CD-45II **$449.95**

For antenna arrays up to 8.5 sq. feet mounted inside tower or 5 sq. ft. with mast adapter. Low temperature grease good to -30 F degrees. *New* Test/Calibrate function. Bell rotator design gives total weather protection, dual 58 ball bearing race gives proven support. Die-cast ring gear, stamped steel gear drive, heavy duty, trouble free gear train, North center scale, lighted directional indicator, 8-pin plug/socket on control unit, snap-action control switches, low voltage control, safe operation, takes maximum mast size to $2^{1}/_{16}$ inches. MSLD light duty lower mast support included.

CD-45II Rotator Specifications	
Wind load capacity (inside tower)	8.5 square feet
Wind Load (w/ mast adapter)	**5.0 square feet**
Turning Power	600 in.-lbs.
Brake Power	**800 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/48 ball brings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	22 lbs.
Effective Moment (in tower)	**1200 ft.-lbs.**

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. $2^{1}/_{16}$ inch maximum mast size. MSLD light duty lower mast support included.

AR-40 Rotator Specifications	
Wind load capacity (inside tower)	3.0 square feet
Wind Load (w/ mast adapter)	**1.5 square feet**
Turning Power	350 in.-lbs.
Brake Power	**450 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/12 ball bearings**
Mounting Hardware	Clamp plate/steel bolts
Control Cable Conductors	**5**
Shipping Weight	14 lbs.
Effective Moment (in tower)	**300 ft.-lbs.**

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TH-D72A

2M/440 FM HT with Built in GPS

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TM-V71A Dualband FM Mobile

• TX: 144-148, 430-450 MHz • RX: 118-524, 800-1300 MHz (cell blocked) • Power: 50/10/5W • Dual receive (V+V) (U+U) • Cross-band repeat • EchoLink® ready • Optional RC-D710 can replace the TM-V71A control panel to enable all the features of the original TM-D710A

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TS-480HX 200W HF/6M Mobile

•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

Closeout

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• TX: HF/6M • RX: 0.13-60 MHz • Power: 2-200W • Built-in Auto Antenna Tuner and AC Supply • Dual TFT Display • Dual receivers • Narrow-band roofing filters • Triple DSP • Serial port, USB ports and Ethernet port

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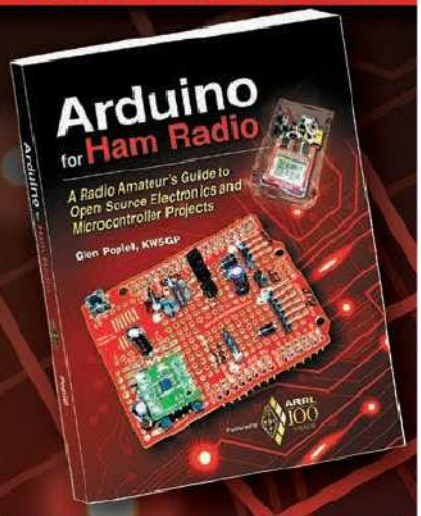

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Dual Band Handheld

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• TX: voice memory for repeat calls • Integrated GPS receiver with GPS loggins function • Repeater search function searches up to 20 nearby repeater sites • Battery pack, BP-271 • Voice synthesizer function announces frequency, mode and call sign • Voice memory function records incoming and outgoing calls and can be used as a voice recorder • Large full dot-matrix display • DR (D-STAR repeater) mode operation makes it easy to access D-STAR repeaters • micro SD card slot for voice, log data storage and data cloning • Antenna, FA-S270C • Cloning software • Wall charger • Belt clip • Hand strap

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• TX: HF/6M • RX: 0.03-60 MHz • Power: 2-100W • 15kHz 1st IF Filter and optional 3kHz & 6kHz filters to protect against strong unwanted adjacent signals • Much faster DSP unit compared to the IC-746PRO • Automatic antenna tuner • USB connector for PC control

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HF/VHF/UHF All Mode Transceiver

• TX: HF/6M/2M/440MHz • RX: 0.03-199.999, 400-470 MHz MHz • Power: 2-100W/2-50W (2M)/2-35W (440) • Memories: 495, 900 D-Star Repeater Channels • Remote Head • Intuitive Touch Screen Interface • D-Star DV Mode • Detachable Angled Screen • SD Memory Card Slot • USB Port • Optional RS-BA1 Remote Control Software • Optional RC-28 USB Remote Encoder

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Ameritron **AutomaticTune™** ***mode automatically tunes your screwdriver antenna for lowest SWR as you tune your transceiver!***

You get super accurate, ultra-fast and extremely reliable tuning with 88 programmable memories.

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Precision four digit LED readout gives you antenna position, motor current and transceiver frequency -- it's so bright you can even read it in direct sunlight.

Its super compact, ergonomic design is so intuitive to use you'll never need the instruction book! 3⅝Wx3½H x1⅝D inches fits anywhere.

Fully RFI protected with RF chokes and bypass capacitors on incoming and outgoing wires and other sensitive points. All aluminum RF-tight cabinet. Completely eliminates troublesome RFI problems.

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Menu allows change of motor direction without physically reversing wires.

Works with single/dual magnetic sensor screwdriver antennas. Includes interface cable for your transceiver, power, motor control and sensor wires. Specify Icom, Kenwood, Yaesu or Elecraft. Additional cable, $24.95 each.

SDC-102, $129.95

Program in ten favorite frequencies and simply push a button to send your antenna there! Up/down buttons easily tune to any frequency. Super bright *read-in-sunlight* LED digits tell exact antenna position. Easy-to-use. AutoPark™, StallProtector™.

SDC-100B, $109.95

Up/down buttons let you manually tune your screwdriver antenna quickly! Super bright *read-in-sunlight* LED digits tell exact antenna position with -999 to +999 digital count range. On/off switch. Reset switch lets you easily recalibrate.

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ALS-500M

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500 Watts PEP SSB/400 Watts CW output! Covers 1.5-22 MHz (10/12 Meters with MOD-10M, $29.95, requires FCC license).

Turn on and operate -- no warm-up, no tuning, instant bandswitching. 9Wx3¼Hx15D", 7 lbs.

Virtually indestructible! *Load Fault Protection* eliminates damage due to operator error, antenna hitting branches, trucks passing by. *Thermal Overload Protection* disables/bypasses amplifier if temperature is excessive. Automatically resets.

60-70 Watts in gives full output. On/Off switch bypasses amplifier for barefoot operation. Extremely quiet fan turns on as needed. Excellent harmonic suppression, push-pull output, DC current meter. Use 13.8 VDC/80 Amps.

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ARI-500, $119.95. Lets your transceiver auto bandswitch your ALS-500M amplifier.

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AWM-35B *Precision* Mobile SWR/Wattmeter

AWM-35B/BH

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Just 1⅝" thick -- easily mounts on your dashboard for easy viewing. Remote sensor with 25' thin, flexible cable lets you place the sensor and coax *out-of-the-way*. Handles full 1500 Watts, 1.8-60 MHz. LED lighted Cross-Needle SWR/Watt-meter. Read *true peak* or average power in two power ranges. Has high SWR LED. Wattmeter is 5Wx3¼H x1⅝D inches. Remote is 3½Wx 2¾H x2¾D inches. Use 9V battery or 12 VDC.

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MFJ-870 Wattmeter, $79.95

GrandMaster MFJ SWR/Wattmeters. **MFJ-870, $79.95.** 1.6-60 MHz. 30/300/3000 Watt power ranges. **MFJ-874, $109.95.** 1.8-525 MHz. 5/20/200 Watt power ranges.

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Flat Mobile MFJ SWR/Wattmeter has large 3" Cross-needle meter. Use 12 VDC or plug into cigarette lighter plug with **MFJ-5510, $9.95** to light meter. 1.8-30 MHz. 5Wx3Hx2D".

MFJ-1703 SafetySwitch $29.95

Keeps your expensive transceivers safe from transmitting into nothing! Covers 1.8-30 MHz, connects two rigs and two antennas. 300 Watts PEP SSB, 150 Watts CW. Switches 50-75 Ohm unbalanced.

Antenna Window Feedthrough Panels

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Three SO-239 *Teflon*® **coax connectors let you feed HF/VHF/UHF antennas. High voltage ceramic feed-thru insulators bring in 450/300 Ohm balanced lines. 48" cuts to your size to fit most windows. Ceramic feedthru insulator for long wire or random wire, stainless steel ground post brings in your ground. More models, see: *www.mfjenterprises.com***

MFJ-1708 T/R Switch $79.95

RF sense T/R switch switches your antenna from receive to transmit using a relay. Shorts antenna input to ground to protect receiver, provides auxiliary contact closure.

MFJ-250 DummyLoad $69.95

VersaLoad™ dummy load handles 1kW CW or 2kW PEP for 10 minutes. Run continuous duty 400 Watts PEP. Under 1.2:1 to 30 MHz. Includes transformer oil (no PCB). SO-239

MFJ-9296 QRPocket $229.95

QRPocket™ transceiver has a no-compromise receiver, solid QRP+ 5Watts transmit power on every band, QSK T/R switching, DDS Frequency control, Precise 100 Hz readout. All modules included: 80/40/30/20/17/15M.

MFJ-916B Duplexer $24.95

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17-foot stainless steel telescopic whip is manufactured with a solid 7/8" diameter by 23/8" long chrome-plated brass base. Collapses to 27 inches. Operate 20M without loading coil and 30/40/60/80/160M with a loading coil. 5/8" diameter bottom section.

MFJ-407D Keyer $79.95

MFJ Curtis-Keyer has all keyer modes, dot-dash memories, jam-proof spacing, weight, sidetone, built-in speaker. Speed, weight and tone controls and tune, semi-auto and on/off switches are on the front panel.

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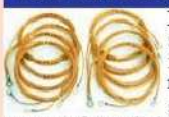

Provides necessary return path for ground currents to reduce ground losses. 2-sets of 4 radial wire assemblies giving a total of 14 radial wires. Each end wire has 1/4" ring lug

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Universal Antenna Tilt base fits most vertical antennas with or without a base bracket. Mount one side of tilt to mast and other to the base. Raise your antenna up/down with ease. Hardware included.

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Suppress annoying TVI caused by 2-way, broadcast, commercial, amateur and CB radios below 30 MHz. Use between cable/antenna and TV/VCR. Type F connectors.

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Tiny Iambic paddle is just 1¾Wx ¾Hx1¾D inches and weighs just 2½ ounces. Precision paddle formed from phosphorous bronze, rugged metal base, non-skid rubber feet.

MFJ-1750 2M Antenna $34.95

5/8 Wave ground plane 2-Meter base antenna handles 300 Watts. Gives maximum possible calculated gain of any single element antenna.

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Ultra wide-band antenna receives 25-1300 MHz, transmits 50-1300 MHz. Handles 200W. Includes SO-239, 50' coax, stainless steel elements and mounting hardware.

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Reads voltage 95-135, with a 2% accuracy. Built-in AC socket, so you don't lose the outlet. Perfect for the ham shack and motor homes. Color coded scale for quick glances. 2¼Wx2¼Hx1½ in.

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Super-strong 5" magnets with 17" coax. Choose SO-239 (S), NMO (M) or 3/8-24 thread (T).

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HF trunklip mobile mount has 17' coax, adjustable 360° and up/down. 3/8-24 threaded connector.

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VHF/UHF *RuffRider*™ High Gain Antennahandles 200 Watts, just 40" long. Great gain on 2-Meters and 440 MHz. Fold-over lets you take it down in garage.

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MFJ-269C Analyzer, $399.95

Upgraded MFJ-269C has all features of MFJ-259C plus 415-470 MHz, 12-bit A/D converter, characteristic impedance 0-600 Ohms, coax calculator, parallel equivalent R/X.

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Plots graphs on MFJ graphical analyzer. Two-port VNA measurement. Display/print on PC using IG-mini VNA freeware. DDS frequency control. 1.5-179.9 MHz.

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More hams use MFJ-949E tuners than all others in the world! Large 3" cross-needle SWR/Wattmeter, 8 position antenna switch, dummy load, Match any antenna 1.8-30 MHz.

MFJ-969 Tuner $229.95

World's only 6-160 Meters 300 Watt *AirCore*™ Roller Inductor antenna tuner gives you absolute minimum SWR. 3" cross-needle meter, true peak reading meter, dummy load, 8 pos. antenna switch.

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Compact *roller inductor* antenna tuner handles popular Ameritron AL-811H/811 amps. *AirCore*™ inductor, 3" Cross-Needle meter, 6-position antenna switch, 800W SSB PEP output.

MFJ-989D Tuner $409.95

Legal-limit antenna tuner has *Air-Core*™ inductor, 500pF air variable capacitors, fast-tune crank, high voltage balun, 3" meter, dummy load, ant. switch.

MFJ-929 AutoTuner $229.95

Compact 200 Watt *IntelliTuner*™ tunes any unbalanced antenna *ultra-fast!* 20,000 Virtual Memories, Antenna Switch, Efficient L-network, Matches 6-1600 Ohms from 1.8-30 MHz.

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Select 300 Watts (6-1600 Ohms) or 150 Watts (6-3200 Ohms) with the *world's only dual power* automatic tuner. 1.8-30 MHz, 4:1 current balun, LED lighted cross meter, backlit LCD, more!

MFJ-998 AutoTuner $699.95

Full 1500 Watts SSB/CW Digital and analog SWR/Wattmeter, 12-1600 Ohms from 1.8-30 MHz, built-in antenna switch, auto amp bypass.

MFJ-1778 G5RV $44.95

Efficient, *all band* G5RV antenna is only 102' long, has 32.5' ladder line matching section ending in an SO-239 for feedline. Operate 80-10 Meters with tuner. 1500 Watts.

MFJ-16XX HF Sticks $14.95

Rugged, sleek **6-40M** mobile *HamTenna*™ antennas, **$14.95** each band. 250 Watts, 7' extended, collapse to about 4 feet for storage. Quickly screws into any 3/8-24 female mount for quick band changing. **60-75M, $19.95.**

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7.0-55 MHz *Big Ear*™ antenna has 34 feet of radiating elements for BIG signal! Backpack portable, fast set-up/tune, 1 KW PEP SSB/CW, rugged construction.

MFJ-1786 HiQ Loop $419.95

10-30 MHz Super Hi-Q loop, remote control. 36" dia. all welded construction, butterfly tuning capacitor. ABS plastic housing. **MFJ-1788, $499.95.** 7-22 MHz.

MFJ-260C Dry Load $39.95

300W VHF/HF Dry Dummy Load handles full load for 30 seconds. Derating curve to 5 minutes. SWR below 1.1:1 to 30 MHz. 1.5:1 from 30-650 MHz. **MFJ-264, $74.95.** 1.5kW load.

MFJ-1702C Ant Switch $39.95

2-position antenna switch has center ground, auto grounding of unused position, 2.5 kW PEP and works to over 500 MHz. Lightning surge protection. SO-239 Connectors. **MFJ-1704, $79.95.** 4 positions.

MFJ-915 RFI Isolator $29.95

Prevents unwanted RF from traveling on your coax shield into your expensive transceiver. Prevents stray RF that cause painful RF "bites" and erratic operation. Heavy duty weather protected PVC is 2Wx5H inches. 1.5 kW. 1.8-30 MHz.

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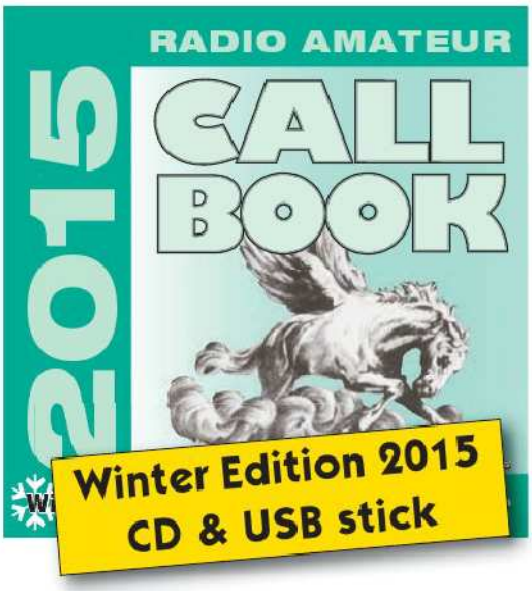

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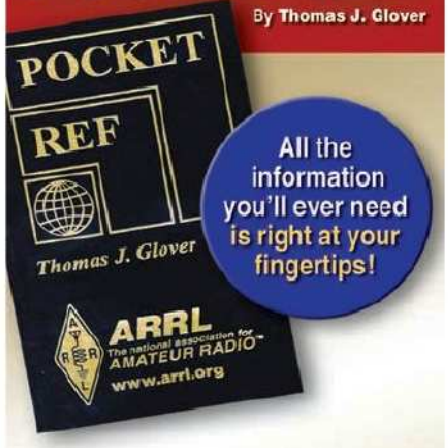

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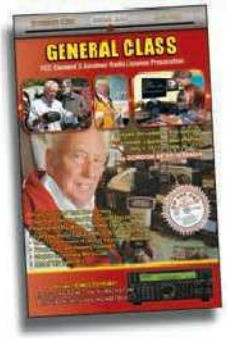

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- ***Convenient - No annoying jumpers!***
- ***Precise - FSK & CW controllers on board***
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MFJ-266B, $299.95. Has all the features of MFJ-266C but MFJ-266B covers 1.5-65 MHz, 85-185 MHz and 300-490 MHz. Does not cover 220 MHz band.

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MFJ-213, $199.95. Reads SWR, complex impedance, impedance magnitude. Measures capacitance, inductance, field strength, frequency, generate test signals. Fine tune stubs, analyze coax, test baluns, RF transformers, plus other RF tasks.

MFJ SWR Analyzer Accessories

A. MFJ-29D/MFJ-39D, $24.95. Carry Pouch for MFJ-259C/269C.
B. MFJ-92AA10, $29.95. 10-Pack 2500 mAh Ni-MH Supercells.
C. MFJ-66, $24.95. Dip coils, set of two covers 1.8-230 MHz.
D. MFJ-731, $99.95. Tunable Analyzer Filter, 1.8-30 MHz, for strong RF fields.
E. MFJ-917, $29.95. 1:1 Current balun for SWR Analyzers to test balanced line antennas, other loads.
F. MFJ-5510, $9.95. 12VDC cigarette lighter adapter.
G. MFJ-7737, $5.95. PL-259 to BNC Female.
H. MFJ-7727, $5.95. PL-259 to SMA Female.
I. MFJ-633, $29.95. Ultra-fast intelligent charger.

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MFJ *IntelliTuner*™ Automatic Tuners

More hams use MFJ tuners than all other tuners in the world!

World's most advanced Automatic Antenna Tuners feature world renowned MFJ AdaptiveSearch™ and AutomaticRecall™ algorithms -- world's fastest ultra-wide range tuning. Nine World Class models! Choose your features: Digital/Analog/Audio SWR-Wattmeter, Antenna Switch, Balun, Radio Interface, Digital frequency readout, Remoteable, Coax/Balanced Lines/Wire Tuning, Field Upgradeable . . .

MFJ-998 1500 Watt *Legal Limit IntelliTuner*™

Only the MFJ-998 gives you fully automatic antenna tuning for your legal limit full 1500 Watts SSB/CW linear amplifier!

MFJ-998 **$699.95**

Ultra-fast Automatic Tuning

Instantly match impedances from 12-1600 ohms using MFJ's exclusive *IntelliTune*™, *Adaptive Search*™ and *InstantRecall*™ algorithms with over 20,000 *VirtualAntenna*™ Memories.

Safe auto tuning protects amp

MFJ's exclusive *Amplifier Bypass Control*™ makes tuning safe and "stupid-proof"!

Digital/Analog Meters

A *backlit* LCD meter displays SWR, forward/reflected power, frequency, antenna selected, an auto-ranging bargraph power indication, and much more.

Has quick-glance auto-ranging Cross-Needle SWR/Wattmeter.

MFJ VirtualAntenna™ Memory

MFJ new *VirtualAntenna*™ Memory system gives you 4 antenna memory banks for *each* of 2 switchable antenna coax connectors. Select up to 4 antennas on each antenna connector. Each antenna has 2500 memories, 20,000 total. Has binding post for end-fed long wire antennas.

Download & Upgrade Remotely

Download from internet and upgrade your MFJ-998 firmware as new features are introduced.

Plus Much More!

Built-in radio interface controls most transceivers.

Automatically bypasses with excessive tuning power.

Use balanced line antennas with external **MFJ-912, $59.95**, 1.5 kW 4:1 balun.

Small 13Wx4Hx15D inches easily fits into your ham station. 8 pounds. Requires 12-15VDC at 1.4 amps maximum or 110 VAC with **MFJ-1316, $21.95**.

for 600 Watt amps

AL-811/ALS-600/ALS-500

For 600 Watt amps like Ameritron AL-811/ALS-600/ALS-500M. Matches 12-800 Ohms. 10,000 *Virtual Antenna*™ memories. Cross-Needle SWR/Wattmeter. 10Wx2¾Hx9D inches.

MFJ-994B **$359.95**

***No Matter What*™ Warranty**

Every MFJ tuner is protected by MFJ's famous one year *No Matter What*™ limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

300 Watt...Best Seller

Digital Meter, Ant Switch, Balun

The *world's best selling* automatic antenna tuner is *highly acclaimed the world over* for its ultra high-speed, wide matching range, reliability, ease-of-use! Matches virtually *any* antenna.

MFJ-993B **$269.95**

300 Watt...Extra Wide Range

SWR/Wattmeter, 10000 VA Memories

Extra *wide matching range at less cost.* Exclusive dual power level: 300 Watts/6-1600 Ohms; 150W/6-3200 Ohms. Cross-Needle SWR/Wattmeter.

MFJ-991B **$229.95**

200 Watt ...Compact

Digital Meter, Ant Switch, Wide Range

World's fastest compact auto tuner uses MFJ *Adaptive Search*™ and *InstantRecall*™ algorithms. 132,072 tuning solutions instantly match virtually any antenna with near perfect SWR.

MFJ-929 **$229.95**

200 Watt ...Econo

Small, Ant Switch, 20K VA Memories

High-speed, wide matching range and compactness at low cost! Leave in-line and forget it -- your antenna is *always* automatically tuned! 2-position antenna switch.

MFJ-928 **$199.95**

200 Watt *MightyMite*™

Matches IC-706, FT-857D, TS-50S

No *extra space needed!* Just set your IC-706/7000, FT-857D, TS-50S on top of this matching low-profile automatic tuner -- it's all you need for a completely automated station using *any* antenna! Just tune and talk!

MFJ-925 **$179.95**

G5RV Antenna

MFJ-1778 **$44.95**

Covers all bands, 160-10 Meters with antenna tuner. 102 ft. long. Can use as inverted vee or sloper. Use on 160 Meters as Marconi.1500 Watts. Super-strong fiberglass center/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.

200W...Weather-sealed

for Remote/Outdoor/Marine

MFJ-926B **$279.95**

Fully *weather-sealed for remote Outdoor/Marine use!* Tough, durable, built-to-last the elements for years.

200 Watt...Remote

Coax/Wire Ant, No pwr cable needed

MFJ-927 **$259.95**

Weather protected fully automatic *remote* auto tuner for wire ***and*** *coax* antennas -- an MFJ exclusive. Powers through coax -- No separate power cable needed.

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MFJ TUNERS

Ham Radio's *Most Popular* 300 Watt Antenna Tuner

More hams use MFJ-949s than any other antenna tuner in the world!

Why? Because the world's leading tuner has earned a world-wide reputation for being able to match just about anything.

Full 1.8-30 MHz Operation

Tune your antenna for minimum SWR! Works 1.8-30 MHz on dipoles, verticals, inverted vees, random wires, beams, mobile whips, shortwave receiving antennas . . . Use coax, random wire, balanced lines. Has heavy duty 4:1 balun for balanced lines.

Custom inductor switch

Custom designed inductor switch, 1000 volt tuning capacitors, *Teflon*(R) insulating washers and proper L/C ratio gives you *arc-free* no worries operation up to 300 Watts PEP transceiver input power.

MFJ-949E **$189.95**

The MFJ-949E inductor switch was *custom* designed to withstand the extremely high RF voltages and currents that are developed in your tuner.

8-Position Antenna switch

Antenna switch lets you select two coax fed antennas, random wire/balanced line or dummy load through your MFJ-949E or direct to your transceiver.

Lighted Cross-Needle Meter

Full *size* 3-inch lighted Cross-Needle Meter. Lets you easily read SWR, *peak* or average forward and reflected power simultaneously. Has 300 Watt or 30 Watt ranges.

QRM-Free PreTune™

MFJ's *QRM-Free PreTune™* lets you pre-tune your MFJ-949E *off-the-air* into its built-in dummy load! Makes tuning your actual antenna faster and easier.

Plus Much More!

Full *size* built-in non-inductive 50 Ohm dummy load, scratch-proof Lexan multi-colored front panel, $10^5/_8$x$3^1/_2$x7 inches. Superior cabinet construction and more!

MFJ-948, $169.95. Econo version MFJ-949E. Has all features except for dummy load.

No Matter What™ Warranty

Every MFJ tuner is protected by MFJ's famous one year *No Matter What™* limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

More hams use MFJ tuners than all other tuners in the world!

MFJ-989D *Legal Limit* Tuner

MFJ-989D **$409.95**

New, improved MFJ-989D *legal limit* antenna tuner gives you better efficiency, lower losses and a new *true* peak reading meter. Easily handles *full* 1500 Watts SSB/CW, 1.8-30 MHz, including MARS/WARC bands. Six position antenna switch, dummy load. *New* 500 pF air variable capacitors. *New* improved *AirCore™* Roller Inductor. *New* high voltage current balun. *New* crank knob. $12^7/_8$Wx6Hx$11^5/_8$D".

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

Superb *AirCore™* Roller Inductor tuning. Covers *6 Meters* thru 160 Meters! 300 Watts PEP SSB. *Active* true peak reading lighted Cross-Needle SWR Wattmeter, *QRM-Free PreTune™*, antenna switch, dummy load, 4:1 balun, Lexan front panel. $10^1/_2$Wx$3^1/_2$Hx$9^1/_2$D inches.

MFJ-969 **$229.95**

MFJ-941E *super value* Tuner

The *most for your money!* Handles 300 Watts PEP, covers 1.8-30 MHz, *lighted* Cross-Needle SWR/Wattmeter, 8 position antenna switch, 4:1 balun, 1000 volt capacitors, Lexan front panel. Sleek $10^1/_2$Wx$2^1/_2$Hx7D in.

MFJ-941E **$149.95**

MFJ-945E HF/6M *mobile* Tuner

Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 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-945E **$129.95**

MFJ-971 *portable/QRP* Tuner

Tunes coax, balanced lines, random wire 1.8-30 MHz. Cross-Needle Meter. SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ transceivers. Tiny 6x$6^1/_2$x$2^1/_2$ in.

MFJ-971 **$129.95**

MFJ-901B *smallest* Versa Tuner

MFJ-901B **$99.95**

MFJ's smallest (5x2x6 in.) and most affordable wide range 200 Watt PEP Versa tuner. Covers 1.8 to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-902B *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-903, $69.95,** Like MFJ-906, less SWR/Wattmeter, bypass switch.

MFJ-906 **$99.95**

MFJ-921/924 *VHF/UHF* Tuners

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 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-934, $209.95,** Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

MFJ-931 **$109.95**

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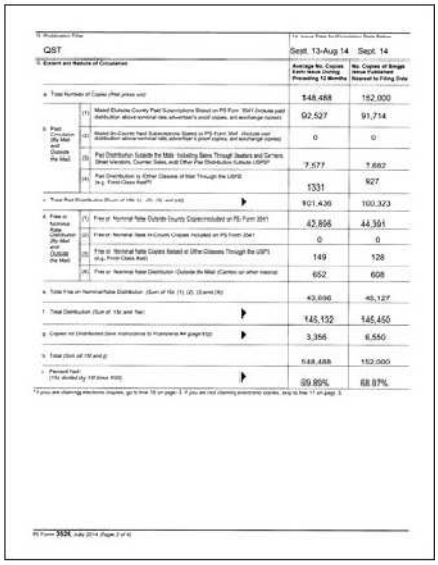

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MFJ *Switching* Power Supplies

Power your HF transceiver, 2 meter/440 MHz mobile/base and accessories with these highly reliable 15, 22, 30, 40 or 75 Amp MFJ Switching Power Supplies!

No RF hash . . . Super lightweight . . . Super small . . . Volt/Amp Meters . . .

MFJ's adjustable voltage switching power supplies do it all! Power your HF or 2M/440 MHz radio and accessories.

MFJ's *MightyLites*™ are so light and small you can carry them with one hand! Take them with you anywhere.

No more picking up and hauling around heavy, bulky supplies that can give you a painful backache, pulled muscle or hernia.

These babies are clean . . . Your buddies won't hear *any* RF hash on your signal! *None* in your receiver either! These super clean *MightyLites*™ meet all FCC Class B regulations.

Less than 35 mV peak-to-peak ripple under 25 or 45 amp full load. Load regulation is better than 1.5% under full load.

You won't burn up our power supplies! MFJ Power supplies are *fully protected* with Over Voltage, Over-temperature and Over Current protection circuits.

MFJ *MightyLites*™ can be used anywhere in the world! They have switchable AC input voltage and work from 85 to 135 VAC or 170 to 260 VAC. Replaceable fuse.

A whisper quiet internal fan efficiently cools your power supply for long life.

22 Amp Continuous

Ham Radio's smallest and lightest 22 Amp continuous power supply is also its best selling!

MFJ-4125 **$84.95**

22 Amps continuous/25 Amps max at 13.8VDC. 5-way binding posts on front, 5A quick connects on back. 85-135/170-260 VAC input. 2.9 lbs. 5¾Wx3Hx5¾D".

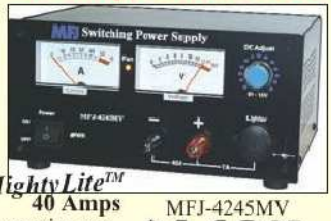
MFJ-4125P, $94.95. Adds 2-pairs *Anderson PowerPoles*™.

22 Amp Continuous

MFJ-4225MV **$99.95**

22 Amps continuous, 25 Amps maximum. Like MFJ-4125 but adds Volt/Amp meters, cigarette lighter plug. Adjustable 9-15 VDC Output. 5¼Wx 4½Hx6D in. Weighs 3.7 lbs. Use 85-135 VAC or 170-260 VAC input. Replaceable fuse.

40 Amp Continuous



MFJ-4245MV **$149.95**

40 Amps continuous, 45 Amps max. Adjustable 9-15 VDC output. Volt/Amp meters, cigarette lighter plug, front 5-way binding posts, two rear quick connects. 5.5 lbs. 7½Wx 4¾Hx9D inches. Use 85-135 VAC or 170-260 VAC input. Replaceable fuse.

70 Amp Continuous

MFJ-4275MV **$249.95**

75 Amps maximum and 70 Amps continuously. Adjustable voltage 4.0-16 VDC. Short circuit, overload and over-temperature protection, 10.5 lbs. 9¾Wx5½Hx9½D". Great for Ameritron's ALS-500M mobile amplifier!

High Current Multiple DC Power Outlets

Power multiple Transceivers/accessories from a* single *DC power supply . . . Keeps you neat, organized and safe . . . Prevents fire hazard . . . Keeps wires from tangling up and shorting . . . Fused and RF bypassed . . . 6 foot, 8 gauge color coded cable . . .

Versatile 5-Way Binding Posts

MFJ-1118 **$84.95**

MFJ-1118, $84.95. Power two HF and/or VHF rigs and six accessories from your main 12 VDC supply. *Built-in 0-25 VDC voltmeter.* Two pairs 35 amp 5-way binding posts, fused and RF bypassed for transceivers. Six pairs RF bypassed binding posts provide 15 Amps for accessories. Master fuse, ON/OFF switch,"ON" LED. 12½x2¾x2½ in.

MFJ-1116 **$59.95**

MFJ-1116, $59.95. 8 pairs binding posts, 15A total.Voltmeter, on/off switch.

MFJ-1112 **$44.95**

MFJ-1112, $44.95. 6 pairs binding posts, 15 Amps total.

MFJ-1117 **$64.95**

MFJ-1117, $64.95. Powers *four* transceivers simultaneously (two at 35 Amps each and two at 35 Amps combined). 8x2x3 inches.

MFJ-1128 **$104.95**

All PowerPoles™

MFJ-1128, $104.95. 3 high-current outlets for transceivers. 9 *switched* outlets for accessories. Mix & match included fuses as needed (one-40A, one-25A, four-10A, four-5A, three-1A fuses installed). 0-25 VDC *Voltmeter.* *Extra* contacts, fuses. 12Wx1¼Hx2¾D".

MFJ-1126 **$84.95**

MFJ-1126, $84.95. 8 outlets, each fused, 40 Amps total. Factory installed fuses: two 1A, three 5A, two 10A, one 25A, one 40A. *0-25 VDC Voltmeter.* Includes *extra PowerPoles®, extra* fuses -- *no extra cost.* 9Wx1¼Hx2¾ inches.

MFJ-1129 **$114.95**

PowerPoles™ *AND 5-Way Binding Posts*

MFJ-1129, $114.95. 10 outlets each fused, 40 Amp total. 3 high-current outlets for rigs -- 2 *PowerPoles®* and one 5-way binding post. 7 *switched* outlets for accessories (20A max) -- 5 *PowerPoles®* and 2 binding posts. Fuses include (1- 40A, 2-25A, 3-10A, 3-5A, 2-1A installed). *0-25 VDC Voltmeter.* Includes extra *PowerPoles®* and fuses, 12½Wx1¼Hx2¾D inches.

MFJ-1124 **$64.95**

MFJ-1124, $64.95. 6 outlets each fused, 40 Amps total. 4 *PowerPoles®*, 2 high-current binding posts, Installed fuses: 1-40A, 2-25A, 2-10A, 1-5A, 1-1A. Includes extra *PowerPoles®* & fuses -- *no extra cost.*

15 Amp Continuous

MFJ-4115 **$59.95**

15 Amps continuous, 17 Amps max at 13.8 VDC. Over-voltage, over-current protection. 5-way binding posts. Load fault indicator and automatic shutdown. 90-130 VAC input. 1½ lbs. Tiny 3¾Wx2¼Hx3¾D inches fits easily in an overnight bag.

30 Amps Continuous

Linear with 19.2 lb.Transformer

MFJ-4035MV **$149.95**

This heavy-duty linearly regulated MFJ-4035MV has *abolutely no RF Hash.* It delivers 30 Amps continuous, 35 Amps maximum from its massive 19.2 lb. transformer. Front panel adjustable 1-14 VDC output with convenient detent at 13.8 VDC. Volt/Amp Meters. 1% load regulation, 30 mV ripple. Over-voltage/current/temperature protection, 5-way binding posts, 2 pairs of quick-connects and a covered cigarette lighter socket for mobile accessories. Front panel replaceable fuse. 110 VAC input. 9½Wx6Hx9¾D in.

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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 September 3, 2014 through October 3, 2014.
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Is your station computer used for activities other than Amateur Radio?

Yes **73%**
No **20%**
I don't have a station computer **7%**

Do you leave your station computer on at all times?

Yes **35%**
No **58%**
I don't have a station computer **7%**

Is your primary station computer a desktop, laptop, or tablet?

Desktop **61%**
Laptop **30%**
Tablet **1%**
Other **1%**
I don't have a station computer **7%**

If your primary station computer is a laptop or desktop, have you ever suffered a hard drive failure?

Yes, but it was a long time ago **30%**
Yes, within the last year **7%**
No **54%**
My station computer isn't a desktop or laptop **7%**
I don't have a station computer **7%**

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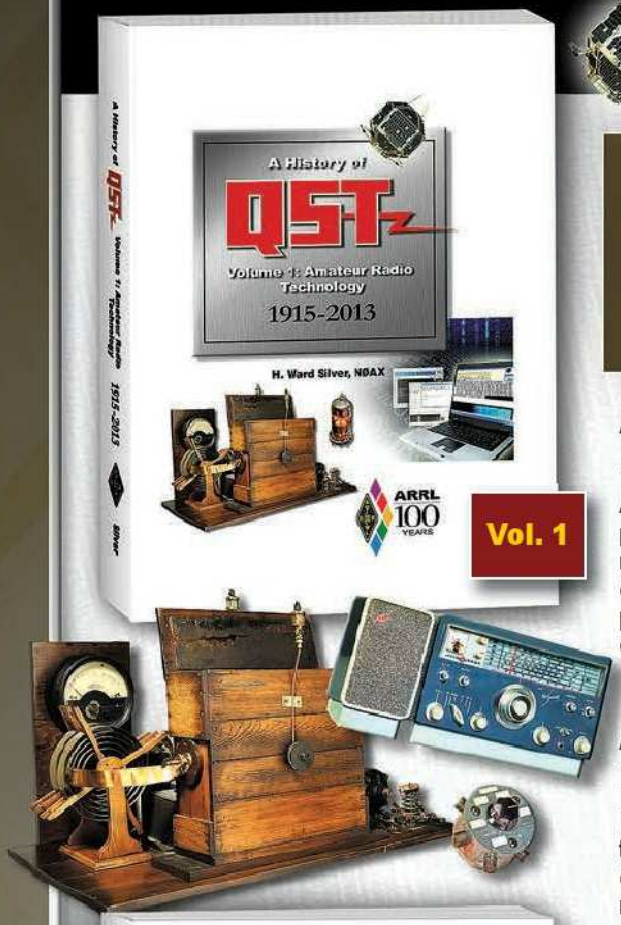

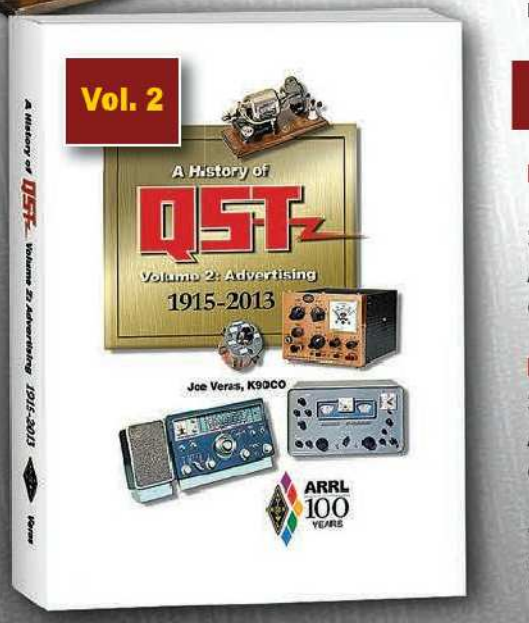

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ROHN

25G	$119
25AG2/25AG4	$189/239
AS25G/AS455G	$65/119
BPC25G/BPH25G	$69/279
BAS25G/BPL25G	$299/199
EP2534-3/5	$49/65
GA25GD/GA45GD	$159/189
GAC3455	$139
GAR30/GAS604	$45/69
HB25AG/HB25BG	$119/129
SB25G/SB25G5	$79/109
SBH25G	$249
TB3/TB4	$159/179
TRT36/TRT60	$59/69
TRTAG2/9H50	$219159
WP25G/WP45G	$149/159

IIX EQUIPMENT

BP1X Snatch Block	$149
GP21X Clamps/Kit	$279/319
GP31T Clamps/Kit	$329/409
GP-81 Clamp/Kit	$239/299
GP-UPS Gin Pole	$209
GPP Gin Pole Pulley	$109
SO1X Stand-Off	$199
SO4 Stand-Off	$169
SO5-6" Stand-Off	$99
SO5-26" Stand-Off	$139

TEXTENNA
TexHex 5-Band $589
Provides broadband (typical VSWR <1.5:1) coverage of 10/12/15/17/20m. Optional 6m kit. Improved heavy-duty mounting plate fits masts up to 2" OD. Pre-tuned elements, easy to install. In stock!

TIMES LMR COAX
Lower loss than traditional coaxes without the water displacement problems common to 9913 and 9086 types.

LMR-200	$.65/FT.
LMR-200 Ultraflex	$.85/FT.
LMR-240	$.69/FT.
LMR-240 Ultraflex	$.89/FT.
LMR-400	$.89/FT.
LMR-400DB	$1.09/FT.
LMR-400 Ultraflex	$1.39/FT.
LMR-600	$1.59/FT.
LMR-600 Ultraflex	$2.49/FT.

MORE LMR CABLES IN STOCK

DAVIS RF

COAX - MADE IN USA
All have high-quality non-contaminating outer jackets.

RG-58C/U	$.29/FT.
RG-8X Mini	$.29/FT.
RG-213/U	$.79/FT.
BuryFlex	$.89/FT.
Belden 9913F7	$1.29/FT.

COMET ANTENNAS

CAA-500 Analyzer	$439
CHA-250B	$389
GP-3/GP-6	$99/149
GP-9/GP-9N	$189/189
GP-15/GP-98	$169/189

DIAMOND ANTENNAS

X-30A/X-50A	$69/99
X-200A/X-300A	$129/139
X-510HDMA/HDNA	$199
X-3200A/X-6000A	$179

MFJ

MFJ-259C Analyzer	$249
MFJ-269C Analyzer	$359

GLENMARTIN

H2 Hazer	$609
H3 Hazer	$459
H4 Hazer	$589
RT-424 Roof Tower	$319
RT-832 Roof Tower	$469
RT-936 Roof Tower	$779
RT-1832 Roof Tower	$1029
RT-2632 Roof Tower	$1709

texcom RF PRODUCTS

Crimp Kit $99
Tool kit to prepare and crimp RF connectors for .100", .200", .240" and .405" diameter coax cables, including LMR-100, LMR-200, LMR-240, LMR-400, RG-8/8X/58/213, BuryFlex, 9913, 9086, 9096 and other similarly sized cables. With rugged plastic storage case.

Crimp Kit Plus $109
Same as the Crimp Kit, but also includes dies for Anderson PowerPole™ connectors.

WE HAVE A HUGE STOCK OF CRIMP CONNECTORS FOR MANY COMMON COAX CABLES. PLEASE CHECK OUR WEB SITE OR CALL.

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Hygain, CD-45II	$429
Hygain, Ham-IV	$599
Hygain, Ham-V	$939
Hygain, T2X	$699
Hygain, T2X Digital	$1,159

ROTOR CABLE - US MADE

R62, 6-#18	$.59/FT.
R81, 2-#18/6-#22	$.49/FT.
R82, 2-#16/6-#18	$.79/FT.
R83, 2-#14/6-#18	$.89/FT.

STEEL MASTS
High-carbon steel masts. Typical yield strength of 83,000 PSI.

	.12"	.18"	.25"
5 FT.	$69	$79	$99
8 FT.	$109	$129	$159
10 FT.	$129	$149	$189
12 FT.	$159	$179	—
13 FT.	—	$199	$239
15 FT.	—	$229	—
18 FT.	—	—	$329
21 FT.	$269	$319	—
22 FT.	$279	—	—
23 FT.	—	$339	$429

ALUMINUM TUBING
Our 6063-T832 aluminum tubing is all American made to our exacting standards for the highest quality and precision.

O.D.	WALL	COST/FT.
6063-T832 DRAWN ALUMINUM TUBING		
.375"	.058"	$.65
.500"	.058"	$.70
.625"	.058"	$.80
.750"	.058"	$.90
.875"	.058"	$.95
1.000"	.058"	$1.00
1.125"	.058"	$1.10
1.250"	.058"	$1.30
1.375"	.058"	$1.40
1.500"	.058"	$1.50
1.625"	.058"	$1.65
1.750"	.058"	$1.80
1.875"	.058"	$1.95
2.000"	.058"	$2.10
2.125"	.058"	$2.25
6061-T6 EXT. AL. SQUARE TUBING		
.750"	.062"	$.95
1.000"	.062"	$1.25

TEXAS TOWERS

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- CUSTOM DESIGNED EAR PADS PROVIDE 26 dB OF ISOLATION TO KEEP UNWANTED NOISE OUT.

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