DEVOTED ENTIRELY TO AMATEUR RADIO

QST

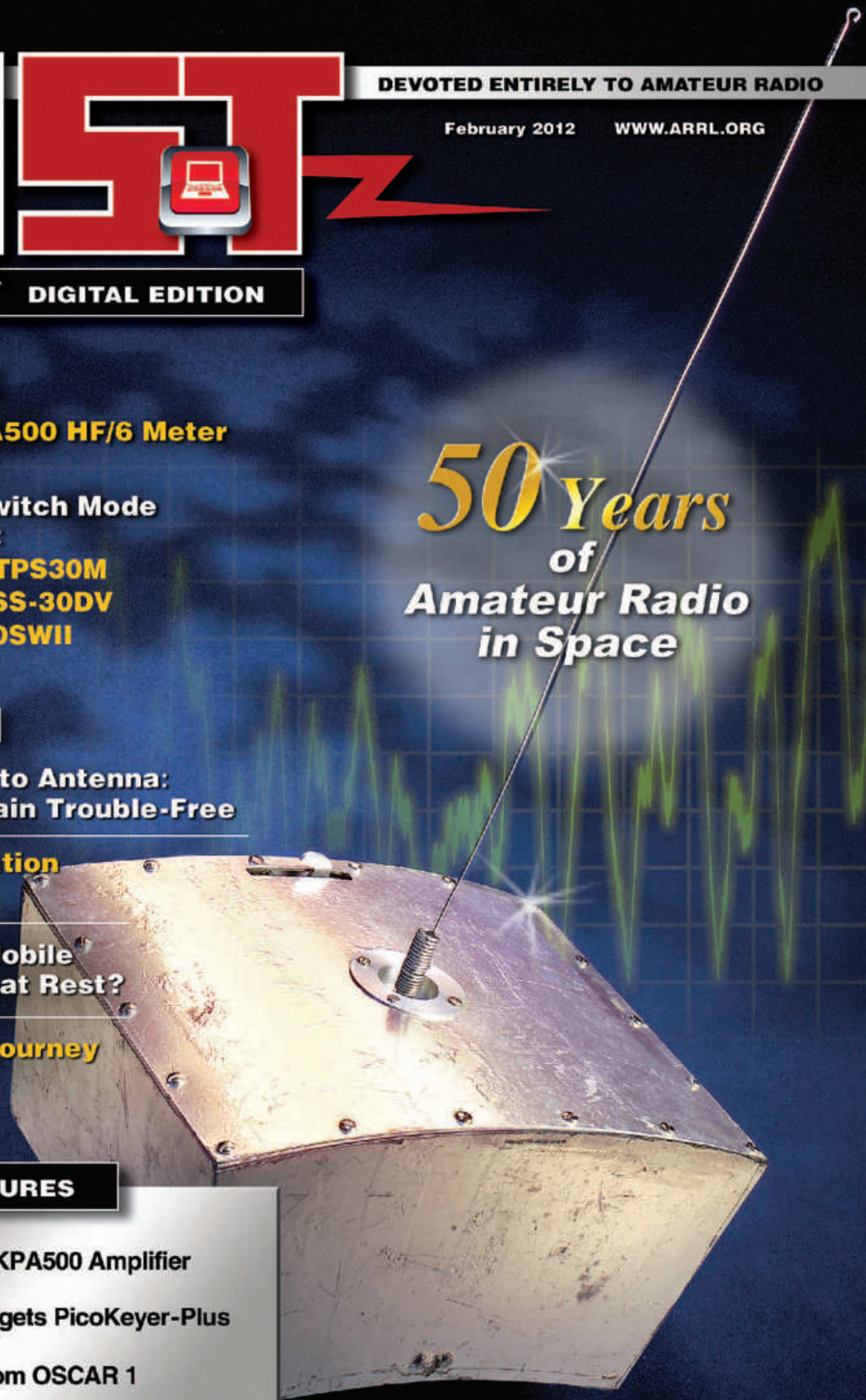
DIGITAL EDITION

February 2012 WWW.ARRL.ORG

QST reviews:

Inside:

50 Years of Amateur Radio in Space



DIGITAL FEATURES

Official Journal of ARRL The national association for AMATEUR RADIO®

Advanced Dual Band Mobile Radio
5.2" x 1.6" Large dot matrix (264 x 64 dots) LCD display
GPS / APRS® / Bluetooth® Features
FTM-350AR

New Vacuum Cup-Mounting Bracket permits Angle Adjustment
New APRS® Operation Capability, and newly Expanded User Friendly Functions

144/(220)*/430 MHz 50 W FM Dual Band Transceiver

FTM-350AR NEW

220 MHz 1 W (USA version only)

New Features of The FTM-350AR

1. New Vacuum Cup-Mounting Bracket with Angle Adjustment

The new MMB-98 Mounting bracket allows easy installation of the radio control display to your Dashboard by placing the vacuum mount in the desired location and pressing a lever. You may then adjust the display to the optimum viewing angle.

2. Expanded APRS® functions

- Uses the worldwide-accepted GPS NMEA data format
- Navigation to another APRS® BEACON station is possible, even if the beacon station is moving.
- Waypoint data (Data in/out) is available from the ACC connector on the rear of the main unit.
- Sub-Band APRS® operation may be active in the background, even when operating in Mono-Band Display mode.
- Newly added Voice Alert function
- Re-allocated often used keys to more convenient positions for easier operation
- Programmable keys on the DTMF Microphone provide direct access to APRS® functions

*APRS® is a registered trademark of Bob Bruninga WB4APR
*SmartBeaconing™ from HamHUD Nichetronix

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

Specifications subject to change without notice. Some accessories and/or options may be standard in certain areas. Frequency coverage may differ in some countries. Check with your local Yaesu Dealer for specific details.

YAESU
Choice of the World's top DX'ers™

Vertex Standard U.S.A. Inc.
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A TECHNOLOGY BREAKTHROUGH

New Advanced VX-8 Series GPS/APRS® Handheld Transceivers
Choose the Yaesu that meets your APRS® operating preferences in the field

50/144/(222)*/430 MHz
FM 5 W/AM 1W (50 MHz) Triple Band Handheld
VX-8DR * 222 MHz/1.5 W (USA version)
(7.4V 1,100 mAh Lithium Ion battery/FNB-101LI and battery charger/NC-86A included)

Actual Size

144/430 MHz
FM 5 W Dual Band Handheld
VX-8GR
(7.4V 1,100 mAh Lithium Ion battery/FNB-101LI and battery charger/NC-86A included)

Actual Size

VX-8DR NEW

All-in-one Prestigious Tri-band Transceiver
Bluetooth® for hands-free Operation with optional accessories
Waterproof/Submersible IPX 7 rated - 3 ft for 30 minutes

Optional GPS and antenna unit for GPS/APRS® operation

The optional GPS Antenna Unit FGPS-2 attached to the optional speaker Microphone MH-74A7A

Bluetooth®

Attached to the radio (microphone input) using the optional GPS Antenna Adapter CT-136

VX-8GR NEW

144/430 MHz Dual Band Transceiver with GPS unit included
Built-in GPS Antenna - Waterproof
Wide Band Receive for 108-999 MHz (Cellular blocked – US Version)

Supports APRS® communication by the Built-in Worldwide Standard AX.25 Data TNC

The VX-8 series radios are compatible with the world wide standard APRS® (Automatic Packet reporting System) using the GPS system to locate and exchange position information.

- SmartBeaconing™ Function
- Memories to list 50 stations
- Memories to store 30 APRS® messages
- DIGI-PATH routing indication function
- 8 DIGI-PATH routing settings
- GPS Compass Display - "Heading Up" or "North Up"
- APRS® Symbol Icon pre-set function
- Clearly displayed APRS® Beacon Messages
- Selective Message Received indicated by Flashing LED

APRS® is a registered trademark of Bob Bruninga WB4APR. SmartBeaconing™ from HamHUD Nichetronix

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Choice of the World's top DX'ers℠

Vertex Standard U.S.A. Inc.
6125 Phyllis Drive, Cypress, CA 90630 Phone: (714) 827-7600

Cushcraft R8 *8-Band Vertical*

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

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

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

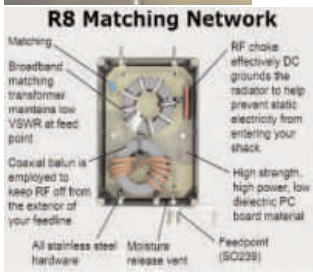
Rugged Construction: Thick fiberglass insulators, all-stainless hardware, and 6063 aircraft-aluminum tubing that is double or triple walled at key stress points handle anything Mother Nature can dish out.

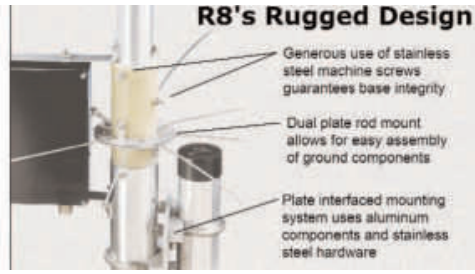
Compact Footprint: Installs in an area about the size of a child's sandbox -- no ground radials to bury and all RF-energized surfaces safely out of reach.

Legal-Limit Power: Heavy-duty components are contest-proven to handle all the power your amplifier can legally deliver and radiating it as RF rather than heat.

The sunspot count is climbing and long-awaited band openings are finally becoming a reality. Now is the perfect time to discover why Cushcraft's R8 multi-band vertical is the premier choice of DX-wise hams everywhere!

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





MA-5B *5-Band* Beam

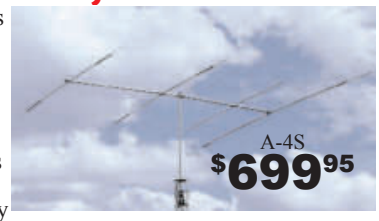
Small Footprint -- Big Signal

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!

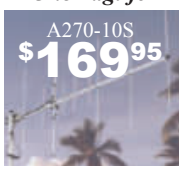


It goes without saying that the World-Ranger lineup is also famous for its rugged construction. In fact, the majority of these antennas sold years ago are still in service today! Conservative mechanical design, rugged over-sized components, stainless-steel hardware, and aircraft-grade 6063 make all the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

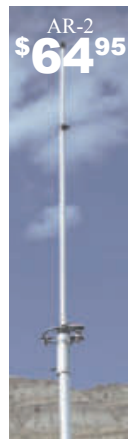
Cushcraft Dual Band Yagis

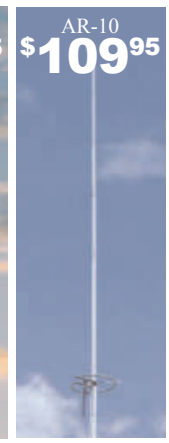
One Yagi for Dual-Band FM Radios



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!

***Free* Cushcraft Catalog**
and Nearest Dealer . . . 662-323-5803
Call your dealer for your best price!

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Amateur Radio Antennas
308 Industrial Park Road, Starkville, MS 39759 USA
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Life is a JOURNEY, Enjoy the ride!

MINI COOPER SHOWN WITH CP-5M UNIVERSAL LIP MOUNT ON THE DOOR EDGE.

All the mounts attach to van doors, truck side doors, SUV doors, etc... and require no holes. Includes 16' 6" deluxe cable assy w/18" mini RG-1888A/U type coax for weather seal entry.

Choose a mount depending on the antenna size and vehicle mounting location space.

For Small Antennas & Limited Space

MODEL / ANT CONN / COAX CONN	
Maldol EM-5M	SO-239 / PL-259
Footprint:	1.1"x .75"
Max Antenna:	40"

For Medium Size Antennas

MODEL / ANT CONN / COAX CONN	
COMET CP-5M	SO-239 / PL-259
COMET CP-5NMO	NMO / PL-259
Footprint:	3.4" x 1.25"
Max Antenna:	60"

For Tall or Multi-band HF Antennas

MODEL / ANT CONN / COAX CONN	
COMET HD-5M	SO-239 / PL-259
COMET HD- 5 3/8-24	3/8-24 / PL-259
Footprint:	3.75" x 1.1 "
Max antenna:	80"

COMET NEW! CSB750A DUAL-BAND 2M/440MHZ W/FOLD-OVER
Wavelength: 2M 1/2 wave, 70cm 5/8 wave x 2 • VSWR: 1.5:1 or less • Length: 42" • Conn: PL-259 • Max Pwr: 150W

COMET NEW! CSB770A DUAL-BAND 2M/440MHZ W/FOLD-OVER
Wavelength: 2M 5/8 wave center load, 70cm 5/8 wave x 2 center load • VSWR: 1.5:1 or less • Length: 51" • Conn: PL-259 • Max Pwr: 150W

COMET NEW! CSB790A DUAL-BAND 2M/440MHZ W/FOLD-OVER
Wavelength: 2M 7/8 wave center load, 70cm 5/8 wave x 3 center load • VSWR: 1.5:1 or less • Length: 62" • Conn: PL-259 • Max Pwr: 150W

Maldol AX-50 DUAL-BAND 2M/440MHz
Wavelength: 2M 1/4 wave • 70cm 9/8 wave • Length: 21" • Conn: PL-259 • Max Power: 60W

Maldol AX-75 DUAL-BAND 2M/440MHz W/FOLD-OVER
Wavelength: 2M 1/2 wave center load • 70cm 5/8 wave x 2 • Length: 30" • Conn: PL-259 • Max Power: 60W

Maldol AX-95 DUAL-BAND 2M/440MHz W/FOLD-OVER
Wavelength: 2M 1/2 wave • 70cm 5/8 wave x 2 • Length: 38" • Conn: PL-259 • Max Power: 60W

COMET B-10 / B-10NMO DUAL-BAND 2M/440MHz
Wavelength: 146MHz 1/4 wave • 446MHz 1/2 wave • Length: 12"
• Conn: B-10 PL-259 ,B-10NMO - NMO style • Max Pwr: 50W

COMET SBB-2 / SBB-2NMO DUAL-BAND 2M/440MHz
Wavelength: 146MHz 1/4 wave • 446MHz 5/8 wave center load • VSWR: 1.5:1 or less • Length: 18"
• Conn: SBB-2 PL-259 • SBB-2NMO NMO style • Max Pwr: 60W

Maldol EX-107RB / EX-107RBNMO DUAL-BAND 2M/440MHz
Wavelength: 146MHz 1/2 wave • 446MHz 5/8 wave x 2 • VSWR: 1.5:1 or less • Length:29"
• Conn: EX-107RB PL-259 • Ex-107RBNMO NMO style • Max Pwr: 100W

COMET SBB-5 / SBB-5NMO DUAL-BAND 2M/440MHz W/FOLD-OVER
Wavelength: 146MHz 1/2 wave • 446MHz 5/8 wave x 2 • Length: 39"
• Conn: SBB-5 PL-259, SBB-5NMO - NMO style • Max Pwr: 120W

COMET SBB-7 / SBB-7NMO DUAL-BAND 2M/440MHz W/FOLD-OVER
Wavelength: 146MHz 6/8 wave • 446MHz 5/8 wave x 3 • Length: 58"
• Conn: SBB-7 PL-259, SBB-7NMO - NMO style • Max Pwr: 70W

COMET BNC-24 DUAL-BAND 2M/70CM HT ANTENNA RX range: 100-1200MHz
• Wavelength: 2M 1/4 wave • 440MHz 1/2 wave • Length: 17" • Conn: BNC Super flexible featherweight whip

COMET SMA-24 DUAL-BAND 2M/70CM HT ANTENNA RX range: 100-1200MHz
• Wavelength: 2M 1/4 wave • 440MHz 1/2 wave • Length: 17" • Conn: SMA Super flexible featherweight whip

COMET SMA-503 DUAL-BAND 2M/70CM HT ANTENNA RX range: 100-1200MHz
• Length: 8.75" • Conn: SMA

Maldol MH-209 *(BNC Conn)* **MH-209SMA** *(SMA Conn)* **2M/70CM DUAL-BAND HT ANTENNAS**
3" length, soft rubber cover. Good performance in a small package!

COMET and Maldol Mobile

For a complete catalog, call or visit your local dealer.
Or contact NCG Company. 15036 Sierra Bonita Lane, Chino, CA 91710
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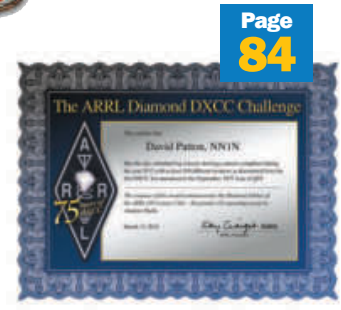
Technical



News and Features

Our Cover
On December 12, 1961, an Amateur Radio satellite dubbed OSCAR 1 launched into space aboard a Thor Agena rocket, leading to the creation of the Amateur Satellite Service. The satellite was built, quite literally, in the basements and garages of the Project OSCAR team. The total out-of-pocket cost (not including material donations) of OSCAR 1: Only $68, including the $1.15 spring from Sears that was used to eject the satellite from the rocket. Today, more than 100 amateur satellites — from those the size of a spacesuit to 10 cm cubes — have followed in OSCAR's orbit. The article beginning on page 80 celebrates 50 years of Amateur Radio satellites and those who have contributed to the Amateur Satellite Service.

Radiosport

Contest Corral 91
H. Ward Silver, N0AX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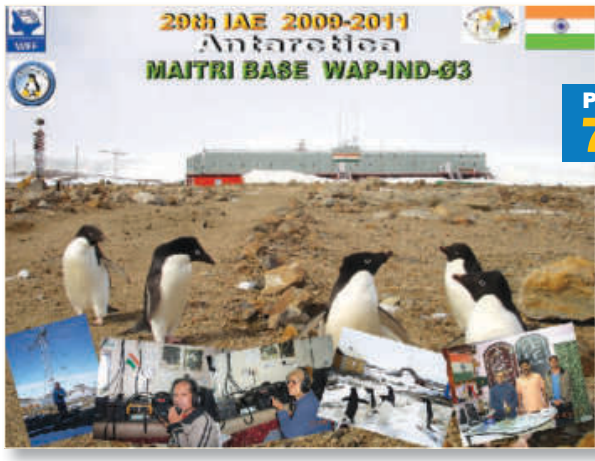

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Columns

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e-mail: qst@arrl.org

February 2012
Volume 96 Number 2

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Covering HF and 6 meters the FT-DX9000 Series answers the call for the ultimate DX base station.

FT DX 9000MP

No other Amateur transceiver offers you 400 Watts of transmitter power for the biggest, cleanest voice on the bands. And switching to Class-A operation at 100 Watts of output, you enjoy the benefits of ultra low distortion others can't match at 100 Watts! Two pairs of Meters, plus LCD Window; Data Management Unit and Flash Memory Slot Built In. Main/Sub Receiver VRF, plus Full Dual Receive Capability, External 50V/24 A Switching Regulator Power Supply and Speaker with Audio Filters.

FT DX 9000D

The "Fully loaded" model represents the total FT DX 9000 experience. Included is the large TFT display, along with 1.8-14 MHz high-Q "μ" front-end RF tuning circuit, utilizing a large-diameter 1.1" (28mm) ferrite core and precision motor drive. Its Q of over 300 provides razor-sharp RF tuning-ideal for today's crowded bands! Large TFT, Data Management Unit and Flash Memory Slot Built In, Main/Sub Receiver VRF, plus Full Dual Receive Capability, Three μ-Tuning Modules for 160 – 20 M, 50 V/12 A Internal Switching Regulator Power Supply.

FT DX 9000 Contest

The FT DX 9000 gives you the opportunity to build up your radio to match your operating style and competitive requirements. World-class ergonomics combine with leading-edge performance to put more QSOs in your log faster. This is what Amateur Radio is about: building the best, so you can be your best! Two Pairs of Meters, plus LCD Window, VRF Input Preselector Filter, Three Key Jacks, and Dual Headphone Jacks, 50 V/12 A Internal Switching Regulator Power Supply.

FT-2000, FT-2000D, FT-950 and the FT-450D

FT-2000 and FT-2000D

This rugged DX hunter has power and performance to spare. The FT-2000 provides a full 100 Watts RF output on 160 through 6 meters with an internal power supply, but the FT-2000D version doubles down with 200 Watts and an external supply. The impressive feature list for both versions includes dual receive capability for effortless split frequency operation; a receiver front-end VRF (Variable RF Tuning) preselector; 1st IF roofing filters (3/6/15 kHz) for superb dynamic range; variable IF bandwith and IF Shift; receiver DSP with Auto-Notch, Manual Notch, Digital Noise Reduction; and a continuously-variable passband contour control.

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Top DXing Rig Picks

World's top DX'ers

FT DX 5000 Series

The FT DX 5000 Series HF/50 MHz 200 Watt Transceivers are a premium Class of Yaesu radios with 2 Independent Receivers plus many options and accessories designed for the serious DXer.

With 112 dB dynamic range and an IP3 [3rd Order Intercept Point] of +40 dBm (CW, 500 Hz BW), you'll find extra sharp roofing filters for VFOA/Main receiver are selectable between 300 Hz (optional on some versions), 600 Hz, 3 kHz, 6 kHz and 15 kHz.

Three electro-luminescent sub-displays indicate sub frequency, graphical wave and menu functions. Additional features: Parametric Microphone Equalizer; Dual Receive In Band Function Contest-ready Antenna Selection; Manual and Automatic Digital Notch; High Speed Automatic Antenna Tuner; DSP Noise Reduction.

FT DX 5000MP
Station Monitor SM-5000 included; 0.05 ppm
OCXO included; 300 Hz
Roofing Filter included

FT DX 5000D
Station Monitor SM-5000 included; 0.5 ppm
TCXO included; 300 Hz
Roofing Filter optional

FT DX 5000
Station Monitor SM-5000 optional; 0.5 ppm
TCXO included; 300 Hz
Roofing Filter optional

FT-950

Whether you're a serious or casual DXer, the Yaesu FT-950 should be at the top of your list. The FT-950 packs a 100 watt punch on 160 through 6 meters and includes a built-in antenna tuner; triple-conversion superheterodyne receiver; three factory-installed 1st IF roofing filters; variable IF bandwidth and IF shift, manual IF notch filter, an Automatic Digital Notch Filter (DNF) and many other expanded features available with optional DMU-2000 Data Management Unit.

FT-450D

This easy-to-pack radio is a DXpeditioner's dream come true – a lightweight, high performance transceiver spanning 160 through 6 meters with 100 Watts RF output. When it's time to wade into the pileups, you'll appreciate the FT-450D's 10 kHz bandwidth roofing filter in the 68 MHz first IF, right after the first mixer. This filter provides outstanding selectivity when the going gets rough – a feature rarely found in rigs in this price range!

The No-Hassle, Ready-to-Roll Rig

Actual Size
4.5 x 1.6 x 7

FTM-10R

Great New Features to Support Motor Sports Activities

- Detachable waterproof front control panel
- Bluetooth Accessories for those new vehicle laws
- Receive and Transmit Text Messages
- External Audio Input to connect your iPod
- Powerful audio amplifier for PA audio
- Separate AM/FM stereo broadcast receiver
- Monitor AM/FM and an Amateur Band at the same time!

Whether you're travelling by car, motorcycle, ATV, bicycle, you name it, the FTM-10R is ready to go, outfitted with a super compact detachable front panel ready to hit the road with you.

The unique, lightweight, Waterproof/Dustproof Front Operation Panel is designed to support All-Weather Outdoor Activity in a manner never before possible.

You will appreciate the Big Bright LED Characters and easy to read Blue Display!

Obtain an ideal easy-to-use short-form guide with laminated pages for this unique radio from Nifty Accessories.
www.niftyaccessories.com/Yaesu_cards.htm

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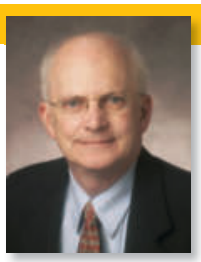

It Seems to Us

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

Distracted Driving

"In mid-December a recommendation from the National Transportation Safety Board (NTSB) that the 50 states and the District of Columbia should ban all drivers' nonemergency use of portable electronic devices (PEDs), other than those designed to support the driving task, attracted a great deal of media attention."

This and more than a dozen other recommendations are contained in a NTSB report related to a fatal multi-vehicle collision on I-44 in Gray Summit, Missouri that occurred on August 5, 2010. The accident killed the young driver of a pickup truck who, according to the report, was fatigued from inadequate sleep and had engaged in six text message exchanges in the 10 minutes immediately prior to slamming into the back of a truck-tractor. A school bus whose driver was distracted by a motor coach that was stationary on the shoulder then ran into the trucks. A second school bus was following too closely and rammed the back of the first bus, killing one of its passengers. In addition to the two fatalities there were 38 injuries ranging from minor to serious.

It is indisputable that the tragedy would have been avoided if three of the four drivers had been properly attentive. (The driver of the truck-tractor was blameless; he had simply slowed down because of traffic merging from two lanes into one before a work zone.) It is equally indisputable that distracted driving is a leading cause of motor vehicle accidents. Even so, it is a bit curious that the NTSB chose this particular accident report to recommend a sweeping ban on drivers' use of PEDs. The driver of the pickup truck was violating Missouri's Teen Text Messaging law that had gone into effect the previous year. In other words, had he been obeying existing law it is almost certain he would be alive today.

For drivers of all ages, texting while driving is a fundamentally bad idea. CTIA, the association for the wireless telecommunications industry, recognizes that it is clearly incompatible with safety and supports banning the practice, which is all too common even among drivers who recognize the risks. In a March 2010 White Paper entitled *Understanding the distracted brain,* currently available at **distracteddriving.nsc.org**, the National Safety Council (NSC) notes "near-public consensus" that texting while driving is a serious safety risk.

There is less consensus on other specific distractions such as cell phone use. State legislative efforts to curb cell phone use by drivers generally target texting and handheld cell phones, drawing a distinction between holding the phone and using it hands-free. The NSC White Paper argues that this gives the false impression that using a hands-free phone is safe, whereas in fact the cognitive distraction is about the same in either case. The NSC was quick to applaud the NTSB recommendation. On the other hand, drivers experience countless distractions every day and it is utterly unrealistic to try to eliminate them all.

The question whenever we bring up a subject on this page is, of course, what it has to do with Amateur Radio. In this case there are at least two answers.

The first and most important is that when operating mobile, safety must be our number one concern. Guiding a motor vehicle is an awesome responsibility. Radio amateurs have been operating mobile for decades without being perceived as a threat to public safety, but if there is ever any doubt in your mind about your ability to discharge that responsibility you should either pull off the road (if it is safe to do so) or turn off the radio.

The second is that the NTSB recommendation, coming as it does just before new legislative sessions in many states, is bound to trigger proposals for tougher distracted driving laws. There was a wave of such bills three years ago, which led the ARRL Board of Directors in January 2009 to instruct the Executive Committee to develop a policy statement, including recommended statutory language to protect amateurs' ability to operate mobile prudently. The statement, entitled *Mobile Amateur Radio Operation*, explains why two-way radio use is substantially different from full-duplex cell phone use. It has been used successfully by ARRL volunteers and members at the state level to argue either for narrow definitions that clearly do not include amateur and other two-way radios or for an appropriate exception. It is available at **www.arrl.org/other-state-issues** under the heading "Cell Phone Issues." We are currently reviewing the statement to see if any changes are needed to bring it up to date.

At this point the NTSB has only released a synopsis of its Gray Summit accident report, not the full report. We don't yet know whether the broad term "portable electronic devices" is intended to encompass all or some Amateur Radio equipment, but it seems likely that it could be construed that way. Thus it becomes even more important that proposed distracted driving legislation be reviewed for possible unintended consequences early in the 2012 state legislative sessions.

In August 2009 NSC President Janet Froetscher responded to an ARRL inquiry to say that "Until such time as compelling, peer-reviewed scientific research is presented that denotes significant risks associated with the use of Amateur Radios, two-way radios or other communications devices, the NSC does not support legislative bans or prohibitions on their use." However, she also noted that the "best safety practice is to have one's full attention on their driving, their hands on the wheel and their eyes on the road. Drivers who engage in any activity that impairs any of these constitutes an increased risk." Those are good words to remember even as we seek to protect Amateur Radio mobile operation from the impact of new legislation.

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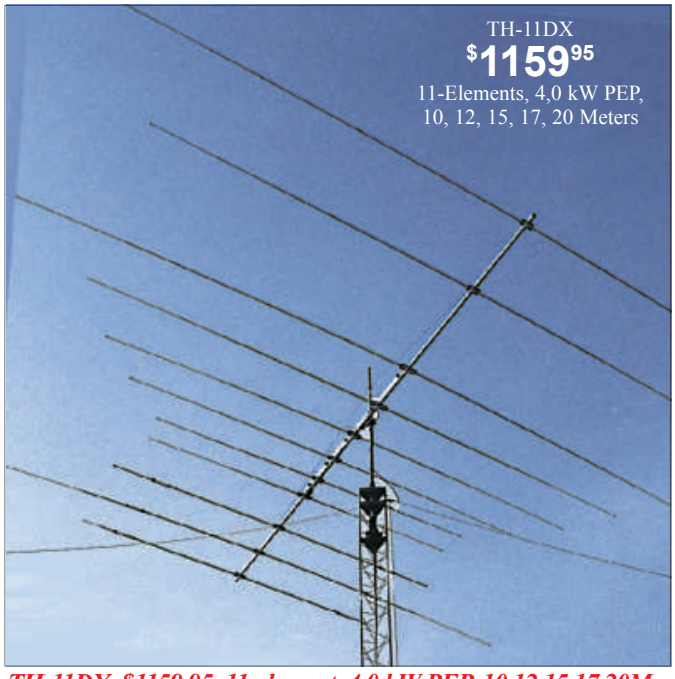

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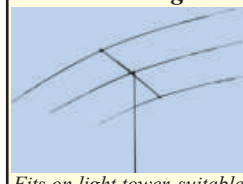

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TH-11DX	11	*For Gain and F/B ratio--See...*		4000	10,12,15,17,20	12.5	100	24	37	22	88	1.9-2.5	T2X	$1159.95
TH-7DX	**7**			**1500**	**10, 15, 20**	**9.4**	**100**	**24**	**31**	**20**	**75**	**1.5-2.5**	**HAM-IV**	**$869.95**
TH-5MK2	5	• www.hy-gain.com		1500	10, 15, 20	7.4	100	19	31.5	18.42	57	1.5-2.5	HAM-IV	$759.95
TH-3MK4	**3**	• Hy-Gain catalog		**1500**	**10, 15, 20**	**4.6**	**95**	**14**	**27.42**	**15.33**	**35**	**1.9-2.5**	**CD-45II**	**$469.95**
TH-3JRS	3	• Call toll-free		600	10, 15, 20	3.35	80	12	27.25	14.75	21	1.25-2.0	CD-45II	$359.95
TH-2MK3	**2**	800-973-6572		**1500**	**10, 15, 20**	**3.25**	**80**	**6**	**27.3**	**14.25**	**20**	**1.9-2.5**	**CD-45II**	**$369.95**
EXP-14	4			1500	10,15,20 opt. 30/40	7.5	100	14	31.5	17.25	45	1.9-2.5	HAM IV	$599.95

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2. *Tooled* *Boom-to-Element Clamp*

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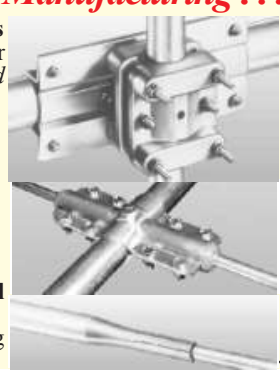

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FT-8800R
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FT-8900R
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2 meter transceiver

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Joel P. Kleinman, N1BKE – jkleinman@arrl.org

In Brief

- ARRL HQ staff worked with the producers of *Last Man Standing*, an ABC-TV comedy that will be featuring Amateur Radio in the storyline. See Happenings, this issue, for details.
- On November 30, the four FCC Commissioners unanimously agreed to allocate spectrum and adopt service and technical rules for the utilization of new implanted medical devices that operate on 413-457 MHz (70 cm).
- On December 12, hams around the world commemorated the 50th anniversary of the launch of OSCAR 1, the first Amateur Radio satellite and the first nongovernmental satellite to achieve orbit.
- Stations in Canada sported new prefixes during December to commemorate the 75th anniversary of the Canadian Broadcasting Corporation and Radio Canada.
- ARRL Laboratory Manager Ed Hare, W1RFI, spoke at a policy meeting of the HomeGrid Forum, an industry group implementing the ITU-T G.hn BPL standard.
- ARISS (Amateur Radio on the International Space Station) international delegates and committee members from all over the world met in Houston for the ARISS Annual Meeting.
- The FASTRAC-1 satellite (FO-69) is now open for use as a packet radio digipeater.
- The winner of the *QST* Cover Plaque Award for November is Allen Baker, KG4JJH, for his article "Build Your Own DSP Speaker."

Media Hits

Allen Pitts, W1AGP – apitts@arrl.org
Media & Public Relations Manager

- It may be hard to recall that for New Englanders this winter started late October with record-breaking wet snow. For many days into November people went without electricity or cable connections. In some places, entire towns were cut off from the world. The *New Hampshire Union Leader* had no idea how prophetic their article "Ham radio stays relevant for many across NH" would become for them. Just days later they went dark under the snow along with those in many other states. "Ham radio provides link during power outage disaster" headlined the Examiner.com. Even a month later, the memory of those events still made news with "New Providence Amateur Radio Club to talk about the next power failure" in both NJ.com and Patch.com. Similar storm stories came out of Alaska with "As howling storm battered Alaska, ham operators provided vital link" in the *Alaska Dispatch* reporting that "When other communications failed, ham radio operators came to the rescue. Throughout the storm, they were the eyes for scientists in Fairbanks and Anchorage who otherwise would have been blind to weather conditions they could predict but not see."
- A much brighter note was struck in the *New York Daily News* and *New York Times* articles about Steve Mendelsohn, W2ML, with "Cancer won't keep this marathon volunteer down" and "Communications Director Finds Energy in Fight Against Cancer." As the NYC Marathon's communications director, Mendelsohn organizes roughly 400 ham radio operators. Another "feel good" piece was *New River Valley Magazine's* "Amateur Radio in the NRV & First Woman President of the ARRL" about Kay Craigie, N3KN.
- And then we hit the jackpot for PR. The first article was "Ham radio in the 21st century" posted by *EDN* Magazine. "Ham radio today differs greatly from that of past years, but it still offers a fascinating way to explore electronics..." was read by engineers and students alike. It dovetailed well with the reports of Apple mogul Steve Wozniak's talk at Rutgers discussing his history of working with technology, growing from an early love of ham radio.
- The biggest payoff came with "Radio Days Are Back: Ham Radio Licenses at an All-Time High" appearing on the Fox TV News Network. "The newest trend in American communication isn't another smartphone from Apple or Google but one of the elder statesmen of communication: Ham radio licenses are at an all-time high." (We couldn't buy a better headline than that!) Many thanks to John, W6JWK; Rob, AE6GE; Ron, N6MTS, and Craig, K6QI who were instrumental in this report. Fox TV News triggered a landslide, including "FOX ON TECH: Ham radios on the rise" by Fox News Radio saying, "I think there's something magical about being able to communicate with people around the world using nothing other than a radio, wireless communications." After that, "Ham Radio's Popularity At All-Time High" quickly appeared in TPM (Talking Points Media, which covers political news). "Ham Radio Licenses Top 700000, An All-Time High" in Slashdot.com's technical news headlines, "Ham radio licenses in the US top 700000, still plenty of call signs to go around" in Engadget.com (consumer electronics) and even "Radio Days Are Back: Ham Radio Comeback" was in *Discovery News*. There were also many localized TV newscasts such as Atlanta Fox Affiliate, WAGA-TV, on their Good Day Atlanta show telling of the growth of ham radio, while many local papers also picked it up, such as "Ham radio licenses hit an all-time high" in the *Lewiston Sun Journal* (ID).

[Does anyone remember the AOL story of "25 things disappearing from the American scene" listing Amateur Radio as #16? I trust they "got the memo."]

Nothin' Could be Finer Than a Successful VE Session in Columbia

In late October, a new state record of 88 individuals tested in Columbia, South Carolina to obtain their FCC ham radio license or upgrade an existing license. A total of 74 were successful, including 24 new Technician class licensees. The ARRL VE session, organized by the Columbia ARC, was so successful that plans are underway for another session. — *Tammy Livingston, KI4PTJ*

THOM ASHTON, W4THA

Technician class instructor Dave Zugsberger, KL7FO, was one of five instructors for the recent test sessions in Columbia, South Carolina.

Fall Hike Provides Opportunity to Spread the Word

Members of the Wireless Society of Southern Maine ventured to the top of Bradbury Mountain in Pownal in early November to operate some ham radio and enjoy the warm fall weather. This is a very popular hiking destination, and a steady flow of visitors stopped by. According to a park ranger, more than a thousand people hiked to the summit that day.

The popularity of this spot gave participants a great opportunity to talk about the hobby and meet a bunch of people. The highlight of the afternoon was when Cub Scout Pack 97 from Portland stopped by for a demo. Many of them were able to get on the air for the first time. — *Tim Watson, KB1HNZ*

FRANK ALLEN, WA1PLD

Tim Watson, KB1HNZ, gives an impromptu "Amateur Radio 101" lesson atop Maine's Bradbury Mountain.

Helping Feed Those in Need

The Portage County Amateur Radio Service (PCARS), its members and friends, recently donated $2500, along with a carload of food, to the Center of Hope in Ravenna, Ohio, for its holiday food distributions. It was the sixth year that PCARS has donated food and cash to the Center. — *Jim Aylward, KC8PD, president, PCARS*

JIM AYLWARD, KC8PD

Tom Sly, WB8LCD, left, incoming PCARS president, and Dave Rarrick, WB2DFC, former PCARS vice president, present the donation to Sister Denise Stiles. The donations were collected at the November PCARS meeting. It was the sixth year that PCARS has made a donation at Thanksgiving.

Inside HQ

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

The ARRL Technical Information Service

Have a question? TIS has answers!

What rig should I buy? What can I do to improve my antenna? How do I reduce the noise level on my radio? These are three of the most commonly asked questions of the ARRL Technical Information Service (TIS), according to Senior ARRL Lab Engineer Zack Lau, W1VT.

The ARRL Technical Information Service is one of the most valuable and popular benefits of ARRL membership. TIS provides technical assistance on Amateur Radio matters using the staff's considerable technical knowledge, practical experience and extensive collection of technical literature. The TIS service receives about 5,000 email and telephone inquiries per year and the ARRL has provided technical support to its members since its inception. It's part of our organizational mission as the national association for Amateur Radio.

The ARRL Lab manages the Technical Information Service. Along with Zack, Lab Manager Ed Hare, W1RFI, Product Review Engineer Bob Allison, WB1GCM, RFI Engineer Mike Gruber, W1RFI, and Lab Reprint Specialist Tony Nesta, AA1RZ, respond to the majority of the questions. When additional expertise is required, the staff also taps into other volunteers such as ARRL Technical Coordinators.

The staff has also begun placing the most frequently asked questions on the Technology Section of the ARRL Technical Forums (**www.arrl.org/forum**) for members to view and comment. The Technical Forums are quickly evolving into an archive of Amateur Radio technical information and discussion. They are the first place to look for technical information. The TIS staff has also posted the most relevant technical articles for free download on the TIS web pages, **www.arrl.org/technical-information-service**. These pages also contain Frequently Asked Questions, access to the ARRL Periodicals Index Search (**www.arrl.org/arrl-periodicals-archive-search)** and a search of *QST* Product Reviews (**www.arrl.org/list-of-qst-product-reviews)**.

After the forums and website, e-mail is the preferred way to contact TIS since it provides the staff time to thoroughly research your question and craft an appropriate answer. You can contact them directly at **tis@arrl.org**. Please include your call sign and/or your membership number in your e-mail. Telephone inquiries can be directed to the 860-594-0214 or you can call the ARRL's main number 860 594 0200 and the call will be directed to TIS. All questions will be personally answered, usually within one or two business days.

TIS support is not just limited to hardware questions. Zack notes that he "handles lots of software questions that are just misunderstandings between how someone chose to do it and how the caller thought it should be implemented. There are also a lot of issues with old software that isn't supported by newer operating systems." He also notes that TIS is also happy to answer questions from amateurs who are just getting started or renewing their interest in Amateur Radio.

The ARRL Technical Information Service is an important service that we provide for our members and for Amateur Radio. If you have a technical question that you need to have answered, give it a try.

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- **Free E-Newsletters**
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- **Customized ARRL.org home page**
  Customize your home page to see local ham radio events, clubs and news.
- **ARRL Member Directory**
  Connect with other ARRL members via a searchable online Member Directory. Share profiles, photos and more with members who have similar interests.

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

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

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

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

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

- **ARRL "Special Risk" Ham Radio Equipment Insurance Plan**
  Insurance is available to protect you from loss or damage to your station, antennas and mobile equipment by lightning, theft, accident, fire, flood, tornado, and other natural disasters.
- **The ARRL Visa Signature® Card**
  Every purchase supports ARRL programs and services.
- **MetLife® Auto, Home, Renters, Boaters, Fire Insurance and Banking Products**
  ARRL members may qualify for up to a 10% discount on home or auto insurance.

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

Programs

Public Service — www.arrl.org/public-service

Amateur Radio Emergency Service® – **www.arrl.org/ares**
Emergency Communications Training – **www.arrl.org/emcomm-training**

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Awards – **www.arrl.org/awards**
Contests – **www.arrl.org/contests**
QSL Service – **www.arrl.org/qsl**
Logbook of the World – **www.arrl.org/lotw**

Community

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

Licensing, Education and Training

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President
KAY C. CRAIGIE,* N3KN
570 Brush Mountain Rd
Blacksburg, VA 24060
540-552-3903; n3kn@arrl.org

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

Second Vice President
BRUCE FRAHM, K0BJ
1553 County Rd T, Colby, KS 67701
785-462-7388; k0bj@arrl.org

International Affairs Vice President
JAY BELLOWS, K0QB
1925 Bidwell St,
West St Paul, MN 55118
651-238-4444; k0qb@arrl.org

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*Executive Committee Member

Atlantic Division

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

Vice Director: **Tom Abernethy, W3TOM**
PO Box 73, Accokeek, MD 20607
(301-292-6263); **w3tom@arrl.org**

Central Division

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

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

Dakota Division

Gregory P. Widin, K0GW
13457 Sixth St N, Stillwater, MN 55082
(651-436-8811); **k0gw@arrl.org**

Vice Director: **Kent R. Olson, KA0LDG**
148 Ironwood Dr, Horace, ND 58047;
(701-298-0956); **ka0ldg@arrl.org**

Delta Division

David A. Norris, K5UZ
640 Josephine Dr, Batesville, AR 72501
(870-793-6431); **k5uz@arrl.org**

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

Great Lakes Division

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

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

Hudson Division

Joyce Birmingham, KA2ANF
235 Van Emburgh Ave, Ridgewood, NJ
07450-2918 (201-445-5924); **ka2anf@arrl.org**

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

Midwest Division

Cliff Ahrens, K0CA
65 Pioneer Trail, Hannibal, MO 63401
(573-221-8618); **k0ca@arrl.org**

Vice Director: **Rod Blocksome, K0DAS**
690 Eastview Dr, Robins, IA 52328-9768
(319-393-8022); **k0das@arrl.org**

How to Find an ARRL HQ Staff Member

Can't find the department you're looking for? Call 860-594-0200 or e-mail **hq@arrl.org**. Sending e-mail to any ARRL Headquarters staff member is a snap. Just put his or her call sign (or first initial and last name) in front of **@arrl.org**. For example, to send to Allen Pitts, W1AGP, Media Relations manager, use **w1agp@arrl.org** or **apitts@arrl.org**. If all else fails, send a message to **hq@arrl.org** and it will get routed to the right person or department.

New England Division

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

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

Northwestern Division

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

Vice Director: **Grant Hopper, KB7WSD**
PO Box 3318, Everett, WA 98213
(425-238-1433); **kb7wsd@arrl.org**

Pacific Division

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

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

Roanoke Division

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

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

Rocky Mountain Division

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

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

Southeastern Division

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

Vice Director: **Andrea Hartlage, KG4IUM**
PO Box 608, Grayson, GA 30017
(404-509-4054); **kg4ium@arrl.org**

Southwestern Division

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

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

West Gulf Division

Dr David Woolweaver, K5RAV*
2210 S 77 Sunshine Strip, Harlingen, TX 78550
(956-425-3128); **k5rav@arrl.org**

Vice Director: **John Robert Stratton, N5AUS**
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(512-282-7851); **n5aus@arrl.org**

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Eastern Pennsylvania: Eric Olena, WB3FPL, 284 Blimline Rd, Mohnton, PA 19540 (610-775-0526); **wb3fpl@arrl.org**
Maryland-DC: James E. Cross III, WI3N, 16013 Dorset Rd, Laurel, MD 20707-5314 (301-725-6829); **wi3n@arrl.org**
Northern New York: Thomas Dick, KF2GC, 11 Jenkins St, Saranac Lake, NY 12983 (518-891-0508); **kf2gc@arrl.org**
Southern New Jersey: George Strayline, W2GSS, 10 E Pacific Ave, Villas, NJ 08251-2630 (609-741-8322); **w2gss@arrl.org**
Western New York: Steve Ryan, N2ITF, 3036 Route 394, Ashville, NY 14710-9734 (716-763-7555); **n2itf@arrl.org**
Western Pennsylvania: John Rodgers, N3MSE, 803 S Main St, Butler, PA 16001 (724-287-0424); **n3mse@arrl.org**

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Illinois: Tom Ciciora, KA9QPN, 1887 Irene Rd, Sandwich, IL 60548 (815-498-4929); **ka9qpn@arrl.org**
Indiana: John Poindexter, W3ML, 204 S Main St, Knox, IN 46534-1620 (574-772-2772); **w3ml@arrl.org**
Wisconsin: Donald Michalski, W9IXG, 4214 Mohawk Dr, Madison, WI 53711 (608-274-1886); **w9ixg@arrl.org**

Dakota Division (MN, ND, SD)

Minnesota: Richard H. "Skip" Jackson, KS0J, 1835-63rd St E, Inver Grove Heights, MN 55077 (651-260-4330); **ks0j@arrl.org**
North Dakota: Lynn A. Nelson, W0ND, 6940 4th St SW, Minot, ND 58701 (701-839-8200); **w0nd@arrl.org**
South Dakota: Scott Rausch, WA0VKC, 15362 Canyon Trl, Piedmont, SD 57769-7286 (605-787-7566); **wa0vkc@arrl.org**

Delta Division (AR, LA, MS, TN)

Arkansas: Dale Temple, W5RXU, 5200 Timber Creek Circle, North Little Rock, AR 72116 (501-771-1111); **w5rxu@arrl.org**
Louisiana: Gary L. Stratton Sr, K5GLS, 8424 Kaw Court, Shreveport, LA 71107 (318-309-0023); **k5gls@arrl.org**
Mississippi: Malcolm Keown, W5XX, 64 Lake Circle Dr, Vicksburg, MS 39180 (601-636-0827); **w5xx@arrl.org**
Tennessee: Keith E. Miller Sr, N9DGK, 1635 Jarratt Dr, Rockvale, TN 37135 (615-631-9952); **n9dgk@arrl.org**

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

Hudson Division (ENY, NLI, NNJ)

Eastern New York: Pete Cecere, N2YJZ, 329 W Saugerties Rd, Woodstock, NY 12498 (845-246-4359); **n2yjz@arrl.org**
NYC-Long Island: Mike Lisenco, N2YBB, 1635 E 46th St, Brooklyn, NY 11234-3604 (917-865-3538); **n2ybb@arrl.org**
Northern New Jersey: Richard Krohn, N2SMV, 23 Sweetmans Ln, Manalapan, NJ 07726; **n2smv@arrl.org**

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Iowa: Tom Brehmer, N0LOH, 1114 East Tenth St, Muscatine, IA 52761 (563-263-3097); **n0loh@arrl.org**
Kansas: Ronald D. Cowan, KB0DTI, PO Box 36, LaCygne, KS 66040 (913-757-3758); **kb0dti@arrl.org**
Missouri: Dale C. Bagley, K0KY, PO Box 13, Macon, MO 63552-1822 (660-385-3629); **k0ky@arrl.org**
Nebraska: Art Zygielbaum, K0AIZ, 6601 Pinecrest Dr, Lincoln, NE 68516-3573 (402-421-0839); **k0aiz@arrl.org**

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

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

Alaska: Jim Larsen, AL7FS, 3445 Spinnaker Dr, Anchorage, AK 99516-3424 (907-345-3190); **al7fs@arrl.org**
Eastern Washington: Mark Tharp, KB7HDX, PO Box 2222, Yakima, WA 98907-2222 (509-965-3379); **kb7hdx@arrl.org**
Idaho: Edward Stuckey, AI7H, 2300 W Polo Green Ave, Post Falls, ID 83854-9680 (208-457-0354); **ai7h@arrl.org**
Montana: Doug Dunn, K7YD, 216 Fiddle Creek Rd, Livingston, MT 59047-4116 (406-686-9100); **k7yd@arrl.org**
Oregon: Bonnie Altus, AB7ZQ, 7770 Harmony Rd, Sheridan, OR 97378 (971-237-0711); **ab7zq@arrl.org**
Western Washington: Jim Pace, K7CEX, PO Box 1602, Centralia, WA 98531 (360-508-8437); **k7cex@arrl.org**

Pacific Division (EB, NV, PAC, SV, SF, SJV, SCV)

East Bay: James Latham, AF6AQ, 1798 Warsaw Ave, Livermore, CA 94550-6140; (925-447-6136); **af6aq@arrl.org**
Nevada: Joe Giraudo, N7JEH, 720 Holyoke Dr, Spring Creek, NV 89815-5306 (775-738-7110); **n7jeh@arrl.org**
Pacific: Bob Schneider, AH6J, PO Box 131, Keaau, HI 96749-0131 (808-966-8146); **ah6j@arrl.org**
Sacramento Valley: Ronald D. Murdock, W6KJ, 998 Bogue Rd, Yuba City, CA 95991-9221 (530-674-8533); **w6kj@arrl.org**
San Francisco: Bill Hillendahl, KH6GJV, PO Box 4151, Santa Rosa, CA 95402-4151 (707-544-4944); **kh6gjv@arrl.org**
San Joaquin Valley: Dan Pruitt, AE6SX, 4834 N Diana St, Fresno, CA 93726 (559-779-2974); **ae6sx@arrl.org**
Santa Clara Valley: Phil Steffora, K6TT, PO Box 657, Los Altos, CA 94023-0657 (650-793-4970); **k6tt@arrl.org**

Roanoke Division (NC, SC, VA, WV)

North Carolina: Bill Morine, N2COP, 101 Windlass Dr, Wilmington, NC 28409-2030 (910-452-1770); **n2cop@arrl.org**
South Carolina: Marc Tarplee, N4UFP, 4406 Deer Run, Rock Hill, SC 29732-9258 (803-327-4978); **n4ufp@arrl.org**
Virginia: Carl Clements, W4CAC, 4500 Wake Forest Rd, Portsmouth, VA 23703 (757-484-0569); **w4cac@arrl.org**
West Virginia: L. Ann Rinehart, KA8ZGY, 1256 Ridge Dr, South Charleston, WV 25309 (304-768-9534); **ka8zgy@arrl.org**

Rocky Mountain Division (CO, NM, UT, WY)

Colorado: Jack Ciaccia, WM0G, PO Box 21362, Boulder, CO 80308-4362 (303-587-0993); **wm0g@arrl.org**
New Mexico: Bill Kauffman, W5YEJ, 1625 36th St SE, Rio Rancho, NM 87124-1719 (505-349-0460); **w5yej@arrl.org**
Utah: Mel Parkes, NM7P, 2166 E 2100 North, Layton, UT 84040 (801-547-1753); **nm7p@arrl.org**
Wyoming: Garth Crowe, N7XKT, 1206 Avalon Ct, Gillette, WY 82716-5202 (307-686-9165); **n7xkt@arrl.org**

Southeastern Division (AL, GA, NFL, PR, SFL, VI, WCF)

Alabama: David Drummond, W4MD, 5001 Lakehurst Dr, Northport, AL 35473 (205-339-7915); **w4md@arrl.org**
Georgia: Gene Clark, W4AYK, 1604 Lynwood Lane, Albany, GA 31707 (229-888-1090); **w4ayk@arrl.org**
Northern Florida: Paul L. Eakin, KJ4G, PO Box 625, Panacea, FL 32346 (850-591-0442); **kj4g@arrl.org**
Puerto Rico: Roberto Jimenez, KP4AC, PO Box 360536, San Juan, PR 00936-0536 (787-567-7373); **kp4ac@arrl.org**
Southern Florida: David Fowler, K4DLF, 2702 Starwood Ct, West Palm Beach, FL 33406-5145 (561-676-3007); **k4dlf@arrl.org**
Virgin Islands: John Ellis, NP2B, PO Box 24492, Christiansted, St Croix, VI 00824 (340-773-9643); **np2b@arrl.org**
West Central Florida: Dee Turner, N4GD, 10132 64th St N, Pinellas Park, FL 33782 (727-548-7474); **n4gd@arrl.org**

Southwestern Division (AZ, LAX, ORG, SDG, SB)

Arizona: Thomas J. Fagan, K7DF, 10650 E Bridgeport St, Tucson, AZ 85747-5925 (520-574-1129); **k7df@arrl.org**
Los Angeles: David Greenhut, N6HD, 5260 Darro Rd, Woodland Hills, CA 91364-1933 (818-992-5507); **n6hd@arrl.org**
Orange: Carl Gardenias, WU6D, 20902 Gardenias St, Perris, CA 92570 (951-443-4958); **wu6d@arrl.org**
San Diego: Stephen M. Early, AD6VI, 4724 Maple Ave, La Mesa, CA 91941 (619-461-2818); **ad6vi@arrl.org**
Santa Barbara: Robert Griffin, K6YR, 1436 Johnson Ave, San Luis Obispo, CA 93401-3734 (805-543-3346); **k6yr@arrl.org**

West Gulf Division (NTX, OK, STX, WTX)

North Texas: Walt Mayfield, KE5SOO, 305 Broken Arrow, Krum, TX 76249-7502 (940-368-4659); **ke5soo@arrl.org**
Oklahoma: Kevin O'Dell, N0IRW, 1405 N 7th St, Perry, OK 73077-2206 (580-220-9062); **n0irw@arrl.org**
South Texas: Lee H. Cooper, W5LHC, 2507 Autrey Dr, Leander, TX 78641 (512-260-7757); **w5lhc@arrl.org**
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Replace **8** coax with 1! SWR<1.3 to 60 MHz.**RCS-10L, $219.95** with lightning arrestors.

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

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Portable/Emergency 2 Meter Antenna System

Horace Lesley, W3NSP, **k4jlh@aol.com**

As a teenager I became very interested in electronics and obtained my Amateur Radio license in 1948 (W3NSP). The knowledge I developed as an Amateur Radio builder and operator was instrumental in my joining the new postwar aerospace industry, where I remained for many years until my retirement. Retiring gave me the opportunity to catch up on my Amateur Radio activities and do some traveling.

When traveling, I always carry a VHF transceiver and operate from my place of lodging. It soon became apparent that a better antenna was needed. I had built a J-pole and choose it as my portable antenna. It worked very well, but it was easily damaged and difficult to carry in a car. I liked the basic configuration so I decided to see what improvements I could make and at the same time design a carrying case to include all the components.

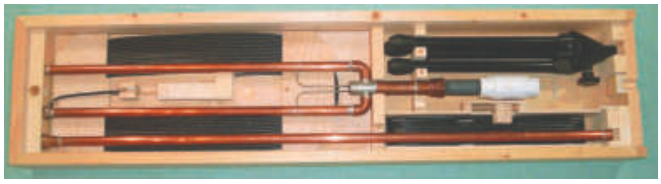

Figure 1 — The system contains six subassemblies all contained in a 39½ × 9 ½ × 3½ inch case.

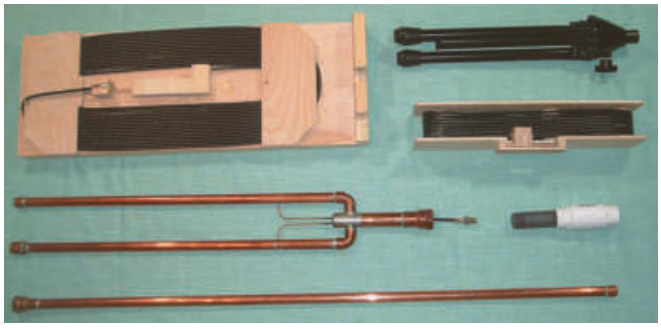

Figure 2 — All of the 2 meter antenna system components are shown here removed from the case.

Figure 3 — The reverse side of the cable tray provides storage space for needed accessories.

The antenna was foremost. After some trial an error, an acceptable design was obtained. This antenna configuration is portable, rugged, stealthy and requires no adjustments. Five antennas were built and tested at 100 W with repeatable test results.

With the antenna design completed, the carrying case and system component requirements were next. These I designed to be compatible with as many 2 meter transceivers as possible. The whole system can be assembled or disassembled in total darkness with no hook and loop fasteners, nuts, brackets, clamps, clips or similar devices required. The antenna can be erected in about 2 minutes.

The carrying case contains six subassemblies; antenna and extension, tripod, tripod adapter, short coax cable and reel (cable reel) and the long coax cable and tray (cable tray). These subassemblies are designed to nest into the carrying case and support each other (see Figure 1).

The major subassemblies are shown removed from the carrying case in Figure 2. The cable reel with the cable is shown at the upper left. The reverse side of the cable tray provides storage for some special components (see Figure 3) such as a *Repeater Directory* and SMA, BNC and UHF to BNC adapters.

The carrying case is about 39½ × 9½ × 3½ inches and weighs approximately 18 pounds. It is all wood and has no metal fasteners.

I carry this system with me on all road trips and it is a pleasure to finally have something that is compact and easy to use. This portable/emergency antenna system is ideal for hamfests, Field Day, fox hunts, RVs and the like.

In memory of Joan. — *Photos by Horace Lesley, W3NSP*

ALLEN OLENDER, WA8IWK

Card collector: Courtesy of my wife Amy, here's my beautiful Mod Podge box made of the many DX stamps arriving with QSL cards — perfect for those DXCC QSLs. — *Allen Olender, WA8IWK*

LARRY L. LEDLOW JR, KL7/N1TX

Lights show: The Hex-Beam antenna at KL2R, Two Rivers, Alaska under the northern lights. The photo was taken in late September. According to spaceweather.com, three coronal mass ejections also produced an impressive display of the aurora borealis in the lower 48 during the month.

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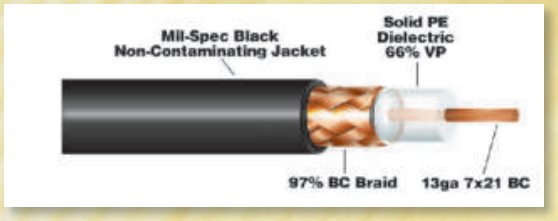
Buying lower quality (translation: lower cost) coax, connectors and other items you need to make your station work may seem like a good idea at the time. After all, they're not the most expensive part of your station. but make no mistake, they are critical components. And not buying high quality components will cost you. Maybe not in dollars but in transmission and reception loss—especially at VHF and higher.

— Not All Cable Assemblies are Created Equal... See the ABR Difference. —



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• 1.4dB @ 50MHz	1.5kW	73%

Part #	Length/Ft	Price/ea
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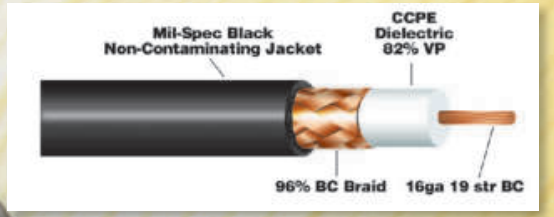
2213A-PL-100	100	$99.95
2213A-PL-150	150	$144.95



218XA RG8X (240F)
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• 0.9dB @ 10MHz	2.16kW	80%
• 1.4dB @ 30MHz	1.24kW	69%
• 2.1dB @ 50MHz	0.96kW	62%

Part #	Length/Ft	Price/ea
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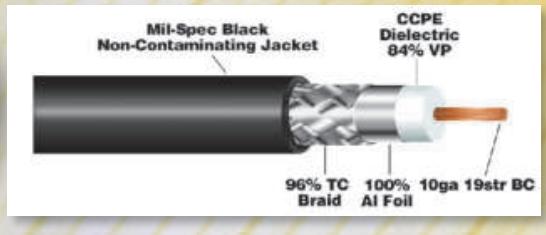
218XA-PL-18	18	$14.95
218XA-PL-50	50	$26.95
218XA-PL-75	75	$35.95
218XA-PL-100	100	$44.95
218XA-PL-150	150	$62.95



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• 0.8dB @ 30MH	2.77kW	83%
• 1.1dB @ 50MHz	2.14kW	78.5%
• 1.8dB @ 150MHz	1.22kW	65.4%
• 3.3dB @ 450MHz	0.69kW	47.3%

Part #	Length/Ft	Price/ea
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25400F-PL-18	18	$26.95
25400F-PL-35	35	$43.95
25400F-PL-50	50	$58.95
25400F-PL-75	75	$83.95
25400F-PL-100	100	$100.95
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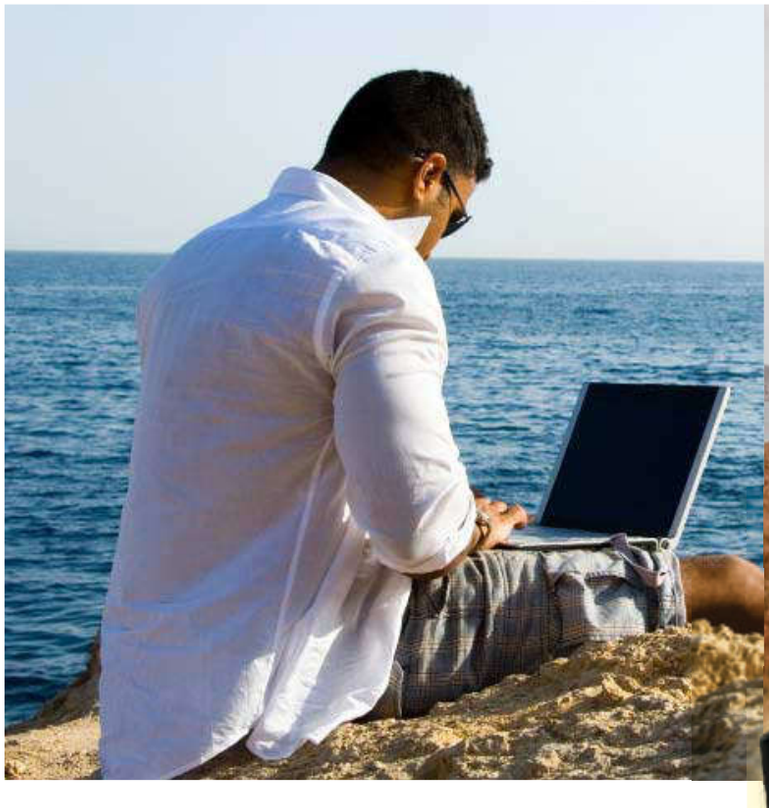

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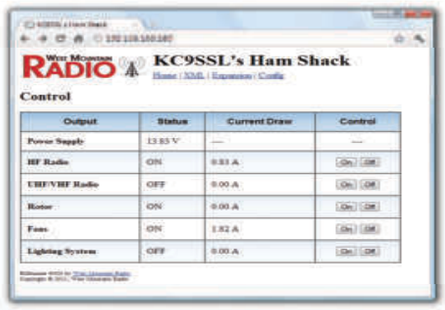

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Letters from Our Members

Grooming Quality Hams

I was pleased to see that our ham population is at an all-time high ["Happenings: US Amateurs Now 700,000 Strong!" Dec 2011, pages 65-67]. But I was disappointed that the article focused on *quantity* only, with no mention of the *quality* of the operators we are licensing. We have all read and heard complaints about misconduct and poor operating procedures on the air and have no doubt experienced them first-hand. Such actions have prompted the development and publishing of a DX Code of Conduct.

I am an advocate for increasing our ham population, but I suggest that hams looking to upgrade be required to show on-the-air proficiency. I have been licensed for more than 50 years; before I upgraded to Amateur Extra about five years ago, I had a great deal of operating experience under my belt. Although the current Technician license has 10 meter privileges on Phone, there is no license requirement to demonstrate any operating expertise, unlike for a driver's or pilot's license. It may be worth reviewing the Australian Foundation license approach wherein the new hams have frequency allocations on many HF bands — along with multi-mode privileges — but with a maximum power of 10 W. In so doing, these operators learn about the need for efficient antennas and gain on-air experience.

Whether this approach is adopted or not, I think it is essential that new licensees demonstrate operating expertise before being viewed as qualified to upgrade. A set of criteria like a minimum of 10 hours on-air time with a minimum of 50 QSOs — with at least 50 percent on HF — as shown in the station log seems a reasonable quality check. This would, in my view, develop and deliver better operators to the community.

Alan Swinger, K9MBQ
Charlottesville, Virginia

No HIPAA Concerns

I must take a bit of issue with the comments made by Rich Painter, AB0VOA, concerning the use of radio amateurs assisting hospitals during emergencies and compliance with the HIPAA regulations ["Correspondence: Privacy Concerns," Dec 2011, page 24]. As long as the radio traffic cannot be tied to a specific patient, no violation of HIPAA would occur. Ergo, EMS dispatch that states location, gender, age and the nature of emergency over unencrypted radios is quite common. An example might be "Unit 21, respond to 53 year old male complaining of chest pains at 111 Main Street." I would think that assisting any agency with logistical support and dispatch would not require encryption, but rather awareness of communications security.

As an emergency response team leader for my company, one of the things I stress at training sessions is to be aware of what traffic is sent over the air. If you need to communicate sensitive information, do it face-to-face or in a hand-delivered written message. Think about what you are going to say before keying that microphone. Use plain English without codes or jargon, and keep you traffic to a minimum to keep the frequency clear. In an emergency situation, traffic encryption could create more problems than it solves.

Mark Carpenter, N0ZOF
New London, Missouri

Cluing in the Clubs

I read with great interest the article by Harold Kramer, WJ1B ["Clubs: Amateur Radio's Future," Nov 2011, page 74]. The author stated "With the breadth and depth of service that clubs perform, we need to keep them growing and successful." I could not agree more! A successful future for Amateur Radio is clearly linked to the future success of Amateur Radio clubs all over this country.

I do believe, however, that the author projects a more optimistic picture of the present status of ham radio clubs than actually exists. One has only to attend several monthly meetings of a few local Amateur Radio clubs to understand that many are "graying" and slowly losing membership. These clubs have a high probability of not being in existence in a few years. While it is true that a number of clubs are vibrant and active, many suffer from the inability to attract new and younger members.

The efforts at ARRL Headquarters toward reviewing its Affiliated Club program are encouraging, but from my perspective a more significant change in approach is required to keep the majority of Affiliated Clubs growing and successful. Although the suite of benefits to Affiliated Clubs from Headquarters is great, it really does little to address the major issues facing clubs today. Clubs need to know how to grow their club and recruit new members. Many clubs have been doing the same thing for years with the same membership and do not understand why their club is in decay.

I suggest that ARRL HQ initiate a study of highly successful clubs to determine what they do to constantly be on the forefront of our hobby. I am sure there are characteristics that these clubs all have in common. I highly suspect it is not what these clubs do that makes them successful, but how they go about doing it. It seems that outstanding clubs are those that focus on teaching activities, social activities and just having fun. The next step would be to convey the insights gained in this study to the ARRL Affiliated Clubs throughout the country.

A. Bowman "Bo" Budinger, WA1QYM
Westford, Massachusetts

Lifelong Learning

I am writing in response to the letter by Tony Sirianni, KD8OEE ["Correspondence: What I Learned from the NTS," Sep 2011, page 24]. It seems that when people are just starting out on the radio and have no idea what they are up against or how they are challenged, they can be quite surprised in the many new things that they learn over time. I am legally blind. My computer teacher is always encouraging me to try more tasks with my talking computer, including downloading all of my favorite music. Thank you for publishing this letter in *QST* because that in itself points out how important our dedication should be to learn such a difficult subject, whether or not we can see.

Steve Rhodes, KF6JIN
Orange, California

In the Eye of the Beholder

This past November — participating in my first ever ARRL Sweeps — confirmed for me why I got into Amateur Radio. I read about the ARRL November Sweepstakes in *QST* and decided I would try it. With the limited time I had and my 50 W home-built radio, amps and antenna, I was able to make 125 contacts in 53 different ARRL Sections. I thought that was respectable for a new Amateur Extra class amateur. But during the contest, I had to repeat my call numerous times — not due to power limitations, but because no one liked or believed my call! I heard such things as "That's got to be terrible on CW," "Is that a new prefix?" and "What an ugly call." My call sign is a vanity call based on my initials HMT and I love my ugly call.

Henry M. Terwilliger, WZ3HMT
Union City, Pennsylvania

Send your letters to "Correspondence," ARRL, 225 Main St, Newington, CT 06111. You can also submit letters by fax at 860-594-0259, or via e-mail to qst@arrl.org. We read every letter received, but we can only publish a few each month. We reserve the right to edit your letter for clarity, and to fit the available page space. Letters published in "Correspondence" may also appear in other ARRL media. Of course, the publishers of *QST* assume no responsibility for statements made by correspondents.

Leveraging SDR for Better Digital Mode Communications

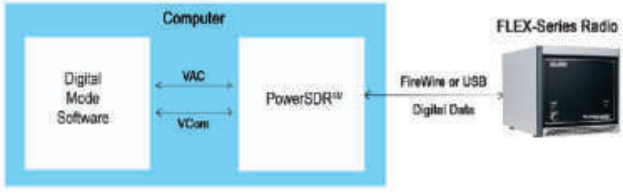
FlexRadio Systems PowerSDR™ Advantage

History and the Problem

As computers and software grow more advanced, more and more digital modes have been added to the amateur's repertoire. Some of these modes include Olivia, RTTY, Clover, PACTOR, AMTOR, PSK31, MT63 and numerous modes supported by WSJT. Many of these modes are able to be modulated and demodulated in a computer and, as such, do not require and external modem device. For the modes supported in a computer, numerous software packages have sprung up that do everything from basic mod/demod all the way to complex contest support operations, logging and integrated spotting. While the software packages and the radio are both very functional as individual components, interfacing these two system components requires electronics, effort and quite often, an interactive try-this-try-that approach to remove interference and signal issues between the two components.

The PowerSDR Advantage

So how does an SDR help out with all of these problems? To understand this, we need to review the architecture of an SDR system. In the figure below, the digital data line represents the digital spectrum data and the radio control signals that are passed between the radio and PowerSDR™.



PowerSDR™ Digital Mode Connections

This data path is digital rather than traditional analog signals. A single cable between the radio carries the PTT signal for transmitting, as well as, both receive and transmit audio data. Since the data is digital, it doesn't suffer the same degradation that an analog signal travelling down an analog cable is likely to experience. This means your audio is ultra clean and cannot be degraded once it leaves the radio.

Once the data is delivered to the computer, PowerSDR demodulates the signal then passes it via a Virtual Audio Cable (VAC) to the users' digital mode software inside the computer. VAC was designed to be a "pass-through" that connects two digital sound programs as if each is seeing a sound card rather than another piece of software. A virtual interface also eliminates the need for additional cables, interface boxes and all the headaches related to interfacing in a high RF environment.

If the digital mode audio can be virtual, why not the control signals too? Using virtual COM port software, the user's digital mode software can be easily interfaced to PowerSDR for controlling frequencies and PTT signals. All with no more wires!

Further, once connected, this virtual digital mode interface requires no work on the operator's part -- he does not have to constantly adjust levels or protect the system from radio frequency interference. It just works.

Summary

Amateurs have come to recognize that SDR systems provide superior audio and filtering capabilities, but few are aware of the key advantages that an SDR brings to digital modulation schemes. These include:

- No additional wiring between the computer and the radio.
- No 3rd party interfaces to connect the computer and radio.
- No additional sound cards are required.
- Because all data is already digital when it leaves the radio, all signals are protected from degradation and interference typically encountered with traditional analog audio interfaces.

For more information or to download the full white paper on Digital Mode Communications, visit www.flexradio.com.

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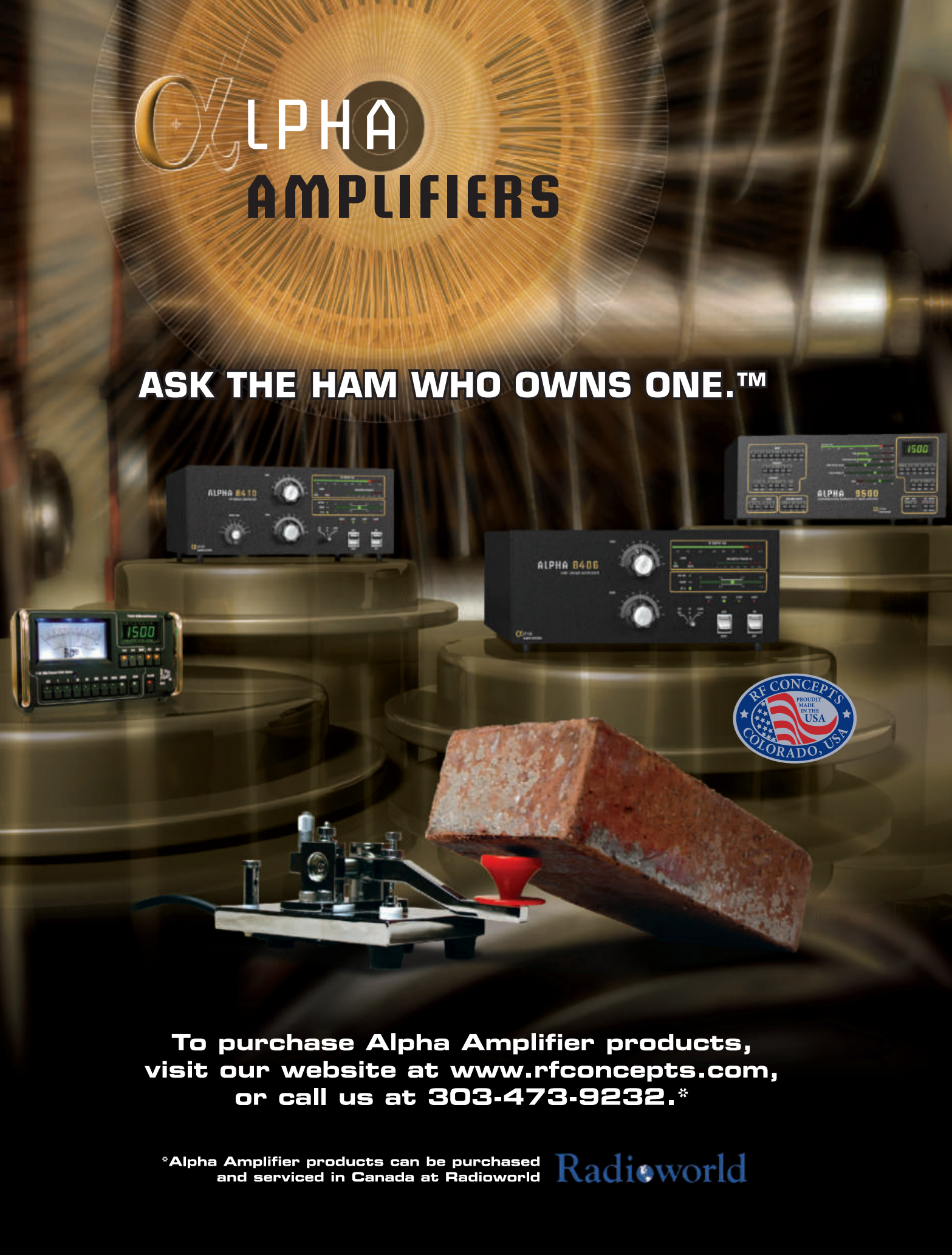
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- Stand-alone Digipeater
- USB port (mini B)
- MIL-STD810 and IP54 weatherproofing
- 1000 memory channels
- Cross-tone

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The GPS and its logging functions can be used for up to 35 hours by turning off the transceiver functions and running in the GPS only mode. Store up to 5000 points of track data, there are three ways to save track data: Interval, Travel Distance or APRS® Beacon.

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Avoiding Problems in the RF Chain

Ensure maximum signals through solid installation and maintenance of key connections from rig to antenna.

Devere "Dee" Logan, W1HEO

Achieving your station's maximum efficiency requires close attention to each link in the RF chain from rig to antenna. Poor installation and maintenance can result in major problems, from attenuated signals to total station failure. So let's look at some problem areas and several tips to ensure that your antenna receives the maximum power possible from your transceiver.

There are four critical links in the RF chain connecting your rig to the antenna. These include connectors and fittings, accessories such as antenna tuners and coaxial switches, transmission lines and antenna matching devices such as baluns (see Figure 1). Problems with any of these links can reduce the efficiency of power transfer — even stopping it entirely — and can affect the standing wave ratio (SWR). No one wants to waste watts.

It all starts with the transceiver. No matter how many or how few watts are available at the rig's antenna connector, your goal should be to deliver the maximum amount of that power to the antenna via the RF chain, especially the feed line. Each connection or link in this RF chain must be sound to accomplish this.

Connectors — Link One

Most components in the RF chain, such as antenna tuners and coaxial switches, are connected with various types of fittings such as the common PL-259 or SO-239 (UHF type) connectors. Selecting good quality fittings may avoid possible problems later due to deterioration of the insulator or corrosion of the center pin. (See comments by ARRL Senior Lab Engineer Zack Lau, W1VT.)[1] Check the manufacturer's specifications regarding SWR vs. frequency. The less information you're given, the greater the reason to suspect poor electrical performance.

There are four critical links in the RF chain connecting your rig to the antenna.

Note that UHF connectors, such as the PL-259, don't maintain a 50 Ω impedance. Type N connectors, however, can provide a true 50 Ω characteristic impedance and are preferred for VHF and higher applications. There are both 50 Ω and 75 Ω versions of N connectors, so avoid mixing them in the RF chain to avoid damage by expanding the narrow inner socket of a 75 Ω female connector. The 75 Ω type has a smaller diameter pin than the 50 Ω version.

Proper soldering techniques are necessary to ensure a good electrical bond between the connector and the coaxial cable. I use a 250 W soldering iron to ensure a good joint while avoiding cold solder joints. Don't crimp unless you have the correct crimp tool for the connector. Check *The ARRL Handbook* or *The ARRL Antenna Book* for information on soldering tools and techniques.[2,3] Also check out the step-by-step installation directions appropriate for various fittings and types of coaxial cable. Always check your work by testing for electrical continuity or shorts with a multimeter and be sure that contact surfaces are clean and shiny.

Avoid the use of adapters whenever possible, since each adds a small amount of attenuation and may increase SWR. These can become a major factor as frequency increases. (Adapters can, and will, break.) For example, if your beam antenna comes with a type N connector, don't use a PL-259 adaptor, but do use coax with the correct N connector. A good practice is to minimize the number of connectors in the RF chain.

While installing coaxial fittings, be sure that the internal teeth are tightly seated. Ensure a solid connection by using pliers to ensure a snug fit. Not all fittings are weatherproof, so if you're using them outside the shack, be sure to protect them by wrapping them with good quality electrical tape, waterproof self-sealing tape and then a final wrap with more electrical tape. Remember that the number one cause of

[1]Notes appear on page 32.

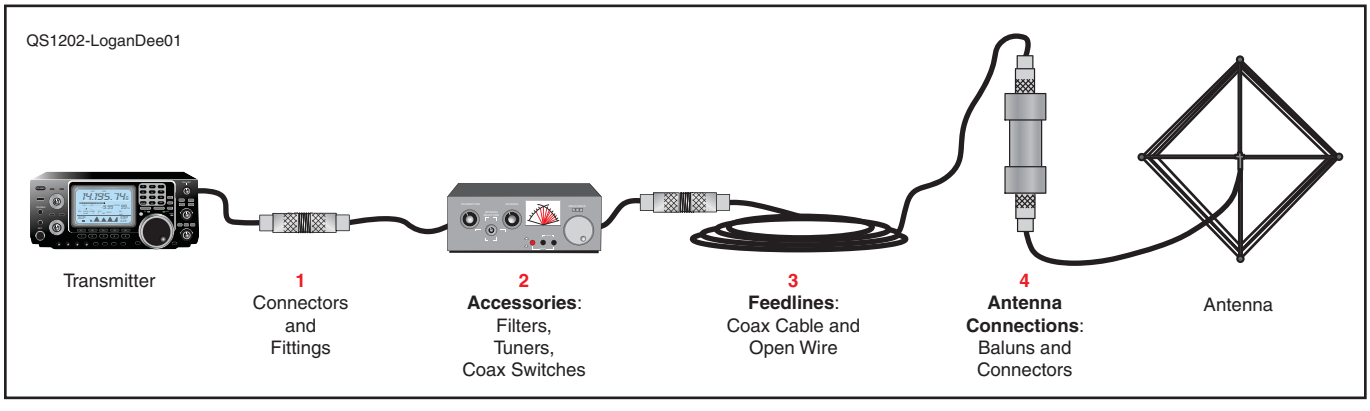

Figure 1 — Typical RF chain. A given installation may not include all items, but any that are there can reduce station effectiveness if not at peak efficiency.

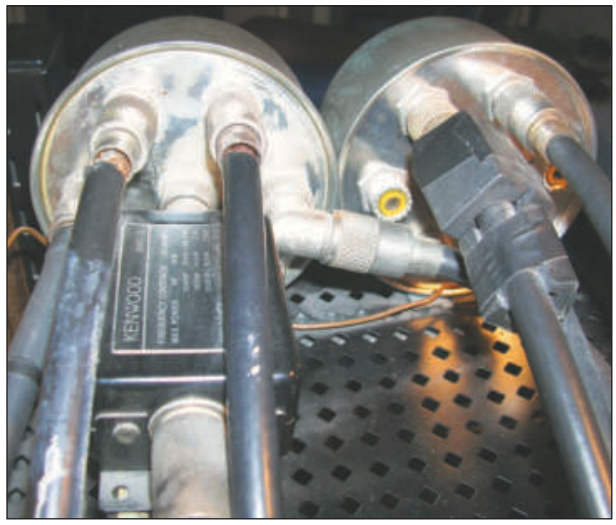

Figure 2 — Coax connectors and associated switches often add loss due to wear and tear — especially of the spring contacts on SO-239 sockets. Watch for oxidation under any riveted connections. They should read 0.0 Ω when checked with an ohmmeter.

Figure 3 — Multiple transmission lines, such as these at the PJ2T contest station in Curaçao, require multiple connections, multiplying the probability of something failing. Care in installation and frequent inspection will minimize problems.

coaxial cable failure is moisture contamination, so keep connections dry (see Figure 2).

Accessories — Link Two

Antenna tuners, low-pass filters and coaxial switches are among the most common accessories to be found in the RF chain. Their inclusion will result in a certain amount of insertion loss. A low-pass TVI filter may introduce less than 0.5 dB of loss at 30 MHz or lower, and a remote antenna switch may have a loss of 0.25 dB at frequencies below 150 MHz. While these are modest numbers for brand new units, wear and tear over years of use can increase losses significantly, ultimately causing failure.

Antenna tuners, for example, can suffer from worn or dirty switch contacts, loss of spring tension in coax connectors and particularly corroded or dirty contacts in roller inductors, if used. A current or power meter connected to a dummy load can be used to measure power with and without an adjusted tuner to determine approximate loss. Note that the losses of all the elements in the line from radio to antenna add cumulatively.

A few lost decibels here and there can turn your giant signal into a weakling! In most climates, you want to radiate a signal, not heat.

Coaxial Cable — Link Three

The important first step in ensuring a good transmission line such as coaxial cable is selecting the proper type. Consider such factors as the frequency of operation, power level to be carried, type of installation and length of the cable. Try to avoid cut-rate, bargain basement cables that can reduce the efficiency of your RF chain.

"It's easy to make cheap coax line," as Bill Orr, W6SAI, (SK) once reminded us.[5] "Copper creates the major material cost. The cost can be reduced when there is less than the optimum number of fine wires in the outer braid, and the braid's weave is looser. When copper is eliminated in a cheap cable, the cable characteristics change. The 75% shield coverage of the cable can result in a characteristic impedance of about 60 Ω. Velocity of propagation changes, too," he added. "So using cheap cable can get you into trouble if you're cutting ¼ wave line sections to formula."

Check cable specifications carefully, especially its loss over a given length and frequency. For example, 100 feet of matched standard RG-58/A at 30 MHz has a loss of 2.5 dB, compared to RG-213's 1.2 dB, and LMR-400 at only 0.7 dB. For a comparison of specifications for various transmission lines, check the chart in *The ARRL Antenna Book*.[6]

Calculate the total cable loss based on frequency and length and decide if it is acceptable, suggests coaxial cable engineer Carl Dole, WB0NPR.[7] "A power loss of 1 dB represents a loss of approximately 21%. At 3 dB the loss is 50%."

To find the actual loss in your transmission line, Dole recommends a wattmeter, SWR meter and a dummy load. "Measure the power going into the cable from the transmitter and as it enters the dummy load at the opposite end of the cable," he explains. "Calculate the dB loss and compare it to the cable manufacturer's specifications."

If you really want to cut feed line losses to a minimum, consider open wire or window line. *The ARRL Handbook* has an interesting comparison of transmission lines in a chart showing modeled data for a 100 foot flat top antenna.[8] It shows that at 28.4 MHz, 100 feet of RG-213 coax has a loss of 9.4 dB, but 450 Ω open wire has only 0.5 dB of attenuation. Using open wire line will usually require an antenna tuner or balun to transition from its balanced design to the unbalanced coaxial line or transmitter output, and to match the different impedances. These devices may also add losses.

Careful installation of coaxial feed lines will avoid potential problems and losses. Protect the feed line by observing proper design and installation techniques, especially where it passes through walls and windows (see Figure 3).

Dole warns against crushing, pinching or using too small a bending radius. "Sharp bends or squeezing should be avoided." Heat is a problem, especially with foam-type cables. The center conductor may shift and come in contact with the shield. "Avoid tension on the ends of the cable. This can damage the cable. Only black-jacketed cable, or cable specified as sunlight (UV) resistant, should be used outdoors," he warns. "Coax cable should not be directly buried, that is, without using metal or plastic conduit, unless the manufacturer specifies it as acceptable." If conduit is used, make sure that it can't fill with water from condensation or other sources. Window or open wire line should be kept at least a foot away from lossy ground.

Figure 4 — Feed-line connections, such as on this ground mounted vertical antenna, require protection from the adverse effects of weather. The use of stainless steel hardware and protective tapes can minimize problems.

Feeding the Antenna — Link Four

An ideal antenna installation will enjoy a perfect match between the transmission line and the antenna. A big plus is that no matching system is needed. If there is a mismatch due to different impedances or the need to feed balanced antennas with unbalanced feed lines, however, complications can arise.

Connecting a balun, for example, may cause problems if not done correctly. Improper soldering of antenna leads to the balun, for example, may "fry" the internal connections (we've experienced this). Connecting the feed line to the balun via coaxial connectors provides another possible problem, as noted earlier. Any mechanical connections at the antenna should be made carefully to minimize corrosion and to protect against weathering. Avoid stress on the feed line and seal coax carefully to keep rainwater out (see Figures 4 and 5).

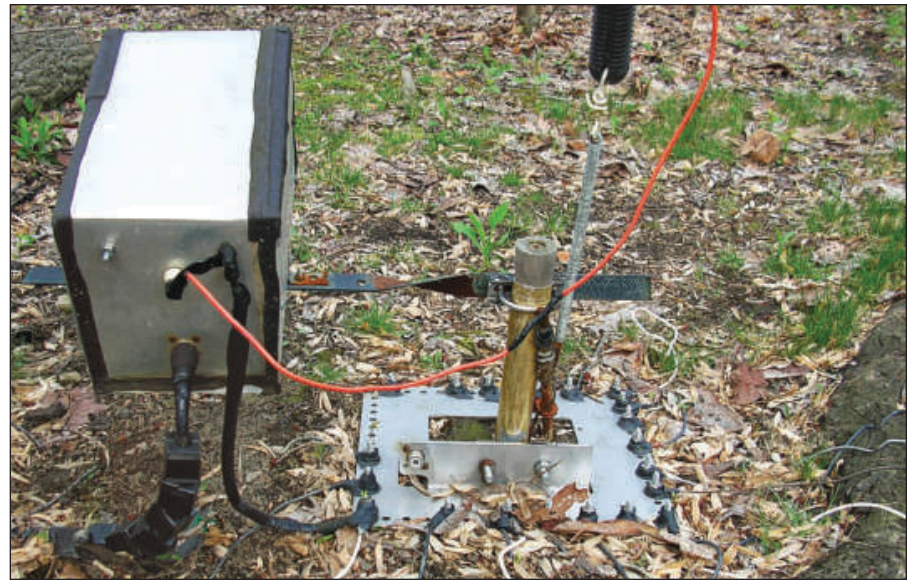

Figure 5 — Using a weatherproof aluminum box to protect a base mounted series capacitor, as for this inverted L, can reduce failure rate. Be sure to include a small hole in the bottom to allow condensation to escape.

Maintenance Tips

Regardless of how well your RF chain is installed, time and weather can change things. Make a record of the SWR at the time of installation and check it periodically for signs of trouble. Examine the key links in your system regularly. After keying up for a few seconds, feel the connectors. If they're hot, you may have a problem. Clean dirty switches with a squirt of contact cleaner. Inspect transmission lines for signs of wear, cracking, unusual twisting or aging. Inspect buried cable near its entrance into the ground for jacket deterioration, water or rodent damage. Be sure the connection of the transmission line to the antenna is solid and secure. Inspect for oxidation, corrosion or moisture infiltration. Small losses from any one key connection can become major headaches if allowed to continue.

So take care when installing your station's RF chain, be aware of the loss sources and conduct regular maintenance inspections. The result will be the best performance possible from your station by delivering the maximum signal that your antenna can radiate.

My thanks to those who assisted in the development of this article, including Robert Leskovec, K8DTS; Mike Gruber, W1MG; Joseph Gutoskey, W8DOE; Carl Dole, WB0NPR, and James Arcaro, WD8PFK.

Notes

[1]J. Hallas, W1ZR, "The Doctor is In," *QST*, Mar 2010, p 56.

[2]*The ARRL Handbook for Radio Communications,* 2012 Edition. "Soldering Tools and Techniques," pp 23.7-23.9. Available from your ARRL dealer or the ARRL Bookstore, ARRL order no. 6672 (Hardcover 6634). Telephone 860-594-0355, or toll-free in the US 888-277-5289; **www.arrl.org/shop**; **pubsales@arrl.org**.

[3]*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**.

[4]See Note 2, "RF Connectors and Transmission Lines," pp 22.46-22.52.

[5]B. Orr, W6SAI, "Coax Revisited," *Ham Radio*, Jun 1989, pp 21-24.

[6]See Note 3, pp 24-18.

[7]C. Dole, WB0NPR, personal e-mail to author.

[8]See Note 2, "Choosing a Transmission Line," p 20-6.

Photos by the author.

ARRL Life Member Devere "Dee" Logan, W1HEO, holds an Amateur Extra class license and was first licensed as KN8WZJ in 1962. An active DXer and writer, his articles have appeared in a variety of radio publications. You can reach him at 9901 Cypress Circle, Mentor, OH 44060 or at **deverelogan@gmail.com**.

Characterizing Solar Panels for Amateur Radio Applications

Mert Nellis, W0UFO

If you happen upon a solar panel, here's how to find out what it can do.

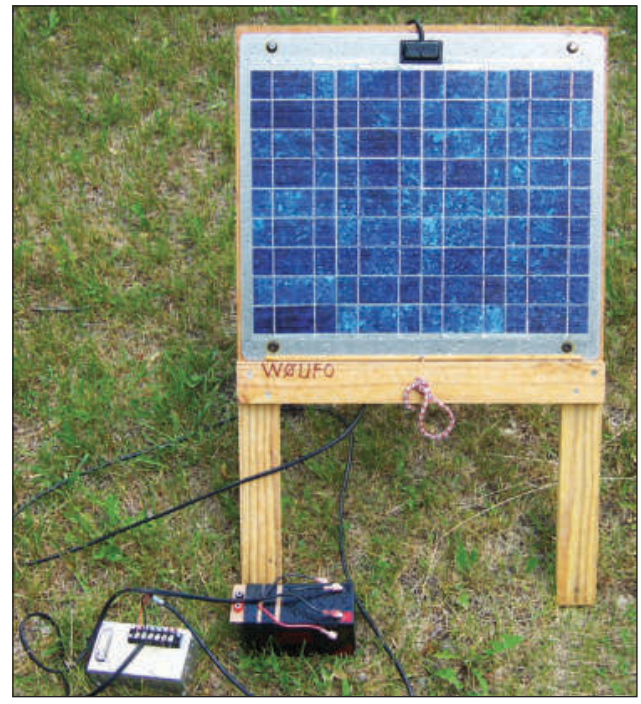

Figure 1 — Solar panel with a 7 Ah battery and controller used for low power (QRP) operations.

With all the emphasis on alternative energy and with the supply and price of solar panels improving, their use is becoming attractive for many Amateur Radio applications. This is especially true for EmComm and low power (QRP) operation while camping. Although sunlight is variable and intermittent, a solar panel can use it to produce electrical current to charge a battery that will provide steady power for radios and small appliances. Figure 1 shows a solar panel with a 7 Ah battery and controller used for QRP operations.

But What Will the Panel Do?

Understanding an equivalent circuit for your solar panel is helpful in fitting it to an appropriate application. Thevenin's theorem allows a device such as a solar panel to be represented by its open circuit voltage in series with its internal resistance as shown in Figure 2. In this circuit model, a 24 V open circuit source is shown with a 24 Ω internal series resistance. A load test of this circuit would produce a voltage versus current curve as shown in Figure 3. Between terminals A and B we would measure 24 V with no load (an open circuit) and it would deliver 1 A into a short circuit.

Because the 24 Ω resistance is constant, the straight line between the open circuit point and the short circuit point gives voltages and currents for any load from short to open circuit. The output of a solar panel is similar to this except that the internal resistance is not constant and varies with load. The curve for a typical solar panel under constant sunlight and a variable load is shown in Figure 4. A family of curves results if the load test is done for various amounts of sunlight, shown in Figure 5.

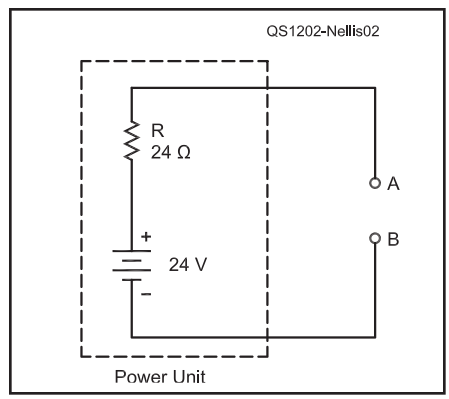

Figure 2 — A 24 V open circuit source is shown with a 24 Ω internal series resistance.

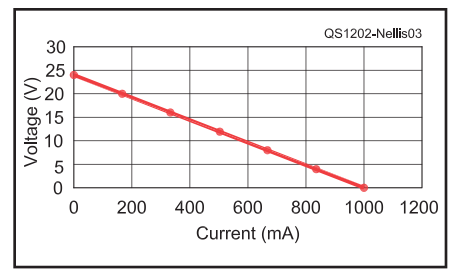

Figure 3 — Voltage versus current curve of the circuit of Figure 2.

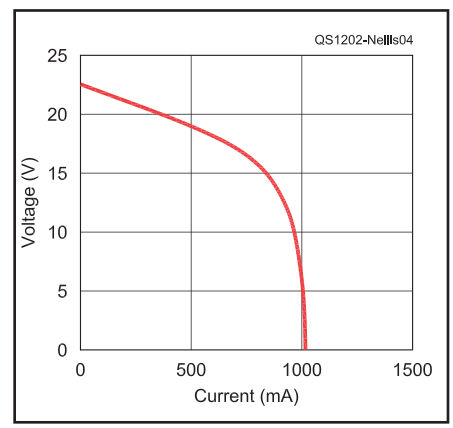

Figure 4 — Curve for a typical solar panel under constant sunlight and a variable load.

What Does it All Mean?

The measured output power from a solar panel can be used to determine its power rating. The power delivered at any load value is the product of the load voltage and current. The output power versus current curve for the circuit of Figure 2, shown in Figure 3, has a maximum at 0.5 A at a load of 24 Ω. This agrees with the maximum power transfer theorem that states that the maximum power transfer occurs if the load is equal to the internal resistance. At a 24 Ω load, the output voltage is 12 V giving a power output of 6 W.

You get a power versus current (I) curve for your solar panel by plotting the product of each V-I point (V × I = power) versus I. Because the internal resistance of the solar panel is not linear, it is hard to predict the point of maximum power until you see your plot. Figure 7 shows plots of both voltage

A Variable Load for Power Testing

A variable load that can sink several amperes of current is useful for testing your solar panel or power supply. A power rheostat is nice for this purpose, but one that can handle several amperes of current is very expensive. Here are two alternatives:

Switched Resistors

Using 6 to 10 power resistors and a switch for each one can make the circuit shown at the top of Figure A. The table of switch positions shows how to obtain a resistance by using all the resistors in series, for a maximum, to all the resistors in parallel for a minimum. Not all possible switch positions are shown, only those with the most useful values.

Ten 50 Ω, 10 W resistors would give a range of values between 500 Ω and 5 Ω with a 100 W dissipation rating. This would work for most small solar panels at a parts cost of around $25. Six resistors instead of 10 give a good range too at reduced cost. Notice that the switches need to be SPDT center off type (ON-OFF-ON).

An Electronic Load

An electronic load is easy to build and convenient to use. A combination of power resistors and power transistors, such as shown in the schematic at bottom of Figure A will provide a load that can be varied using a low cost, ½ W potentiometer. The power transistor, Q2, must dissipate a lot of power so must have adequate heat sink to maintain reasonable stability of the current. If the power transistors have TO-220 cases such as the 2N3055A, MJE3055 or TIP31A, the mounting to a heat sink is easy and all parts are large so that *ugly* construction works well. A transistor drives the main power transistor so that a low power potentiometer is sufficient for control. It can all be built on a piece of aluminum that serves as a heat sink and the panel of a cabinet or box, but must be thick enough (0.06 to 0.12 inches) to provide a good heat sink, as the heat causes the transistor gain to change resulting in current drift. Of course, if you take your data quickly, the heating of the transistor can be reduced. You have the option of insulating the transistor tabs if the panel needs to be electrically neutral.

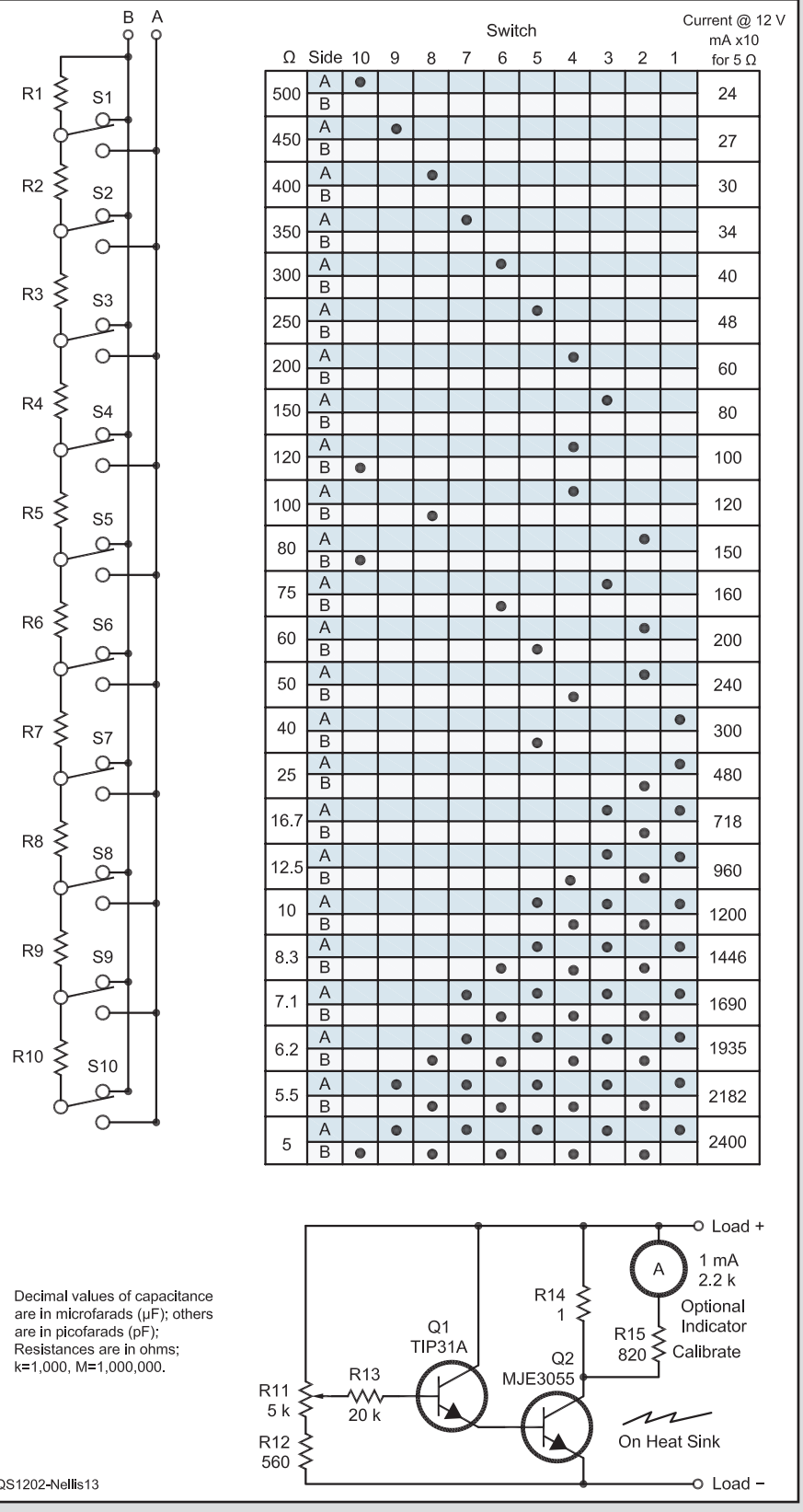

Figure A — At the top, a *TinyCAD* schematic of the resistor based load bank. R1-R10 are 50 Ω, 10 W resistors for a range of loads from 500 to 5 Ω. S1-S10 are SPDT with center off position rated at 10 A. At the bottom schematic diagram and parts list for an electronic variable load.

Q1 — TIP31A.
Q2 — MJE3055.
R11 — 5 kΩ potentiometer, ½ W linear taper.
R12 — 560 Ω, ¼ W, 5% resistor.
R13 — 20 KΩ, ¼ W, 5% resistor.
R14 — 1 Ω, 20 W, 5% resistor.
R15 — 820 Ω, ¼ W, 5% resistor, or as needed for meter calibration.

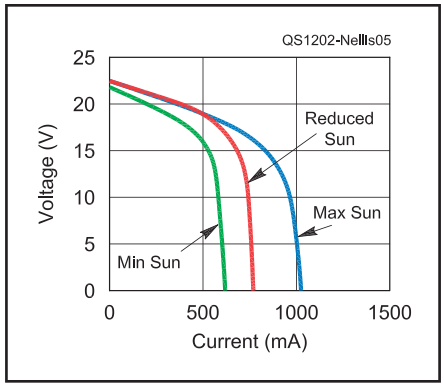

Figure 5 — A family of curves results if taken for various amounts of sunlight, as shown.

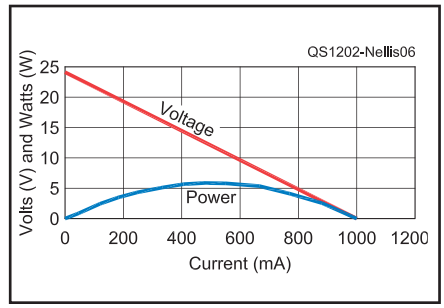

Figure 6 — The output power versus current curve for the circuit of Figure 2.

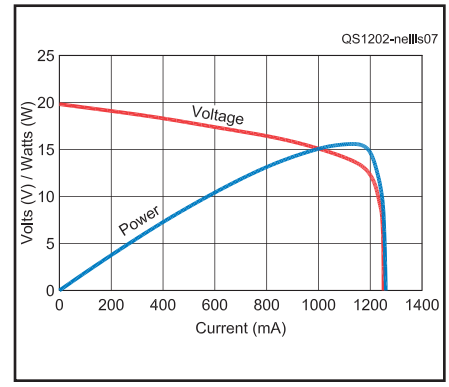

Figure 7 — Plots of both voltage and power versus current for a typical solar panel.

and power versus I for a typical solar panel. Notice that the power versus current curve has a maximum nearer to the short circuit current.

The maximum power under full sun is the power rating of the panel. Figure 7 is for a panel rated at 20 W, so there must have only been enough sun to develop 15 W when this data was taken.

Testing Your Panel

If you want to know the characteristics and capability of your solar panel, run a simple load test. An ammeter, voltmeter and a variable load resistor are all that is required to gather data to plot its output voltage versus current curve. Figure 8 shows a panel with a rheostat and meters ready for testing and Figure 9 shows a small 5 W panel with its rheostat load. The variable load resistor may be a power rheostat, switched power resistors or an active variable electronic load. The sidebar describes making an appropriate variable load.

Most digital multimeters have suitable current and voltage ranges. Current may range from 0 to 2 A dc and voltage from 0 to 25 V dc for solar panels up to 20 W rating. You need constant sunlight while taking data for an output curve because the curve changes for various amounts of sun energy. In constant, cloudless sunlight, take readings of voltage and current while varying the load from open circuit to short circuit. Take at least 10 readings of voltage and current. Enter this data into an *Excel* spreadsheet and, with the chart wizard, make a V-I plot.

A 12 V battery is common for use with many Amateur Radio setups and there are many solar panels designed to provide current for charging them. From a typical solar panel curve such as Figure 4, several observations are made:

- The open circuit voltage and the short circuit current give two limiting values that are useful for evaluating a solar panel.
- The open circuit voltage of the panel must be higher than the fully charged battery voltage in order for the panel to deliver current into the battery.
- The short circuit current at maximum sun is the maximum current that it can deliver under any circumstances.
- If the battery can take the maximum charge current available and also reduce the current to a safe trickle at full charge voltage, a controller may not be needed.
- A controller may be needed to limit the voltage applied to the battery. This will stop the charging after the full charge voltage is reached.
- To be safe, select a controller that limits the current and voltage applied to a battery to safe values at all times.

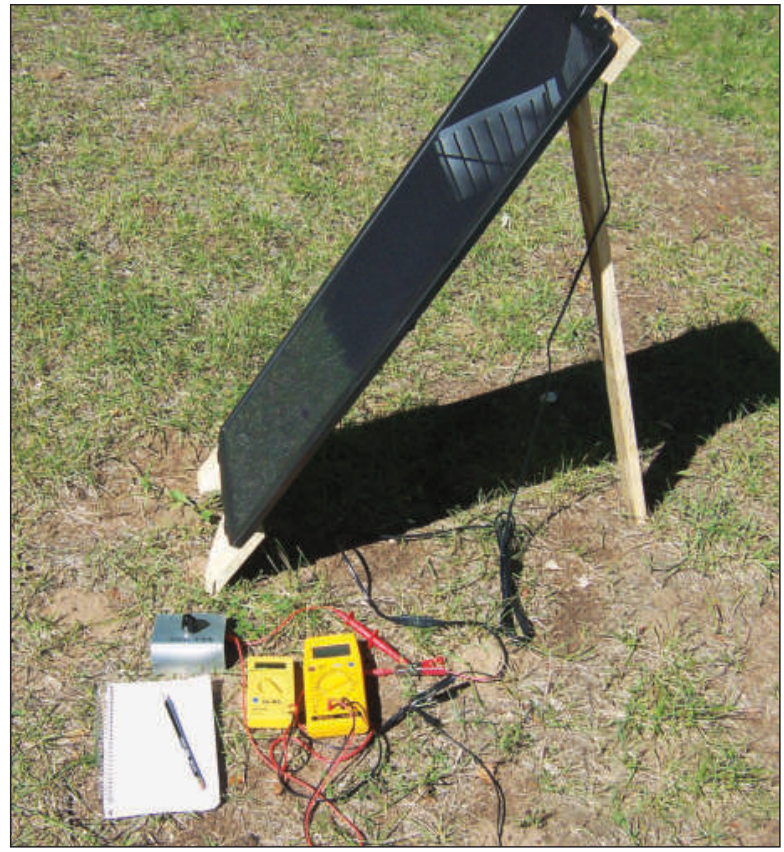

Figure 8 — A panel with rheostat and meters ready for testing.

A graphical solution is possible for the circuit of a solar panel charging a battery. The graphical representation of the 13.0 V battery, if zero internal resistance is assumed, is a horizontal line at 13.0 V. When the solar panel V-I curve and the battery V-I curve are plotted together as shown in Figure 10, the intersection of the two curves gives the current that the solar panel will send to a 13 V battery.

Keep it all Under Control

Note that as the battery voltage rises, a lower charge current flows, but a robust solar

Figure 9 — A small 5 W solar panel with a rheostat load.

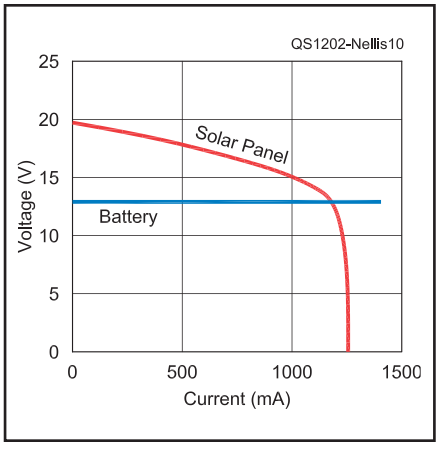

Figure 10 — If the solar panel V-I curve and the battery V-I curve are plotted together as shown here, the intersection of the two curves gives the current that the solar panel will send to a 13 V battery.

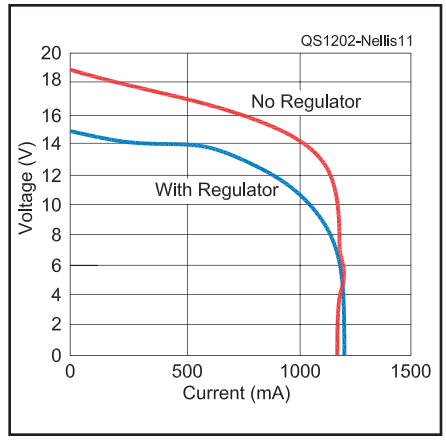

Figure 11 — The battery with a controller that limits both current and voltage. Here, if the voltage rises to around 14.5 V, the current is essentially turned off and the battery floats at this voltage.

panel could still overcharge a battery. A controller can limit both voltage and current from the solar panel if the panel V-I curve exceeds the controller limits. Figure 11 shows the battery with a controller that limits both current and voltage. Here, if the voltage rises to around 14.5 V, the current is essentially turned off and the battery *floats* at this voltage.

The above discussion provides a method for you to gather data from your solar panel to use for graphical analysis to understand how to charge your station batteries safely using a controller if necessary.

Photos by the author.

Amateur Extra class operator Mert Nellis, W0UFO, was first licensed as W9UFO in Nashwalk, Minnesota, then as W8CNC in East Lansing, Michigan before he obtained his current call. He received a BSEE degree from Iowa State University, then an MSEE from Michigan State University and is a Registered Professional Engineer in Minnesota, working in magnetic and industrial control.

Mert enjoys low power operating, homebrewing gear and building kits. Mert is a member of ARRL, QRP-ARCI, FISTS, NAQCC, SKCC and SOC, and is a life member of IEEE. He also enjoys hunting, fishing, private flying and gardening, as assistant to his wife the Master Gardener. You can reach Mert at 651 11th Ave NW, St Paul, MN 55112 or at **mertnellis@msn.com**.

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Dave Gauger, W9CJS

Figure 1 — The author sitting at the operating position of his solar powered station. The solar control box can be seen at the far left, mounted on the wall.

For some long time I've had a growing interest in powering my entire ham station from a source other than the ac mains. Of course I could use a generator, but what I had in mind was using a renewable energy source — going green as it were. What follows are details of how I accomplished my goal. Perhaps it will inspire many of you to do an even better job of going green.

We all are concerned about protecting our environment. What we disagree on is how and how much. Some feel that existing laws may be a bit of overreach; however, I think we can all agree that there are many things that we can and should do to protect the environment and our natural, consumable resources.

Lots of Choices

This is my first dabble into the world of alternate energy sources, and I've found a huge library of wonderful resource material in print and on the Internet. Battery technology is making forward strides, albeit slowly. Who can deny that Li-Ion batteries are a quantum leap over previous rechargeable battery technology? They are not without fault, and not best for every application, but for a host of uses they are superb.

Similarly, solar panels are enjoying slow, steady improvement in their efficiency. Experimental technology could raise today's nominal 16% efficiency to perhaps 60% in one giant leap, if it can be done economically.[1] So, in the words of the late Paul Harvey, "We aren't doing nothing about developing renewable energy sources."

Because I've been an electronics engineer, and now a physics teacher, I'm naturally intrigued by the thought of total independence from commercial power. This fueled my effort to run my ham station totally off of solar energy. Be it noted here, I do not run a kilowatt linear amplifier, only a typical 100 W transceiver. My solar powered station is shown in Figure 1.

Possible Solutions

It is certain that in our neighborhood a windmill charging system would not be looked upon with favor, and our location is not at all appropriate for wind generation of power, in any case. Similarly, geothermal and micro-hydro generating systems are out of the question, as are fuel cells. So it boiled down to practicality and in my case that dictated solar power. Solar panels are quiet, aesthetically acceptable and in some cases may be mounted all but out of sight to neighbors.

The cost of solar panels has dropped substantially in recent months to a point at which purchasing a sizable panel is far more attractive than even a year ago. After considerable research on the Internet, I decided on the purchase of a solar panel in the 80 W range.

Deciphering Solar Specs

I found solar panel specs a bit confusing at first, but the rational slowly came through. Panels seem to be rated as the product of the open circuit voltage and the short circuit current. Thus, a panel that develops about 20 V open circuit, and in bright sunlight produces about 5 A is rated at 100 W. In actuality, one charges a nominal 12 V storage battery to a voltage between 13.8 and 14.2 V when fully charged. It's easy to see that the maximum usable power might be 5 A times 14 V or around 70 W, not 100 W.

Still, the "headroom" — the voltage difference between a fully charged battery and the output of the solar panel in bright sunlight, is necessary to allow for regulation and to account for the inevitable drop in the panel voltage as the solar panel heats up.

How Much is Enough?

Everyone's operating habits are different. I operate perhaps 1 hour, 4 mornings a week and perhaps 1 hour in the evening time 3 days a week. I am not a heavy contester, nor do I ragchew for hours on end. If one operates AM, FM or RTTY, then the continuous duty nature of these modes during transmit times produces more of an energy drain than my typical operation, using 100 W PEP in an SSB round table in which

[1] **blogs.discovermagazinecom/80beats/2010/06/21/making-super-powered-solar-panels-via-quantum-dots**

Figure 2 — Rear view showing the aluminum frame mounted to the solar panel itself.

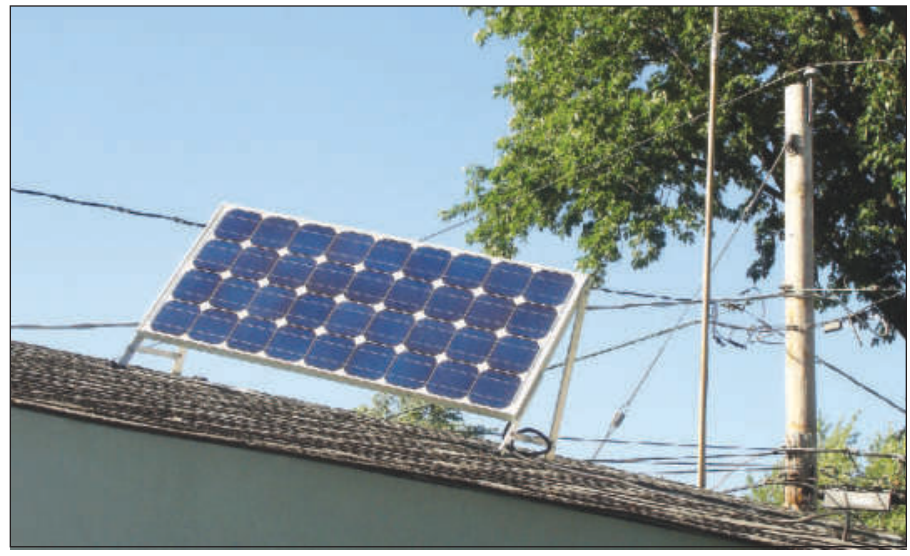

Figure 3 — The solar panel mounted on the garage roof. The odd looking angle is to optimize sun radiation capture, but also helps keep a low profile to minimize both wind resistance and neighbor annoyance.

I may speak only 10% of the time.

When one operates CW the transmit duty cycle approximates 50% and the transmit time might be 50%, with 50% listening. So even on CW the total ampere-hour use is relatively low. PSK31 is typically run at low power and is intermittent. What is continuous is the receive power, and in the case of my ICOM IC-756PRO, the receive current runs about 3 A.

The Battery Keeps it at the Ready

I figured that one deep discharge recreational vehicle (RV) style battery of 80 Ah capacity would serve me well. The next step up would be a 130 Ah deep discharge battery at a modest increase in cost, size and weight. With this reasoning in place, I purchased a deep discharge RV battery having an energy rating of 80 Ah and designed my system around it.

It might be appropriate to mention here that batteries are built for specific types of service. An automotive starting battery is intended for relatively high current while starting the engine of the car, followed almost immediately by recharge from the alternator. These batteries do not fare well if discharged to a low value more than a few times.

Deep discharge batteries are internally different. They can withstand being discharged to a lower point, time and again, such as being used to run appliances in an RV while "dry camping." One should never drain them totally, but they can withstand a much deeper discharge without significant long term damage.

Figure 4 — The deep discharge battery mounted in a standard RV battery case. The top has been removed to show the connections via the two SAE 25 A automotive circuit breakers.

Hanging it Out to Dry

The output of solar panels is proportional to the intensity of the sun's light but also depends also on how directly the sunlight hits the panel. The ideal condition is for the sun's light to strike perpendicular to the solar panel surface.

Let's Not Follow the Sun

Commercial setups use motor driven mounts in which the angle of the panel(s) is slowly rotated to face the sun as directly as possible for the greatest portion of the day. Building this mechanism would be an interesting project for some, but overkill for my application.

I mounted the solar panel using sturdy aluminum brackets fabricated by friend Bill Farmer, K9BTF. Using lag bolts, I bolted the panel and frame to my garage roof at an angle and direction that I felt would maximize the panel output (see Figure 2). Actually, I tilted the frame a bit more vertically than I might have, hoping to get a little more charge current in the winter months when the sun's angle is lower (see Figure 3). In the winter, battery capacity is lower due to the cold temperature so this drove my thinking about the mounting angle.

Getting the Juice From Here to There

My ham shack is in the house. The garage is unattached to our home so feeding the solar panel current from the garage to the battery, mounted outside the back room was no problem because, for years my ham shack was in a heated room in the garage. I had a number of buried utility cables leading from the garage, under 30 feet of lawn to a tower bolted to the back room of the house. This back room, once a bedroom for teenage sons is now my ham shack.

I used one of the buried utility cables to feed the solar panel current underground and into the house and to the PANEL terminals on the solar controller. I determined the dc round trip resistance of the cable by shorting the far end and measuring the resistance from conductor to conductor. I found it to be about 0.35 Ω.

Stowing the Storage Battery

Batteries produce hydrogen gas while being charged. This dictated mounting the battery outside. I used a commercial RV battery container box, on a little shelf that I screwed to the outside of the back room ham shack wall (see Figure 4). Fortunately it gets some additional protection from the weather by an overhanging eave.

Using an AGM (absorbed glass matt) type battery or a gel-cell would have virtually eliminated any possible danger from hydrogen gas being vented and would have allowed the battery to be mounted inside the room, but the trade-off is the higher cost of these batteries.

The solar panel was on the garage roof and the battery was mounted on the outside wall of the ham shack. I needed to feed power from the battery to the control box inside the house. My junk box produced a pair of 25 A manual reset SAE automotive circuit breakers. These are small and can be screwed directly to the battery terminals using little brackets. In a car, both leads need to be protected; here, I needed to break only one lead in the case of an overload. I had two breakers so I used both as an extra measure of safety in case of a heavy short. I mounted one on the + line and one on the – line. There is a lot of potential energy in a fully charged battery of this sort.

To minimize resistive losses in the battery feed cable, I used #8 AWG red/black wire purchased from Quick Silver Radio (**www.qsradio.com**). This heavy wire feeds the battery power into the control box inside my ham shack through the same wall-port that also passes my RF coax and heavy earth ground wire.

Figure 5 — Front panel view of the control box with the solar controller mounted on the front surface. The white rocker switch is a center off, three position switch that allows selection of BATTERY POWER, OFF or AC POWER SUPPLY.

Running the Radio Station

My station is normally powered by a Kenwood PS-30 power supply that has both a 20 A regulated output for my ICOM radio and a 5 A auxiliary output. I used both, the auxiliary terminals feed an Alpha Delta VRC speaker, the pilot light in my Ten Tec 238A tuner, a laptop computer and an overhead light. Total auxiliary drain is about 4.5 A. If one does not have the dual dc output such as is found on the PS-30, the auxiliary power connections could be made to any appropriate 12 V dc power supply of adequate power rating.

Seeing is Believing

The hanging, overhead desk light posed a minor problem. I really like the circular, semi-parabolic shape of the lamp hanging over the operating desk. To go green, I purchased a screw-in 12 V compact fluorescent lamp (CFL) on the Internet and replaced the 120 V ac plug on the lamp cord with a bi-pin banana plug to connect the lamp cord into my 12 V distribution box. The existing lamp fixture is now 12 V dc operated and the 15 W CFL bulb gives adequate illumination. I ordered the 12 V CFL lamp from **cgi.ebay.com/ebaymotors/12-V-fluorescent-lamp**.

Keep the Situation Under Control

I wanted to be able to switch easily from battery power to my conventional ac supply. Within my control box (see Figure 5) I've wired a 25 A center-off DPDT rocker switch that allows me to power the station from the PS-30 ac supply or from the solar backed battery.

A pair of meters from Fair Radio Sales (**www.fairradio.com**) were just the right size, one 0-15 V dc and the other 0-5 A dc. The voltmeter reads the battery voltage, and the ammeter reads the solar panel charging current (see Figure 6). The part numbers for the meters are AIM605000 for the 5 A meter and AVM6015 for the 15 V dc meter. These meters are petite, yet large enough to be read, are surprisingly accurate and are reasonable in cost.

I wired the control box with #12 AWG flexible wire, also purchased from Quick Silver Radio, and I crimped and soldered all lugs to minimize any resistive losses. Down the inside center of the control box I mounted a heavy duty terminal strip, large enough to handle the sizable lugs on the heavy wires (see Figure 7).

The main disconnect from the battery line into the back room uses a pair of 75 A Anderson Powerpole connectors obtained from Quick Silver Radio Products. These large Powerpole connectors are big honkers, only loosely akin to those 30 or 45 A connectors that have become ubiquitous throughout the ham fraternity.

The control box is made in a 6 × 17 × 3 inch aluminum chassis donated by friend Owen Davis, W9GYL. It turned out to be a perfect size and was easy to work with. It mounts on the back wall of my ham shack, near where all antenna and power cables enter from the outside through a port. Large grommeted holes provide for cable passage in and out of the chassis.

Avoid Too Much of a Good Thing

Since solar panels can put out sizable charging currents, some means is needed to prevent overcharging of the battery. There are many such controllers, most of which use the PWM (pulse width modulation) method that provides continuously

Figure 6 — The panel meters in operation. It is interesting to watch the charge current vary as clouds pass by, obscuring the direct sunlight.

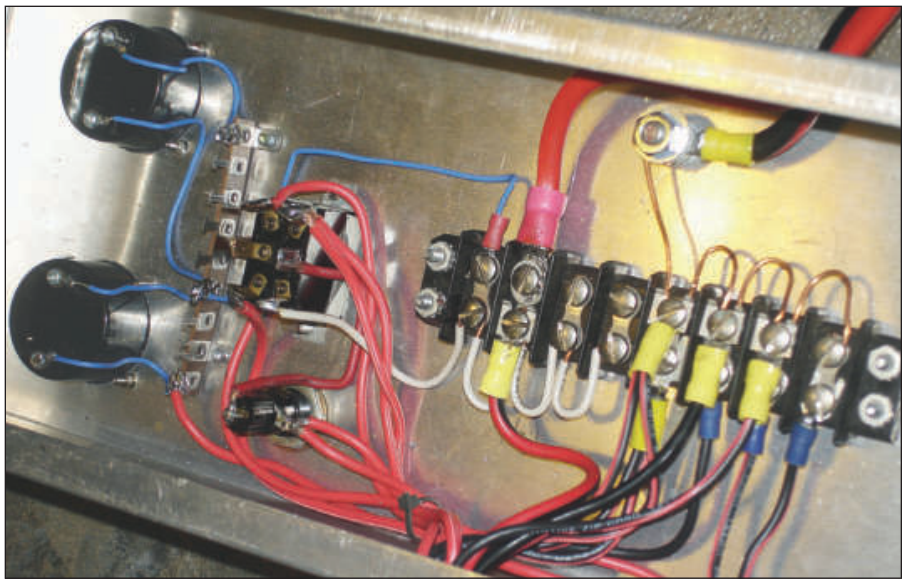

Figure 7 — Internal wiring of the control box using heavy lugs, both crimped and soldered.

modulated charge current, but in so doing is capable of producing substantial digital switching noise in an HF radio. Similar techniques are used in battery chargers and these are infamous for producing this same noise. I wanted no part of that.

I did find, and subsequently purchased, a simple little controller that uses a pair of disconnect relays. One relay disconnects the solar panel when the battery is fully charged. The other disconnects the load when the battery voltage falls below a minimum threshold so as to prevent over-discharge of the battery. Best of all, no PWM — I hear no radio noise. I found such a device available from Green Energies LLC (**info@greenenergiesllc.com**, **www.greenenergiesllc.com**). The model number is SCC1215 and the price at this writing is under $25. The controller has three pairs of terminal connections, SOLAR PANEL INPUT, BATTERY and OUTPUT LOAD.

Since the radio peak current can be greater than the 15 A load limitation on the output of the controller, I chose to wire the radio directly to the switched battery buss, circumventing the controller load feed. This minimizes the controller load current. When and if the battery reaches the minimum voltage level, the load will shut off and with it will go my powered speaker and overhead light, both of which do obtain their power from the controller load terminals. This should be adequate warning to me that the battery is nearing depletion.

Operation

So far the operation of the station on dc, mirrors that on ac — no problems, no distortion on peaks, no other surprises of any sort except one. On 20 meter CW, I noticed that my CW keying triggered relay transfers in the solar regulator. A 0.01 µF bypass capacitor across the solar panel input terminals on the regulator fixed that problem.

I've operated several hours in an SSB roundtable and the battery voltage has dropped about 0.5 V. If I do discover problems due to battery voltage sag, the addition of a battery booster in the transceiver line will ensure that the transceiver always sees an adequate voltage level. I'll wait until then to decide.

Meanwhile, my station has been 100% solar powered for some time now. So far so good. It's obvious that during any major power outage, my station will be operable for many hours without generator assistance.

I intend to run the station in some contests to determine just how long I can operate before the rig objects to low voltage levels. Such data will define the parameter footprint and allow me to tailor my operation so as to maximize battery life.

Fortunate Fallout

During a recent storm the commercial ac power to our entire neighborhood was disrupted. I took the opportunity to fire up my rig to see if the S9 line noise I've been plagued with for weeks was still there. It was, so I can conclude that the source of the noise is not in our immediate area.

For a long time, my laptop computer has also generated significant hash on the lower bands. Interestingly, it wasn't the laptop, but rather it was the switching power supply that produced the noise in the radio. This switching power supply is rated for 15 V dc at 3 A. I wondered if I could run the computer on my 12 V dc source and the answer is yes. It runs fine and best of all there is no hash noise at all.

In Closing

Did I make the setup with the thought of saving money on my electric bill? No, that would be naive. I did it for the fun, for the challenge, for self education and also to provide substantial HF communication capability during a major power outage. As the Boy Scouts say, "Be prepared."

Perhaps these notes and my experiences will give others some ideas for similar solutions. Hams are ingenious in solving their individual problems. I look forward to seeing others' solutions to the goal of going green.

Photos by the author.

ARRL member and Amateur Extra licensee Dave Gauger, W9CJS, was first licensed in 1948 and has held the call since then except for a short break as KF9X due to a missed renewal. Dave was educated as a teacher with a BS from Northern Illinois University and an MS in Education from the University of Pennsylvania. He taught in public schools from 1958 to 1963 and then became Chief Electronics Engineer at Littelfuse Inc until his retirement in 1995. Now he teaches physics, electronics, aviation, photography and ham radio at a private school. Dave and his wife reared six children, three of whom obtained ham licenses, although only one, David II, WB9BMM, is still licensed. During the '70s his musical family entertained at the Dayton Hamvention three different years as The Gauger Brass. Dave spoke at Dayton one of those years on the subject of WEFAX reception using a five turn helix antenna on an azimuth-elevation mount. You can contact Dave at 3900 Bluebird Lane S, Rolling Meadows, IL 60008 or via e-mail at **w9cjs@arrl.net**.

Feedback

◊ In "Vintage Radio" [Dec 2011, p 98] George Ulm's original call sign from 1938 was actually W1ABU.

◊ In the "Season's Greetings" list [Dec 2011, p 37], we inadvertently left off Youth Editor Sterling Coffey, N0SSC.

◊ In Figure 1 of "A Transistor Tester in a Tin" [Jan 2012, pp 30-31] the pin out diagram for the TO-92 plastic transistor (lower drawing) has the emitter and collector leads reversed.

Double Your Mobile Antenna Use

An easy way to use your mobile antenna as a fixed vertical and get higher performance.

R. "Andy" Wiedeman, WA0AW

If you are looking for an easy, low cost way to double the usage of your center or base loaded HF mobile antenna at a fixed location with higher efficiency, look no further. The design described in this article can be built in a half day. It is adapted for use with a recreational vehicle (RV) for your vacation or ARRL Field Day, but also has applications as a stealth antenna, or a quick and easy way to erect an antenna at a portable location. Best of all you can take your favorite rig along.

You can adapt the principle shown in this article to use your mobile whip on both your tow vehicle while traveling and your trailer or fifth wheel. You can also use it at your vacation cabin after you arrive at your destination. You simply unscrew the vertical resonator from its vehicle mount and screw it into a support base with four ¼ wave radials attached to a PVC mast that will raise your resonator base about 18 feet above the ground. This allows four radials for 20 meters enough height to slope down at 35 to 45°.

The use of tuned, elevated, sloping radials provides higher efficiency and lower radiation angles than typical vehicle body mounting schemes. No matching network is required as you can feed this antenna directly with 50 Ω coax. This project, adaptable to many commercial or homebrew mobile resonators that you probably already have, is inexpensive. The complete project can be made for less than $50 if you have the mobile resonator, if starting from scratch it can be less than $130, including a commercial resonator and mast. No special tools are required, and no climbing is necessary to erect the antenna.

I will describe how to build this antenna using a Hustler center loaded vertical as a single 20 meter band fixed antenna. Other *QST* articles, however, describe how to use such antennas as multiband radiators and those techniques could be applied here as well.[1] While I was preparing for an RV snow

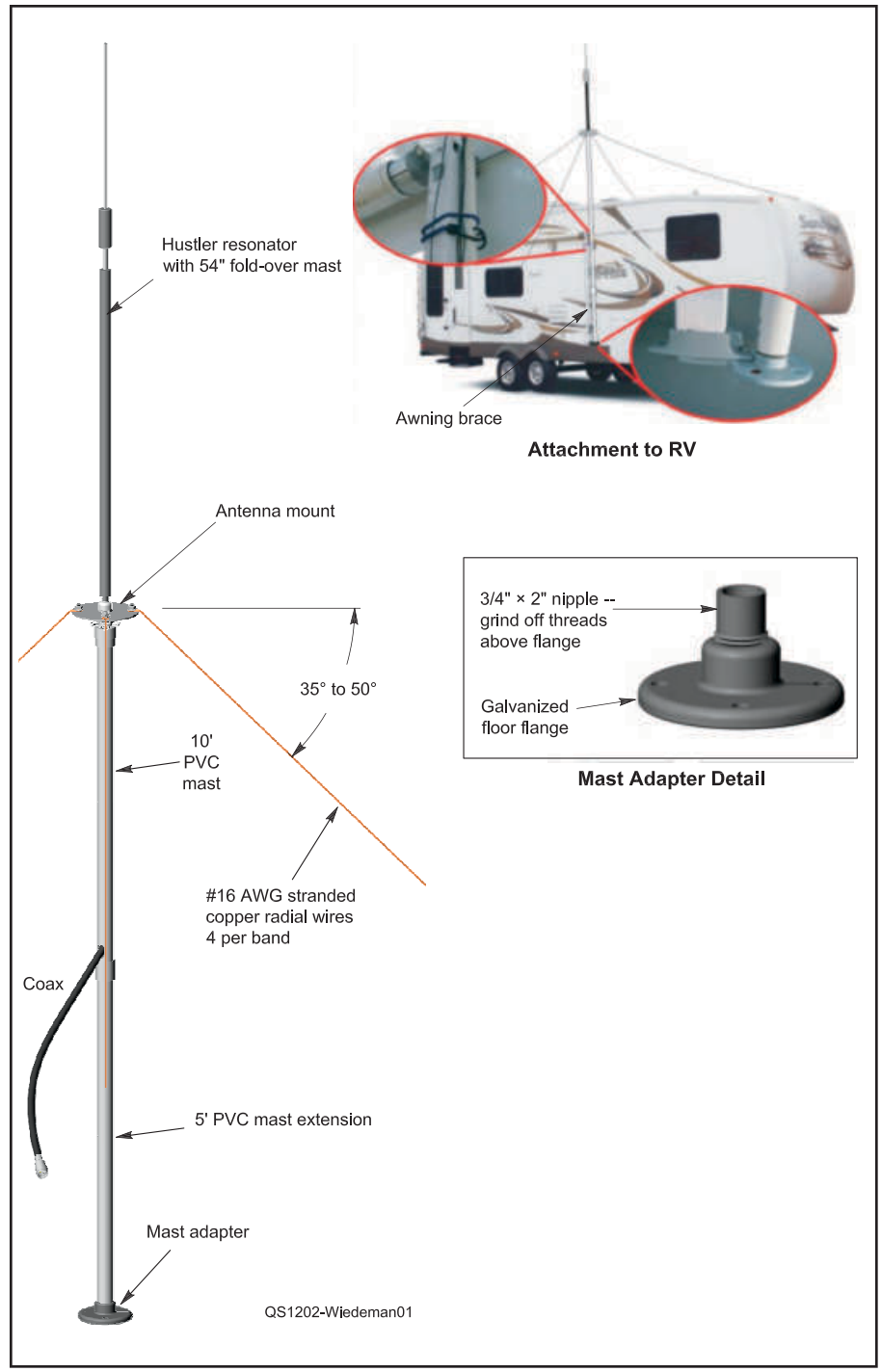

Figure 1 — An example of one design possibility.

[1]Notes appear on page 43.

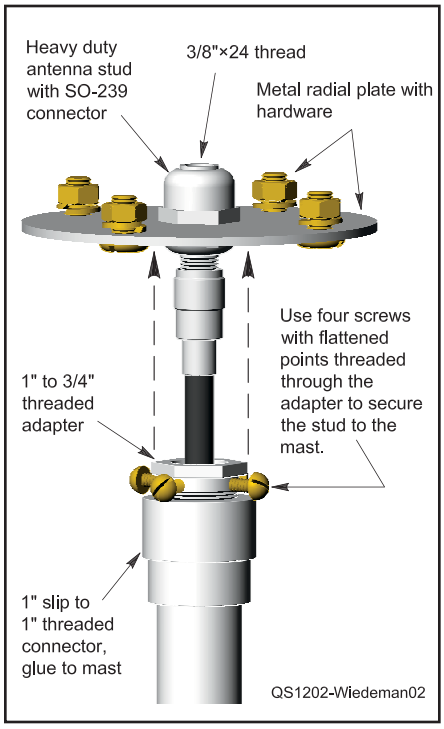

Figure 2 — The homebrew antenna mount installed on the mast.

bird trip to the West Coast, I found that RV antenna mounting information is hard to come by. The primary difficulty is developing a low loss ground or counterpoise, especially for fiberglass and composite construction RVs. Other problems are determining how to attach the antenna to the RV and where to stow the antenna while travelling.

All materials for this project can be obtained from your local home improvement center, truck stop, RadioShack or the Internet. The awning brace that most RVs have makes a convenient attachment support and puts the base of the vertical about 6 feet above the RV roof and near the RV center.

How to Develop the Ground Plane

Most portable locations, RVs included, do not provide suitable situations for efficient vertical antenna ground planes. Your usual choices are to use the RV chassis as a capacitive connection to real earth (inefficient) or to deploy many radials on the ground (not usually practical). Fortunately in a recent *QST* article, Rudy Severns N6LF, provided a solution to this ground plane problem.[2] Severns' testing indicated that four elevated ¼ wave radials will perform about the same as many radials mounted on the ground and far better than using the RV chassis as a counterpoise. Elevating a horizontal radial system results in an antenna impedance of about 30 Ω, resulting in a poor match to a 50 Ω coax. Sloping radials sloped at 30 to 50° provide an improved match. This technique avoids the need for an antenna tuner or a matching network.

I found experimentally that raising the base of the vertical above the RV roof about 6 feet allows sloping the radials at 35 to 45°, an angle that provided a good match to 50 Ω coax. The total height of the base of the vertical above earth ground is about 18 feet.

Example Design

Although I happened to have an old Hustler mobile antenna composed of a standard length 54 inch fold-over mast for mounting a Hustler RM-20 resonator, many other antennas can be used. If you have a mobile antenna, as shown in Figure 1, all you need is a support mast and some hardware to attach and raise the base of the fold-over mast about 18 feet in the air. You can build a simple mast using 15 feet of 1 inch diameter PVC pipe and a few PVC fittings, available at your local home improvement center or a plumbing supply house.

While you can build the mast in one piece, it is easier to transport on your RV if it is in two pieces. My mast is made from a 10 foot length with the mobile antenna mount at one end and a slotted hole for the coax on the other end. I used a 5 foot length of PVC pipe to extend the length of the support mast. Sanding the lower end of the 10 foot piece will let you easily separate the two piece support mast.

You will need a resonator antenna mount. This mount can be homebrewed, as shown in Figure 2, from locally available parts. Use a heavy duty antenna stud, commonly used for CB antennas, with an SO-239 socket. These studs can be found at most truck stops, RadioShack or from the Internet for about $10. The stud will have a provision for a radial attach plate that is insulated from the vertical resonator. A convenient material for the plate is a round aluminum electrical box cover.

To assemble the support mast, route a piece of coax with a PL-259 UHF plug on one end through the PVC pipe and the adapters. After connecting the coax to the antenna mount, push the antenna mount down into the PVC 1 × ¾ inch threaded adapter, and secure it with four short screws. Grind the sharp ends of the screws flat.

Attachment to the RV is easily accomplished using a ¾ inch galvanized floor flange and a 2 inch nipple. Grind the threads down on one end of the nipple to allow the PVC pipe to slide on and off easily. Making two of these allows one for attachment to the awning brace and one for stowing the mast on the RV rear bumper while traveling.

Simple Deployment

When complete, the antenna can be assembled and deployed in about 15 minutes by one person without climbing. After removing the vertical radiator from your tow vehicle, screw it to the antenna mount. Since the coax is already attached to the antenna mount, no coax attachment is necessary. Attach the PVC mast adapter to the bottom of the awning brace bracket. Now attach the radials to the radial attach plate and raise the antenna and slip the lower end of the mast over the mast support. Secure the PVC support mast to the awning brace with a bungee as high as you can. Tie radial extension nylon cords to each of the radials and deploy the radials approximately at right angles to each other, sloping them down at about 35 to 45°. If your RV roof is EPDM rubber or plastic, as most are, do not worry if the radials touch the roof. At least one of the radials will probably cross the roof. I leave a nylon cord over the roof while traveling to make deploying this radial easier. Connect your coax feed to the antenna coax and route into the RV through a convenient hole and you are finished.

The first time you use the antenna you may have to adjust the resonator length, requiring you to raise and lower the antenna a couple of times. The measured 2:1 SWR bandwidth on my 20 meter installation was about 200 kHz, pretty typical for a short center loaded vertical with ¼ wave radials.

Results and Conclusions

Anecdotal performance shows excellent performance in rural areas with low ambient noise levels. Good results were obtained for contacts in the USA. I found that DX can be worked, but may take a little patience due to the lower performance of the shortened resonator. My personal experience showed that 20 meter performance is about the same as my low home station dipole. When the band was open, I was able to easily work Europe, Asia, Oceania and South America from an RV park in Minden, Nevada. With the resonator mounted on my Ford F350 without the radials, most of these stations could not be heard, attesting to the increased performance due to the radials.

Parting Thoughts

Variations and uses are many for this simple low cost design. Multiband operation is easy by adding additional resonators to the top of the 54 inch fold-over resonator mast, and additional radials cut to ¼ wavelength. I have successfully used this antenna on 20 and 40 meters with four radials on 20 and two radials on 40 meters. Adding a 15 meter resonator and substituting two 15 meter radials for two of the 20 makes this a tribander.

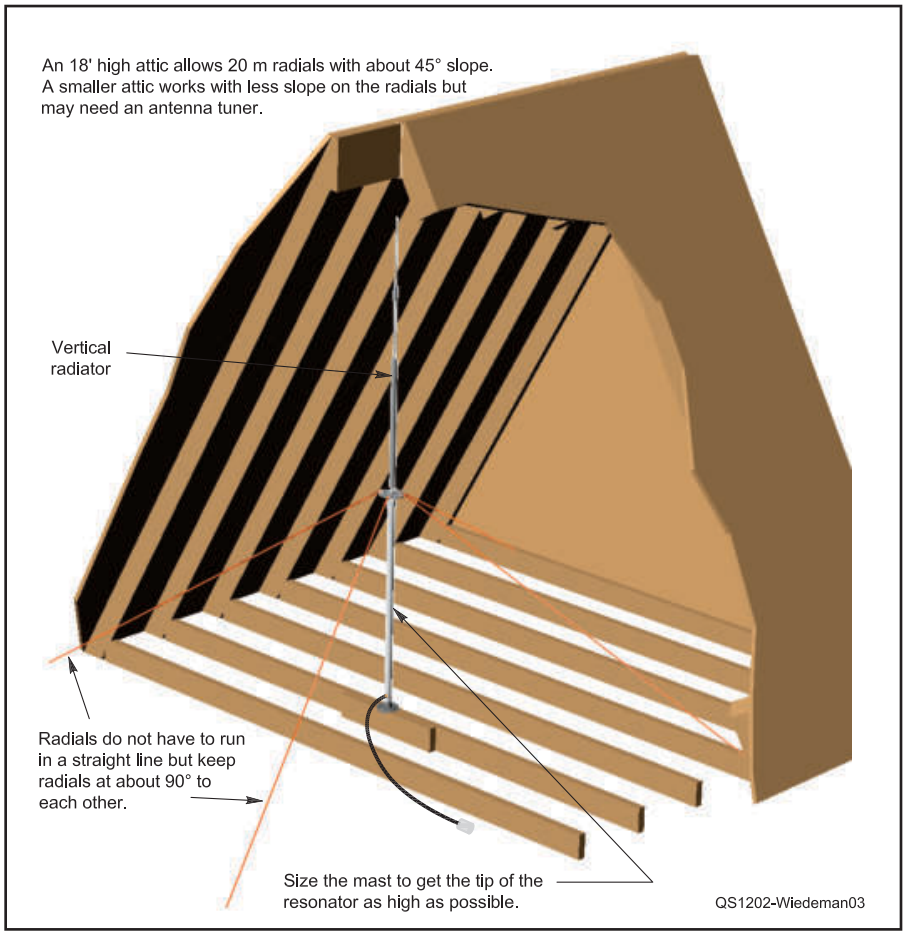

Figure 3 — A stealth antenna application in an attic space.

A stealth installation can be achieved by erecting the antenna in an attic, shown in Figure 3, or hiding it inside the canopy of a tree. Portable installation at a vacation cabin is achieved without drilling, nailing or damaging the cabin. More applications are shown at the QST-In-Depth website.[3]

In fact you don't even need an RV, a cabin, a tree or anything else to erect this antenna. The radials make great guy wires and a few stakes will allow you to erect the antenna without any supporting structure. I found that a couple of 1 gallon milk bottles filled with water will anchor the radials without using stakes.

Wherever you mount the antenna, use caution to ensure that no one can come in contact with the ends of the radials. These are high voltage points while transmitting. Also take into account RF safety with any antenna set up in proximity to people.[4]

Notes

[1]For example, see: S. Robeson, K4YZ, "One Ham's Fix for Limited Space Antennas," *QST*, Mar 2011, pp 37-39.
[2]R. Severns, N6LF, "An Experimental Look at Ground Systems for HF Verticals," *QST*, Mar 2010, pp 30-33.
[3]**www.arrl.org/qst-in-depth**
[4]See for example: J. Hallas, W1ZR, "Getting on the Air — Learning to Live with RF Safety," *QST*, Mar 2009, pp 70-71.

ARRL member and Amateur Extra class operator Robert "Andy" Wiedeman, WA0AW, was first licensed in 1967. He is a graduate of the Engineering School at the University of Santa Clara. Andy retired from Globalstar Limited in 2000 where he was Vice President of Engineering. Globalstar is a satellite cellular telephone system that he invented. Andy is the holder of over 60 patents in the satellite communications field. He also was the responsible engineer for the Apollo service module while at North American Aviation. You can reach him at PO Box 461, Sedalia, CO 80135 or at **wa0aw@arrl.net**.

In The January/February 2012 Issue:

■ Luiz Amaral, PY1LL/AC2BR, describes how he built his own high voltage capacitors using mica sheets and copper foil tape, to build a filter for a 500 kHz station, in anticipation of permission to operate on that band in his home country of Brazil. In "Some Homemade Capacitors," Luiz describes the template he used to build the capacitors and explains the steps he took to calculate the size and number of plates needed to achieve the desired capacitance with his home made models.

■ Jacques Audet, VE2AZX, explains a new method of "*Q* Factor Measurements on L-C Circuits." Jacques explains how to make measurements sing an SWR analyzer, and then use an *Excel* spreadsheet that he provides to calculate the *Q* of the L-C circuit.

■ Fred Brown, W6HPH, shows us how to "End Man-Made Noise with the Noise Canceller." Fred's circuit uses a separate antenna to sample the noise, and then uses a bipolar transistor phase shift network with a variable resistor to shift the phase of the noise signal by up to 180°. A second bipolar transistor provides an additional 180° phase shift, so the circuit can shift the phase of the noise signal 0 to 360°. The amplitude of the noise signal is adjusted with a dual gate MOSFET. The processed noise signal is added to the signal coming in on the main antenna. By adjusting the phase and amplitude of the noise, you can null out most types of man-made noise.

■ John Maetta, N6VMO, presents a PIC microcontroller project that will monitor the status of a Trimble Thunderbolt GPS disciplined oscillator and report when it has acquired enough satellites to phase lock its 10 MHz and 1 pulse per second output signals in "PIC'n on the Thunderbolt."

■ You will find all this and more in the January/February 2012 issue of *QEX*!

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A Relay-Based Full Break-in TR Switch for your Vintage Station

Bring the operation of your old-time CW station into the 21st century.

Phil Salas, AD5X

As a CW operator, I enjoy full break-in (QSK) operation with my Elecraft K3 transceiver and QSK-modified ALS-600 amplifier.[1] My Johnson Ranger/Drake 2B vintage station, however, employs a traditional Dow-Key relay-based Transmit-Receive (TR) switch controlled by the Ranger's relay control output. So TR switching only occurs when I manually switch the Ranger from STANDBY to CW. Because I miss full break-in when operating my vintage station, I decided it was time to look into a QSK TR switch.

A Relay-Based QSK Solution

Like modern transceivers, the typical RF output of most vintage transmitters is 200 W or less. This level is easily handled by very fast miniature signal relays. For example, 100 W into 50 Ω results in an RF current of 1.4 A. The OMRON signal relays I chose can handle 3 A_{RMS} of current continuously or 2 A if hot-switched. They can also handle 1000 V_{RMS} between open contacts and between the contacts and coil. Further, these relays switch in less than 5 ms (typically 3 ms) — perfect for QSK operation.

The switching portion of the QSK TR relay switch is shown in Figure 1. Two DPDT relays are used. K1 handles CW keying and optionally receiver mute control — although receiver muting is usually not used in CW, in order to allow you to monitor your transmit signal. K2 handles the transmitter output and receiver input antenna routing. K2 also grounds the receiver RF input on receive to protect the receiver front-end from overload. The 22 pF capacitor compensates for the relay and wiring inductance.

Figure 2 is the schematic of the relay driver circuitry. As you can see, you key the TR switch and then the TR switch both keys the transmitter and provides TR antenna

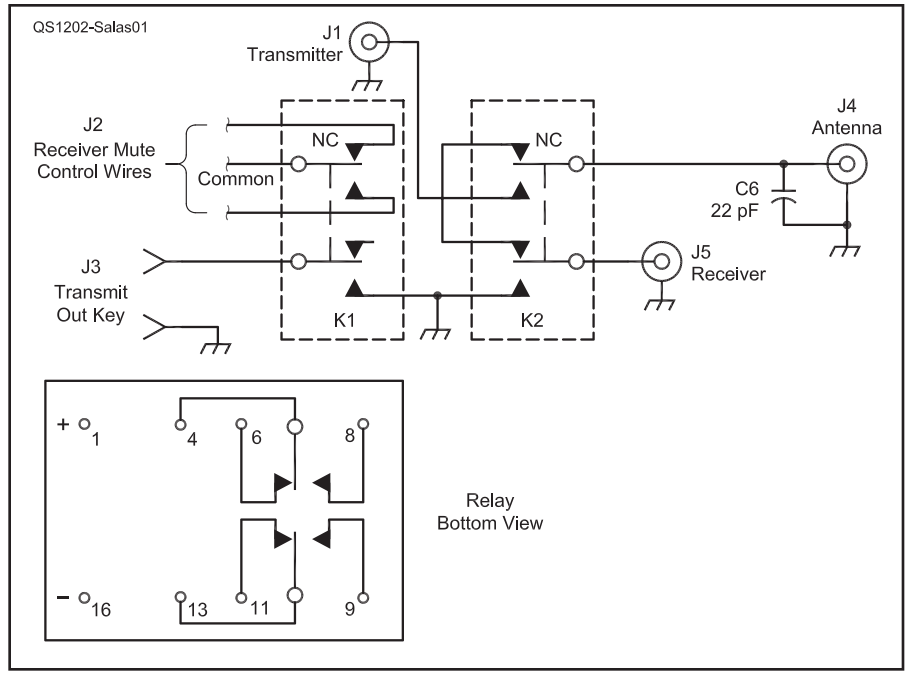

Figure 1 — Schematic of the relay contact portion of the circuit. Parts for Figures 1 and 2 are listed in Table 1.

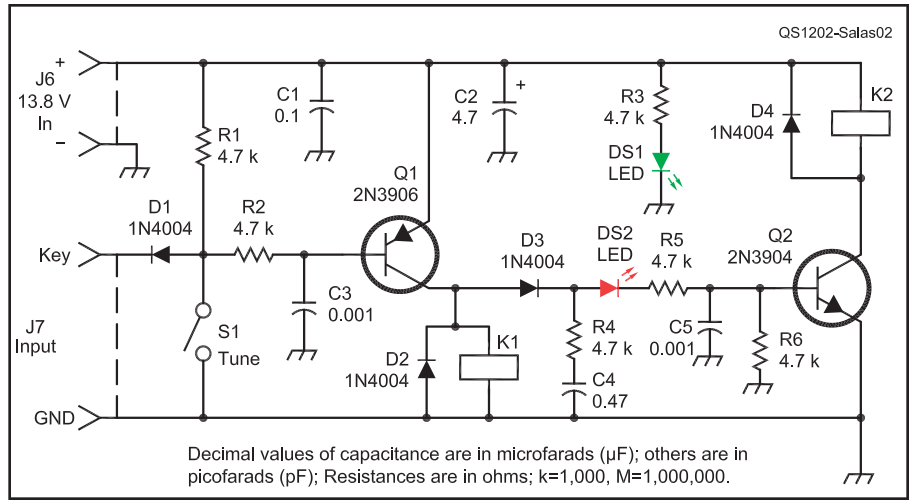

Figure 2 — Schematic of the low current switching and timing delay portion of the circuit.

[1]P. Salas, AD5X, "Low Cost QSK Conversion for the Ameritron ALS-600 HF Amplifier," *QST*, Jun 2009, pp 47-49.

Table 1

Parts List for Boat Anchor QSK TR Switch

All parts can be ordered from Mouser Electronics at **www.mouser.com**.

C1 — 0.1 µF, 100 V capacitor (Mouser 581-SR211C104KAR).
C2 — 4.7 µF, 25 V electrolytic capacitor (Mouser 140-XRL25V4.7-RC).
C3, C5 — 0.001 µF, 100 V capacitor (Mouser 581-SR211C102KAR).
C4 — 0.47 µF, 25 V electrolytic capacitor (Mouser 140-XRL25V0.47-RC).
C6 — 22 pF, 200 V COG ceramic capacitor (Mouser 80-C315C220J2G).
D1-D4 — 1N4004 diode (Mouser 512-1N4004).
DS1 — Ultrabright green LED (Mouser 604-WP7113MGC).
DS2 — Ultrabright red LED (Mouser 630-HLMP-EG15-RU000).
J1, J4, J5 — SO-239 chassis mount jack (Mouser 601-25-7350).
J2 — ⅛" stereo jack (Mouser 161-7300-EX).
J3, J7 — Phono jack (Mouser 161-1052).
J6 — 2.1 × 5.5 mm dc power jack (Mouser 163-1060-EX).
K1, K2 — DPDT signal relay (Mouser 653-G6A-234P-DC12).
Q1 — 2N3906 PNP transistor (Mouser 512-2N3906TA).
Q2 — 2N3904 NPN transistor (Mouser 512-2N3904TA).
R1-R6 — 4.7 kΩ resistor (Mouser 71-CCF074K70GKE36).
S1 — SPST or SPDT toggle switch (Mouser 108-1AS1T1171-EVX).
Project box, 4 × 4 × 2" (Mouser 537-CR-442).
2 each 16-pin IC socket (Mouser 535-16-3518-10).
Perf board, 4.5 × 6.5" (Mouser 534-3404).

switching including grounding the receiver input. Switch S1 provides a constant-key input for transmitter tune-up, or for manually enabling the TR switch for phone operation. The relay drive circuitry presents a low-current keying interface (less than 2 mA) so any key or keyer can be used. And because transmitter keying is via relay contacts, grid-block keying, cathode keying or any other transmitter keying input is easily handled.

Both relays are enabled simultaneously so hot-switching of the transmitter output does not occur as it typically takes a few milliseconds for RF to be generated after the transmitter is keyed. However, we must ensure that no relay switching occurs until *after* the RF waveform has completely decayed, which typically takes 3 to 5 ms. Since K1 directly keys the transmitter, we must delay K2 turn-off switching until at least 5 ms after K1 unkeys the transmitter. The 4.7 kΩ resistor and 0.47 µF capacitor R-C network on the collector of the 2N3906 provides about 8 ms of turn-off delay for the transmitter output relay.

Construction

The complete parts list is shown in Table 1. Note that the relay coil is polar-

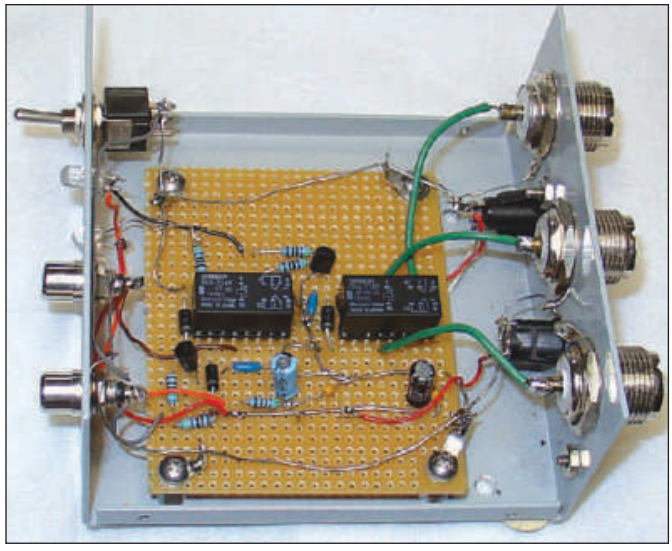

Figure 3 — View of the inside showing wiring arrangement.

Figure 5 — The rear panel has the jacks for the antenna connections as well as power and standby switching.

Figure 4 — The front panel includes controls, indicators and the key in and out jacks.

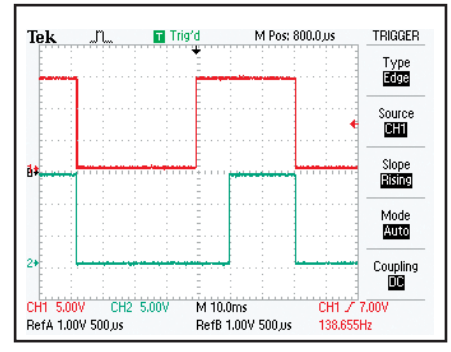

Figure 6 — Relay timing diagram. Red is timing of keying relay K1, blue is timing of antenna switching relay K2.

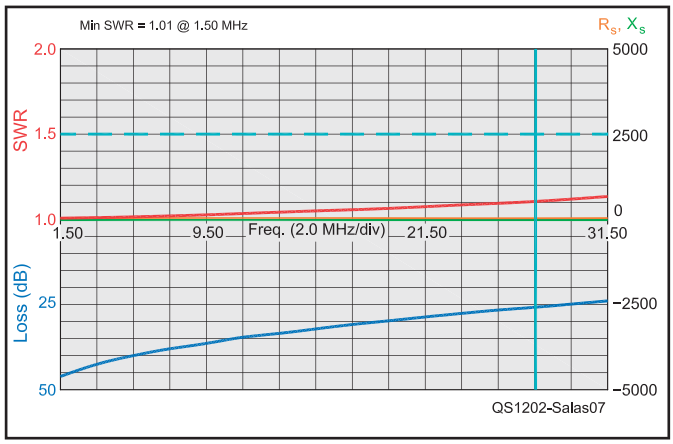

Figure 7 — VSWR/return loss scan with 22 pF compensation capacitor.

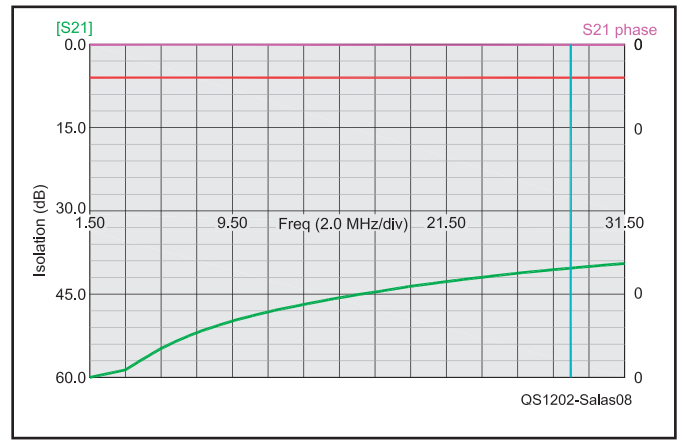

Figure 8 — Measurement of transmit-receive isolation.

ity sensitive (pin 1 is positive and pin 16 is negative). Everything is built on a small piece of perf-board cut from the larger perf board specified in Table 1. A ⅛ inch stereo jack is used for the RECEIVER MUTING terminals, and phono jacks provide the KEY IN KEY OUT interfaces. Figure 3 is an internal view of the keying interface. Figures 4 and 5 show all external interfaces.

Timing Measurements

I measured the relay timing just to make sure everything works as required. Figure 6 shows the timing of the two relays. The upper trace is the keying/rcvr mute relay, and the lower trace is the antenna switching relay. As you can see, both relays are enabled simultaneously — that is, the transmitter is keyed at exactly the same time as the antenna relay is switched. When K1 unkeys the transmitter, however, K2 is delayed by 8 to 10 ms to give the RF time to fully decay. The equivalent CW keying speed is approximately 40 WPM.

VSWR and Isolation Measurements

The upper portion of Figure 7 is a VSWR/Return loss scan of the QSK switch. Without the 22 pF output capacitor (C6), the VSWR on 10 meters was about 1.3:1. Not that big a deal, but I like things to be as transparent as possible.

Next I checked the transmit-to-receive port isolation, shown on the bottom of Figure 7. The worst case isolation is about 40 dB on 10 meters. This means that a 100 W transmitter on 10 meters will leak 10 mW into the connected receiver's front end. This 0.707 V_{RMS} or 2 V_{P-P} signal shouldn't cause problems to a vacuum-tube receiver front end. And as you can see, the isolation improves as you go lower in frequency — typically by 6 dB per octave.

Operation is simple. Simply connect your key or keyer to the KEY INPUT, and connect the KEY OUTPUT to your transmitter CW jack. Connect your coax cables to the appropriate connectors, and provide +13.8 V dc power to the unit. If desired, you can connect your receiver muting inputs to J2 on the QSK switch (both NO and NC contacts are provided). To manually enable the TR switch for transmitter tuning purposes or phone operation, simply set the front panel switch to TUNE. Set the switch to OPR for normal QSK operation.

Conclusion

I've described an external TR switch that is fast enough to permit full break-in operation with a vintage transmitter/receiver setup. To really enjoy CW with your vintage ham station, this QSK TR switch will certainly enhance your CW operating pleasure.

Phil Salas, AD5X, an ARRL Life Member, has been licensed continuously since 1964 when he was in ninth grade. Phil is now fully retired after a 33 year engineering career in microwave and lightwave new product development. He enjoys spending his retirement with his wife and best friend Debbie, N5UPT, as well as designing and tinkering with ham-related electronic projects. You can reach Phil at 1517 Creekside Dr, Richardson, TX 75081 or at **dpsalas@tx.rr.com**.

New Products

LMR SERIES CONNECTORS FROM TIMES MICROWAVE

♢The Times Microwave Systems No-Braid-Trim-X series of connectors for LMR coaxial cable has been expanded. Solder and non-solder type N and TNC connectors for LMR-400 and LMR-600 cable are now available. The No-Braid-Trim-X series of connectors do not require trimming of the braid shield during installation. Cable can be stripped using a CST type LMR cable stripping tool. The combination hex/knurl coupling nut allows tightening by hand or with a wrench. Tri-metal plating instead of silver eliminates tarnishing. For more information, visit your favorite dealer or see **www.timesmicrowave.com**.

TIMES MIROWAVE LMR-SW CABLE

♢Times Microwave LMR-SW is a low loss, low PIM (passive intermodulation distortion) 50 Ω coax cable with a seamless aluminum outer conductor. Compared to corrugated cables, LMR-SW cable is said to be lighter and less expensive. Field installed type N and 7/16 DIN connectors are specified for weather sealing, low SWR and consistent PIM performance and may be installed with matching cable prep tools. Grounding kits, hangers and other installation accessories are also available. LMR-SW396 (0.45 inch) loss per 100 feet ratings: 2.06 dB at 450 MHz, 3.0 dB at 900 MHz and 4.41 dB at 1800 MHz. LMR-SW540 (0.61 inch) loss per 100 feet ratings: 1.46 dB at 450 MHz, 2.11 dB at 900 MHz and 3.06 dB at 1800 MHz. For more information, visit your favorite dealer or see **www.timesmicrowave.com**.

Link Coupled Tuners for HF

For matching balanced antenna systems, the classic link coupled tuner is hard to beat.

Steven Pituch, W2MY, AAR6CX

As a child, my earliest recollection of seeing a magical ham radio object was the link coupled tuner in the shack of my father, W2MBY (SK). I was fascinated by the shiny silver coil with the copper colored alligator clips and the rotating fins of the variable capacitor. Connected to it was the copper open wire ladder that seemed to be a stairway to the heavens where all of the signals on my father's receiver came from.

Several years ago I decided it was time to build an antenna system that was more effective than the coax fed "all band" dipole that I was currently using. I studied enough of the technical literature to learn about the pros and cons of using coax and parallel feed lines. I came to appreciate the loss expected if using lengths of coax with a high SWR.

The Answer for Me

For my next dipole I used 450 Ω window line connected to a 1:1 current balun. It next ran through a short piece of coax into the shack where I connected it to my commercial unbalanced T network tuner. This setup seemed to work for the casual operating that I did. My existing tuner could not tune every frequency I wanted to work, however. I also still had my doubts as to the efficiency of the overall antenna system.

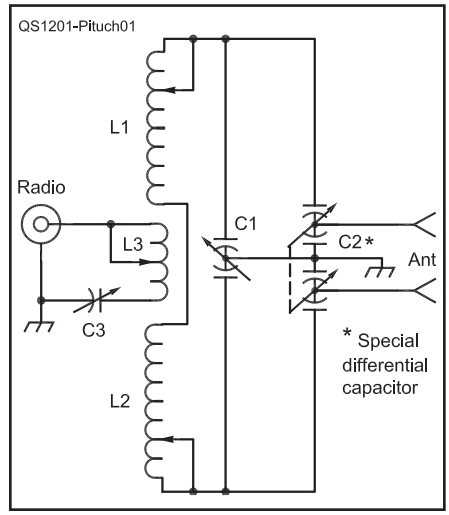

Figure 1 — Circuit diagram of the high power Annecke type, or modified Johnson Matchbox, tuner.
C1 — E. F. Johnson Matchbox split stator TUNE capacitor.
C2 — E. F. Johnson Matchbox dual differential LOAD capacitor with insulated shaft.
C3 — 270 pF transmitting variable capacitor.
L1, L2 — 22 turns of tubing or heavy wire, 3⅞ inches in diameter.
L3 — 7 turns tubing or heavy wire between L1 and L2.

This all came to a head after I joined Texas Army MARS (Military Auxiliary Radio System). I needed to have an effective signal on many frequencies between about 2.3 and 7.0 MHz. After using *EZNEC* for a while I realized that unless I went to several dipoles, or a fan dipole arrangement, I was going to have to deal with very high SWR on many of my operating frequencies.

Link Coupling Isn't Old Hat

I discovered the wonderful articles by the late LB Cebik, W4RNL, on the design of link coupled tuners (LCT).[1] The LCT design gives the balanced output needed for parallel feed lines and the necessary impedance transformation in its coil arrangement to tame the high SWR inherent in an all band dipole. In one of his articles Cebik describes the LCT design of the famous Johnson Matchbox. In the 1980s there was an improvement in this design by Annecke, in which he added a resonating third capacitor to the radio side of the circuit. This circuit is shown in Figure 1. I also discovered that some of the things about LCTs that Cebik

[1]Notes appear on page 50.

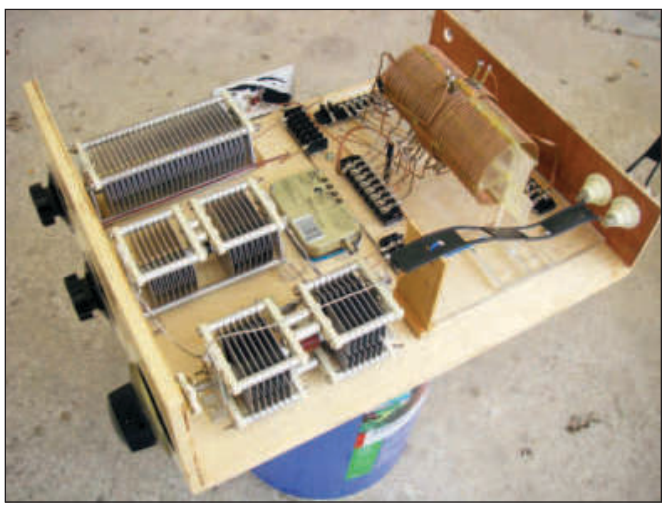

Figure 2 — View of the 100 W LCT tuner laid out breadboard style.

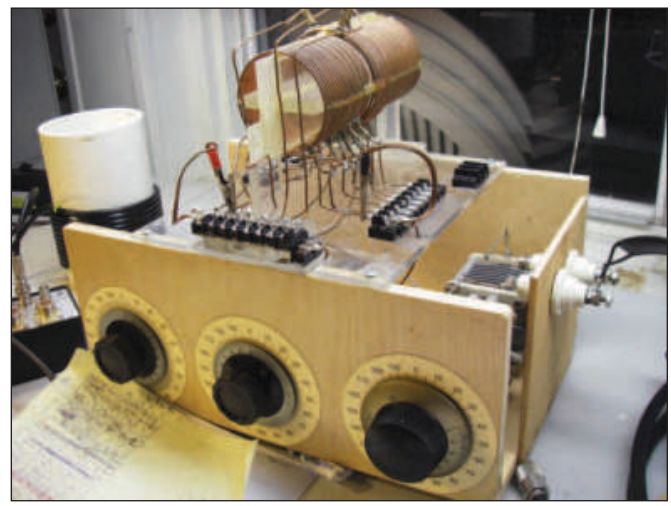

Figure 3 — Final layout of the 100 W tuner with the coil mounted on top, symmetrical with the two output capacitors.

elaborated on are also detailed in my 1960 *ARRL Antenna Book*.[2]

I was determined to build an LCT tuner and eliminate my T network tuner, the balun and the piece of lossy coax between my antenna system and radio equipment. Unfortunately, I had neither the tapped coil nor the three required capacitors. I first built the coil using Cebik's suggested inductances for both the radio side (input) and the antenna side (output) coils for the various ham bands. This classic information is shown in Table 1. From this information, with the aid of a spreadsheet, I was able to calculate the geometry of the two link coupled coils.

I located the shorter input coil outside of the longer output coil. For the coil form I made a hole drilling template with my CAD program and glued it to a piece of acrylic plastic. I formed the coils on a piece of PVC pipe with #12 AWG house wire from which I had stripped the insulation. I mounted the coil on an acrylic base and tapped both of the coils at the points recommended by Cebik to allow operation on the ham bands. I then wired these taps to terminal strips so that I could adjust the tap positions rather easily. The completed coil sat on a shelf for a few months while I pondered how to acquire the variable capacitors needed for the project.

One of the capacitors has an unusual layout using two split stators (a total of four capacitors) in one. I finally procured a very ugly looking Johnson Matchbox in a state of disrepair that gave me the two output capacitors. I was able to do a trade with a friend to obtain a nice capacitor for the input side of the circuit. I will not describe the details of its construction here, as they are available on my website.[3]

The tuner worked. It was large, since I had assembled it on a wood plank in "breadboard" style (see Figure 2). It tended to work on each band near the coil tap positions recommended by Cebik. I used this tuner with my 100 W HF transceiver for quite a while and never had a problem with it. Since it has many adjustments, it did take some patience to find the correct settings for each frequency.

An antenna analyzer is a good tool for this kind of setup in order to minimize on-the-air interference. Along with my 40 meter dipole fed with window line, I finally had a good antenna system. I used this setup for Texas Army MARS with excellent results. Eventually I mounted the coil over the two output capacitors for a more compact and symmetrical arrangement as shown in Figure 3. I also added wire to the dipole to make it a nominal 80 meter antenna.

I ended up learning a tremendous amount about operating HF from being a member of MARS. I was fortunate to have an opportunity to become a net control station (NCS) for one of their weekly nets. Being an NCS requires that you have an effective signal. My signal was competitive compared to other MARS stations but not the strongest. After about 2 years of weekly operating, I knew which stations were consistently the loudest on the regional nets. Many of these stations were running 400 to 500 W output (500 W is the maximum power allowed in Army MARS from 2 to 15 MHz). Also with the decline in the solar flux we needed to be able to operate on lower frequencies. The dipole went from 132 feet to 200 feet in length to make it easier to tune closer to 2 MHz. This was not an easy task on a deed restricted lot, but the S shaped dipole works well in NVIS mode.[4]

Table 1

LB Cebik's Suggested Values for LCT Tuners

Also found in the 1960 *ARRL Antenna Book*

Circuit	*Output*		*Input*	
Band	*L (µH)*	*C (µF)*	*L (µH)*	*C (µF)*
160	42	170	4.2	1700
80	22	90	2.2	900
40	12	45	1.2	450
30	8	32	0.8	320
20	6	23	0.6	225
17	4.5	18	0.45	180
15	4	15	0.4	150
12	3.2	13	0.32	130
10	2.9	12	0.29	120

Moving Up a Notch

I finally purchased an Ameritron ALS-600 HF linear amplifier. Now I needed a new tuner that could take more power. Everything in the tuner would have to be larger than the first LCT I had built to be able to withstand the voltage and current associated with the higher power. I designed a new coil that used #10 AWG wire (see Figure 4). This coil has a larger diameter, is longer, and has more space between the wire turns to allow for a bigger alligator clip to be used for the taps.

I also put the input coil inline and at the center of the longer output coil, that now had to be split in half to simplify construction. As fate would have it, I then acquired a Johnson Kilowatt Matchbox. Although not in pristine condition it was fully operable. After using it for a while I determined that although it seemed to be a good tuner for most of the amateur bands, for my needs its range was limited. Needing more range I contemplated modifying it, but decided not to risk defacing a classic antique. Instead the capacitors were gently removed from it for use in my new homebrew tuner, and

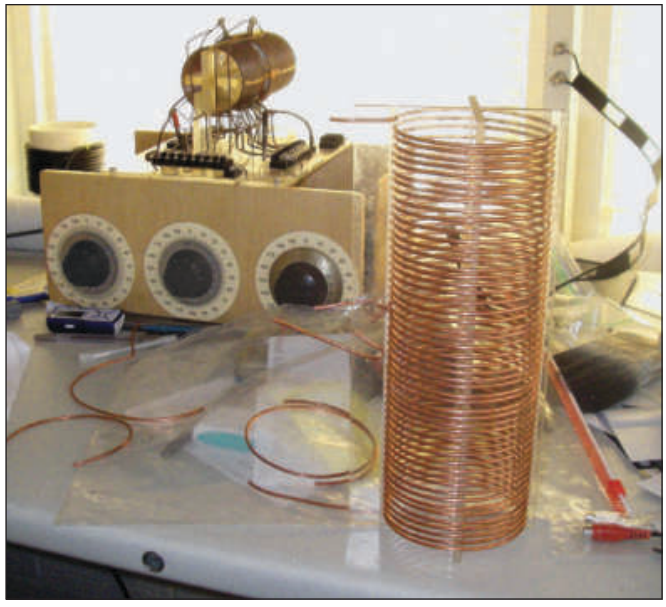

Figure 4 — The new larger high power coil next to the 100 W tuner.

Figure 5 — The bus bar and the copper terminal lug.

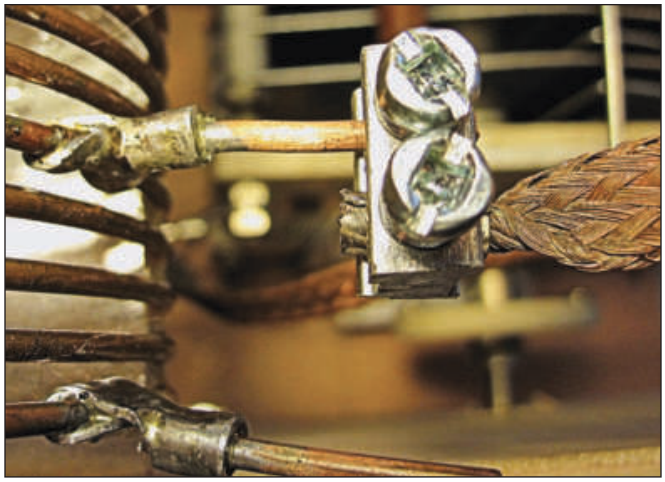

Figure 6 — The preliminary tap assembly showing the ring lug, the #10 AWG wire stub, the bus bar terminal strip and the coax braid jumper.

Figure 9 — Final tap assembly showing the ring lug, the #10 AWG wire stub, the copper terminal lug soldered to the ferrule, and the braid jumper.

the remains of the Matchbox were placed in storage for future use.

At first I used large alligator clips for the taps for this new coil, but the clips often got hot with 400 W applied to the tuner. The rest of the tuner never got warm. Occasionally three small columns of smoke would rise from the clips if I tuned beyond the limits of the tuner. The alligator clips simply did not have enough contact area with the coil to transfer the RF current.

In desperation (or perhaps inspiration) I went to the electrical section of the local home improvement store. I found two inexpensive items that I thought might work as replacements for the alligator clips. One was a ground bus bar for a residential electrical service panel. It has 23 heavy duty screws and holes to insert wires. I also found a small copper terminal lug that appeared to be equally useful in this regard (see Figure 5). When I got home I decided use a rotary grinding tool to cut the bus bar into pieces having two screws each. This allowed me to permanently screw the coax braid jumper in one hole, and use the other hole and screw to attach the jumper to a #10 AWG wire stud soldered to the coil.

Figure 8 — A ring terminal used as a coil tap connection.

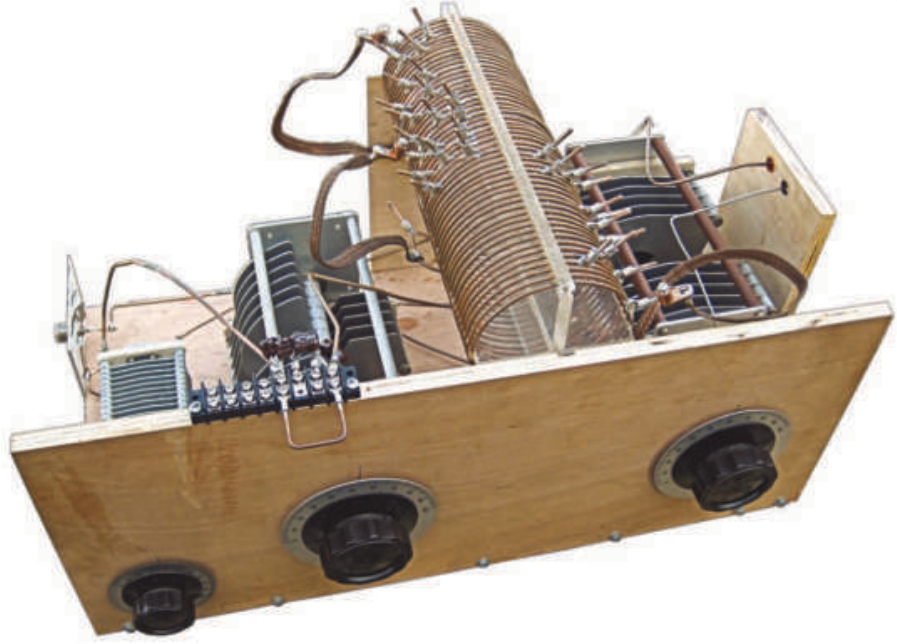

Figure 7 — Top view of the completed high power tuner. The capacitor padder arrangement built on the terminal block was not used in the final design.

These fabricated connectors worked but were clumsy (see Figure 6). I decided to install the copper terminal lugs instead. When I had cut off the large alligator clips from the braid jumpers I had left the soldered ferrules in place. The ferrule inserted perfectly into the hole in the lug. I soldered this connection. The copper lugs work nicely in this application (see Figure 7). It is now quite easy to switch the taps for different frequencies.

I had fashioned connecting lugs for the coil taps of the original 100 W tuner from flattened out small brass alligator clips. These worked but were brittle and a bit clumsy. For the new tuner I used a large ring terminal connector instead. The ring part is bent around the coil wire and soldered into place wherever a coil tap is wanted (see Figure 8). A #10 AWG wire is then soldered to the lug as a stud. The copper terminal lug device bolts the coax braid jumper to the stud (see Figure 9).[5]

The results were gratifying. I could now run the ALS-600 at the 400 to 450 W power level that I felt comfortable with at a 1:1 SWR on all frequencies except at about 3.2 MHz.

The tuner stayed cool at these power levels. At 3.2 MHz running more than 350 W sometimes causes the dual capacitor to arc, tripping the ALS-600 to standby. Changing the feed-line length slightly would likely bring the system input impedance at the tuner down enough to allow using more power, but since I am being heard well on this frequency at 300 W I have decided not to change the feed-line length. It now seemed that I was one of the loudest MARS stations in the region.[5]

There are many ways to make an LCT tuner. Instead of taps on the coils you can have plug in coils for each band. You can simplify the design by omitting the input capacitor and the split stator output capacitor, and have a tuner similar to what is shown in the 1960 edition of *The ARRL Antenna Book*.[6] The LCT design is also not limited to high power. Smaller tuners for QRP are feasible. Imagine winding the coils with magnet wire on a toilet paper cardboard tube or a toroid. Use your imagination, and have fun.

Notes

[1]**www.cebik.com** (free sign-on required), *Tales and Technicals* section, "Link-Coupled Antenna Tuners" and "Link-Coupled Antenna Tuners: A Tutorial: Parts 1-5."

[2]*The ARRL Antenna Book*, Ninth edition, 1960, p 91, Figure 3-31c. This tuner is likely the basis of my father's tuner.

[3]Go to **www.pituch.net.** Click on STEVE'S AMATEUR RADIO page, then scroll down to 100 W LINK COUPLED TUNER for photos of the construction of the 100 W tuner.

[4]Go to **www.pituch.net.** Click on STEVE'S AMATEUR RADIO page, then scroll down to STEVE'S TEXAS ARMY MARS page and then MY ANTENNA for more information on my antenna.

[5]Go to **www.pituch.net.** Click on STEVE'S AMATEUR RADIO page, then scroll down to 500 W LINK COUPLED TUNER for photos of the construction of the 500 W tuner.

[6]See Note 2.

Photos by the author.

ARRL member and Amateur Extra class operator Steve Pituch, W2MY, is a professional engineer with an MS in Civil Engineering living in Corpus Christi, Texas. His father, Sigmund (SK), was W2MBY, and Steve's son, John, now holds his grandfather's call. Steve is a member of Texas Army MARS and is ARES® EC of Nueces County. He was licensed in 1991, is a VE and enjoys QRP, building and Elmering. He can be reached 14118 Bounty Ave, Corpus Christi, TX 78418 or at **w2my@arrl.net**. *Also see his ham radio pages at* **www.pituch.net**.

ARRL Award Nominations Open

Here are five ways to honor a ham radio innovator or educator.

Each year the ARRL Board of Directors has the opportunity to select recipients for a number of awards in various categories that honor Amateur Radio operators.

The nomination period is now open for the ARRL awards that are designed to recognize educational and technological pursuits in Amateur Radio. There is also an award to honor a young Amateur Radio operator. Please log onto **www.arrl.org/arrl-award-nominations** for specific details and information on how to nominate or submit supporting endorsements.

The **ARRL Herb S. Brier Instructor of the Year Award** will be awarded to an ARRL volunteer Amateur Radio instructor or to an ARRL professional classroom teacher who uses creative instructional approaches and models the highest values of the Amateur Radio community. The award has been focused to reflect quality of instruction and commitment to licensing instruction. Nominations should be received by March 15, 2012, to be considered for this year.

The **Hiram Percy Maxim Award** is for a licensed radio amateur under age 21 (and an ARRL member) whose accomplishments and contributions are of the most exemplary nature within the framework of Amateur Radio activities. Nominations for this award need to be made through your Section Manager (see page 16) who will then forward the nomination to ARRL Headquarters by March 31, 2012.

The ARRL Microwave Development Award is presented to a licensed radio amateur or to individuals who are licensed radio amateurs who contribute to the development of the Amateur Radio microwave bands. The nomination deadline is March 31, 2012.

The ARRL Technical Service Award recognizes a licensed radio amateur or individuals who are licensed radio amateurs that provide Amateur Radio technical assistance or training to others. The nomination deadline is March 31, 2012.

The ARRL Technical Innovation Award is granted to a licensed radio amateur or to individuals who are licensed radio amateurs who develop and apply new technical ideas or techniques in Amateur Radio. The nomination deadline is March 31, 2012.

For more information about these awards, visit **www.arrl.org/arrl-award-nominations**. You may also contact Steve Ewald, WV1X, at **wv1x@arrl.org** or 860-594-0265 at ARRL Headquarters.

ARRL the national association for AMATEUR RADIO

Type-N Plugs for the Dedicated UHF Plug User

Joel R. Hallas, W1ZR

There is no question, hams are wedded to the ubiquitous PL-259 "UHF" series plug.[1] No wonder, since most HF and a large portion of VHF equipment provides matching UHF sockets for connection to antennas. Still, the limitations of UHF connectors have been well documented and include the tendency of backshells to loosen with resulting intermittent shield connection, the lack of waterproofing and the fact that they don't provide a constant 50 Ω characteristic impedance. The last factor becomes important if the connector length is a significant fraction of a wavelength, typically at frequencies above 2 meters. The other issues are potentially important at all frequencies.

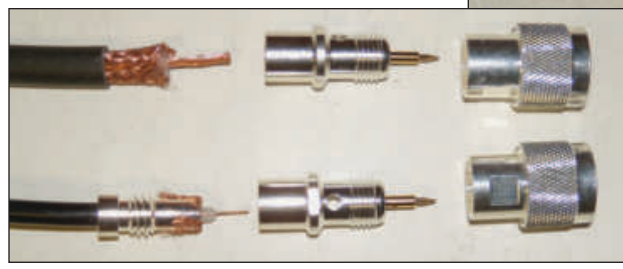

Figure 1 — RG-213 and RG-8X cable about to be assembled into UHF-like Type-N plugs.

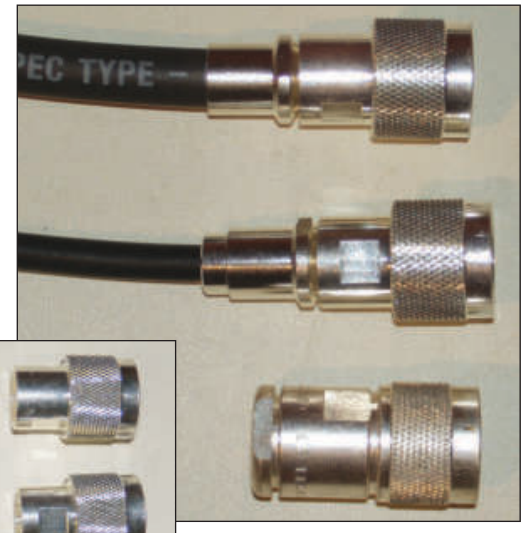

Figure 2 — Fully assembled Type-N coax connectors on RG-213 and RG-8X cable. A standard type-N plug is shown for comparison.

Enter the Type-N Connector

Like broccoli, everyone knows that Type-N connectors are good for us. We just don't all agree that we're willing to put up with them. Besides, we cut our teeth (not to mention our fingers) installing UHF plugs and who wants to learn to do something different? Actually, the Type-N connectors may be easier to install than UHF plugs, but we won't open that debate since we no longer have to.[2]

The reason is that there is a line of Type-N plugs that assemble in almost the same way as a PL-259 plug. In fact, as seen in Figure 1, the shield is connected in exactly the same way, whether the cable is RG-8 or RG-8X. The same UG-176 adapter for RG-59 or similar sized coax that fits a PL-259 also fits in this Type-N connector, as does the UG-175 for RG-58.

Can it be this Easy?

Well, if you think installing a PL-259 is easy, you will also find this easy. The same techniques that are used to prepare either size cable for a PL-259 are also used here. The same tools, such as the Ripley UT-8000 jacket and dielectric stripper, can be used to prepare the larger cables, or the traditional knife and pliers approach will work as well (or poorly) for this connector.

The connector comes in two pieces: an inner body where all the soldering takes place that includes a captive pin, and a housing that includes the backshell and the shield connection arrangement. The captive pin is nice, in that I don't know how many of the usual N plugs I have that are complete "except for the pin." As with a PL-259, this Type-N can be disassembled, cleaned out and reused. The usual Type-N includes a gasket that is destroyed upon first assembly, and those can't be found either.

With the backshell removed, the soldered connector interior has a diameter of 0.6 inches, significantly less than assembled Type-N at 0.83 inch, or even PL-259 at 0.74 inch. This can make it easier to route cables through smaller holes in partitions. The standard Type-N can be soldered to its pin and routed through holes as small as the cable itself, but the final assembly has to be completed on the far side of the partition. Of course the current connector also needs final assembly, but it's just the threaded backshell piece. This can easily be tightened up using two 9/16 inch open end wrenches, or one wrench and a vise.

The only difference between assembling this connector and a PL-259 is that the center conductor wire has a maximum length before it bottoms out inside the center pin. It must be trimmed until it can be screwed in far enough that the shield appears beyond the solder holes, as the connector is screwed onto the coax or the UG-175/6 adapter. Figure 2 shows the assembled connectors in comparison to the size of a standard solder and clamp Type-N plug.

And the Downside?

Not many issues that I can see. These connectors cost between $5 and $7, about twice what a quality PL-259 costs, but about the same as the standard solder and clamp Type-N plugs.[3] They are somewhat longer than the usual Type-N, which may be an issue in some installations. The standard N plug is about 1.5 inches long, while the item under discussion is 1.785 inches, 1.96 with a UG-176 adapter.

It's never a bad idea to have a few different choices available!

[1]I have UHF in quotes to highlight that the name does not really specify the frequency range. Before WW2, when the connector was developed, the "ultra highs" extended from 30 to 300 MHz, now considered the VHF range. Current terminology defines UHF as 300 to 3000 MHz, not a range generally appropriate for "UHF" connectors.

[2]J. Hallas, W1ZR, "Those Type N Coax Connectors," *QST*, Apr 2008, p 69.

[3]These connectors are available from a number of the usual sources including ABR Industries (**www.abrind.com**), DX Engineering (**www.dxengineering.com**) and RF Parts Company (**www.rfparts.com**).

Joel R. Hallas, W1ZR, is Technical Editor of QST *and can be reached at* **w1zr@arrl.org**.

Elecraft KPA500 HF/6 Meter Power Amplifier

Reviewed by Phil Salas, AD5X
ARRL Contributing Editor
ad5x@arrl.net

A recent entry in the solid state amplifier market is the Elecraft KPA500, a 160 to 6 meter, 500 W solid state amplifier with automatic band switching and PIN diode TR switching. The KPA500 is ruggedly built and uses an internal microprocessor to control amplifier operation, metering, displays and protection. It includes an internal highly efficient linear power supply, making the KPA500 suitable for home, portable or DX operations. Physically, it complements Elecraft's K3 transceiver in size and styling. The KPA500 is available factory built and tested, or as a no-solder kit. The unit reviewed here is the KPA500-K no-solder kit.

First We Get to Build It!

I built my personal K3 transceiver from a no-solder kit in about 10 hours. Besides saving money, I wanted to feel comfortable opening up the transceiver to add options or make any hardware upgrades that would come along. For these same reasons, I requested the kit version of the KPA500 for this Product Review. The KPA500 kit arrived in a small 15 × 15 × 13 inch box containing four fully assembled and tested circuit assemblies (control/display card, power supply module, I/O module and PA assembly) and an assortment of cabinet pieces and hardware. See Figures 1 and 2.

This kit is much less complex than the K3 transceiver. As with the K3, P3 panadapter, and W2 wattmeter kits, the assembly process requires only basic mechanical skills. The *Assembly Manual* can be downloaded from **www.elecraft.com** for review prior to ordering.

The assembly process will go quickly if you sort the hardware as you open each package. I used a 12 cupcake baking pan for hardware sorting, as this gave me plenty of space for my fumbling fingers. And 12 compartments are plenty, as you will empty most of the compartments of hardware as you open, assemble and install each subassembly. The instructions are clear and well illustrated, and there is a box to check as each step is completed. I was amazed at how well everything fit together — there was no confusion and I found no mechanical tolerance problems. Once I got going, the complete assembly took me just under 4 hours (it was hard to stop once I'd started). I was concerned about installing the power transformer since it is pretty heavy, but this turned out to be no big deal. Figure 3 shows the power transformer ready for installation.

I made one minor modification as I was building the kit. The fan mounts with four 2 inch #6 machine screws that pass through the finger guard and holes in the corners of the muffin fan. The screws don't have any real locking mechanism, and it is *very* easy to over tighten them and possibly damage the fan. To mount the fan more securely, I used four 6-32 × ½ inch screws and lockwashers to attach the fan to the back panel, and four 6-32 × ½ inch screws and lockwashers and 6-32 nuts to attach the finger guard to the fan (see Figure 4). An angled-in #1 Phillips screwdriver easily tightens the back panel fan mounting screws.

In my opinion, this is a very easy kit to build. Just follow the instruction manual, check off each step as you complete it, and before you know it you'll be finished.

Bottom Line

The fully featured Elecraft KPA500 solid state amplifier looks and works great on your desk or at your DX location. Its 160 to 6 meter 500 W capability, auto band switching and PIN diode switching integrate well with all transceivers.

KPA500 Amplifier Technical Details

The KPA500, including its internal 120/240 V ac linear power supply, matches the K3 in size. Half of the KPA500's weight is due to the hefty 13 pound toroidal ac power transformer. A handle on the right side and rubber feet on the left side make transporting the amplifier quite easy.

The amplifier outputs 500 W from 160 through 6 meters with 25 to 35 W of drive. PIN diode TR switching provides silent full break-in (QSK) operation. The TR switch is specifically designed to handle switching even with RF applied should the amplifier be bypassed by a fault condition or by an external antenna tuner or power meter (such as the W2) that interrupts the AMP KEY line during key-down operation. Finally, while the KPA500 is off or in STANDBY, you can transmit up to 200 W from your transceiver through the amplifier.

The KPA500 includes always-active frequency sensed automatic band switching — even while the amplifier is in STANDBY. This makes automatic bandswitching compatible with all transceivers. When a band change is detected, amplification is disabled, the correct low pass filter and input network are selected, time is given for the relays to settle and amplification is re-enabled — all in

less than 30 ms. Automatic band switching can also occur via an optional transceiver/amplifier cable, though frequency sensing always takes precedence.

The KPA500 final RF section uses a pair of rugged VRF2933 FETs. Amplifier cooling is provided by a large internal heat sink and a single 4½ inch fan with speed stepped from OFF to full speed in six increments based on the internal heatsink temperature. (The minimum fan speed can be set to other than OFF in the KPA500 menu if desired).

The KPA500 includes effective monitoring and protection circuitry. Soft faults switch an input 3 dB attenuator inline, and critical faults inhibit amplification and bypass the amplifier. Clearing a soft fault automatically reverts the KPA500 to full power. A critical fault requires that you manually re-enable the OPERATE mode. The fault condition is displayed on the KPA500 display, recorded in the *KPA Utility* program, and the amplifier fault code is also displayed on your K3 transceiver (if AUXBUS is enabled).

SWR faults are based on absolute reflected power. A soft fault occurs if reflected power exceeds about 60 W which corresponds to a 2:1 SWR at 500 W, so you can operate the KPA500 into a higher SWR at reduced power. Reflected power greater than 100 W, or an SWR of 18:1 at 25 W or more results in a critical fault. Input power exceeding 45 W causes a soft fault for up to 10 seconds after which a critical fault occurs. Input drive exceeding 60 W causes a critical fault instantly, as does an output power level above 650 W. Other critical faults include V_{dd} out of range (<40 V or >90 V), 270 V error (TR switch bias <200 V), heat sink temperature >90°C, and PA dissipation >600 W (PA dissipation = P_{in} dc – P_{out} RF).

Display and Menu System

There is significant monitoring and display information available on the KPA500's attractive front panel. LEDs provide OPERATE, STANDBY and FAULT indications as well as bargraph displays for power output and SWR (700 W and 5:1 SWR maximum, respectively). An LCD display provides detailed menus, frequency band, RF power, SWR, PA temperature, current and voltage information. The LCD display also provides a menu for setting amplifier features to your liking. While there are numerous features that can be set, BAND CHG, RADIO and TR TIME are worthy of some discussion.

For matched antennas BAND CHG can be set so the KPA500 stays in OPERATE mode while changing bands if the amplifier was in OPERATE prior to the band change. If you use an antenna tuner, however, BAND CHG can be set so the amplifier switches to

Table 1
Elecraft KPA500, serial number 0218

Manufacturer's Specifications	*Measured in ARRL Lab*
Frequency range: All amateur frequencies in the range of 1.8 to 29.7 MHz and 50-54 MHz.	As specified.
Power output: 500 W.	As specified.
Driving power required: 30 to 40 W.	As specified.
Input SWR: Less than 1.5:1.	As specified.
Spurious and harmonic suppression: Not specified.	HF, –51 dBc, worst case*; typically –55 to –60 dBc; 50 MHz, –60 dBc. Meets FCC requirements.
Third order intermodulation distortion (IMD): Not specified.	3rd/5th/7th/9th: 34/53/46/54 dB below PEP (14 MHz, 500 W PEP output).
Primary power requirements: 100-125, 200-250 V ac.	At 117 V ac: Transmit, 980 W maximum; standby, 14 W; standby with fan (low speed, 18 W; standby with fan (high speed), 24 W.
Size (HWD): 4.5 × 10.8 × 11.7 inches, including cooling fan. Weight: 26 lbs.	
Price: KPA500-K kit, $1999.95; KPA500-F assembled, $2399.95; KPAK3AUX cable, $34.95.	

*160 meters at maximum output.

Figure 1 — The kit subassemblies are packed in separate boxes to make construction easier.

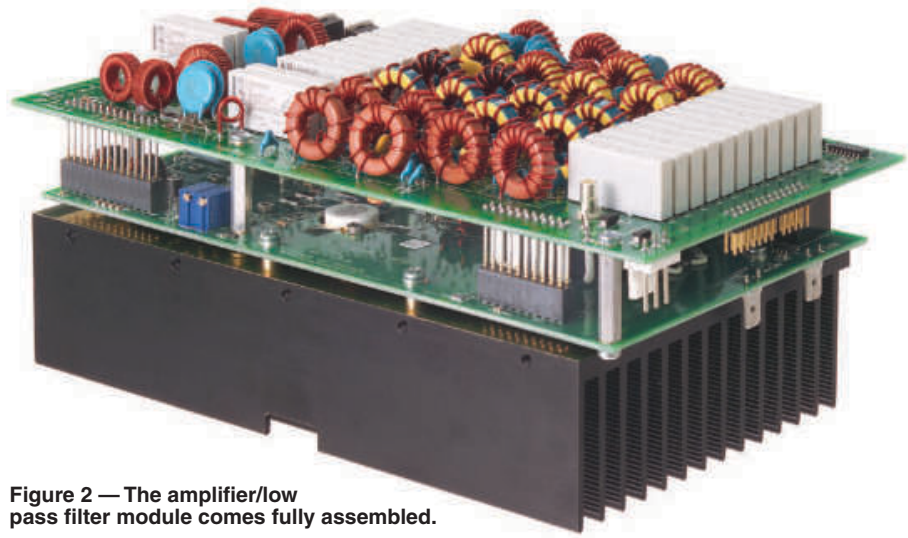

Figure 2 — The amplifier/low pass filter module comes fully assembled.

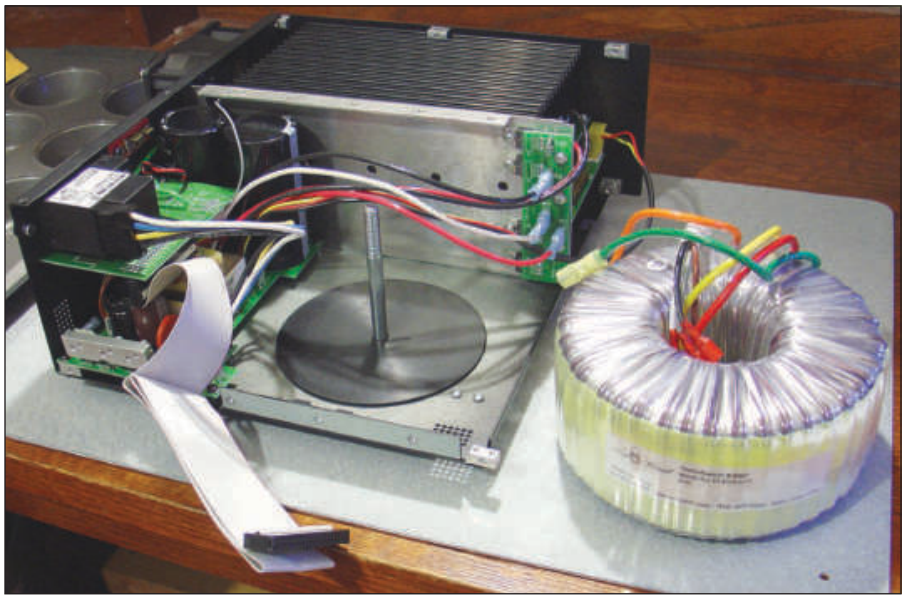

Figure 3 — The toroidal power transformer, ready for installation.

Figure 4 — The author's alternate fan mounting method.

Figure 5 — Rear panel of the KPA500.

STANDBY when changing bands — requiring that you manually select OPERATE after tuning your antenna system.

The RADIO setting supports the K3 and Yaesu binary coded decimal (BCD) interface, ICOM analog band voltage and the Kenwood serial interface for transceiver-initiated amplifier band changes. The K3 setting enables AUXBUS (requires the optional Elecraft interface cable), which permits the KPA500 to follow K3 band changes prior to transmitting, provides amplifier status and fault information to the K3 (which appears on the K3 display) and sets the K3 automatically to a "power-per-band" drive level for your desired output power when the KPA500 is in OPERATE. Switching the KPA500 to STANDBY automatically causes the K3 to revert to your normal output power level.

Finally, the TR TIME sets an amplifier drop-out time delay in milliseconds after your transceiver unkeys the amplifier. For example, I've found that older Ten-Tec radios that use TX EN/TX KEY for amplifier keying and some ICOM transceivers unkey the amplifier 5-10 ms before the transceiver RF output decays to zero. This can result in hot-switching on key-up when operating QSK in a PIN diode switched amplifier. While this will not damage the KPA500, it can cause key clicks and possible ALC output power foldback of your transceiver.

Setting Up the Amplifier

Figure 5 shows the rear panel connections. The first thing to do is to install the proper fuses and attach a power cord. The manual provides detailed instructions for removing and replacing the fuse block and adjusting the power transformer primary taps if needed.

The KPA500 can be supplied with European 240, US 120 or US 240 V ac power cords. You simply specify which cord you want when ordering. Fuses for both 240 V ac (6 A) and 120 V ac (12 A) are supplied. The rear PIM (power input module) is easily configured for either 120 or 240 V ac by the user.

Next, plug in the amplifier and verify that the displayed high-voltage is within the recommended range. Next, connect a PC to the RS-232 (PC) connector and download and install the *KPA Utility*. Finally, check if the firmware is up to date and update it if it is not. The *KPA Utility* provides fault table display and the ability to operate the amp remotely.

Next, connect a ground wire, RF IN/OUT and PA KEY and ALC cables to your transceiver. The PA KEY interface is 5 V dc open circuit/ground-to-enable at 1 mA making it compatible with all transceivers with no need for a special interface. ALC is not mandatory, but if used, adjust your

drive level for normal KPA500 output power and set the ALC to kick in just above this power level.

For K3 transceivers, the optional KPA-K3AUX package includes a 3 foot cable that provides band data, AUXBUS, amp keying and ALC connections. Also included in the KPAK3AUX package is an HD15 splitter cable for connecting other accessories to the K3 accessory connector, and an M/F HD15 "port saver" with pin 10 missing so an external amp-keying cable can be used for amplifier disabling by external equipment.

Power and Gain Measurements

The KPA500 digital power meter and bar graph display can be calibrated precisely per-band if you have an accurate wattmeter. Simply select the desired band and adjust the KPA500 menu PWR ADJ setting so the digital power reading tracks the external wattmeter (the 500 W bargraph LED just lights at the 500 W level if the KPA500 digital wattmeter is properly calibrated). I checked the KPA500 digital power meter against my calibrated Array Solutions PowerMaster wattmeter and found the worst-case default KPA500 digital wattmeter readings to be within 3%. As the PowerMaster spec is ±3%, I'm not sure that calibrating the KPA500 wattmeter really bought me anything other than consistency between the two wattmeter readings.

The KPA500 easily outputs 500 W. As a matter of fact, I could drive the amplifier up to 650 W output on all bands, at which point the amplifier would fault. Of course, IMD performance will suffer at higher power. The KPA500 typically requires just 25 to 35 W of drive for full output. Low drive power also means that your transceiver should be operating at a much lower IMD point.

Operating

I really like the tight integration between the KPA500 and K3. When you turn the amplifier ON or OFF or switch the amplifier from STANDBY to OPERATE, that information momentarily shows on the K3 display (as does any amplifier fault condition that occurs). Not having to remember to reset the K3 drive level when enabling the KPA500 makes operation virtually stupid-proof. Just tap the OPERATE button and you instantly have a 500 W K3. Also, the fan is normally very quiet. I sometimes even forget that the amplifier is on. Finally, as an almost 100% CW operator I thoroughly enjoy the perfectly silent full break-in operation.

Conclusion

The KPA500 is a compact, well-protected amplifier that integrates perfectly with the K3 transceiver — and to a slightly lesser extent with virtually all other transceivers. It is reasonably priced as solid-state amplifiers go, and the no-solder kit is quite easy to build. If your amplifier requirements are satisfied with a 7 dB increase over normal operating power, the KPA500 is certainly worthy of your consideration.

Manufacturer: Elecraft, PO Box 69, Aptos, CA 95001-0069; tel 831-763-4211, fax 831-763-4218; **www.elecraft.com**.

KPA500/K3 AUX Cable Options

The 3 foot Elecraft KPAK3AUX cable is fine if the KPA500 is placed next to your K3. If you need a longer cable, a modified SVGA cable works well. However, you *must* verify that all 15 pins in the SVGA cable are connected through, none are missing and none are shorted to ground or to each other. A 6 foot SVGA M/F cable from **www.cablewholesale.com** (10H1-01206) satisfies this requirement. Modify the cable by breaking off the pins shown in Figure A. Do this by grasping the pin right up against the connector body with long-nose pliers. Then twist and pull out the pin.

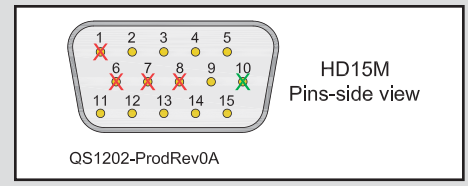

Figure A — To modify an SVGA cable, on the male end break off pins 1, 6, 7 and 9 (shown with an X). If you want to use a separate PTT cable with the PA KEY jack, also break off pin 10.

You can also build your own cable. I built a cable (Figure B) so my modified MFJ-998 auto-tuner will disable the KPA500 during tuning via the KPA500 AMP-INHIBIT input. This eliminated the need for a separate amp-key cable from my K3 through the MFJ-998 to the KPA500, and the AMP-INHIBIT input is much faster than interrupting the AMP-KEY line due to the MFJ-998 relay speed (<1 ms vs 5 ms). The MFJ-998 modification info is in the "Equipment Modifications" section of my website at **www.ad5x.com**. A 10 conductor shielded cable (10CS22) and an RCA cable (ACB-6 cut to length) were purchased from **www.allelectronics.com**. The DB15HD connectors and hoods came from **www.mouser.com** (male 156-1815-E, female 156-1915-E, hoods 156-2009-EX).

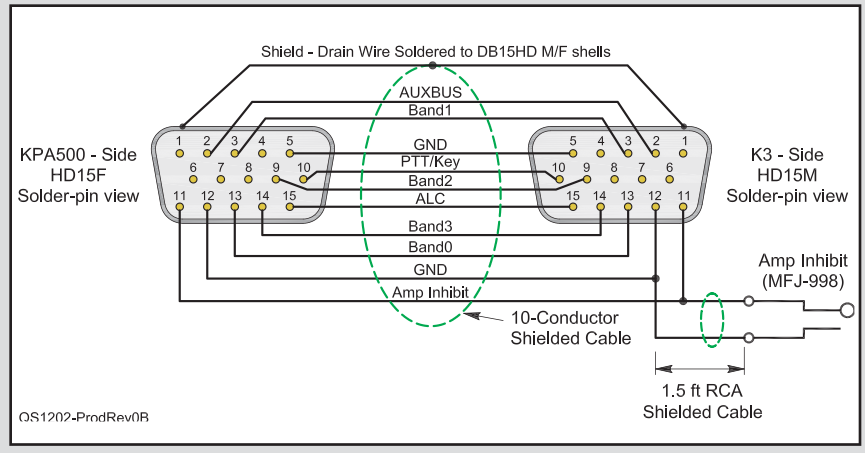

Figure B — Details of the author's cable for using the K3 and KPA500 with an MFJ-998 automatic antenna tuner.

Click for Video

Watch as ARRL Test Engineer Bob Allison, WB1GCM, shows you the features of the KPA500 amplifier.

Four 25 A Switch Mode Power Supplies

Reviewed by Mark Wilson, K1RO
QST *Product Review Editor*

The four switch mode power supplies reviewed here are all rated at 25 A continuous output at 13.8 V dc — a good match for a typical 100 W class HF transceiver and a few station accessories. Past reviews have featured a wide variety of power supplies from many manufacturers, and you can find these articles online.[1-5] The units described here are new since our last roundup in 2009.

Note that the 20 A data, while generally worst case, occurs during transmit not receive. This will be most significant in a multioperator, multitransceiver, environment. The data in Table 6 at 1 and 7 A may be more important for most users.

Bottom Line

The power supplies in this group are small and light and ready to power transceivers and station accessories. There are some differences in features, and some perform better than others with regard to emissions that can cause interference in your MF/HF receiver.

[1]J. Bottiglieri, AA1GW, "*QST* Compares: Switching Power Supplies," Product Review, *QST*, Jan 2000, pp 70-73. *QST* Product Reviews are available to ARRL members online at **www.arrl.org/product-review**.
[2]J. Bottiglieri, AA1GW, "Switching Power Supplies Revisited," Product Review, *QST*, Sep 2000, pp 76-79.
[3]S. Ford, WB8IMY, "ICOM PS-125 Power Supply," Product Review, *QST*, Sep 2002, p 62.
[4]M. Wilson, K1RO, "More Switching Power Supplies," Product Review, *QST*, Jul 2006, pp 58-61.
[5]M. Wilson, K1RO, "Four Switching Power Supplies," Product Review, *QST*, Aug 2009, pp 48-52.

JETSTREAM JTPS30M

Jetstream's JTPS30M is packaged in a sturdy metal case with heat sink fins on top and four soft rubber feet. A rear panel VOLTAGE switch sets the output to 13.8 V fixed or 9 to 15 V adjustable via the front-panel VOLTAGE ADJUST knob. It's rated for 25 A continuous output and 30 A maximum. The supply is protected against short circuits at the output and current overload.

The illuminated front panel meter is switchable between voltage (0-16 V) and current (0-32 A). The front panel also offers two low current dc connections — a cigarette lighter socket rated for 10 A maximum, and a set of spring loaded terminals rated for 3 A.

The rear panel has binding posts for the high current output and a detachable ac line cord with a fuse holder on the line cord socket. The quiet cooling fan is mounted on the inside rear panel. It draws air through slots on the front.

The four page instruction manual includes illustrations of the front and back panels with a short description of each feature, a table of specifications and a list of cautions. There are a few minor glitches in the English translation. No warranty information or schematic is included, but the Jetstream website indicates that there is a 1 year warranty on all products and an online warranty registration form is provided.

Manufacturer: Jetstream, 44 Hancock Ave, Hamilton, OH 45011; tel 800-524-4889, fax 513-868-6574; **www.jetstream-usa.biz**.

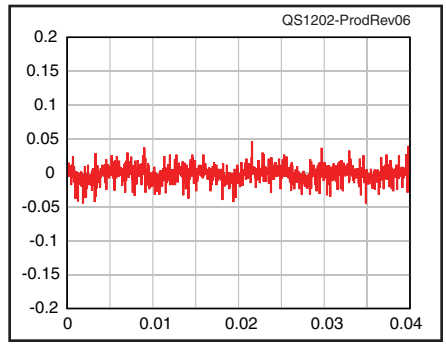

Figure 6 — An oscilloscope trace of the dc output of the Jetstream JTPS30M under 20 A load. The vertical scale is 50 mV/div and the horizontal scale is 5 ms/div. The level of the dc ripple is approximately 40 mV p-p. Spikes due to switching measure about 100 mV p-p.

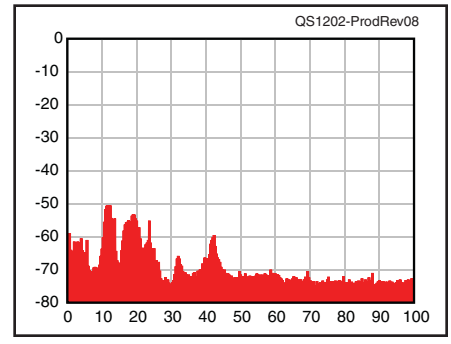

Figure 7 — Spectral plot (0-100 MHz) of the output of the Jetstream JTPS30M under 20 A load. The reference level is 0 dBm and the vertical scale is 10 dB/div.

Table 2
Jetstream JTPS30M, serial no. 006902

Manufacturer's Specifications

Power requirement:	115 V ac ±10%, 60 Hz.
Output voltage:	13.8 V dc (fixed), or 9-15 V dc (variable).
Output current (continuous):	25 A (30 A max).
Size (HWD): 2.7 × 7.5 × 8.5 inches; weight, 5.1 pounds.	
Price: $130.	

ARRL Lab Measurements

Output voltage, no load:	13.8 V dc (fixed), or 7.98-14.96 V dc (variable).
Output voltage, 20 A load:	13.69 V dc.
Low line drop out voltage:	78 V ac.
DC variation during dynamic testing:	110 mV.

Table 3
Powerwerx SS-30DV, serial no. n/a

Manufacturer's Specifications

Power requirement:	100-120 or 200-240 V ac, 50/60 Hz.
Output voltage:	13.85 V dc.
Output current (continuous):	25 A (30 A max).
Size (HWD): 2.5 × 5.0 × 7.0 inches; weight, 3.0 pounds.	
Price: $120.	

ARRL Lab Measurements

Output voltage, no load:	13.92 (fixed).
Output voltage, 20 A load:	13.8 V dc.
Low line drop out voltage:	73 V ac.
DC variation during dynamic testing:	120 mV.
Efficiency:	74.4% at 7 A; 80% at 20 A.

POWERWERX SS-30DV

At three pounds, the SS-30DV is the lightest and smallest supply in this group. It's rated for 13.85 V dc fixed at 25 A continuous output current (30 A maximum). Thermal and overcurrent protection are included. There is no output metering.

The front panel includes an illuminated power ON/OFF switch and two sets of Anderson Powerpole connectors. The Powerpoles conform to the typical ARRL ARES® configuration and can handle the maximum supply output current. A set of binding posts is available on the rear panel, along with a removable power cord. An adjacent switch selects between 115 V and 230 V ac line voltage.

The temperature controlled internal cooling fan on the rear panel is quiet. It draws air through vents in the side and bottom panels of the metal case.

Documentation is on a single sheet and covers features, specifications, installation, operation and troubleshooting. It also includes a list of certifications, including FCC Part 15 compliance — the only supply in this group to do so. Terms of the limited three year warranty are spelled out in detail.

Powerwerx notes that they are in the process of increasing the output voltage of the SS-30DV to 14.1 V dc to make it more compatible with the West Mountain Radio Super Powergate, used to charge Gel and AGM batteries. As of press time, we have not yet seen this version.

Manufacturer: Powerwerx, 263 N Berry St, Brea, CA 92821; tel 888-321-0073, fax 714-674-4949; **www.powerwerx.com**.

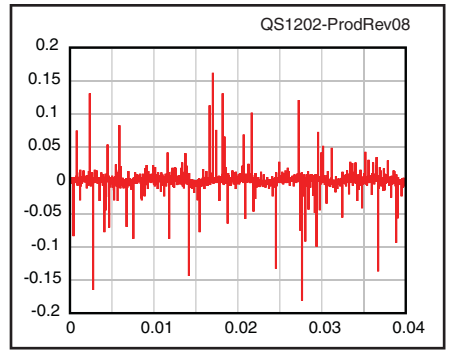

Figure 8 — An oscilloscope trace of the dc output of the Powerwerx SS-30DV under 20 A load. The vertical scale is 50 mV/div and the horizontal scale is 5 ms/div. The level of the dc ripple is approximately 30 mV p-p. Spikes due to switching measure about 350 mV p-p.

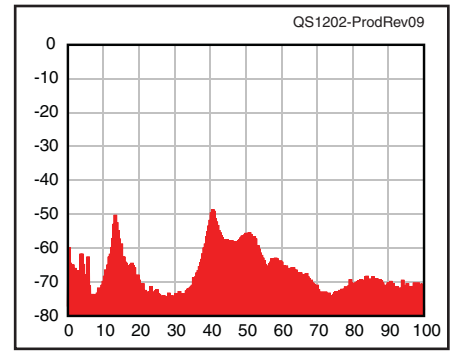

Figure 9 — Spectral plot (0-100 MHz) of the output of the Powerwerx SS-30DV under 20 A load. The reference level is 0 dBm and the vertical scale is 10 dB/div.

QJE DX PS30SWII

The QJE DX PS30SWII is very similar to the Jetstream JTPS30M. Packaging and specifications are nearly identical. Output voltage is switchable — either 13.8 V fixed or 9 to 15 V adjustable. Current rating is 25 A continuous output or 30 A maximum. Thermal protection, short circuit protection and current limiting at more than 30 A are included.

Like the Jetstream unit, an illuminated front panel meter is switchable be-

Table 4
QJE DX PS30SWII, serial no. 004716

Manufacturer's Specifications

Power requirement:	110 V ac.
Output voltage:	Adjustable, 9-15 V dc.
Output current (continuous):	25 A (30 A max).
Size (HWD): 2.7 × 7.5 × 8.5 inches; weight, 5.1 pounds.	
Price: $120.	

Lab Measurements

Output voltage, no load:	13.67 V dc (fixed), or 8.01-14.77 V dc (variable).
Output voltage, 20 A load:	13.56 V dc.
Low line drop out voltage:	68 V ac.
DC variation during dynamic testing:	110 mV.
Efficiency:	79.5% at 7 A; 80.2% at 20 A.

tween output voltage (0-16 V) and current (0-32 A). Low-current dc connections are provided by a cigarette lighter socket rated for 10 A maximum and a set of spring-loaded terminals rated for 3 A on the front panel. The high current output is via binding posts on the rear panel. The rear panel cooling fan draws air through slots in the front panel.

The most significant difference between the QJE and Jetstream supplies is the addition of a NOISE OFFSET control on the front panel. This feature increases/decreases the switching rate of the power supply and can be used to shift the frequency of any power supply noise that's heard in the receiver. In the Lab, some signals from the power supply were evident at 500 kHz. Increasing the NOISE OFFSET control from full counter-clockwise to full clockwise, the noise pulses changed from 29.7 kHz spacing to 33.3 kHz spacing. Switch mode power supplies can generate noise, and this one gives you an option to move the noise off of a frequency of interest.

Documentation is two 8.5 × 11 inch sheets folded in half. It includes information and cautions on using the supply, specifications, and descriptions of each control or connection on the front and rear panels. The last four pages are devoted to "For Your Safety" with Warning, Danger and Caution sections. No schematics or warranty information are included.

Manufacturer: Beijing Liontronics Technology Co, Beijing, China; **www.ftdbjb.com**. Available from a number of Amateur Radio dealers in the US.

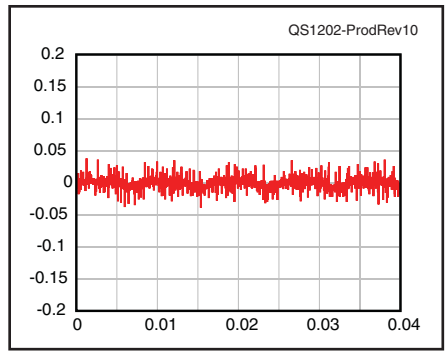

Figure 10 — An oscilloscope trace of the dc output of the QJE DX PS30SWII under 20 A load. The vertical scale is 50 mV/div and the horizontal scale is 5 ms/div. The level of the dc ripple is approximately 40 mV p-p. Spikes due to switching measure about 80 mV p-p.

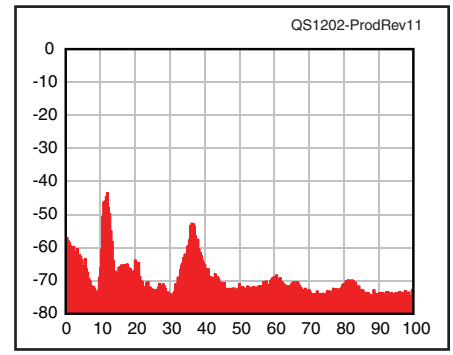

Figure 11 — Spectral plot (0-100 MHz) of the output of the QJE DX PS30SWII under 20 A load. The reference level is 0 dBm and the vertical scale is 10 dB/div.

TEN-TEC MODEL 941

Ten-Tec's Model 941 is a low profile 13.8 V, 25 A power supply intended for powering 100 W class HF transceivers. It uses a sturdy metal case with the cooling fan and air intake slots on the top panel. According to the instructions, the 941 needs at least 2 inches of clearance for the fan. The fan rarely ran, finally starting up after 10 minutes of testing with a 20 A load. When it ran, it was the loudest of the bunch. The supply can be mounted horizontally or vertically, and stick-on rubber feet may be attached to the bottom or side panel.

Controls and connections couldn't be simpler. There's an illuminated POWER switch on the front panel and a pair of binding posts on the rear panel for dc output. The

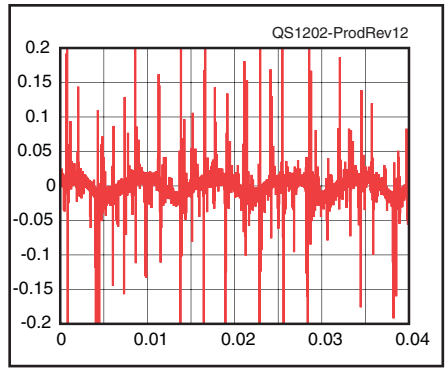

Figure 12 — An oscilloscope trace of the dc output of the Ten-Tec 941 under 20 A load. The vertical scale is 50 mV/div and the horizontal scale is 5 ms/div. The level of the dc ripple is approximately 70 mV p-p. Spikes due to switching measure >400 mV p-p.

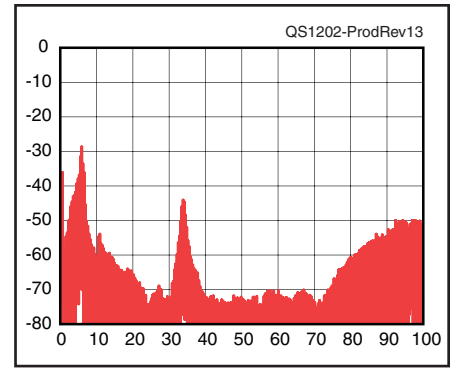

Figure 13 — Spectral plot (0-100 MHz) of the output of the Ten-Tec 941 under 20 A load. The reference level is 0 dBm and the vertical scale is 10 dB/div. See text for Ten-Tec's response.

Table 5
Ten-Tec 941, serial no. n/a

Manufacturer's Specifications

Power requirement:	90-132 or 180-264 V ac, 50/60 Hz.
Output voltage:	13.8 V dc.
Output current:	25 A (full load).

Size (HWD): 2.1 × 7.3 × 10.6 inches; weight, 4.6 pounds.
Price: $169.

Lab Measurements

Output voltage, no load:	13.84 V dc (fixed).
Output voltage, 20 A load:	13.35 V dc.
Low line drop out voltage:	72 V ac.
DC variation during dynamic testing:	490 mV.
Efficiency:	80% at 7 A; 81.9% at 20 A.

socket for the detachable ac line cord has a built-in fuse holder, and there's a GROUND lug with wing nut. An internal switch accessible from the side panel toggles between 90-132 and 180-264 V ac input. Ten-Tec let us know that the power module vendor was changed in early 2011. The test results shown are for the current production model.

As shown in Figure 13, this unit has significant spurious output with a 20 A load such that it is audible, especially at 5 MHz. ARRL Lab Engineer Bob Allison, WB1GCM, tried wrapping 10 turns of the dc power leads around a mix 31 ferrite toroid with the result that the spurious was reduced by 24 dB, making it, and other spurious outputs, inaudible. Ten-Tec noted that they didn't hear any noise during their testing of this supply at normal receive power levels. Based on the input from our testing, Ten-Tec has informed us that all power supplies in current stock, and those in future production, will include similar filtering within the unit cabinet. In addition, they will supply a simple to install (no soldering required) retrofit kit that fits into the cabinet at no charge to owners of earlier units who request one.

Instructions are on a single 8.5 × 11 inch sheet and include a general description, installation and use instructions and specifications. No warranty information or schematic is included, but the Ten-Tec website describes a 1 year warranty on Ten-Tec products.

Manufacturer: Ten-Tec Inc, 1185 Dolly Parton Parkway, Sevierville, TN 37862, 800-833-7373; **www.tentec.com**.

Lab Testing

Tables 2 through 5 show the results of operational testing in the ARRL Lab. All of the supplies measured very close to 13.8 V output with no load. To simulate typical use during SSB or CW operation, the Lab tested dynamic regulation by switching rapidly between 1 A and 20 A loads. The test result appears as *DC variation during dynamic testing* in the tables. The supplies reviewed here all tested between 110 mV and 140 mV, in line with the best of the supplies reviewed previously.

Typical of switch mode power supplies, all of the supplies reviewed are tolerant of swings in ac line voltage. Any of these supplies would be a good choice for emergency or portable operation with variable ac sources. The *Low line drop out voltage* is the point at which a power supply's output drops to 11.4 V dc, the minimum specified operating voltage of most transceivers. This test was done with a 20 A load. With the supply loaded down and operating at the dropout threshold, a substantial ac ripple at the output was observed — between 1 and 1.5 V peak to peak. The ripple disappears when each supply gets to about 90 V ac input. The ripple is not as severe with a light load; no audible hum was observed on reception. However, the Lab does not recommend transmitting at full power with a line voltage below 90 V.

Figures 6 through 13 show the output of each supply under a 20 A load. In the first plot in each set an oscilloscope was used to observe ripple on the dc output, as well as the presence of high frequency switching spikes while under load. All of the supplies exhibit low ripple. High frequency switching spikes were evident on the output of the Powerwerx and Ten-Tec supplies.

The second plot in each set shows broadband noise on the output of each supply. In this test, the supply is connected to a 20 A load. The supply output is ac-coupled to a spectrum analyzer and the analyzer set up to sweep the frequencies from 1.5 to 100 MHz. The resulting spectral plot shows the level of noise generated by the power supply at these frequencies. The spectral plot is actually made up of carriers approximately 30 kHz apart. Since the entire plot is 100 MHz wide, there is not enough resolution to see each carrier.

The level of broadband noise generated by the switching power supplies is generally higher with higher loads. These plots show performance under a typical 100 W transmitter load, and the noise levels are lower with the 1 A load typical during receive. All of the power supplies reviewed here produce higher levels of broadband noise throughout the HF and low VHF spectrum compared to the best supplies featured in previous reviews.

Finally, each supply was tested for conducted emissions (noise that the device conducts into the ac house wiring and power lines via the device power cord). The sidebar "Conducted Emissions Testing" that accompanied the August 2009 power supply review (Note 5) covers this test in detail.

Table 6 shows the FCC limits of conducted emissions and the five highest levels inside and outside the amateur bands as measured in the ARRL Lab. Tests were conducted with 1 A, 7 A and 20 A loads. All of power supplies tested here passed Part 15 requirements for conducted emissions levels except the Ten-Tec 941 with a 20 A load on 160 meters. Overall, the QJE DX PS30SWII was the quietest of the units tested, followed closely by the Jetstream JTPS30M. The Powerwerx SS-30DV was the only supply in this group with the required FCC Part 15 compliance notice on the cabinet. Remember that the Part 15 compliance levels are stringent enough to reduce — but not eliminate — interference.

Any of the supplies tested here will power a 100 W HF transceiver and accessories. As noted here and in previous reviews, there is a lot of choice in features and specifications. Take a close look at noise performance, particularly if you operate at 7 MHz or lower.

Table 6
Conducted Emission Levels of Switching Power Supplies†

FCC Part 15 conducted emission limits (dBμV) are:
0.15 - 0.5 MHz, 66 to 56 (decreases with the logarithm of the frequency);
0.5 - 5.0 MHz, 56; 5.0-30.0 MHz, 60;
>30.0 MHz, none.

†Lower numbers indicate better Part 15 compliance.

Conducted Emissions in dBμV
Measured in the ARRL Lab

Jetstream JTPS30M

MHz	*1 A*	*7 A*	*20 A*
0.522	44.2	45.0	49.7
0.770	46.5	47.9	51.1
1.635	41.3	45.9	51.3
9.336	39.7	42.0	47.0
9.783	40.4	45.0	52.0
1.834	31.0	44.4	51.7
1.898	31.0	45.6	51.7
3.582	28.9	40.0	47.6
3.782	28.6	38.7	46.6
7.171	22.7	39.6	38.6

Powerwerx SS-30DV

MHz	*1 A*	*7 A*	*20 A*
0.472	42.6	50.0	52.4
0.801	42.6	49.0	50.4
1.606	40.0	48.6	52.8
9.396	41.2	51.0	53.0
9.678	47.3	53.7	58.1
1.801	36.6	44.8	49.7
1.872	36.6	44.0	50.6
3.524	33.6	40.5	49.6
3.812	32.0	42.0	44.1
10.103	44.9	49.7	56.1

QJE DX PS30SWII

MHz	*1 A*	*7 A*	*20 A*
0.462	36.1	42.9	42.9
0.970	33.6	42.9	47.0
1.595	30.8	42.0	47.9
6.011	20.0	36.2	43.7
10.860	23.7	35.6	38.0
1.848	24.6	42.1	48.2
1.975	27.0	41.8	48.0
3.892	21.2	34.9	42.2
3.986	18.8	36.1	42.2
7.042	18.0	35.1	38.8

Ten-Tec 941

MHz	*1 A*	*7 A*	*20 A*
0.340	44.9	48.0	48.1
1.130	35.9	39.2	40.5
2.644	27.8	37.3	42.0
4.311	23.7	30.7	39.8
9.071	24.3	30.3	38.2
1.809	30.6	34.7	41.0
1.861	24.3	39.2	42.0
3.629	23.8	33.2	42.0
5.341	21.0	33.8	38.4
14.313	17.0	29.2	35.0

*Frequency for 20 A measurement if different from 1 A and 7 A measurements.

W1ZR

THE DOCTOR IS IN

Q Jon, NS4SC, asks: I read your test mobile antenna coupling test results in the November 2011 Doctor column.[1] I thought about multiple VHF antennas on a vehicle and thought about APRS. Since in the US APRS is on 144.39 MHz, wouldn't it solve the problem if one installed a ¼ wave coaxial notch trap for 144.39 MHz on the coax of the voice radio?

This way the transmissions from the nearby APRS transmitter wouldn't swamp the input to the voice VHF FM radio. What would the dimensions of this trap be and is it an acceptable way to keep the RF from damaging the other radio's front end? I am sure if the APRS radio has a receiver it would be nice to have a band-pass filter on it for only the 144.39 MHz APRS channel.

A Well, your idea has merit. Unfortunately, it will take a more serious pair of filters to do the job. A coax stub, while useful to trap signals on other bands, will not provide sufficient discrimination between 144.39 MHz and the 2 meter repeater channels.

As an example, an open ¼ wave stub of LMR-400 low loss coax at resonance at 144.39 will act like a 0.12 Ω resistance at 144.39, nicely shunting most of the received APRS energy to ground. Thus it could keep the APRS energy from damaging the voice radio.

If we pick 146.52 as one of the frequencies you want to use for voice (and some repeaters are even closer to 144.39 MHz), that same stub will have an impedance at 146.52 MHz of $0.13 + j1.16$, or a very small inductance across the coax. Thus, it will almost short the antenna on that frequency as well. The approach will work, but takes a lot of higher Q hardware. Take a look at the duplexer at a 2 meter repeater site — that's really what you would need.

Another possibility would be to use a relay to switch your voice radio to a dummy load whenever the APRS sends a burst. You would suffer short gaps in your transmit and receive on the voice radio, but it wouldn't be subject to the RF from the APRS set. You could use a similar setup on the APRS set, if you had access to the voice radio's PTT line.

[1]J. Hallas, W1ZR, "The Doctor is In," *QST*, Nov 2011, pp 61-62.

Q Ron, WD8SBB, asks: I have been looking for a way to reduce power output from my older 100 W HF transceiver to a level that can safely drive a 6 meter transverter. I've found a 40 dB tap type attenuator designed for power meter use in a *QST* article.[2] It looks like an interesting and easy-to-implement idea, but I have come up short on finding the formula to create custom attenuation values. Can you help?

My station has a good high power dummy load to absorb the excess transmit power. In addition, the transceiver has a separate receive antenna input and my 6 meter transverter has separate receive and transmit ports.

A While many current HF transceivers have special ports designed to provide the milliwatt level transmit signal needed by a transceiver, many others don't. The choices are to modify the transmit side of the transceiver to disable the final amplifier and connect to the driver output, or attenuate the typical 100 W HF output to the needed level. This is frequently accomplished with a two-port power attenuator, but the attenuating tap approach you found is easier if you already have a 50 Ω dummy load that will handle your 100 W output.

The required interconnections are shown in Figure 1 with the attenuating tap schematic shown in Figure 2. The tap routes most of your transmit power to the dummy load while providing a small sample at the third TAP port. This is useful not only for transverters, but also can be used (with the appropriate attenuation) to provide samples of your transmit signal to use with oscilloscopes, frequency counters, milliwatt power meters or other monitoring equipment.

This approach, or using a two-port attenuator, is not a simple way to drive your transverter unless the HF transceiver also has a separate receive input port. Otherwise the attenuation will also reduce the received signal by the same amount — not a formula for VHF success. That limitation can be overcome by relay switching, usually driven by the transceiver's linear amplifier keying line — but make sure you make it fail safe. You need to make sure a pulled out keying connector doesn't allow the full HF transceiver power to go to the transverter — unless you have a shelf full of spares. That may be the subject for another time. In

[2]W. Hayward, W7ZOI, B. Larkin, W7PUA, "Simple RF-Power Measurement," *QST*, Jun 2001, pp 38-43.

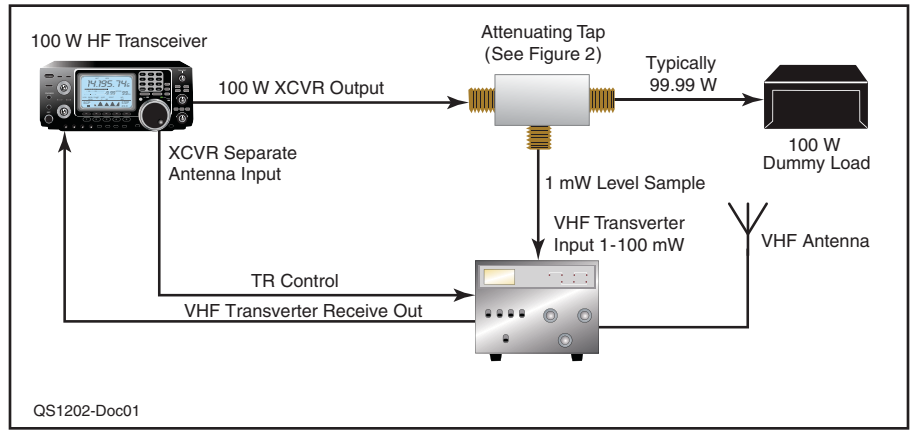

Figure 1 — Interconnections diagram showing how to implement the attenuating tap line sampler. For HF use, just replace the dummy load with your HF antenna. The tap can stay in the circuit without impacting anything.

Joel R. Hallas, W1ZR ♦ *QST* Technical Editor ♦ jhallas@arrl.org

Table 1

Design Resistance Values for Attenuating Tap at Different Output Levels

Assumes 100 W HF transceiver input, non-inductive resistors, 51 Ω for R2 and a 50 Ω transverter input impedance.

Tap Output (mW)	*dBm*	*Attenuation (dB)*	*Voltage Out (V)*	*Voltage Ratio*	*R1 (Ω)*	*P_{R1} (W)*	*P_{R2} (W)*
1000	30	20	7.07	0.1000	227	17.8	1
100	20	30	2.24	0.0316	773	6.1	0.1
10	10	40	0.71	0.0100	2500	2.0	0.01
1	0	50	0.22	0.0032	7960	0.6	0.001

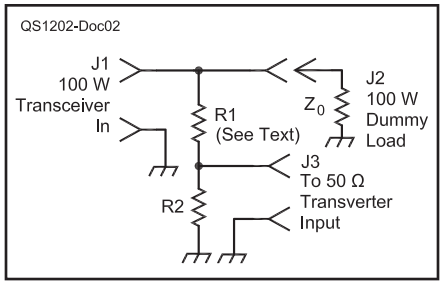

Figure 2 — Circuit of the attenuating tap. See Table 1 for resistance values. Note that resistors must be of a non-inductive type to obtain the design attenuation. The tap is also useful to provide a sample of the transmitter signal for various monitoring and measurement tasks.

Ron's case, he has the perfect configuration for this — all the ports needed to make it work without problems.

This circuit is just a voltage divider. Ohm's law tells us that your 100 W PEP transmitter will result in 70.7 V_{RMS} into 50 Ω on the path from J1 to the dummy load on J2.

The combination of R1 in series with the parallel combo of R2 and the 50 Ω Z_{IN} of your transverter won't impact that noticeably because the resistance will be many times higher than 50 Ω as we'll see.

As noted in the referenced article, strictly speaking, R2 isn't necessary — if we were sure that the transverter Z_{IN} would be exactly 50 Ω, but we can't usually be. That impedance is usually a resonant circuit that will have a somewhat different impedance on each frequency. We'll put another resistor in parallel to make sure that if it has a higher Z, the voltage at the transverter input won't rise too high.

The voltage at your transverter input wants to be 40 dB down from the 70.7 V, so that's 0.707 V_{RMS} at 50 Ω, which equals our desired 10 mW. Let's pick 51 Ω, a standard value. This, in parallel with the Z_0 gives us 25.25 Ω.

Now we need a value for R1 that will provide $\frac{1}{100}$ of the applied voltage to the parallel combination. That means $\frac{1}{100} = R_{PAR}/(R1 + R_{PAR})$. R1 is 99 × R_{PAR} or 2500 Ω. So now we have all the needed resistance values.

We now need to determine the power dissipation requirements. We note that R2 will have about the same current and dissipate the same power that goes into the transverter, 10 mW, not a problem for even a ¼ W (250 mW) resistor.

R1 will have a drop of about 70 V so the power dissipated will be $V^2/R = 2$ W. That corresponds to the 100 W peak output, so the average will be lower. Still, if you ever do FM, RTTY or whistle too long, you will need a 2 W resistor. The *QST* article used three ½ W resistors in series. Since resistors tend to be inductive, I would think four ½ W, 10 kΩ resistors in parallel would be a better choice, since the inductance will be divided instead of adding. I have provided the calculated resistor values for other transverter input levels in Table 1.

This brings up an important point — you need to have non-inductive resistors and keep leads short to minimize wiring inductance. The old carbon composition type resistors were great for that, but not easily found these days, except in old timers' basements. I trust W7ZOI and W7PUA to know that the carbon film resistors they suggest will work, too. Another possibility is using higher power Caddock non-inductive film resistors, available with higher power ratings (**www.caddock.com**). Their MS-221 series are rated at 3 W dissipation and are available in values from 45 Ω to 10 MΩ, so a single 2500 Ω unit should do the trick. The *QST* article describes using capacitive compensation to make the attenuation flat within 0.1 dB over 500 MHz. While that would be good for precision power measurements, I think it's overkill for this application — can't hurt though.

Whatever you do, I'd check the power level before hooking up the transverter. Or start out with the transceiver in TUNE mode, if, as in my transceiver, that can be adjusted down to the single digits of power output or lower. Then slowly bring up the power while watching the transverter output. If it reaches full power before the transceiver hits 100 W, it's back to the drawing board.

Q Mark, WB8ZTP, asks: I see all these dipoles with multiple length wires from the center for different bands, for example, 80-10 meters, some with just different fanned wires, some with traps to make them appear shorter on higher frequency bands. Would it be possible to just use a half wave 80 meter dipole with a wide range antenna tuner to work on 80 through 10 meters?

A Such an antenna will work very well on all bands 80 meters and higher — even more efficiently in some ways than the other choices you mention. There are only two issues:

- The big problem is that if that dipole is fed with coax transmission line, the SWR on the bands other than 80 meters will be very high, perhaps 20:1. Unless the coax is quite short, or very good coax is used, the losses in the coax will make it not work well. It will still radiate whatever power gets to the antenna, but not as much will.

Fortunately, the solution is easy — replace the coax with low loss window line. The losses will almost disappear. You will need that wide range tuner with some kind of a balanced output, or a separate balun or common mode choke — but it will work like gangbusters on 80 through 6 meters.[3]

- With trap or fan dipoles, the pattern on each band will be like that of a dipole — mainly perpendicular to the wire with a fairly wide beamwidth. The 80 meter dipole, on the bands above 40 meters will have a different pattern. This may or may not be a problem. I plotted all my lobes on each band on pages of an azmuthal projection map and knew where I could go on each band. If I had a null toward a DXpedition on one band, I'd wait until he was on another band and then make the contact. If, on the other hand, you want to reach a single destination, an emergency operations center or perhaps your parents' house, on whatever band is open, this might not be the best antenna choice. For more discussion on this topic, see two earlier *QST* articles.[3,4]

[3]J. Hallas, W1ZR, "Your Second HF Antenna," *QST*, Jul 2008, pp 69-70.
[4]J. Hallas, W1ZR, B. Allison, WB1GCM, "A Closer Look at Window Transmission Line," *QST*, Nov 2009, pp 66-67.

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

HamGadgets PicoKeyer-Plus

My quest began at a hamfest fleamarket. I had stumbled upon a lonely Small Wonder Labs 30-meter low-power (QRP) CW transceiver sitting in the sunshine and marked with a price that was too low to ignore. Before I knew it, my wallet had popped open and the little rig was mine.

As much as I sometimes enjoy sending CW with a straight key, I'm really more of a paddle guy. That meant I needed an electronic keyer to allow me to use my favorite set of touch paddles with my new transceiver.

The problem is that I often hew to the stereotype of the penny pinching ham. I wanted a capable keyer, but I didn't want to pay very much for it. With frugality in mind, a Web search pointed me toward Dale Botkin, N0XAS, and his HamGadgets site. That's where I discovered his PicoKeyer-Plus kit.

The HamGadgets PicoKeyer-Plus shown with the optional enclosure.

The PicoKeyer-Plus

The PicoKeyer-Plus is the latest version of the original PicoKeyer designed almost 10 years ago. The device is built around a single chip with just a tiny handful of parts. It all fits on a circuit board just 1.3 × 2 inches. The PicoKeyer-Plus is more than just a simple keyer, however. It is also a *memory keyer* capable of storing up to four message strings that it can send automatically (such as a CQ).

In addition to keying a transceiver, the PicoKeyer-Plus includes a miniature sidetone speaker that doubles as a code practice oscillator. The speaker isn't very loud, but even my rock 'n' roll damaged ears had no trouble picking it up in a quiet room.

The PicoKeyer-Plus has a long list of features, but the ones that got my attention were:

- On-board battery (coin cell) operation with the option for external power.
- Low current drain with a sleep current at less than 0.1 µA and only a 1 to 2 mA draw when operating. The lithium coin cell supplied with the kit will last many months at that rate.
- PC board mounted ⅛ inch jacks to connect the key and transceiver.
- A board-mounted speed potentiometer. The speed range is about 5 to 60 WPM.
- Dual 2N7000 keying output MOSFETs for solid-state rigs and some tube gear (handles up to 60 V positive or negative).
- A single-button menu function.
- Four message memories, each holding up to 60 characters.
- A hands-free "Tune Mode."
- Straight key "auto detect." It knows when you've plugged in a straight key and changes its operation accordingly.
- The ability to automatically insert a QSO number into a CW message string, with the ability to automatically increment. That's ideal for contest use.
- Flash memory with no battery backup required.

It is remarkable that so many features (and quite a few more) can be stuffed into such a small kit at such a low price: only $17.99.

Building the PicoKeyer-Plus

The instructions state that most hams can assemble the PicoKeyer-Plus in less than 30 minutes. If yowatch the accompanying video, you'll see that this is true. I built the keyer in 25 minutes flat, and I am probably slower than most.

All of the components are through-hole — no microscopic surface-mount parts. The IC fits into a socket, which I was glad to see. Speaking of which, the PicoKeyer-Plus firmware is updatable should N0XAS decide to add more features.

When you insert the coin cell into the battery holder, the PicoKeyer-Plus responds by sending "73." That's your first indication that you've built the kit correctly. Frankly, you'd have to try very hard to botch this kit. The board is clearly labeled; it even indicates the correct orientation for the 2N7000 transistors. As long as you solder everything correctly, the PicoKeyer-Plus should work perfectly. This makes the kit a good candidate for club projects and new hams with an interest in CW.

For this review I also ordered the optional enclosure for an additional $8. Yes, I could have instal-led the PicoKeyer-Plus into the radio itself, but I wanted a keyer that I could easily swap from one rig to another.

Watch *QST* Editor Steve Ford, WB8IMY, as he builds a PicoKeyer-Plus.

Simple and Smooth

Not only does this kit come together very quickly, you have the instant gratification of plugging in a set of paddles and blasting away. My impulse is to always send CQ — I don't know why I do it. When I'm just fooling around with paddles and a keyer, I send CQ straight away. It is wishful thinking, I suppose.

With a thin ribbon of smoke still curling up from my soldering iron, I was banging out CQ over and over with the PicoKeyer-Plus. Just a slight twist of the knob took me from about 20 to well over 30 WPM. All that from a little black box that I built, as N0XAS says, in less time than it takes to drink a cup of coffee.

Manufacturer: HamGadgets, 16624 Elm St, Omaha, NE 68130-1826; tel 888-777-1393; **www.hamgadgets.com**. *$17.99; enclosure, $8.*

Steve Ford, WB8IMY ♦ *QST* Editor ♦ sford@arrl.org

N0AX

HANDS-ON RADIO

Experiment 109
PCB Layout — *Part 3*

After last month you have a complete schematic that is ready for layout. Now we'll switch over to the PCB layout software and turn the circuit design into a circuit board that can be ordered from ExpressPCB. I assume that the reader is somewhat familiar with circuit board structure. If not, additional background is available in the CAD chapter of the 2011 or 2012 edition of *The ARRL Handbook*.[1]

Checking and Fixing Errors

First, the schematic should be checked to see if there are any connection or configuration errors. From the FILE menu select CHECK SCHEMATIC FOR NETLIST ERRORS. My first pass was not happy with Q1 — there were no pin numbers assigned on the component because I was using a general-purpose transistor symbol. I followed the instructions given by the error checker and assigned the pins as 1 — Emitter, 2 — Base and 3 — Collector, the standard order for a 2N3906 in a TO-92 package. Rerunning the error check turned up one not quite connected wire that I would have never spotted by eye. I fixed it and was ready for layout.

ExpressPCB Layout

Run the *ExpressPCB* software and read the *Quick Start Guide* as before. Because the layout software will be unfamiliar, open the HELP file, too. The default size of the circuit board is the same as for the Miniboard service we'll be using, but check anyway by moving the cursor between opposite corners and checking the X-Y coordinates in the lower left. It should be 3.8 inches wide and 2.5 inches high. Assign a name to the file and save it using the SAVE AS function.

Instead of component symbols, the layout software has component outlines with a pad for each pin of the component. Operation is similar to the schematic editor — click the PLACE A COMPONENT tool (look for the IC symbol), select a component from the list, and click to place it on the layout.

To obtain a list of the components you'll need, go back to the schematic and from the EDIT menu, select the COPY BILL OF MATERIALS TO CLIPBOARD function. Open a text editor, paste the list into a blank document and print it. Place the required quantity of each component onto the layout:

- (C1, 2) Cap — Lead spacing 0.1 inch (2.5 mm)
- (C3) Cap — Radial electrolytic — Lead spacing 0.1 inch (2.5 mm)
- (D1) Diode — Zener 0.5 W (lead spacing 0.3 inch, hole 0.029 inch)
- (D2) LED — T1
- (D3) Diode — DO-41 (lead spacing 0.4 inch, hole 0.040 inch)
- (Q1) Semiconductor — TO-92
- (U1) DIP — 8 pin
- (R1-7) Resistor — 0.25 W (lead spacing 0.4 inch)
- (R8) Potentiometer — Bourns series 3386F
- (SW1) Switch — 6 mm push button

Place the components more or less as the schematic has them arranged as in Figure 1 which shows the *silk screen* layer (yellow on the display). The silk screen shows the shape of each component and the placement of all pads along with the designator of the component.

Right-click on each component and edit the component properties to assign designators (R1, C1, D1, etc) to each component corresponding to the designators on the schematic. This tells *ExpressPCB* which layout pins and pads should be connected together. If you were using an *auto-router* program, the software could then create the traces just by looking at the *net list* from the schematic and matching up designators and pin numbers (*net* is short for network). *ExpressPCB* has a manual routing tool so you'll be doing that chore yourself.

Connecting Components

Laying out the traces is a lot of fun and can be an interesting puzzle, as you will see. Print out a copy of the schematic and get a highlighter pen or colored pencil. As you make connections, highlight or trace them on the paper schematic to show the connection has been made. That way, it will be easier to

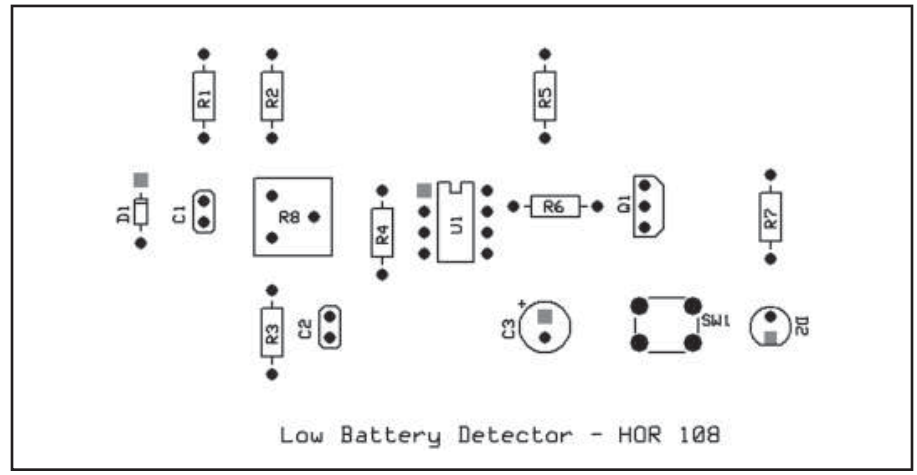

Figure 1 — PCB layout begins by selecting a component outline for each required component on the layout. At this stage exact placement is not important.

[1] *The ARRL Handbook for Radio Communications,* 2012 Edition. Available from your ARRL dealer or the ARRL Bookstore, ARRL order no. 6672 (Hardcover 6634). Telephone 860-594-0355, or toll-free in the US 888-277-5289; **www.arrl.org/shop**; **pubsales@arrl.org**.

H. Ward Silver, N0AX ♦ 712 Jefferson St, St Charles, MO 63301 ♦ n0ax@arrl.org

be sure you've made all necessary connections.

The next step is to link the schematic and layout so the software can be sure you are making the necessary connections. From the FILE menu, use the LINK TO SCHEMATIC function and select the schematic file.

Click the HIGHLIGHT NET CONNECTIONS tool button (at the bottom of the column of buttons) then click on a component pin. All of the other pins that should be connected to that pin will be shown in blue. Select the TRACE tool or type T and connect all of the highlighted pins using traces on the copper (bottom) side of the board shown in green. Don't worry about making corners or choosing board layers — just make straight traces for now. (It's no surprise that this stage of the layout is called a *rat's nest*.) Keep double checking against the schematic. Complete a section of the circuit then move the parts around or rotate them if you want to make the traces less snarled.

Now use the CORNER tool to bend the traces around and between pins. You can change the trace from the component side of the board (red) to the copper side of the board (green) by selecting it and clicking on the toolbar MOVE TO LAYER CONTROLS. When a segment of a trace is moved from one layer to another, a new pad at one or both ends of the segment is created. This is called a *via* and consists of a small hole and pad on each layer. I enjoy the puzzle of "solving the board" with the fewest vias — or even none, on a simple board like this one.

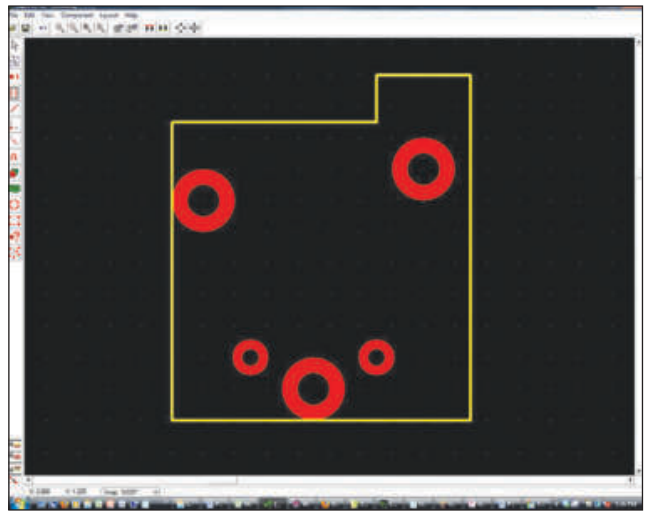

Figure 2 — A custom component is created for the SPST relay used for K1. The component is created by selecting and arranging pads, then drawing a component outline on the silkscreen layer.

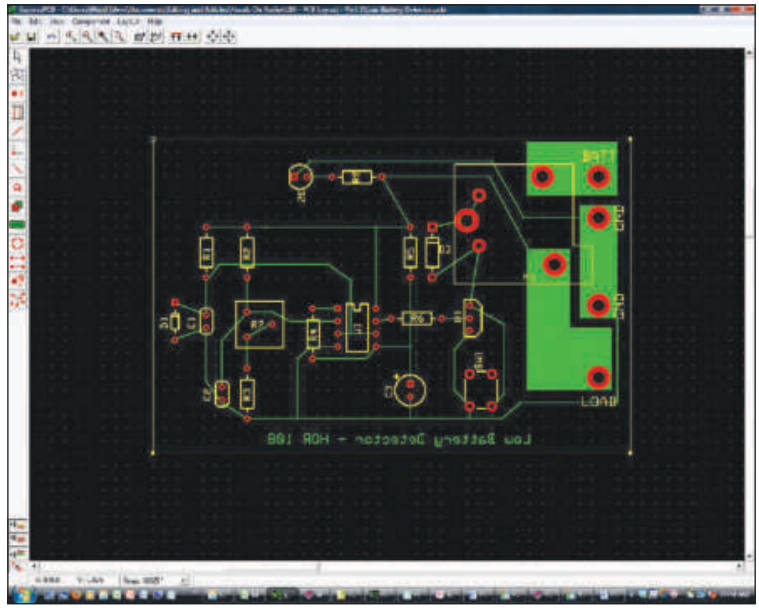

Figure 3 — The final PCB layout with all traces on the board's copper side shown in green. Large rectangular areas of copper are used to carry the high load current.

Creating the Relay

The relay we're going to use is a T90N1D12-12 SPST (Form 1A) with contacts rated for 30 A. It is available from Digi-Key (**www.digikey.com**), part number PB104-ND. Download the data sheet for reference. Page 3 of the data sheet is where you'll find mechanical drawings showing the pin connections. This is a bottom view of the pins that will have to be reversed since we view the board from the component side. Also note that the data sheet's top pin is not present on the SPST relay and the metal frame of the relay is "live" — connected to the moving pole of the relay — with its own pin.

Because the software library doesn't include this relay, we'll have to create the component. In the HELP file, read the instructions for creating custom components. The procedure involves using the PLACE A PAD tool to create and arrange pads for each of the relay pins in the pattern specified on the data sheet (remembering that the data sheet pattern is looking from the bottom, not the top).

Once you have the pads placed, a component outline is then drawn on the yellow silkscreen layer. The outline and pads are grouped into the single component in Figure 2 and saved in the custom component folder. I've done all of that work for you and placed the component file Relay - T90N1.p on the Hands-On Radio website.[2] Download that component and save it in the **C:\Program Files\ExpressPCB\PCBComponents_Custom** folder. (If you want to make the component yourself, save the layout and work using a new blank layout.)

Using the COMPONENT menu's COMPONENT MANAGER function, you'll find the relay in the CUSTOM COMPONENTS group. Click INSERT INTO SCHEMATIC then move and rotate the component, place it in the desired location, moving other components if necessary. Complete the coil connections, leaving the high-current connections for last.

The BATTERY, LOAD and GROUND connections can carry up to 25 A, so wide copper traces are required. (See the *Circuit Board Design Tips* document in the HELP menu for information on trace width and current capacity.) I began by placing 0.2 inch pads with 0.1 inch holes for #12 AWG wire at the edge of the board. I then used the PLACE A RECTANGLE tool to create large blocks of copper connecting the wire and relay pads. Power and ground connections to the rest of the circuit can then be made to the LOAD and GROUND pads.

Figure 3 shows the layout I came up with. The components are placed roughly as the schematic shows them. I managed to route all of the connecting traces on the bottom layer but that's just a matter of personal taste. Clear areas are left in three corners of the board for mounting holes to be drilled if desired. The next step is to order boards and get ready to build.

In "PCB Layout — *Part 4*" we will build our board.

[2]All previous Hands-On Radio experiments are available to ARRL members at **www.arrl.org/hands-on-radio**. The design spreadsheet is available in the section for this experiment.

AG1YK

HINTS & KINKS

AN AC POWER FAILURE ALARM FOR REPEATERS

◊One of the local VHF Amateur Radio repeaters is located out in the country at a camp. There is no telephone line available and the power line snakes through some heavily wooded areas. For that reason the local electric power company service is not very reliable.

The repeater owner, Lee Lewis, N3NWL, has equipped the site with a generator and means to supply backup power to the radio system during extended outages. The repeater is also equipped with a heavy-duty 12 V battery that handles short-term power requirements. If, after several hours, the electric service is not restored or the generator isn't connected, the battery discharges and the repeater goes off the air. Lee has had this happen several times and the battery, damaged by being fully discharged, required replacement.[1] Since there are few full-time residents in the area it might be days before the electric company is notified of the power outage.

We discussed the situation and decided to build an alarm that would add a tone to the audio of the repeater when the electric power was interrupted. It would be adjusted to be loud enough to be noticed by users while not interfering with normal voice traffic. Club members would be advised to notify N3NWL that the tone was heard so that he could visit the camp and connect the generator.

The next question was how to switch the tone in and out of the circuit. We decided to add a 12 V relay to the power circuit of the alarm that would pull when power was present. The 9 V battery for the tone board would be wired through the *normally closed* contacts of the relay, which would be *open* when 12 V was present. The completed circuit would be wired to the 12 V power supply that powers the repeater (see Figure 1).

My junk box had an old Potter & Brumfield 12 V relay that had an octal base pin arrangement. Just about any 12 V SPDT (single pole double throw) relay would work. I was concerned that the relay might heat up and fail from being energized continually. As a test, I connected the relay coil to a 12 V car battery in the shop and let it run for several hours. There was no apparent increase in temperature of the relay. I was satisfied that the relay would operate in continuous service inside the housing of the alarm unit without any temperature problems.

These homebrew devices may serve for years before needing service so I drew the schematic for this project and placed a copy of the completed schematic in the housing.

The tone board is a standard 555 IC with minimal parts to produce a tone of about 850 Hz. The 330 Ω variable resistor at the output adjusts the volume of the tone and therefore the modulation of the repeater audio. Drain from the 9 V battery is about 15 mA when the tone is switched on so it will last quite a long time. I used hook and loop material to attach the relay and battery to the inside of the housing with two small tubular standoffs to mount the circuit board (see Figure 2).

There are two connections to the housing. One is the two-wire line to the output of the 12 V power supply that powers the repeater. It would also be possible to use a 120 V ac relay connected directly to an electrical wall outlet if the repeater has an internal power supply. The other line connects the tone output to the audio input of the repeater controller. It could be strapped across the terminals for the ID message or the audio from the repeater receiver. It also should be wired on the output side of the carrier operated relay (COR) so it doesn't hold the repeater in transmit mode when active. Since there are quite a variety of controllers used with repeaters some experimentation might be needed to marry the circuit to a particular controller application.

Set up and testing are pretty straightforward. Turn on the tone circuit on-off switch. Once the 12 V line from the circuit is connected to the power supply and the tone is wired to the controller, just unplug the 12 V power supply. The backup battery should power the repeater and the 12 V relay will drop out. This connects 9 V to the tone board, which sends a tone to the repeater controller. Then, ping the repeater from a handheld radio and listen to the squelch tail

[1]For more information on batteries refer to *The 2012 ARRL Handbook for Radio Communications* (Newington: 2011), pp 7.32 to 7.38. Available from your ARRL dealer, or from the ARRL Store, ARRL order no. 6672. Telephone toll-free in the US 888-277-5289, or 860-594-0355, fax 860-594-0303; **www.arrl.org/shop/**; **pubsales@arrl.org**.

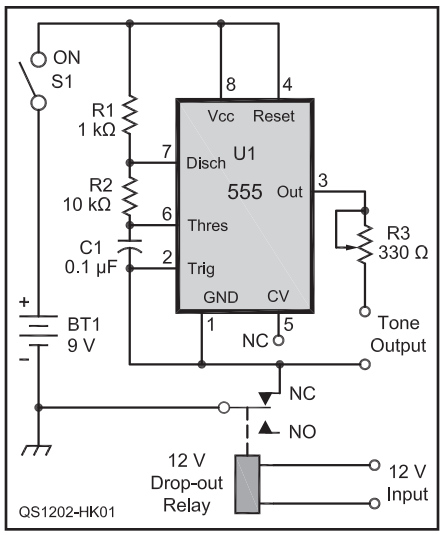

Figure 1 — The schematic of the power failure alarm.

PETER CARR, WW3O

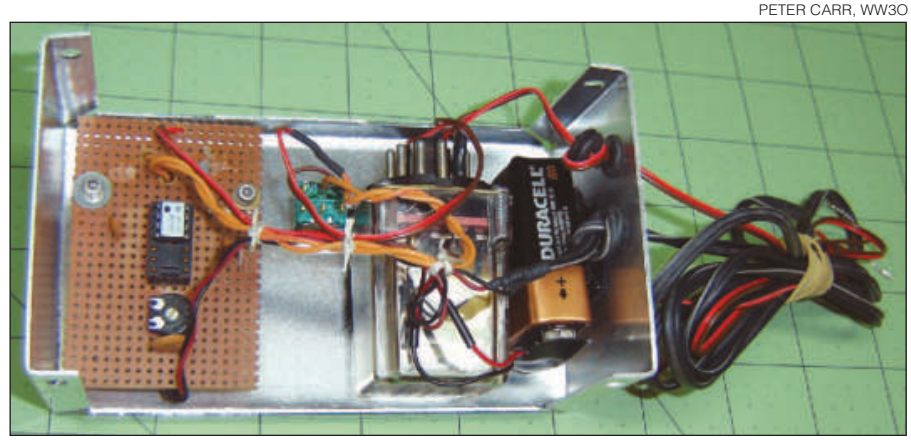

Figure 2 — The power-failure alarm all boxed up and ready to be hooked into the repeater's circuitry.

Steve Sant Andrea, AG1YK ♦ Assistant Editor ♦ h&k@arrl.org

or repeater ID message. The tone from the alarm circuit should be heard on the signal. Adjust the variable resistor on the tone board for best modulation and replace the cover on the housing. If, over time, the tone weakens or quits completely it is time to replace the 9 V battery. [If your installation permits, connecting the tone generator to the 12 V battery will provide power for it as long as the repeater is active. — *Ed.*]

There are many repeaters located in remote locations that provide excellent coverage to their users. The downside of their location is the maintenance problems for the hams who service them. I would hope that this circuit will help them with the work they do so the rest of us can continue to enjoy this part of the hobby. — *73, Peter Carr, WW3O, 329 Little Ave, Ridgway, PA 15853-1220*, **ww3o@arrl.net**

CHECKING TOROIDS

◊I needed to remove some HF band noise that was radiating from my furnace's thermostat wires. When the furnace was on, the noise floor would rise about 10 dB as viewed on an RFSpace SDR-IQ receiver — an unacceptable situation. In my "might-need-it" garage, I found a bunch of random toroids that were the right size to make chokes.

None of the toroids were marked or color coded. Winding chokes and testing them would be a pain because there are about 10 wires in the two thermostat lines and it would be very hard to determine which chokes were effective.

Then I thought: "How about using an antenna analyzer to evaluate the toroids?" I have a MFJ-259, which is a good HF signal source. If one places a 51 Ω resistor across the output, the meter will read 1:1 and 50 ohms [remember to set the analyzer's frequency band to the one you are trying to block — *Ed.*]. That's good. Now put a 1 foot piece of wire across the resistor and the SWR goes infinite and the resistance goes to zero.

Now make the wire disappear. Thread a few of the same looking toroids on the wire and put the wire across the resistor. [When working with toroids remember that while different toroids may look alike, their electrical behavior depends on the composition of the toroidal material and can vary widely. When testing, test individual toroids singly before attempting to combine them. — *Ed.*] What happens? If the analyzer shows 50 Ω and 1:1 SWR, you have found the toroids that will "choke" the signal at the frequency of the analyzer. Go up and down the HF band to see how effective the toroids will be on the frequencies you are concerned about. Next, wind a few turns of wire through one of the "good" ones and do the same test. If it shows 1:1, the toroid will work.

This method quickly identifies toroids that would be effective at blocking the desired frequencies. It will not tell you the power handling capability of the toroid, just its ability to prevent RF from passing.

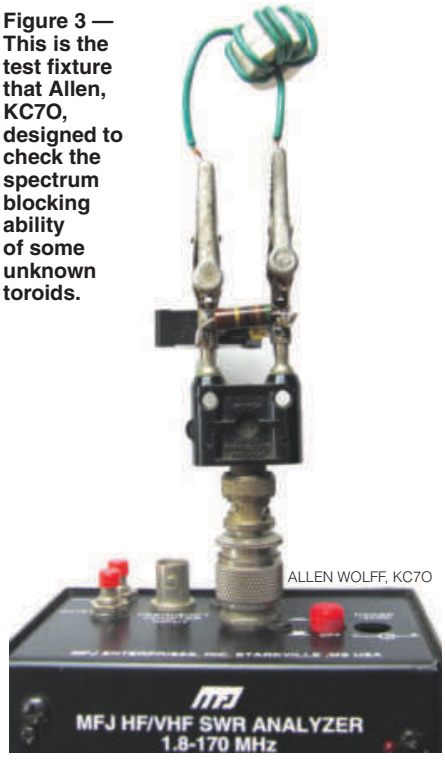

Figure 3 — This is the test fixture that Allen, KC7O, designed to check the spectrum blocking ability of some unknown toroids.

I made a simple fixture to attach to the MFJ analyzer to do the measurements (see Figure 3). The parts needed are a PL-259 connector, two alligator clips, a 51 Ω carbon resistor (any noninductive resistor around 50 Ω will do) and an insulated support for all the parts. I also added a normally open pushbutton switch to place a short across the resistor to verify that RF is present, but it's not necessary. — *73, Allen Wolff, KC7O, 57 West Grandview Ave, Sierra Madre, CA 91024*, **kc7o@arrl.net**

A T-CONNECTOR L-MATCH

◊It is well known that the low radiation resistance of a shortened vertical antenna means it will not be a good match for 50 Ω coax unless some kind of matching network is used. Fortunately, an L-match circuit is easy to make by shunting a capacitor or an inductor to ground at the antenna feed point.

I use helically wound Hamstick-type antennas for HF mobile. The L-match is a good way to get a match to the coax. I was inspired by a *QST* article by Phil Salas, AD5X, that described a mobile mount with switchable capacitors.[2] I wanted something quicker and easier than the elegant AD5X method.

My solution is to use a base mount with an SO-239 connector opposite the antenna stud end. Instead of connecting the coax directly to the mount I attach a coax T-connector. On one side of the connector I connect the coax from the transceiver. On the other side I connect a coax plug with a fixed capacitor attached. I prepared plugs with capacitors for the bands I expected to operate. Figure 4 shows how this works. I use cut-down crimp-type connectors for the capacitor plugs.

It is easy to experiment with different capacitor values using alligator clips and a banana plug. In this way I determined that 400 pF made for a good match for 40 meters and that 150 pF worked well for my 20 meter antenna. Experiments indicated I had satisfactory matches on 15 and 10 meters with no shunt capacitor, but I may revisit this when I start to operate more on the higher bands.

Weatherproofing is a concern for any outdoor antenna, mobile or fixed. I coat the capacitor and the body of its plug with a weatherproof material like so-called liquid electrical tape or I wind a generous length of ordinary electrical tape over it. When I want to operate without a capacitor I put a weatherproof cap on the open end of the T-connector. Rubber furniture feet from the hardware store work well for this. — *73, Al Woodhull, N1AW, 199 Eden Tr, Leyden, MA 01337-9580*, **n1aw@arrl.net**

[2]P. Salas, AD5X, "A Mobile Antenna Base with Internal Capacitive Matching," *QST*, Feb 2004, pp 43-46.

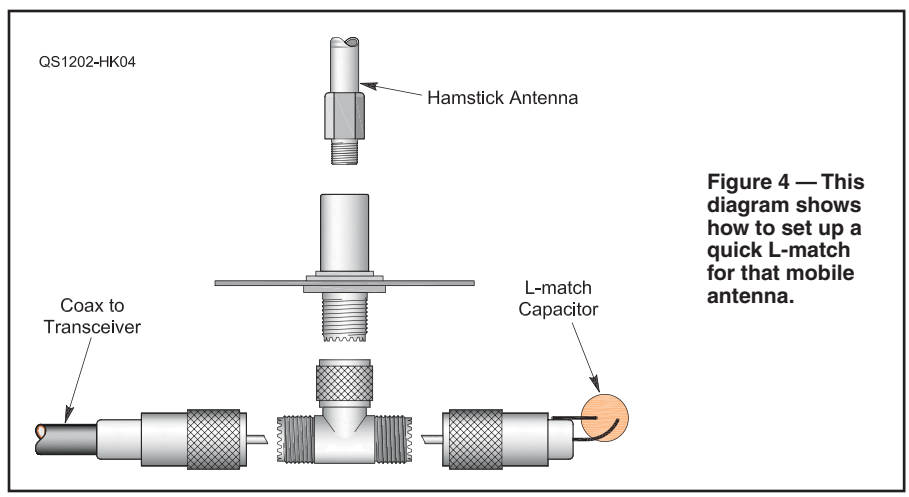

Figure 4 — This diagram shows how to set up a quick L-match for that mobile antenna.

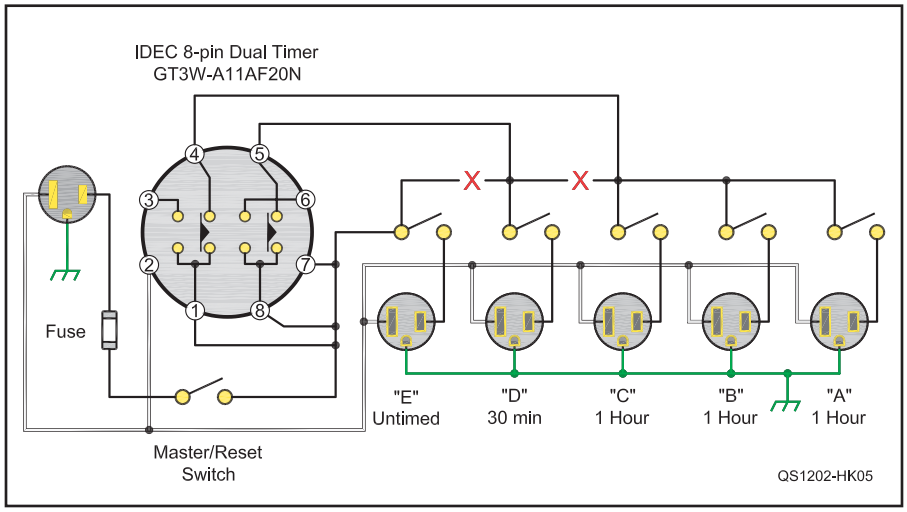

Figure 5 — Schematic of the soldering station timer.

SOLDERING STATION SAFETY TIMER

◊ Over lunch one day, Wayne Frazier, WA4FTY, revealed to me that he was always forgetting to turn off his soldering station and he was thinking about putting it on a timer. Since I have left my soldering station on longer than needed a time or two also, I decided to take his idea on as a project.

First, I repurposed a computer power center that was originally designed to go under a CRT computer monitor as my project box. I then wired a prepackaged 100-240 V ac dual timer in series with the box's main power switch, which can then also be used as a reset switch for the timer (see Figures 5 and 6). I left one of the outlets untimed. After securing the timer in place I buttoned up the box and relabeled the switches and outlets. I then super glued a bunch of magnets to its top for holding my soldering station and tools in place. This little project is not only useful and satisfying but it saves electricity, extends the life of your soldering iron's tips and who knows, it could prevent a fire.

The parts used in this project were dictated mainly by the contents of my junk box. The timer that was in my junk box is a fairly expensive dual timer manufactured by IDEC (part #GT3W-A11AF20N). It can be purchased at **Newark.com** (part #26H1600). A more common single timer such as the GT3A-1AF20 (Newark.com #30B6173) can also be used, at substantial savings. Both of these timers have a built in power supply that runs off of 100-240 V ac, can handle a 350 W load and, although I chose to set mine at 30 minutes and 1 hour, they can be easily adjusted to operate from less than 1 second to more than 100 hours. — *73, Joe Morse, AD4W, 317 Westlawn Rd, Columbia, SC 29210-5622*, **ad4w@sc.rr.com**

JOE MORSE, AD4W

Figure 6 — Here is the computer power center with the timer installed.

GROUND REMOVAL TOOL

◊When it comes to ground rods it's the same old problem: How do you get them out once they're in the ground? This can be a big problem on Field Day with its temporary ground rods. This tool makes removal easy.

The handle is made of 1-inch-OD black pipe (see Figure 7). The pivot is a 4 inch length of 3-inch-OD ¼-inch-wall pipe with a 1 inch U-bolt. The steel plate is 3 × 2 × ¼ inch steel

JOSEPH BUTVIN, KB3QQT

Figure 7 — Joe's removal tool in position and ready to lever the "ground rod" out of the Field Day site.

plate with a ¾ inch hole drilled a ½ inch from the end. The chain is 1¾ inches long with ¼ inch links. The welds should be on top of the handle and on the bottom of the steel plate.

To use the tool, position the U-bolt about 5 inches from the handle's end. Place the steel plate over the rod as shown in the figure. When you push down on the handle the plate will grab onto the rod and pull the rod from the ground. — *73, Joseph Butvin, KB3QQT, 114 Circle Dr, Donegal, PA 15628*, **kb3qqt@gmail.com**

MOBILE MIC MOUNT

◊When I purchased my 2005 Mazda pickup, I immediately installed a 2 meter mobile radio but had problems finding a good place to attach the microphone hanger. There were no available screws or tie points and using the cup holder to hold the microphone was inconvenient and sometimes unsafe. Looking over the dashboard, a couple of possibilities emerged, namely, the 12 V power taps. This vehicle has two on the dashboard.

I found a piece of PVC rod that was 0.810 inch diameter and cut it 1.5 inches long. Then I drilled a pilot hole, concentric in the center of the rod, and used a small screw to attach the microphone hanger to the rod. I pressed it into the power tap; it was a perfect fit and very convenient spot to hang the microphone. It won't come out until you take it out and will not damage or short out the power tap. Since most people won't have PVC rod of this diameter, an acceptable substitute might be a piece of ¾ inch dowel, with some ¾ inch electrical tape wrapped around it to increase the diameter. — *73, Henry Brown, K1WCC, 19 Sao Paulo Dr, East Falmouth, MA 02536,* **k1wcc@arrl.net**

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QRP to the ISS

Contacting the International Space Station with a few watts and a shoestring budget antenna.

Doug Cook, KD5PDN

There's a Kenwood TM-D700A transceiver traveling 4.3 miles every second as it dashes across the sky 240 miles above our antennas. This D700A is the Amateur Radio station aboard the International Space Station (ISS), which zips around the Earth every 90 minutes.

This radio serves several roles. It can be used to contact schoolchildren during flyovers. Astronauts can talk with students using Amateur Radio equipment set up in the classroom by a local volunteer. Astronauts can also call down and talk to operators in their spare time — many have ham licenses themselves. Finally, it could serve as a backup communications method should the multimillion-dollar space communications system falter.

It's usually operating 24/7. This radio has a function known as a digipeater. Amateur Radio operators can send packets of data to it and the ISS will retransmit it back to Earth. It's like text messaging or SMS — information is being exchanged. We call it APRS (Automatic Packet Reporting System) and it's useful for distributing real-time reports of information.

An FM transmitter with packet capabilities, a terminal node controller (TNC), 50 W of power and an omnidirectional whip antenna should allow ISS contacts. I discovered how to use my Kenwood TM-D710A transceiver to make contacts in this manner. A search on the Internet will locate websites and several YouTube videos that show how to set up this radio.

My Yaesu VX-8R had APRS capabilities thanks to its built in packet modem. These radios are handy on the ground for communications, but 5 W to the omnidirectional flexible antenna probably would not reach the ISS in most attempts even under ideal conditions. We need to get 5 W of power to an orbiting station traveling at 17,000 MPH. A beam antenna can best fill this role.

A beam antenna can take most of the radio's output energy and focus it in one direction. I decided to build a tape measure antenna since its cost is minimal and it requires only basic crafting skills. The tape measure antenna is a modified Yagi design with elements made of the metal blade from a tape measure, cut to a specific frequency and positioned to create a focused radiation pattern.

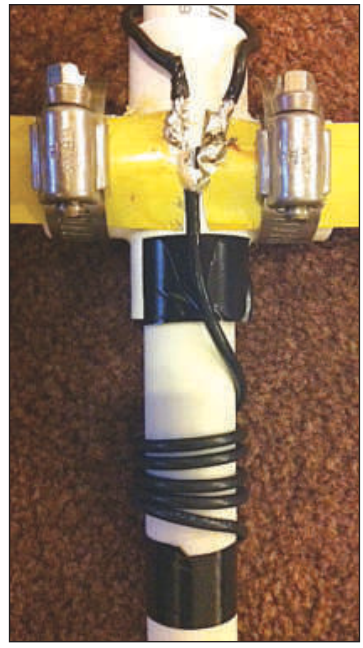


Figure 1 — The director elements can be moved closer in or out to optimize the SWR a little. Don't let them touch.

Figure 2 — This is a close-up view of the Yaesu VX-8R and camcorder assembly.

Tape Measure Antenna

I began my antenna using the design on Joe Leggio's, WB2HOL, website (**theleggios.net**). I also consulted a Yagi antenna calculator on James Stewart's, N3DNO, website (**bfn.org/~bn589/antenna.html**). I wanted my antenna optimized for 145.825 MHz — the frequency of the ISS digipeater. The lengths of the elements from the calculator came out a bit longer than the design published by WB2HOL. I decided to cut mine to this length knowing that I could trim them down if needed. After assembly I used an MFJ-259B antenna analyzer to tune it to an optimum SWR.

My original length of the director element was set at the original spec of 12.5 inches. My SWR measured 6.8 as constructed. I maneuvered the driven elements closer and the SWR lowered just a little (see Figure 1). I next varied the forward director element until it reached the best SWR reading at 1.0. This ended up about 4.5 inches from the driven element — a lot shorter than the original plan's specified 12.5 inches or even the Yagi calculator result. The distance from the driven element to the reflector remained unchanged at 8 inches as the design specified. I didn't seem to get much change in varying this distance. I trusted the readings from the analyzer so I finished the assembly. The nice thing about PVC pipe is that you can easily adjust and cut a new piece if you have to change it later.

My total cost was about $15 including hardware. I used a spare length of RG-174A cabling with an SMA male connector so it would hook up to my VX-8.

Enhancements for Ease of Use

The tape measure antenna is designed for handheld use. However, I wanted to record the audio and video of the encounter and desired an assembly that could mount to a common camera tripod so my hands would be free. I fabricated a steel slotted bracket bought at a hardware store to attach the antenna assembly to my radio (see Figure 2). I bent the steel bracket into an L-shape. At the far end of the L I attached a camcorder so it could record the audio output and video the radio display as well as act as a counterweight for the antenna assembly. The camcorder was attached with a standard ¼ inch bolt trimmed to securely mate the bracket to the existing camera's tripod mount.

A second smaller L bracket was made and attached to the larger L bracket by wing nuts and bolts. This bracket holds the VX-8, which itself attaches by its belt clip. The whole assembly attaches to a traditional camera tripod secured by a ¼ inch wing nut. This attachment point is its balance point and the antenna can be aimed with one hand after adjusting your tripod's positioning levers to offer just enough resistance to keep the antenna aimed without drifting (see Figure 3).

Planning for Flyovers

Amsat.org offers prediction services but I chose to use **heavens-above.com** to discover upcoming ISS flyover opportunities. This online utility can project both visible passes and all passes. I chose "all passes" to increase the number of opportu-

nities. If you find a "visible pass" it will be easy to keep your antenna pointed accurately, but passes will be less frequent (see Figure 4). The predictions plot the opening time of the expected flyover window, the minimum angle compass bearing from your position at the beginning, the maximum elevation and the bearing at the end of the flyover. A hardcopy and a synchronized watch are the only tools you'll need to help aim the antenna in the proper position at the correct time. Once you start hearing the ISS signal, your transceiver's S meter and audio output will offer cues toward aiming.

You can also use NASA's online app (**spaceflight1.nasa.gov/realdata/sightings**) to predict overflights. The NASA predictor may be more up to date if maneuvers are underway before the satellite elements data gets updated on other online resources.

Satscape (free) is a very good *Java* application that can be used with *Windows*, *Mac* and *Linux*. *Windows* software includes *NOVA for Windows* ($59.95). Mac users can consider *MacDoppler* ($98). In addition to prediction, *NOVA* and *MacDoppler* can control automated systems for antenna rotators.

For smartphone and tablet users other programs I find useful are *ProSatHD* ($9.99 for iOS) and *PocketSat3* ($24.99 for iOS or Android). I use *ProSatHD* more often. It offers an updated display of the satellite in its current position. This software provides a real-time position of your target along with a circle of its horizon to let you know when the satellite is nearly in position to make contact. It offers an overflight plot that can assist in planning your antenna trajectory for your hand tracking and offers real-time elevation data to determine the antenna's angle of elevation for best reception. You will want to update the database before leaving for a remote location so you have the most recent and accurate satellite position data elements.

The program also offers calculations to estimate the effects of the Doppler shift of the frequency as it approaches and recedes. I found that adjusting my frequency was not necessary in any of my attempts in the 2 meter band but 70 cm band operations often do require adjusting for the effect since Doppler shifting is more pronounced there.

Finally, it pays to see if the digipeater is turned on. Websites such as the ISS Fan Club at **www.issfanclub.com** will have reports on the status of the ISS's Amateur Radio station. The website **ariss.net** displays the latest APRS beacon information, or you can look at the Twitter feed **twitter.com/RS0ISS** to get the latest update. This can avoid the disappointment of waking up in the middle of the night only to find the station's radio is off.

Beaconing or Messaging

The APRS functions of the built-in modem and TNC include transmitting and receiving both beacons and messages. For your first ISS flyover, I recommend using the beacon function. Radios with APRS beacon functions let you set up a message to be included with your beacon. For the VX-8 this setting is labeled BEACON STATS TXT. Once you are more familiar with using your radio for beaconing, you can explore message sending.

Figure 3 — This is how the setup looks ready for action. A protractor is mounted below the antenna with a washer on a string to "display" the elevation angle. On the left are the handheld transceiver and the camcorder attached to a homebrew mounting bracket. The whole assembly is being held on a standard photo tripod.

Figure 4 — I took this image on August 10, 2011 from my backyard. In the foreground my tape-measure antenna is set up in position to make contact with the digipeater on the International Space Station, which is traversing the sky leaving a trail in the exposure.

Radio Setup

Whether you are a novice or an Elmer, there is a learning curve with sophisticated transceivers like the Yaesu VX-8 series. Guides exist on the Internet to help users set up specific models. The VX-8 can be programmed to provide position information and call sign. It also has customizable beacon settings and alert features that can be activated upon receipt of messages and beacons. See the sidebar for VX-8 links.

The Encounter

I set up my antenna at about a 10° elevation and free from obstructions in preparation for encounters. I found my antenna design does not require absolute laser precision in keeping the antenna aimed, but the best results occur if you can aim by following a printout or program display that predicts the elevation with time. For handheld use, it's easy to aim. With the bracket I have a counterbalanced assembly adapted for one-handed operation.

I adjust the antenna about once every 15-30 seconds. Adjustments occur more often when the ISS is near overhead. The packet data is broadcast in brief pulses that lasts about ½ second. The sound of an APRS transmission is similar to the handshaking sounds that occur at the beginning of a telephone modem connection. You will hear the signal attempts coming in for a minute or more before your radio will give you an indication that it is receiving good data.

Keeping your APRS MUTE settings OFF is required for the Yaesu VX-8 family to allow you to hear the first signal coming in, but do not turn your squelch to zero as you might for voice contacts. If you hear the signal degrading audibly it may be time to reorient the antenna. Some radios have musical note pattern tones that give feedback on good acknowledgments and fully received data for beacons, data and your position. I recommend keeping radio settings for audio feedback turned on if equipped. Beacons can be sent manually to minimize interference to other stations transmitting.

Results

With my antenna aimed properly I commonly hear transmissions when the ISS is

more than 1000 miles away. Almost all of these signals are not strong enough for the modem/TNC to interpret and log. Signals robust enough to be decodable began when the ISS was 600-300 miles away during my tests with the antenna I built (see Figure 5). I have seen valid beacons in my log from as far as 1000 miles away on a few occasions.

You should expect an average operating window of about 4 minutes during the best passes (2 minutes advancing plus 2 minutes receding on near overhead encounters). I would get an acknowledgment about 40% of the time with my beacon transmissions during this window. Reasons for not having 100% response probably include local pileups of the ISS receiving packet signals from other sources — especially if others are using more powerful transmitters. It's also possible the return packet acknowledgments are not being received because of the same interference. The farthest I have sent a packet to get an acknowledgment was 700 miles with my 5 W radio. As the ISS wanders away from you, signals will, of course, become more difficult to decode.

When your ISS encounter is over, you can review the APRS beacon data and messages logged in the radio's station listing and APRS message log. You can review this during your encounter, but it may be difficult to press buttons while aiming.

On my radio's station listing, I found the ISS call sign at the time of this writing as RS0ISS-3. Its APRS icon appeared as an airplane. There were no GPS coordinates and it reported no course or altitude. Its position comment appeared as IN SERVICE. The BEACON STATS TXT on its beacon said Atlantis&Nicole heading home. This information may sit for months on the ISS radio without attention, or could be updated at any time.

You can also look at **ARISS.net** or **APRS.fi** to see if your beacon made it to a ground station, which forwarded the information to the Internet. Not all beacons make it to the Internet, so don't be disappointed if you don't see yours. It's also possible for your beacon to make it to one site but not the other. Obviously, if your own call sign appears in your TNC's "head list," that's proof you were successful.

Messaging

Messaging is the second APRS function apart from beaconing that was used on that first flyover. Handheld transceivers and mobile radios with APRS functions can store messages received from others for later review. Reading then composing a message on the fly with just your radio keypad is cumbersome during passes. Many hams attach a computer to send and receive APRS messages. This allows less awkward message composition during the limited time window. *UISS for Windows* is a freeware program that allows you to turn off the radio's APRS function while leaving its TNC on to review and send messages via a computer. *AGW Packet Engine* (also freeware) allows a PC to communicate to the radio connected by a serial cable.

You can include a message of a few characters with your beacon by setting it up on your radio. This function may be labeled as STATUS TEXT or BEACON STATS TXT in your settings. Once you are more familiar with reliably working your radio for beaconing, you can explore message sending.

Astro Chats

Now that you have APRS accomplished, you can try voice contacts with the same gear. On rare occasions you may be lucky to hear 145.800 MHz frequency activity. Astronauts use this frequency to chat with other ham operators in their off-duty time or, more commonly, engaged in the middle of a scheduled contact with schoolchildren on the ground.

It surprises me that a small handheld transceiver and a handheld antenna with such small amounts of power can work the ISS. With a little crafting, a little reading and persistence you too can work the satellites.

NASA

Figure 5 — The International Space Station is featured in this image photographed by an STS-133 crew member on space shuttle *Discovery* after the station and shuttle began their post-undocking separation.

Additional Information

Doug's YouTube video of an ISS encounter with tips on using a Yaesu VX-8R can be seen at **www.youtube.com/watch?v=HdS3EqRooN8**. Other online resources helpful for amateur satellite information:

www.work-sat.com — probably the best website; updated frequently with tips for working satellites with your handheld transceiver

amsat.org — for any Amateur Radio satellite information

issfanclub.com — for ISS information and current status of its Amateur Radio from user submitted reports.

arissat1.com — for information on the ISS-launched ARISSat-1 satellite

www.worldwidedx.com/satellites-space-communication-topics — discussion forum

groups.yahoo.com/group/VX_8R — advice on the Yaesu VX-8R radio

I would like to acknowledge the following hams for their help in preparing this article: Lisa Cook, KD5PJM; Bob Bruninga, WB4APR; Clint Bradford, K6LCS; Larry Holden, W5MPA; Oscar Staudt, WB5GCX; Clayton Coleman, W5PFG; Erwin van der Haar, PA3EFR; Fred Piering, WD9HNU; Scott Patterson, KC9TVK, and Andy Cunningham, M0HAK.

Photos by Doug Cook, KD5PDN, except as noted.

Dr Doug Cook, KD5PDN, an ARRL member, works as an optometric physician in Guthrie, Oklahoma. He has been licensed since 2001 and is active in Scouting as well as Amateur Radio. He can be reached at 217 Mockingbird Rd, Guthrie, OK 73044, **twoeyedox@gmail.com**.

To the End of the Earth – Antarctic Activity Week

Swing your beam south and join in the Antarctic action February 20-26.

Ruth Vano, KB0USC

OLEG SAKHAROVM, R1ANF

The Russian Bellinghausen Base is visited by a group of seals. This Russian Antarctic station is located at Collins Harbor, on King George Island, part of the South Shetland Islands.

During 2011 worldwide hams participated in a special event that ran from February 21-27. This special event was the eighth edition of Antarctic Activity Week (AAW). Amateur Radio operators participating in the event made contacts to raise awareness of the international science community and Amateur Radio operators in Antarctica. Some contacts were like a contest, one after the other, with a signal report and QRZ for the next call; some were more relaxed with longer ragchewing conversations with fellow hams, but all centered on Antarctica.

Danilo Collino, IZ1KHY, at Mario Zucchelli Station standing before the rhombic antenna holding the hat of I1HYW that was given to him before his departure.

Gianni Varetto, I1HYW, is one of the founders of the Worldwide Antarctic Program (WAP) an organization dedicated to hams and Antarctic chasers that has been active since 1979. As part of the Worldwide Antarctic Program, a special Amateur Radio activity was created called Antarctic Activity Week (AAW). The first AAW was in 2004. The creators were looking for special call signs that ended in ANT or AAW, and Amateur Radio operators all over the world who were willing to participate. The WAP effort has continued with the AAW yearly activity in the last week of February each year. The program is growing in participants and numbers.

Fifteen nations were active in the 2011 Antarctic Activity Week. These included Austria, Bulgaria, Canada, England, France, Germany, India, Italy, Lithuania, Romania, Slovenia, Spain, Switzerland, Ukraine and the USA. Forty-five special event stations from these countries worked their radios and gave out WAP reference numbers during this eighth annual AAW.

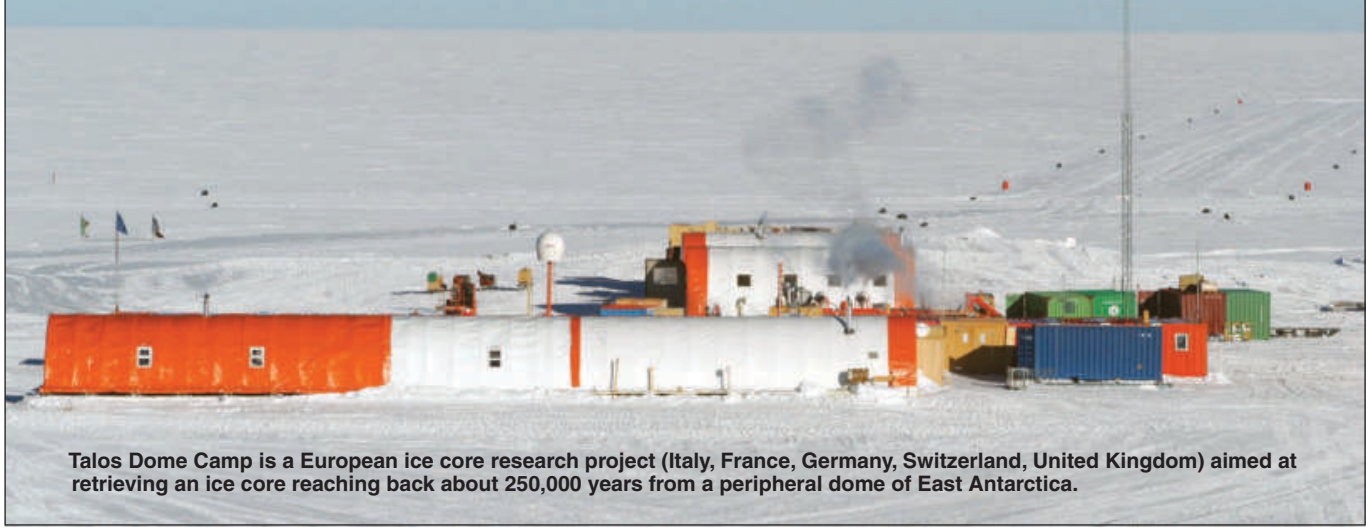
The Kansas Antenna Club station with the call sign K0ANT and Worldwide Antarctic Program (WAP) reference number 198, in the United States participated making over 40 contacts despite being shutdown for a time due to thunderstorms in the operating area. One notable contact was a retired pilot, a South African now living in Tennessee, who had worked for the British expedition. He reminisced of a time when he flew a C-130 transport regularly carrying supplies to McMurdo station. Others enjoyed talking about friends, relatives and/or children who have spent time working in Antarctica.

In Canada, using the special call sign VB3ANT and WAP number 188, Edmondo Conetta, VA3ITA, worked over 400 contacts. He set up a link to a live Internet stream of his station's webcam for anyone who wished to see him operate. Contacts he worked worldwide could get instant feedback and hear their signals live online from his shack. From Italy, with the special call sign IR0AW, WAP number 202, the Italia Zero DX Group made over 2000 contacts during the 2011 AAW.

The International Continent

Despite extreme conditions, vast amounts of ice and long periods of darkness, scientists from all over the world come together to conduct research in remote Antarctica — the coldest place on earth. The coldest temperature ever recorded for the region is –129° F.

It is the most southern land mass in the world. The environment is less than friendly, its surface consisting mostly of a snow-covered ice sheet with long periods of darkness where the sun seems to have abandoned the continent. Although hostile, the icy area hosts seals, penguins, skua birds, plants and other organisms that adapted to withstand the cold conditions. And for periods of time, it is also



Talos Dome Camp is a European ice core research project (Italy, France, Germany, Switzerland, United Kingdom) aimed at retrieving an ice core reaching back about 250,000 years from a peripheral dome of East Antarctica.

home to a few thousand international scientists and their support staff.

International effort and cooperation resulted in treaties acknowledged and adopted by several countries, which designate Antarctica as a scientific preserve. Countries have agreed that military activity is prohibited on the continent and it is politically neutral. There are various scientific research stations located in Antarctica, supported by several countries such as McMurdo (US), Esperanza (Argentina), Mario Zucchelli (Italy) and St Kliment Ohridski (Bulgaria).

These stations are manned with dedicated scientists and skilled staff. Among them are active licensed Amateur Radio operators eager to make contacts and send QSL cards. All over the world there are hams who wish to make contact with those stationed there.

In Antarctica hams raise their antennas on the ice sheet where seals and penguins are within arm's reach. Their unique surroundings are filled with beautiful scenery, such as an ice formation on the water, the eerie depths of an ice cave, icebergs with their unique formations or penguins as they waddle across the frozen land.

Kindred to the international spirit that drives scientists all over the world to work together is the international spirit of the Amateur Radio community. Hams, with their love for radio and the opportunity to communicate with people all over the world, come together to participate annually in the AAW. The event spotlights the sacrifice of these scientists as they seek to increase our knowledge of the Antarctic.

The Amateur Radio community recognizes the dedication of the scientist and understands their isolation and sacrifice in this region. Some of them are separated from family for long periods of time and all are without many luxuries we take for granted. The weather conditions can be dangerous, with some areas not accessible all year round. The world is grateful for their willingness to brave these extremes to further advance science and to preserve and protect this pristine environment while working to unlock its secrets for all the world to know.

For the Amateur Radio operator stationed there, it is an opportunity to hone their radio skills in a challenging location. Whether it is figuring out how to put up an antenna on the mainland or working operations on a polar ship, it is a challenge.

Antarctic Activity Week

The purpose of AAW is to draw attention to the Antarctic Continent and to help everyone to understand what the world's nations are doing to protect Antarctica, which is still uncontaminated by modern human activity. The AAW is held in February because that is the middle of the Antarctic summer and almost all the Antarctic bases are open and active. During the AAW hams can collect Antarctic Special Event Stations (SES) contacts that can then be applied to the three Antarctic awards:

- Antarctic Special Events Award (ASEA) (**www.waponline.it/WapAwards/tabid/61/Default.aspx**) for working at least five of the 43 Special Event Stations. A list of Antarctic SES can be found at **www.waponline.it/WAPSpecialCallsign/tabid/116/Default.aspx**. Endorsements are available for working Antarctic stations beyond the basic level of five.
- Worked Antarctic Call signs Award (**www.waponline.it/WapAwards/WACAAwards/tabid/90/Default.aspx**) for stations who have worked 10 different Antarctic call signs. An endorsement for working the full list of stations is also available.
- Worked Antarctic Directory Award (**www.waponline.it/WapAwards/WADAAwards/tabid/92/Default.aspx**) for working 10 different Antarctic bases belonging to at least three different countries.

The AAW Special Event

For detailed information about WAP, AAW and Amateur Radio operations in Antarctica, visit the WAP website at **www.waponline.it**. This extensive and entertaining website brings fascinating Antarctica to you. On the site you can find the history of the Antarctic Activity Week, which countries participated in the past and where you can register your club or personal call sign to participate in this year's event. Each registered station is assigned a WAP number for special event awards.

You can access stories from Amateur Radio operators who have resided in Antarctica as well as articles describing WAP activities for the special event and how you can earn the awards that are available. Whether it is a maritime contact or a contact from one of the base stations, the Antarctic region makes a fine addition to any QSL collection.

The WAP enthusiasts hope to hear you February 20-26 for the ninth edition of the Antarctic Activity Week. Collect those WAP reference numbers. Better yet, get one for your special event call sign. Hope to work you during AAW 2012. 73 and good DX.

Unless otherwise noted, pictures are courtesy of Gianni Varreto, I1HYW.

Ruth Vano, KB0USC, an ARRL member, is an attorney who has been in private general practice for 24 years. She obtained her Amateur Radio license in 1995. Ruth has taken part in storm spotter certification with the Johnson County Emergency Communication Services, Inc and is a member of the Santa Fe Trail Amateur Radio Club. Ruth volunteers as counsel for these two organizations. She is also a member of the area CERT program. She has two Yaesu FT-7900R U/VHF transceivers, one for her vehicle and one for a base station. She enjoys EchoLink operation. Ruth can be reached at 11713 Hardy St, Overland Park, KS 66210, **kb0usc@arrl.net**.

A Beginner's QRP Moonbounce Adventure

It only takes a small station to work the biggest DX.

Clair Cessna, K6LG

Until recently, moonbounce communications have been the domain of high power stations using large antenna arrays. In the last few years, weak signal digital mode innovations, especially JT65B (**physics.princeton.edu/pulsar/K1JT**), have made it possible for modestly equipped stations to make EME contacts.

Like many hams, I was largely unaware of these developments — and that I had gear that, with some additions, could be cobbled into a low power (QRP) moonbounce station. It was April 18, 2010 and I was on hand at a friend's station to hear KP4AO, the Arecibo Observatory ARC, on 432 MHz CW, SSB and JT65B — the first ham signals I had ever heard from the Moon.[1] John Oppen, KJ6HZ, was using a four Yagi array, but we could also hear the signals on a small handheld Yagi. John would become my mentor as I embarked on a project to try EME.

Setting Up the Hardware

Having been active on the high orbiter ham satellites some years ago, I already a Yaesu FT-847 transceiver, an old Tokyo Hy-Power HL-120U amplifier (rated 40-60 W continuous duty) with internal preamp and a Yaesu G-5400 azimuth-elevation rotator, but not the Yagi.

I was lucky to have a friend who loaned me an M^2 432-9WL beam, which uses 28 elements for a 9 wavelength Yagi (17 dBd). He also made up two lengths of new LMR-400 coax with N connectors — 8 feet from amplifier to Yagi and 40 feet from amplifier to shack. Later an autoswitching ARR preamp (17.7 dB gain, 0.6 dB noise figure) was added just before the power amplifier to replace the noisier internal preamp.

A steel fence pole elevated the rotator to 10 feet off the ground. The boom mount clamp was rigged to facilitate polarization adjustment (see Figure 1). The 21 foot long Yagi was trussed with a PVC support and cotton clothesline rope to counter sag and misalignment of the elements (see Figure 2).

The amplifier, preamp and power supplies were put on a small wagon, which is wheeled outside under the Yagi when operating making possible the short coax run from amplifier to antenna, keeping losses at a minimum (see Figure 3).

An outdoor wired remote switchbox was rigged and connected to the rotator control in the shack. This makes it possible to visually aim at the Moon and also to adjust polarization at the rear end of the Yagi. A step ladder is used to do this if the boom is nearly horizontal. Fortunately, since the pattern of the Yagi is relatively broad, alignment needs to be done only every 5-10 minutes.

With regard to polarization, one big advantage of using a single Yagi is that polarization can be easily changed by twisting the boom. The Moon data in the JT65 program indicates the spatial polarization angle necessary for aligning with a given DX station. For example, generally from Southern California polarization should be near vertical for a horizontally polarized European. This is a starting point, since Faraday rotation of the signal as it passes through the ionosphere (daytime) on either end of the path may make the angle quite different. Also, at times, best results will be obtained while transmitting vertical and receiving horizontal or vice versa.

Next the Software

The JT65B digital mode, created a few years ago by Joe Taylor, K1JT, with his subsequent improvements and those of collaborators, is the secret of QRP EME success.[2] JT65 is a soundcard mode. If you are set up for PSK or other digital modes just download the free program from Joe's website. You need to be proficient in using this mode before you try to use it on EME. You can usually find JT65A stations on 7.076 or 14.076 MHz, where the signals are generally strong and steady. (JT65A is used on HF; JT65B is optimized for EME but there is no difference in operation.) Read the documentation and practice until you're comfortable with it.

The JT65 mode compresses and encodes standardized text blocks, sends them via FSK composed of a sync tone and 64 data tones. Then, at the receiving end, data is uncompressed and decoded back into text. The

Figure 1 — The PVC bushings allow the boom to be twisted in its mount to adjust the polarization for receiving and transmitting.

Figure 2 — This is the 28 element Yagi mounted on the directional and azimuth/elevation rotators.

[1]Notes appear on page 74.

blocks are sent in automated 1 minute transmissions. Decoding takes place only after the entire transmission is complete. One station transmits on the odd numbered (first) minute and the other on the even numbered (second) minute UTC. Since time accuracy to the second is essential, I set my computer clock via the Internet each time I operate.

Although 13 random characters can be put into text blocks, the standard message format is much more robust. The two-tone short-hand messages RO, RRR and 73 are readable at 5 dB less than even the standard messages (see Table 1).

Tools of the Trade

There are some valuable operating aids available to EME operators. The EME loggers are a great assist especially for beginners. One can get a quick view of who is operating on a particular band and coordinate schedules. The *VK3UM EME Planner* (**www.vk3um.com**) gives all the astronomical data for your station and a particular DX station. Moon windows are shown for both stations, including UTC and local times, azimuth and elevation of the Moon, Doppler shift, spatial polarization, path degradation, sky temperature and more. This makes schedule planning easy.

The JT65 program itself will display astronomical data for the Moon and path conditions in real time. Yes, moonbounce conditions vary from excellent to poor over time. Weekends that are predicted to have excellent conditions bring more action. Programs such as *Nova* or data from **www.vhfdx.info/w5luu.html** and **www.vhfdx.info/emecalendar.html** are great prediction resources.

Operating EME with minimal QRP gear is a challenge and much different from QRP HF operating. This is particularly true on 432 MHz where there are only a fraction of the EME stations operating on 2 meters, the most popular EME band. On 432 it is difficult to find stations by "tuning the band." All of my contacts have been made by prearranged schedules with *very big* guns running high power and using very large antenna arrays.

Figure 3 — The wagon holds the power amplifier, preamp and power supplies. The elevated platform raises the amplifier when the Yagi is horizontal and provides shade. The wired remote rotator switch box is shown on the left resting on the power supply.

Their stations make my contacts possible. Many of the operators of these stations are eager to assist and kindly accommodate us "little fish."

A couple of these have worked stations running 30 W, with Yagis half the length of mine. I e-mailed these operators to arrange schedules, then tried to contact them on the *HB9Q logger/chat* page (**hb9q.ch**) around the appointed time. Even then, my initial attempts at contacts failed.

The Longest DX

Then it happened. Bernd, DL7APV, was calling CQ at the scheduled time and frequency. He was visible on my waterfall display and loud enough to hear through my speaker. I called him and waited on the edge of my chair as his signal came back. The 1 minute receive period seemed endless, but finally the decoded signal popped onto my screen: K6LG DL7APV JO62 OOO. I was ecstatic and went on to complete my first EME contact. It was the greatest thrill of my 60 years of ham radio.

I was fortunate to have been assisted by Al Katz, K2UYH, well known for his encouragement and guidance of EME newbies and editor of the *432 and Up* EME newsletter. After many helpful e-mails and a couple of failed tries, we connected for my second EME contact.

Jan, operating at the Dwingeloo Radio Telescope, PI9CAM, was my third contact, followed by Zdenek, OK1DFC, and Nando, I1NDP. Five countries via the Moon and I still have several more big guns on my schedule request list.

I would still like to make a CW contact via EME but that will require substantial upgrading of my EME station. Of course, the numbers of stations you potentially can work is directly proportional to your power and the gain of your antenna system. You also may wish to consider starting on 2 meters, where the greatest number of EME stations operate.

I'm indebted to my friends John, KJ6HZ, for his guidance and support; Dave, W6DL, for the Yagi and custom made coax; Dave, WB6OVZ, for setting up the wired remote and his valuable suggestions, and Rein, W6SZ, for his help. Thanks to all the big gun operators who accommodated and assisted me, exemplifying the best spirit of ham radio and especially, to Joe, K1JT, whose contributions made it all possible.

I have sent signals from my backyard to travel 240,000 miles to the Moon with a tiny portion reflected to travel 240,000 miles back to Earth to be detected by another ham on the other side of the globe — the *ultimate* DX. Imagine that!

Notes

[1]J. Taylor, K1JT, A. Vazquez, WP3R, J. Breakall, WA3FET, "Moonbounce from Arecibo Observatory," *QST*, Aug 2010, pp 62-65.
[2]S. Ford, WB8IMY, "JT65 — The 'Musical' Mode," *QST*, Apr 2011, pp 45-46. Feedback, *QST*, Jun 2011, p 64.

All photos by Clair Cessna, K6LG.

Clair Cessna, K6LG, an ARRL member and Amateur Extra Class operator, was first licensed in 1949 at age 15 as W6GZP. He is a retired high school science teacher and was radio club advisor in schools where he taught. Clair operates on 160 meters through UHF, using most modes. His favorite is still casual DX contesting on CW. He currently serves as secretary of the Riverside County Amateur Radio Association. He can be contacted at 3975 Madrona Rd, Riverside, CA 92504, **k6lg@arrl.net**.

Table 1
A Typical EME JT65B Contact

First Minute	*Second Minute*	*Information*
CQ K2UYH FN20		CQ call, grid
	K2UYH K6LG DM13	K6LG reply, grid
K6LG K2UYH FN 20 OOO		K6LG copied solid by K2UYH
	RO	K6LG received report, solid copy of K2UYH
RRR		K2UYH received report and confirmation
73		73

Two Bands to Go

The low bands are a rough road on the way to 5BDXCC.

Louis Sica, AC0X

I am a DXer, a chaser of stations far away from my own. The idea that RF energy from my radio can bounce around the ionosphere and wind up at someone else's station in some remote part of the world has an irresistible romance to me. No matter how many times I'm told about the physics behind it, the idea that I can talk to someone thousands of miles away without any wires is just magic. It's even more magic when the place I'm talking to is so exotic that I can only dream about visiting there and even *more* so when the place is so foreboding I wouldn't want to visit.

The appeal of this minor sorcery of sorts has kept me DXing for over 25 years now and in those 25 years I've made contact with hundreds of countries in every region of the world. I'm at a point now in my DXing hobby that the only "entities" (a DXing term for countries that is a combination of actual political countries with remote colonies, possessions and other quasi-principalities) I still haven't contacted can be counted on one hand. I reached DXCC (100 entities contacted) long ago and have gone well past it.

Being so close to the pinnacle of DXing, there are fewer and fewer challenges. Although still in love with DXing in general, I began to miss the frequency that new entities were available to me when I was more of a neophyte in the hobby. I began to look at other DXing awards to chase. The one I decided on is the coveted "Five Band DXCC;" an award where you contact 100 entities on *each* of the 80, 40, 20, 15 and 10 meter bands.

A look at my logbook showed well over 10,000 contacts over the last 20 years and that DXCC had already been reached on 20, 15 and 10 meters. It was in the longer wavelength bands that I was lacking and that was to be expected. The lower wavelength bands are simply more difficult to DX in. Lightning, static and electrical noise are more prevalent, making weaker stations more difficult or even impossible to hear. The longer wavelengths mean antennas have to stretch longer and rise higher to be as efficient as shorter antennas on the smaller wavelength bands.

Most amateurs use compromise aerials on these bands, much lower and smaller, in relative terms, than those used on 20, 15 and 10 meters. Still I had several dozen entities on 40 meters and about a couple of dozen on 80. I expected my goal of 100 on each to not only be possible, but not even all too difficult. I was going to find out how naively wrong I was.

Game On

I first concentrated my efforts on 40 meters, believing that the shorter wavelength band would be the easier one. Although I was correct, the band wasn't without its difficulties. First was a disturbance of my normal sleeping schedule, but I had expected that. Eighty and 40 meters are "darkness bands" and any DXing on them is done between sunset and sunrise. The 40 meter band is also populated by high-powered international broadcast stations. The skills I had learned combined with the judicious use of Morse code, got me past broadcasters, this despite the fact that my station is what many DXers would call "limited." For various reasons I am unable to operate my transmitter at 1500 W and am limited to only 100 W. Although a common limitation in the Amateur Radio world, it is unusual for DXers at my level.

Here is Louis, AC0X, at his station with his hard-earned plaque and the QSL for entity #100 on 80 meters.

My antennas for the lower bands are also shorter and lower than typically used by DXers attempting to reach the goals I was aiming for. This made my signal harder to hear over the increased noise levels at other stations with their often-compromised antennas. This gave me my first real experience of what is called "being CQed in your face." This refers to a station not responding and not hearing your own repeated attempts to answer their CQ and continuing to call, "in your face," as if you weren't there.

Still, I persevered and with some time, effort, frustration and lack of sleep, I reached my goal of 100 entities on 40 meters. One more band to go and I was sure it wouldn't be very difficult, especially with the skills I gained and honed on 40 meters.

The Big Leagues

I had made several contacts on 80 meters before, mostly local and stateside, but also enough foreign contacts to accumulate the previously mentioned couple of dozen entities. But those entities were the "easy ones," mostly Caribbean, Central American or other North American places. My goal of 100 entities forced me to look past those places and face the painful reality.

First, my "compromise station" was far more of a hindrance on 80 meters than it ever was on 40 meters. I discovered that although hams with such a limited station could do some DXing on 80 meters, it was *extremely* rare for them to even think of actual *goals* on that band.

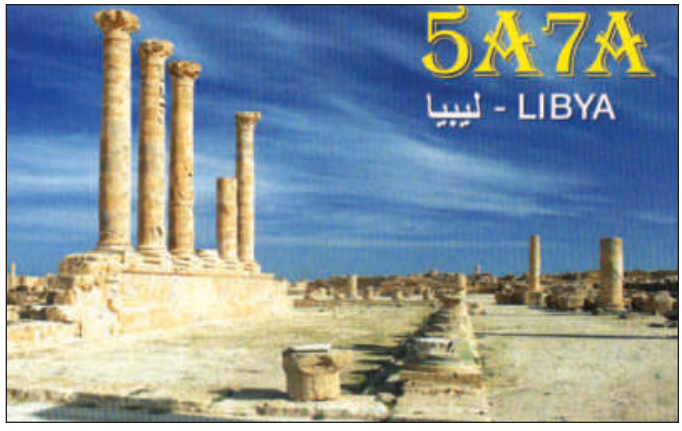
My location, in almost the dead center of the continent, hindered me even more. Considering the compromises of my station, the extra 1000 miles my signal needed to travel over land versus water seemed as if it were the flight path of a moon mission. Stations heard outside of the North American area were few and far between. In addition, the "mountains" of difficulties I had encountered on 40 meters seemed to be sheer vertical drops on 80.

Noise levels were immense, even in the supposedly electrically quiet months of winter. I had heard the amateur metaphors describing it as "muck," "mud," "crap" and many much more colorful epithets and *really* understood them now.

The University of DXing Humility

Operating on 80 made me the recipient of an 18 credit semester in the University of DXing Humility. A place where I learned that the dreaded "CQ in Your Face" I was introduced to on 40 meters is normal practice on 80. This is even *more* painful because

The AC0X antenna farm with the inverted V he used to capture those elusive low band contacts.



This is QSL number 500 — the final prize.

many of the stations doing this were often *very* loud at my station. So, I had to endure listening to other, less compromised stations make *easy* contacts with the CQing station only to end with the fatal blow of hearing the CQing station say "I guess not many stations are on tonight, I think I'll sign off." All the while I was sending my last desperate calls, voice hoarse or hand cramped from desperate keying and my whole body depleted from a lack of sleep.

My late night contacts on 40 meters became multi-hour, early-morning desperation sessions on 80 meters. The only reason my spouse didn't wonder why my side of the bed was empty all night was that she was awakened frequently by a rhythmic buzzing or garbled voice from the clock radio every time I made another desperate call.

I also learned about operating limitations I never even had to think about on the other bands. I learned that, for many, even for many very strong stations, 80 meters is a band they go to, to *avoid* DXing. They go there for casual chats. So while they may clamp their headphones to their ears and try to hear that weak station (yup, that's me) calling them on the other bands, on 80 meters they're only interested in stations strong enough for a ragchew. Your weak signal gets ignored.

Even the tools used on the higher bands proved inadequate on 80 meters. The various Internet spotting websites with information on what frequencies rare DX stations are heard and worked might as well be maps to Bigfoot sightings. I went to the listed frequencies and often heard nothing but noise and local stations contacting a DX station I couldn't hear or spent another night desperately calling a station who just couldn't hear me. DXing contests that, on other bands, are wonderful ways of getting unusual and rare entities on the air, only fill 80 meters with local stations calling specters of unheard DX stations.

But....

Sometimes, I did get a contact. I would hear a voice or the tones of a Morse code station in my headphones saying AC0X UR 599 QSL? Often I was so tired I almost missed it. Sometimes I'd been calling desperately so long I forgot how to react when a station *did* hear me. These are the times when I see the magic in DXing again, when *everything* is telling me the contact is impossible; computer programs saying there's no propagation between me and the other station, noise levels higher than ever, dozens of other stations calling and despite all that I *still* made the contact. And better than magic, sometimes it's my experience that scores. When the skills I learned for timed calling, off frequency calling and other tricks enabled me to make the contact.

And these things happened just enough to keep me going after my goal. It's no longer the "relatively easy" task I'll accomplish in a few months. I stretch out my goal to a year or more. But eventually I make contact with entity number 100 on the 80 meter band and after some waiting I get the QSL card. Then, with all 100 cards in hand, I *finally* fill out the long awaited application for Five Band DXCC. In a few weeks, my personalized plaque comes back and is hung in a place of esteem.

I look at my radio and swear I'll never turn it on again. And it does sit idle for quite a while. But then, the DXing bug that's been nibbling at me for 25 years starts biting again. I find myself saying, "You know, there *is* also a 160 meter band…"

All photos by Louis Sica, AC0X.

Louis Sica, AC0X, an ARRL member, has been licensed since 1982. He is on the DXCC honor roll with 345 entities and, since writing this article has achieved DXCC on 30, 17 and 12 meters. His attempts at 160 meter DXCC have been sidelined by high noise levels. Louis can be reached at PO Box 9842, Saint Paul, MN 55109-0842, **ac0x@arrl.net**.

CS — A New Signal Reporting System

Bruce Prior, N7RR

"Okay, the Great Lakes Retreads 75 meter net is ready for this evening's roll call. This is Kilo Alfa Zero Romeo Victor November, in Duluth. We'll start with Akron, W8GYB."

"K . . .VN this . . . skey eight . . . kee Bra . . . . ffic . . . net."

"W8GYB, Kyle, it's good to hear you. We've been missing you for a few weeks. You're 6 on the S-meter, but we have loud static crashes here, so I'm only copying about half of what you're saying."

"Okay Susan, KA0RVN, this is Whiskey Eight Golf Yankee Bravo. You're armchair copy here and 20 over S9. By the way, Susan, you're flat-topping a bit; you might try backing off on your audio a tad. No traffic for the net. Over."

Genuine Signal Reporting

This is the way most signal reports are given these days. We need to know how much of our transmission is being copied, how strong our signal is and about any quality problems. This article introduces a signal reporting system that meets these real communication needs.

The Copyability and Strength (CS) system (see sidebar) is designed to replace the now-antiquated RST system. The problem is that RST reports do not foster genuine signal reporting. The CS system does a better job of telling the real story about our signals in a very brief, two-character format with optional suffixes similar to those in RST but with two additions: R and O. For example:

- On phone: "Your CS is papa six." That's a 100% perfectly copyable S-6 signal. The optional suffix "x-ray" could be added, but no suffix implies excellent quality.
- On CW: CS GA or GAX means good 100% copy at 10 dB over S-9 or CS 74K for about 70% copy at S-4 with key clicks.
- On PSK-31: CS G8O for good 100% copy at S-8 but overdeviated.

Replacing R with C

The CS system replaces the subjective R-scale with a readily understandable Copyability (C) scale based on the approximate percentage of the message being received. N means no recoverable signal. Note that some digital modes are actually recoverable even when they are below the noise level for human ears. Just as in our Retreads Net example, amateurs often talk about copying a certain percentage of the transmitted text.

The RST Strength scale is also behind the times. Radio amateurs didn't have S-meters in the early 20th century when RST was first published. Originally defined as a nine-level list of relative signal strengths, today S-meter values have replaced it. Hams frequently report strong signals as decibels over S-9. It's a useful practice that is reflected in the CS system. The CS Strength scale uses the numbers 0 through 15 in hexadecimal notation, thereby summarizing 16 levels of signal strength with just one character. The common expression, "10 over 9" becomes simply "A" in the CS system.

Replacing Tone with Readability

During the move from spark to CW, the nine-level Tone reports were helpful for alerting amateurs about ac power supply products in their signals. Now we rarely hear ac ripple in CW signals. When RST was applied to phone modes, the T was dropped but no optional suffixes for overmodulation or overdeviation were added.

The CS system adds the optional R suffix for any level of ac ripple and the optional O suffix for AM and SSB overmodulation or for FM and digital mode overdeviation. Instead of the three-character report for RST, CS requires only two characters for all modes unless an optional quality suffix is added. No suffix implies excellent quality but X may also be added for emphasis.

Copyability and Strength

Copyability and signal strength are very different. Sometimes a signal that doesn't budge the S-meter will still be perfectly copyable. This situation occurs frequently with some digital modes. Under difficult operating conditions, even a signal with S-9 or A-level strength may not be 100% copyable. Under CS, a "P" copyability report will be quite common, but an "F" strength report will be very rare, indeed.

Since this succinct CS system reflects actual amateur usage, hopefully it will replace RST and become a routine part of many Amateur Radio contacts. Also, it seems reasonable that all signal reporting, including CS and RST, should disappear from fast-paced DXpedition and contest operations, where canned signal reporting serves no useful purpose.

The CS System

Copyability Scale

N	=	no recoverable signal*
0	=	discernible but not copyable*
1-9	=	10-90% copy
G	=	Good 100% copy, but short of perfect
P	=	Perfect armchair 100% copy or full-quieting on FM

Signal Strength Scale

0	=	no S-meter reading
1-9	=	S-1 to S-9
A	=	10 dB over S-9
B	=	20 dB over S-9
C	=	30 dB over S-9
D	=	40 dB over S-9
E	=	50 dB over S-9
F	=	60 dB or more over S-9

Optional Quality Suffixes

X	=	excellent quality
R	=	ac ripple in transmission
C	=	chirp or tail on make and/or break
K	=	key clicks or other keying transients
O	=	overmodulation or overdeviation in phone or digital modes

*If the C report is N or 0, then no S report is needed.

Bruce Prior, N7RR, an ARRL member, was a Novice as a teenager and now holds an Amateur Extra class license. As an ARRL technical advisor, he has written a number of articles for QST. *He's a retired diplomat and an educator who's teaching ranges from middle school through university level. Bruce has lived and operated in Alaska, British Columbia, Turkey, Tajikistan, Jamaica and at home in Washington State. He enjoys backcountry travel. Bruce quips, "The purpose of low power equipment is to reduce backpack weight!" He manages Summits On The Air (SOTA) for Washington State. He's a longtime member of the American Alpine Club and serves on the board of the Pacific Northwest Trail Association. Bruce recently joined The CW Operators' Club. Last spring, Bruce taught 11 middle school students to become hams. Bruce can be reached at 853 Alder St, Blaine, WA 98230-8030,* **n7rr@hotmail.com**.

ARRL Teachers Institute on Wireless Technology Delivers!

If you're an educator, you'll want to sign up for the 2012 Institute.

Debra Johnson, K1DMJ

The ARRL Teachers Institute (TI) is a four day intensive, expenses paid, in-service training opportunity for classroom teachers. The introductory TI-1 focuses on basic electronics, the science of radio, bringing space technology into the classroom, microcontroller programming, and basic robotics. 2012 is the 9th year ARRL will be able to offer these professional development workshops as a result of donor support for ARRL's Education & Technology Program, sponsorship from Dayton Amateur Radio Association (DARA) and generous in-kind support from Yaesu, Ham Radio Outlet and Parallax, Inc. The Teachers Institute program is one component of the grant offerings within the ETP portfolio of resources made available to schools and schoolteachers to advance the integration of wireless technology literacy and ham radio into school curricula.

Darwin Piatt, W9HZC, attended the 2011 TI held at ARRL headquarters last July. He had this report to share with teachers who might be entertaining taking a plunge into this professional development activity:

I was lucky enough to attend the ARRL Teachers Institute this past July 2011, and I'm happy to report that not only were the classes informative and fun but that the ARRL HQ staff went above and beyond to insure our visit was perfect.

On day one we all got to know each other and then got down to business. Everyone had brought along their laptops and after checking to see if they were all up to task at hand, we moved on to the Science of WT (Wireless Technology) with the following:

- Oscilloscope set up and use: We were all given a small USB device that enabled our laptops to function as oscilloscopes. Nice, as my old Heathkit scope had died earlier in the year.
- Ohms Law Board
- Basic Electronics Course
- Modulation and Demodulation Board

Soldering 101, homework, solder the 24-hour Clock Kit: We were all given a nice little 4 digit clock to build and began soldering. As some of our fellow students were K-12 teachers and soldering was a new thing to them, those of us "old timers" lent a hand. The day was over before we knew it and several folks took the kit 'home' (like back to the hotel) to work on. After supper, class members met in the breakfast area of the hotel and the soldering continued.

Tuesday morning got underway with our instructor (Nathan McCray—K9CPO) checking our clocks to see whose worked and whose did not. After a couple of small fixes we went on to the next subjects. Keep in mind that these classes and the curriculum are designed as aids to equip these teachers with skills to apply technology to their classroom. Each of these bullet points were accompanied by teaching modules (boards) — which we got to take home with us — Wow!

- Teaching the Science of WT
  - –5-Building blocks of WT
  - –TV Remote Decoder board and wave propagation
  - –DSP Fundamentals
- WT and the vocational education student: Great paying jobs for the non-college bound student, or while they are in college
- Bringing space into your classroom: Using NOAA satellites in your classroom
- Satellite operations (times depend on satellite orbits)
- Ham radio operations that support your teaching
  - –Making radio contacts (HF/VHF radio station operating)
  - –Radio direction finding (Fox Hunting)
  - –Using QSLs in your classroom
- Working with a local ham radio club

On Wednesday we began "playing" with the brains of the little robot we would be messing with (I mean learning with…)

CHARLES OLINDA, N2SRQ

Darwin Piatt, W9HCZ, and Abraham Sims, KE5UFG, touch up some soldering on a clock kit.

LARRY KENDALL, K6NDL

Participants in the 2011 TI-2 on *Space in the Classroom* sponsored and hosted by DARA look right at home with their Arrow satellite antennas.

"RED" WILLOUGHBY, KC4LE

"Red" Willoughby, KC4LE, mathematics teacher at Crossroads School, Hoover, Alabama writes: "I attended the Parallax session of TI-1 this past summer and enjoyed it very much. We have been using the robot in one of my math classes lately and it is a *big* hit. It is amazing how quickly students grasp the concept of programming a microcontroller!"

2012 TI Calendar

Date	*Location*	*Application Deadline*
TI-1		
July 9-12, 2012	Parallax Inc, Rocklin, CA	May 15, 2012
July 23-26, 2012	ARRL Headquarters, Newington, CT	May 15, 2012
TI-2 Remote Sensing and Data Gathering*		
March 15-18, 2012	Mississippi State University CAVS Extension Center, Canton, MS	In-district teachers only
TI-2 Space in the Classroom*		
July 9-12, 2012 (tentative)	TBA	May 15, 2012

*Though participants need not hold an Amateur Radio license to enroll in the TI-1, to be considered for a seat in TI-2, participants must possess at least a Technician class license at the time of application. They must also have previously completed the TI-1.
Visit **www.arrl.org/teachers-institute-on-wireless-technology** for the most current information and to download an application. Space is limited — enroll today!

As the back-up instructor for the Introduction to Robotics class at our local community college, this day and the next were where I really wanted to pay attention. My college uses the Lego series of bots, so learning the Boe-Bot and the basic stamp would be a new challenge. The built in breadboard proved to be really great. If you are even a little interested in learning about "bots" this is an excellent start.

- Introduction to "What is a Microcontroller"
- Getting started; lights on/lights off; digital inputs
- Applications
- Controlling motion
- Measuring rotation
- Digital display
- Frequency and sound

Thursday: Wow, Thursday already? Hey we aren't even done playing with what we all learned yesterday. Of course the fact that we are all trying to "out geek" each other has nothing to do with it. I actually managed to program mine to "play" my call sign before it set off on the obstacle course. Cool. This is one toy that will never gather dust!

- Robot component setup
- Assemble the robot
- Build the low battery indicator
- Robot navigation: Learning to navigate as a "bot" was a new challenge. Like how in the world do I keep it from banging into the wall? Ha, read the next lesson!
- Navigating by touch: It no longer hits the wall and stops.
- Navigating with infrared: So — now we have to figure out how to get around that darned brick in the floor.
- Detecting distance
- Mars exploration activity: Putting it all together

5:00 PM Thursday. Packing up, saying good-bye, and reflecting on the past 4 days. The ARRL instructors know a secret about day-to-day classroom routine that some of the rest of us who have been teaching in one form or another also know — "Hey this is supposed to be FUN!" Teaching, for me is fun! Amateur radio is fun! Robotics is fun! Space communications is fun! All of the ARRL instructors worked hard to insure that the classroom environment was educational and fun. Their subject knowledge was great and they made us all relaxed and unafraid to ask even the dumb questions. (Duh, remember the only dumb question is the one you don't ask!)

If you are a science teacher, you should apply for this class right away, with any luck, not only will you come away from this with tons of valuable information, but like me, you will also come away with 12 to 15 new friends that you did not have when you walked in. Go for it!

— Darwin (Dar) Piatt, W9HZC, Adjunct Instructor, Metro Community College, Omaha, Nebraska

On top of those glowing words, here's an early outcome reported by one of last year's participants. After attending the 2011 TI session in Albuquerque, Bob Sterner, KN0BOB, teamed up with 2010 TI participant Bryon "Paul" Veal, N0AH, to teach two weeks of wireless technology classes for gifted and talented youth in Aurora, Colorado. Sterner reported, "We now have at least 16 students actively working on getting licensed. We will have a Technician class in September for those who need more formal instruction. One of our students even made a CW contact with Belgium after only 2 days in class."

Visit the ARRL website at **www.arrl.org/classroom-activities** to read more reports and stories we've received from schools and teachers receiving support from the Education & Technology Program and training from the Teachers Institute.

Plans for 2012

Four sessions of the Teachers Institute are planned for 2012, including the introduction of a new advanced TI on *Remote Sensing and Data Gathering* that will be piloted in a project partnership with Mississippi State University's Student Technology Exchange Program (STEP) in the Canton Mississippi School District. At the conclusion of the 2011-2012 school year, teachers and students participating in the project will launch a high altitude balloon and use amateur radio to track and download data from the balloon.

Satellite communications proves to be a popular follow-on subject for previous TI participants at the TI-2 *Space in the Classroom*. Participants receive a complete radio station to take back to their classrooms and during 4 days of activities, teachers will learn to set up, operate and make on-the air contacts through satellites.

The Teachers Institute is funded by donations to the ARRL Education & Technology Program. You can help us continue to provide this valuable training by contributing your financial support. You can donate online at **www.arrl.org/education-and-technology-fund**.

50 Project OSCAR

A celebration of 50 years of amateur satellites

Click for Audio

Listen to a recording of OSCAR 1 from 1961.

Bob Allison, WB1GCM

A year ago at this time, I walked down the main hallway at ARRL Headquarters and contemplated the many historic items in the display cases. If you have been to the ARRL Headquarters, you've likely seen the Wouff Hong, spark era equipment, a fine collection of Morse code keys and bugs, and other historic items on display. As I pondered the various pieces, some representing the "firsts" of their time, my gaze fell upon a silver-colored box — ARRL's OSCAR 1 prototype, a duplicate of the very first Amateur Radio satellite.

OSCAR 1 (OSCAR is an acronym for Orbiting Satellite Carrying Amateur Radio) was launched December 12, 1961. The satellite was in orbit for 22 days and was heard by more than 570 amateurs in 28 countries. Since there were no propulsion or navigation components installed within OSCAR 1, its time in orbit was predestined to be short lived.[1] Fortunately for us today, two backups were built. One is on static display at the Smithsonian National Air and Space Museum in Washington, DC and the other resided in the display cabinet at Headquarters.

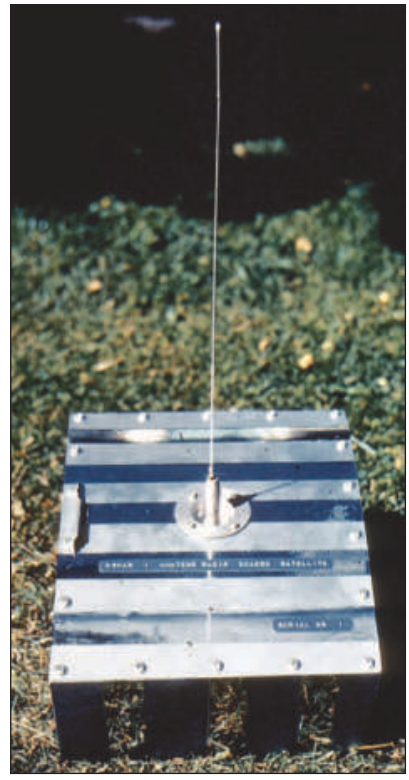
As I contemplated the monumental achievement made nearly 50 years ago, the proverbial light bulb above my head lit up. Why not refurbish OSCAR 1 in honor of Project OSCAR, and all those who have contributed to 50 years of amateur satellites, and display it at the 2011 Dayton Hamvention®?

The idea seemed feasible. With the go-ahead from Lab Manager Ed Hare, W1RFI, and Chief Operating Officer Harold Kramer, WJ1B, *Project OSCAR +50* was underway.

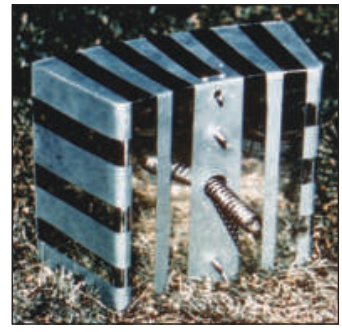
Debugging

ARRL historian Perry Williams, W1UED, told me the League obtained OSCAR in 1963 after it had traveled to many schools around the US. I found out quickly that our OSCAR had endured a hard terrestrial journey. Scratches and dings showed that it had been bumped around quite a bit and, at some time, someone had glued heavy duty aluminum foil to the outer case to "shine it up." The foil skin covered the gold and blue striping used for the thermal stability of the spacecraft.

Worse yet, someone tried to "fix it." Oh yes, they sure fixed it alright! Close inspection showed the original output transistor was missing and the transmitter's crystal had been replaced with one that would transmit on the FM broadcast band. I also noticed that an old glass-epoxy capacitor had cracked in half.



OSCAR 1, serial number 1, before launch. The striping was used in an attempt to regulate the spacecraft temperature.



The underside of OSCAR 1, showing the $1.29 spring used to eject OSCAR from the host spacecraft. OSCAR was curved to fit the contour of the Thor-Agena rocket.

Poor OSCAR needed help, and it came from W1AW Station Manager Joe Carcia, NJ1Q. Quickly grasping the importance of the project, he whisked OSCAR away to the W1AW workbench.

Joe's first task was to literally get the bugs out of the satellite. OSCAR had spent years on open display, hanging from the ceiling in the Headquarters lobby. During its tenure as a floating ornament, OSCAR had accumulated a substantial collection of flying insects. Once Joe had banished the bug carcasses, he removed OSCAR's three circuit boards to allow a thorough cleaning of the magnesium case.

Joe inspected the transmitter board carefully and removed each of the 50-year-old components so that they could be tested and evaluated. Most were in remarkably good condition. His first order of business was to order a new 72.5 MHz crystal for the oscillator. The transmitter's doubler circuit transformed the output of the oscillator to 145 MHz.

The 145 MHz signal was applied to the transmitter's output stage, which was built around the missing RCA 2N493 transistor. The 2N493 was originally designed to deliver 140 mW of RF to OSCAR's quarter-wavelength, spring-loaded whip antenna. With slim hope of finding another 2N493 in time for Dayton, Joe substituted a Motorola 2N2907A.

The broken glass-epoxy capacitor was successfully glued together and one resistor was replaced. With some trepidation we applied power to the transmitter and…it worked!

Our excitement soon died when we examined the keyer board, which used flip-flop circuitry to key the word HI in

[1]For a timely article about Project OSCAR and an account of its launch day, see B. Orr, W6SAI, "Sixty Years of Radio Amateur Communication," *QST*, Feb 1962, pp 11-15,130.

The February 1962 issue of *QST* celebrated the launch of OSCAR 1.

A young Lance Ginner, K6GSJ, working on OSCAR 2. It was launched on June 2, 1962.

JERRY RAMIE, KI6LGY

K6GSJ and the ARRL OSCAR 1 prototype, reunited at the 2011 AMSAT Symposium.

Morse code. All the parts seemed to be there, but the wiring to and from the board was puzzling. Without access to a schematic, we couldn't quite make heads or tails of it.

Joe was able to contact one of Project OSCAR's key builders, Lance Ginner, K6GSJ. Lance gladly shared the original photos that he had at hand, but couldn't provide documentation. Needless to say, Lance gave us the encouragement to carry on.

With no documentation and a risk of damaging the keyer and nearby temperature-sensing board, Joe opted to install a programmable PIC keyer, which he hid in one of the three battery compartments. A 12 V, 500 mA dc power supply was found to power both the transmitter and PIC keyer. It is interesting to note that the original OSCAR was powered by three 18 V mercury batteries in parallel.

In the original OSCAR, a thermistor controlled the code speed at which the satellite sent its HI message. Recordings of OSCAR 1 show the code speed to be very fast, due to the high temperature of the spacecraft. Joe adjusted the PIC keyer to a more listenable 12 words per minute.

Three weeks before Dayton, Joe and I presented the working OSCAR to the Headquarters staff. A modern satellite transceiver provided reception of OSCAR's somewhat chirpy CW signal. RF power output was measured at 100 mW. That may not seem like much, but on 2 meters it can travel a considerable distance. To keep everything legal, our OSCAR transmitter had to send its call sign every 10 minutes.

The original OSCAR 1 never sent a call sign — just HI. Duplicating OSCAR's behavior precisely would create a legal dilemma. Joe's solution was to place a 50 Ω resistor at the base of the antenna to dramatically reduce the radiated power. This limited transmissions to a measured 100 feet and met power level requirements under FCC Part 15 rules for *unidentified* transmitters.

OSCARs 1 and 2, along with many other satellites, were launched by the family of Thor-Agena rockets.

OSCAR on the Road

ARRL's OSCAR 1 exhibit at the Dayton Hamvention was a smashing success. Thousands of attendees had a chance to see and hear an original working prototype of the very first amateur satellite and the first non-military payload to ever go into space. OSCAR attracted large crowds and was photographed like a rock star. It also caught the attention of astronaut Doug Wheelock, KF5BOC, who quizzed me on its details.

Less than a month later OSCAR made an appearance at the ARRL National Convention in Plano, Texas. To make the display even better, ARRL Graphic Artists Diane Szlachetka, KB1OKV, and Sue Fagan, KB1OKW, created three table-top posters for the exhibit.

OSCAR 1 in San Jose

At this point you might say Project OSCAR+50 was a success. However, the story doesn't end there. Barry Baines, WD4ASW, president of AMSAT, was impressed with our display at Dayton and requested OSCAR's attendance at the AMSAT Symposium, November 4-6, 2011 in San Jose, California. I soon learned the guest speaker at the Saturday night banquet would be none other than Lance Ginner.

The OSCAR exhibit at the AMSAT Symposium went as planned, but with an added bonus. With the help of ARRL Laboratory Consultant Jerry Ramie, KI6LGY, I was able to produce six interesting video interviews with some of the key people in amateur satellites today such as ARISSat-1 Project Leader Gould Smith, WA4SXM; AMSAT Past President Keith Baker, KB1SF; satellite pioneer Jan King, VK4GEY/W3GEY and AMSAT President Barry Baines, WD4ASW. Carroll Swain, W7DU, a radio amateur since 1929, tells of his satellite activities and Lance Ginner, K6GSL, gives insight to the very beginning of amateur satellites. The space communications page on the ARRL website at **www.arrl.org/space-communication** has links to each video.

Photos courtesy Lance Ginner, K6GSJ, unless noted otherwise.

Bob Allison, WB1GCM, is the Lab Test Engineer at ARRL Headquarters. He can be reached at **ballison@arrl.org**.

ARRL DX – Success for the Little Pistol

Ward Silver, N0AX

N0AX

The author found operating from the water's edge to be a great strategy for maximizing the signal from a mobile station.

Beginning in September of last year Solar Cycle 24 suddenly roared back to life after a few short-lived sputters — 15, 12 and 10 meters sported openings worldwide that hams hadn't experienced in years! Recently licensed operators, no doubt weary of hearing endless OTs' (Old Timers') 10 meter tales, are now finally getting a taste of what fuels that nostalgia.

You might have turned on the radio during the CQ World Wide contests or the ARRL 10 Meter Contest to find the bands jam-packed with DX stations. If you think it sounded like fun, you are correct — filling your log with call signs from near and far is one of ham radio's most exciting activities. It's a great workout for you and your station.

This article will help you get started in the 2012 ARRL DX Contests (**www.arrl.org/arrl-dx**) and have a good time doing it. We'll step through what to expect on the air, the basics of making and logging contacts and how to submit your log to the ARRL for contest scoring.

What Kind of Station is Needed

"I'm just a little gun, with 100 W and a vertical. Working J5NAR on 10 meters was one highlight of the contest and new country on that band." — K6CU, ARRL DX CW 2011

If you have an HF rig capable of 100 W output with an antenna such as a dipole or vertical, that's enough to get started! (See the sidebar "QRP or QRO?") A mobile or portable station can be effective, too, or try operating from a friend's station.

To get rolling on HF, you can find complete instructions for making a dipole or vertical on the ARRL website at **www.arrl.org/hf-wire** or **www.arrl.org/hf-vertical**. Install your antenna as high and as in the clear as you can. If you keep your feed line short (say, 50 feet or less) an antenna tuner can often allow you to use the antenna on multiple bands.

If you plan on operating during the CW weekend, you should have a 500 Hz CW IF filter installed in your radio. Trying to operate on crowded bands with a phone-width filter is an exercise in frustration for beginners. If you have one of the new rigs that uses DSP filters, get out the manual and find out how to adjust filter bandwidth and shift the passband to avoid interference.

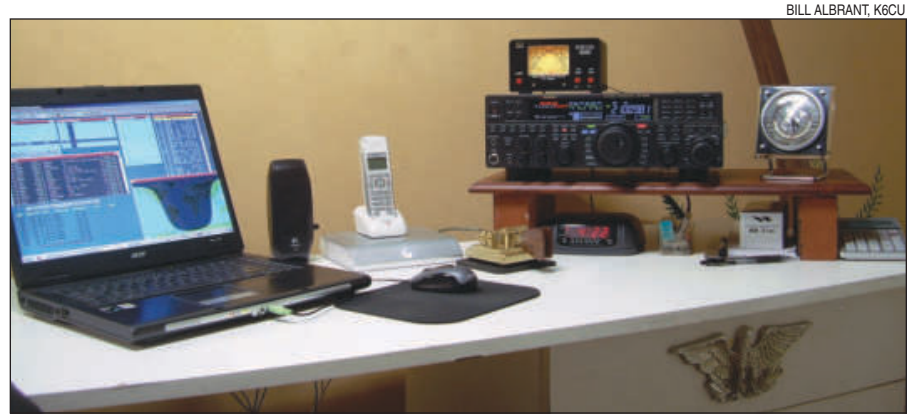
Operating under crowded conditions can bring even a good receiver to its knees — here's how to help it perform well:

- *Preamplifier* — turn it off. There are so many strong signals present during a contest, having the preamp turned ON will likely cause overloading of your receiver.
- *Noise Blanker* — turn it off, too. In a contest with lots of strong signals, the noise blanker gets confused and starts turning off the receiver in sync with them, instead. This makes it sound like a strong signal is splattering all across the band!
- *Attenuator* — this control can be your best friend when dealing with strong nearby signals. Add 6 to 12 dB of attenuation and you may find that interference and band noise drops dramatically, making it easier to hear other stations.
- *RF Gain* — turn it down. Maximum RF Gain makes your receiver very sensitive, but also leaves your IF (and sometimes the RF) amplifiers susceptible to overload. You'll find that reducing RF Gain improves receiver

QRP or QRO?

Many operators new to HF try QRP (low power) operating because it doesn't require a lot of equipment and is well-suited to low profile or temporary stations. Successful QRP operation requires skill under the best of circumstances and a crowded contest band makes QRP contacts even more difficult. Although CW contests are far friendlier to QRP operation, I recommend that you operate at the 100 W level (QRO) until you get a good feel for contest operating.

BILL ALBRANT, K6CU



Bill Albrant, K6CU, made good use of a new FT-950 transceiver in the 2011 ARRL DX CW contest's low power category.

Cut Numbers and Abbreviations

DIT DAH-DIT DAH-DIT…DI-DAH DAH DAH. What? Those are "cut numbers" — abbreviated versions of 5NN 100 — as even numbers are even shortened during a fast-paced contest! For more information on cut numbers, read the excellent contesting FAQ at **www.qsl.net/zs1an/contesting_faq.html**.

performance in a strong signal environment. Even during casual operating, backing off the RF Gain can dramatically reduce background noise.

■ *Special features* — does your receiver have Passband Tuning, IF Shift, Variable Bandwidth or similar controls? All those new DSP features also clean up noise and low or high-frequency interference.

What to Expect on the Air

"Sweet, almost a new mult with every spin of the dial!" — K6WSC

The ARRL DX contests are particularly attractive for smaller and mid-level stations: Since the DX has to work US and Canadian stations, they are looking for you!

Your best daytime opportunities will be on the highest band open to DX locations. At sunrise, expect 20 meters to open, followed by 15 meters a little while later and finally 10 meters. The initial openings will be to the east, spreading west throughout the day, and finally closing after sunset to the west in the reverse order that they opened. Technician licensees will find their best opportunities on 10 meters to be during the hours before and after local noon.

As 20 meters closes, it will be time for 40 and 80 meters — try your hand with the louder stations first to see how well your station is getting out. 160 meters will be busy, too — often around the top of the hour as DX stations try for a few multipliers on Top Band. If you find the pileups difficult, especially on Friday night, get some rest — Saturday night is a lot easier.

Remember to watch your carrier frequency on phone — make sure your sidebands are inside the band as described in the article "What Your Frequency Display Tells You" at **www.arrl.org/files/file/Technology/tis/info/pdf/9108028.pdf**. Similarly, double-check before you tune to the frequency of a station posted on the Internet. DX stations often transmit outside the US phone bands!

How to Make Contacts

Once you tune in a DX station calling CQ TEST, listen for a contact or two to be sure of their exchange information. The exchange in the ARRL DX contest is a signal report and your US state or Canadian province. KH6 and KL7 count as DX.

DX stations will give a signal report and a number representing their power. A full power station will probably just say KILOWATT or send KW or just K — so log 1000 or KW or K.

When you are ready, as soon as they finish the CQ, give your *full call sign just once*. Use standard phonetics on phone. (Don't call US or Canadian stations as there is no point value for W and VE stations working each other.)

If you get a response, you'll already know the DX station's exchange information so just say THANK YOU, give a signal report (stay with a simple 59 or 599) and your state — again, just once. They'll let you know if they didn't copy all of the information. If they are having trouble getting your state or province, send only the abbreviation and use phonetics on phone, such as MIKE OSCAR for Missouri.

Sunday is friendly to newcomers and Little Pistols. Most of the Big Gun stations have worked all the strong stations and can now hear weaker signals. As a "Sunday driver" you will find contacts much easier to make. Watch out for the "Sunday pileups" though as new stations appear on a band, attracting a *lot* of attention!

You will enjoy the contest more with a couple of useful and helpful resources. A DXCC country list is essential and can be downloaded from the ARRL website or purchased for a few dollars. A world map or two — one azimuthal projection centered on your location and another showing countries and prefixes in the usual style — will help you figure out where signals are coming from. An online website showing where the Earth is in sunlight and darkness will also be useful because stations in the "gray line" often increase in strength — your signal will, too!

Logging Contacts and Submitting a Log

The easiest way for a newcomer to record contest logs is to use paper log sheets from the ARRL DX Contest website or a simple contest logging program. Be sure you record all of the information from every QSO — especially when you change bands. (You only need to indicate band, not the exact frequency.)

If you expect to make more than one log sheet's worth of contacts, be sure to keep a *dupe sheet* as you go (see the contest website for a downloadable version). This helps you keep from making duplicate contacts (or *dupes*). Computer software takes care of this chore automatically.

Once you are done (and I bet you'll have a lot more contacts in your log than you expected) it's easy to complete your entry by submitting your log to the ARRL. If you used a contest logging program to keep your log, create a *Cabrillo format* log and e-mail the resulting file as described in the article "Submitting an Electronic Contest Log" (**arrl.org/files/file/SubmittingAnElectronicContestLog.pdf**).

If you used paper log sheets, the best way to submit a log is by using the handy Cabrillo format web tool by Bruce Horn, WA7BNM, at **b4h.net/cabforms**. Entering your contacts is less work than you think and your log will be whisked off to HQ. Then drop by the ARRL Soapbox page (**arrl.org/soapbox**) and post your photos and comments.

DOUG FERRIS, VA3DF

Doug Ferris, VA3DF, uses a K3 to get through the pileups from Ontario on phone and CW.

Why Only 59 or 599?

The goal of the contest is to make contacts, not compare signals. If you can get through the pileups and be heard, that's good enough. Nevertheless, a signal report has been part of the contest since its inception more than 80 years ago so the convention is to simply give 59 or 599.

Are You Ready?

"Really had a great time…the YL and I work from the same shack. We both had fun and I was able to add some new ones to the log." — N9JZN

After you make some QSOs in the ARRL DX contest, I'm betting that you'll be looking forward to future contests and the fast-paced fun of making contacts around the world. How about the CQ WPX SSB contest at the end of March? Or the Russian DX Contest? Each month has one or more state QSO parties, too. *QST* publishes Contest Corral every month to provide a one-page calendar of upcoming events. WA7BNM (**www.hornucopia.com/contestcal**) and SM3CER (**www.sk3bg.se/contest**) both publish excellent online contest calendars, as well.

I'm confident you'll enjoy taking part in a contest whether for an hour or for a weekend. You'll find your skill level increasing with each event, making you a better operator for emergency communications or just day-to-day operating — and that's the whole point of Amateur Radio.

Ward Silver, N0AX, is an ARRL Contributing Editor. He can be reached at **n0ax@arrl.org**.

Announcing: The ARRL Diamond DXCC Challenge

Are you up for a new DXCC challenge?

Dave Patton, NN1N

2012 is the 75th anniversary of the ARRL's DXCC Award. The world's preeminent DXing award continues to be DXCC, so reaching the "Diamond milestone" is an event that we all want to celebrate. Going back to the roots of the award, and specifically reading the 1937 DXCC List (January 1937 *QST,* pages 52-53) to learn which countries were counted at the onset led us to create the Diamond DXCC Challenge.

The country list we will use for the Diamond DXCC Challenge is based upon the list of 231 places shown in 1937. We tried to find corresponding entities today that would represent the places listed in 1937, but there are four places (Baluchistan, British Cameroons, Canal Zone, Hejas) that were on the oldest list that don't exist today in a form that could even loosely be represented by someplace current. The Diamond DXCC List represents 227 of the 233 1937 "countries." The list is fascinating and leads us to learn more about world history and how geopolitics has changed leading up to today.

As you "check off" these entities during the course of 2012 working DX (which is an achievement even today) using spotting networks, panadapters, 200 W rigs and stacked tribanders, imagine how DXing was different in the early years of radio and DXCC! Working Tibet or Aldabra with 50 W and crystal-controlled transmitters to simple wire antennas had to be a thrill like no other in that time for ham radio operators.

We anticipate that this award will be very popular thanks to the unique nature of the entities we will try to put into the log in 2012. Not only are there traditional DXCC entities, but there are cities, Islands on the Air (IOTA by RSGB) island groups, and various sub-political entities inside DXCC entities, such as the Indian State of Goa, and many States in Malaysia and islands in Indonesia. There are even three individual "countries" that make up today's Yemen (7O — Yemen, Socotra Islands and the City of Aden)! Yes, we would like to have even one of them on the air. An interesting factoid about this 1937 list came via the late Jim Maxwell, W6CF. Jim said the only entity from the 1937 list to be removed without a single contact being made was Wrangel Island.

For some entities that today consist of multiple countries, you may work any of today's entities to qualify for that single 1937 country. For example, French Equatorial Africa will be considered worked if you log a station in TL, TN, TR or TT in 2012. The Diamond DXCC country tables show the current entity names and prefixes that qualify for the 1937 countries.

On Your Honor

The Diamond DXCC Challenge is an "Honor Award" and will not require acquisition or inspection of QSLs or proof of confirmation, although it still will be fun and useful to seek out cards or LoTW confirmations. We will provide forms online to use at your operating position to track what you have worked and forms for applying for awards and endorsements. As the year goes on, we will also provide hints and tips about what is happening with the Diamond DXCC Award and, for instance, who might be on the air from Goa or Gdansk!

The Diamond DXCC certificate will be available for working 100 of the 226 entities, and will be endorsable at five levels: 125, 150, 175, 200 and 225. If anyone works all 226, there will be a special award for that remarkable achievement! We hope to publish award recipients' call signs online during the year, and identify high numbers.

There will be a Diamond DXCC Challenge Honor Roll. The Honor Roll level will be determined by the leader in worked entities submitted to HQ, and the bottom of the Honor Roll will be 9 entities fewer than that of the leader. Example: If W1AW has worked 165 entities, the bottom of the Honor Roll will be 156 entities. In February 2013, HQ will issue a final Honor Roll tally with overall leaders.

Dave Patton, NN1N, is Manager of the Membership and Volunteer Programs Department at ARRL Headquarters. He can be reached at **dpatton@arrl.org**.

Diamond DXCC Challenge Rules

The Diamond DXCC Challenge Awards are available to all amateurs worldwide who contact a minimum of 100 countries from the Diamond DXCC List. US Amateurs must be members of the ARRL. Generally, the rules for the Diamond DXCC Challenge are the same as the rules for the DXCC Program, except as listed here.

Contacts must be made from within the same DXCC entity by the same operator.

Contacts must be made during 2012 — from 0000Z on January 1 through 2359Z on December 31. All amateur bands may be used except for 60 meters.

There are no mode endorsements or band endorsements. The Diamond DXCC Challenge is considered to be a Mixed-Mode/ Mixed-Band award. There are no power categories or restrictions for the award.

Confirmations are not required to obtain this award, but HQ will review submitted entries for accuracy and validity.

The Diamond DXCC Challenge certificate will be available for working 100 entities and will be endorsable with stickers at the following levels: 125, 150, 175, 200 and 225.

Applications should use ARRL-supplied forms available online or obtained by writing: DXCC, 225 Main St, Newington, CT 06111.

The Diamond DXCC Award certificate fee is $12 including shipping within the USA, and $13 including shipping outside the USA.

Endorsement stickers are $2, including shipping in the US, and $3 outside the US.

Comedian Tim Allen Stars as Radio Amateur on New TV Show

Tim Allen plays Mike Baxter, KA0XTT, on the ABC comedy *Last Man Standing*.

Tim Allen — star of *Home Improvement*, *Toy Story*, *The Santa Clause* and *Galaxy Quest*, to name just a few — now stars in *Last Man Standing*, an ABC comedy airing at 8 PM (EST) on Tuesday nights. Allen plays Mike Baxter, KA0XTT, a married father of three and the director of marketing at an outdoor sporting goods store in Colorado whose life is dominated by women. While Amateur Radio has not been prominently featured in the first episodes, according to John Amodeo, NN6JA — the producer of *Last Man Standing* — it is a part of the show and an important part of Mike's character. At press time, the episode that will establish Mike as a radio amateur is scheduled to air in mid-January.

"Tim's character Mike is involved in creating the sales strategy for the store, including their catalog and Internet identity," Amodeo told the ARRL. "The store is like Bass Pro Shops or Cabelas. There is a strong self-sufficiency overtone to Mike's approach to life. Ham radio fits in the story as a means of emergency communication. It's not directly featured in the foreground story, but at the moment, it's a background element on the home set. Once I allow something to be put on the set, there's a chance the writers will feature it. Now that we have actually established Mike Baxter as KA0XTT, we can do more things featuring Amateur Radio."

To make Mike a ham, Amodeo needed Mike to have a call sign. So he contacted ARRL Media and Public Relations Manager Allen Pitts, W1AGP, to help him out. "In film and TV, we create fictitious telephone numbers, addresses and brands," Amodeo explained. "We do this mostly to avoid being sued by real brands and to avoid complications with advertisers. As a producer and a ham, I was torn between wanting the show to be accurate and needing to keep my studios out of trouble. An accurate and positive portrayal of ham radio on TV would be a good thing." Many TV shows and movies use telephone numbers with a 555 exchange, as that exchange is not valid.

Together with Tim Allen and with help from Pitts, Amodeo created a call sign for Mike Baxter: KA0XTT. Since the show is set in Colorado, they wanted Mike to have a call sign with a 0 in it. "We wanted a call sign that sounded real, but was not valid," Amodeo said. "The call sign is a 2×3 format with an X suffix. A call sign in this format is an experimental call sign and is not assignable to a radio amateur except in special circumstances. We especially liked the suffix, as it is a play on Tim's character from his former show, *Home Improvement*: 'ex-Tim Taylor.'"

Amodeo told the ARRL that both his studio (Fox) and ABC were "delighted to have a useable call sign. In the past, TV shows just made up some crazy call or used someone else's without permission. And because we've had so much talk about Amateur Radio here on the show, a few of my production assistants took their Technician exam." Amodeo applied to be an ARRL Volunteer Examiner so he could help administer the exams. On October 6, 2011, Amodeo and two other ARRL VEs administered the Technician exam to seven prospective hams. All seven passed, with two making perfect scores.

Since Mike Baxter is a ham, he needed a shack. So Amodeo and the set designers installed an Amateur Radio station in the corner of Mike's set office. Allen, as Baxter, uses an ICOM 9100 HF/6 meter/2 meter transceiver and an IC-92AD handheld transceiver, both provided to the show courtesy of ICOM America. Amodeo told the ARRL that he has plans to add vintage equipment to the shack in the future. "The radio equipment was originally intended to be used as props and set dressing items," Amodeo told the ARRL. "But since eight of the show's staff members are radio amateurs, it didn't take long before we made the radio equipment 'practical,' which is to say, actually capable of making radio calls live from the stage when we're not shooting."

Pitts and ARRL News Editor S. Khrystyne Keane, K1SFA, have been working with Amodeo to make sure that Amateur Radio is correctly portrayed in the show. Keane also provided ARRL and Amateur Radio-related materials that are used on the set, such as issues of *QST*, *NCJ* and *QEX*, as well as a call sign map, a *2012 ARRL Handbook*, a 2012 ARRL calendar and various ARRL stickers. Keane sent fake versions of DXCC, Worked All States and Worked All Continents certificates, as well as a Morse Code Proficiency

S. Khrystyne Keane, K1SFA ♦ ARRL News Editor ♦ k1sfa@arrl.org

Certificate. Each certificate bears the name Mike Baxter and has KA0XTT as the call sign. All the certificates have issue dates of December 25, playing upon Tim Allen's roles in *The Santa Clause* movie series.

Amodeo told the ARRL that he also installed a Comet CHV-5X HF dipole and a GP-1 antenna for 2 meters and 70 cm (courtesty of NCG/Comet) "up high, about 50 feet, inside the sound stage. The ultimate goal is to have the hams on our staff make contacts from our stage during down times."

Last Man Standing also stars Nancy Travis (*Three Men and a Baby*) as Mike's wife and Hector Elizondo (*Pretty Woman*, *The Princess Diaries*, *Monk*) as Mike's boss. Amodeo also produced the critically acclaimed *Sports Night* and *Arrested Development*.

FCC GRANTS SECONDARY SERVICE ALLOCATION TO WIRELESS BROADBAND MEDICAL MICROPOWER NETWORKS

In their regular meeting on November 30, 2011, the four FCC Commissioners unanimously agreed to allocate spectrum and adopt service and technical rules for the utilization of new implanted medical devices that operate on 413-457 MHz (70 cm). These devices will be used on a secondary basis as part of the Medical Data Radiocommunication Service in Part 95 of the FCC rules. The Amateur Radio Service also has a secondary allocation on the 70 cm band. Even with adding the MMNs to the 70 cm band, there are no changes to the Part 97 rules and thus there are no changes to the frequency sharing requirements in Section 97.303. These new rules are the result of a *Notice of Proposed Rule Making* (*NPRM*) that the FCC released in March 2009.

According to the FCC, these devices would greatly expand the use of functional electric stimulation to restore sensation, mobility and function to those persons with paralyzed limbs and organs; they would be implanted in a patient and function as wireless broadband medical micropower networks (MMNs).

Calling the new rules an "advance[ment of] its mobile broadband agenda," the FCC said this will create "a new generation of wireless medical devices that could be used to restore functions to paralyzed limbs. Medical Micropower Networks are ultra-low power wideband networks consisting of multiple transmitters implanted in the body that use electric currents to activate and monitor nerves and muscles." The Commission also noted that its *National Broadband Plan* — released in 2010 — observed "that the use of spectrum-agile radios and other techniques can significantly increase the efficient use of radio spectrum to meet growing demand for this valuable resource. MMNs illustrate how advanced technology can enable the more efficient use of spectrum to deliver innovative new services."

COURTESY ALFRED MANN FOUNDATION

A implantable microstimulator of the kind that would be used with a wireless medical micropower network.

Researchers with the Alfred Mann Foundation — a leading medical research organization located in Santa Clarita, California — have developed a wireless medical micro-power network to tie together tiny devices implanted in those with paralysis, creating an artificial nervous system to restore sensation, mobility, and function to paralyzed limbs and organs.

"The Mann Foundation argues that the frequency range just above 400 MHz is optimum for their application, which requires no more than 1 mW of RF spread across about 5 MHz of bandwidth," ARRL Chief Executive Officer David Sumner, K1ZZ, wrote in "It Seems to Us: Coexistence," published in the June 2009 issue of *QST*. "However, recognizing the presence of a variety of incumbent radio services in that range, specifically including the amateur service, they have proposed four channels for flexibility in avoiding localized interference." Two of the four channels are 426-432 and 438-444 MHz; the other two are above and below the 420-450 MHz band.

"The bottom line is that the Commission has done essentially what the Alfred Mann Foundation asked them to do back in 2007," Sumner explained after the *R&O* was released. "When the Commission opened the rulemaking proceeding in 2009, we investigated and determined that the very low power, broadband nature, and frequency agility of the MMN devices posed little potential for harmful interference to the Amateur Radio Service, even though two of the four channels — 426-432 and 438-444 MHz — fall within the 420-450 MHz amateur secondary allocation. We were more concerned about the potential for interference to the devices from amateur transmitters. In our comments, we asked that the Commission clarify that MMNs must tolerate interference from amateur stations, as well as from stations in services that are primary in the 413-419, 426-432, 438-444 and 451-457 MHz bands."

According to the *R&O*, MMNs will not be regulated as unlicensed emitters under Part 15, but instead will be regulated under Part 95, more familiar to radio amateurs as housing the CB rules, but also used for other license-by-rule services. Each MMN transmitter that is certificated under the Commission's rules is presumed to be licensed. Coupled with the secondary allocation, this gives MMNs a status equivalent to that of the Amateur Radio Service in the 426-432 and 438-444 MHz bands.

Stations in secondary services must protect primary services from harmful interference and must tolerate interference from primary services. Stations in secondary services are not required to protect other secondary services from harmful interference, except that they "can claim protection from harmful interference from stations of the same or other secondary service(s) to which frequencies may be assigned at a later date." This provision in Section 2.105 of the Commission's Rules actually doesn't help clarify the relative status of the Amateur Radio Service and MMNs because stations in neither service are assigned to frequencies.

The *R&O* repeatedly refers to MMNs having to tolerate interference from "incumbent services" — which includes the Amateur Radio Service: "Given that MMN devices are expected to implement measures to mitigate the effects of interference, it is reasonable to expect the MMN devices to tolerate some interference from the Amateur Service or to move to another frequency band as needed." The required interference mitigation measures apply equally with respect to both primary and secondary services, and involve shifting the network to another channel if other activity is detected on the channel.

FCC RELEASES NEW RULES FOR 60 METERS

On November 18, 2011, the FCC released a *Report and Order* (*R&O*) defining new rules for the 60 meter (5 MHz) band. These rules are in response to a *Petition for Rulemaking* (*PRM*) filed by the ARRL more than five years ago and a June 2010 *Notice of Proposed Rulemaking* (*NPRM*). In the *R&O*, the FCC replaced one of the channels in the band, increased the maximum authorized power amateur stations may transmit in this band and authorized amateur stations to transmit three additional emission designators in the five channels in the 5330.6-5406.4 kHz band (60 meters).

At press time, these changes have not yet taken effect. The new rules will take effect *30 days after they are published in the Federal Register*. The ARRL will announce on its website when the rules are published. Any radio amateur who is operating under the new rules before this time *is in violation of the current rules*.

The Amateur Radio Service in the

United States has a secondary allocation on 60 meters. Only those amateurs who hold General, Advanced or Amateur Extra class licenses may operate on this band. Amateur stations must not cause harmful interference to — and must accept interference from — stations authorized by any administration in the fixed service, as well as mobile (except aeronautical mobile) stations authorized by the administrations of other countries.

Here is a summary of the changes:

- The frequency 5368.0 kHz (carrier frequency 5366.5 kHz) is withdrawn and a new frequency of 5358.5 kHz (carrier frequency 5357.0 kHz) is authorized.
- The effective radiated power limit in the 60 meter band is raised by 3 dB, from 50 W PEP to 100 W PEP, relative to a half-wave dipole. If another type of antenna is used, the station licensee must maintain a record of either the antenna manufacturer's data on the antenna gain or calculations of the antenna gain.
- Three additional emission types are authorized. *Data* (emission designator 2K80J2D, for example, PACTOR-III), *RTTY* (emission designator 60H0J2B, for example, PSK31) and *CW* (150HA1A, such as Morse telegraphy by means of on-off keying). For CW, the carrier frequency must be set to the center frequency. For data and RTTY the requirement to transmit "only on the five center frequencies specified" may be met by using the same practice as on USB, i.e. by setting the suppressed carrier frequency of the USB transmitter used to generate the J2D or J2B emission to the carrier frequency that is 1.5 kHz below the center frequency.
- Automatic control on data and RTTY is not permitted; a control operator must be in a position to exercise either local or remote control over the transmitter. The FCC noted that "amateur operators must exercise care to limit the length of transmissions so as to avoid causing harmful interference to Federal stations." This is a very important caveat: If a Federal station requires amateurs to cease using a frequency, the amateur station must be able to do so without delay.

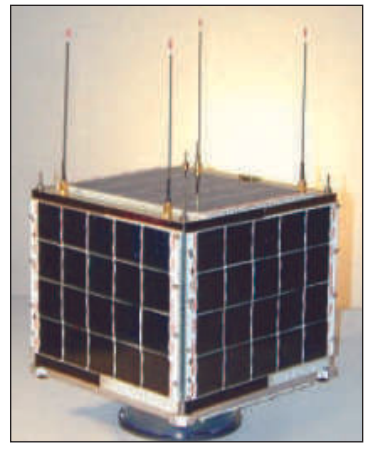
A reasonable person might wonder what the difference is between data and RTTY. According to former ARRL Chief Technology Officer Paul Rinaldo, W4RI, there used to be a difference, but there's not much of one today. "Years ago, a B designator (telegraphy for automatic reception [i.e. narrow-band direct-printing telegraphy emissions]) meant decoding and display on a teletypewriter (TTY) or other mechanical machine," he explained. "A D designator signified transmission of data, telemetry or telecommand intended for data processing or just storage for possible future use. When computers or computer-like devices were introduced to emulate RTTY transmission and/or reception, the line between telegraphy and data transmission blurred to the point of little or no practical distinction."

PACTOR-III and PSK31 are cited in the new rules as examples of data and RTTY emissions, respectively, that will be authorized; however, in paragraph 28 of the *R&O*, the Commission states that amateur stations will be permitted to use "any unspecified digital code, subject to the requirements of Section 97.309(b)." Therefore, as a practical matter it appears that any J2D data emission is to be permitted up to a bandwidth of 2.8 kHz, provided that care is exercised to limit the length of transmissions.

AMSAT ANNOUNCES END OF OSCAR 51 MISSION

AMSAT-OSCAR 51 — the popular FM repeater satellite, has likely reached the end of its operational lifespan. AMSAT-NA Vice President of Operations, Drew Glasbrenner, KO4MA, issued the following statement on November 29, 2011: "It is with a heavy heart I report that AO-51 has ceased transmission and is not responding to commands. The last telemetry data indicated that the third of six batteries was approaching failure to short, and observations indicate the voltage from three cells is insufficient to power the UHF transmitters. The Internal Housekeeping Unit may continue to be operative. Initial tests with the S band transmitter were also not positive, although more attempts are in order. We have tried leaving the satellite in an expected state where if voltages climb high enough, the 435.150 transmitter may possibly be heard. The command team will regularly attempt communications with the satellite over the coming months (and years). There is always the possibility that a cell will open and we could once again talk to our friend while illuminated. Thanks to all who helped fund, design, build, launch, command and operate AO-51. Its 7 year mission has been extraordinary."

AMSAT



OSCAR 51 was launched in 2004 and became one of the most popular Amateur Radio satellites ever created.

SECTION MANAGER NOMINATION NOTICE

To all ARRL members in the Illinois, Indiana, Maine, Northern Florida, Oregon, Santa Clara Valley, Vermont and Wisconsin sections: You are hereby solicited for nominating petitions pursuant to an election for Section Manager (SM). Incumbents are listed on page 16 of this issue.

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

We suggest the following format:

(Place and Date)

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

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

(Signature___ Call Sign___ City___ ZIP___)

Any candidate for the office of Section Manager must be a resident of the Section, an Amateur Radio licensee of Technician class or higher and a full member of the League for a continuous term of at least two years immediately preceding receipt of a nominating petition. Petitions must be received at Headquarters by 4 PM Eastern Time on March 9, 2012. If more than one member is nominated in a single Section, ballots will be mailed from Headquarters on or before April 2, 2012, to full members of record as of March 9, 2012, which is the closing date for nominations. Returns will be counted May 22, 2012. Section Managers elected as a result of the above procedure will take office July 1, 2012.

If only one valid petition is received from a Section, that nominee shall be declared elected without opposition for a two-year term beginning July 1, 2012. If no petitions are received from a section by the specified closing date, such Section will be resolicited in the July 2012 *QST*. A Section Manager elected through the resolicitation will serve a term of 18 months. Vacancies in any Section Manager's office between elections are filled by the Membership and Volunteer Programs Manager. — *David Patton, NN1N, Membership and Volunteer Programs Manager*

SM Resolicitation Notice: *Since no nominations were received for the Michigan Section Manager election by the nomination deadline of September 9, 2011, nominations are hereby resolicited.*

Putting Amateur Radio in Context in the EOC

In the October 2007 "Public Service" column, I took readers on a tour of a typical, modern county EOC to foster understanding of the EOC work environment.[1] The article appeared a scant 2 years after Hurricane Katrina, the costliest natural disaster of all time and one of the five deadliest storms in recorded history. Consequent changes in the emergency management and public safety arenas were inevitable and I decided to interview the two principals of the Flagler County, Florida, EOC team again to see how these changes have affected them and their EOC operations.

RICK PALM, K1CE

Flagler Emergency Management Chief Troy Harper (right) and Emergency Management Technician Bob Pickering, KB4RSY, at the Flagler County, Florida Emergency Operations Center.

Troy Harper is emergency management chief and Bob Pickering, KB4RSY, is the emergency management technician. Both are veterans in their positions with vast experience in all aspects of the EOC and public safety. Pickering is a communications specialist and a former County Employee of the Year. If I were to pick two words to describe the pair, they would be "dedicated" and "enthusiastic."

Flagler County has a population of 90,000 with 19 miles of exposed coastline on the upper east coast of Florida. It has a western rural aspect with farms and forests. Although the Emergency Services Department was forced to cut back its staff from 18 to 12 as many state governments and agencies have slashed budgets since the 2008 economic crisis, Harper has managed to increase its funding through FEMA grants, which have allowed him and his team to effect the enhancements discussed below.

As far as telecommunications is concerned, two words were first off their lips: interoperability and redundancy. Since Katrina the mantra in the field has been "let's get to where we can talk to each other," which applies to both interagency communications and also to intra-EOC functioning. Their goal has been to "patch" communications systems together so that talk across system, function and agency is seamless, regardless of the radio or Internet service employed. For example, in the EOC's Public Safety Answering Point (PSAP) dispatch center "E-911," Harper had their system join the *Florida Interoperability Network* that uses voice over Internet protocol (VoIP) for instantaneous communications networking with other public safety agencies throughout the state.

Interconnecting Agencies

The EOC's primary workhorse and backbone for EOC operations remains their robust, hardened analog/digital 800 MHz trunking system, with many enhancements effected in the post-Katrina years. One of these enhancements is more physical antenna sites throughout the county, five in total, with another single site backup. The trunking system provides all communications between the EOC and those county government officials and workers involved with the various emergency support functions (ESFs). The system is also "hard-patched," that is, linked into the more old-fashioned but tried and proven VHF FM system for redundancy and also communications with Fire/Rescue and the Department of Forestry, which operate primarily using this mode.

The EOC's pagers are also on this VHF system, which has a single repeater and backup simplex capability. Pickering picked up his beaten-up, heavy-duty Maxon handheld transceiver and beamed as he demonstrated instant communications across the entire Flagler EOC grid of radio and Internet systems. He can communicate with other EOCs, agencies and functions on his handheld transceiver.

For public alerting, the EOC employs the *CodeRed* notification system (like reverse 911) where citizens are called with warnings. The system is able to strip severe weather warnings from the NWS and call residents in the warning area immediately with advice like "Get under the bed now." The EOC also has AM and FM broadcasting facilities and is on the DHS/FEMA-sponsored National Warning System (NAWAS), an automated telephone party line to more than 2000 EOCs around the country.

The EOC also has access to the Shared Resources HF Radio Program (SHARES), an HF system sponsored by the National Communications System, with which the ARRL has a formal memorandum of understanding. It promotes interoperability between HF radio systems used by the Federal departments and agencies. "This role has taken on added importance with the widespread purchase and use of automatic link establishment (ALE) technology throughout the HF radio community," according to the NCS website.

For communications with the Florida state mega-EOC facility at Tallahassee, Harper and Pickering just pick up the phone (fancy name: the Public Switched Telephone Network or PSTN). If the landline is out or overloaded, the EOC relies on *EMnet*, (Emergency Management Network), a satellite-based emergency messaging system serving state and municipal government emergency operation centers, police, firefighters, broadcasters, hospitals and other organizations. It's a voice/data over IP system that is monitored at the Flagler EOC 24/7 and tested daily.

Formerly, the Auxiliary Communications room at the EOC featured a full HF Amateur Radio station, fixed mobile VHF/UHF FM radios and a bay of docked dual-band mobile radios on desk tops. Now, that equipment is sorted by type and kept and maintained in Pelican cases ready for instant deployment to the field to be operated by registered and certified amateur teams. More on this program later. The EOC also relies on the General Mobile Radio Service (GMRS) on UHF FM, CB

[1]R. Palm, K1CE, "A Tour of a Modern County EOC," *QST*, Oct 2007, pp 77-78.

Rick Palm, K1CE ♦ 31 Burning Ember Ln, Palm Coast, FL 32137 ♦ k1ce@arrl.net

RICK PALM, K1CE

Local ham hero Bob Pickering, KB4RSY, veteran EOC communications specialist and ardent supporter of the local volunteer radio communications groups. The local Amateur Radio community has been fortunate to have Pickering, a former County Employee of the Year, as an advocate.

RICK PALM, K1CE

A photo of the operations room, with a desk for each of the Emergency Support Functions (ESFs).

REACT and others for communications with volunteers in the field in a disaster scenario. The EOC actively maintains dual-band, multimode radios that are monitored constantly for situational awareness with GMRS, the airport and the marine environment.

Turning the corner into the main operations room, where each ESF has a desk, computer and communications systems, the specialists pick up the phone first. If they are not working, they can pick up a deployable ground-based voice/data/Internet capable satellite phone (*TracStar*), similar to the old INMARSAT units, only with greater functionality and lower cost. Communications with the state EOC can also be achieved through the *ESATCOM* satellite system combined with land mobile system connectivity.

I asked the pair about any secret communications systems. They said they couldn't tell me.

The EOC runs *E Team* software for incident management and also *WebEOC*, another web-enabled crisis information management system that provides secure real-time information sharing with other EOCs to help managers make sound decisions quickly. Their *EMWIN* weather system described in 2007 has now been replaced with the weather function of the *EMnet* program. According to the *EMnet* website, "Emnet's most significant benefit is that it provides the EOC with a single, efficient and effective interface for all inbound hazard notices, and to all outbound warning systems. Over the last few years, EOCs have experienced an increase in the demands to continuously sort through e-mail, monitor numerous websites, radio and telephone networks, and to watch fax machines for urgent messages from many sources . . ."

New Systems Being Evaluated

Harper and Pickering are evaluating "new" communications options, modes that have been in traditional use by radio amateurs for a long time: SSTV, APRS and burst messaging systems (like packet). The pair is also looking to new cellular broadband networks, especially *LTE Advanced*, a new standard for wireless communication of high-speed data for mobile phones and data terminals, that will allow more interoperability with handheld radios and cell phones for communications with other EOC field operators in the region.

Amateur Radio in the EOC

In 2010, Flagler County Emergency Services, the governmental agency responsible for the management of the large EOC, elected to change the way it coordinates with volunteers, including several citizen-based emergency communications groups. Instead of having volunteer communicators and operators serve the EOC via liaison with leaders of the volunteer groups, emergency management now recruits, selects, registers and manages the volunteers directly.

Each volunteer applies and is trained for specific duties under the direct supervision of EM officials. The Flagler Emergency Management Volunteer (FEMV) program is open to all residents of Flagler County. All volunteers in this organization are trained, issued uniform shirts and an identification badge. FEMV members will be under the direction of Flagler County Emergency Management for preparedness, response, recovery and mitigation efforts.

The program now boasts 85 members, even before a public roll-out of the program expected soon. There are several units within the volunteer auxiliary: E-Comm, Training, Marketing/Recruitment, Logistics and Landing Zone. There are currently six members of the E-Comm unit, who are all radio amateurs, GMRS licensees and trained SKYWARN spotters. More E-Comm unit members are expected. The E-Comm unit is responsible for providing auxiliary communications support in the event of a disaster, under the direction of the EOC and under the umbrella of NIMS/ICS protocols. The EOC also trains CERT teams throughout the county, which use mostly GMRS and Family Radio Service (FRS) radios for communications.

Requirements for membership in FEMV include the FEMA ICS courses IS-100 and IS-700, on ICS and NIMS protocols. Volunteers are credentialed and "typed" or classified by their training certifications and experience and placed in a database so that as a situation develops, the EOC can alert the appropriate type of volunteers needed.

Harper and Pickering on Amateur Radio

I asked the pair about what they see as the most important elements necessary to keep Amateur Radio useful and relevant in today's continually evolving EOC environment: "Stick to Amateur Radio's core values of simplicity and on-the-fly innovation, while not losing sight of new technologies like D-STAR," they said. Harper and Pickering also said that Amateur Radio is their "When All Else Fails" system, but with the interoperability, redundancy and hardening of their own systems, the likelihood of all else failing is remote.

They said that radio amateurs can increase their value to emergency management by branching out and broadening their training and capabilities as volunteers into other areas besides just radio communications: "Gone are the days when a radio amateur just sits at a table with his handheld in front of him waiting for messages to be handed to him for relaying, and no other function," they said. "The bottom line is, the EOC wants people cross-trained for the fastest, most effective response to save lives and property as possible. The more hams can contribute to this effort, the more valuable they will be," Harper and Pickering concluded.

OP-ED

Ham Radio Unchained

Rick Lindquist, WW3DE

Freedom is again a popular buzzword, and hams have more of it than ever before. It's never been easier to get on the air! Amateur Radio has largely evolved from a tightly regulated pursuit that designed and implemented its own technology to a lightly regulated avocation that uses technology others have designed and implemented. Shifting regulatory and technological sands have influenced our operating habits over the years, but we rarely give any thought to how liberated we have become.

I go back roughly a half-century in ham radio and, with many others — *too* many, some would argue — have witnessed a sea change in technology and regulatory oversight. Where once you could count the available modes on one hand, today you'd run out of toes. Still, nostalgia is a *force majeure* in ham radio circles, and many find it next to impossible to break free. Each generation of radio amateurs does carry its own emotional baggage.

Unshackled Regulation

Amateur Radio operators once lived in fear of the FCC and trod very carefully on the bands. Big Brother might not have been watching, but he *was* listening! Having harmonics or inadvertently slipping outside your allocation could get you a so-called "pink ticket" from "The Charley" (I received a couple of advisory notices, but these were not pink). Modern technology has eased technical compliance, subsuming issues common with our often homebrewed gear of yore. For example, the rules once required hams to have an external means of accurately determining transmitting frequency. I built a wavemeter. It didn't work all that well, and, fortunately, no one in charge ever asked to inspect it. Today we just turn on the transceiver and trust the readouts.

To operate away from home in the Olden Days, you had to inform the FCC in writing, not to mention pack up the boat anchors. Shrinking gear has freed us to take our "stations" anywhere, and a less-persnickety FCC no longer cares to know where. This has implications for emergency communication, which more often takes place on VHF and UHF using handheld gear (for some reason, none of the handheld HF transceivers that reached the market ever really caught on). We're further free to operate our stations hundreds or thousands of miles away via the Internet.

As for compliance, ham radio continues to be self-policing. Operate outside the rules, and you're far more likely to get an Official Observer (OO) report than correspondence from the FCC, which has far bigger wireless fish to fry. We operate with no fear these days.

Of all the regulatory changes affecting ham radio, the 2007 blanket deletion of the Morse code requirement reigns supreme. In the Dark Ages the FCC imposed rigorous sending and receiving tests. Now the Commission no longer considers Morse proficiency essential, although we're still free to indulge. Today's CW segments remain busy, and even some so-called "no-coders" have "discovered" this venerable mode. A few use code readers or software to decipher the dits and dahs, even for contesting. Emotions aside, the extinction of the Morse code requirement has had no substantive impact on how we *operate*, beyond giving us more people to contact.

Liberating Technology

Crystal oscillators once determined a transmitter's frequency. Not coincidentally the FCC allocated the bands in harmonic sequence, so you could readily use the same crystal on several bands. (Early Novices *had* to use crystal control.) The accepted practice was to call "CQ," then start "tuning the band for any calls." This cumbersome practice faded away once stable, reliable VFOs came along, although today's QRPers using crystal control still "tune around" for replies.

Remember "tuning up"? Not having to dip the plate and peak the grid (or was it the other way around?) anymore means you can band-hop with alacrity. Within seconds, you can work a station in a contest on one band, shift to another to hand out a quick multiplier, and then return to the original band. Computers, of course, can track these operating functions and eliminate other onerous operating chores.

The introduction of single-sideband (SSB) phone in the 1950s — another major ham radio milestone — initially met with considerable resistance. Diehard AMers derided SSBers as "Donald Ducks" and asserted that spectrum-inefficient full-carrier AM sounded better (well, it probably *does*, but…). Few would argue, however, that eventual widespread adoption of SSB freed up untold spectrum on our phone allocations. Add today's better filters, and many more users can enjoy the phone bands simultaneously.

Oddly, the advent of voice-operated transmit (VOX) seems to have barely changed the operating habits of many hams, except possibly contesters. A lot of ops with VOX-equipped rigs still insist on making individual transmissions — often bloviating at length, rather than taking advantage of the freedom VOX offers to enjoy greater give-and-take. The same sorts of operating habits persist on CW, even though full-break-in (QSK) capability is commonplace. Give VOX and QSK a try!

The Future

Shakespeare said, "What's past is prologue." Five decades ago, however, we scarcely imagined the possibilities now at hand: More ham radio licensees than ever, a streamlined all-volunteer licensing system, less-burdensome regulation, eye-popping technology and innovative operating modes offer myriad opportunities to spread your wings. The marvel of ham radio is expanding exponentially, along with the ways and means to embrace it. Break out of your customary box and enjoy your freedom!

Rick Lindquist, WW3DE, is the editor of NCJ, the National Contest Journal. He can be reached at **ww3de@arrl.org**.

Op-Ed Policy

The purpose of Op-Ed is to air member viewpoints that may or may not be consistent with current ARRL policy.

1) Contributions may be up to 900 words in length.

2) No payment will be made to contributors.

3) Any factual assertions must be supported by references, which do not necessarily have to be included in the body of the article to be published.

4) Articles containing statements that could be construed as libel or slander will not be accepted.

5) The subject matter chosen must be of general interest to radio amateurs, and must be discussed in a way that will be understandable to a significant portion of the membership.

6) With the exception that the article need not be consistent with League policy, the article will be subject to the usual editorial review prior to acceptance.

7) No guarantee can be made that an accepted article will be published by a certain date, or indeed, that it will be published at all; however, only articles that we intend to publish will be accepted, and any article we have decided against publishing will be returned promptly.

8) Send your contributions to ARRL Op-Ed, 225 Main St, Newington, CT 06111 or via e-mail to **qst@arrl.org** (subject line Op-Ed).

Contest Corral – February 2012

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

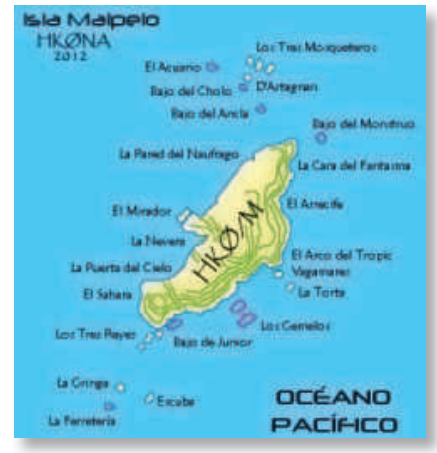
Start - Finish Date-Time		Date-Time		Bands HF / VHF+	Contest Title	Mode	Exchange	Sponsor's Website
3	0200Z	3	0300Z	1.8-14 / -	SNS and NS Weekly Sprints	CW	Serial, name, and S/P/C	www.ncccsprint.com/rules.html
4	0000Z	5	2359Z	1.8-28 / -	YLISSB QSO Party	CW	Call sign, RS(T), ISSB number	www.ylsystem.org
4	0000Z	5	2400Z	3.5-28 / -	EPC WW PSK Contest	Dig	RST and serial	www.epcwwdx.srars.org/index.php/contest-rules.html
4	0000Z	5	2400Z	1.8-28 / 50,144	Vermont QSO Party	Ph CW Dig	RS(T) and VT county or S/P/C	www.ranv.org
4	0001Z	5	2359Z	28 / -	Ten-Ten Winter Phone QSO Party	Ph	Call sign, name, QTH, 10-10 nr	www.ten-ten.org
4	1200Z	5	1200Z	1.8-28 / -	Black Sea Cup International	Ph CW	RS(T) and org'n ID, member nr or ITU zone	www.bscc.ucoz.ru
4	1400Z	4	2400Z	1.8-28 / -	FYBO Winter QRP Field Day	Ph CW	RS(T), S/P/C, name, power, temp in deg F	www.azscqrpions.com
4	1400Z	4	2400Z	1.8-28 / 50+	Minnesota QSO Party	Ph CW Dig	Name and MN county or S/P/C	www.w0aa.org
4	1600Z	4	1900Z	3.5 / -	Straight Key Party	CW	RST, serial, category, name, age	www.agcw.de
4	1600Z	5	0400Z	1.8-28 / -	British Columbia QSO Party	Ph CW Dig	RST and BC district or S/P/Territory or DX	orcadxcc.org
4	1700Z	5	2359Z	1.8-28 / 50+	Delaware QSO Party	Ph CW Dig	RS(T) and DE county or S/P/C	www.fsarc.org
4	1800Z	5	1759Z	3.5-28 / -	XE Int'l RTTY Contest	Dig	RST and XE state/district or serial	www.fmre.org.mx
5	**0000Z**	**5**	**0400Z**	**3.5-14 / -**	**North American Sprint**	**CW**	**Both call signs, serial, name, and S/P/C**	**www.ncjweb.com**
7	0200Z	7	0400Z	3.5-28 / -	ARS Spartan Sprint	CW	RST, S/P/C, and power	www.arsqrp.blogspot.com
8	1100Z	9	See web	1.8-28 / -	CWops Monthly Mini-CWT Test	CW	Name and member nr or S/P/C	www.cwops.org/onair.html
10	1400Z	12	0200Z	1.8-28 / -	YL-OM Contest	Ph CW Dig	Call sign, RST, serial and S/P/C	www.ylrl.org
11	0000Z	12	2400Z	3.5-28 / -	CQ WW RTTY WPX	Dig	RST and serial	www.cqwpxrtty.com
11	1100Z	11	1300Z	7,14 / -	Asia-Pacific Sprint	CW	RST, serial	jsfc.org/apsprint/aprule.txt
11	1200Z	12	1200Z	1.8-28 / -	Dutch PACC Contest	Ph CW	RS(T) and Dutch province or serial	www.dutchpacc.com
11	1500Z	12	0300Z	3.5-28 / -	Louisiana QSO Party	Ph CW Dig	Call sign, RS(T), LA parish or S/P/C	laqso.w5yl.org
11	1500Z	12	1500Z	3.5-28 / -	OMISS QSO Party	Ph	RS, S/P/C and OMISS nr or "DX"	www.omiss.info
11	1600Z	12	0400Z	1.8-28 / -	New Hampshire QSO Party - CW	Ph CW Dig	RS(T) and NH county or S/P or "DX"	www.w1wqm.org
11	1700Z	11	2100Z	3.5-28 / -	FISTS CW Winter Sprint	CW	RST, S/P/C, first name, FISTS nr or power	www.fists.org
11	2100Z	12	0100Z	1.8 / -	RSGB - First 1.8 MHz Contest	Ph CW	RST, serial, UK district	www.rsgbcc.org
12	**0000Z**	**12**	**0400Z**	**3.5-14 / -**	**North American Sprint**	**Ph**	**Both call signs, serial, name, and S/P/C**	**www.ncjweb.com**
12	1400Z	13	0800Z	1.8-28 / 50,144	Classic Exchange	Ph	RST, QTH, model of rcvr and xmtr	www.classicexchange.org
12	1900Z	12	2130Z	- / 50-440	Milwaukee FM Simplex Contest	Ph	Call sign and grid square	www.w9rh.org
12	1900Z	12	2300Z	- / 144	Maine FM Simplex Challenge	Ph	Call sign, power, city name	www.qsl.net/ws1sm/contest.html
13	**1300Z**	**17**	**2359Z**	**1.8-28 / 50+**	**School Club Roundup**	**Ph CW Dig**	**RS(T), Class, S/P/C**	**www.arrl.org/school-club-roundup**
14	8 PM	15	2 AM	1.8-7 / -	PODXS Valentine Sprint	Dig	Name, OM or YL, S/P/C	www.podxs070.com
15	0130Z	15	0330Z	3.5-14 / -	NAQCC Monthly QRP Sprint	CW	RST, S/P/C, and NAQCC mbr nr or power	naqcc.info
15	1900Z	15	2030Z	3.5 / -	Semi-Automatic Key Evening	CW	RST, serial, first year of bug use	www.agcw.org
17	2100Z	18	2100Z	1.8-28 / -	Russian WW PSK Contest	Dig	RST and oblast code or serial	www.qrz.ru/contest/detail/384.html
18	**0000Z**	**19**	**2400Z**	**1.8-28 / -**	**ARRL Int'l CW DX Contest**	**CW**	**RST, state/province or power**	**www.arrl.org/contests**
18	2000Z	18	2200Z	1.8-28 / -	Feld-Hell Annual WAS Sprint	Dig	RST, S/P/C, Feld-Hell member nr	www.feldhellclub.org
18	2300Z	19	2300Z	3.5-14 / -	AM QSO Party	Ph	RS, name, and S/P/C	www.antiquewireless.org
24	2200Z	26	2200Z	1.8 / -	CQ WW 160 Meter SSB	Ph	RST and state/province or CQ zone	www.cq160.com
25	7 PM	25	11 PM	- / 50-440	Pennsylvania FM Sprint	Ph	Call sign, serial, and 5-digit ZIP code	www.harcnet.org
25	0600Z	26	1800Z	3.5-28 / -	REF Contest	Ph CW	RS and French dept or serial	www.ref-union.org
25	1300Z	26	1300Z	3.5-28 / -	UBA Contest	CW	RS, serial, and ON province	www.uba.be/en/hf/contest-rules
25	1500Z	26	0300Z	3.5-28 / 50-432	Mississippi QSO Party	Ph CW	RS(T) and MS county or S/P/C	www.arrlmiss.org
25	**1800Z**	**26**	**0600Z**	**3.5-28 / -**	**North American QSO Party**	**Dig**	**Name and S/P/C**	**www.ncjweb.com**
26	1700Z	27	0300Z	3.5-28 / -	North Carolina QSO Party	Ph CW	RS(T) and NC county or S/P/C	www.w4nc.com
27	0100Z	27	0259Z	3.5-14 / -	CQC Winter QSO Party	Ph CW	RS(T), S/P/C, name, CQC nr or power	www.cqc.org

All dates refer to UTC and may be different from calendar date in North America. Times given as AM or PM are local times and dates. No contest activity occurs on 60, 30, 17, 12 meters. Publication deadline for Contest Corral listings is the first day of the second month prior to the cover date (February 1 for April *QST*).

W3UR

HOW'S DX?

HK0 — Malpelo Island



In 1526 Malpelo Island was discovered by Spanish Captain Barolome Ruiz who was sailing for the Spanish conquistador Francisco Pizarro. The volcanic rock island is located in the Pacific Ocean at 4° 00' 10" N and 81° 36' 20" W, which is about 373 km (232 miles) from the mainland of Colombia. Malpelo is a steep and bleak rock with 60 degrees or more vertical walls. There are three peaks, the highest being 300 meters (980 feet). It has little to no vegetation, yet supports birds, land crabs and lizards.

The island is bordered by multiple offshore rocks. The island and rock are surrounded by hundreds of hammer head and silky sharks. In 1891 the island was surveyed by the U.S. Fish Commission steamer *Albatross*. Other than a Colombian military outpost, which was established in 1986, the island is uninhabited. The garrison is located on the only flat surface of the island on the east side about 120 meters above sea level. The United Nations Educational, Scientific and Cultural Organization (UNESCO) named Malpelo a natural World Heritage Site on July 12, 2006.

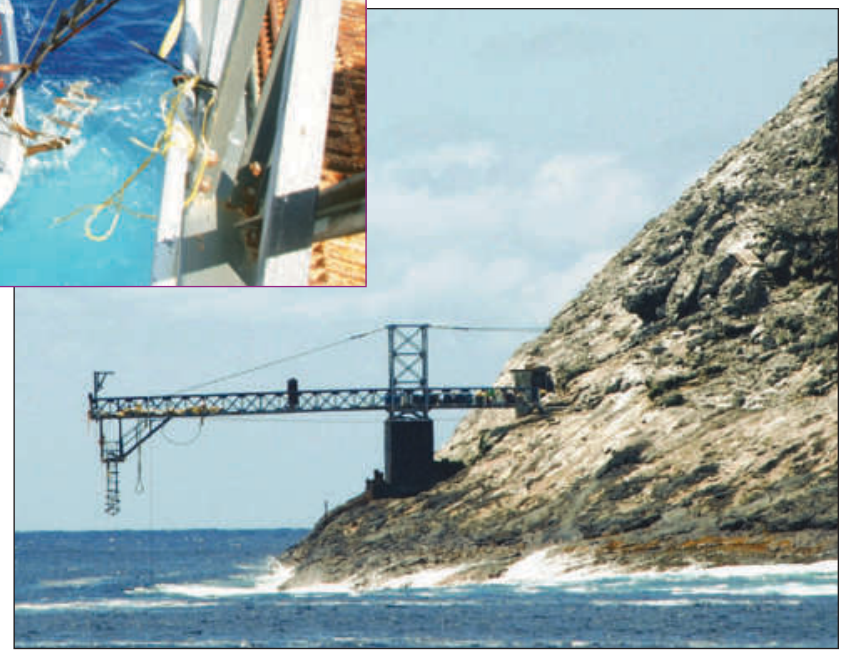
DXCC History

Malpelo Island was not on the original post WW II DXCC list from November 15, 1945. The inception of the first DXpedition to Malpelo took place in 1959 during the KS4BB DXpedition to Serrana Bank, which was "masterminded" by Mac Reynolds, W9EVI. The plan was to go in May 1960 with a team from Colombia and America, celebrating the 150th anniversary of the declared independence of the Republic of Colombia. The leaders of this first DXpedition attempt were Ed, HK3LX, a retired Colombian Army officer, and Mac. The actual team consisted of HK3LX, W4CVI, W9DUB and W6HAW. Once they got to the island they realized how difficult it would be to land as there was nowhere to land, no ladder and no harbor. Unfortunately after several days of circling the island and one attempt to get the team on the island the captain decided to head back to the mainland. Once back home, the team decided to make another attempt the following year. On April 1, 1961 just after 0315Z HK0TU came on the air and the first QSO was made by George Morrow, W8BKP, on 20 meters SSB. The first Malpelo Island DXpedition team included Herman, HK1QQ; Jaime, HK2YO; Ed, HK3LX; Carlos, HK5EV; Dale, W4DQS (now W4QM); Boots, W6HAW; Mac, W9EVI; and Bob, W0NWX (W0DX/VP2VI). They had three stations and the DXpedition lasted just three days.

In the June 1961 issue of *QST*, page 83, the DXCC Notes stated:

> Announcement is hereby made of the addition to the ARRL Countries List of Malpelo Island. Malpelo Island is located in the Pacific Ocean some 310 miles west of Bueneventura, Colombia. The closest point of Colombian territory to Melpelo Island measures 232 miles, thus placing it under Point 2 of the criteria (see page 80, April 1960 *QST*, DXCC Note). DXCC credit claims may be made for this addition starting August 1, 1961. Confirmations for contacts with Malpelo Island must be dated November 15, 1945 or later. DXCC credit claims for this addition received before August 1, 1961 will be returned without credit.

The HK0NA team and their equipment will be ferried to this ladder on the Tangon.



In order to get both people and equipment onto Malpelo Island this large Tangon (boom) will be used.

Bernie McClenny, W3UR ♦ 3025 Hobbs Rd, Glenwood, MD 21738-9728 ♦ w3ur@arrl.org

The second DXpedition to Malpelo Island likewise used the HK0TU call sign in February 1969. It included team members Bill, HK3RQ; Bob, W0DX/VP2VI; Jose, HK-5BFJ; Raul, HK3BM; Gab, HK3HY; Carlos, HK3VA/TI2CF; Pacho, HK3BAS; Carlos, HK5EV; Luis, HK5ACI; Enrique, HK5ASF; Don, K6JGS/HK3 (now W4PUL); Dale, W4DQS (now W4QM); and Enos, W4VPD. Fuad, HK3WO, was listed on the 1969 QSL card but he did not go to Malpelo. At the beginning of this DXpedition just after the men landed two of the team members were washed off the island after being hit by a huge wave. Liga Colombiana de Radioaficionados (LCRA) President Bill Elasmar, HK3RQ, was hit by a giant wave causing him to fall into the ocean and then he was hit by a 900 pound balsa raft leaving him unconscious and in a large pool a blood in shark infested waters.

Jose Saouda, HK5BFJ, immediately sprang into action without thinking about his own life as he jumped in and saved Bill's life. That same wave also tossed Gabriel Becerra, HK3HY, into the dangerous waters, and he was also injured. Also during this DXpedition the team celebrated Colombia's 150th anniversary of their recognized independence. "One evening the president of Colombia spoke to the amateurs and to the nation on public radio and congratulated them on a successful DXpedition" remembers Don, W4PUL.

Members of the LCRA made the third DXpedition to Malpelo in March 1977. The list of operators as shown on the QSL were HK2AQT, HK3DEU, HK3CEC, HK3BAE, HK3BQM, HK3XU, HK4BPD, HK4DKR, HK5ASF, HK5HK, HK5RL, HK5VF, HK5SK, HK5LA, HK6CYH and HK7AJP. During this operation HK5ASF was injured, as mentioned on the 1990 HK0TU QSL card.

In celebration of the 50th anniversary of the LCRA an all HK team once again put HK0TU on the air during October 1983. They included 1AWM, 1DBO, 1QQ, 2YO, 3BAE, 3BAV, 3BED, 3DDD, 4BHC, 4COK, 4DUM, 5LA and 8BYG.

November 1990 was the last time for HK0TU to be QRV from Malpelo Island. The multi-op HK team was led by HK3BED and also included HKs 1HHX, 1KXA, 1LDG, 3AHM, 3CC, 3DDD, 3DPY, 4BHA, 4DUM, 4HHG, 5LEX, 6BDX, 6HFY and 6KKK. The QSL manager was HK3DDD. The team was QRV for five days making approximately 40,000 QSOs.

During April 1998, March 1999 (18,000+ QSOs) and April 2001 (15,000 QSOs) HK3JJH, Pedro Allina, did single op efforts from the rock as HK3JJH/0M for the first two and HK3JJH/HK0 for the last one. All three operations were for just a few days each.

The last DXpedition to Malpelo Island was a 10 day operation by HK5QGX/0M (JA8BWI), Hiro, and HK5MQZ/0M, Jairo in June 2001. They made 12,000 QSOs.

The *Seawolf* will transport the international HK0NA team from Colombia's mainland to Malpelo Island.

Malpelo 2012 DXpedition

Malpelo Island ranks number 12 on *The DX Magazine*'s most wanted list and has not been on the air for more than a decade. There had been rumblings about a future DXpedition to HK0/M for more than a year until the first official word in April of last year. That's when the DX Colombia Amateur Radio Club team leader HK1R, Jorge Prieto, announced plans for a team of eight HK ops and four "international" ops to put HK0NA on the air from Malpelo Island in 2012. Since the original announcement a lot has changed.

The team of ops includes team leader Jorge, HK1R; Salim, HK1T; Pedro, HK1X; Bolmar, HK1MW; Jaime, HK1N; Pedro, HK3JJH; Faber, HK6F; Franz, DJ9ZB; George, N4GRN; Gregg, W6IZT; Gary, K9SG; Bob, K4UEE; Steve, VE7CT, Manu, LU9ESD; Jerry, WB9Z; Neil, VA7DX; Glenn, W0GJ; Peter, PY5XX; Box; N6OX; and Ralph, K0IR.

The dates for this one have been extended, due to the unlikeliness "that the various Colombian authorities will permit another DXpedition to Malpelo anytime soon". In early January four team members are expected to land on the island to set up "all equipment, radios, antennas and infrastructure". Originally the plans were for a 12-14 day operation, which has now been enhanced to a 16-17 day DXpedition expected to begin with all team members on approximately January 21 and last through February 5 or 6.

Plans are to operate from two locations: One from the military garrison, which is located about a third of the way up the island and a second location near the very top, which will help the W6/7, JA/Asia and Pacific ops. From the second location they will be operating from a platform just below the peak of the top, where the antennas will be located. At times during the operation the HK0NA team could have as many as nine stations QRV simultaneously.

The team will be QRV on all bands from 1.8 through 50 MHz, except 5 MHz, on CW, SSB and RTTY. Suggested frequencies to listen for HK0NA are as follows:

CW — 1.824, 3.504, 7.004, 10.104, 14.024, 18.074, 21.024, 24.894, 28024 and 50.103 MHz

SSB — 3.780, 7.056/7.180, 14, 195, 18.145, 21.295, 24.945, 28.495 and 50.120 MHz

RTTY — 7.035, 10.140, 14.080, 18.100, 21.080, 24.920 and 28.080 MHz.

In all cases they will not be operating simplex, but rather split operation is expected. Listen carefully for the operators instructions as to where they are listening. Do not transmit on their transmit frequency!

For the 6 meter ops, HK0NA will be operating from grid locator EJ93fx using a brand new M^2 DXpedition antennas and an amplifier and very experienced "Magic Band" operators. The antenna will be "on the tippy top of the highest peak". Please do not give your grid locator as it will be a waste of time and the DXpedition ops don't care! They plan to have a 6 meter beacon.

For those who are new to DXing, or maybe even a few of the old timers, who want to know "how to work HK0NA" check out this helpful web page at **http://hk0na.com/how-to-work-us/**.

DXpeditions of this magnitude need financial support and you can help via their website at **www.hk0na.com**. Bob Schenck, N2OO, and the members of the SJDXA will be handling the QSL duties. You can QSL direct using the OQRS (online QSL Request System), via the bureau using their OQRS, direct with SASE/IRC/$ or via the bureau. Please only choose one method to avoid extra work on behalf of the QSL team.

WRAP UP

That's all for this month and good luck to everyone who needs HK0NA. A special thanks to HK1R, K4UEE, W0WOI, W2VRK and *The Daily DX* for helping to make this month's column possible. Send your DX news, photos and club newsletters to **bernie@dailydx.com**. Until next month see you in the pileups — *Bernie, W3UR*

Strays

HAVE A *QST* DELIVERY ISSUE?

◊If your copy of *QST* does not arrive by the end of the month before the issue date, please contact the ARRL Circulation Department at **circulation@arrl.org**, tel 860-594-0200. Also contact them if your address changes or your copy of *QST* arrives in damaged condition.

N0JK

THE WORLD ABOVE 50 MHz

When Will 6 Meters Open for Worldwide DX?

(It already has!)

The F2 and transequatorial propagation (TEP) openings this fall, along with the increasing solar activity of cycle 24, have been encouraging for 6 meter DXers. TEP openings were discussed last month. But how can one know when 6 meters will be open for northern latitude F2 DX such as North America to Europe and the Far East?

Generally, solar flux must be high and the higher the better. Often a solar flux of 150 is needed and 200 for more northern paths. The F-layer MUF is generally much higher in the northern hemisphere from October to April. This is due to a number of complicated factors related to the decay rate of ions created by UV light photoionization in the F2 region. During northern winter the decay rate is decreased raising the overall ionization.

The F-layer MUF tends to peak around noon and a few hours later midpath. Normal F2 propagation deteriorates when the K-index is 3 or greater, though some F2 paths closer to the equator improve with geomagnetic activity. This is due to the two bands of ionization north and south of the geomagnetic equator, which are responsible for TEP.

MUF Forecasts

There are some ways to make a more precise prediction of when F2 may occur. Programs such as *Miniprop* (**www.panix.com/clay/ham/propagation.html**) can help. Note these propagation prediction programs deal with probabilities of an opening occurring. A forecast may say that on a certain date and time for a given solar flux there is a 50% chance of the F-layer MUF reaching 48 MHz between New England and Europe. There is a smaller chance the MUF won't reach 48 MHz, but also a chance it will reach 50 MHz. Six meter DXers look for these smaller probabilities as a chance for DX.

Take a close look at Figure 1. It shows a "best-fit" curve of 3 years of actual European openings from the eastern USA and Canada on 50 MHz via F2 during solar cycle 22. Six meters was open about half the days when the solar flux reached 210. But more significantly for us in cycle 24, it was open *25%* of the days when the flux reached just 160!

One can apply the same logic to other popular propagation forecast programs and models. Many of these tend to underestimate the potential MUF that may occur. Part of the reason for this is that they assume 3000 km F2 hops, when 4000 km or even longer hops may occur. This may add 10% to the predicted MUF. Also it is the MUF at the midpoint of a given path that is important. F2 forward scatter may occur allowing high-power large-array stations to make F2 contacts with the MUF at 48-49 MHz. Despite these limitations, the propagation prediction charts do accurately show at what time the MUF will be the highest.

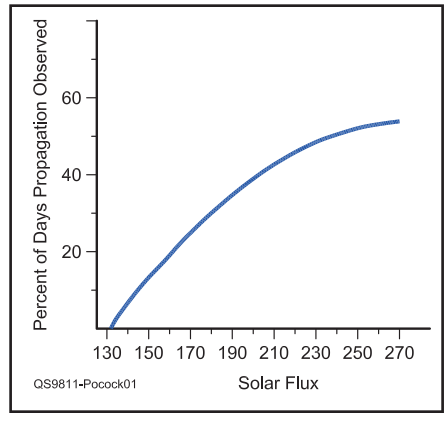


Figure 1 — Percentage of days 50 MHz propagation was observed from New England to Western Europe during November to February, 1988-89, 1989-90 and 1990-91.[1]

This Month

February 11-12	Good EME conditions*
January 21-February 6	HK0NA Malpelo DXpedition

*Moon data from EA6VQ

What Time Will 6 Meters Be Open?

For F2, a good starting place is when the midpoint of the path is near local noon. For East Coast and Midwest to Europe, mid-morning local time. For transcontinental (trans-con) contacts, when local noon occurs in the mid-USA. Look for Japan and the Far East in late afternoon; 2200-0000 UTC were productive periods in cycle 23 for the Midwest USA. Paths from Alaska to the mid and eastern USA are most probable in the early afternoon local time for stateside stations.

This turned out to be the case with the trans-con 50 MHz openings reported in "ON THE BANDS." The openings occurred centered around 1800 UTC, "local noon" in the middle of the path. Oddly, signals from Greenland and Iceland peaked about the same time.

I would encourage reading up on F2 propagation in the *ARRL Handbook*, *The ARRL Antenna Book* and Emil Pocock's, W3EP, excellent discussion of this in the November 1998 *QST*.[2]

ON THE BANDS

Trans-Con. The appearance of trans-con openings from the East Coast states and eastern Canada to the West Coast and Pacific Northwest on 6 meters was a major event in mid November. Starting on Saturday November 12 and continuing almost all week through Friday the 18th there were daily trans-con 50 MHz F2 openings. The solar flux was above 150 and on several days above 180. These openings were primarily from W1, VE1, VY2 and W2

[1]E. Pocock, W3EP, "Predicting Transatlantic 50-MHz F-Layer Propagation," *QST*, Mar 1993, pp 32-34

[2]E. Pocock, W3EP, "World Above 50 MHz," *QST*, Nov 1998, p 87-88

Jon Jones, N0JK ♦ 5212 Eisenhower Pl, Lawrence, KS 66049 ♦ n0jk@arrl.net (316-655-4331)

DX SHERLOCK

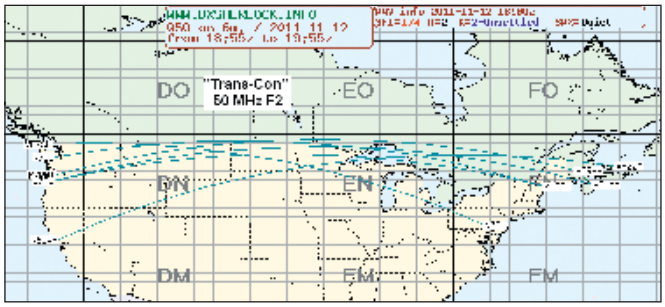


Figure 2 —This is a DX Sherlock map of trans-con 50 MHz F2 contacts between New England, W3 and eastern Canada to the Pacific Northwest and northern California on November 12 at 1900 UTC. The solar flux was 174.

Table 1

Call	*UTC*	*MHz*	*Notes*	*Call*
K7CW	1937Z	50007.0	CN87>FN44	K1TOL
VY2ZM	1936Z	50010.0	very weak to WEST coast	K6QXY
VY2ZM	1932Z	50010.0	CQ WEST!	VE9AA
VE1YX	1925Z	50125.0	CQ WEST-ssb	VE9AA
W7EW	1921Z	50096.0	cn84>fn74	VE1YX
W7EW	1920Z	50096.0	CN84>FN44	K1TOL
VE9AA	1901Z	50099.0	Hearing weakly in CN85	K7RWT
VE7SL	1900Z	50095.0	F2	NZ3M

DX SHERLOCK

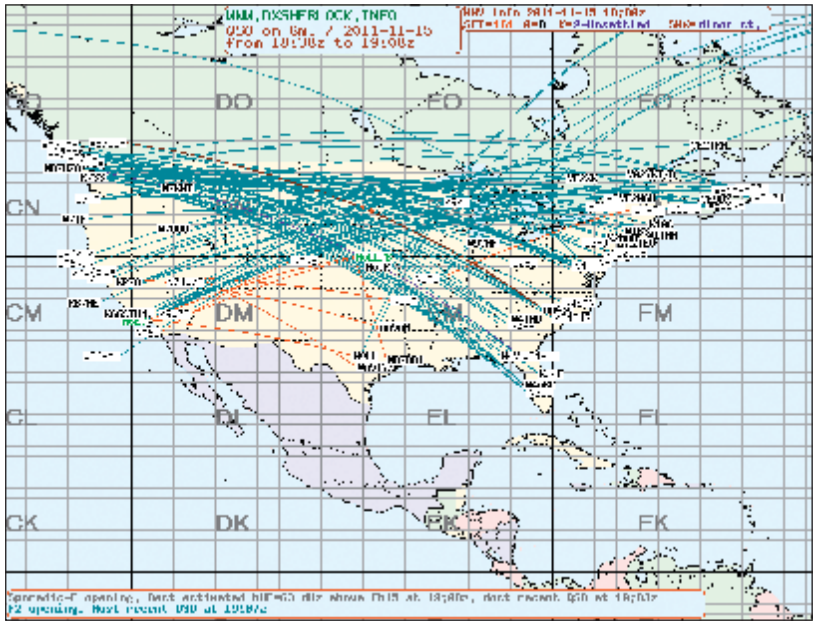


Figure 3 — November 15 was the best day for trans-con as this cluttered map demonstrates!

DX SHERLOCK

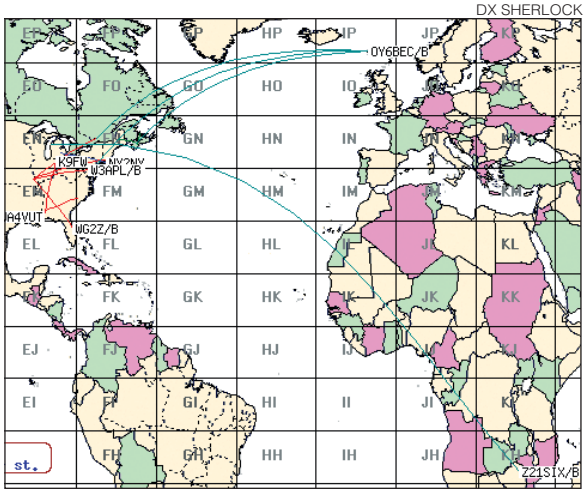


Figure 4 — Reception of the Z21SIX/b by N8JX (EN64) and OY6BEC/b by VE3KU.

to W7 and VE7. Some were weak, suggesting perhaps F2 forward scatter.

On the 12th, K1TOL (FN44) worked W7EW (CN84) and K7CW (CN87) at 1920 UTC (see Figure 2). Lefty notes "then started to hear W7EW at around 1915 but spotted him only later after I spotted him on the KST website. W7EW was the strongest, at S-0 best on my meter, but perfectly easy listening out of the speaker for about 45 total minutes. K7CW was weaker but heard for about 15-20 solid minutes. Seems Jeff, VY2ZM, said he worked Lew, W7EW, when Lew was S7-9 on his meter *wowie*!"

Some 50 MHz F2 trans-con spots from November 12 are listed in Table 1.

The next day, November 13, the F2 opening lasted longer and signals were stronger. K7RWT worked K1TOL at 1824 UTC and noted "F2 like the days of old!" KB7ME (CN85) noted "numerous police and fire" stations between 42-46 MHz on the 13th. He heard no 6 meter beacons, but he made contacts with VE1YX, VE9AA, then N1BUG, K1TOL, W1AIM, W1IPL and W1JR. Mike runs an ICOM IC-7700, 7 element M^2 and 1300 W amplifier. VE3KU in Toronto worked VE7DAY and VE7SL. Dana notes he has worked Steve, VE7SL, via F2 on 50 MHz in each of the last four solar cycles! N7DB (CN85) got VE1YX, VE9DX and K1CP in the log on the 13th with a modest station.

November 15 was the best day for the trans-con and the first North America to Europe F2 contacts of solar cycle 24 were reported that morning (see Figure 3 and 4). Dana, VE3KU, worked EI7IX at 1555 UTC! Dana notes "at that time the OY6BEC beacon was 30 over S9 here in Toronto FN03fq. Also in were the TF1SIX beacon …. and had a partial contact with F6FHM who then worked his 1st F2 on 6 Meters with N8JX about 1629z." N1BUG reported hearing OY9JD at this time. N8JX (EN64) heard the Z21SIX/b Zimbawe at 1523 UTC. He worked MM0AMW at 1740 UTC.

Here in Lawrence, Kansas I set up portable at 1750 UTC on the 15th. A perfect day to be outside, 65 degrees, sunny and no wind. Heard OX3SIX/b, TF1SIX/b, OY6BEC/b and OX3VHF/b via F2 on the 2 element Yagi. This was my first time ever to hear the Iceland and Faroe Islands beacons on 6 meters. I made some "YouTube" style recordings of these with my cellphone. Unfortunately, there were no live operators on today.

E_s appeared to southern California at the same time and N0LL (EM09) and I worked N6EQ (DM14) at 1815 UTC. Later I heard N6EQ work W1, W2, VE1, VE2 and VE3 on F2, and then he worked Kansas on E_s. N0LL heard OX3VHF/b at 1842 UTC. At 1800 UTC K9KU heard TF1SIX/b and OX3SIX/b, both 559, on a dipole! N3DB also heard the OY6BEC/b. NW0W (EM47) reported "JW9SIX/b, TF1SIX/b, OY6BEC/b, OX3VHF/b, OX3SIX/b, VY0SNO/b all in today...it was *awesome*! At times they were 599...Really COOL to hear some DX beacons in on F2 so strong!"

Many trans-con contacts reported between both coasts and, in addition, Florida to the Northwest and southern California to New England. K5SW reported hearing MM0AMW weakly around 1830 UTC. KB7ME reported over 30 contacts via F2 to the East Coast, followed by E_s to the Rocky Mountain states. K0GU in Colorado worked VY2ZM, also probably via F2. I thought there might be an opening to Alaska but none developed on the 15th. On November 18, K7TNT worked KL7NO (BP54), though with very weak signals. Al was heard by K0GU in DN70. The 18th was the last good day for trans-con with KB7ME working VE9AA. November 21 was the last day for trans-con with VY2ZM and VE1YX working VE7DAY at 2000 UTC. This is later in the day than the majority of trans-con contacts reported.

Sporadic E. E_s was reported on a number of days in November. N6EQ (DM14) to N0LL and N0JK KS on November 15 at 1815 UTC. Rocky Mountain States to Oregon and Washington State also on the 15th.

On November 5, E_s from the Midwest to the East Coast in the morning. K0GU (DN70) heard the XE2O/b (EL05) at 1916 UTC. The 20th found widespread E_s. K0HA (EN10) heard XE2O/b at 1733Z and worked KE5GNZ in EL17 at 1743 UTC. That evening Bill had strong E_s to Florida. He noted N3LL (EL86) was much stronger by 10-15 dB at a high elevation angle on his phased array.

E_s to F2. On November 26, K1SIX, K1TOL, VE2XK and others in New England heard OA4TT/b around 1610 UTC. E_s was present along the East Coast and K4RX (EM70), KE4WBO and XE1FAA spotted the OA4TT/b possibly via F2. So I would suspect an E_s link from New England and Quebec to the Gulf Coast, with F2 on to Peru.

Tropo. A rare late fall tropo opening appeared over the Thanksgiving and "Black Friday" Holidays. This appeared to be due to relatively high seasonal temperatures, humid moist air close to the ground and a high pressure system aloft.

On the morning of the November 24, JD, N0IRS (EM29) and I in EM28 both worked KX4R (EM73) Georgia on 2 meters. I was running 50 W and a 7 element M^2 Yagi on CW. KX4R is over 1100 km away and called me when I called CQ. JD worked him on SSB. Earlier JD and I worked KJ4UGO (EM64) Alabama on 2 meter SSB. Other DX contacts included N4QWZ (EM66). Rick, W0RT (EM27) worked K4QH (EM66) and KI4ROF (EM55). The evening before Rick worked N7MB (EN50) IL and WW8M (EN72) MI on 2 meters around 0322 UTC. K5SW reported the tropo started on Wednesday November 23. "It started for me about 7PM Wed evening when on the 144 MHz prop logger I saw where a station reported from WI that he was hearing Quincy, Il & Ft. Smith, AR via APRS." Sam later found activity on 2 meters, which is listed in Table 2.

It reminded me of the huge 1986 Thanksgiving tropo opening, though not as widespread. But activity seemed to be very low, perhaps due to the holidays? Had activity been higher, I wonder what else could have been worked? It seemed like "what if someone threw a tropo party and no one showed up… ?"

Table 2

Call	*Grid*	*State*	*Distance*
WA9KRT	EN61	IN	602 miles
K9MRI	EN71	IN	647 miles
WW8M	EN72	MI	753 miles
N7NB	EN50	IL	471 miles
K8MD	EN82	MI	777 miles
N9RXM	EN41	IL	457 miles

The tropo continued as the weather system moved east. Ron, WZ1V, reports that the Thanksgiving 2011 tropo finally drifted east into Connecticut Sunday morning:

Ron says just a "small station here, just a 6 element beam at 42 feet with 400 W."

Unusual 144 MHz APRS Report

Andy Hanis, K7FED, sent the following:

"I was looking over the logs for my APRS digipeater K7FED-1 on 144.390 MHz and noted an interesting event on 11-1-2011 between 17:40 and 20:50 UTC. The beacon was heard by 9M4GGL-2 digi in Thailand. Doing a bit of homework I found that the digi heard many US stations in that period including at least one other high level digi here in the San Francisco Bay area. Also interesting is that appears to not have been a 2-way event, at least not for my station or WA6ODP… Interestingly it did not seem to hear my ground level IGate which I would expect so it seems to make the logs legit as having been some sort of propagation event for a few hours on that day."

I am not sure what propagation mode could be responsible? Not a good TEP path and I am not aware of any tropo across the entire Pacific. Andy continued…

"I know that here my digipeater hears packets almost continuously from hundreds of miles up and down the central valley to San Francisco. The Thailand station however averages hearing 1 packet every 101 seconds so there is very little activity there and the frequency would have been very very quiet.

"As for the mode, I am in the dark also. ERP is defiantly low on APRS, I know all of my stuff is below 25 watts and 3 dB gain omni antennas."

I welcome comments from readers as to what they think may be transpiring.

Draconids Meteor "Outburst"

On October 8, 2011 the Earth passed through a network of dusty filaments shed by Comet 21P/Giacobini-Zinner. Forecasters expected the encounter to produce anywhere from a few dozen to a thousand meteors per hour visible mainly over Europe, northern Africa and the Middle East. The meteors stream from the northern constellation Draco — hence their name, the "Draconids."

High meteor rates were predicted to occur between 1600 UTC and 2200 UTC (noon-6 PM EDT) with 2000 UTC as the peak as Earth grazed a series of filaments intersecting its orbit. This was during daylight in North America. A disappointment for visual observers, but an opportunity for Amateur Radio operators to observe if the Draconid outburst would occur as predicted.

I was portable in EM28, 100 W and a 2 element Yagi on 6 meters to monitor the meteor reflections by 1945 UTC. I heard several beacons including the N8PUM/b (EN66) on meteor scatter. It sounded like weak steady E_s punctuated by stronger bursts. There was a lot of activity on 50 MHz and I made contact with W6OAL (DM79) and K7TNT (DN74) easily on SSB on 50.125 MHz.

KA9CFD, W6OAL and K7TNT were in constantly on 50 MHz via residual meteor scatter from 1945-2030 UTC. It was a steady drizzle of small meteors with longer, louder bursts every few minutes. At 2010 UTC, K7TNT sounded like E_s. Running 100 W, I needed the louder bursts to complete a contact. K7TNT reported he worked stations on CW, SSB and WJST during the outburst. Best DX for Richard was N8JX (EN64) east and KE7V (CN88) west. W6OAL (DM79) logged KA9CFD (EN40), K9OIM (EM56), N0JK (EM28), N0KK (EN35), W0ALC (DM68), KE7V (CN88), KB0PE (EM48) and W9SE (EN50) on 6 meter SSB/CW.

Perhaps due to the lower altitude where the Draconid meteor ionization occurred, relatively short distances were worked via meteor scatter on 50 MHz. EM28-EM48, EM28-EN40 and DM79-DM68 over a few hundred kilometers were reported. As the Draconids are slow meteors with less intense ionization than the Perseids, few 144 MHz and above contacts were reported. By 2045 UTC the meteors had vanished and the bands were quiet.

According to worldwide visual observers reporting to the International Meteor Organization, there was an outburst of Draconid meteors on October 8. Preliminary counts suggest a peak rate of 660 meteors per hour at 2010 UTC. This correlated with the radio meteor reflections VHF operators observed in North America.

There are some lessons to be learned from the 2011 Draconids "outburst." The meteor forecasting models by scientists such as Dr Paul Wiegert of the University of Western Ontario and others were validated both on the time of and predicted rate of the peak. These same models may help predict other meteor shower "outbursts" and "storms" in the future. Amateur Radio operators can play an important role helping validate the science and accuracy of the shower predictions, particularly the daytime meteor showers where radio can monitor the meteor rate.

SPECIAL EVENTS

Contact these stations and help commemorate history. Many provide a special QSL card or certificate!

Jan 12-Jan 14, 1800Z-0600Z, W4V, Winchester, VA. Shenandoah Valley Amateur Radio Club. Virginia Lee-Jackson Day. 14.260 14.070 14.030 7.035. Certificate & QSL. Shenandoah Valley ARC, PO Box 139, Winchester, VA 22604. *Members will use multiple modes from 80 m through 6 m.* **SVARC.us**

Jan 14, 1400Z-2100Z, N4F, Port Saint Joe, FL. Gulf Amateur Radio Society. State of Florida 174th Constitution Convention Commemorative Special Event. 28.374 21.374 14.274 7.174. QSL. Norm Bixler, 2003 Cypress Ave, Port Saint Joe, FL 32456. **www.gulfars.net**

Jan 28, 1700Z-2300Z, W8NCK, Fremont, OH. Sandusky Valley Amateur Radio Club. 60th Anniversary of the Sandusky Valley Amateur Radio Club. 14.250 7.250. QSL. J. Schlipf, N8TRQ, 1600 Port Clinton Rd, Apt #2, Fremont, OH 43420. **www.w8nck.org**

Feb 2-Feb 5, 1200Z-1800Z, W3C, Washington, PA. Washington Amateur Communications Inc. Washington County PA Sportsman Show. 21.250 18.130 14.260 7.210. QSL. Ed Oelschlager, N3ZNI, 60 Carl Ave B2, Eighty Four, PA 15330. *Event is held at a Washington Crown Center.* **www.wacomarc.org**

Feb 3-Feb 5, 1500Z-0400Z, W5B, Lubbock, TX. Buddy Holly Memorial. 53rd Anniversary of the Death of Buddy Holly. 18.150 14.260 7.260 3.860. QSL. QSL W5B, 109 N Pontiac Ave, Lubbock, TX 79416. **www.amcrc.com/w5b**

Feb 4, 1400Z-2100Z, K3HWJ, Punxsutawney, PA. Punxsutawney Area Amateur Radio Club. Commemorating Groundhog Day at Punxsutawney Airport. 14.330 7.138 3.845 147.290 PL 173.8. Certificate. Mike Miller, N3HBH, 1097 Wishaw Rd, Reynoldsville, PA 15851. **sites.google.com/site/punxyhamclub**

Feb 4, 1500Z-2200Z, W5NAC, Nacogdoches, TX. Nacogdoches Amateur Radio Club. Shuttle Columbia Commemorative Special Event Station. 28.540 21.340 14.240 7.240. QSL. NARC, 167 CR 2093, Nacogdoches, TX 75965. **w5nac.com**

Feb 4, 1600Z-2100Z, KS0KS, Olathe, KS. Santa Fe Trail Amateur Radio Club. Santa Fe Trail Stagecoach Stop. SSB/CW/Digital 10 15 17 20 40 m 28.320 21.320 14.250 7.250. QSL. Dell Sawyer, 1259 E Frontier Ln, Olathe, KS 66062. *Operating two stations.* **sftarc.org**

Feb 4-Feb 5, 1600Z-0059Z, W6IER, Ontario, CA. Inland Empire Amateur Radio Club. IEARC Radio Day. 28.400 14.070. QSL. Inland Empire Amateur Radio Club, PO Box 1433, Ontario, CA 91762. *Talk-in frequency 145.460 (-) PL=77.0Hz.* **president@w6ier.org** *or* **www.w6ier.org**

Feb 8-Feb 28, 2300Z-2300Z, WA7ITZ/W19OG, Salt Lake City, UT. Utah Radio Amateurs. 2002 Winter Olympics 10 Year Anniversary. 28.425 21.300 14.250 7.250. QSL. Ray Friess, 1801 Jennifer Way, Salt Lake City, UT 84116. *Send $1 to cover postage and envelope.*

Feb 11, 1500Z-2100Z, W2EF, Caldwell, NJ. West Essex Amateur Radio Club. Thomas Edison's Birthday. 146.55 21.377 14.277 7.177. Certificate. West Essex ARC, 34 Eastern Pkwy, Caldwell, NJ 07006. **www.wearc.org**

Feb 11, 1700Z-2359Z, NI6IW, San Diego, CA. USS *Midway* (CV-41) Museum Radio Operations Room. Women Marines' Birthday, Lincoln's Birthday and Boy Scouts of America Founded 1910. SSB 14.320 7.250 PSK31 14.070 D-STAR 012C and 2 m/70 cm SOCAL rptrs. QSL. USS *Midway* Museum Radio Room, 910 N Harbor Dr, San Diego, CA 92101. **kk6fz@arrl.net**

Feb 11-Feb 12, 1500Z-2200Z daily, NI8G, Milan, OH. Thomas Edison Memorial Radio Club. Thomas Edison Birthday Memorial. 28.385 21.385 14.285 7.285. QSL. Jack Hubbard, 13113 River Rd, Milan, OH 44846. **ni8n1@yahoo.com**

Feb 11-Feb 12, 1700Z-2359Z, W7EI, Prescott , AZ. Verde Valley Amateur Radio Association. Arizona Statehood Centennial. 14.292 14.288 14.284 14.280. QSL. Mike Wingate, W7EI, PO Box 3960, Camp Verde, AZ 86322. **www.vvara.org**

Feb 11-Feb 13, 0000Z-2359Z, W7A, Glendale, AZ. Thunderbird Amateur Radio Club. Arizona Statehood Centennial. SSB 14.255 7.190 PSK31 14.070. QSL. Thunder Bird Amateur Radio Club/W7A, PO Box 30841, Phoenix, AZ 85046. **www.w7tbc.org**

Feb 12-Feb 19, 0000Z-2359Z, K7Z, Sun City, AZ. Dick Hale. Arizona Centennial Week 1912-2012. 28.450 21.405 14.285. Certificate. K7Z, 9874 W Magnolia Ct, Sun City, AZ 85373. *Send call/freq/time/UTC day info to* **K7Z@cox.net** *to receive a certificate by e-mail. Choose 5MB or 185K file size.* **www.qrz.com/db/K7Z**

Feb 12, 1700Z-2100Z, WE7GV, Green Valley, AZ. Green Valley Amateur Radio Club. State of Arizona Centennial .14.246 14.244 14.242. Certificate & QSL. Green Valley Amateur Radio Club, 601 N La Canada Dr (SAV), Green Valley, AZ 85614. **tlang1080@gmail.com**

Feb 13-Feb 19, 1500Z-2359Z, K7UGA, Various location, AZ. Central Arizona DX Association. Arizona Centennial. All bands CW SSB RTTY PSK31 Satellite. QSL. Bob Davies, K7BHM, 1623 N Los Altos Ct, Chandler, AZ 85224. *100th Anniversary operation on February 14 from Prescott, Tucson and Phoenix only.* **www.cadxa.org**

Feb 14, 1600Z-2200Z, N7A, Prescott, AZ. Granite Mountain Middle School and Yavapai Amateur Radio Club. Arizona's 100th Birthday. 28.390 21.335 14.250 7.250. QSL. Terry Pemberton, Granite Mountain Middle School, 1800 Williamson Valley Rd, Prescott, AZ 86305. **kb7tre@cableone.net** *or* **www.w7yrc.org**

Feb 17-Feb 18, 1900Z-2359Z, W1AW/7, Yuma, AZ. Yuma Amateur Radio Hamfest Organization. 2012 ARRL SW Division Convention & Arizona Centennial. 28.348 21.312 14.248 7.212. QSL. George Scott, 2408 S Greenwood Ave, Yuma, AZ 85364. **www.yumahamfest.org**

Feb 18, 1400Z-2200Z, W0EBB, Leavenworth, KS. Kickapoo QRP Amateur Radio Club. 8th Annual "Freeze Your Keys" Winter Operating Event. 14.285 14.060 7.285 7.040. QSL. Gary Auchard, 34058 167th St, Leavenworth, KS 66048. **w0ebb@juno.com**

Feb 18, 1500Z-0000Z, N0HV, Belton, MO. South Side Amateur Radio Club. Harry S. Truman. 28.460 21.360 14.260 7.260. QSL. Robert Beard, PO Box 1514, Belton, MO 64012. *Look for us on CW and digital modes.* **www.southsidearc.net**

Feb 18-Feb 19, 1500Z-2200Z, W0FSB, Waterloo, IA. 5 Sullivan Brothers Amateur Radio Club. 67th anniversary of the Battle for Iwo Jima and the Flag Raisings. 21.240 14.240 7.240. Certificate & QSL. W0FSB ARC, 4015 Independence Ave, Waterloo, IA 50703. *#10 SASE for QSL; $1, no envelope for certificate.*

Feb 18-Feb 19, 1600Z-2100Z, K4US, Alexandria, VA. Mount Vernon Amateur Radio Club. George Washington Special Event. 14.240 7.240 7.035. Certificate. Mount Vernon ARC, Box 7234, Alexandria, VA 22307. *Commemorating George Washington's 280th birthday from his estate.* **k4us@mvarc.com** or **www.mvarc.org**

Feb 20-Feb 26, 0000Z-2359Z. WAP – Worldwide Antarctic Program. Antarctic Activity Week, 9th Edition. 28.450 21.350 14.250 7.150. Certificate & QSL. WAP Reference Numbers Worked (see URL). *This is an all bands, all modes worldwide event celebrating the international scientific work in Antarctica. Certificates may be obtained from the WAP, and QSLs from the WAP-Reference Numbered stations worked.* **kb0mzf@arrl.net** *or* **waponline.it**

Feb 22, 0001Z-2359Z, WS7G, George, WA. Columbia Basin DX Club. Celebrating George Washington's Birthday. 28.450 28.040 18.135 14.250 14.042 3.880. QSL. Brian J. Nielson, 11650 Road 1 SE, Moses Lake, WA 98837. **cbn.homestead.com/WS7G.html**

Feb 24-Mar 19, 1200Z-0200Z, K5R, Houston, TX. Northwest Amateur Radio Society 80th Annual Houston Livestock Show and Rodeo. 28.390 21.390 14.290 7.185. QSL. Tom King, 9438 Cedar Point Cir, Houston, TX 77070. **hlsr.com** *or* **k5r.org**

Feb 26-Feb 27, 1800Z-0200Z, K5NEA, Jonesboro, AR. Northeast Arkansas Radio Club. Johnny Cash 80th Birthday Celebration. 28.330 14.260 7.260 3.795. Certificate. Timothy S. Goodrich, N5ASH, 4501 Aggie Rd, Jonesboro, AR 72401. *We will be operating at least one station in Johnny Cash's boyhood home of Dyess Colony, Arkansas. Stations contacting the Dyess Colony station will get a special designation on their certificate.* **nea-rc.org**

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

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 **Apr** *QST* would have to be received by **Feb 1**. In addition to being listed in *QST*, your event will be listed on the ARRL Web Special Event page. Note: All received events are acknowledged. If you do not receive an acknowledgment within a few days, please contact us.

Special Events listed in this issue include current events received through December 10. You can view all received Special Events at **www.arrl.org/special-event-stations**.

Maty Weinberg, KB1EIB ♦ Special Events ♦ events@arrl.org

WB8IMY

ECLECTIC TECHNOLOGY

Click for Audio

Listen to columnist Steve Ford, WB8IMY, discuss CW apps for the iPad.

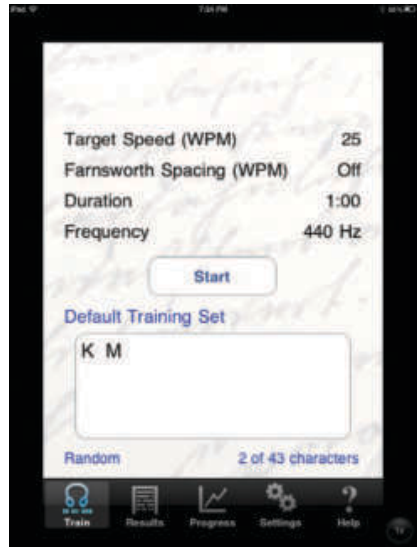
More Morse Apps

I've occasionally mentioned Amateur Radio apps that have been cropping up for the Apple iPhone and iPad, as well as the various Android devices. We even published an article on this topic in the November 2011 issue ("Android Apps for the Amateur" by William Vartorella, KJ4ORX). With almost 50% of hams owning tablets, smartphones or both, this app trend is accelerating.

Two of the latest ones to grab my attention are devoted to Morse code. *Morse Elmer* by Morgan Jones, KI4OWG, is a nice CW trainer for the iPhone, although I've used it on the iPad as well. It sends groups of characters at the desired speed and then allows you to check your results. *Morse Elmer* also graphically plots your progress. I recently used *Morse Elmer* to hone my CW skills during a cross-country flight. I imagine the person in the seat next to me was wondering why I was wearing headphones and frantically scribbling gibberish on a pad of paper. Since you didn't read about me being taking off the flight in handcuffs, you can assume that all went well.

Luca Facchinetti, IW2NDH, the author of several popular iPhone/iPad apps for RTTY and PSK31, has released a remarkable CW decoder called *MorseDec*. Most CW decoders do a mediocre job of translation, but Luca's app is well ahead of the pack. Using the iPad's built-in microphone I simply start the app and place the iPad near my transceiver. I slide the tuning bar over my CW signal of choice and text begins to appear. *MorseDec* is able to decode just about any signal it can "hear" and seems to track even the most inconsistent fists. *MorseDec* also has the ability to transmit CW, but I've yet to see an iPad interface that can key a radio quickly and reliably on CW.

Both of these apps are available in the iTunes Store. Just enter their names in the search window.



***Morse Elmer* by Morgan Jones, KI4OWG.**

***MorseDec* by Luca Facchinetti, IW2NDH.**

Tiny Inductors, Big Inductance

TDK Corporation claims to have produced multilayer ceramic coils with some of the world's highest inductance values for these types of devices. Their new TDK MLG0603S line features an inductance of up to 180 nH at 100 MHz. This may not seem impressive, but consider the fact that these are exceedingly small surface-mount inductors.

According to TDK, the miniature inductors offer dc resistance values ranging from 0.1 to 8.5 Ω, rated currents from 50 to 600 mA, and inductances from 0.3 to 180 nH. The operating range is roughly –55 to +125 °C.

Big Magnetic Fields, Too

Now we'll jump from the realm of very small to the world of the very large — large magnetic fields, that is.

I must have a dozen magnets on the family refrigerator, each holding photographs, grocery lists and so on. Most of these magnets generate a field on the order of one-half Tesla. Keep that in mind when you consider the following: A world-record-breaking magnet developed recently by the High Magnetic Field Laboratory in Dresden, Germany generates nearly 200 times that much, a whopping *91.4 Tesla*.

They call their *über* magnet a Pulse Cell. It's constructed from a special copper alloy wire fitted into custom-designed Kevlar corsets and wrapped in a steel jacket. This allows it to withstand the unimaginable forces that are present at over 90 Tesla.

According to laboratory director Joachim Wosnitza, "At 100 Tesla the Lorentz force inside the copper would generate a pressure which equals 40,000 times the air pressure at sea level." That's enough force to make the Cell explode in spectacular fashion.

To compensate for this, the researchers used a two-layer design: The inner six-coil layer is built to handle up to 50 Tesla while the outer 12-coil layer of copper coil can support another 40 Tesla for the .02 second duration of the test. This method allowed the researchers to squeeze 91.4 Tesla from their magnet — at least for a very short time.

Low Cost DSP Development

Larry Randall, WA5BEN, reminded me about the debut of the Texas Instruments C5535 eZdsp USB Stick Development Kit. This is a very low cost USB-powered DSP development package that includes all the hardware and software needed to create new projects around the C553X generation 16-bit DSP processors. The $99 kit includes the following:

- TMS320C5535 fixed point ultra-low-power DSP
- Embedded XDS100 emulator
- USB 2.0 port
- Micro SD card slot with 2-GB micro SD card
- Line In/Mic in, headphone out audio jacks
- 60-pin expansion connector
- 96 × 16-pixel OLED display
- *Code Composer Studio IDE 4.x*

When this column went to press, Texas Instruments was selling these directly from their website at **www.ti.com/**.

Steve Ford, WB8IMY ♦ *QST* Editor ♦ sford@arrl.org

K2TQN

VINTAGE RADIO

Wireless Pioneer W2ZI — *Part 2*

This is the second part of the Ed Raser, W2ZI, story, which continues from the January issue.

We continue with Ed Raser's seagoing career as a wireless operator, starting in 1919, taken from the August-September 1969 issue of the OOTC *Spark-Gap Times*, (**www.ootc.us**) [lightly edited].[1]

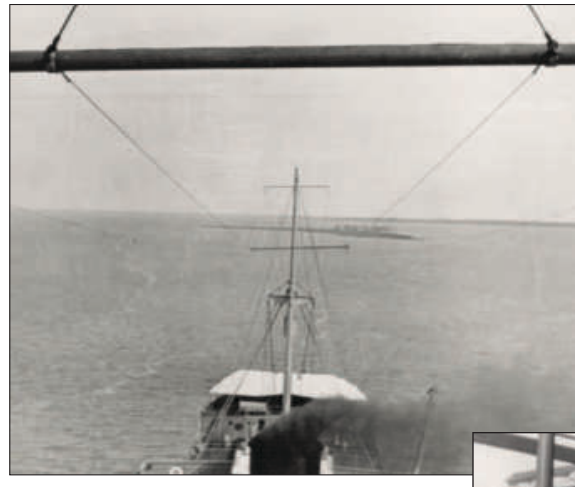
Ed had received his First Grade Radiotelegraph license before War I. After his Navy service he continued as a commercial wireless operator at both land and shipboard stations. In 1919 he was operator aboard the coaster SS Lake Strabo, KEBR, on runs between New England and Gulf ports. In 1920 he transferred to the new collier SS Ethan Allen, KUJQ, which carried a 2 kW Federal arc set. On its maiden voyage to Balboa and Chile he maintained contact over most of the trip with Charleston Navy Yard, NAO, and Colon, Panama, NAX, there being few stations along the way able to receive the Ethan Allen's arc signals. During his maritime days he worked for such early operating companies as Kilbourne and Clark, Marconi Co., and Tropical Radio Telegraph Co.

As a pioneer broadcast engineer on 1922, Ed was to help establish WMAL, Trenton's first station, and later to design and construct the city's first 500 watt station, WOAX, which was considered high-powered at that time. His last participation in commercial radio came in 1935-6, when he returned to sea for the Columbian Steamship Co. Plying the banana boat routes, he served aboard the SS Columbia, WKEG, the SS Pastores, KDED. His trips to Haiti, Jamaica, the Canal Zone and Columbia brought him in contact with many a Caribbean wireless station operator.

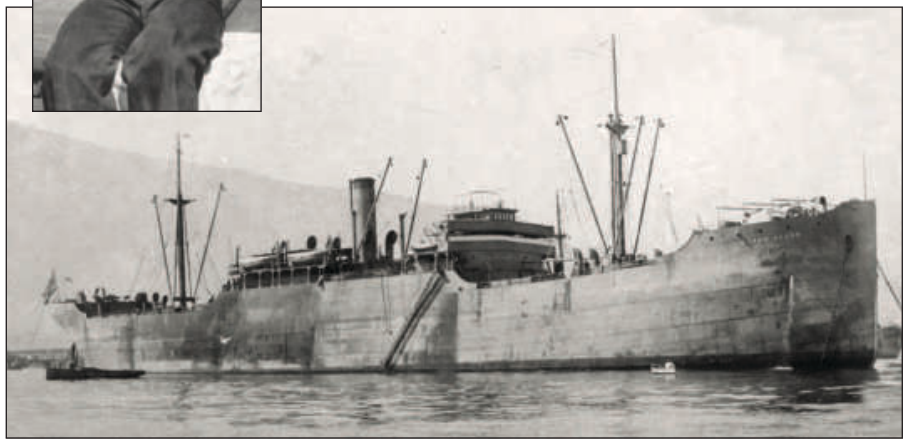
Ed's interest in military radio stayed with him for many years. In 1926 he enlisted in the 112th Field Artillery, Headquarters Battery, NJ National Guard, where he became regimental communications sergeant and senior signal instructor. In 1933 he transferred to the 119th Observation Squadron, Army Air Corps 6 Reserve, based at Newark, NJ. He was Communications Chief of the squadron, with supervision over twenty communicators, two ground stations and 13 observation aircraft types 0-46 and 0-47. During World War II he was engaged in vehicular radio development work as a radio engineer for the Signal Corps Radio Laboratories, Fort Monmouth, NJ. He traveled over most of the eastern United States on various communications missions, for the Army, Air Force and other agencies. One of his most notable assignments

[1]F. C. Crowell Jr, W9MIB, Ed., OOTC *Spark-Gap Times*, Aug-Sep 1969, Vol 8, No 10.

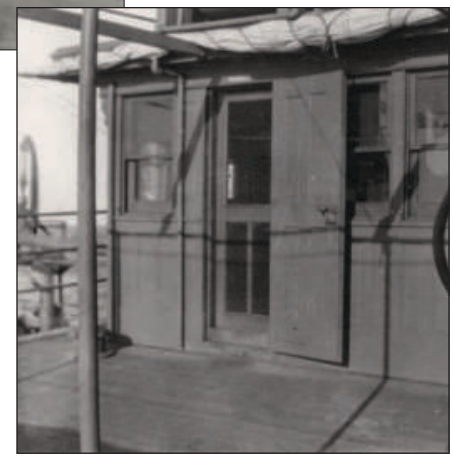
This is Ed Raser aboard the SS *Ethan Allen*, 1919 down South America way (west coast).



The antenna aboard the SS *Ethan Allen*'s 60 foot mast. Ed repaired this antenna while at Balboa, Canal Zone.

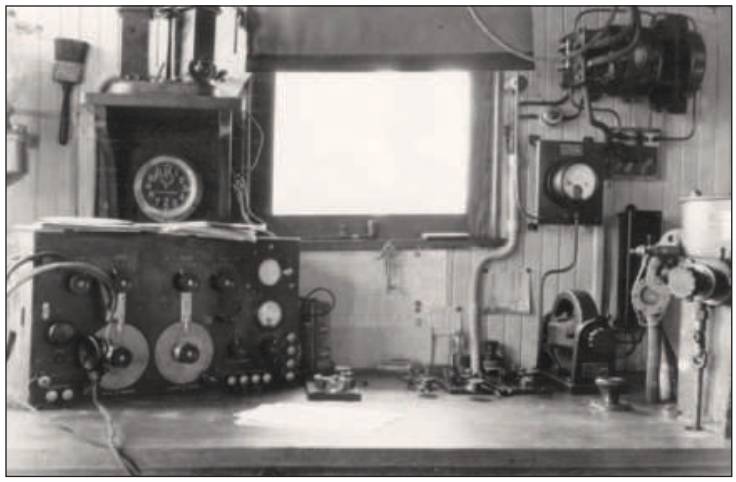


SS *Ethan Allen*, KUJQ, 13,200 ton freighter.

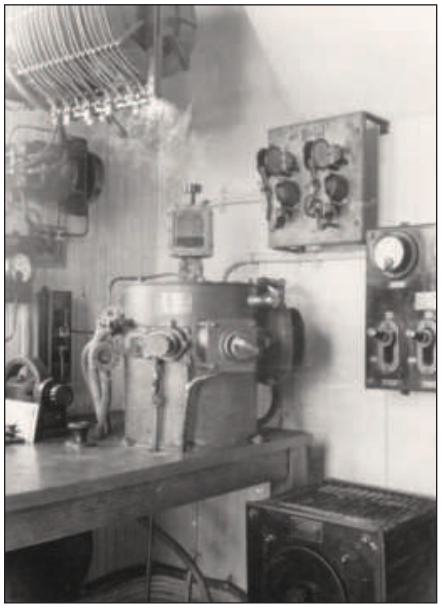


This is the outside of the radio "shack" aboard the SS *Ethan Allen*. Located on the upper bridge deck, Ed's quarters were the next room on the same deck, a nice setup for a wireless operator.

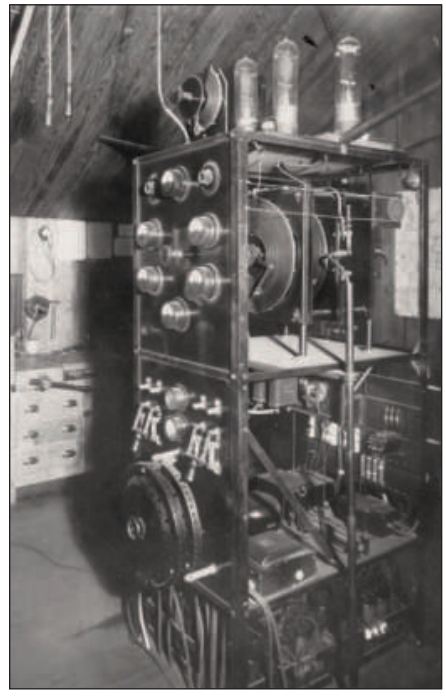
John Dilks, K2TQN ♦ 125 Wharf Rd, Egg Harbor Township, NJ 08234-8501 ♦ k2tqn@arrl.org



The receiving gear and part of the arc transmitter used aboard the SS *Ethan Allen.*



The 2 kW Federal Arc Generator showing the alcohol dropper on top, tuning coils above, chopper, antenna ammeter, variometer key on desk, circuit breakers on wall and field rheostat for motor generator. This was the equipment setup aboard the SS *Ethan Allen* when Ed Raser was chief operator.



The 500 W broadcast transmitter at WOAX, Trenton, NJ in 1923. Constructed by Ed Raser (then 3CS). He was chief engineer for the Monument Pottery Co until 1929.

was to President Roosevelt's security network, with his headquarters in the White House.

With all his on-the-air activity, and with commercial operating in between, Ed has found time to be active in radio club work. He served in 1915 as secretary of the very early YMCA Radio Club of Trenton, NJ. He joined the Trenton Radio Association in 1920, and was a co-founder of The Delaware Valley Radio Association, Inc., now [1963] in its 33rd year. He is also a member of many other radio organizations: The Radio Club of America (the world's first radio club), Charter Member of The DeForest Pioneers, The Veteran Wireless Operators Association, Life Member of the Quarter Century Wireless Association, Morse Telegraph Club of America, Charter Member of the Old Old Timers Club (40 years in radio), The Antique Wireless Association, and Senior Member of the Institute of Radio Engineers.

He still holds Commercial Radiotelegraph License, First Class, and an Amateur Extra class license of early issue. He has been cited five times for the ARRL Public Service Award certificate, for the Delaware Valley Radio Association's Silver Cup Award for faithful service, the Achievement Statuette conferred by the Conamaugh Valley Radio Association of Johnstown, PA, and the A-1 Operators Certificate.

Ed is probably best known for his Wireless Museum, with its large collection of antique radio equipment dating back to 1899, when Marconi first came to America. His collection of historical books and papers on the art of wireless and radio number over 250 volumes, and represent some 35 years of research work. This unique exhibit [was] open to all visitors by appointment, and [was] located [at his home] in West Trenton, NJ. There [were] over 400 pieces of old radio and wireless gear on display making every visit most interesting and worthwhile.

Along with the above activity, Ed found time to run the original Old Timer's Nite Round-up. Held in Trenton each year during the month of April, the annual event has run for 16 years. His Old Timer's Nite Round-up idea, which originated in 1945, has been perpetuated in Old Timer's Nite affairs being run all over the country.

Presently employed as Supervising Engineer and Technical Advisor to the NJ State Police Radio System, he pioneered the early FM systems, having installed the second state-wide system in America or elsewhere. After some 22 years in mobile radio work, Ed is about to retire from police radio activity and settle down to enjoying his several hobbies. So ends the saga of a very active wireless man, now enjoying some 55 years on the air and covering just about all phases of "the wireless game."

Ed was born April 1, 1899. He was first licensed in April, 1914 as 3NG and he presently holds Extra class of an early issue. He and his XYL, Paulie, just recently returned from an eventful trip to the South Sea Islands, New Zealand and Australia aboard the SS Monterey of the Matson Lines. Last year the Rasers toured Europe and the British Isles.

Ed was hospitalized on May 28 this year [1969] for surgery but pulled through ok. On July 15 he reported, "Sitting up at home but weak, so weak I can't even pound a 'mill'. Hi. Had to learn to walk all over again. Sure I'll have my sea legs' again in a few weeks."

Ed recovered and enjoyed his ham radio and collecting hobbies for 17 more years. — *K2TQN*

Silent Key

Edward G. Raser, W2ZI, of Trenton, NJ died on October 23, 1985. Ed was "Dean of the Collectors." He built his first receiver in 1910 and was a ship operator in his youth. In time he became a broadcast engineer and eventually retired from the New Jersey State Police Communications System. W2ZI started acquiring his fabulous wireless collection nearly 60 years ago. In time, it became one of the nation's finest. Many of the pieces are in the AWA Museum. We've lost a great wireless pioneer and historian. — *Bruce Kelley in the AWA Old Timers Bulletin*

Photos by Edward Raser, W2ZI (SK)

CONVENTION AND HAMFEST CALENDAR

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

ALABAMA SECTION CONVENTION

March 3-4, Birmingham
D F H Q R S T V

The Alabama Section Convention, sponsored by the Birmingham ARC, will be held at the Zamora Shrine Temple, 3521 Ratliff Rd (Irondale). Doors are open 9 AM-4 PM. Features include flea market, dealers, tailgating, QSL card checking, forums, VE sessions, handicapped accessible, refreshments. Talk-in on 146.88 (88.5 Hz). Admission is $8. Tables are $24 for 6-ft. Contact Bill Davidson, KW4J, 326 S Burbank Dr, Birmingham, AL 35226; 205-587-1993; **kw4j@arrl.net**; **w4cue.com**.

Alabama (Locust Fork) — Feb 18
D F H R T V

8 AM-2 PM. *Spr:* Blount County ARC. Locust Fork High School, 155 School Rd. *TI:* 146.7 (91.5 Hz). *Adm:* $5. Tables: $5. Bill Pond, AE4IE, 150 Smoke Rise Ln, Warrior, AL 35180; 205-647-5705; **ae4ie@juno.com**; **w4blt.org**.

SOUTHWESTERN DIVISION CONVENTION

February 17-18, Yuma, AZ
D F H Q R S T V

The Southwestern Division Convention (8th Annual Yuma Hamfest), sponsored by the Yuma AR Hamfest Organization, will be held at the Yuma County Fairgrounds, 2520 E 32nd St. Doors are open Friday noon-5 PM, Saturday 8 AM-5 PM. Features include swapmeet; commercial vendors ($50 for the weekend by Feb 1; $60 Feb 1 and after; additional tables $5 each in advance, $10 each at the event); tailgating ($15 per space by Feb 1; $20 Feb 1 and after); AR equipment; seminars; special guest from ARRL HQ Norm Fusaro, W3IZ, MVP Assistant Manager; DXCC card checking; Antenna Clinic; T-Hunt; VE sessions (Friday 3-5 PM; Saturday, 9-10:45 AM); hospitality area; Country Store consignment sales; Buzzard BBQ dinner (Saturday, 6-8 PM, $10); on-site RV camping ($15 per night in advance, $20 per night at the event). Talk-in on 146.84 (88.5 Hz). Admission is $5 for the weekend (under 13 free). Contact Roger Hunt, K7MEX, 13156 E 51st Ln, Yuma, AZ 85367; 928-305-1034; **rhunt7@gmail.com** or **info@yumahamfest.org**; **www.yumahamfest.org**.

ARKANSAS SECTION CONVENTION

February 18, Hoxie
D F H R S V

The Arkansas Section Convention, sponsored by the Lawrence County ARC, will be held at the Hoxie Community Service Center, 500 SW Lawrence St. Doors are open 8 AM-1 PM. Features include dealers, flea market, forums, VE sessions, handicapped accessible, refreshments. Talk-in on 147.045. Admission is $5. Tables are $7 (flea market), $10 (dealers). Contact Carl Richardson, KB5FJX, 146 Lawrence Rd 2645, Smithville, AR 72466; 870-878-0044; **carl@cwrnet.com**; **www.w5wra.org/**.

Arkansas (Russellville) — Mar 3
D F H Q R S T V

8 AM-2 PM. *Spr:* Arkansas River Valley AR Foundation. Hughes Center, 1000 E Parkway. *TI:* 146.82 (131.8 Hz). *Adm:* $5. Tables: $10. Andy (Volta) Anders, KE5YGA, 303 River Oaks Ln, Russellville, AR 72802; 479-967-5484; **aanders@suddenlink.net**; **www.arvarf.com**.

SANTA CLARA VALLEY SECTION CONVENTION

March 3, Del Rey Oaks, CA
D F H R S T V

The Santa Clara Valley Section Convention, sponsored by the Naval Postgraduate School ARC, will be held at the Monterey Moose Lodge, 555 Canyon Del Rey Blvd. Doors are open 8 AM-4 PM. Features include dealers, indoor flea market, tailgating, forums with special guest speakers, VE sessions, handicapped accessible, breakfast and lunch served at a great price. Talk-in on 146.97 (94.8 Hz). Admission is $1. Tables are $25. Contact Sal DeFranco, N6SPD, Box 721, Seaside, CA 93955; 831-324-0008; **sal@spdavanti.com**; **www.radiofest.org/**.

Coming ARRL Conventions

January 20-21
North Texas Section, Fort Worth*

January 21
Georgia ARES, Forsyth*

January 21-28
Quartzfest, Quartzsite, AZ*

January 27-28
Mississippi State, Jackson*

February 4
South Carolina State, Ladson*
Virginia State, Richmond*

February 10-12
Northern Florida Section, Orlando*

February 17-18
Southwestern Division, Yuma, AZ

February 18
Arkansas Section, Hoxie

February 25
Vermont State, South Burlington

March 3
Santa Clara Valley Section, Del Rey Oaks, CA
South Texas Section, Rosenberg

March 3-4
Alabama Section, Birmingham

March 9-10
Louisiana State, Rayne
Oklahoma State, Claremore

March 10-11
Roanoke Division, Concord, NC

March 17
Southern Florida Section, Stuart
Nebraska State, Lincoln
West Texas Section, Midland

April 7
North Carolina State, Raleigh

*See January *QST* for details.

Colorado (Henderson) — Feb 12 D F H R V

8:30 AM-1 PM. *Spr:* Aurora Repeater Assn. Adams County Fairgrounds Exhibition Hall, 9755 Henderson Rd. *TI:* 147.15 (88.5 Hz). *Adm:* $5. Tables: $10. Wayne Heinen, N0POH, c/o ARA, Box 471802, Aurora, CO 80047; 303-699-6335; **n0poh@arrl.net**; **www.n0ara.org**.

Florida (Brooksville) — Feb 18 D F H R T V

8 AM. *Spr:* Hernando County ARA. Sand Hill Scout Reservation, 11210 Cortez Blvd (Hwy 50). *TI:* 146.715. *Adm:* $6. Tables: $10. John Nejedlo, WB4NOD, 15430 Waxweed Ave, Spring Hill, FL 34610; 813-838-5432; fax 727-819-9658; **wb4nod@tampabay.rr.com**; **hcara.org**.

Florida (Sebring) — Feb 18 D F H R T

8 AM-1 PM. *Spr:* Highlands County ARC. Highlands County Agra Civic Center, 4509 George Blvd. 19th Annual Hamfest. *TI:* 147.045 (100 Hz). *Adm:* $5. Tables: $5. John Bliss, KF4IZT, 615 N Roberts Rd, von Park, FL 33825; 863-452-6600; **kf4izt124@gmail.com**; **strato.net/~hamradio/**.

Florida (West Palm Beach) — Mar 10
D F H Q R S T V

8 AM-2 PM. *Spr:* Palms West ARC. Fraternal Order of Police Lodge, 885 N 62nd Dr. *TI:* 146.67 (110.9 Hz). *Adm:* $5. Tables: $10 (tailgate spaces $5 each). Rob Pease, KS4EC, 11894 Brier Patch Ct E, Wellington, FL 33414; 561-358-9999; **ks4ec@arrl.net**; **palmswestarc.org**.

Florida (Zephyrhills) — Mar 10 D F H R T

8 AM-1 PM. *Sprs:* East Pasco ARS and Zephyrhills Area ARC. Zephyrhills Lions Club, 5827 Dean Dairy Rd. *TI:* 147.135 (100 Hz). *Adm:* $2. Tables: $10 (indoor; includes 1 admission); tailgate spaces $5 each (includes 1 admission). Charles Nelson, KE7UTH, c/o ZAARC, Box 1534, Zephyrhills, FL 33539; 813-395-6329; **greygoose4@aol.com**; **www.eparsonline.org**.

Georgia (Dalton) — Feb 25 D F H R S T V

8 AM-2:30 PM. *Spr:* Dalton ARC. North Georgia Fairgrounds, 501 Legion Dr. 30th Annual Hamfest. *TI:* 145.23. *Adm:* $5. Tables: $5. Harold Jones, N4BD, 3033 Davis Rd SW, Rocky Face, GA 30740; 706-673-2291; fax 706-673-2436; **n4bd@windstream.net**; **DaltonHamfest.com**.

Illinois (Sterling) — Mar 4 D F H R S V

7:30 AM-2 PM. *Spr:* Sterling-Rock Falls ARS. Challand Middle School, 1700 6th Ave. 52nd Annual Hamfest. *TI:* 146.625 (114.8 Hz). *Adm:* advance $5, door $6. Tables: $7. Paula Portner, KC9FQK, 1302 W 2nd St, Dixon, IL 61021; 815-284-5650; **pportner@comcast.net**; **www.w9mep.org**.

Indiana (Brownsburg) — Feb 25. David Lucas, K9MSG, 317-518-4577; **dlucas002@indy.rr.com**.

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

Gail Iannone ♦ Convention and Hamfest Program Manager ♦ giannone@arrl.org

Indiana (Dugger) — Mar 3 D F R T V
Set up 6 AM; public 8 AM. *Spr:* Dugger ARC. Dugger City Park Community Building, S Hicum St. *Tl:* 146.775 (136.5 Hz). *Adm:* $5. Tables: 1 free with $5 admission; additional tables $1 each. Kyle Shipman, KB9ZGN, 7084 E Monroe St, Dugger, IN 47848; 812-648-2487; **kb9zgn@sbcglobal.net**; **www.kc9ak.org/**.

Indiana (LaPorte) — Feb 25 D F H R
7 AM-1 PM. *Spr:* LaPorte ARC. LaPorte Civic Auditorium, 1001 Ridge St. *Tl:* 146.61 (131.8 Hz). *Adm:* $5. Tables: $12. Clarence Rozinski, N9ROH, Box 30, LaPorte, IN 46352; 219-380-9684; **n9roh@csinet.net**; **k9jsi.org**.

Iowa (Perry) — Feb 25 D F H R V
7 AM-noon. *Spr:* Hiawatha ARC. Crossroads Church, 2810 1st Ave. *Tl:* 146.61 (114.8 Hz). *Adm:* $5. Tables: $5. Robert Dittert, N0QIX, 1722 1st Ave, Perry, IA 50220; 515-465-2383; fax 515-323-5445; **n0qix@arrl.net**; **www.qsl.net/kd0neb/index_files/Page383.htm**.

Kentucky (Cave City) — Mar 3 D F H Q R S T V
7:30 AM. *Spr:* Mammoth Cave ARC. Cave City Convention Center, 502 Mammoth Cave St. 36th Annual Cave City Hamfest. *Tl:* 146.94. *Adm:* $6. Tables: $8. Larry Brumett, KN4IV, 108 Withers Dr, Glasgow, KY 42141; 270-651-2363; **lbrumett@glasgow-ky.com**.

LOUISIANA STATE CONVENTION
March 9-10, Rayne
D F H Q R S V

The Louisiana State Convention (52nd Annual Hamfest), sponsored by the Acadiana ARA, will be held at the Rayne Civic Center, 300 Frog Festival Dr. Doors are open Friday 5-8 PM, Saturday 8 AM-2 PM. Features include dealers; flea market; forums; DXCC, WAS, and VUCC card checking; VE sessions (walk-in basis Saturday, 9 AM; $15 test fee); Special Event Station; foxhunt; handicapped accessible; famous Crawfish Boil (Friday); on-site RV camping with hookups; refreshments. Talk-in on 146.82 (103.5 Hz). Admission is $4 in advance, $5 at the door. Tables are $10 (swap), $15 (dealers). Contact Herman Campbell, KN5GRK, 416 Dale St, Lafayette, LA 70501; 337-234-5364; **kn5grk@arrl.net**; **www.w5ddl.org/hamfest/**.

Massachusetts (Feeding Hills) — Mar 10 D F H R T V
Set up 6:30 AM; public 8:30 AM-1:30 PM. *Spr:* Mount Tom Amateur Repeater Assn. Springfield Turnverein Club, 176 Garden St. 24th Annual Hamfest. *Tl:* 146.94 (127.3 Hz). *Adm:* $5. Tables: 8-ft $15; tailgating $10 per space. Mary Elkins, N1TOY, 24 Shoreline Dr, Ware, MA 01082; 413-222-1990; **n1toy@arrl.net**; **www.mtara.org**.

Massachusetts (Marlborough) — Feb 18 D F H R V
Set up 7 AM; public 9 AM. *Spr:* Algonquin ARC. 1 Lt Charles W Whitcomb School (formerly Intermediate/Middle School), 25 Union St. *Tl:* 147.27 (146.2 Hz), 449.925 (88.5 Hz). *Adm:* $5. Tables: advance $15 (before Feb 1), door $20. Timothy Ikeda, KA1OS, 7 Birchwood Rd, Hudson, MA 01749; 508-919-6136; **fleamarket@n1em.org**; **www.n1em.org**.

Michigan (Livonia) — Feb 19 D F H R
8 AM-noon. *Spr:* Livonia ARC. Livonia Civic Park Seniors Center, 15218 Farmington Rd. 41st Annual Swap-n-Shop. *Tl:* 145.35 (100 Hz), 146.52. *Adm:* $5. Tables: advance $16, door $20. Michael Rudzki, N8MR, Box 51532, Livonia, MI 48151; 734-941-5043; **k8uns@arrl.net**; **www.livoniaarc.com/Swap.htm**.

Michigan (Traverse City) — Feb 11 D F V
8 AM-noon. *Spr:* Cherryland ARC. Immaculate Conception Elementary School, 218 Vine St. 39th Annual Swap-n-Shop. *Tl:* 146.86. *Adm:* $5. Tables: $8. Joe Novak, W8TVT, 201 S Spruce St, Traverse City, MI 49684; 231-947-8555; **jjnovak@charter.net**; **cherrylandarc.com**.

Minnesota (St Cloud) — Feb 18 D F H R V
9 AM. *Spr:* St Cloud ARC. National Guard Armory, 1710 Veterans Dr. *Tl:* 147.015. *Adm:* $6. Tables: See web site for details. David Leigh, W0DZW, 2855 Aurora Ct, St Cloud, MN 56303; 320-251-1720 (Home) or 320-250-0390 (Cell); **w0dzw@charter.net**; **w0sv.org**.

New Hamphire (North Conway) — Mar 10 D F R V
8:30 AM-1:30 PM. *Spr:* White Mountain ARC. North Conway Community Center, 2628 White Mountain Hwy. *Tl:* 145.45 (100 Hz). *Adm:* $5. Tables: $15. Thaire Bryant, W2APF, c/o White Mountain ARC, Box 1932, Conway, NH 03818; 603-447-2376 or 508-245-3522; **W2APF@hughes.net**; **www.w1mwv.com**.

New Jersey (New Providence) — Feb 24 H R
7 PM. *Spr:* New Providence ARC. New Providence Municipal Center, 360 Elkwood Ave. Auction. *Tl:* 147.255 (141.3 Hz). *Adm:* $5 (buyers and sellers). Barry Cohen, K2JV, 39 Cromwell Ct, Berkeley Heights, NJ 07922; 908-464-1730; **bgcohenusa@verizon.net**; **www.nparc.org/auction.htm**.

New York (Hicksville) — Mar 4 D F H Q R V
Set up 7 AM; public 9 AM. *Spr:* Long Island Mobile ARC. Levittown Hall, 201 Levittown Pkwy. *Tl:* 146.85 (136.5 Hz). *Adm:* $6. Tables: $20. Richard Cetron, K2KNB, 198 Haypath Rd, Old Bethpage, NY 11804; 516-694-4937 (phone and fax); **k2knb@arrl.net**; **www.limarc.org**.

ROANOKE DIVISION CONVENTION
March 10-11, Concord, NC
D F H Q R S V

The Roanoke Division Convention (Charlotte Hamfest™), sponsored by the Mecklenburg ARS, will be held at the Cabarrus Arena and Events Center, 4751 Hwy 49 N. Doors are open Saturday 8:30 AM-5 PM; Sunday 9 AM-1 PM. Features include commercial dealers, manufacturers, exhibitor booths, flea market, QSL card checking, forums, VE sessions (all classes; registration 12:30 PM, testing at 1 PM), on-site camping, handicapped accessible, refreshments. Talk-in on 146.655, backup 146.94 (118.8 Hz). Admission is $7 in advance, $10 at the door (good both days); under 12 free when accompanied by a paying adult. Tables are $20 (electricity $40, chairs $1). Contact Charlotte Hamfest Info, W4BFB, 16007 Wynfield Creek Pkwy, Huntersville, NC 28078; 704-948-7373; **HamfestInfo2012@w4bfb.org**; **www.w4bfb.org/hamfest.html**.

OKLAHOMA STATE CONVENTION
March 9-10, Claremore
D F H Q S V

The Oklahoma State Convention, sponsored by the Green Country Hamfest, Inc, will be held at the Claremore Expo Center, 400 Veterans Pkwy. Doors are open for setup on Friday at noon and Saturday at 7 AM; public Friday 5-9 PM, Saturday 8 AM-3 PM. Features include radio, electronics and computer show; large indoor flea market; commercial vendors and dealers; fantastic free forums; free test table (check it before you buy it); VE sessions (Friday and Saturday); low cost on-site RV parking; handicapped accessible. Talk-in on 147.09. Admission is $8 in advance, $10 at the door (under 13 free). Tables are $10 in advance, $15 at the door (electricity is $20; cords not provided). Contact Merlin Griffin, WB5OSM, Box 470132, Tulsa, OK 74147; 918-520-7668; fax 918-591-4562; **wb5osm@hotmail.com**; **greencountryhamfest.org**.

Oklahoma (Elk City) — Mar 3 F H R S V
8 AM-5 PM. *Spr:* West Central Oklahoma ARC. Civic Center, 11 Rte 66. *Tl:* 146.76. *Adm:* $5. Tables: $5. Earl Bottom, N5NEB, Rte 1, Box 62A, Hammon, OK 73650; 580-821-0633; **n5neb@waywireless.com**.

Pennsylvania (Castle Shannon) — Feb 26 D H Q R
8 AM-3 PM. *Spr:* Wireless Assn of South Hills. Castle Shannon VFD Memorial Hall, 3600 Library Rd (Rte 88). WashFest 2012. *Tl:* 146.955 (131.8 Hz). *Adm:* $5. Tables: $10 (power $5 extra). Carol Danko, KB3GMN, 4246 Seton Dr, Pittsburgh, PA 15227; 412-884-1466; **n3sbf@comcast.net**; **n3sh.org**.

Texas (Georgetown) — Feb 25 D F H R V
8 AM-5 PM. *Spr:* Williamson County ARC. Georgetown Community Center, San Gabriel Park, 445 E Morrow St. *Tl:* 146.64 (162.2 Hz). *Adm:* $2. Tables: $8. Rick Trommer, W5NR, 302 Rio Bravo Rd, Georgetown, TX 78628; 512-863-2428; **w5nr@arrl.net**; **wcarc.com**.

Texas (Irving) — Mar 10 D F H R S V
8 AM-2 PM. *Spr:* Irving ARC. Betcha Bingo Hall #1, 2420 W Irving Blvd, #125. 10th Annual Hamfest. *Tl:* 146.72 (110.9 Hz). *Adm:* advance $3, door $4. Tables: advance $8, door $10. Coleta Taylor, KD5QFH, 107 E 7th St, Irving, TX 75060; 972-579-9089; **coleta.mt@verizon.net**; **irvingarc.org/iarchamfest.html**.

Texas (Orange) — Feb 25 D F H R S T V
8 AM-3 PM. *Sprs:* Orange ARC and Jefferson County ARC. VFW Hall Post #2775, 5303 16th St. *Tl:* 147.18 (103.5 Hz). *Adm:* $5. Tables: $15. Rocky Wilson, N5MTX, 3736 Third Ave, Orange, TX 77630; 409-988-8906; **rockygwilson@hotmail.com**; **www.qsl.net/w5nd/index_files/HAMFEST%20INFO/hamfest%20info.htm**.

SOUTH TEXAS SECTION CONVENTION
March 3, Rosenberg
D F H Q R S T V

The South Texas Section Convention (11th Annual Greater Houston Hamfest), sponsored by the Brazos Valley ARC, will be held at the Fort Bend County Fairgrounds, 4310 Highway 36 S. Doors are open 8 AM-2 PM (registration begins at 7 AM). Features include swapmeet; commercial vendors; free tailgating with early buyer access before 8 AM; emergency vehicles and displays; training seminars; hands-on demos; QSO via satellite; informative lectures; featured speakers including ARRL EMC Engineer Mike Gruber, W1MG; Special Event Station W5H; DXCC card checking; foxhunt (10 AM); equipment test table; VE sessions (registration 8 AM, testing begins at 9 AM and 10:30 AM; $15 fee); ARRL AREC certification testing (11 AM); breakfast and lunch available. Talk-in on 146.94 (167.9 Hz). Admission is $5, under 14 free. Tables are $10 ($15 with power). Contact Kirk Kendrick, KK2Z, Box 2997, Sugar Land, TX 77487; 281-639-5088; **kmkendrick@gmail.com**; **houstonhamfest.org**.

VERMONT STATE CONVENTION
February 25, South Burlington
D F H Q R S T V

The Vermont State Convention (HAM-CON), sponsored by the Radio Amateurs of Northern Vermont, will be held at the Holiday Inn Convention Center, 1068 Williston Rd (I 89, Exit 14).

Doors are open 8 AM-2 PM. Features include flea market with specialty tables, new equipment dealers, vendors, forums, demonstrations of AR communications, Special Event Station W1V, VE sessions (1 PM, all exams; $14 fee, exact change in cash), FCC Commercial License exams (1 PM, $50 fee), handicapped accessible. Talk-in on 145.15 (100 Hz), bulletins on 146.67. Admission is $6 in advance (by Feb 15), $8 at the door (under 13 free); early admission at 6 AM is $12 in advance (by Feb 15), $15 at the door. Tables are free while they last (first-come, first-served). Contact Mitch Stern, W1SJ, 802-879-6589; **w1sj@arrl.net**; **www.ranv.org/hamcon.html**.

Virginia (Annandale) — Feb 26
D F H Q R T V
8 AM-5 PM. *Spr:* Vienna Wireless Society. Northern Virginia Community College (Annandale Campus), 8333 Little River Turnpike. Winterfest 2012, VE sessions Saturday (Feb 25, 9 AM-noon). *TI:* 146.91. *Adm:* $6. Tables: $25 (tailgate spaces $15 each). Jack Welch, AI4SV, 3925 Wilcoxson Dr, Fairfax, VA 22031; 314-266-8426; **dhakajack@gmail.com**; **www.viennawireless.org/winterfest.php**.

Washington (Puyallup) — Mar 10 D F H R V
9 AM-3 PM. *Spr:* Mike and Key ARC. Puyallup Fair and Events Center, Pavilion Expo Hall, 110 9th Ave SW. 31st Annual Electronics Show and Fleamarket, club info, consignment store, overnight RV camping. *TI:* 146.82 (103.5 Hz). *Adm:* $8. Tables: $32. Michael Dinkelman, N7WA, 22222 148th Ave SE, Kent, WA 98042; 253-631-3756; **n7wa@arrl.net**; **www.mikeandkey.org/flea.htm**.

West Virginia (Oak Hill) — Feb 18 H R V
Noon-6 PM. *Spr:* Plateau ARA. Lewis Community Center, 469 Central Ave. 32nd Hamfest. *TI:* 146.79 (100 Hz). *Adm:* $5. Tables: $10 ($5 extra for electricity). Charles Hardy, WV8CH, 1203 Bachman Rd, Fayetteville, WV 25840; 304-640-4162 or Jane, WV8JH, 304-640-1120; **wv8ch@arrl.net**; **plateauamateurradio.com**.

Wisconsin (Brookfield) — Feb 18 F H R
8 AM-noon. *Sprs:* Milwaukee RAC and Milwaukee Area ARS. Milwaukee Public Television Friends Auction site, 12560 W Townsend St. *TI:* 145.39 (127.3 Hz). *Adm:* advance $4, door $5. Tables: 6-ft advance $10, door $12. David Schank, KA9WXN, 5943 W Edgerton Ave, Greenfield, WI 53220; 414-423-0872; **ka9wxn@513repeater.org**; **w9rh.org**.

Wisconsin (Eau Claire) — Mar 10 D H R
8 AM. *Spr:* Eau Claire ARC. Grace Lutheran Church, 202 W Grand Ave. 25th Annual AR Equipment Auction. *TI:* 146.91 (110.9 Hz). *Adm:* $5. Jim Staatz, KI9H, 520 Congress St, Ste 6, Eau Claire, WI 54703; 715-514-8976; **KI9H@arrl.net**; **www.ECARC.org**.

Wisconsin (Fitchburg) — Feb 11 D F H R T
9 AM-1 PM. *Spr:* New Era Repeater Technocrats. Memorial Church, 5705 Lacy Rd. Capital City Hamfest (Madison). *Adm:* $5 (under 13 free). Tables: $10. Steve Johnston, WD8DAS, 2309 Tulare St, Fitchburg, WI 53711; 608-276-5581; **wd8das@arrl.net**; **www.wd8das.net/hamfest**.

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 **February 1** to be listed in the **April** issue. Information in this column is accurate as of our deadline; contact the sponsor or check the sponsor's Web site 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**.

Sean's Picks

Sean Kutzko, KX9X

All dates/times are in UTC.

- **State QSO Parties this month:** Louisiana, Mississippi, New Hampshire, North Carolina, Vermont
- **QRP Contests this month:** FYBO QRP Field Day (Feb 4), ARS Spartan Sprint (Feb 7), NAQCC Monthly Sprint (Feb 15), Flying Pigs Run for the Bacon (Feb 20).
- **Ten-Ten Winter Phone QSO Party (Feb 4-5):** With 10 meters back in business, here's a fun way to keep the excitement going on the band. Exchange includes your 10-10 number. Don't have one? Work at least 10 stations in the contest that have a 10-10 number and you can get your own!
- **North American Sprint, CW (Feb 5):** 4 hours of intense CW contesting. Many CW contesters think this is one of the purest CW competitions around. Are you up to the challenge? Find out!
- **CQ WPX Contest, RTTY (Feb 11-12):** The first of *CQ* Magazine's "prefix" contests. Prefixes are the multiplier; how many can you work?
- **North American Sprint, Phone (Feb 12):** If CW isn't your cup of tea, try the equally-intense Phone version of the Sprint. It's fast, frenetic and fun!
- **School Club Roundup (Feb 13-17):** A contest for school clubs of all shapes and sizes! Get on the air and work the schools all week long, or set up an effort from your school club!
- **ARRL DX Contest, CW (Feb 18-19):** DX works W/VE and W/VE works DX in the longest-running DX contest on the planet. The bands should be in great shape for this one.
- **North American QSO Party, RTTY (Feb 25-26):** This is an easy contest to get started with RTTY. Exchange is your name and state, and there's a 100 W power limit. Very casual and a lot of fun. Check it out!

February 2012 W1AW QUALIFYING RUNS

W1AW Qualifying Runs are 7 PM EST Wednesday, February 8 (0000Z February 9) and 4 PM EST (2100Z) Thursday, February 23. The West Coast Qualifying Run will be transmitted by station K9JM on 3590 and 7047.5 kHz at 9 PM PST Wednesday, February 15 (0500Z February 16).

Strays

***QST* congratulates...**

◊Dean Revell, K0JYZ (50 years), John Wickenkamp, W0JA (61 years) and John Nelson, K0IO (50 years), who recently received service awards from the Newton (Iowa) Amateur Radio Association for their longtime service.

◊ARRL member John W. Poulton, K4OZY, of Chapel Hill, North Carolina, who has been named an IEEE Fellow for his work in high-speed, low-power signaling and his work in graphics architecture.

◊ARRL Life Member Jerry Boyd, N7WR, of Baker City, Oregon, whose 7th book *Firestone Park: Policing South Central Los Angeles*, is available through Amazon.com. A portion of the proceeds will benefit the National Law Enforcement Officers Memorial Foundation.

75, 50 AND 25 YEARS AGO

February 1937

- The cover photo shows a ham yawning, as his wall clock displays the time as being in the wee small hours of the morning.
- The editorial reminds us of the passing, a year ago, of Hiram Percy Maxim and Charles H. Stewart. It also announces that the F.C.C. has issued T.O.M.'s call sign of W1AW to the A.R.R.L. headquarters station as a permanent radio memorial.
- James Tynes, W6GPY, discusses the "Practical Organization and Equipment for Emergency Operation."
- By Goodman, W1JPE, helps us keep up to date with his description of a "Medium-Power Pentode Transmitter for Smooth Break-In Operation." The rig uses suppressor-grid modulation for 'phone work.
- "About this Harmonic Radiation Problem," by R. W. Woodward, W1EAO, discusses the measurement and suppression of harmonics.
- Clinton B. DeSoto, W1CBD, reports that, on this past December 30, W4DLH established a new WAC record — an "All-Continent 'Phone Round Table." Other participants were VU2CQ, SU1CH, HK1Z, G5ML, and VK4LO. Bravo, gentlemen!
- Bruce Montgomery, W9AHH, tells about "The Doherty High-Efficiency Amplifier Applied to Amateur 'Phone," with practical circuit design and experimental results on 3950 Kc.
- J. H. Dellinger of the National Bureau of Standards continues his research into the odd phenomenon of "Radio Fadeouts through 1936."
- In "More DX per Dollar," Part I, Charles Perrine, W6CUH, describes the oscillator and automatic driver stages of his 1-Kw. three-band transmitter, which switches among multiple crystals for rapid frequency hopping.
- Manfred Asson, ES21D, describes "A Simple Directive Antenna," a wire array that uses a four-wavelength radiator and one reflector.

February 1962

- The cover photo shows the USAF *Discoverer 36* rocket lifting off its pad — carrying OSCAR into orbit!
- The editorial provides a few details about OSCAR, the first non-government satellite ever sent into orbit. The launch took place on December 12, 1961.
- Bill Orr, W6SAI, looks at "Sixty Years of Radio Amateur Communication" — from Marconi to OSCAR.
- The article "OSCAR Congratulations" reprints letters from a number of government agencies.
- "The Honor Roll: OSCAR Participants" lists the many hams who were key figures in the OSCAR effort.
- T. M. Lott, VE2AGF, discusses "Communications for Project OSCAR."
- "The OSCAR Satellite," by Harley Gabrielson, W6HEK, looks at the satellite's hardware, reliability, and packaging.
- Getting back down to earth, Lew McCoy, W1ICP, describes "An Easy-to-Build V.F.O."
- "An All-Transistor Six-Meter Receiver," by Samuel Daskam, K2OPI, and Anthony Troiano, provides good performance and long battery life in a small package.
- George Hanchett, W2YM, tells us about "Zero-Bias Sweep-Tube Modulators."
- "Building an Antenna Coupler," by Horner Kuper, K2CU, is an excellent overview of what the antenna coupler does, and how it does it.
- Dave Harper, W4NIQ, tells us about "The Beetle Box," a compact transmitter, power supply, and receiving converter for the small-car owner.
- George Hart, W1NJM, reports on the ham response to "Hurricane Carla," the worst storm in Texas history.

February 1987

- The cover photo shows a ham doing some RF designing using MMICs.
- The editorial discusses our taking advantage of new advances in technology.
- "Life after the License," by Lee Hayford, AH2W, tells our newcomers how they can call on their local ham clubs for help getting into our exciting hobby.
- In "Using *QST*s to Choose an Old HF Rig," George McCanless, KA4GSQ, points out that the "Product Review" columns on those older rigs can help you decide which one suits you best.
- Al Ward, WB5LUA, discusses how we can use "Monolithic Microwave Integrated Circuits" to greatly simplify RF design, pointing out that the devices work "from DC to daylight."
- Mike Huddleston, KJ4LN, tells us how to "Build the Morsemaster II," a deluxe code trainer.
- Paula McKnight, N1DNB, reminds us of Amateur Radio's accomplishments during the past year, in "1986: Reaffirming Amateur Radio's Objectives."
- A new *QST* column is introduced — "Exploring Ham Radio," by John Foss, W7KQW.

Al Brogdon, W1AB ♦ Contributing Editor

Field Organization Reports

November 2011

Public Service Honor Roll

This listing recognizes radio amateurs whose public service performance during the month indicated 70 or more points in six categories. Details on the program are at this web page: www.arrl.org/public-service-honor-roll

544
W5KAW

425
KT2D

420
KI4KWR

412
W4CAC

373
KBIBS

335
KA2ZNZ

315
N9VC

300
WB9YBI

262
WB8RCR

254
W2MTA

251
W2LIE

240
W7FQQ
K2HAT

235
NX0K

231
K2DYB

225
WA9LFO

212
KC5ZGG

211
NC4VA

210
WD9FLJ

201
WB9FHP

191
K2AEX

190
KB2KOJ

186
AE5VY

185
KB8DN

182
WA2BSS

180
K7BFL

176
N8OSL

175
K4JGA

167
K8FRG

166
KT5SR

160
VE7DXD
NM1K
K9GGG
N2FDB

154
KA4IZN

150
KE5HYW
N9IO

147
K2LQB

145
K8HTN
KB2BAA

140
K0LGU
KB2RTZ
KB1RGQ
W4DNA

135
N7CM
W3YVQ
WK4P
K7OAH

134
KA8ZGY
WD8USA

130
WB2FTX
K8JT
W5DY
W9WXN
K4NWW

126
AD4BL
KC2SYM

125
NN7H
K7EAJ

120
KC8M
AG9G
KF5IOU
WA5LOU
K4JUU
N2WKT
KA4FZI
NC3F

W8LAW
WB8HHZ
W8UL
WU2G
N2UBA
WB8WKQ

118
WM2C

117
KK5NJ

115
WS8P
K2VTT
W9CB

113
W8RJA

110
W4DTN
W7CM
K5CRX
KC5OZT
WB8SIQ
K7BDU
K3RC
WA3EZN
K4BG
K4GK
NA8L
N9WLW
KI4AAN
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N7XG
N7YBS
KB1NMO
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N2RTF
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W4TTO
WE2G

109
KD8KWG

108
N3RB
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K2GW

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KB5PGY

101
W2DWR
KJ7NO

N2VC

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K4SCL
W6WW
KE4CB
N1JX
N5OUJ
WG8Z
N3SW
W3TWV
KA1G
KJ4HGH
NU8K
KT4YA
W8CPG
WB4FDT
AA3SB
KB3LNM
W8CLS
N8MEA
K8VFZ
KF7GC

99
KD8EBY

98
W5GKH

93
WB3JS
KB8DTI

92
N7EIE
N8BY

91
W2CC
N7IE
K7FLI

90
WA2CUW
AA2SV
WA2NDA
N8CJS
N8DO
WB4BIK
W8BGJ
W9MET
W3GQJ
WB1M
KZ8Q
K3IN
N3ZOC
N4MEH
NA7G
N6ASU
KA2EJD

89
N2DW

88
W8LW

86
KB9KEG

85
KB5KKT
K5AXW
WB4IAL
WA4UJC
WB8OTS
KD2AEX

83
KB8HJJ

82
KD8LZB

81
N4ELI

80
AL7N
K4MSG
K7MOF
N5EED
K8KV
WB8KPE
WS4P
KJ4JPE
KI3DEU
NI3I
N9MHJ
N8UKO
KF8XO
KC9BW
KB7RWF
KC2SBO

79
N9WQA

78
WD8GUF

77
KK7DEB

76
N2YHQ
N2RQ

75
KK7TN

73
WB8YSS

72
KD8QPF
KD7OED

70
N9VT
W5XX
KD8WYN
N8DLK
N8DUW
N8DUX
W8FUI
N8NTV
K8PTK
K8PXC
WA8VNC
KC8ZDA
K2KYQ

The following stations qualified for PSHR in previous months, but were not recognized in this column: (Oct) KB8DTI 138, K1EIC 135, KB1NMO 120, KB1RGQ 120, NM1K 110.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AR, AK, AZ, CO, CT, ENY, EPA, EWA, GA, IL, KS, LAX, MDC, ME, MI, MN, MS, NC, NE, NFL, NLI, NNJ, NTX, OH, OK, OR, ORG, SC, SD, SFL, SJV, SNJ, STX, TN, UT, VA, WI, WCF, WNY, WV, WY.

Section Emergency Coordinator Reports

The following ARRL Section Emergency Coordinators reported: ENY, EWA, GA, IA, IN, KS, MDC, MI, MN, MO, NLI, NM, OK, SD, SFL, STX, WTX, WV.

Brass Pounders League

The BPL is open to all amateurs in the US, Canada and US possessions who report to their SMs a total of 500 or more points or a sum of 100 or more origination and delivery points for any calendar month. Messages must be handled on amateur radio frequencies within 48 hours of receipt in standard ARRL radiogram format. Call signs of qualifiers and their monthly BPL total points follow.

W5KAW 4265, WB9FHP 2031, W8WW 1897, WB5NKD 1477, WB2FTX 1094, K7BDU 969, WB9JSR 790, W9UL 758, K8HTN 753, W0WXN 650, NX0K 637, N9VC 628, WD8Q 578, WB8WKQ 548, W7QM 545, WB5NKC 529; Originations plus Deliveries: NM1K 111.

The following station qualified for BPL in September, but was not recognized in this column: W8WW 1529.

SILENT KEYS

It is with deep regret that we record the passing of these amateurs:

K1BU **Power**, James E., Norwell, MA
KB1EFA **Small**, Thomas W., Gray Court, SC
N1HLG **Gladding**, John E., North Clarendon, VT
N1JXS **Molin**, Alan, Stoughton, MA
W1ODO **Azadian**, Harry D., Wolcott, NY
K1TFX **Holst**, George W., Presque Isle, ME
W1WFN **Jarvis**, George, Seymour, CT
K2AGF **Beirne**, Eugene F., Roxbury, NY
KA2CPS **Hollister**, Mark E., New Smyrna Beach, FL
N2DRJ **Eeckhout**, Joseph M., Spencerport, NY
K2EID **Andrews**, Paul S., Schenectady, NY
WF2F **Robert**, Francis G., Malone, NY
N2FNH **Baran**, William, Albany, NY
ex-WJ2I **Kiel**, Donald G., Otego, NY
KB2IZB **Calitre**, Ralph G., Newton, NJ
W2LNB **O'Donnell**, Philip M., Oakhurst, NJ
W2NUD **Schwartz**, Harvie E. Jr, Darien, CT
WA2OTL **Middleton**, Robert C., North Port, FL
N2OZS **Kiel**, Darlene P., Otego, NY
W2PCV **Carpenter**, Henry S., Mechanicsburg, PA
N2PDI **Perry**, Ronald E., Delanson, NY
W2PGU **Coulthart**, William F. Jr, Oneida, NY
W2QIK **Petrick**, Daniel L., Camillus, NY
WB2URP **Pores**, Faye A., Manhasset, NY
KB2WEL **Young**, Jonathan C., Rahway, NJ
W2YBN **Mentha**, John W., Raleigh, NC
W2YLM **Boyd**, Robert E., Endwell, NY
W2ZYU **Campbell**, Robert C., Wrentham, MA
NG3A **Kenyon**, Donald D., Butler, PA
N3ELQ **Burtt**, James C., Richboro, PA
♦WB3EZG **Frederick**, Nancy D., Chandler, AZ
♦W3FM **Burhans**, Harry T. Jr, Malvern, PA
KB3HSG **Kenworthy**, Lynn G., Montesano, WA
K3ISS **Grau**, Robert G., Hellertown, PA
WA3MKM **Schmidt**, Raymond G., Solomons, MD
W3PRB **Townsend**, John W. Jr, Cabin John, MD
W3SNN **Sutton**, Francis L., Johnstown, PA
WA3UTL **Shadle**, Jerry L., Pittsburgh, PA
W3ZVY **Henry**, Raymond W., Pottstown, PA
W4ACC **Collins**, Michael A., Winchester, VA
KF4AYG **Galloway**, James "Ronnie," Hendersonville, NC
W4BNM **Arnett**, Aubrey F., Alabaster, AL
K4BOE **Green**, John R., Elba, AL
K4BVZ **Royston**, R. A., Mountain City, TN
♦WA4CHV **Walters**, James V., Tuscaloosa, AL
KB4CJS **Sharrock**, Lucile P., Martin, TN
WD4DKE **Brown**, Jesse T., Elkhorn, KY
KD4DLD **Fowee**, Ralph E., Troy, AL
♦WF4F **Staudenmaier**, William M., Hendersonville, NC
W4FFX **Fleming**, Bonnie M., Monticello, FL
WA4GEE **Yokley**, George W., Kingsport, TN
AD4HT **Reed**, James W., Gadsden, AL
KB4HWJ **Perea**, Francisco H., Raleigh, NC
W4IJA **Bryant**, Ellis H. Jr, Atlanta, GA
WN4J **Abbey**, Robert L., Fort Myers, FL
WN4K **Weller**, Richard I., Cocoa Beach, FL
KF4KFV **Brown**, Louis R., Mobile, AL
WB4KVB **Yandell**, Paul T., Hendersonville, TN
K4LEZ **Branch**, Clinton L., Dublin, GA
W4MYI **Roberts**, Raymon M., Richmond, VA
KE4NLO **Ashmore**, Clyde A., Tallapoosa, GA
W4PNT **Almquist**, Dee C., Crimora, VA
♦WA4RV **Velazquez**, Ramon E., Cleveland, TX
N4SCC **Stokes**, Lee S., Eddyville, KY
N4SWI **Oglesby**, Jerry D., Port Charlotte, FL
ex-K4UYP **Moore**, Johnson C., Warner Robins, GA
W4VDA **Steiner**, Russell E., Guntersville, AL
W4WIC **Chamblin**, Thomas E. Jr, Fincastle, VA
NT4Z **Armstrong**, Hugh, Milton, FL
N5ADF **Allor**, C. Russell, Baton Rouge, LA
N5FDQ **Ketelsen**, James M., Dallas, TX
♦W5GI **Basilotto**, John P., Lakeway, TX
K5ILJ **Langston**, Paul D., Perkinston, MS
K5IOV **Merritt**, Edward B., Moriarty, NM
N5JH **Hitt**, John, Shreveport, LA
K5KXL **Miller**, Melvin E., Shawnee, OK
K5LSM **Roberts**, Keith A., San Angelo, TX
KB5TGH **Betts**, Charles, Marcella, AR
N5WLA **Muehlen**, Frederick, Azle, TX
WA6AFT **Spindler**, Roger G., Pacifica, CA
N6ATR **Rader**, Joseph A., Fresno, CA
WA6AXH **Hoffman**, William "Bud" H., Shawnee, OK
WA6DYJ **Ritscher**, George, Arcata, CA
N6FYM **Warren**, W. L. "Bill," Sacramento, CA
WA6GKN **Carleton**, Agnes, Norwalk, CA
KE6HMM **Martz**, Franklin R., Sutter Creek, CA
KB6KTV **Sereni**, Donald A., Volcano, CA
K6LSU **Jacob**, Nelson H., Jayess, MS
KH6NYC **Steffens**, Edward W. Sr, Pearl City, HI
K6OKL **Lindell**, Walter C., San Rafael, CA
WB6QDN **Benson**, Rodney A., Fresno, CA
KB6SCU **Keates**, Barbara A., Sun City West, AZ
♦WB6SLZ **Erhardt**, Willard S., Fair Oaks, CA
WB6SZW **Munzinger**, Erwin K., Pleasonton, CA
KE6UBE **Kent**, William C., San Luis Obispo, CA
NH6WG **Prybutok**, Leonard, Philadelphia, PA
W6WKE **James**, Ivor J. Jr, Los Gatos, CA
ex-N7AFS **Hough**, Mark W., Butte, MT
WA7BGF **Rosenzweig**, Kenneth J., Beaverton, OR
♦W7DRR **Roberts**, Joe G., Page, AZ
KC7EYS **Elrod**, Locket, Red Oak, TX
AL7GO **Nichols**, Robert A., Ephrata, WA
K7GSN **Nash**, Gerald S., Bremerton, WA
W7ICS **Brown**, Don, Yamhill, OR
♦W7JPH **Rose**, Donald E., Lake Forest Park, WA
KE7JVZ **Mansfield**, Marvin G., Flagstaff, AZ
WA7KCD **Dresbach**, Richard "Neil," Reno, NV
W7OW **Peters**, A. F. "Pete," Spokane, WA
KG7X **Sheldon**, Jack L. Sr, Mesa, AZ
K8DCV **Vande Kieft**, William, Dearborn Heights, MI
WB8FAA **Chadwick**, J. W., Duncanville, TX
KO8I **Hughes**, Paul A., Canton, OH
K8ICB **Eisenman**, Dan R., Clearwater, FL
KC8IOR **Fisher**, James H., Canton, OH
KF8J **Brady**, Leonard E., Findlay, OH
W8LOU **Harter**, Robert W., La Salle, MI
K8LRN **Mooney**, Noel F., Ashland, OH
KB8QEK **Booth**, Charles M., Huntington, WV
WA8WCK **Norona**, Mary J., Morgantown, WV
K8WMD **Dowling**, Wayne M., Kentwood, MI
♦W8YMO **Hooker**, Harrison F. Jr, Middleburg Heights, OH
WB8ZOS **Wilson**, Donald J., Muskegon, MI
W9BCV **Haas**, Duane B., Beaver Dam, WI
KB9BYE **Schroeder**, Robert C., Woodstock, IL
W9EBY **Mussatt**, Thomas J., Riverton, IL
KC9FCN **Carl-Haas**, Ines A., Platteville, WI
♦N9IGM **Ficht**, Raymond, Fort Madison, IA
♦N9IOV **White**, Donna J., Goshen, IN
KJ9J **Straup**, Newton F., South Bend, IN
W9JBD **Williams**, Gene V., Columbia City, IN
N9KM **Marker**, Kenneth D., Richmond, IN
ex-W9KMJ **Marshe**, Peter, Bensenville, IL
WA9LBC **Rheinheimer**, Floyd L., Goshen, IN
K9LJR **Rempe**, Louis J., Clinton, IL
W9MFG **Schobert**, Daniel L., Plover, WI
N9NLQ **Hofrichter**, Wayne, South Milwaukee, WI
W9NUE **Rogers**, Roger "Ken," New Berlin, WI
N9OOK **Rogers**, James W. Jr, Berkeley, IL
KC9PBQ **Lowry**, Jack C., Warsaw, IN
WA9PIV **Pequignot**, Lynn E., Fort Wayne, IN
K9RFW **Bass**, Richard, Somerville, IN
WB9TYU **Greischar**, Lawrence L., Columbus, WI
K9UYU **Smith**, Robert L., Mishawaka, IN
N9VPZ **Cooley**, David R., New Holstein, WI
KE9YZ **Huffman**, Herman C., Advance, IN
NØANX **Lamppa**, Ernest A., Phoenix, AZ
NØAXE **Allerheiligen**, David A., Casper, WY
WAØCKR **Holmgren**, Arthur C., White Bear Lake, MN
WØFSY **Ankeny**, Henry L., Clarinda, IA
KBØHLV **Nicolai**, Eugene R., Delano, MN
ex-WAØP **Schoene**, Charles O., Kansas City, MO
WBØVAD **Cecka**, David J., Otsego, MN
NØWWO **Kuehn**, James O., Heartwell, NE
G4UWK **Birkenshaw**, Ian, Ripley, Derbys, Great Britain
LU3OE **Jovanovics**, Francisco, Villa San Lorenzo, Salta, Argentina

♦ Life Member, ARRL

Note: Silent Key reports must confirm the death by one of the following means: a letter or note from a family member, a copy of a newspaper obituary notice, a copy of the death certificate, or a letter from the family lawyer or the executor. Please be sure to include the amateur's name, address and call sign. Allow several months for the listing to appear in this column.

Many hams remember a Silent Key with a memorial contribution to the ARRL Foundation or to ARRL. If you wish to make a contribution in a friend or relative's memory, you can designate it for an existing youth scholarship, the Jesse A. Bieberman Meritorious Membership Fund, the Victor C. Clark Youth Incentive Program Fund, or the General Fund. Contributions to the Foundation are tax-deductible to the extent permitted under current tax law. Our address is: The ARRL Foundation Inc, 225 Main St, Newington, CT 06111.

Silent Keys Administrator ♦ sk@arrl.org

Strays

TACOMA AREA SCOUTS ENJOY TECHNOREE

◊This past year's annual Jamboree morphed into a "Technoree" in October. Just south of Tacoma, Washington near the Frederickson Boeing plant, an indoor/outdoor event challenged and delighted more than 400 scouts with a broad array of technical activities, including biology, tree identification, robotics, astronomy, recycling, antique autos, computer technology and good old fashioned gold panning.

The Radio Club of Tacoma team set up an operating Amateur Radio station with the call W7T. HF and VHF stations were set up by Steve Blacksten AD7VL, and Dale Morrison AD7SQ, who were joined by Rich Patrick, KR7W and Chuck Kemmer, AC7QN, who deployed hidden transmitters to set up a Direction Finding challenge.

Many of the 100-plus scouts who visited the Radio Club of Tacoma station were working on their Radio merit badge. — *Steve Blacksten, AD7VL, and Larry Watson, KD4VOM*

MIKE ELWELL W7GHW

Hidden Transmitter Hunting 101: **Rich Patrick, KR7W, reports that the Scouts were very good at both grasping the idea of ARDF/ transmitter hunting and using the equipment to find the hidden transmitters.**

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• 2M/70CM @ 5W • Wide-band RX 495 kHz - 999.9 MHz** • 1304 alphanumeric memories • Dualwatch capability • IPX7 Submersible*** • Optional GPS speaker Mic HM-175GPS

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• 1.8-24MHz + 6M Amp • 1KW amplifier • 100% duty cycle • Compact body • Detachable controller • Automatic antenna tuner

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• 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

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• 2M @ 5.5W • Loud BTL audio output • Military rugged • Classic 2M operation

IC-80AD Analog + Digital Dual Bander D-STAR

D-STAR READY

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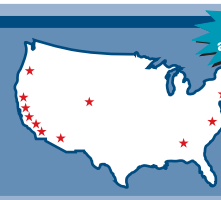

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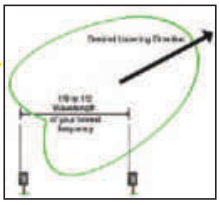
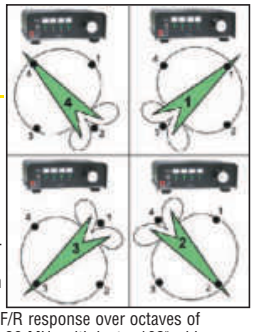


The NCC-1 is a two-channel receiving phasing system. This sophisticated controller allows the user to combine and independently adjust the phase and level of two antenna inputs, creating a fully adjustable phased array from any two antennas.

DXE-NCC-1	Receive Antenna Phasing Controller	$599.95
DXE-AAPS3-1P	Two Antenna System, electronically rotatable	$1,099.95

Receive Four Square Arrays



The patented* DXE-RFS-SYS-2P uses time delay phasing to produce wider and deeper rear nulls and a narrower main lobe in four selectable directions. The result is greatly reduced levels of noise and undesirable signals for a superior front-to-rear ratio. Use with DX Engineering Active Vertical Antennas for great F/R response over octaves of bandwidth from 100 kHz to 30 MHz with just a 102" whip as the antenna element.

US Patent Number 7,423,588

DXE-RFS-SYS-2P	Four Square Controller/ Switch Package	$389.95
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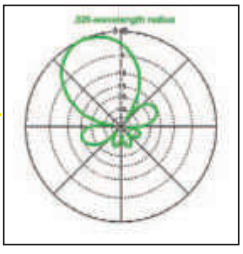

This switchable 8-direction array allows the user to pinpoint the exact direction for maximum receive signal performance. It uses the same time delay phasing technique as the Receive Four Square system to provide excellent bandwidth and pattern control with 102" long active antenna elements.

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DXE-BFS-1	Beverage Antenna System, single direction	$49.95
DXE-RBSA-1P	Reversible Beverage System, two direction	$199.95

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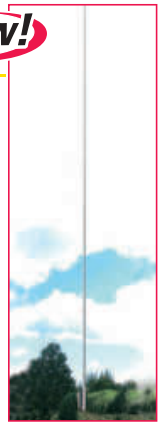

DX Engineering's FULL SIZE quarter-wave vertical antennas provide the highest possible performance. Now you can achieve the strongest possible presence at your power level and be competitive!

The 68-foot tall antennas have rugged base sections starting from 2, 3 and 4-inch diameter aircraft-grade aluminum tubing. The VA-1 requires simple guying, while the VA-2 and VA-3 models are very stout antennas that can stay up with no guying necessary and no worry on your part. The VA-2 and VA-3 antennas can easily be lowered with the supplied Heavy Duty Plus Stainless Pivot Base and the optional hand winch.

- Ultra-WIDE SWR bandwidth
- Highest Wind Ratings—high strength 6063/6061 tubing manufactured to DX Engineering specifications
- High Power Handling Capacity—BIG high strength, UV-protected Extren® insulator
- Reliability Second to None—specially manufactured stainless steel and aluminum saddle clamps, stainless steel bolts, and precision machining
- Easy Tilt Up and Down—specially manufactured heavy duty stainless steel Pivot Base supplied with VA-2 and VA-3 antennas

DXE-7580FS-VA-1	Vertical Antenna, standard HD	$379.50
DXE-7580FS-VA-2	Vertical Antenna, Heavy Duty	$675.50
DXE-7580FS-VA-3	Vertical Antenna, Ultra Duty	$1,675.50

DXE-VRW-1 Manual Winch

This optional winch for the VA-2 and VA-3 Vertical Antennas allows easy one-man raising and lowering. You can use the DXE-VRW-1 winch on similar DX Engineering antennas in a multi-antenna installation.

DXE-VRW-1	Manual Winch Add-on Raising Kit	$169.99

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- Stainless steel element clamps

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DXE-400MAXDU006	6 ft.	$15.88
DXE-400MAXDU009	9 ft.	$19.88
DXE-400MAXDU012	12 ft.	$24.88
DXE-400MAXDU018	18 ft.	$31.88
DXE-400MAXDU025	25 ft.	$39.88
DXE-400MAXDU050	50 ft.	$61.88
DXE-400MAXDU075	75 ft.	$85.88
DXE-400MAXDU100	100 ft.	$104.88
DXE-400MAXDU150	150 ft.	$159.88
DXE-400MAXDU175	175 ft.	$179.88
DXE-400MAXDU200	200 ft.	$199.88

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Coaxial Cable Prep Tools

- Precision, two-step operation
- No nicks or scratches to conductor
- Premium, long-lasting cutter blades
- For foam or solid dielectric cable preparation

DXE-UT-8213	Cable Stripper for RG-8, RG-213, etc	$39.95
DXE-UT-808X	Cable Stripper for RG-8X, 9258, etc	$39.95
DXE-UT-80P	PL-259 Assembly Tool	$22.95
DXE-UT-80N	2-Piece N Connector Tool	$22.95
DXE-CNL-911	Coax Cable Cutters	$23.75
DXE-170M	Precision Shear Side Cutters	$7.95

Now available in cost-saving tool kits with carrying case

DXE-UT-CASE	Molded carrying case only	$22.95
DXE-UT-KIT1	Basic Coax Cable Prep Kit	$99.95
DXE-UT-KIT2	Complete Coax Cable Prep Kit	$174.95

We Will Beat Any Competitor's Prices—Call Us For Details!

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DXE-213U

New!

- 96% Bare Copper Braid Shield
- 1.3 dB loss/100 ft. @50 MHz
- Polyethylene Dielectric .285" O.D.
- .405" O.D. Non-Contaminating Black Vinyl Jacket
- Center Conductor 12.5 AWG
- UV Resistant—Direct Burial

DXE-400MAX

New!

- Bonded Aluminum Tape plus Tinned Copper Braid Shield, 95% coverage
- 1.8 dB loss/100 ft. @150 MHz
- Gas Injected Foam Polyethylene Dielectric,.285" O.D.
- .405" O.D. Black Low Density Polyethylene Jacket
- Center Conductor 10 AWG
- UV Resistant—Direct Burial

Plus Great Customer Service and Fast and Inexpensive Shipping!

hy-gain

Antenna Rotors

HYG-AR-35	Light Beam/TV	$89.95
HYG-CD-45II	8.5 Sq. ft. Rating	$419.95
HYG-HAM-IV	15 Sq. ft. Rating	$594.95
HAM-HAM-V	15 Sq. ft. Digital Control	$919.95
HYG-T-2X	20 Sq. ft. Rating	$689.95
HYG-HDR-300A	25 Sq. ft. Rating, Heavy Duty	$1,339.95

Rotor Accessories

DXE-CW8	8-Wire Rotor Cable	$0.48/ft.
DXE-CW8-HD	8-Wire Heavy Duty Rotor Cable	$0.98/ft.

Green Heron Digital Rotor Controller

Replaces your existing rotor control system. Preprogrammed for Hy-Gain HAM series and T2X rotors. Solderless setup for other rotor types (with jumpers) and field programmable. Fully user-programmable including reversal and brake delay, maximum/minimum speed, limits, ramps, etc.

- RS-232 and USB interface for computer control
- Master/slave for stacked arrays—turn together or separately
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- FREE Software for easy setup
- Precision heading accuracy up to 720° of travel
- Fully supports side-mounted antennas
- Offset control for multiple directions on one mast
- High visibility display with adjustable backlight

GHE-RT-21	Green Heron Rotor Controller	$559.00
HYG-HAM-IVRLC	HAM-IV rotor only	$499.95
HYG-T-2XRLC	T2X rotor only	$599.95

The Experts in Phased Antenna Systems!

Four-Square Hybrid Controllers

Our hybrids offer 20dB F/B and up to 5dB gain at a lower cost than most beams. Available for 160 through 10 meters.

COM-ACB-4 Series ..... from **$364.95**

2-Element Vertical Controllers

No space for a four-square phased vertical array? Three switched patterns—available for 160 through 10 meters.

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Stack Yagi Switches

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COM-STACK-2 ..... **$221.95**

COM-STACK-3 ..... **$399.95**

Call us for custom-tuned phasing cables and monoband antenna systems!

Limited Time Offer— FREE Shipping on Comtek Baluns!

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COM-BAL-11130E

Better Performance, Lower Prices—from just $49.95

COMTEK W2FMI Series Baluns

Design inspired by Jerry Sevick W2FMI and perfected by DX Engineering's balun R&D department.

- High voltage compensating capacitors for unequalled low SWR—a DX Engineering innovation!
- Large fender washers distribute fastener loading to prevent case `
- Special coated toroid core handles close coupling without extra stress
- High, consistent common mode impedance across specified bandwidth—provides isolation where most needed
- Special wire sizing and Teflon-insulated wire sleeves for exact impedance matching and better isolation than Thermaleze wire
- Typical insertion loss: less than 0.2 dB
- Power handling: 3 kW continuous to 5 kW+ intermittent depending on model
- Silver-plated gasketed SO-239 connectors, stainless hardware, weatherproof NEMA box

1:1 Dual Wire/Single Core, 1.8 to 54 MHz

COM-BAL-11130E	3 kW, side eyebolts	$49.95
COM-BAL-11130ET	3 kW, side and top eyebolts	$49.95
COM-BAL-11130S	3 kW, side studs/wingnuts	$49.95
COM-BAL-11130T	3 kW, top studs/wingnuts	$49.95

1:1 Coax/Single Core

COM-BAL-11150E	5 kW, side eyebolts	$49.95
COM-BAL-11150ET	5 kW, side and top eyebolts	$49.95
COM-BAL-11150S	5 kW, side studs/wingnuts	$49.95
COM-BAL-11150T	5 kW, top studs/wingnuts	$49.95

1:1 Dual Wire/Dual Core

COM-BAL-11140T	5 kW, top studs/wingnuts	$69.95
COM-BAL-11140S	5 kW, side studs/wingnuts	$69.95

1:1 Coax/Dual Core

COM-BAL-11150DS	5 kW, side studs/wingnuts	$69.95
COM-BAL-11150DT	5 kW, top studs/wingnuts	$69.95

4:1 Dual Wire/Single Core

COM-BAL-41130E	3 kW, side eyebolts	$59.95
COM-BAL-41130ET	3 kW, side and top eyebolts	$59.95
COM-BAL-41130T	3 kW, top studs/wingnuts	$59.95
COM-BAL-41130S	3 kW, side studs/wingnuts	$59.95

4:1 Dual Wire/Dual Core

COM-BAL-41150T	5 kW, top studs/wingnuts	$89.95
COM-BAL-41150S	5 kW, side studs/wingnuts	$89.95
COM-BAL-41150E	5 kW, side eyebolts	$89.95

Contact DX Engineering Customer Support for recommendations for your application.

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Great for wire antenna spreaders or insulated stacking frames! Build your favorite antenna design!

50 Ft. Telescoping Fiberglass Tubing Mast Kit

- Tubing custom made just for DX Engineering
- Smoothly telescoping sections
- Neutral light gray color
- Uses DX Engineering Stainless Steel Element Clamps to assemble slit lengths

DXE-FTK50 Telescoping Tubing Kit..... **$138.00**

Telescoping Fiberglass Tubing

- 1/8" nominal wall x 8 feet long

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DXE-FT0500-8	0.500" O.D.	$6.45
DXE-FT0750-8	0.750" O.D.	$8.95
DXE-FT1000-8	1.000" O.D.	$9.95
DXE-FT1250-8	1.250" O.D.	$11.95
DXE-FT1500-8	1.500" O.D.	$18.95
DXE-FT1750-8	1.750" O.D.	$20.95
DXE-FT2000-8	2.000" O.D.	$25.95

Tubing with One End Slit

DXE-FT0750-8S	0.750" O.D.	$13.95
DXE-FT1000-8S	1.000" O.D.	$14.95
DXE-FT1250-8S	1.250" O.D.	$16.95
DXE-FT1500-8S	1.500" O.D.	$23.95
DXE-FT1750-8S	1.750" O.D.	$25.95
DXE-FT2000-8S	2.000" O.D.	$30.95

PSK-31 SSTV WSJT

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TIG-SL-USB..... $86.95

Then choose a cable for each radio!

Any Radio Interface Cable*, only **$12.95** when purchased with SignaLink™ unit

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For your complete digital solution!

**except the special Elecraft K3 cable*

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- *RF Sensing*
- *Tunes Automatically*
- *No Interface Cables Needed*

NEW! AT-200Pro II

The AT-200ProII now includes LEDs to show antenna position and if the tuner is in bypass. A two position antenna switch stores 2000 memories per switch. Handles up to 250 watts SSB or CW on 1.8 to 30 MHz and 100 watts on 54 MHz. Rugged and easy to read LED bar graphs simultaneously show RF power and SWR. Includes a six foot DC power cable.

Suggested Price $259.99

Z-11Pro II

Meet the Z-11ProII, everything you always wanted in a small, portable tuner. Designed from the ground up for battery operation. Only 5" x 7.7" x 1.5", and weighing only 1.5 pounds, it handles 0.1 to 125 watts, making it ideal for both QRP and standard 100 watt transceivers from 160 - 6 meters. The Z-11ProII uses LDG's state-of-the-art processor-controlled Switched-L tuning network. It will match dipoles, verticals, inverted-Vs or virtually any coax-fed antenna. With an optional LDG balun, it will also match longwires or antennas fed with ladder-line. Includes six foot DC power cable.

Suggested Price $179.99

radio not included

Z-817

The ultimate autotuner for QRP radios including the Yaesu FT-817(D). Tuning is simple; one button push on the tuner is all that is needed - the Z-817 takes care of the rest. It will switch to PKT mode, transmit a carrier, tune the tuner, then restore the radio to the previous mode! 2000 memories cover 160 through 6 meters. The Z-817 will also function as a general purpose antenna tuner with other QRP radios. Just transmit a carrier and press the tune button on the tuner. Powered by four AA internal Alkaline batteries (not included), so there are no additional cables required.

Suggested Price $129.99.

We have a tuner that will work for you!

We make tuners that will work with any transceiver. Don't know which one is right for you? Give us a call or see the ***Tuner Comparison Chart*** *on our web site for more selection help!*

radio not included

AT-897Plus

for the Yaesu FT-897

If you own a Yaesu FT-897 and want a broad range automatic antenna tuner, look no further! The AT-897Plus Autotuner mounts on the side of your FT-897 just like the original equipment and takes power directly from the CAT port of the FT-897 and provides a second CAT port on the back of the tuner so hooking up another CAT device couldn't be easier. ***Suggested Price$199.99***

AT-600Pro

The AT-600Pro handles up to 600 watts SSB and CW, 300 on RTTY (1.8 – 30 MHz), and 250 watts on 54 MHz. Matches virtually any kind of coax-fed antenna and will typically match a 10:1 SWR down to 1.5:1 in just a few seconds. You can also use it with longwires, random wires and antennas fed with ladder line just by adding a balun. Two antenna ports with a front-panel indicator, and separate memory banks for each antenna. LED bar-graph meters shows RF power, SWR and tuner status, tactile feedback control buttons and an LED bypass indicator. Operates from 11 – 16 volts DC at 750 mA. Includes six foot DC power cable.

Suggested Price $359.99

Z-100Plus

Small and simple to use, the Z-100Plus sports 2000 memories that store both frequency and tuning parameters. It will run on any voltage source from 7 to 18 volts; six AA batteries will run it for a year of normal use. Current draw while tuning is less than 100ma. The Z-100Plus now includes an internal frequency counter so the operating frequency is stored with tuning parameters to make memory tunes a blazingly fast 0.1 seconds; full tunes take an average of only 6 seconds. Includes six foot DC power cable.***Suggested Price $159.99***

LDG Electronics, Inc. 1445 Parran Road, St. Leonard, MD 20685 ***Phone 410-586-2177 • Fax 410-586-8475***

The #1 Line of Autotuners!

Designed to handle the higher power of the Tokyo Hi Power HL-45B.

NEW! Z-817H

The ultimate autotuner for QRP radios including the Yaesu FT-817(D) with addition of the Tokyo High Power HL-45B. Interfaces to the CAT port (ACC) on the back of the radio with the provided cable. One button push on the tuner and the Z-817H takes care of the rest. Will also function as a general purpose antenna tuner with other QRP radios or QRP radios with up to 75 watt HF amps. Powered by four AA internal Alkaline batteries (not included). 2000 memories cover 160 through 6 meters.

Suggested Price $159.99

- *RF Sensing*
- *Tunes Automatically*
- *No Interface Cables Needed*

AT-100Pro II

This desktop tuner covers all frequencies from 1.8 – 54 MHz (including 6 meters), and will automatically match your antenna in no time. It features a two-position antenna switch with LEDs, allowing you to switch instantly between two antennas. The AT-100ProII requires just 1 watt for operation, but will handle up to 125 watts. Includes six foot DC power cable.

Suggested Price $229.99

AT-1000Pro

The AT-1000Pro has an Automode that automatically starts a tuning cycle when the SWR exceeds a limit you set. Operates at any power level between 5 and 1,000 watts peak. RF Relay protection software prevents tuning at greater than 125 watts. Tunes from 1.8 to 54.0 MHz (inc. 6 meters), with tuning time usually under 4 seconds, transmitting near a frequency with stored tuning parameters, under 0.2 seconds. 2000 memories. 2 Antenna connections. Includes six foot DC power cable.

Suggested Price $599

IT-100

Matched in size to the IC-7000 and IC-706, for either manual or automatic tunes, and status LEDs. Control the IT-100 and its 2000 memories from either its own button or the Tune button on your IC-7000 or other Icom rigs. For your Icom radio that is AH3 or AH-4 compatible. ***Suggested Price $179.99***

YT-100

For Yaesu FT-857, FT-897 and FT-100 (and all D models) an integrated tuner, powered by the interface. Press the tune button on the tuner, and everything else happens automatically. ***Suggested Price $199.99***

KT-100

For AT-300 compatible Kenwood transceivers (except TS-480HX). The KT-100 actually allows you to use the Tune button on the radio. 2,000 memories for instant recall of the tuning parameters for your favorite bands and frequencies. ***Suggested Price $199.99***

YT-450

Designed for Yaesu's newest 100 watt radios. Interfaces directly with the Yaesu FT-450 and FT-950 radios. Press the tune button on the tuner and the rest happens automatically. It will quickly match nearly any kind of coax fed antenna with an SWR of up to 10:1. 2000 memories recall settings in an instant! Seamless connection to a PC.

Suggested Price $249.99

YT-847

YT-847 Autotuner is an integrated tuner for the Yaesu FT-847. An included CAT/Power cable interfaces with your FT-847. Just press the tune button on the tuner and everything else happens automatically!

Suggested Price $249.99

FREE!

RBA-1:1 Balun or RU-4:1 Unun

When You Buy A S9V 43', 31' or 18' Multiband Antenna

Purchase an S9V 43', 31' or 18' antenna and fill out the included form. Mail it to LDG Electronics, and we will send you either a 200 watt balun or unun, your choice!

Antennas!

S9V 43' $199.99

80-6 meters *Fixed Operation*

The S9V 43' is a high-performance lightweight telescoping fiberglass vertical. The best value in high-performance 'tall' verticals!

S9V 31' $99.99

40-6 meters *Fixed or Portable Operation*

S9V 18' $49.99

20-6 meters *Fixed or Portable Operation*

The S9V 31' and 18' are tapered, ultra-lightweight fiberglass vertical antennas. Friction-locking sections and high-tech polymer tube rings allow the antenna to be quickly and safely deployed in practically any environment without tools!

S9RP $39.99

Aluminum Radial Plate

Includes 20 sets of stainless steel nuts & bolts

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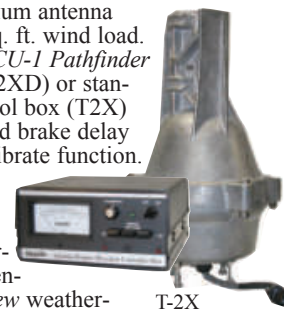
HAM-IV

HAM-IV **$649.95**

The most popular rotator in the world! For medium communications arrays up to 15 square feet wind load area. *New* 5-second brake delay! *New* Test/Calibrate function. *New* low temperature grease permits normal operation down to -30 degrees F. *New* alloy ring gear gives extra strength up to 100,000 PSI for maximum reliability. *New* indicator potentiometer. *New* ferrite beads reduce RF susceptibility. *New* Cinch plug plus 8-pin plug at control box. Dual 98 ball bearing race for load bearing strength and electric locking steel wedge brake prevents wind induced antenna movement. North or South center of rotation scale on meter, low voltage control, max mast size of $2^{1}/_{16}$ inches.

HAM IV and HAM V Rotator Specifications	
Wind Load capacity (inside tower)	15 square feet
Wind Load (w/mast adapter)	**7.5 square feet**
Turning Power	800 in.-lbs.
Brake Power	**5000 in.-lbs.**
Brake Construction	Electric Wedge
Bearing Assembly	**dual race/96 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	26 lbs.
Effective Moment (in tower)	**2800 ft.-lbs.**

TAILTWISTER SERIES II



T-2X **$799.95**

T-2XD **$1229.95** with DCU-1

For large medium antenna arrays up to 20 sq. ft. wind load. Available with *DCU-1 Pathfinder* digital control (T2XD) or standard analog control box (T2X) with *new* 5-second brake delay and *new* Test/Calibrate function. Low temperature grease, alloy ring gear, indicator potentiometer, ferrite beads on potentiometer wires, *new* weatherproof AMP connectors plus 8-pin plug at control box, triple bearing race with 138 ball bearings for large load bearing strength, electric locking steel wedge brake, North or South center of rotation scale on meter, low voltage control, $2^{1}/_{16}$ inch max. mast.

TAILTWISTER Rotator Specifications	
Wind load capacity (inside tower)	20 square feet
Wind Load (w/ mast adapter)	**10 square feet**
Turning Power	1000 in.-lbs.
Brake Power	**9000** in.-lbs.
Brake Construction	Electric Wedge
Bearing Assembly	**Triple race/138 ball brngs**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	31 lbs.
Effective Moment (in tower)	**3400 ft.-lbs.**

CD-45II

CD-45II **$449.95**

For antenna arrays up to 8.5 sq. feet mounted inside tower or 5 sq. ft. with mast adapter. Low temperature grease good to -30 F degrees. *New* Test/Calibrate function. Bell rotator design gives total weather protection, dual 58 ball bearing race gives proven support. Die-cast ring gear, stamped steel gear drive, heavy duty, trouble free gear train, North center scale, lighted directional indicator, 8-pin plug/socket on control unit, snap-action control switches, low voltage control, safe operation, takes maximum mast size to $2^{1}/_{16}$ inches. MSLD light duty lower mast support included.

CD-45II Rotator Specifications	
Wind load capacity (inside tower)	8.5 square feet
Wind Load (w/ mast adapter)	**5.0 square feet**
Turning Power	600 in.-lbs.
Brake Power	**800 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/48 ball brings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	22 lbs.
Effective Moment (in tower)	**1200 ft.-lbs.**

HAM-V

HAM-V **$1099.95** with DCU-1

For medium antenna arrays up to 15 square feet wind load area. Similar to the HAM IV, but includes *DCU-1 Pathfinder* digital control unit with gas plasma display. Provides automatic operation of brake and rotor, compatible with many logging/contest programs, 6 presets for beam headings, 1 degree accuracy, auto 8-second brake delay, 360 degree choice for center location, *more!*

AR-40

AR-40 **$349.95**

For compact antenna arrays and large FM/TV up to 3.0 square feet wind load area. Dual 12 ball bearing race. Automatic position sensor never needs resetting. Fully automatic control -- just dial and touch for any desired location. Solid state, low voltage control, safe and silent operation. $2^{1}/_{16}$ inch maximum mast size. MSLD light duty lower mast support included.

AR-40 Rotator Specifications	
Wind load capacity (inside tower)	3.0 square feet
Wind Load (w/ mast adapter)	**1.5 square feet**
Turning Power	350 in.-lbs.
Brake Power	**450 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/12 ball bearings**
Mounting Hardware	Clamp plate/steel bolts
Control Cable Conductors	**5**
Shipping Weight	14 lbs.
Effective Moment (in tower)	**300 ft.-lbs.**

HDR-300A

HDR-300A **$1499.95**

King-sized antenna arrays up to 25 sq.ft. wind load area. Control cable connector, *new* hardened stainless steel output shaft, *new* North or South centered calibration, *new* ferrite beads on potentiometer wires reduce RF susceptibility, *new* longer output shaft keyway adds reliability. Heavy-duty self-centering steel clamp and hardware. Display accurate to 1°. Machined steel output.

HDR-300A Rotator Specifications	
Wind load capacity (inside tower)	25 square feet
Wind Load (w/ mast adapter)	**not applicable**
Turning Power	5000 in.-lbs.
Brake Power	**7500 in.-lbs.**
Brake Construction	solenoid operated locking
Bearing Assembly	**bronze sleeve w/rollers**
Mounting Hardware	stainless steel bolts
Control Cable Conductors	**7**
Shipping Weight	61 lbs.
Effective Moment (in tower)	**5000 ft.-lbs.**

ROTATOR OPTIONS

MSHD, $109.95. Heavy duty mast support for T2X, HAM-IV and HAM-V.
MSLD, $49.95. Light duty mast support for CD-45II and AR-40.
TSP-1, $34.95. Lower spacer plate for HAM-IV and HAM-V.

Digital Automatic Controller

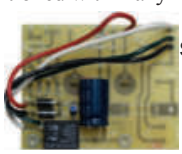
DCU-1 **$749.95**

Automatically controls T2X, HAM-IV, V rotators. 6 presets for favorite headings, 1° accuracy, 8-sec. brake delay, choice for center of rotation, crisp *plasma* display. Computer controlled with many logging/contest programs.

AR-35 Rotator/Controller

AR-35 **$89.95**

For UHF, VHF, 6-Meter, TV/FM antennas. Includes automatic controller, rotator, mounting clamps, mounting hardware. 110 VAC. One Year Warranty.



RBD-5 **$29.95**

NEW! **Automatic Rotator Brake Delay**
Provides automatic 5-second brake delay -- insures your rotator is fully stopped before brake is engaged. Prevents accidentally engaging brake while rotator is moving. Use with HAM II, III, IV, V, T2Xs. Easy-to-install. Includes pre-assembled PCB, hardware.

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IC-91A

RX-7-05 Wideband Receiver

• RX: 150 kHz - 1300 MHz (cell blkd) • Memories: 1650 • AM, FM Narrow & Wide Mode • Scans 100 Channels per second • 1100mAh Lith-Ion Battery & Charger

IC-91A 2M/440 FM Dual Band HT

• TX: 144-148, 420-450 MHz
• RX: 0.495-999 MHz (cell blkd) • Power: 5/0.5W
• Memories: 1304 • D-Star w/optional UT-121 board

IC-2200H 2M FM Mobile

• TX: 144-148 MHz • RX: 118-174 MHz
• Power: 65/25/10/5W • Memories: 207
• D-Star upgradable with optional UT-118

IC-208H 2M/440 FM Mobile

• TX: 144-148, 430-450 MHz • Memories: 512
• RX: 118-173, 230-549, 810-999 MHz (cell blkd)
• Power: 55/15/5W (2M), 50/15/5W (440 MHz)

LAST CHANCE!

IC-7000 HF/6/2M/440 MHz Mobile

• TX: HF/6/2M/440 MHz • RX: 0.03-199, 400-470 MHz
• Power: 2-100W (HF/6M), 2-50W (2M), 2-35W (440)
• Memories: 503 • 41 band-widths with sharp or soft filter shape • RMK-7000 included for limited time!

IC-7200 HF/6M Portable

• TX: HF/6M • RX: 0.03-60 MHz • Power: 2-100W
• Memories: 201 • Rugged design for outdoor use
• 32-bit IF-DSPs + 24-bit AD/DA Converters
• USB Port for CI-V Format PC Control & Audio In/Out

IC-7410 HF/6M Transceiver

• TX: HF/6M • RX: 0.03-60 MHz • Power: 2-100W
• 15kHz 1st IF filter and optional 3kHz & 6kHz filters to protect against strong unwanted adjacent signals
• Much faster DSP unit compared to the IC-746PRO
• Automatic antenna tuner • USB connector for PC control

IC-7600 HF/6M Transceiver

• TX: HF/6M • RX: 0.03-60 MHz • Power: 2-100W
• Memories: 101 • 5.8 inch color screen
• High-resolution real time spectrum scope using a dedicated DSP unit • Automatic antenna tuner

IC-9100 HF/6/2M/440 MHz All Mode

• TX: HF/6/2M/440 MHz • RX: 0.03-60, 136-174, 420-480 MHz • Optional 1.2 GHz, 1-10W Operation
• Power: 2-100W HF/6/2M & 2-75W 440 MHz
• Memories: 297 • Optional D-Star Board • Auto Tuner
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• USB Port for CI-V Format PC Control & Audio In/Out

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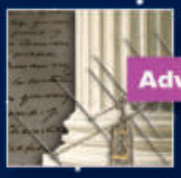

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KG-UV3D2/440 2M/440 MHz FM HT

• TX: 144-148, 420-450 • RX: 136-174, 420-520, and 76-108 MHz FM Broadcast • Power: 5/1W VHF & 4/1W UHF • Memories: 128 • Dual Band Monitor (VHF/UHF, VHF/VHF, UHF/UHF) • Li-Ion Battery

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KG-UV3D2/220 2M/220 MHz FM HT

• Same but TX: 144-148, 223-225 and RX: 136-174, 216-280 and 76-108 MHz FM Broadcast • Power: 5/1W

$119.99

KG-UV6D VHF/UHF Commercial HT

• TX/RX: 136-174, 420-470 MHz • 76-108 MHz FM Broadcast RX Only • Power: 5/1W VHF & 4/1W UHF • Memories: 199 • Dual Band Monitor (VHF/UHF, VHF/VHF, UHF/UHF) • 2.5 kHz step for FCC 2013 narrow-band compliance • Li-Ion Battery

$184.99

KG-UVA1 VHF/UHF Commercial HT

• TX/RX: 136-174, 400-470 MHz • 76-108 MHz FM Broadcast RX Only • Power: 5/2W VHF & 4/2W UHF • Memories: 16 • Dual Band Monitor (VHF/UHF, VHF/VHF, UHF/UHF) • Li-Ion Battery

SPECIAL ORDER $129.99

KG-UVA1X VHF/UHF Commercial HT

• Same but includes 2.5 kHz step for FCC 2013 narrow-band compliance & uses standard SMA antenna connector

$149.99

WX-AAB	"AA" Battery Case	$10.99
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Supports virtually ALL sound card digital and voice modes. Includes traditional modes such as RTTY, SSTV and CW as well as today's new modes like PSK31, WSPR, WINMOR, MT-63 and EchoLink®. Optimized performance on all modes. Ease of operation is provided by front panel controls that let you adjust your Transmit Audio, Receive Audio and Transmit delay "on the fly". Some features: FCC Class B Certified; Built-in Low-noise Sound Card; Simple Installation and Setup; Complete Radio Isolation; USB Port Powered; Works with virtually all Radios; Uses the Radio's Mic, Data or Accessory Port.

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• Simply enter a ZIP code via the touch screen and press Enter • RX: 25-54, 108-512, 758-960 MHz (less celluar) • Systems: TruckTracking EDACS (N/W), LTR, Motorola (analog/mixed/digital) and APCO P25 (trunked and conventional)

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Easy To Use Scanner

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MFJ-259B *World's* most popular Antenna Analyzer is super easy-to-use!

MFJ-259B
$289.95

The MFJ-259B is the world's most popular Antenna Analyzer and the easiest to use! Just select a band and mode. Set frequency. Your measurements are instantly displayed!

Handheld Antenna Lab

Owning the MFJ-259B is like having an entire antenna lab in the palm of your hand!

Measure SWR quickly or make sophisticated measurements such as Return Loss, Reflection Coefficient, Resonance, Complex Impedance (R+jX), Impedance Magnitude (Z) plus Phase in degrees. Covers 1.8 to 170 MHz -- no gaps.

Coax Analyzer

Determine coax cable velocity factor (Vf), loss in dB, coax length, distance to open or short plus detect wrong coax impedance.

Frequency Counter

Measure frequency of external signals using the separate BNC counter input.

Signal Generator

Use as a signal source 1.8-170 MHz with digital dial accuracy for testing and alignment.

Inductance and Capacitance

Measure Inductance (uH) and Capacitance (pF) at RF frequencies not at audio frequencies used by most L/C meters.

Digital and *Analog* Meters

A high-contrast backlit LCD gives precision readings and *two* side-by-side *analog meters* make antenna adjustments intuitive.

Smooth, Stable Tuning

Velvet-smooth reduction drive tuning and precision *air-variable capacitor* makes setting frequency easy and stable.

Battery Saver & More

Battery-saver, low-battery warning, battery voltage meter and charger are all built in. Use ten Alkaline, NiCad or NiMH AA batteries (not included) or 110 VAC with MFJ-1312D, $15.95. 4Wx6¾Hx2D inches.

Here's What You Can Do

Find true antenna resonant frequency
Tune *antenna quickly for minimum SWR*
Match complex loads to your feedline
Adjust *mobile whips without stressing finals*
Determine safe 2:1-SWR operating windows
Adjust *tuners without generating QRM*
Find exact location of shorts and opens
Cut *stubs and phasing lines accurately*
Check cable for loss and contamination
Find *value of unknown coils and caps*
Test RF transformers and baluns
Troubleshoot *filters and networks*
Find self-resonance and relative Q
Check *patterns and compare gain*
MFJ-259B does all this and more!

MFJ Analyzer Accessories

MFJ-29C, $24.95. Tote your MFJ-259B anywhere with this *genuine* MFJ custom carrying case. Special foam-filled fabric cushions blows, deflects scrapes and protects knobs and meters from harm. **MFJ-39C, $24.95.** Like MFJ-29C, but for MFJ-269.

MFJ-66, $24.95. Plug-in coils turns any MFJ Antenna Analyzer into a sensitive and accurate *band switched* dip meter. 2 coils.

MFJ-92AA10, $29.95. Ten MFJ *SuperCell*™ Ni-MH AA rechargeable batteries.

MFJ-99B, $88.90. ***Save $7!*** MFJ-259B Deluxe Accessory Pack: MFJ-29C Pouch, 10 Ni-MH batteries, dip coils, AC adapter. **MFJ-98B, $88.90.** Like MFJ-99B but for MFJ-269.

MFJ-99, $60.85. ***Save $5!*** Like MFJ-99B, less batteries, for MFJ-259B. **MFJ-98, $60.85.** Like MFJ-99 but for MFJ-269.

MFJ-99C, $40.90. ***Save $5!*** AC Adapter and 10 Ni-MH batteries for MFJ-259B/269.

MFJ-917, $29.95. Current balun lets you make balanced line antenna measurements on HF with your MFJ Analyzer. **MFJ-7702, $3.95.** MFJ-917 to MFJ Analyzer adapter.

MFJ-731, $99.95. Tunable RF filter allows accurate Antenna Analyzer measurements in presence of strong RF fields. 1.8-30 MHz.

MFJ-5510, $9.95. Cigarette lighter cord.

MFJ-269 ...1.8-170 MHz and 415-470 MHz plus 12-bit A/D!

The MFJ-269 does everything the MFJ-259B does - and much more!

Expanded Frequency Coverage

MFJ-269 adds UHF coverage from 415 to 470 MHz -- right up into the commercial band. With it, you can adjust UHF dipoles, verticals, Yagis, quads and repeater collinear arrays with ease -- plus construct accurate phasing harnesses and timed cables. Also use it as a signal source to check UHF duplexers, diplexers, IMD filters and antenna patterns.

Much Better Accuracy

New *12-bit* A/D converter gives much better accuracy and resolution than common 8-bit A/D converters -- *an MFJ-269 exclusive!*

Complex Impedance Analyzer

Read Complex Impedance (1.8 to 170 MHz)as series equivalent resistance and reactance (Rs+jXs) or as magnitude (Z) and phase (degrees). Also reads *parallel* equivalent resistance and reactance (Rp+jXp) -- *an MFJ-269 exclusive!*

MFJ-269
$389.95

CoaxCalculator™

Lets you calculate coax line length in feet given electrical degrees and vice versa for any frequency and any velocity factor -- *an MFJ-269 exclusive!*

Use any Characteristic Impedance

You can measure SWR and coax loss with *any* characteristic impedance (1.8 to 170 MHz) from 10 to over 600 Ohms, including 50, 51, 52, 53, 73, 75, 93, 95, 300, 450 Ohms -- *an MFJ-269 exclusive!*

Logarithmic Bar Graph

Has easy-to-read LCD *logarithmic* SWR bargraph and SWR meter for quick tuning.

Uses instrumentation grade N-connector to ensure minimum mismatch on all frequencies. Includes N to SO-239 adapter.

MFJ-269*PRO*™ Analyzer

Like MFJ-269, but has extended commercial frequency coverage in UHF range ***(430 to 520 MHz)*** and *ruggedized* cabinet that protects LCD display, knobs, meters and connectors from damage in the field/lab.

MFJ-269PRO
$419.95

MFJ-266 ...Wide range 1.5-185 MHz and 300-490 MHz!

New!

MFJ-266
$349.95

The compact MFJ-266 covers HF (1.5-65 MHz) in 6 bands, plus VHF (85-185 MHz) and UHF (300-490 MHz).

In *Antenna Analyzer* mode, you get Frequency, SWR, Complex Impedance (R+jX), and Impedance Magnitude (Z) *all displayed simultaneously* on a high-contrast backlighted LCD (SWR only on UHF).

In *Frequency-Counter* mode, the MFJ-266 functions as a 500-MHz counter with up to 100 Hz resolution and measures relative field strength of a signal and its frequency and can be used for tracking measurement interference.

MFJ-266 also functions as a 10 dBm signal source with digital-frequency readout. It can also measure inductance and capacitance at RF frequencies.

Features include solid-state band switching and electronic varicap tuning with a smooth 10:1 lockable vernier tuning drive.

Use eight AA *alkaline* batteries or 110 VAC with MFJ-1312D, $15.95. Includes N-to-SO-239 adapter. 3¾Wx6½Hx2¾D inches. 1.3 lbs.

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MFJ TUNERS

New, Improved MFJ-989D 1500 Watt *legal limit* Antenna Tuner

World's most popular 1500 Watt Legal Limit Tuner just got better -- much better -- gives you more for your money!

New, improved MFJ-989D *legal limit* antenna tuner gives you better efficiency, lower losses and a new *true* peak reading meter. It easily handles *full* 1500 Watts SSB/CW, 1.8 to 30 MHz, including MARS/WARC bands.

New dual 500 pF *air variable capacitors* give you twice the capacitance for more efficient operation on 160 and 80 Meters.

New, improved *AirCore™ Roller Inductor* gives you lower losses, higher Q and handles more power more efficiently.

New *TrueActive™* peak reading Cross-Needle *SWR/Wattmeter* lets you read *true* peak power on all modes.

MFJ-989D **$389.95**

New high voltage *current balun* lets you tune balanced lines at high power with no worries.

New *crank knob* lets you reset your roller inductor quickly, smoothly and accurately.

New larger 2-inch diameter *capacitor knobs* with easy-to-see dials make tuning much easier.

New cabinet maintains components' high-Q. Generous air vents keep components cool. $12^{7}/_{8}$Wx6Hx$11^{5}/_{8}$D inches.

Includes six position ceramic antenna switch, 50 Ohm dummy load, indestructible multi-color Lexan front panel with detailed logging scales and legends.

The MFJ-989D uses the superb time-tested T-Network. It has the widest matching range and is the easiest to use of all matching networks. Now with MFJ's new 500 pF air variable capacitors and new low loss roller inductor, it easily handles higher power much more efficiently.

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Every MFJ tuner is protected by MFJ's famous one year *No Matter What™* limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

More hams use MFJ tuners than all other tuners in the world!

MFJ-986 Two knob *Differential-T™*

MFJ-986 **$349.95**

Two knob tuning (differential capacitor and *AirCore™* roller inductor) makes tuning foolproof and easier than ever. Gives minimum SWR at only one setting. Handles 3 KW PEP SSB amplifier input power (1.5 KW output). Gear-driven turns counter, lighted peak/average Cross-Needle SWR/Wattmeter, antenna switch, balun. 1.8 to 30 MHz. $10^{3}/_{4}$Wx$4^{1}/_{2}$Hx15 in.

MFJ-962D *compact* kW Tuner

MFJ-962D **$299.95**

A few more dollars steps you up to a KW tuner for an amp later. Handles 1.5 KW PEP SSB amplifier input power (800W output). Ideal for Ameritron's AL-811H! *AirCore™* roller inductor, gear-driven turns counter, pk/avg lighted Cross-Needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8-30MHz. $10^{3}/_{4}$x$4^{1}/_{2}$x$10^{7}/_{8}$ in.

MFJ-969 300W *Roller Inductor* Tuner

MFJ-969 **$219.95**

Superb *AirCore™* Roller Inductor tuning. Covers *6 Meters* thru 160 Meters! 300 Watts PEP SSB. *Active* true peak reading lighted Cross-Needle SWR Wattmeter, *QRM-Free PreTune™*, antenna switch, dummy load, 4:1 balun, Lexan front panel. $3^{1}/_{2}$Hx$10^{1}/_{2}$Wx$9^{1}/_{2}$D inches.

MFJ-949E *deluxe* 300 Watt Tuner

More *hams use MFJ-949s than any other antenna tuner in the world!*

MFJ-949E **$179.95**

Handles 300 Watts. Full 1.8 to 30 MHz coverage, custom inductor switch, 1000 Volt tuning capacitors, *full size* peak/average lighted Cross-Needle SWR/Wattmeter, 8 position antenna switch, dummy load, *QRM-Free PreTune™*, scratch proof Lexan front panel. $3^{1}/_{2}$Hx$10^{5}/_{8}$Wx7D inches. **MFJ-948, $139.95.** Economy version of MFJ-949E, less dummy load, Lexan front panel.

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 **$139.95**

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 **$119.95**

MFJ-901B *smallest* Versa Tuner

MFJ's smallest (5x2x6 in.) and most affordable wide range 200 Watt PEP Versa tuner. Covers 1.8 to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-901B **$99.95**

MFJ-902 *Tiny Travel* Tuner

Tiny $4^{1}/_{2}$x$2^{1}/_{4}$x3 inches, full 150 Watts, 80-10 Meters, has tuner bypass switch, for coax/random wire.

MFJ-902 **$99.95**

MFJ-904H, $149.95. Same but adds Cross-needle SWR/Wattmeter and 4:1 balun for balanced lines. $7^{1}/_{4}$x$2^{1}/_{4}$x$2^{3}/_{4}$ inches.

MFJ-16010 *random wire* Tuner

Operate all bands anywhere with MFJ's reversible L-network. Turns random wire into powerful transmitting antenna. 1.8-30 MHz. 200 Watts PEP. Tiny 2x3x4 in.

MFJ-16010 **$69.95**

MFJ-906/903 *6 Meter* Tuners

MFJ-906 has lighted Cross-Needle SWR/Wattmeter, bypass switch. Handles 100 W FM, 200W SSB.

MFJ-906 **$99.95**

MFJ-903, $69.95, Like MFJ-906, less SWR/Wattmeter, bypass switch.

MFJ-921/924 *VHF/UHF* Tuners

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8x$2^{1}/_{2}$x3 in.

MFJ-921/924 **$89.95**

MFJ-931 *artificial* RF Ground

Eliminates RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding. Creates artificial RF ground or electrically places far away RF ground directly at rig. **MFJ-934, $209.95**, Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

MFJ-931 **$109.95**

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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**

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Every MFJ tuner is protected by MFJ's famous one year *No Matter What*™ limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

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 **$259.95**

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 **$219.95**

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 **$219.95**

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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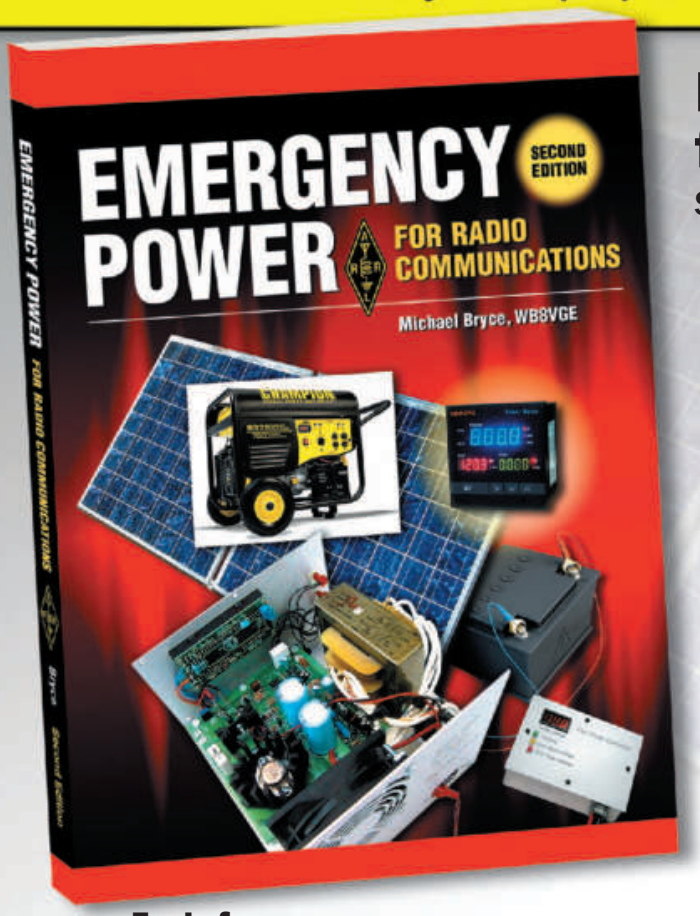
Be Prepared for the Next Blackout!

When the power goes out due to the next storm or natural disaster, will you be prepared? **ARRL can help...**



Emergency Power for Radio Communications

Second Edition

By Michael Bryce, WB8VGE

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Explore the various means of electric power generation for every application—from charging batteries, to keeping the lights on. This book covers the foundation of any communications installation—**the power source**. Find ways to stay on the air during a short-term or long-term power outage and reach beyond the commercial power grid. Identify methods for alternative power generation that will work best in your particular situation.

Contents:

- Keeping the Signals on the Air
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- Load Sizing
- Battery Systems and Storage
- Systems for Emergency Power
- Inverters
- Station Instrumentation
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Self-powered AM/FM/NOAA weather radio with built in LED flashlight, solar power and USB cell phone charger. Get one radio for your disaster supplies kit and another for your ham radio "go kit."

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Be prepared for any emergency with this powerful LED flashlight. Charge it using the built-in solar polar, hand crank, or AC/DC input. Convenient hook allows for hands-free use.

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QST 2/2012

MFJ 160-6 Meter Antenna

Self-supporting 43 foot vertical -- no guy wires required . . . 1500 Watts . . . exceptional performance . . . low-profile . . . includes base mount and legal limit balun . . . assembles in an hour . . .

MFJ-2990
$359.95

New!

Operate all bands 160 through 6 Meters at full 1500 Watt with this self-supporting, 43 feet high performance vertical! It assembles in less than an hour and its low-profile blends in with the sky and trees -- you can barely see it from across the street.

Exceptional Performance

The entire length radiates to provide exceptional low angle DX performance on 160 through 20 meters and very good performance on 17 through 6 Meters. You can shorten it by telescoping it down for more effective low angle radiation on higher bands if desired.

With an automatic antenna tuner there's no fuss -- just talk!

A wide-range automatic or manual antenna tuner *at your rig* easily matches this antenna for all bands 160-6 Meters. There's no physical tuning adjustments on the antenna -- you simply put it up!

An optimized balun design allows *direct coax feed* with negligible coax loss (typically less than 1/2 dB 60-6 Meters and less than 1 dB 160-80 M with good quality, low-loss coax).

Fully self-supporting, Extremely low wind loading, Very low visibility . . .

With just 2 square feet wind load, the fully self-supporting MFJ-2990 -- *no guy wires needed* -- has the lowest wind-loading and lowest visibility of any vertical antenna! The key is a six foot section of tapering diameter *stainless steel* whip that flexes in strong wind instead of stressing the bottom sections. Its 2-inch O.D. and .120 inch thick walled tubing bottom section makes it incredibly strong -- it'll stay up!

Weighs just 20 pounds -- you can easily put it up by yourself because its corrosion resistant *6063 aircraft aluminum* tubing and stainless steel construction make it light *and* super-strong.

Assembles in an hour

You can easily assemble it in an hour! Ground mounting lets you completely hide its antenna base in shrubbery. Includes ATB-65 high-strength antenna mount. Requires ground system -- at least one radial. More extensive ground system will give much better performance.

Great for Stealth Operation in antenna restricted areas

This very low-profile antenna is perfect for stealth operation in antenna restricted areas. Hide it behind trees, fences, buildings, bushes. Use it as a flagpole. Telescope it down during the day. Put it up at night and take it down in the morning before the neighbors even notice!

Quick and easy installation makes it great for DXpeditions, field day and other portable and temporary operations.

MFJ *Automatic* Tuners

MFJ-998
$699.95

For legal limit 1500 Watt SSB/CW amplifiers. Auto-ranging LCD and Cross-Needle SWR/Wattmeter, antenna switch, amp bypass, matches 12-1600 Ohms, 1.8-30 MHz.

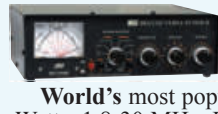
MFJ-993B
$259.95

Dual power range -- 300 Watt range matches 6-1600 Ohms. 150 Watt/6-3200 Ohms. Auto-ranging LCD and Cross-Needle SWR/Wattmeter, antenna switch, 1.8-30 MHz.

MFJ *Manual* Tuners

MFJ-989D
$389.95

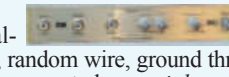
1500 Watts SSB/CW, 1.8-30 MHz. Active peak-reading Cross-Needle SWR/Wattmeter, balun, dummy load, antenna switch, aircore roller inductor.



MFJ-949E
$179.95

World's most popular tuner! 300 Watts, 1.8-30 MHz. Peak/Average Cross-Needle SWR/Wattmeter, 8 pos. antenna switch, dummy load, 1kV capacitors.

Window Feedthru



MFJ-4602
$69.95

Bring 3 coaxes, balanced line, random wire, ground thru window. Connectors mounted on *stainless steel* panel. 3/4" thick *pressure-treated* weather-proof wood.

Free MFJ Catalog

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MFJ Weather-Proof *Window Feedthrough Panels*

Weather-proof window feedthrough panels bring coax, balanced lines, HF/VHF/UHF antennas, random wire antennas, ground, rotator/antenna switch cables and DC/AC power into your hamshack without drilling through walls!

MFJ Weather-Proof *Window Feedthrough Panels* mount in your window sill. Lets you bring all your antenna connections into your hamshack *without* drilling holes through walls.

Simply place in window sill and close window. One cut customizes it for any window up to 48 inches. Use horizontally or vertically. Connectors are mounted on inside/outside stainless steel plates and attached to a 4 foot long, 3½ inch high, ¾ inch thick *pressure-treated* wood panel. Has excellent insulating properties. Weather-sealed with a heavy coat of long-lasting white outdoor enamel paint. Edges sealed by weather-stripping. Seals and insulates against all weather conditions. Includes window locking rod.

Inside/outside stainless steel plates ground all coax shields. Stainless steel ground post brings ground in.

MFJ-4603 Universal Window Feedthru Panel

MFJ-4603 **$89.95**

Four 50 Ohm *Teflon*(R) SO-239 coax connectors lets you feed HF/VHF/UHF antennas at full legal power limit.

A 50 Ohm *Teflon*(R) coax *N-connector* lets you use any antenna up to 11 GHz, including 450 MHz, UHF, satellite, moon bounce and 2.4/5.8 GHz Wi-Fi antennas.

A 75 Ohm, 1 GHz *F-connector* makes it easy to bring in television, Satellite, HD, cable TV and FM radio signals.

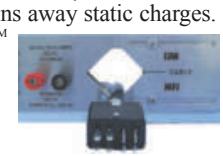
A pair of high-voltage *ceramic feedthru insulators* lets you bring in 450/300 Ohm balanced lines directly to your antenna tuner.

Has random/longwire antenna *ceramic feedthru insulator*.

***5-way** binding posts* lets you supply 50 Volts/15 Amps DC/AC power to your outside antenna tuners/relays/switches.

Stainless ground post brings in ground connection, bonds inside/outside stainless steel panels together and drains away static charges.

MFJ's exclusive *Adaptive Cable Feedthru*™ lets you bring in rotator/antenna switch cable, etc. without removing connectors (up to 1¼X1⅝ in). Adapts to virtually *any* cable size. Seals out rain, snow, adverse weather.



3 Coax, Balanced Line, Random Wire

Best Seller! 3 *Teflon*(R) coax connectors for HF/VHF/UHF antennas. Separate high voltage *ceramic* feed-thru insulators for balanced lines and longwire/random wire, Stainless steel ground post.

MFJ-4602 **$69.95**

6 Coax

6 high quality *Teflon*(R) coax connectors for HF/VHF/UHF antennas. Stainless steel ground post. Full 1500 Watt legal limit.

MFJ-4601 **$59.95**

4 Balanced Line, 2 Coax

4 pairs of high-voltage *ceramic* feed-thru insulators for balanced lines and 2 coax connectors.

New! MFJ-4600 **$79.95**

5 Cables, any-size

5 *Adaptive Cable Feedthrus*™. Pass any cable with connector: 2 cables with large connectors up to 1¼x1⅝ inches and 3 cables with UHF/N size coax connectors. Seals out weather.

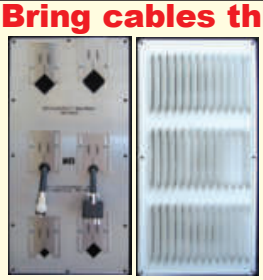
MFJ-4604 **$99.95**

All-Purpose FeedThru/CableThru™

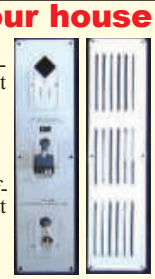
***Stacks** MFJ-4603 **and** MFJ-4604!* Gives you every possible cable connection you'll ever need through your window without drilling holes in wall -- including UHF, N and F coax connectors, balanced lines, random wire, ground, DC/AC power and cables of any size for rotators, antenna switches, etc.

MFJ-4605 **$159.95** **New!**

Bring cables thru eave of your house



MFJ-4616 shown with standard full-size vent (not included) it replaces. For *6 Cables* **$26.95**



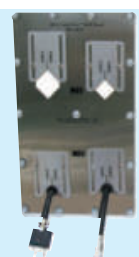
MFJ-4613 shown with standard half-size vent (not included) it replaces. For *3 Cables* **$14.95**

Replace your standard air vents on the eave/sofitt of your house with these *MFJ AdaptiveCable*™ *Air Vent Plates* and…

Bring in coax, rotator, antenna switch, power cables, etc. *with connectors* up to 1¼x1⅝ inches!

Sliding plates and rubber grommets adjust for virtually any cable size to seal out adverse weather, insects and varmints. Use existing vent hole, mounting screws and screw holes.

AdaptiveCable™ Wall Plates



MFJ-4614 *For 4 Cables* **$34.95**

Bring nearly any cable -- rotator, antenna switch, coax, DC/ AC power, etc. -- through walls *without removing connectors* (up to 1¼x1⅝ inches). Sliding plates and rubber grommets adjust hole size to weather-seal virtually any size cable.

Includes *stainless steel* plates for each side of wall, sliding plates, rubber grommets, weather stripping and screws.

MFJ-4612 *For 2 Cables* **$24.95**

MFJ-4611 *For 1 Cable* **$14.95**

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MFJ *Pocket size* Morse Code Reader™

Hold near your receiver -- it instantly displays CW in English! Automatic Speed Tracking . . . Instant Replay . . . 32 Character LCD . . . High-Performance Modem . . . Computer Interface . . . Battery Saver . . . More!

Is your CW rusty?

Relax and place this tiny pocket size MFJ Morse Code Reader near your receiver's speaker . . .

Then watch CW turn into solid text messages as they scroll across an easy-to-read LCD display.

No cables to hook-up, no computer, no interface, nothing else needed!

Use it as a backup in case you mis-copy a few characters - - it makes working high speed CW a breeze - - even if you're rusty.

Practice by copying along with the MFJ-461. It'll help you learn the code and increase your speed as you instantly see if you're right or wrong.

Eavesdrop on interesting Morse code QSOs from hams all over the world. It's a universal language that's understood the world over.

MFJ *AutoTrak*™ automatically locks on, tracks and displays CW speed up to 99 Words-Per-Minute.

Simply place your MFJ-461 close to your receiver speaker until the lock LED flashes in time with the CW. Digs out weak signals. Phase-Lock-Loop even tracks slightly drifting signals.

MFJ-461 **$89.95**

Of course, nothing can clean up and copy a sloppy fist, especially weak signals with lots of QRM/QRN.

The MFJ-461's serial port lets you display CW text full screen on a bright computer monitor -- just use your computer serial port and terminal program.

When it's too noisy for its microphone pickup, you can connect the MFJ-461 to your receiver with a cable. A battery saving feature puts the MFJ-461 to sleep during periods of inactivity. It wakes up and decodes when it hears CW.

Uses 9 Volt battery. Fits in your shirt pocket with room to spare - smaller than a pack of cigarettes. Tiny 2¼x3¼x1 inches. 5½ ounces.

Super easy-to-use! Just turn it on -- it starts copying instantly!

MFJ-26B, $9.95. Soft leather protective pouch. Clear plastic overlay for display, push button opening, strong, pocket/belt clip secures MFJ-461.

MFJ-5161, $16.95. MFJ-461 to computer serial port cable (DB-9).

MFJ-5162, $7.95. Receiver cable connects MFJ-461 to your radio's external speaker 3.5 mm jack.

MFJ-5163, $10.95. Cable lets you use external speaker when MFJ-461 is plugged into radio speaker jack. 3.5 mm.

MFJ Morse Code *Reader and Keyer* Combination

Plug MFJ's CW Reader with Keyer into your transceiver's phone jack and key jack.

Now you're ready to compete with the world's best hi-speed CW operators -- and *they won't even know you're still learning the code!* Sends and reads 5-99 WPM.

Automatic speed tracking. Large 2-line LCD shows send/receive messages. Use paddle or computer keyboard.

Easy menu operation. Front panel speed, volume controls. 4 message memories, type ahead buffer, read again buffer, adjustable weight/sidetone, speaker. RFI proof.

MFJ-464 **$199.95** *(Keyboard, paddle not included.)*

MFJ-551, $39.95. RFI suppressed keyboard, a must to avoid RFI problems.

MFJ Iambic Paddles

MFJ-564 Chrome
MFJ-564B Black
$69.95

MFJ *Deluxe Iambic Paddles*™ feature a full range of adjustments in tension and contact spacing. Self-adjusting nylon and steel needle bearings, contact points that almost never need cleaning, precision machined frame and non-skid feet on heavy chrome base. Works with all MFJ and other electronic keyers.

***Miniature* Travel Iambic Paddle**

MFJ-561, $24.95. 1¾Wx1¾D x¾H inches. *Formed* phosphorous bronze spring paddle, stainless steel base. 4 ft. cord, 3.5 mm plug.

MFJ Code Oscillator

MFJ-557 **$39.95**

MFJ-557 Deluxe Code Practice Oscillator has a Morse key and oscillator unit mounted together on a heavy steel base -- stays put on your table! Portable. 9-Volt battery or 110 VAC with MFJ-1312D, $15.95. Earphone jack, tone and volume controls, speaker. Adjustable key. Sturdy. 8½x2¼x3¾ inches.

MFJ-550, $14.95. Telegraph Key Only with adjustable contacts. Handsome black.

MFJ Deluxe CW Keyer

Deluxe MFJ Keyer has all controls on front panel for easy access -- speed, weight, tone, volume knobs, and tune, semi/auto, on/off push-buttons. You get all keyer modes, dot-dash memories, self completing dots/dashes, jam- proof spacing, sidetone, built-in speaker, type A /B keying. RF proof. Solid state keying. 7x2x6 inches.

MFJ-407D **$79.95**

MFJ-401D, $69.95. Econo Keyer II has front-panel volume/speed controls (8-50 wpm), tune switch. Internal adjust weight, tone. Solid state keying. Tiny 4x2x3½ inches.

Keyer/Paddle Combo

MFJ-422D **$189.95**

Best of all CW worlds -- a *deluxe MFJ Curtis*™ *keyer* that fits right on *Bencher paddle*! Adjustable weight and tone, front panel volume and speed controls (8-50 WPM), built-in dot-dash memories, speaker, sidetone, semi-automatic/tune or automatic modes. Use 9V battery or 110 VAC with MFJ-1312D, $15.95. 4½8x2⅝8x5¼4 in.

MFJ-422DX, $99.95.

MFJ *Curtis*™ Keyer only, fits on your Bencher paddle or MFJ-564 (chrome) or MFJ-564B (black) paddles above.

MFJ*Pocket* Morse Tutor

Learn Morse code anywhere with this tiny *MFJ Pocket-sized Morse Code Tutor*™! Practice copying letters, numbers, prosigns, punctuations or any combination or words or QSOs. Follows ARRL/VEC format. Start at zero code speed and end up as a high speed *CW Pro!* LCD, built-in speaker.

MFJ-418 **$89.95**

MFJ *ClearTone*™ Speaker

MFJ-281, $12.95. Makes copying easier, enhances speech, improves intelligibility, reduces noise, static, hum. 3" speaker, 8 Watts, 8 Ohms.

MFJ 24/12 Hour Station Clock

MFJ-108B, $21.95. Dual 24/12 hour clock. Read UTC *and* local time *at-a-glance*. High-contrast 5/8" LCD, brushed aluminum frame. Batteries included. 4½Wx1Dx2H in.

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MFJ . . . the world leader in ham radio accessories!

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

Mighty Lite™

MFJ-4125

Ham Radio's smallest and lightest 22 Amp continuous power supply is also its best selling!

$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

Mighty Lite™

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

MightyLite™

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

No RF Hash!

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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New Item!
PWRblok4
4-Way Powerpole Splitter

Andy-Crimp *Pro*™

No other tool does all of this:

15-30-45-50-75 Amp Powerpoles
And **Molex-type Connectors**
And **Insulated Terminals**
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B-5018-G	--	2	15	25	40	50	70	100	130	160
Watts In	.25	.5	3	5	8	10	15	25	35	50

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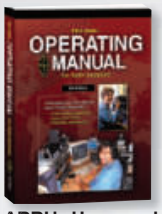

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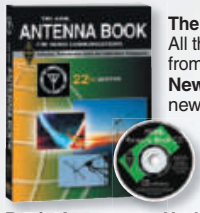

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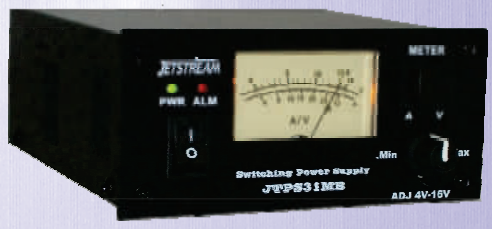

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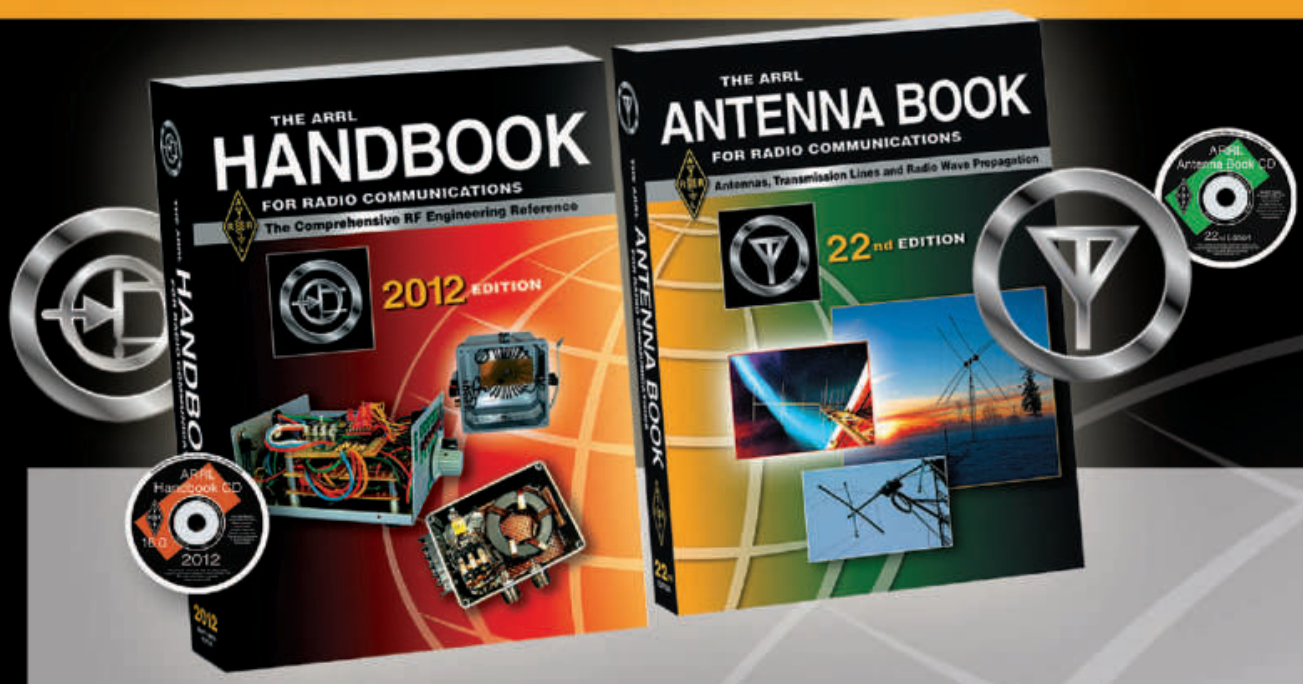

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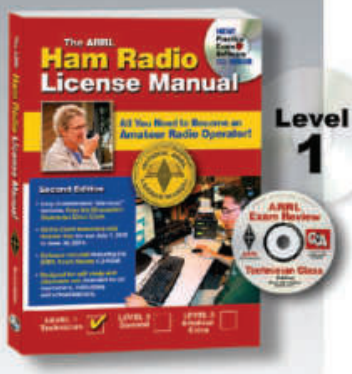

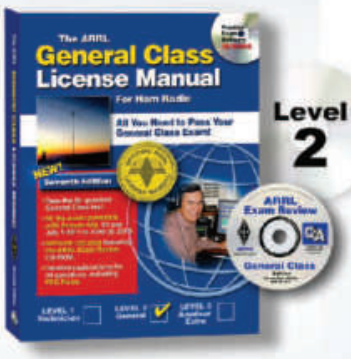

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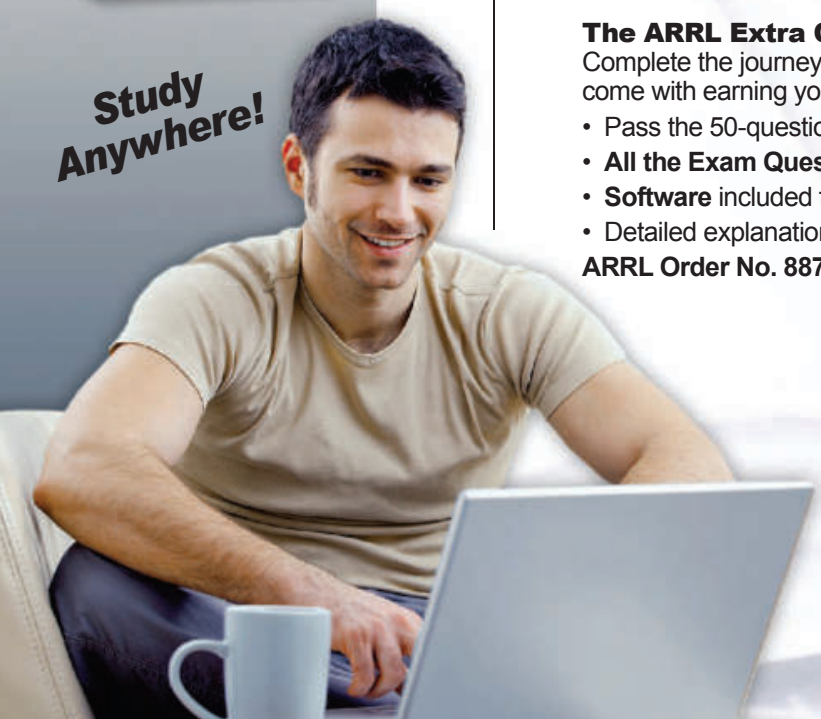

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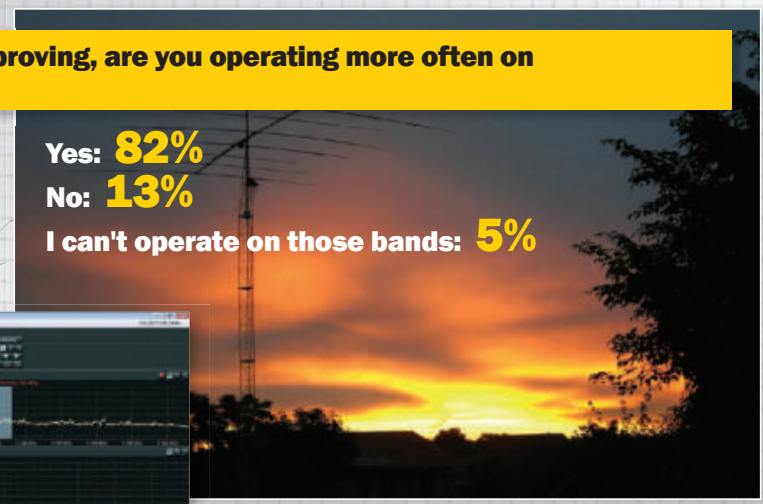

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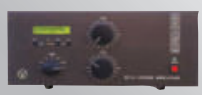

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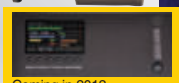

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