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July 2013 WWW.ARRL.ORG

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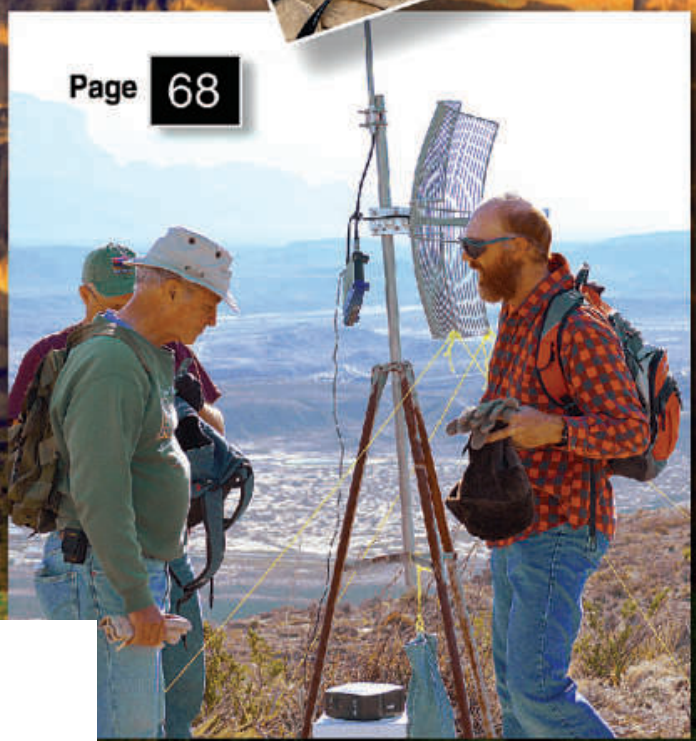
QST reviews:

Inside:



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Official Journal of ARRL The national association for AMATEUR RADIO

Reliable and Exciting, Superior Transceiver - the Real Deal
Indisputably, Best in Class Performance and Supreme Operability

HF/50 MHz 100 W Transceiver

FT DX 1200

This medium-price HF Transceiver Excels on all fronts. The High Frequency Design Technology it has inherited, ensures "Best-in Class Performance". The Outstanding Operability is Perfect for the DX Scene.

- Superior triple conversion receiver, and optimum gain distribution at each IF stage will eliminate out of band unwanted signals.
- The 1st IF frequency is set at 40 MHz and is protected by selectable 3 kHz, 6 kHz and 15 kHz roofing filters, which effectively attenuate interfering signals.
- Similar to the high end series Yaesu transceivers, it uses the 32-bit high speed floating point DSP, TMS320C6727B by Texas Instruments, for its IF DSP. The acclaimed superior Yaesu DSP algorithm is highly effective in weak signal processing and enhancement.
- The Full Color, 4.3 inch TFT display on the left side of the front panel, has a wide viewing angle and provides excellent visibility. It beautifully displays the various functions unique to this high class HF transceiver.
- An optional built-in FFT-1 supports advanced functionality, including the AF-FFT Scope, RTTY/PSK31 Encode/Decode, CW Decode and CW Auto Zero-in.

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Cypress, CA 90630 (714) 827-7600

The radio... YAESU

HF/50 MHz 100 W Transceiver

FT DX 3000

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

The amazing Crystal Roofing Filter performance

The Down conversion 9 MHz 1st IF frequency receiver construction, can realize narrow 300 Hz (optional), 600 Hz and 3 kHz bandwidth roofing filters.

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

The high dynamic range IP3 performance that was realized and proven in the FTDX5000.

IF DSP provides effective and optimized QRM rejection

Independent Frequency display

The newly developed LCD has a wider viewing angle and higher contrast.

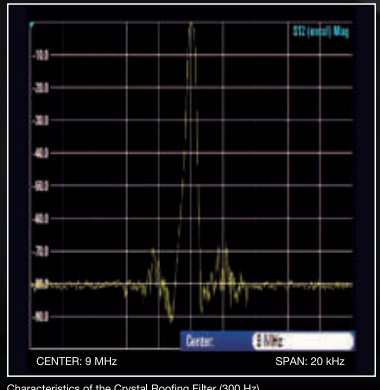
4.3-inch Large and wide color LCD display with high resolution

High Speed Spectrum Scope built-in

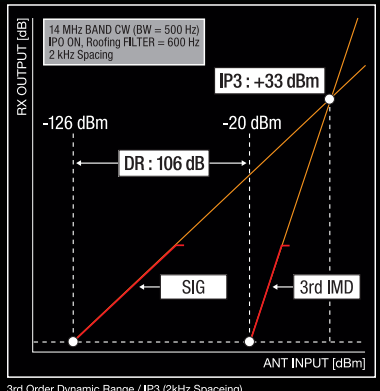
AF SCOPE display and RTTY/PSK encoder/decoder

Other features

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



Characteristics of the Crystal Roofing Filter (300 Hz)



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

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Cushcraft

R9

80-6 Meters!

No Radials!

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

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

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

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

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

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

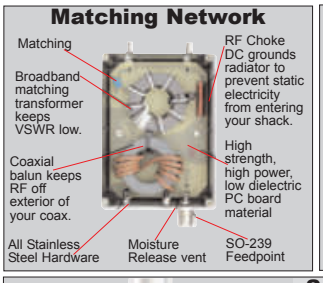
Rugged Construction: Thick fiberglass insulators, all-stainless steel hardware and 6063 aircraft-aluminum tubing is double or triple walled at key stress points to handle anything Mother Nature can dish out.

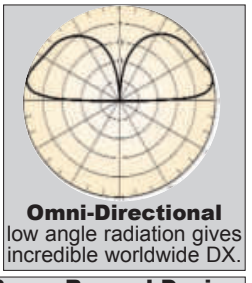
31.5 feet tall, 25 lbs. Mounting mast 1.25 to 2 inches. Wind surface area is 4 square feet.

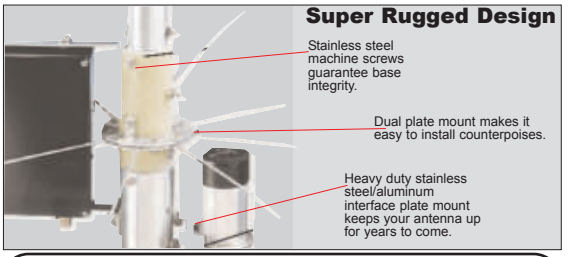
R8, $539.95. Like R9 antenna but less 75/80 Meters.

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

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







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Prices/specifications subject to change without notice/obligation.

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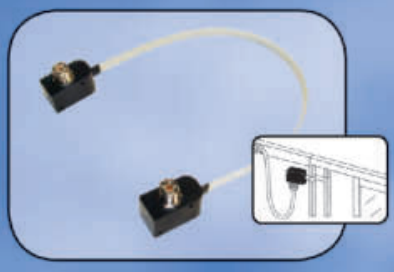
Life is a JOURNEY. Enjoy the ride!



NEW! COMET CTC-50M
Window Gap Adapter!

Max Power: HF 100W PEP
VHF: 60W FM
UHF: 40W FM
900MHz - 1.3GHz: 10W
VSWR: <500MHz 1.3:1
>500MHz 1.5:1
Impedance: 50Ohm
Length: 15.75"
Conn: 24k Gold Plated SO-239s

MALDOL HVU-8
Ultra-Compact 8 Band Antenna!

Unique ground radial system rotates 180 degrees around the base if building side mounting is required.

Max Power: HF 200W SSB/100W FM
6M - 70cm: 150W FM
TX: 80/40/20/15/10/6/2M/70cm
Impedance: 50 Ohm
Length: 8'6" approx
Weight: 5lbs 7oz
Conn: SO-239
Max Wind Speed: 92MPH

Each band tunes independently.
Approx 2:1 band-width:
80M 22kHz
40M 52kHz
20M 52kHz
15M 134kHz
10M 260kHz

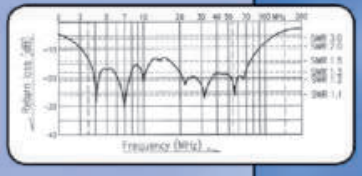
COMET CHA-250B
Broadband HF Vertical!

3.5 - 57MHz with SWR of 1.6:1 or less!

- *NO ANTENNA TUNER NEEDED*
- *NO RADIALS*
- *NO TRAPS*
- *NO COILS*

If you suffer in an antenna restricted area, must manage with space restrictions or you simply want to operate incognito you will be forced to make significant antenna compromises. The CHA-250B makes the most of the situation, making operating HF easy!!

Max Power: 250W SSB/125W FM
TX: 3.5– 57MHz
RX: 2.0– 90MHz
Impedance: 50Ohm
Length: 23'5"
Weight: 7lbs 1 oz
Conn: SO-239
Max Wind Speed: 67MPH



NEW! COMET H-422
40/20/15/10M compact, broadband, rotatable dipole!

Assemble in either a "V or horizontal ("H") configuration.
CBL-2500 2.5kW balun and heavy duty hardware included.

Max Power: 1000W SSB / 500W FM
SWR: Less than 1.5:1 at center frequency
Rotation Radius: "V" 12' 6" "H" 17' 5"
Length: "V" 24' 5" "H" 33' 10"
Weight: 11 lbs 14 ozs
Wind load: 3.01 sq feet
Max Wind Speed: 67 MPH

COMET and Maldol

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

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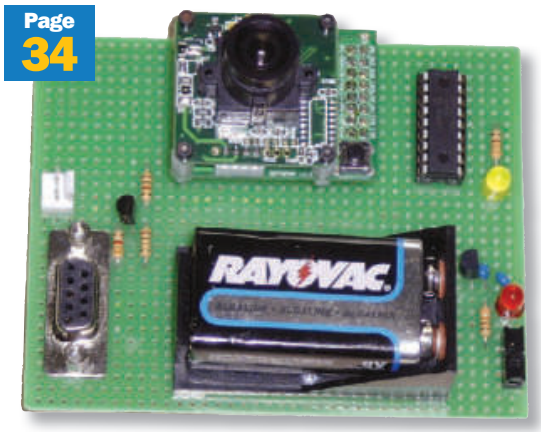
Our Cover
Communications at the Big Bend 50 Ultra Marathon in Texas got an audio-visual enhancement this year — a "finish line cam." The live video feed of runners crossing the finish line was made possible by a high-speed multimedia mesh (HSMM-MESH) network broadcasting a feed from an Internet protocol video camera. Because some of the channels that were used overlapped the ham bands, Amateur Radio antennas were implemented to increase the range of the HSMM-MESH nodes. [Photos courtesy of Lynn Jelinski, AG4IU and Paul Kinney, KD5VRU]

Radiosport



Columns

Departments

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12.5 kHz Digital C4FM

144/430 MHz DUAL BAND DIGITAL TRANSCEIVER

FT1DR

Exciting new amateur digital transceiver

4 Communication Modes

The FT1DR operates in three digital modes and an analog mode. Enjoy communication in the mode that suits each purpose.

1. V/D Mode (Simultaneous Voice/Data Communication Mode)

Half of the bandwidth is used for voice signal with error correction. The very effective error correction code provides benefits such as minimal interruption of communication.

2. Voice FR Mode (Voice Full Rate Mode)

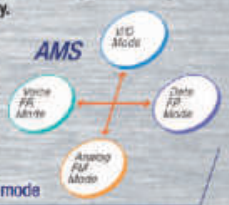
This mode uses the entire 12.5 kHz bandwidth to transmit digital voice data. The larger voice data size allows voice communication with high sound quality.

3. Data FR Mode (High-speed Data Communication Mode)

A high-speed data communication mode that uses the entire 12.5 kHz bandwidth for data communication. The FT1DR automatically switches to this mode when sending and receiving images, allowing a large amount of data to be transmitted quickly.

4. Analog FM Mode

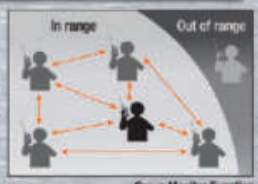
Analog FM is effective for communication with a weak signal that causes voices to break up in the digital modes. The analog mode allows communication even at distances where noise and weak signals make communication almost impossible.



■ **AMS** (Automatic Mode Select)
The function detects the receive signal mode

Digital Group Monitor (GM) Function

Automatically checks whether members registered in a group are within communication range. Displays information such as distance and direction for each call sign on the screen.



Group Monitor Function

Snapshot Function

When using the handy speaker microphone camera (optional MH-85A11U), press the shutter button to capture a snapshot, then press the image transmit button to easily transmit the image data.

MH-85A11U (Optional)

Smart Navigation Function

■ A real-time navigation function that records the location and direction of Group Monitor (GM) stations.

■ Backtrack Function to Return to Departure Point

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Reliable FM 5W Single Band Handheld Transceiver

FT-252

VHF FM TRANSCEIVER

FT-257

UHF FM TRANSCEIVER

Compact and High Performance

FT-252

2 m Single BAND

NEW!

FT-257

70 cm Single BAND

- New Ergonomic design and Large Backlit LCD Display for better operation
- 5 Watts of Stable RF Power
- 800 mW of Loud Audio for noisy field operations
- ATS (Automatic Transponder System) "beeps" when moving out of communication range
- 200 Memory Channels for Serious users
- Water Protection - IPX5 Rating

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HF/VHF/UHF Portable Operation Powerful Transceiver

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- Wide Frequency Coverage
- 20-Watt Portable Operation Using Internal Batteries
- 100 Watts When Using an External 13.8-Volt DC Power Source

FT-817ND

The Ultimate Backpack, Multi-Mode Portable Transceiver

- Self-Contained
- Battery-Powered
- Covering the HF, VHF, and UHF Bands
- Provides up to Five Watts of Power Output
- SSB, CW, AM, FM, Packet, or SSB-based Digital Modes like PSK31

FT-857D

The World's Smallest HF/VHF/UHF Mobile Transceiver

- Ultra-Compact Package
- Ideal for Mobile or External Battery Portable Work
- Wide Frequency Coverage
- Optional Remote-Head
- High-Performance Mobile Operation

FT-450D

HF/50 MHz 100 W Easy to Operate All Mode Transceiver

- Illuminated Key Buttons
- 300Hz / 500Hz / 2.4 kHz CW IF Filter
- Foot Stand
- Classically Designed Main Dial and Knobs
- Dynamic Microphone MH-31 A8J Included

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It Seems to Us

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

CubeSats

"In April I attended a three-day CubeSat Developers' Workshop at California Polytechnic State University (Cal Poly) in San Luis Obispo to learn more about the burgeoning world of tiny satellites. They offer great promise — and some operational and regulatory challenges."

Radio amateurs have been building satellites and getting them launched for more than 50 years. For a time the trend was toward increasingly large and sophisticated packages to provide predictable long-distance communications between modest amateur stations on Earth. A couple of failures, along with shrinking opportunities for launches at prices amateurs could afford, caused such dreams to be put on hold even as rides into orbit for less ambitious satellites, including many built as university projects, continued to be found.

In the late 1990s two West Coast educators, Dr Jordi Puig-Suari of Cal Poly and Dr Bob Twiggs, then of Stanford University and now at Morehead State University in Kentucky, developed a specification for what are known as *CubeSats*. The basic building block is a cube 10 centimeters on a side although a single satellite may be made up of two or three strung together. CubeSats can be commercial, academic or amateur — sometimes in combination. As we shall see, the purpose of the satellite has important implications for licensing.

A single launch vehicle can carry multiple CubeSats along with other payloads. They also can be launched from the International Space Station (ISS). To avoid potential collisions with the ISS, CubeSats typically are placed in a lower orbit and deorbit relatively quickly, burning up on reentry into the atmosphere. While not all tiny satellites are CubeSats, the CubeSat specification has become a popular standard. A mini-industry serving CubeSat developers has sprung up, offering modules and kits so developers don't have to reinvent the wheel for system elements that are common to all satellites; instead they can concentrate on the unique aspects of their projects.

It is always refreshing to be surrounded by bright young people with a passion for science and technology. This was certainly true at Cal Poly, which has an active Amateur Radio club and a well-equipped club station, W6BHZ. This year's Cubesat Developers' Workshop was the 10th annual event and drew about 180 participants from all over the country and a few from abroad, including many students and licensed amateurs. There were more than 50 presentations, many of them by students, on subjects ranging from mission risk analysis to vibration testing to communications. The last, of course, is what brought me to San Luis Obispo.

While some CubeSats are designed in whole or in part to be communications satellites, connecting Earth stations with one another, others are collecting data and images for a wide range of research purposes. For these projects the radio links to and from the satellite are simply means to an end: commanding the satellites and downloading the data that has been collected.

Not all use CubeSats use the amateur-satellite bands — the ones with commercial and governmental objectives generally can access other spectrum — but it has been common practice for educational CubeSats to be commanded by control operators with amateur licenses and to be licensed as amateur satellites. Amateur-satellite spectrum that is available and suitable for use by tiny satellites in low Earth orbit operating in conjunction with simple ground stations is very limited: about 200 kHz just below 146 MHz, and 435-438 MHz. To minimize interference, frequency coordination for amateur satellites is performed by a Satellite Adviser appointed by the International Amateur Radio Union (IARU) Administrative Council. This volunteer position has been held for many years by Hans van de Groenendaal, ZS6AKV. Hans is assisted by an Advisory Panel of satellite experts from several countries.

Coordination was easy as long as such satellites were few in number. Lately, however, the popularity of CubeSats coupled with a dramatic increase in launch availability has caused the numbers to skyrocket. At the workshop it was reported that there are 22 CubeSats manifested for NASA's Educational Launch of NanoSatellite (ELaNa) program this year, with another 16 or so slated for next year and about three dozen more waitlisted. And that's just one NASA program; a European project envisions the deployment of 50 CubeSats in a single launch in 2015!

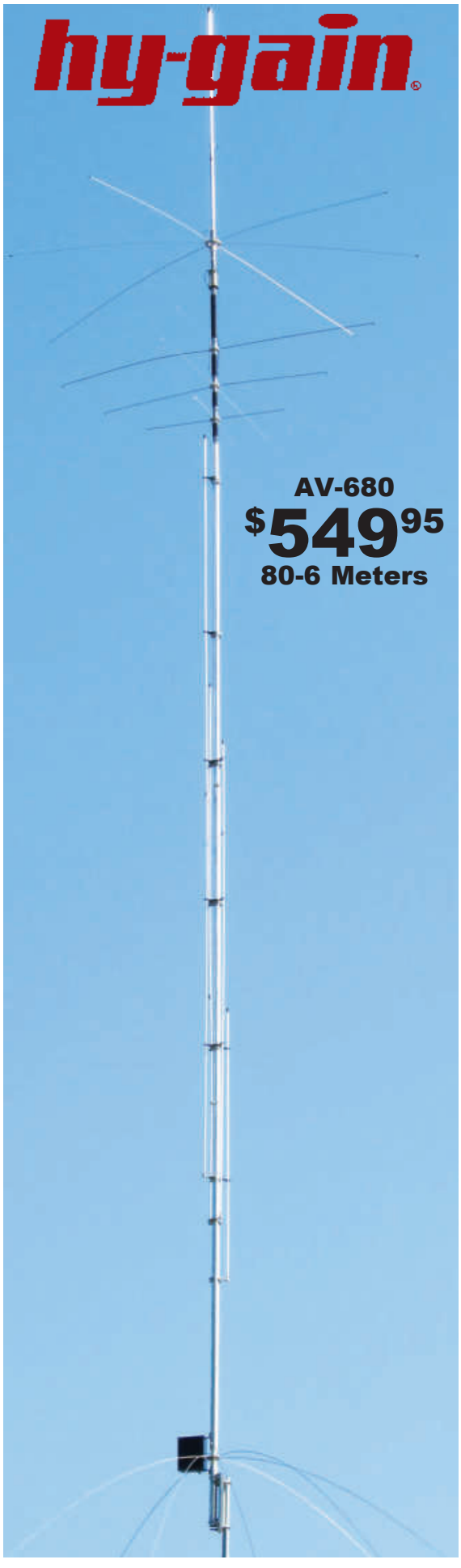
This level of activity has attracted the attention of telecommunications regulators. The FCC has begun taking a closer look at applications for amateur satellite licenses and is concluding in many cases — in spite of the recognition in the Part 97 rules of Amateur Radio's educational role — that the "no pecuniary interest" standard that applies to amateur operation requires experimental licenses instead. At the 2012 World Radiocommunication Conference (WRC-12) a number of European administrations pressed for frequency allocations for nanosats and picosats (satellites with a mass of less than 10 kg) to be placed on the agenda for the next WRC, but they had to settle for a resolution calling for the results of studies of the regulatory aspects for such satellites to be reported to WRC-15. These studies are now underway in Working Party 7B of the International Telecommunication Union's Radiocommunication Sector. Consideration of relaxed regulatory procedures for nanosats and picosats is on the preliminary agenda for WRC-18.

How a satellite is to be licensed is the prerogative of the regulatory administration, but the licensing of experimental satellites in the amateur-satellite bands raises an issue for IARU frequency coordination (as well as ITU issues, but that's another story). Non-amateur operation in the amateur bands should not be encouraged; on the other hand, refusing to coordinate would have significant negative consequences. For now the IARU has agreed to continue coordination while other spectrum for non-amateur satellites is being identified.

CubeSats provide a glimpse into the world of Amateur Radio for students, many of whom become licensed. They deserve a warm welcome to our ranks and support as they work to fulfill their dreams of a successful space mission.

David Sumner, K1ZZ

hy-gain®



AV-680

80-6 Meters

Hy-Gain's new AV-680 adds 75/80 Meters with no radials!

Includes 40, 30, 20, 17, 15, 12, 10 and 6 Meters operation with low 17 degree radiation angle and omni-directional world-wide coverage. No ground or radials needed. Handles full 1500 Watts key down continuous for two minutes.

Highly Efficient

The AV-680 uses quarter wave stubs on 6, 10, 12 and 17 meters and very efficient end loading coil and capacity hats on 15, 20, 30, 40 and 80 Meters -- no traps. End loading allows efficient operation with a low-profile. Resonators are placed in parallel not in series.

Each band individually tunable

Extra wide low VSWR bandwidth. End fed with broadband matching unit. Single coax cable feed. Automatic bandswitching.

Sleek and low-profile

Low 2.9 sq. ft. wind surface area. Small footprint for mounting easily on decks, roofs and patios. 26 feet, 18.5 lbs.

Built-to-last

High wind survival of 65 mph. Broadband matching unit made from all *Teflon*® insulated wire. Aircraft quality aluminum tubing, stainless steel hardware.

Hy-Gain verticals are the best built, best performing and best priced multiband verticals available today.

hy-gain® warranty

Two year limited warranty. All replacement parts in stock.

ATB-75, $79.95. Tilt base for Hygain AV-680/AV-640 and AV-620 verticals.

AGK-8, $56.95. Guy Kit, three point non-conductive guy system for Hygain AV-680/AV-640 and AV-620 verticals.

AV-640, $449.95. 8 bands: 40, 30, 20, 17, 15, 12, 10, 6 Meters. 25.5 ft., 17.5 lbs.

AV-620, $349.95. 6 bands: 20, 17, 15, 12, 10, 6 Meters. 22.5 ft., 10.5 lbs.

Inside of Matching Unit

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10M/6M/2M/440MHz FM Quad Band

FT-8800R
2M/440MHz Dual Band, Dual RX, 50/35 watts

FT-7900R
2M/440MHz 50/45 watts

FT-2900R
2M 75W FM Mobile
Large Display – Heavy Duty

FT-1900R
2M 55W FM Mobile
200 Memory Channels

— Wouxun and Anytone Mobiles —

Anytone AT-5888UV
VHF/UHF 50/40 watts, Detachable Front Panel, True Dual Receive, 758 Memory Channels, Software Programmable, Selectable 35/10/5 watts, 2013 narrowband compliant, FCC Certified

Latest Version

Wouxun KG-UV920P-A
VHF/UHF Dual Display, 50/40 watts, 4 power settings, Detachable Front Panel, 999 Memory Channels, Software Programmable, Dual Receive, 2013 narrowband compliant, FCC certified

Latest Version

KENWOOD

Coupons Expire 6/30/2013

TM-D710A
2M/440MHz FM Mobile
50 watts - APRS ready

TM-V71A
2M/440MHz FM Mobile
50 watts - Dual Display

TM-281A
2M, FM Mobile Transceiver, 200 memory channels

ICOM

Rebates Expire 6/30/2013

IC-2820H
2M/440 50W
(DSTAR option IC-UT123)

ID-880H
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50 watts - 3 power settings
Digital & Analog
1052 Memory Channels
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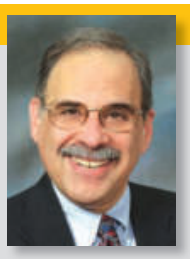

Harold Kramer, WJ1B – hkramer@arrl.org, ARRL Chief Operating Officer/*QST* Publisher

A Witness to Tragedy in Boston

At 2:50 PM I heard it and felt it. It was a loud *thud* like a cannon shot. Did someone fire a celebratory cannon or light a firecracker? Everyone in the medical tent looked at each other. No one spoke, but their expressions said it all: *What was that?*

My volunteer Amateur Radio assignment at the 2013 Boston Marathon was to shadow Chris Troyanos, Medical Director of the Boston Athletic Association. Our team was composed of Ralph Swick, KD1SM, and Jeremy Giguere, AB1SD. Ralph was the team leader and he communicated with the medical groups. I was liaison to the Course Network Control and Jeremy was liaison to the Massachusetts State Emergency Operations Center. We were all working with Chris in Medical Tent A next to the finish line.

For several seconds the tent remained deathly silent. Smoke drifted into the entrance and I smelled what I thought might be gunpowder. Then, maybe 10 seconds later, there was another *thud* and the tent shook.

The medical personnel and first responders bolted from the tent with Chris right behind them. Ralph and Jeremy tried to follow Chris into the crowd, but they lost him almost instantly. Within minutes they lost track of each other as well.

I tried calling Net Control on 2 meters, but the frequency was busy with other signals. "WJ1B to Net Control" produced no answer.

I left the tent and walked into a smoky chaos of shouts, screams and the sight of people on the ground. Although I could hear Net Control on 2 meters, my calls still went unanswered. I tried to raise Ralph on the 70 centimeter intercom channel. I heard him, but he could not hear me very well. At least he was still on the air.

I went back into the tent as the injured began streaming in. People were bleeding and a doctor, pushing an injured woman in a wheelchair, was yelling that the patient had shrapnel in her stomach. I felt helpless and I heard someone say, "All non-medical staff please leave the tent!"

I followed the staff out the back to where the ambulances were parked. They were loading people onto stretchers as quickly as possible. When one ambulance left, another took its place. Sirens were blaring. The police, security officials, EMTs, Boston EMS, doctors and nurses were suddenly everywhere. No one was panicked; they were just trying to understand what was going on.

I heard the 2 meter Net Control asking all hams at the finish line to proceed to the bus control area. I tried calling my wife on my cell phone, but I could not connect, so I sent her a text message: **I'M OK**. I sent the same message to my daughters. I tried calling ARRL Headquarters, but I still could not get a voice connection; only text messages could get through. ARRL Marketing Manager Bob Inderbitzen, NQ1R, sent me a text at 3:28 PM: **CHECKING IN TO SEE IF YOU ARE OK**. Assuming that short messages would stand the best chance of making it out of the area, I simply typed: **I'M OK**.

At the bus dispatch trailers, the guys inside were monitoring half a dozen frequencies. The dispatcher was trying to figure out where the buses with injured runners were located and where they should go. Confusion reigned since many roads were blocked. I offered to contact Net Control to determine the answer.

This time I called on the 2 meter Course Tactical frequency and was pleased to hear, "WJ1B, this is Net Control."

I relayed the question. A minute later I received instructions for the buses to go directly to the Boston College law campus in Newton. The bus dispatcher acknowledged the message and asked me what frequency I had used. I told him it was 146.67 MHz and he switched one of the mobile transceivers in the trailer to that frequency and communicated directly with Net Control from then on.

We were ordered to evacuate the area completely, so I needed to get back to my car. I began walking toward the parking garage and as I was passing the Fairmont Copley Plaza Hotel, there was another explosion. It was further away and I heard it, but I did not feel it or see any smoke. All around me people started yelling "Hit the deck!" and "What's going on? What's happening?" I later learned that this was an intentional detonation of what police suspected to be a third explosive device.

The walk back to the parking garage was difficult because barricades had been erected and emergency personnel were blocking pedestrian access. Fortunately, law enforcement officers allowed me to pass when they saw my ID tags, yellow jacket and radio.

The entire city seemed in disarray. The Massachusetts Bay Transportation Authority trains were shut down. People were milling around the streets trying to figure out how to get home. Runners still in their running gear were looking for their families. Families were looking for runners. Because I had a radio, people kept asking me for directions, or how to locate a loved one. I felt useless since I was not able to help many of them.

While I was walking back to the garage, my cell phone rang. A voice call was coming through! It was the Boston Marathon Amateur Radio Net Control station. The caller asked where I was and if I was okay. I said that I was fine, told them that I was on Clarendon Street and I asked how the other hams were doing. He said that all were accounted for so far and that there were no known injuries. He added that I was officially "cleared" and released from my duties. Soon afterward, I finally reached my car and headed home.

I was proud to be an Amateur Radio operator that day. All of the volunteers did an incredible job under terrible circumstances. For an overall view of Amateur Radio's role in the marathon, see the article in this issue by the Boston Marathon Amateur Radio Communications Team. Also be sure to read Rick Palm's, K1CE, "Public Service" column.

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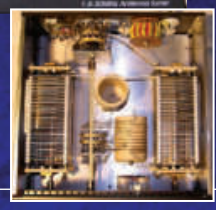

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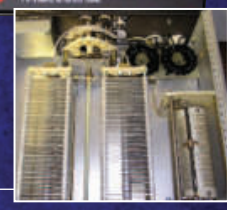

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Steve Ford, WB8IMY, upfront@arrl.org

SNØHQ in the IARU HF World Championship

Henryk Kotowski, SMØJHF, **sm0jhf@gmail.com**

Here is a call sign that will be hard to miss on the bands this month: SNØHQ. The call belongs to the headquarters of the Polish national Amateur Radio organization **Polski Zwiazek Krotkofalowcow**. In the IARU HF World Championship contest, however, SNØHQ is not a single station. It is a network of stations all using the same call sign at the same time!

The first multi-location effort of the organization in the IARU HF Championship took place in the year 2000. The concept was the brainchild of Tomek Niewodniczanski, SP6T (then SP6AYP) and Jurek Smoczyk, SP3GEM.

Before the turn of the century it was unthinkable to even ask for permission to do such a thing. Every Polish Amateur Radio license was issued to only one strictly defined station location. (Licenses for mobile and portable operating had only been granted a few years earlier.) However, Tomek was an employee of the licensing authority and he made a persuasive pitch to those responsible for regulating Amateur Radio. With the scheme approved and the red tape removed, it has been repeated successfully each year since.

Initially only a few Big Gun stations were part of the SNØHQ gang — those who had the best antenna farms, or at least a couple of exceptional antennas. Eventually the group grew bigger, attracting hams with modest stations as well.

The number of participants in the SNØHQ project fluctuates from year to year, occasionally peaking at more than 100 individuals. The number of locations and stations in the network varies from 10 to 20. Some of the Big Gun stations handle two bands, usually one low and one high. The Big Guns usually gather more experienced teams, but they are always on the lookout for new talent.

The backbone of the scheme consists of 12 stations on the air for 24 hours. Additionally, a few stations are standing by in case of a thunderstorm, power failure or other calamity.

Backup stations are also on alert for changes in propagation. Propagation variations are noticeable even in a country the size of Poland — particularly on 28 and 21 MHz. All backup stations monitor designated bands and, if necessary, can get on the air in a matter of seconds. Today all participants are interconnected via the Internet and all use the same logging software.

The development of Amateur Radio in Eastern Europe before the fall of the Iron Curtain was based around radio clubs. Clubs often had superior antennas, surplus gear and the blessing of government support. Today, however, there are very few active clubs in Poland. Thankfully, the SNØHQ network has stepped in to help fill the void. Be sure to listen for them in the 2013 Championship on July 13-14!

All photos by the author.

This SNØHQ team in eastern Poland is headed by Wes Kosinski, SP4Z.

The contest is still 24 hours away, but Jurek Smoczyk, SP3GEM, is making sure his station is ready.

Wes Kosinski, SP4Z (standing), watches Lukasz Komsta, SP8QED, as he monitors 20 meters. In the background, Wojtek Zaluska, SP5MXZ, works stations on 15 meters.

The station of Tomek Niewodniczanski, SP6T, in southwest Poland. As the contest begins, Marek Niedzielski, SP7DQR (standing) and Tomek monitor reports from all stations in the SNØHQ network.

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Letters from Our Members

Processing DSP

Today, with digital signal processing (DSP), some hams create Amateur Radio software in much the same way others create electronic circuits. Many of the construction articles in *QST* describe the operation of the project's circuit (i.e., this transistor does this, that relay does that) so that readers can adapt the circuit for their own purposes. While there have been numerous articles in *QST* on DSP topics, I've never seen one that gives a similar treatment to the various processing steps taken in the software. Even though I develop database software and know how to program, I don't have a clue how to write DSP code — but I'd sure like to learn.

Mark Erbaugh, N8ME
ARRL Life Member
London, Ohio

Controlling the Remote

Remote stations — such as the ones mentioned by *QST* Editor Steve Ford, WB8IMY ["Short Takes: RemoteHamRadio Station Network," May 2013, page 59] — focus on the leadership that Amateur Radio brings to the table. Software such as RemoteHams, EchoLink and IRLP helps the user operate stations that normally would go untouched. For example, using RemoteHams, Mark Stringer, WAØVQL — a missionary in Colombia — is able to check into the Christian Amateur Radio Fellowship on 80 meters via a remote in the US. Using another remote network, the Courage HandiHam group is able to support Amateur Radio operation for its members. I was even able to use a remote in Norway to talk to a station in Hungary, and was able to experience what 40 meters sounds like "over there." As hams age, remote bases may be even more popular among those in nursing homes, as well as those governed by restricted covenants.

Lloyd Colston, KC5FM
Altus, Oklahoma

Editor's Note: Anyone operating a remote station needs to remember that the licensing rules and frequency allocations in place are those of the country in which the transmitter is physically located. This necessitates having a valid license or reciprocal operating permission for the country in question.

Net Skip

In the April 19 edition of "The K7RA Solar Update" (**www.arrl.org/news/the-k7ra-solar-update-266**), there was a comment about 80 meter nets conflicting with one-way-skip. I know the problem of skip interference to nets has been in existence since I started listening in the late 1950s, but now we have computers, propagation programs and global mapping programs to solve the problem. If Hiram Percy Maxim, W1AW (SK), could coordinate stations all over the country during the late spark era, we should be able to do it now.

Perhaps it is time to coordinate the continental nets and use frequency diversity, rather than summer hours and winter hours. I am not sure about the Northeast with their small states, but there are a maximum of 48 continental state nets that could easily fit into the 75 meter band by keeping track of the times and locations — and still leave room for DX and ragchews. People may be slightly unhappy if their net frequency moves, but if they can be assured that another net won't come skipping in on them, they just might accept the change.

Pat Hamel, W5THT
Long Beach, Mississippi

Taking Account

I was dismayed after I read the letter by Vince Cammarata, NT4I ["Correspondence: Quality Beats Out Quantity," May 2013, page 24]. Vince could not be more wrong in his assumptions. The problems that face Amateur Radio today have nothing to do with the "simplification" of earning a ham license — they have everything to do with the *zero accountability* that we have come to accept in this world. I recently observed some hams in California and Nevada trying to blast a net off of "their frequency" with mega doses of power. One ham even announced that he would get them with 2500 W! When I challenged this behavior, I received a terse e-mail from a longtime ham, telling me that Part 97 never mentions that QSOs should move for nets. Without accountability, people think they have the right to do anything they please.

The influx of amateur operators that ARRL News Editor S. Khrystyne Keane, K1SFA, wrote about is indeed a good thing ["Happenings: 2012 Marks All-Time High for Amateur Radio Licenses," Mar 2013, pages 79-81], but we also need accountability. None of us are perfect, but when we all studied for our Amateur Radio licenses, we committed to a course of higher standards. Let each of us be accountable for our actions as befits the license that we hold.

Dan Wright, KC7ICN
Morton, Washington

Tracking Changes

I have been a ham for almost 20 years, but in the last few years, I became discouraged with the Amateur Radio community in my area due to constant bickering over the repeaters, other hams arguing at club meetings and the lack of team spirit. About a year ago, I bought a new handheld transceiver, tuned into the local FM repeaters and found a whole new group of people, once again sparking my interest in ham radio. I also joined the ARRL and started reading *QST*, but after reading the magazine for a few months, I'm a bit disappointed; it's now more than half-full of nothing but ads and articles about HF — you almost need an engineering degree to understand them! It would be nice to read more articles about the happenings in the world of VHF and UHF. I'd like to read articles on how to build antennas, or about people going to other countries and talking on bands *other* than HF. Maybe even articles on VHF and SSB and Amateur Radio satellites or articles that explain electronics in simple detail, so as to help those of us who are interested in upgrading our licenses.

Josh Ainsworth, N4TKR
Phoenix City, Alabama

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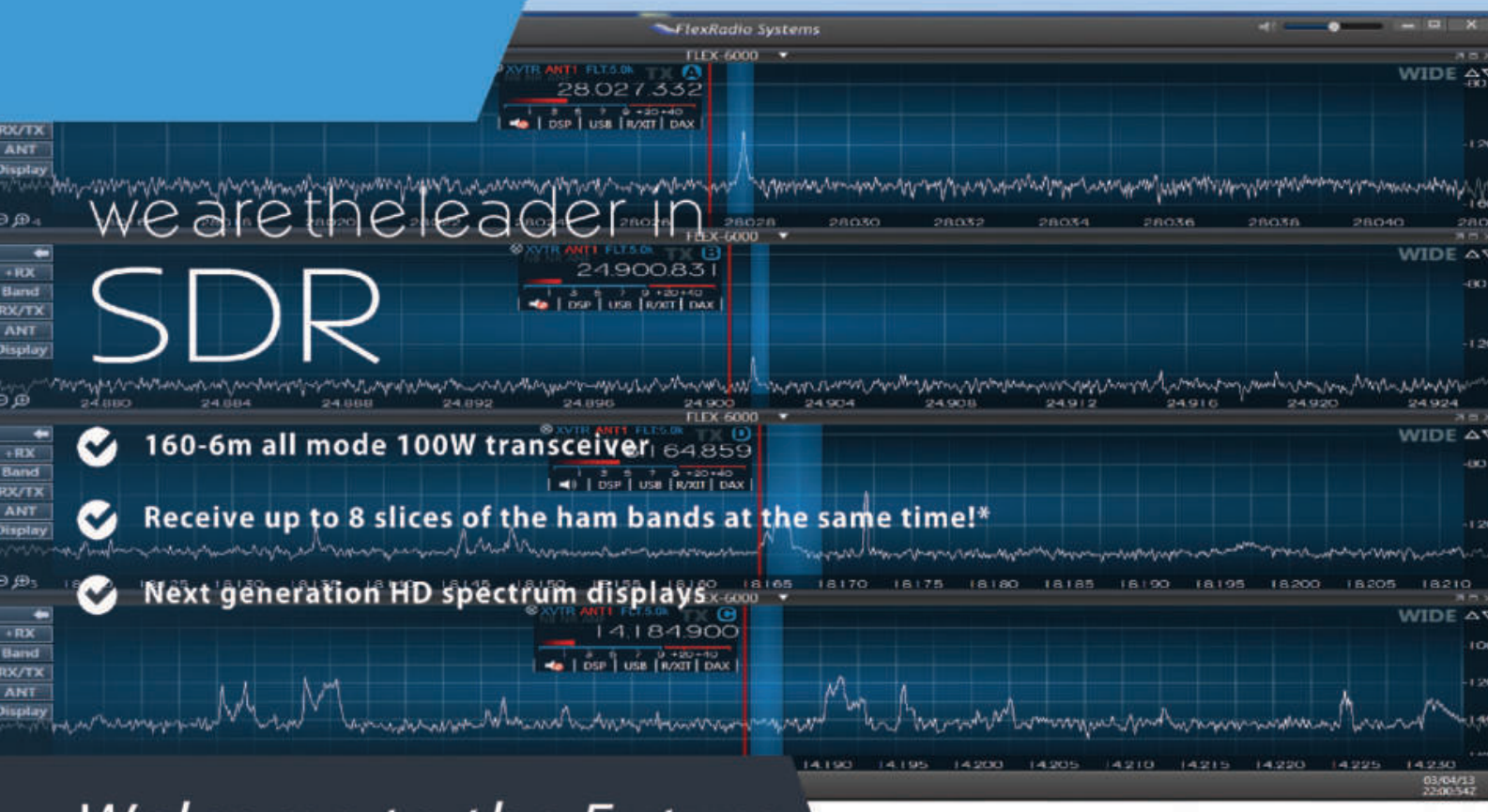

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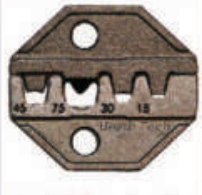

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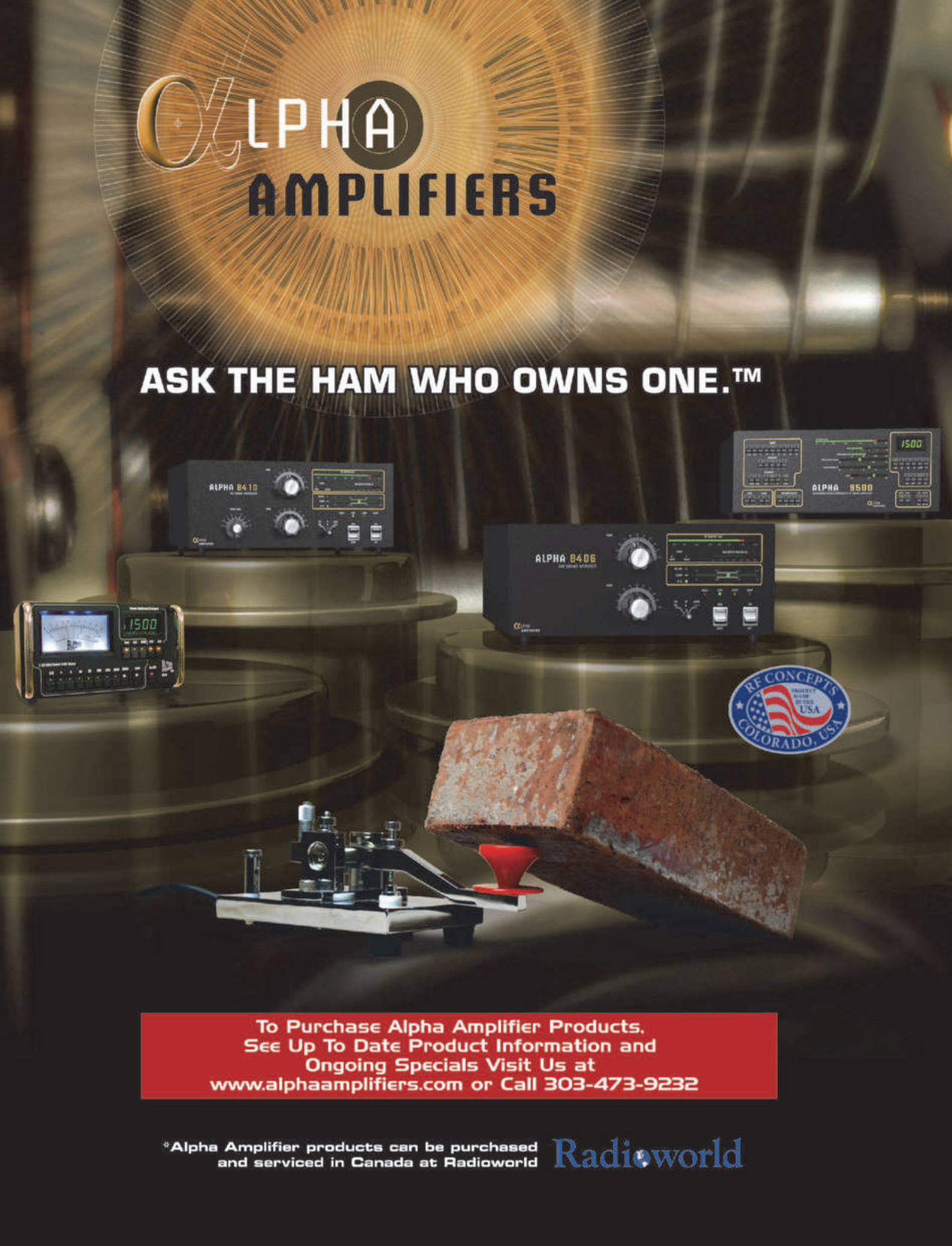
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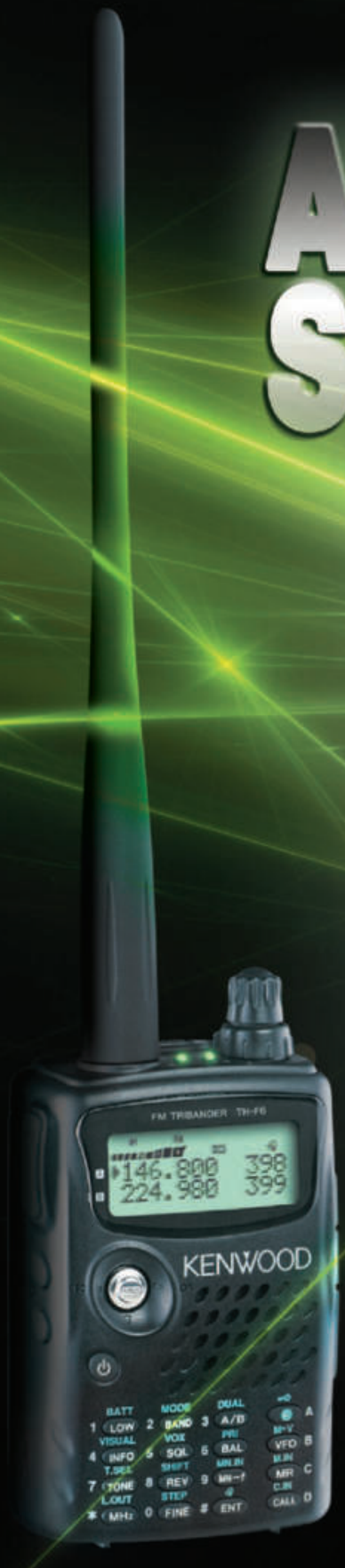

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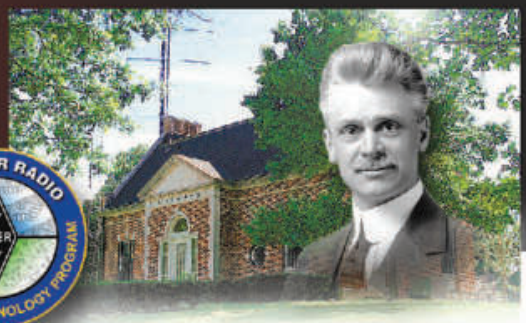

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A Miniature SSTV Camera to PIC Interface

Connect the Argent Data Systems SSTVCAM to the popular PIC microcontroller and unlock application potential.

Mark Spencer, WA8SME

Detailed here is a simple PIC® based interface that will unlock some of the capabilities of an inexpensive miniature camera module. This project came about when Steve Ford, WB8IMY, in his December 2011 "Short Takes" column, reviewed the Argent Data Systems SSTV camera, the SSTVCAM. He thought the camera would be useful in the space/sea buoy system that I have been working on for the ARRL Education and Technology Program so he passed along the little gadget to me.[1] I decided to put the miniature SSTV camera into action as an image sensor to be included in the suite of sensors for the buoy payload. First though, I would have to create hardware and software interfaces to the camera module.

Argent SSTVCAM Module

The Argent SSTVCAM module is comprised of two stacked circuit boards with outside dimensions of 1.5 × 1.28 inches. The 60° field-of-view lens brings the module height to 1.3 inches. The camera module along with the PIC and its interface circuitry are shown in Figure 1. Unfortunately, the SSTVCAM documentation is a bit sparse, but the basic module functions are described online at **http://wiki.argentdata.com/index.php?title=SSTVCAM**. Essentially, the SSTVCAM can:

- Take a photograph and send it via a connected transmitter in one of the popular SSTV formats — Robot 36, Robot 72, Scottie 1 or Scottie 2.
- Snap and record up to eight photos and store them in the camera board EEPROM.
- Send any of the stored photos.
- Automatically take and send real time images at selected time intervals.

The camera function is set by grounding active-low control pins of the camera board to select the desired operation. There are two firmware versions of the camera software: V1.1, which is included on the camera used in the project presented here, and V1.2. The only documented difference between the two firmware versions is that a call sign overlay can be stored in EEROM in the V1.2 firmware and the text will remain there even when power to the camera is turned off. In V1.1, the call sign overlay needs to be loaded each time the camera is powered up (though surprisingly, the recorded images are stored in both firmware versions). While you can control the camera functions with the switch settings, the call sign and overlay text needs to be loaded into the camera using low voltage TTL, 0 to 3.3 V (LVTTL) signals from a terminal program running at 4800 baud. This requires some level shifting and signal inversion to convert the standard RS-232 signal levels of a PC to the LVTTL levels required for the camera.

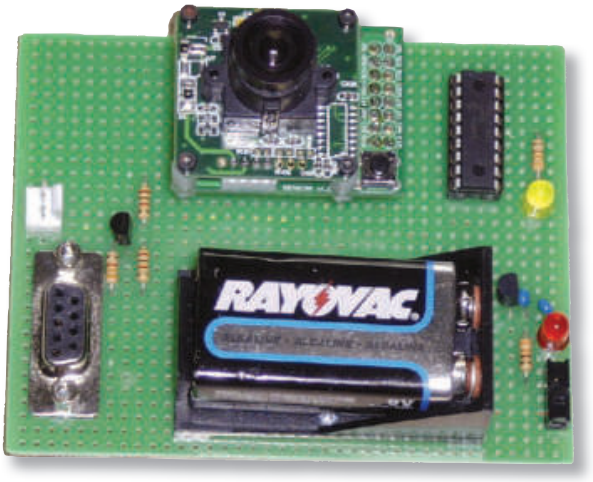


Figure 1 — Argent Data Systems SSTVCAM module mounted on a prototyping board with PIC microcontroller and RS-232 connector.

Simple Switch Control and RS-232 Interface

If you are going to use simple switches to access the camera functions, the RS-232 interface circuit at the left of Figure 2 will provide the level switching and bit inversion necessary to send your call sign and text to label the images in Scottie1 and Scottie2 modes (the Robot modes do not include the call sign overlay). Direct switch control does not require the PIC microcontroller, so simply remove it from the circuit shown in Figure 2 and connect the collector of the 2N3904 transistor to the RXD pin of the camera module. The voltage regulator and its bypass capacitors are still required to provide the proper voltage for the RS-232 interface. Grounding a control pin is interpreted as an "on" condition when referring to the function tables shown on the camera module data sheet.

Three resistors and a 2N3904 transistor form the RS-232 interface. The series 3.3 kΩ and 1.0 kΩ resistors form a voltage divider to take the RS-232 voltage levels down to approximately +/–3 V to drive the NPN transistor base. The 1.0 kΩ resistor serves as the collector load and acts as a pull-up when the transistor is off. When the voltage on the base is high, the transistor is turned on, which effectively grounds the camera RXD pin (inverting the signal applied to the base). When the RS-232 signal goes negative, the transistor is turned off putting 3.3 V on the RXD pin. Speaking of 3.3 V, care must be taken to ensure voltage applied to the camera I/O pins is limited to 3.3 V; 5 V would probably damage the camera.

Communication to the module via your computer's serial COMM port is accomplished with either HyperTerminal or a freeware terminal program called *PuTTY* (**http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html**). Simply set a baud rate of 4800 with the other default port settings in the terminal program and type what you want the overlay label to contain (up to about 35 characters). Sending the return character (0x0d hex or 13 decimal) will load the text into the EEPROM when running V1.2 software. If you are running V1.1, you'll have to reload your call sign every time you apply power to the camera.

[1]M. Spencer, WA8SME, "ARRL Education and Technology Program Space/Sea Buoy," *QST*, May 2012, pp 33-35.

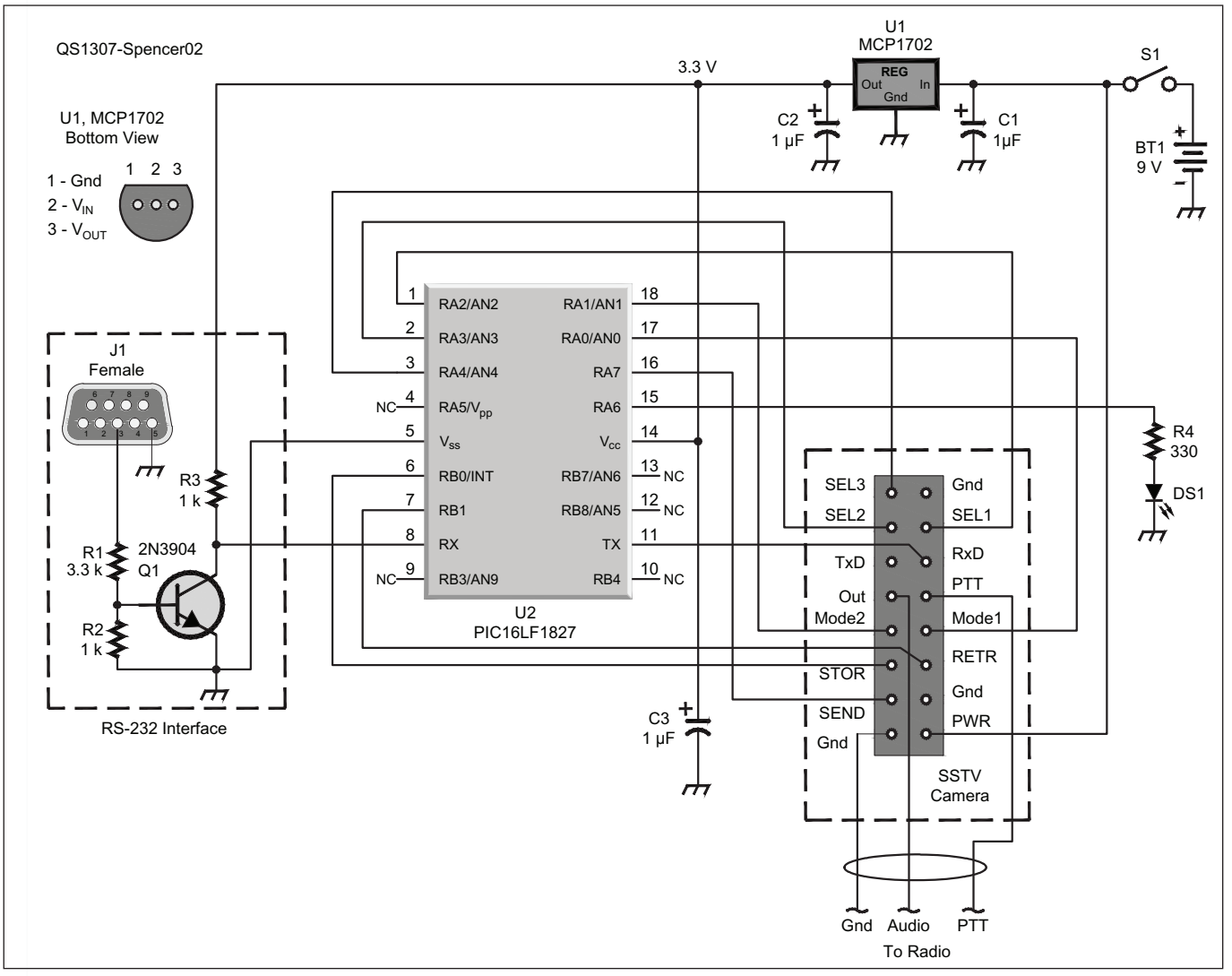


Figure 2 — Schematic diagram and parts list for the SSTV camera to PIC interface.

J1 — RS232 connector (A35107-ND)
R1 — 3.3K Ω resistor (3.3KQBK-ND)
R2, R3 — 1.0K Ω resistor (1.0KQBK-ND)
R4 — 330 Ω resistor (330QBK-ND)
C1,C2,C3 — 1uF ceramic capacitor (445-2861-ND)
S1 — STDT on/off power switch (EG1903-ND)
U2 — PIC16LF1827 microcontroller (PIC16LF1827-I/P-ND)
Q1 — NPN transistor (2N3904FS-ND)
DS1 — LED (any color) (67-1105-N)
U1 — 3.3V regulator (MCP1702-3302E/TO-ND)
9V battery holder (BH9V-PC-ND)
16 pin dual row
Camera connector (S706-ND)
18-Pin DIP socket (A100270-ND)

Controlling the SSTVCAM with a PIC

Yes, you can control the functions of the camera with manual switches, but you can also make the camera much more flexible, including remote controlling it, if a microcontroller is used to control the I/O pins. The circuit depicted in Figure 2 shows the wiring of the PIC to the level shifter and to the camera I/O pins. The software for the PIC is written in C and is available for download from the ARRL web page in source code for user exploration and modification and as a HEX file for direct programming of the PIC.

A Visual Basic (VB) graphical user interface (GUI) program has been developed to allow you to set the desired camera operating parameters (including your call sign and label) that in turn are transferred to the PIC via the COMM port. Figure 3 illustrates how the GUI is presented on the PC screen. The VB source files and executable program are available for download from the ARRL web page at **www.arrl.org/qst-in-depth**.

The advantage of this arrangement is that once the operating parameters are transferred to the PIC, the PIC software stores the information in its on-board EEPROM, so that it will remain when the power to the camera/PIC is removed. Upon power up, the operating parameters are reloaded into the camera to return it to previous operating condition, thus avoiding the problem with V1.1 firmware and losing the call sign.

The operation of the GUI program with the camera is fairly straight forward for SNAP AND SEND MANUAL and SNAP AND SEND AUTO at interval operations (see Figure 3). First, click on the desired SSTV MODE, in this case Scottie 1, which will open the call sign text box. In the example I have typed in WA8SME/1ETP BUOY PROJECT. Next, from the OPERATION section, select SNAP AND SEND AUTO. This will bring up the DELAY selection, which specifies the time interval between automatic photos. Here, I selected a 10 SEC interval. Before finally pressing PROGRAM, be sure that the camera/PIC interface is powered and that the computer is at-

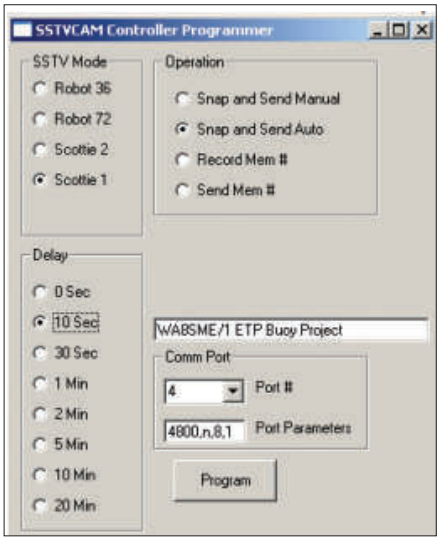


Figure 3 — Screen image of the GUI for the "Snap and Send Auto" operation.

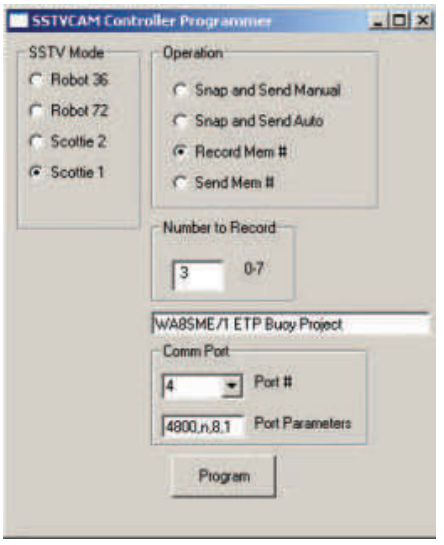


Figure 4 — Screen image of the GUI for the "Record Mem #" operation.

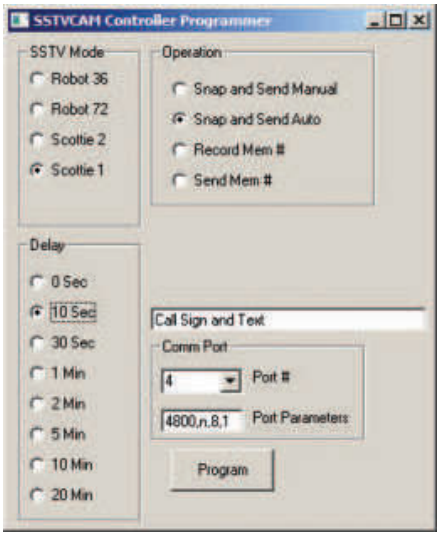


Figure 5 — Screen image of the GUI for the "Send Mem #" operation.

tached. The GUI will send the parameters to the PIC and the PIC will set the specific I/O pins on the camera board and "snap away." If you chose the SNAP AND SEND MANUAL option, you will take and send a picture when the shutter switch (S1 on the camera module) is depressed.

Now on to the possible picture record and retrieve and send options of the camera. There are just too many options possible, so it is impractical to try to anticipate every contingency for using the camera. I'll leave it up to you to make modifications to the programs in the PIC and VB GUI to adapt the system to your requirements. In the program presented here, only the basic record and retrieve functions are demonstrated.

As before, I have selected SCOTTIE 1 from the SSTV MODE (see Figure 4). Next, I selected RECORD MEM # from the OPERATION menu that in turn brought up the NUMBER TO RECORD menu, which specifies where the image will be stored. Here, I selected location 3 from the possible range of 0-7. With this GUI, when you press the PROGRAM button, you send the NUMBER TO RECORD information to the PIC. When you press the shutter button (S1) on the camera, the picture is taken and stored for later retrieval. If you want to take subsequent pictures for storage, you'll have to reprogram the PIC each time, which admittedly is not all that convenient. Remember that previous pictures will remain in the camera memory until over written.

To send the prerecorded pictures (see Figure 5), choose the SEND MEM # option from the OPERATION menu. You will be presented with the frame number to send (NUMBER TO SEND 0-7), then select the appropriate number of the picture you want to send and press PROGRAM. The camera will immediately start sending the prerecorded picture. Each subsequent press of the camera module's shutter button (S1) will transmit that picture. As with the record function, if a different picture is desired, you'll have to reprogram the PIC from the GUI. As I mentioned, this is only the basic record and retrieve and send functions, it is up to you to modify the programs to take full advantage of this capability to meet your needs.

Figure 6 — Recorded snapshot of author taken during the sea buoy test.

Remote Sensing Applications

Now that you have control of the camera, the potential of the system is at your fingertips. By using the PIC to control the camera, you open a whole additional layer of control and coordination with other systems associated with the camera. For example, in a balloon sensor payload application, the sensor data collected during a deployment of a balloon-borne package might be transmitted back to the ground via an APRS UNPORTO packet. The camera could be included in the package to provide snapshots of the Earth at preset intervals as the package ascends. Just prior to transmitting the image, the controlling PIC could command the transmitter to switch from the APRS frequency over to a simplex frequency, send the image, and return the transmitter to the APRS frequency for the next data dump. A similar arrangement might be employed in a sea buoy package, except the PIC could position the camera to a different panoramic view point using a servo or stepper motor before snapping the picture and transmitting it off-APRS channel. Figure 6 is a recorded snapshot of me in the area where the sea buoy prototype is under test.

The options are almost endless — with some minor software changes, the camera can be programmed to send all or only some of the prerecorded images at preset intervals. Or the prerecorded images can be interspersed with real time imagery. What you can do with this system is only limited by your imagination and proclivity for programming. Good luck with your applications — the sky is the limit!

Photos courtesy of the author.

Mark Spencer, WA8SME can be reached 43 Pinelock Dr, Gales Ferry, CT 06335 or at **mspencer@arrl.org**.

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

The *Real* 2 Meter Q-Pole

Our April Fools joke is redeemed! Here's how to make the Q-pole antenna work — honest.

Eric P. Nichols, KL7AJ

I have spent the past four decades of my life attempting to be taken seriously, but to little avail. Thus, it came as a surprise to receive a number of e-mails from readers of my Q-pole article in the April 2013 issue of *QST* who took my attempt at humor seriously.[1] I don't know whether to attribute this to my subtle craftiness, my lovely daughter Jasmine's beguiling gaze or merely the fact that the likes of Larson E. Rapp have been too long absent from the pages of *QST*.

More than April Fiction

Be that as it may, I did at least anticipate that there might be a reader or two who would forge ahead and actually build the Q-pole. With that possibility in mind, I created a genuine functioning 2 meter Q-pole, which is actually not a half bad antenna. Its theory of operation is, however, much more conventional than the original article describes. So, if you happen to be one of those individuals who spent a small fortune on copper tubing based on my attempt at humor, this article will redeem your purchase price and your pride.

With a small modification, the real Q-pole is a sturdy, reliable and fairly broadband full wave loop, with all the normal characteristics thereof, except that the polarization is indeed diagonal with respect to the horizon, at least as I built it. This latter factor will make the antenna (nearly) equally suitable for operation with stations using either horizontal or vertical polarization.

[1]Notes appear on page 38.

The Q-pole is made entirely from ½ inch copper tubing, with appropriate T joints and elbows.

Putting it Together

Start with the ½ inch soft copper tubing. This comes in rolls, and if you're very careful, you can unwind it into a nearly perfect circle. Using a tubing cutter, cut off a 72 inch length without changing the circular shape. Solder the antenna together as shown in Figures 1 and 2 using a propane torch. My "plumber's nightmare" construction was performed during a sub zero subarctic hurricane, which is why it's not as beautiful as it could have been. If you've never soldered with a torch, enlist your friendly local plumber or other competent handyman to show you how it's done. Use rosin core solder only, however, not the acid core that plumbers use.

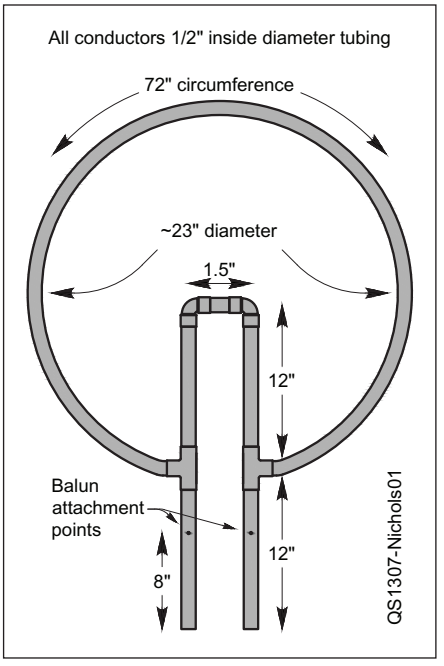


Figure 1 — Dimensioned diagram of the Q-pole. Parts required are 6 feet of ½ inch diameter soft copper tubing, four 12 inch sections of ½ inch hard copper tubing, two ½ inch copper elbows, two ½ inch copper T joints, two copper clad conduit clamps and hardware and ½ electrical wavelength of coax, for construction of the 4:1 balun.

Notice, unlike the original Q-pole, there is a shorting stub between the two rods of the "Q section" on the inside of the loop. The 4:1 balun (see below) is attached to the Q section outside the loop at a distance of 3 inches from the perimeter of the loop. After the antenna is positioned, you can adjust this distance for a perfect match at your frequency of interest.

If you really want to be extra precise, you could build the inner Q section in an adjustable "trombone" manner, allowing you to adjust the resonant frequency, but the fixed short shown in Figure 2 is probably more than adequate.

For a little more elegance, you can solder a couple of end caps onto the open ends of the Q section. End caps will keep moisture and creatures out of the tubing. I've omitted this refinement in the antenna shown.

The Half Wave Loop Balun

Old timers are familiar with this classic ½ wave 4:1 loop or U balun (see Figure 3) as described in *The ARRL Antenna Book* and

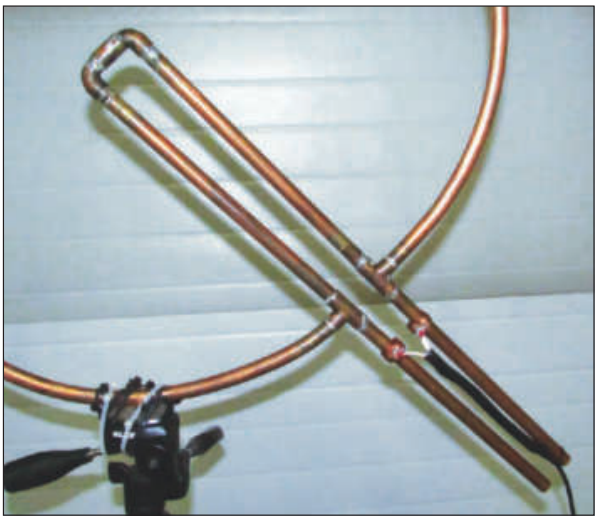


Figure 2 — Detailed view of the shorted end of Q section. This is made using two ½ inch elbows and a short piece of ½ inch tubing.

countless other places, including **www.creative-science.org.uk/balun.html**.[2] The balun transforms our balanced antenna impedance of 200 Ω to 50 Ω for connection to coax feed line with good common mode isolation.

Construct it as shown in Figure 3, carefully measuring the loop length. Just be sure you cut the loop to be an *electrical* half wave, not a physical one. To do that, multiply the free space ½ wavelength (40.44 inches for 146 MHz) by the relative velocity factor of your coax. This is usually about 0.66 for solid polyethylene dielectric coax and ranges from about 0.82 to 0.85 for foam dielectric coax depending on the foam density. To be sure, check your manufacturer's specification sheet — often found on their website.

Solder a couple of lugs on the high impedance terminals and solder the three shields together. Attach the balun to the outer Q section as shown in Figure 4. While the shields could be grounded, we don't really have a ground point at this location. Affix the lugs to the conduit clamps around the outer Q section.

I've found it convenient to lay the feed line and balun section between the two bars of the Q section; this keeps the line out of the radiation pattern of the loop. If you do this, you will want to recheck the attachment points for minimum SWR. You can secure everything in place with *black* tie wraps. (This is true for *any* outdoor antenna; most hams have discovered that white tie wraps deteriorate with amazing speed if exposed to ultraviolet light.)

Making it Play

Mounting the antenna in the "proper" letter Q orientation can be achieved with a sturdy camera mount or other similar means, as long as you take care to insulate the mount from the antenna structure. Maximum radiation is *normal* to the plane of the loop, and polarization is perpendicular to the direction of the Q section. If operated in the horizontally polarized mode (Q section down), the antenna has a sharp null in the plane of the loop, a characteristic drawback of all full wave loops. If operated in the *diagonal* (letter Q) mode, this null is no longer in the azimuth plane, greatly mitigating the null problem.

That's about all there is to it. Of course, this antenna can be scaled to other bands. If you decide to do that, be sure to scale the tubing diameter too. This is probably *the* largest oversight and cause of failure for those redesigning a VHF antenna for another band. Since it is a full wave in diameter, it's pretty big even on 2 meters, as you can see, so lower frequency bands would be even bigger.

I'd be glad to hear field reports from anyone who's built the Q-pole. One astute reader has already modeled the Q-pole using *NotSoEasyNEC* but the Q shaped radiation pattern he submitted looked a little fishy to me. You have to get up pretty early in the morning to fool *this* old timer!

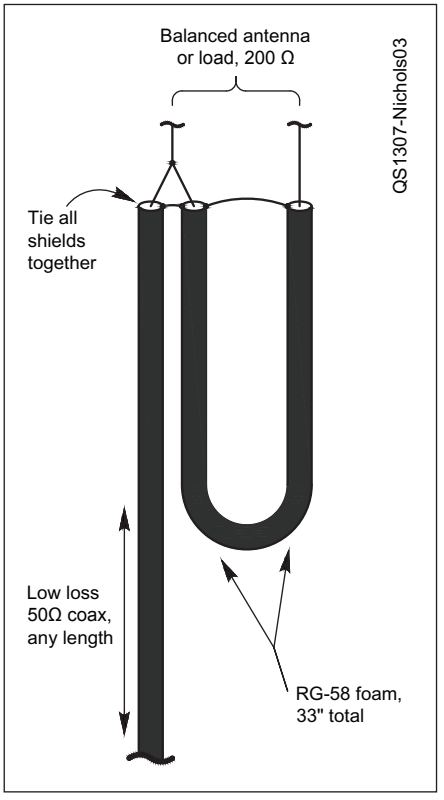


Figure 3 — Drawing of a half wave loop balun. The actual length of the loop will depend on the relative velocity of signals in the coax used (see text).

Figure 4 — Detailed view of the connection of the loop balun to the Q section.

Notes

[1] E. Nichols, KL7AJ, "The 2 Meter Q-Pole," *QST*, Apr 2013, p 33.

[2] *The ARRL Antenna Book,* 22nd Edition, p 24-52, 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**.

ARRL member and Amateur Extra class licensee Eric P. Nichols, KL7AJ, has written numerous articles in just about every existent and defunct Amateur Radio and electronics experimenter publication over the past 30 years, with a strong emphasis on radio design and techniques. He worked as a broadcast engineer for a quarter century, later applying his radio experience to experiments conducted at HIPAS Observatory and HAARP, as well as designing instrumentation for the UCLA Plasma Physics department. His offbeat look at Amateur Radio, *The Opus of Amateur Radio Knowledge and Lore*, was published early in 2011 by CQ Communications. His latest book, *Radio Science for the Radio Amateur*, is available from the ARRL as order number 3381.

Eric has made six trips to the Thailand/Burma border since 2000 to work with the Karen Hill Tribe refugees. He has written numerous articles about the volatile situation in that region, and the brave efforts of those people trying to make a difference. You can reach Eric at PO Box 56235, North Pole, AK 99705-1235 or at **kl7aj@acsalaska.net**.

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

Use Your Mobile Station as a Base Antenna Platform

Can't put up an outdoor antenna? Hide it in plain sight with your vehicle.

Joel Hallas, W1ZR

A large number of amateurs are limited in their operating capabilities by restrictions of various sorts on outdoor antennas. There has been considerable discussion in *QST* and elsewhere on how to overcome this limitation and I am proposing yet another approach.

Make Your Mobile Rig do Double Duty

Many amateurs, with and without antenna restrictions, enjoy HF operation from their vehicles. There is little argument that in most cases the mobile station is a step up from the usual indoor antenna. In addition to better coverage, you are farther away from the RFI of every neighbor's plasma TV or fish tank circulator. Unfortunately, spending an evening operating from the mobile rig in the driveway is a sure invitation to disaster — either from running the vehicle battery down, or if the motor is running, from asphyxiation or carbon monoxide poisoning.

If Conditions are Right, Use the Mobile Antenna

I have never heard of rules about antennas on vehicles, so it seems likely that your parked car or pickup with its HF (or VHF, for that matter) antenna will not run afoul of any rules. In fact, once people are used to it, you might be able to make the antenna taller than you'd take on the road — if it's going to be in place for a long time — but that's another story.

The next question is whether you can get from your station to your parking spot without causing any problems. The ideal case would be to have a permanently assigned or owned spot that could have a buried coax cable with a junction box adjacent to the vehicle. Then when it's time to play radio you just move the antenna cable from your radio in the vehicle to the junction box and you're on the air. It may also be possible to have other arrangements, including a temporary coax run that you roll out when needed — but only if it won't be a trip hazard for you or your neighbors. Let ingenuity be your guide here. Arguably, the coax run won't be more complicated than running power to the mobile rig — and the indoor shack is usually better equipped and more comfortable for an operating session.

Making it Work

One problem with most mobile HF antennas is that they have a narrow bandwidth. If your goal is to work into your favorite net on a given frequency, or operate in a small band segment, that is not a limitation. For most of us, however, we want more flexibility including the capability of operating using multiple modes across the whole band, or even multiple bands.

Enter the Bias T

A *bias T*, a device that allows dc to share a coax cable without interfering with the RF, can be used easily to supply power from the home station to the vehicle antenna system

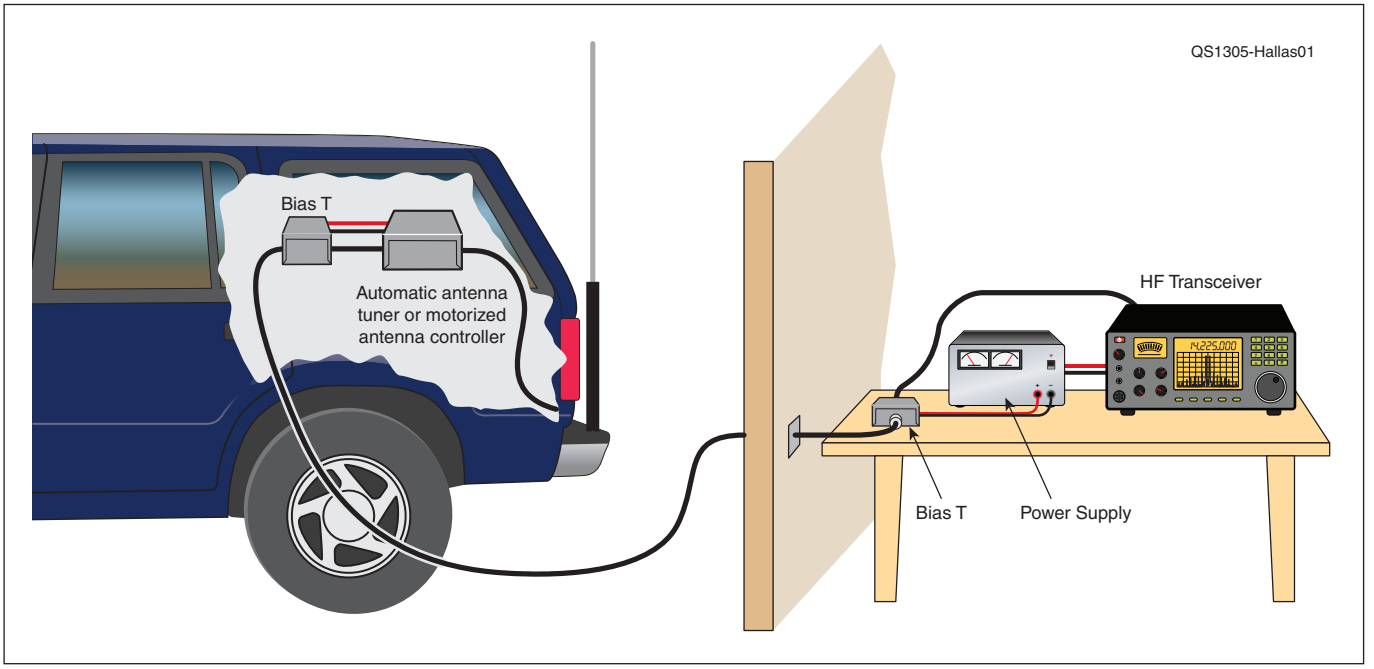


Figure 1 — A parked vehicle with a mobile antenna can serve as your home station antenna as well. The 12 V dc for an auto tuner or screwdriver antenna can be fed down the coax using a pair of bias Ts, as discussed in the text.

(see Figure 1).[1] A bias T at the end of the coax removes the dc. The dc can either be used to power an automatic antenna tuner, or provide power to run a motorized antenna.

Bias Ts are available commercially from Array Solutions and MFJ, both with *QST* Product Reviews available.[2,3] In addition, a recent *QST* article described one that can be built easily at low cost.[4]

In my experience, the usual "monoband" mobile whip, either those with lumped loading inductance or helically loaded types, can be used on lower frequency bands than their self resonant frequency if used with a wide range tuner. For sure, they lose efficiency on the lower bands. Especially if operated one band down from their design point, such as a 20 meter antenna on 30 meters, the antenna works reasonably well and it is much easier than changing antennas or resonators while driving at highway speeds, or going out into the cold.

Another popular multiband antenna is the type that has a motor driven loading coil, often called a *screwdriver* antenna in honor of the early ones made using the motor drives from electric screwdrivers. This is another viable option if it can be remotely operated by reversing the polarity of the dc motor control voltage, as many are. This would require an isolated (ungrounded) dc supply and a DPDT switch to insert the motor voltage. The antenna would be tuned by observing the SWR as measured at the transceiver. However, your antenna manufacturer may already offer a separately wired remote controller.

You're On the Air!

In any of these cases, you have the ability to operate from the comfort of your home station with an antenna that works reasonably well. There are, as always, some caveats:

- While mobile operation does not require RF safety evaluation, you are no longer in that realm, so watch out for RF hazards to you and your neighbors.

- About the third time you drive off to work in the morning with your antenna still connected to your station, you will grow weary of this. I suggest instead that before you hook up the coax, you put a sign on your steering wheel that says ANTENNA CONNECTED TO HOUSE. Remove it only after you have disconnected the feed line. The use of PL-259 "push on" adapters will provide an additional margin of safety.

Notes

[1]Originally used to provide a bias voltage to remote microwave diodes in antenna systems without having separate connecting wires — hence the nonintuitive name.

[2]P. Salas, AD5X, "Product Review — Antenna Accessories from Array Solutions," *QST*, Sep 2009, pp 47-49.

[3]S. Ford, WB8IMY, "Short Takes — MFJ Model 4116 Bias Tee Power Injector," *QST*, May 2006, p 54.

[4]P. Salas, AD5X, "Build a Legal Limit Bias T that Covers 1.8 to 230 MHz," *QST*, Jan 2013, pp 45-48.

Contributing Editor Joel R. Hallas, W1ZR, recently retired as the Technical Editor of *QST*. You can still reach him at **w1zr@arrl.org**.

Feedback

- In "Build a Linear 2 Meter 80 W All Mode Amplifier," by James Klitzing, W6PQL [May 2013, pp 30-34], two heat sinks are included in the parts list, but only one is necessary, specifically: Heat sink extrusion 5.375 × 8 × 1.375 inches (Heat Sink USA A008).

- In "Remote Control of Accessories via the Internet," by Jon Crisman, WØJEC, [April 2013, pp 30-32] in the Figure 1 parts list, the K1-K8 SPDT relays should be identified as Digikey part 225-2077-ND or Mouser part 769-JQ1P-12V-F. These are only examples of relays that can be used in this project. Relays should be selected based on the ac or dc voltages and currents required by the devices being switched.

Share Your Knowledge at the ARRL Centennial Convention

In preparation for the ARRL National Centennial Convention, July 17-19, 2014, the ARRL is issuing a call for papers and programs to be included as part of the extensive slate of forums and presentations planned for the event.

Forum topics will be divided into five broad categories:

- Technical Innovations and Advancements
- On-the-Air Operating Activities
- Club Growth and Development
- Public Service Communications
- Education and Training

Your proposed program should address not only current technology and techniques, but also innovations that are likely to take place in the near future. The Centennial Convention will attract a diverse audience, so your forum should appeal to a diverse audience as well. Even so, we will also consider proposals that target more specialized interests.

Design your program to span either 50 or 110 minutes, including time for questions and answers. The convention staff will provide video and image projection systems as needed to enhance your presentation. In addition, several selected programs may be streamed live on the Internet for those unable to attend the convention in person.

You can submit your forum proposal online at the ARRL National Centennial Convention web page at **www.arrl.org/arrl-centennial-convention-2014**. Be sure to complete all fields in the "Program Presenter Proposal" form. The deadline for proposals is **October 15, 2013**.

Proposals will be reviewed by program organizers with the final decisions being made by December 31, 2013. The complete forum schedule will be available by March 31, 2014.

For more information about the ARRL National Centennial Convention, please visit the ARRL website at **www.arrl.org/convention-presentations**, or contact Dan Henderson, N1ND, the Centennial Convention Programs and Forums Coordinator, at 860-594-0236 or by e-mail at **n1nd@arrl.org**.

LED Facelift for Digital Displays

This process for replacing a Vacuum Fluorescent Display with an LED module can be adapted for many kinds of radios.

Ronald Weinberg, WD4MKL

Replacements for aging and failing vacuum fluorescent displays (VFDs), such as the one discussed here for the Kenwood R-1000 receiver, are difficult to find. One solution is to replace the VFD with modern seven segment light emitting diode (LED) modules. Here's how I did it.

The New LED Display Board

Figure 1 shows an abbreviated schematic diagram of the seven-segment LED components board that contains the segment drivers Q1-Q8 for the seven LED segments a, b, c, d, e, f, g and the decimal point P. The schematic is abbreviated for clarity, so note that all of the pins 2 (for each of the LEDs D1-D5) are tied to resistor R2. Likewise all pins 3 tie to R8, pins 4 tie to R6, pins 5 tie to R4, pins 7 tie to R5, pins 8 tie to R7, pins 9 tie to R1 and pins 10 tie to R3. We select the lit LED segments a-g and P by toggling the LED ground connections G1, G2, G3, G4 and G5. The MSM5524 clock and display driver IC on the R-1000's circuit board provides all of the needed switching and LED selection functions.

Figure 2 shows the wires a-g, P, and G1-G5 connected to the back of the seven-segment LED display board. Those 13 wire connections correspond to pin numbers of the replaced VFD module according to Table 1. A 14th ground wire connects each of the emitters of driver transistors Q1-Q8 on the LED board to a ground point on the radio board. You can see the 14 wire connections in Figure 3. Note that 13 wires connect to the radio circuit board pin holes vacated by the VFD. The 14th ground wire snakes under the radio board to a ground connection as seen in Figure 4. The circuit works with the bank of 47 kΩ pulldown resistors comprising module R81 of the R-1000 board. Please see the *QST* in Depth web page for the details.[1] The original radio display had a colon for the clock function, but here a decimal point will suffice.

[1]Notes appear on page 43.

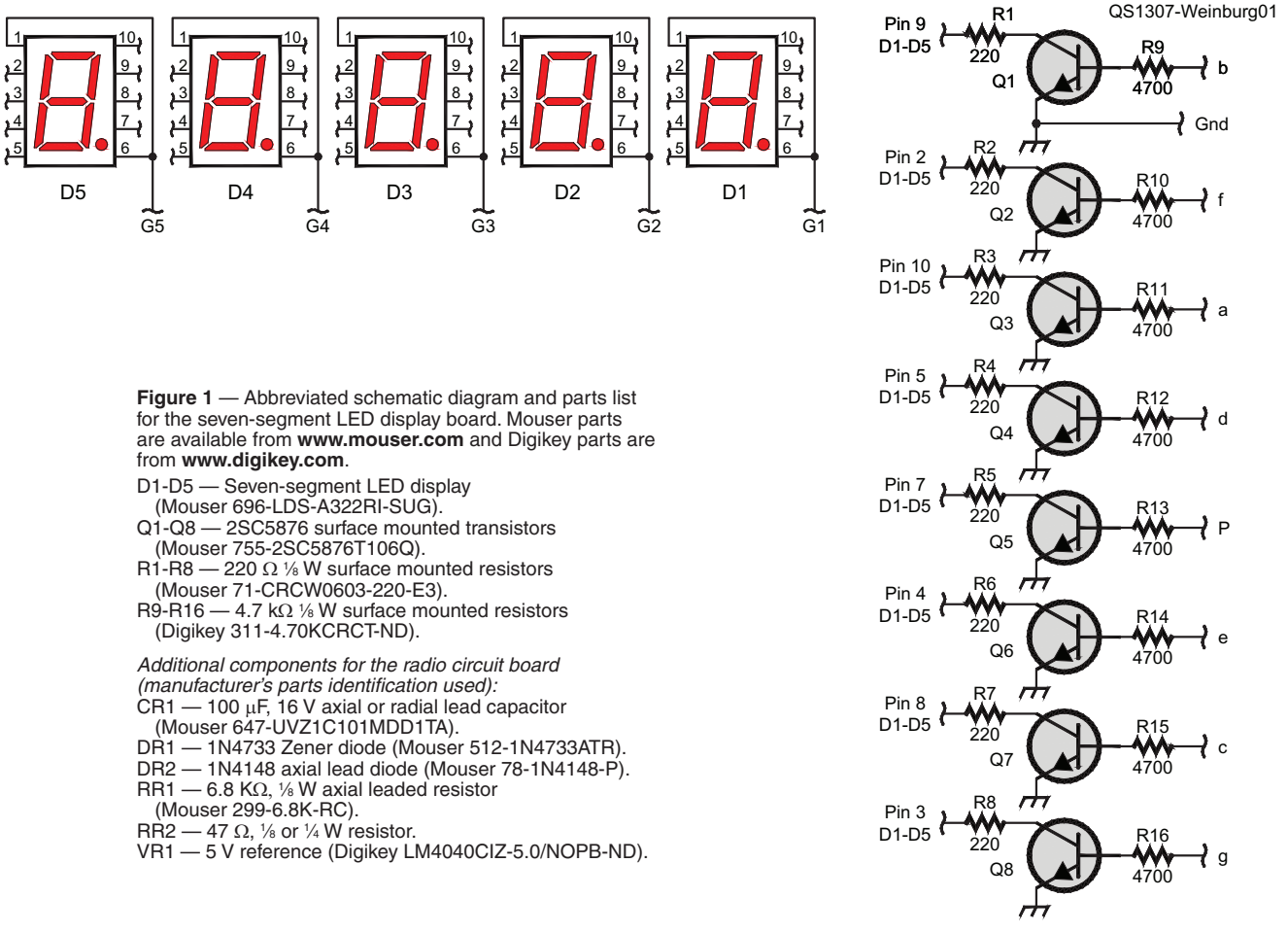


Figure 1 — Abbreviated schematic diagram and parts list for the seven-segment LED display board. Mouser parts are available from **www.mouser.com** and Digikey parts are from **www.digikey.com**.

D1-D5 — Seven-segment LED display (Mouser 696-LDS-A322RI-SUG).
Q1-Q8 — 2SC5876 surface mounted transistors (Mouser 755-2SC5876T106Q).
R1-R8 — 220 Ω ⅛ W surface mounted resistors (Mouser 71-CRCW0603-220-E3).
R9-R16 — 4.7 kΩ ⅛ W surface mounted resistors (Digikey 311-4.70KCRCT-ND).

Additional components for the radio circuit board (manufacturer's parts identification used):
CR1 — 100 µF, 16 V axial or radial lead capacitor (Mouser 647-UVZ1C101MDD1TA).
DR1 — 1N4733 Zener diode (Mouser 512-1N4733ATR).
DR2 — 1N4148 axial lead diode (Mouser 78-1N4148-P).
RR1 — 6.8 KΩ, ⅛ W axial leaded resistor (Mouser 299-6.8K-RC).
RR2 — 47 Ω, ⅛ or ¼ W resistor.
VR1 — 5 V reference (Digikey LM4040CIZ-5.0/NOPB-ND).

Table 1
Wire Connections to Pin Hole Vacated by the VFD.

VFD pin number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Wire connection	NC	g	f	G5	e	G4	d	NC	G3	P	c	G2	b	G1	a	NC

Figure 2 — Wires connect to points a-g, P, and G1 – G5 on the back of the seven-segment LED display board.

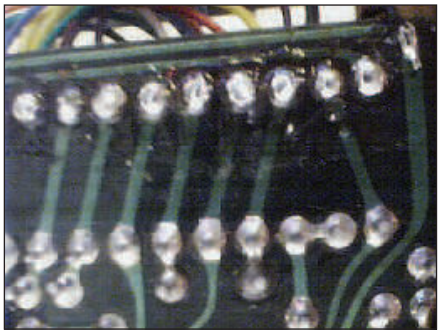


Figure 4 — The ground wire (upper right) connects to the radio board ground.

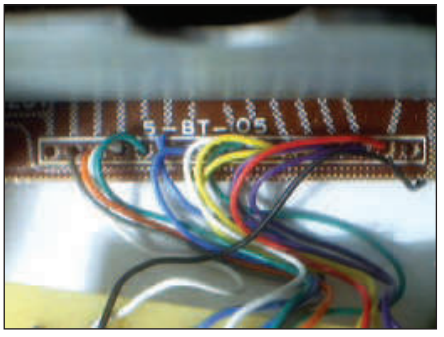


Figure 3 — The 14 wires from the seven-segment LED display connect to the radio board.

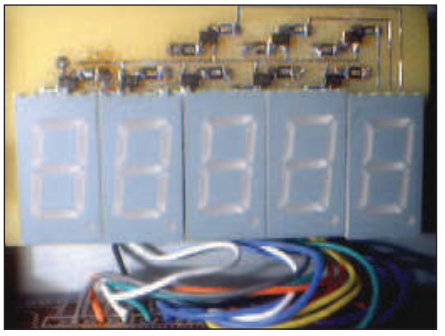


Figure 5 — The completed display uses surface mounted and LED displays.

Building the LED Display Board

You may wish to have the LED display board fabricated by a printed circuit board (PCB) manufacturer since the board contains plated through holes and closely spaced solder pads. I used ExpressPCB, a well known PCB manufacturer.[2] You can download the needed software from their website. (See *QST* in Depth for my PCB layout.) My 1 × 1.7 inch LED components board leaves more than enough clearance to fit the opening of the radio.

Mount all the components on the same side of the board as pictured in Figure 5. Once you have the PCB you will need to place the surface mount components. In this project you will place 8 transistors, 16 resistors and 5 seven-segment display modules on the circuit board. Solder the transistors, resistors and 14 wires before installing the seven-segment LED display modules. I selected seven-segment display modules that provide just enough depth clearance to allow the required clearance for the LED leads on the back of the board.

Making the LED Display Board

After you have fabricated or constructed the LED display board, follow these assembly steps:

- Solder the eight transistors Q1-Q8 to the PCB. The task may require a desolder tool, tweezers, a magnifier, rosin flux and 0.031 inch diameter solder (Mouser 533-24-6337-27, 590-835-100ML or equivalent). I found that working on a white piece of paper helps to keep components visible.
- Solder the eight 220 Ω resistors, R1-R8, and the eight 4700 Ω resistors, R9-R16 to the board. Be sure to leave room for the 14 wires shown in Figure 2.
- Solder the 14 wires to the PCB, leaving about 3 inches of wire per connection.
- Solder the five seven-segment LED display modules to the board as shown in Figure 5. Remember to trim the leads of the LEDs first so that the sharp ends do not protrude and cut through any wire insulation on the back side of the board. Be sure not to cut past the spacer. The LED height choice is important because of limited space.
- Clean the solder flux from the circuit board.

Set the completed LED display board aside while you modify the radio. You will connect the 14 wires to the radio circuit board after modifying the radio circuit board.

Modifying the Radio

You must also modify the radio's circuit board for the unit to operate properly. These instructions are specific to the R-1000 and the details along with graphics and pictorials are on the *QST* in Depth web page but you can modify many other radios in a similar manner. Be sure that the radio is completely disconnected from power and from antennas. Disassemble the radio by removing the top and bottom covers, disconnecting the speaker, and removing the front panel. The R-1000 uses set screws to keep the TONE control knob and the BAND SWITCH knob in place. There are also screws behind the tuning control knob that need to be removed. Disconnect the cables and remove the radio printed circuit board. You will need to consult the schematic diagram and parts layout for your radio.

Referring to parts numbers on the R-1000 circuit board, desolder and remove the VFD, remove capacitor C201 and Zener diode D40. Replace resistor R194 with a new 6.8 kΩ ⅛ W resistor RR1. Replace Zener diode D46 with the new 5 V reference VR1. You will use only two of the three leads on that part. Connect VR1 in place of the original Zener diode D46. Attach the new 1N4733 Zener diode DR1 across C200. Be sure to observe the proper polarity.

Cut the single trace between the emitters of Q35-Q39 and the other components (Q34 Pin 1 and diode D53). We will use the main +5 V supply for the emitters of Q35-Q39. Connect a wire from the emitters of Q35-Q39 to pin 7 of connector 15. Place 1N4148 diode, DR2, with the anode towards the +5 supply and a 47 Ω, ⅛ W resistor, RR2, in series with the wire. You may wish to drill a small hole in the main radio circuit board for

the diode next to the +5 V point. Place the 100 µF, 16 V capacitor CR1 between the common emitter trace of transistors Q35-Q39 and the ground trace.

Optionally, you can build a regulated supply so that you can operate the display TIME function with the radio power switched off. I've included the regulator schematic and parts list at *QST* in Depth. The regulator will attach to the radio 11 V supply and replaces the 1N4148 diode DR2 and 47 Ω resistor RR2. Simply connect the wire from the emitters of transistors Q35-Q38 to the regulator instead of to the 5 V supply. Without the regulated supply, the clock will not display when the radio power switch is OFF. Of course, with the regulator, the clock will still be on only with the radio function switch set to TIME. If desired, you can also connect the AM and PM indicators to the 5 V supply, so the clock and indicators remain unlit with the radio power switched off. Using a small piece of circuit board material you can add a 5 kΩ, ¼ or ½ W potentiometer in series with the LED power lead to control AM and PM indicator brightness.

Finishing the Job

Solder the 13 LED display board wires to the pin holes left by the removal of the VFD as seen in Figure 3. Solder the ground wire to the ground trace under the display, as in Figure 4. Place a piece of insulating tape in the space in the radio behind the location of the LED display board. Use some silicone sealant to hold that display board in place. Close up the radio — you are done! The new LED display now replaces the old VFD. The new parts should be considerably more robust than those of the old display. The dimmer switch on the radio will still function as before. The current is very low so a trim pot (such as one of the sealed ¼ W or ½ W single turn trimmers) will work in place of the fixed resistor. Other seven-segment LEDs will also work as long as the pinouts and size are the same. I chose my particular LEDs because I find the green color is easy on my eyes.

Applying this to Other Radios

You can apply this approach to other radios that use a similar VFD, although with later radios the display becomes increasingly complex. The more complex displays may have additional indicators. You can use a small LED on the display board to mimic the additional indicator function. A tape strip with icons laser printed on transparency material can provide a neat solution. Such transparencies are available at office supply stores.

Closing Comments

Additional details can be found on the *QST* in Depth web page, including the radio display circuit diagrams both before and after the radio modifications. You will also find additional pictures of the parts placement on the radio board and printed circuit board layouts for the new LED display board, along with parts placement details. Finally, I've included details about the optional voltage regulator that you can use in place of diode DR2 and resistor RR2.

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

Ronald Weinberg, WD4MKL, obtained a General class license in 1978 after his interest was piqued at an ARRL Field Day event. Now semi-retired from a career in consumer electronics, computers and communications, Ronald enjoys taking on challenging ham radio projects and serving his local community. You can reach him at 6619 Chantry St, Orlando, FL 32835-1260 or at **articlexyz4375-electro@yahoo.com**.

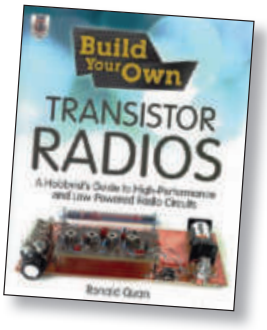
For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

New Books

Reviewed by Rick Lindquist, WW1ME

Build Your Own Transistor Radios

Ronald Quan, KI6AZB



The title of this superb learn-by-doing manual recalled my first transistor portable, a little six transistor job that almost fit in your hand (I still have it!). But Ronald Quan's book, subtitled *A Hobbyist's Guide to High-Performance and Low-Powered Radio Circuits*, covers a great deal more territory. Quan, who obviously knows his stuff and has the credentials to boot, starts with four receiver designs —TRF, regenerative, superheterodyne and reflex — as the building blocks for essentially all radio receivers (he neglects the direct-conversion design popular with QRPers), then expands into a far wider world of experimentation and do-it-yourself construction. Readers who are at sea regarding receiver basics or who need a refresher will find this a terrific tutorial! Chapters include parts lists (Quan encourages scouring the junk box or cannibalizing old radios), block diagrams and complete schematics for various receiver projects you can build on vector board.

The most intriguing chapters delve into design aspects that may pique the curiosity of many radio amateurs, such as inductorless, single-transistor superhet, and low-power (ie, current draw measured in microamps) radios. Perhaps most useful to the modern ham are those sections dealing with software designed radios. Quan introduces SDRs at the conclusion of those chapters aimed at the hobbyist and experimenter. He details a couple of receiver front-end circuits, including one for 40 meters, that can use *Winrad* or similar software to handle the digital aspects and to demonstrate how SDRs function.

The remaining 10 chapters discuss signals and circuits and explore more advanced principles and concepts, employing a fair amount of algebra and trigonometry to explicate these. Quan allows he may be too "math-centric," and the eyes of the non-engineer may glaze over at such discussions as "Finite Pulse-Width Signals" and "Consequences of an Imperfect 90-Degree Phase Shifter on Reducing the Image Signal" (the latter nearly *entirely* mathematical). This is not to suggest that readers with lesser electronics or mathematics backgrounds won't find these later chapters valuable. Quan also reveals the secrets of oscillator, mixer, amplifier (including op amp) and IF circuits, and at several points discusses how these relate to SDR concepts. Each chapter is replete with extensive references for those interested in further investigating specific topics.

Overall, this extremely well written and comprehensively illustrated guide and reference deserves a place on the inquisitive radio amateur's bookshelf. As the author says, "Learning electronics…is a lifelong process. [W]e all become to some degree self-taught…"

McGraw-Hill Companies Inc (TAB), New York/Chicago/San Francisco, 2013. ISBN: 978-0071799706, softcover, 7.2 × 9.1 in, 496 pp. Available from ARRL (**www.arrl.org/shop/Build-Your-Own-Transistor-Radios-McGraw-Hill**), *Order No 1367, softcover, $50; Amazon.com, softcover, $32.77, Kindle edition, $26.13.*

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

Antenna Tuners: MFJ-9982, Palstar AT2K and AT2KD

Three more solutions for tuning your antenna system at legal limit power levels.

Reviewed by Joel R. Hallas, W1ZR
QST *Contributing Editor*
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A few months back, we reviewed a pair of legal limit tuners designed for balanced loads.[1] Here we look at three tuners with unbalanced loads (coax fed antennas) in mind. Each of these units makes use of a high-pass T network configuration with one variable capacitor in series with the input, one in series with the output and a shunt variable inductor to ground between them. This generally results in three controls on the front panel. What differentiates the Palstar AT2KD from the others is that the two capacitors are combined into one *differential* capacitor, so the AT2KD has only two tuning controls. As a differential capacitor is turned, the capacitance increases on one side while decreasing on the other.

MFJ-9982 2500 W Antenna Tuner

The MFJ-9982 is described as a legal limit tuner specified to match loads from 12 Ω (4:1 SWR) to 2000 Ω (40:1 SWR) over the continuous frequency range of 1.8 to 30 MHz. The range of complex loads is not specified, but it may be reasonable to expect it to match loads with reactive components within similar SWR limits. Most amateur antennas, after all, exhibit complex (resistive plus reactive) impedance on many frequencies.

[1]J. Hallas, W1ZR, "Product Review — MFJ-976 and Palstar BT-1500A High Power Balanced Antenna Tuners," *QST*, Mar 2013, pp 53-58.

Tuner Configuration

The MFJ-9982 shown in Figures 1 and 2 uses a T configuration with series capacitors on the input and output and a single shunt roller inductor. The tuner components are isolated from ground so that balanced loads can be tuned. A 1:1 balun on the radio side provides the transition to unbalanced coax. A built in 50 Ω dummy load handles 100 W for 10 minutes or 1.5 kW for 10 seconds.

To change to unbalanced mode, a rear panel strap is used to ground one of the balanced terminals. The strap has two connection points, a round one that fits the terminal and a slotted one to allow it to pivot without removing the wing nuts and washers. Our unit had the strap pivoting on the antenna stud where it could arc to ground if hanging from the terminal. It should be installed with the round hole on the ground stud, so that can't happen.

If strapped for unbalanced operation, two coaxial outputs, a single wire output or the dummy load can be selected from the front panel. The single wire output always goes through the tuner, the dummy load doesn't go through the tuner and the two coax connections can be switched to use the tuner or bypass the tuner.

The variable capacitors have smooth 5:1 vernier knobs that make tuning easy and provide pointer resetability to within about 1/50 of the range. The rotary inductor includes a three digit turns counter dial that provides 90 digit indications for 30 turns and can be interpolated to about ½ a division. This sounds as if it would be a lot of effort to get all three controls to a place that provides a match, and it can be. Fortunately, in many cases, only one of the capacitors requires fine adjustment.

A competent dual needle power meter offers 300 or 3000 W power ranges with average and peak power readings. It can be powered by an internal 9 V battery or an external 12 V supply. With an external supply, a switchable dial light can illuminate the meter.

Figure 1 — MFJ-9982 antenna tuner.

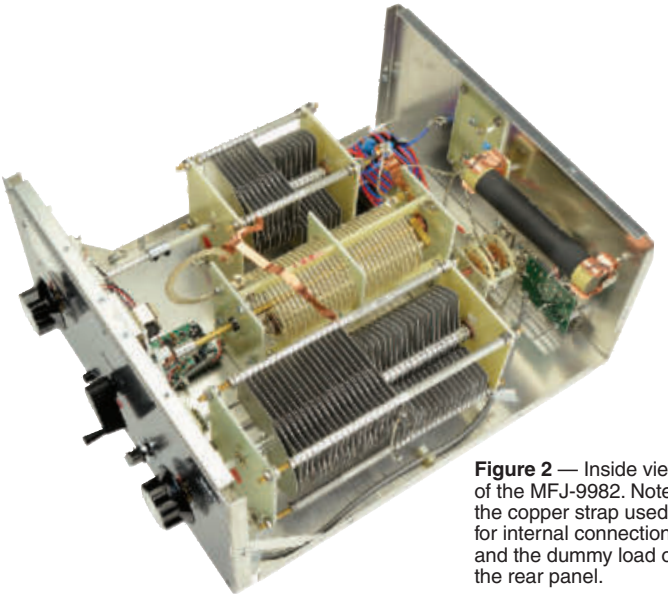


Figure 2 — Inside view of the MFJ-9982. Note the copper strap used for internal connections and the dummy load on the rear panel.

Bottom Line

The MFJ-9982 provides a good value in an antenna tuner that can match most antenna systems on most bands. The built in peak and average wattmeter is also a real plus.

Table 1
MFJ-9982 Antenna Tuner

Circuit configuration: T network.
Frequency range: 1.8 to 30 MHz.
Matching range: 12.5-2000 Ω.
Power rating: 2500 W (PEP), SSB and CW.
Measured current usage: 13.8 V dc at 41 mA (meter lamps only).
Size (height, width, depth): 7 × 13.7 × 18 inches (incl protrusions); weight: 15 lbs.
Price: $630.

ARRL Lab Resistive Load and Loss Testing

SWR	Load (Ω)		160 m	80 m	40 m	20 m	10 m
4.33:1	11.5	Power Loss%	NT	10	10	NT	11
		SWR	—	1.0	1.0	—	1.6
2:1	25	Power Loss%	7	4	NT	7	10
		SWR	1.0	1.0	—	1.9	1.0
1:1	50	Power Loss%	5	4	3	7	9
		SWR	1.0	1.0	1.0	1.9	1.0
2:1	100	Power Loss%	3	2	1	2	7
		SWR	1.0	1.0	1.0	1.0	1.5
4:1	200	Power Loss%	2	2	2	2	8
		SWR	1.0	1.0	1.0	1.0	1.8
7.6:1	380	Power Loss%	5	3	3	6	11
		SWR	1.0	1.0	1.0	1.0	2.0
16:1	800	Power Loss%	2	2	4	8	18
		SWR	1.0	1.0	1.0	1.0	1.2

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

Frequency	Short	Open	
1.8 MHz	NT	NT	Will tune 2000 Ω resistive load 160-10 meters.
3.5 MHz	Yes	NT	
7.0 MHz	NT	NT	
14 MHz	Yes	NT	Yes = will tune into open or short circuit.
28 MHz	NT	Yes	NT = no tuning solution.

High Power ARRL Lab Testing

Tests performed with 1500 W PEP keyed CW, 40% duty cycle, 10 minutes (see March 2013 *QST*, p 58 for details).
High impedance test (20:1 SWR complex load): 160, 20, 10 meters: Passed, ran cool.
Low impedance test (25 Ω resistive load): 160, 20, 10 meters, Passed, ran cool.

Operating the MFJ-9982

The MFJ-9982 is relatively easy to set up and operate. There are three coax connectors on the rear panel, one for the input and two for unbalanced antennas. An insulating block includes the two terminals for balanced feed lines, each equipped with wing nut terminals. Single wire antennas are to be connected to the upper balanced line terminal and fed against the tuner's GROUND terminal.

Using the tuner is relatively straightforward. The manual provides two suggested starting points for each band at 50 and 600 Ω resistive loads. Once there, apply a small amount of power and move each control for the best match as indicated on the reflected power scale of the meter. It is important to set the meter to AVERAGE power for adjustments; if set to PEAK, the delayed needle movement masks changes in tuning.

For some loads, a null in reflected power is found quickly. For other loads it can take a lot of back and forth adjustment to reach a matched setting. As the manual notes, in many cases more than one matched setting can be found, and the one with the least inductance is usually most efficient. It can be a tedious process and you will want to record the settings for each segment of each band in order to return to them whenever you want to change antennas, bands or modes.

Our '9982 came from the factory with a rotary inductor that made intermittent contact, making it virtually impossible to successfully adjust to different loads. It was sent back to MFJ under warranty and returned making good contact, although the resulting cranking force was higher than that of the other tuners in the review. While testing at home, I found that I was having trouble with resetability and determined that the turns counter indicator was slipping. Upon opening the cabinet, it was evident that the nylon gear that drove the counter was not meshed sufficiently with the mating gear on the inductor shaft. By loosening two screws on the drive housing, I was able to pivot the assembly and engage the gears. It worked satisfactorily after that, and was considerably quieter in operation. MFJ has since advised that they are addressing these issues in production.

On the Bench

The MFJ-9982 was able to match all the resistive loads we tested, ranging from 11.5 (4.3:1 SWR) to 800 Ω (16:1 SWR), on all bands as shown in Table 1. As is often the case, the loss near the edges of the operating impedance ranges was higher than for those closer to a matched condition. This tuner passed all our high power tests without problems.

We found that a shorted output could be tuned on 80 and 20 meters, while an open could be tuned on 10 meters. This is not an unusual result, but it does argue for carefully recording tuner settings for each band, antenna and mode. If the tuner settings suddenly change without a good reason, be sure to check for a disconnected antenna, breakage or a short in the system before applying full power. An antenna current meter or a field strength meter can be used to make sure that power is leaving the tuner and going where it should. Dissipating 1.5 kW in a small box is a prescription for melted tuner components.

On the Air at W1ZR

I have a 135 foot dipole, center fed with about 100 feet of 450 Ω window line. While each station's antenna system will exhibit different characteristics on different bands, this is a typical application for an antenna tuner. The 50 Ω SWR of my antenna alone (no attempt at matching) runs the gamut from 2.9:1 on 28.5 MHz to 86:1 on 160 meters, as measured at the tuner interface. The MFJ-9982 was able to reasonably match this antenna on all amateur bands, including 160 meters — somewhat to my surprise.

For unbalanced loads, I tested with my dummy load, a triband Yagi that includes a 6 meter coupled resonator, a 17 and 12 meter coupled resonator dipole and the balanced antenna above, fed through an external 4:1 balun. The tuner was able to match all loads on all appropriate bands. I was able to confirm that this tuner does not operate on 6 meters, in keeping with its specifications — never hurts to check.

My procedure was to start from the manual's recommended 50 Ω settings and first tune with my dummy load. The tuned settings were generally close to the suggested settings, once I figured out that my inductor counter started at 100 rather than 000, and after I fixed the slipping digits. I then used those

settings as a starting point for other loads. I first tuned at 10 W output, then trimmed up the adjustments with 100 W. I found the tuner's SWR meter to be in close agreement with the three digit digital indicator on my transceiver. The wattmeter read somewhat high, about 125 W for a 100 W signal. The manual describes the meter calibration procedure.

While the MFJ-9982 is very flexible in antenna configurations that can be matched, changing from unbalanced to balanced operation requires access to the strap on the rear panel — inconvenient in some stations.

Documentation

The MFJ-9982 comes with a 13 page manual that includes instructions on tuning procedure with suggested starting points for each band and a schematic diagram. There is also an *Antenna System Hints* section with antenna and feed line lengths to avoid, along with other suggestions.

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

See the Digital Edition of *QST* for a video overview of the MFJ-9982 Antenna Tuner

Palstar AT2K and AT2KD 2000 W Antenna Tuners

The Palstar AT2K (Figures 3 and 4) and AT2KD (Figures 5 and 6) are so similar that it makes sense to describe them together. Both models cover 160 through 10 meters plus 6 meters and are rated to match impedances from 20 (2.5:1 SWR) to 1500 Ω resistive (30:1 SWR) on 160 through 10 meters. Lower impedances can be matched at reduced power. The 6 meter tuning range is not specified.

Tuner Configurations

The two tuners are essentially identical except for the different capacitor configurations. Both have the same metering and provide switching for three coax lines. One coax output is identified for use with an external balun for a balanced load, but otherwise is the same as the others, so it is usable with a third coax fed antenna if desired. Another coax output bypasses the tuner for use with a matched antenna, also an ideal spot for a dummy load.

The AT2KD is about an inch narrower than the AT2K because of the single, but larger, capacitor. The capacitors in both are driven by 6:1 vernier drives, but the capacitance indictors are different. The AT2K has moving dial scales, while the AT2KD has a moving pointer that is read against silkscreened numbers on the panel. Both provide a resolution of 100 divisions, although the AT2KD scale has smaller numbers — a bit tough on my bifocals.

Both units have an excellent dual needle average and peak reading wattmeter. The wattmeter has a PEAK-HOLD button that maintains the peak reading for 2 seconds so you can read it more easily — very nice feature. Meter calibration is in close agreement to my transceiver, which has been checked carefully.

On the Bench

Both units were able to match all the resistive loads we tested, ranging from 25 to 800 Ω, on 160 through 10 meters as shown in Tables 2 and 3. The efficiency of this tuner was quite

Figure 3 — Palstar AT2K antenna tuner.

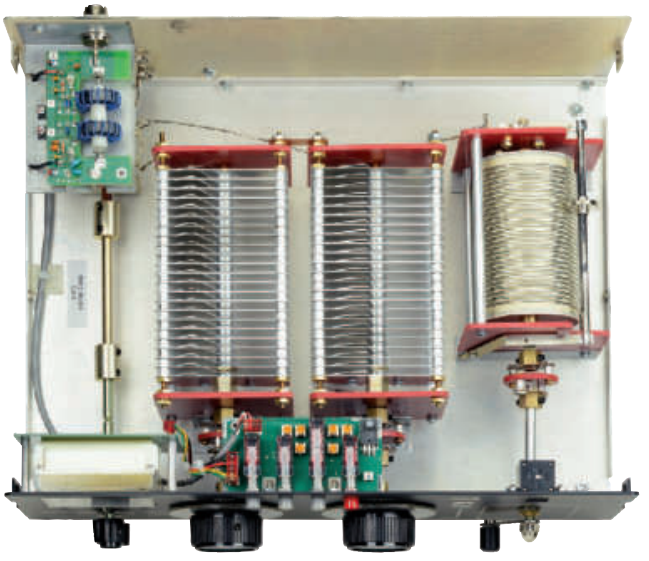


Figure 4 — Inside view of the AT2K tuner. Note the two separate variable capacitors, the usual configuration for a T network tuner.

Bottom Line

The Palstar AT2K and AT2KD are rugged, well built and easy to use antenna tuners that can match most antenna systems on most bands. The AT2KD has the edge on quickly tuning to a match, while the AT2K offers a wider tuning range on 6 meters. Either one would be a great addition to any shack.

good, with some loss at the lower impedances on the lower bands. Tables also show the loss of the AT2KD with optional baluns for balanced line.

Both tuners passed our high power, low impedance tests without problems. During the high power, high impedance tests, both tuners exhibited arcing on 160 meters, the AT2K at 1400 W and the AT2KD at 750 W. Both tuners passed on the other bands, although the AT2KD tripped the amplifier's SWR protection after 3 minutes of continuous operation at 1500 W on 10 meters. Note that our high impedance load (20:1 SWR) presents a complex impedance, while Palstar specifications are for resistive loads, so the tuners may handle more power with a different load.

One concern with the AT2KD was that we found that it would match both shorts and opens on some bands as shown in Table 3. The precautions described in the MFJ-9982 section should be taken with the AT2KD.

Operating the AT2K and AT2KD

Both units offer very smooth operation in both the variable inductor and variable capacitor(s). The inductor goes end-to-end in 279 turns, each having a digit on the turns count window. I could estimate to half a turn for a resolution of 568 positions. This combined with the 100 divisions on each capacitor scale makes for easy resetability if you record your settings.

Table 2
Palstar AT2K Antenna Tuner, s/n 19731

Circuit configuration: T network.
Frequency range: 1.8 to 50 MHz.
Matching range: 20-1500 Ω with resistive load (1.8-30 MHz).
Power rating: 2000 W (PEP), 1500 W (single tone).
Measured current usage: 13.8 V dc at 21 mA (meter lamps only).
Size (height, width, depth): 5.6 × 14.7 × 13.2 inches (incl protrusions); weight: 13 lbs.
Price: $550.

ARRL Lab Resistive Load and Loss Testing

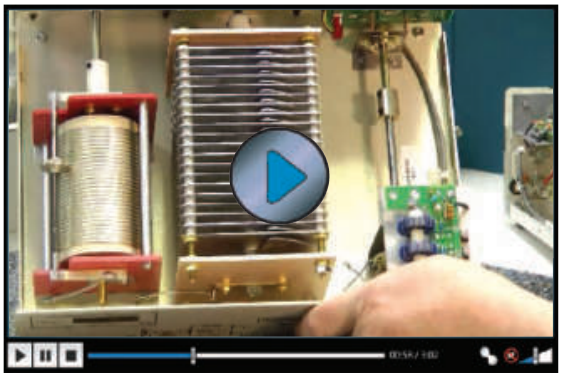
SWR	Load (Ω)		160 m	80 m	40 m	20 m	10 m
2:1	25	Power Loss%	15	11	7	5	5
		SWR	1.0	1.0	1.0	1.0	1.0
1:1	50	Power Loss%	7	5	4	3	6
		SWR	1.1	1.1	1.0	1.0	1.1
2:1	100	Power Loss%	7	3	2	2	4
		SWR	1.0	1.0	1.0	1.0	1.0
4:1	200	Power Loss%	4	6	4	5	11
		SWR	1.0	1.0	1.0	1.0	1.1
7.6:1	380	Power Loss%	8	7	7	8	11
		SWR	1.0	1.0	1.0	1.0	1.0
16:1	800	Power Loss%	5	10	7	9	14
		SWR	1.0	1.0	1.0	1.0	1.0

Frequency	Short	Open	
1.8 MHz	NT	NT	Will tune 1500 Ω resistive load 160-10 meters.
3.5 MHz	NT	NT	
7.0 MHz	NT	NT	
14 MHz	NT	NT	
28 MHz	NT	NT	NT = no tuning solution.

High Power ARRL Lab Testing

Tests performed with 1500 W PEP keyed CW, 40% duty cycle, 10 minutes (see March 2013 *QST*, p 58 for details).
High impedance test (20:1 SWR, complex load): 160 meters, arcing at 1400 W; Passed at 1250 W, warm to the touch.* 20, 10 meters: Passed, mildly warm.
Low impedance test (25 Ω resistive load): 160, 20, 10 meters, Passed, ran cool.

*Note: This tuner may meet the manufacturer's specs, but we cannot verify this since the high impedance load is complex, not purely resistive as the manufacturer's specifications assume.



See the Digital Edition of *QST* for a video overview of the Palstar AT2K and AT2KD antenna tuners.

Figure 5 — Palstar AT2KD antenna tuner.

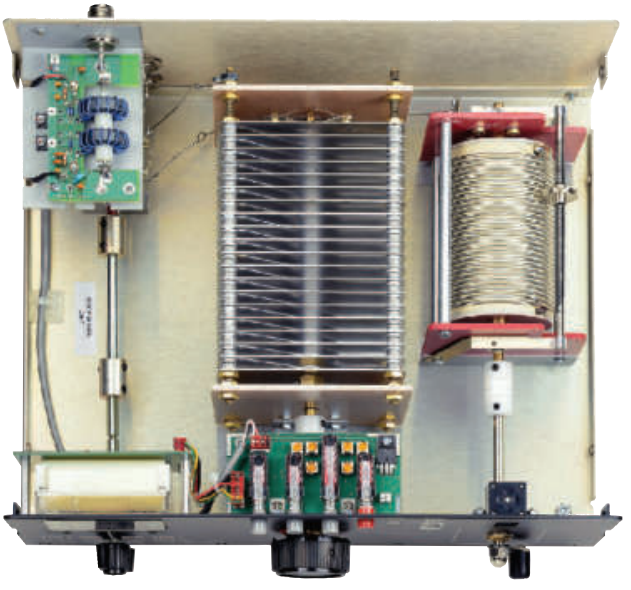


Figure 6 — Inside view of the AT2KD tuner. Note the single variable differential capacitor. While the differential capacitor is wider than either of the capacitors in Figure 4, the result is a narrower unit that tunes with two rather than three controls.

Table 3
Palstar AT2KD Antenna Tuner, s/n 18934

Circuit configuration: T network (differential, see text).
Frequency range: 1.8 to 50 MHz.
Matching range: 20-1500 Ω with resistive load (1.8-30 MHz).
Power rating: 2000 W (PEP), 1500 W (single tone).*
Measured current usage: 13.8 V dc at 21 mA (meter lamps only).
Size (height, width, depth): 5.8 × 13.2 × 12 inches (incl protrusions); weight: 12 lbs.
Price: $550; optional 1:1 and 4:1 baluns, $90 each.
*Two other areas of the manual warned not to exceed 1000 W, single tone.

ARRL Lab Resistive Load and Loss Testing

SWR	Load (Ω)		160 m	80 m	40 m	20 m	10 m
2:1	25	Power Loss%	14	8	6	5	8
		SWR	1.0	1.0	1.0	1.0	1.0
1:1	50	Power Loss%	9	4	4	2	5
		SWR	1.0	1.0	1.0	1.0	1.0
2:1	100	Power Loss%	6	2	2	2	3
		SWR	1.0	1.0	1.0	1.0	1.0
4:1	200	Power Loss%	4	2	2	2	4
		SWR	1.0	1.0	1.0	1.0	1.0
7.6:1	380	Power Loss%	6	6	6	7	9
		SWR	1.1	1.0	1.0	1.0	1.2
16:1	800	Power Loss%	4	3	4	7	12
		SWR	1.7	1.0	1.0	1.0	1.6

With optional 1:1 balun

SWR	Load (Ω)		160 m	80 m	40 m	20 m	10 m
2:1	25	Power Loss%	33	24	20	16	28
		SWR	1.0	1.0	1.0	1.0	1.0
1:1	50	Power Loss%	21	14	11	11	21
		SWR	1.0	1.0	1.0	1.0	1.0
2:1	100	Power Loss%	14	8	6	4	11
		SWR	1.0	1.0	1.0	1.0	1.0
4:1	200	Power Loss%	10	8	6	4	11
		SWR	1.0	1.0	1.0	1.0	1.0
7.6:1	380	Power Loss%	13	6	6	7	14
		SWR	1.1	1.0	1.0	1.0	1.0
16:1	800	Power Loss%	11	7	7	10	14
		SWR	1.0	1.0	1.0	1.0	1.0

With optional 4:1 balun

2:1	100	Power Loss%	7	4	4	4	8
		SWR	1.0	1.0	1.0	1.0	1.0
4:1	200	Power Loss%	4	4	4	7	10
		SWR	1.0	1.0	1.0	1.0	1.3
7.6:1	380	Power Loss%	8	10	12	16	20
		SWR	1.1	1.0	1.0	1.0	1.2
16:1	800	Power Loss%	9	8	14	22	33
		SWR	2.4	1.0	1.0	1.0	1.1

Frequency	Short	Open	
1.8 MHz	Yes	NT	Will tune 1500 Ω resistive load 160-10 meters.
3.5 MHz	Yes	NT	
7.0 MHz	Yes	Yes	
14 MHz	Yes	Yes	Yes = will tune into open or short circuit.
28 MHz	NT	Yes	NT = no tuning solution.

High Power ARRL Lab Testing

Tests performed with 1500 W PEP keyed CW, 40% duty cycle, 10 minutes (see March 2013 *QST*, p 58 for details).
High impedance test (20:1 SWR, complex load): 160 meters, arcing at 750 W; Passed at 700 W, cool to the touch. 20 meters: Passed, cool to the touch. 10 meters: SWR trip after 3 minutes; passed at 900 W, warm to the touch.*
Low impedance test (25 Ω resistive load): 160, 20, 10 meters, Passed, ran cool.

*Note: This tuner may meet the manufacturer's specs, but we cannot verify this since the high impedance load is complex, not purely resistive as the manufacturer's specifications assume.

On the Air at W1ZR

I used both tuners with all my antennas described previously and a dummy load. I was able to obtain a solid 1:1 match on sensible MF and HF antennas. There is no question that on a number of antenna/band combinations the AT2KD found its match more quickly with the two controls, although some came in about as quickly with the AT2K. In all cases, I started with the suggested values in the manual, which were quite close to the settings needed for my dummy load.

The one difference that I found between the tuner capabilities was on 6 meters. Both would tune a 50 Ω dummy load and trim up my coupled resonator Yagi on 6. The AT2K was able to also match my Zepp with 4:1 external balun to 1:1, but the best the AT2KD could do was a 3:1 match. This is not surprising, since the AT2K had both capacitors at a fairly low value for its match, a condition that the AT2KD cannot achieve. All in all, I prefer the AT2KD because of the ease in tuning each new antenna. I suspect that with settings recorded, there would be very little operational difference between the two as long as I didn't plan to use a linear with a high impedance load on 160 meters.

For either tuner, having the balun as an external option offers a potential configuration advantage compared to an internal balun. Many amateurs choose to transition from unshielded balanced line to coax at some distance from the station operating position to avoid problems with coupling from the feed line to other cabling and allow easier routing of cables. The downside, of course, is that the coax is generally mismatched and thus may introduce loss. Still, if top quality low-loss coax is used and the length is short (10 feet or less is a good target), the loss is usually not significant on HF.

Documentation

Both tuners come with similar well written and illustrated 19 page manuals with a schematic, meter calibration instructions and useful instructions on tuning procedure, along with suggested starting points for each band. There are also suggestions on what to do in order to tune antennas that are not within range. The manual recommends cleaning the inductor turns every 4 to 6 months with isopropyl alcohol and they even provide cotton swabs for the purpose.

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

Array Solutions VNAuhf Vector Network Analyzer

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

Previously I had the opportunity to review the Array Solutions VNA2180 Vector Network Analyzer.[2] I found the VNA2180 to be a highly accurate instrument that permitted me to analyze circuits in my home lab to accuracy levels I haven't seen since the measurement capabilities of my pre-retirement microwave lab! However the VNA2180 is limited to a maximum frequency of 180 MHz and much of my tinkering involves projects above this, and so I wanted something that covered up to at least 450 MHz. Enter the VNAuhf, a 5 kHz to 1200 MHz vector network analyzer.

The VNAuhf is an extended frequency range version of the VNA2180. Table 4 compares the differences between these two products. The complete VNAuhf specifications may be found on the Array Solutions website.

First — A Word About Calibration

Like any VNA, the VNAuhf must be calibrated using calibration standards so setup cables and connections and VNA imperfections can be removed from the measurement process. The VNAuhf calibration kit includes precision short and open terminations, a precision 50 Ω load, and two 14 inch LMR-240 cables with N male connectors. The terminations and load consist of N-male-to-SMA-female adapters with the appropriate SMA termination or load attached.

The short is close to ideal over the VNAuhf 1200 MHz frequency range. The open is more critical, as fringing capacitance leads to errors at higher frequencies. This fringing capacitance is measured and removed as part of the calibration process. Because the same type of adapter is used for the open and short, the reference plane between the two is very similar over the VNAuhf frequency range.

The most critical calibration item is the precision broadband 50 Ω termination. Thanks to friends in the microwave lab of a local company, I measured the Array Solutions 50 Ω termination on an HP/Agilent 8722D vector network analyzer. The SMA 50 Ω termination return loss exceeded 40 dB through 1200 MHz. When the SMA termination was installed on the N-to-SMA adapter (the actual calibration load), the worst-case return loss was 32 dB at 1200 MHz (SWR ≈ 1.05:1), improving to better than 40 dB return loss below about 650 MHz (SWR ≈ 1.02:1) — a very good load indeed!

Preparing to Use the VNAuhf

The VNAuhf software runs under recent versions of *Windows*. No software installation is required — the software can run directly from a folder, flash drive or CD. Included with the VNAuhf are the calibration kit, a 120 V ac power supply and a USB interface cable. A padded carrying case is optional.

After downloading a zip file from **www.w5big.com** which includes the latest software and manual, extract the software and run the program. You will need to set up the proper COM port. When the VNAuhf USB cable is plugged into the computer, the *Vista*, *Windows* 7 and *Windows* 8 operating systems will automatically find the correct USB driver for you. Older versions of *Windows* may require you to load the proper driver, available online. Set the COM port in the VNAuhf setup menu, and then close and restart the program.

Calibration is easy, as you simply attach the appropriate termination when prompted. Once calibrated, there is no need to recalibrate each time you use the instrument. Recalibration is necessary only if you change the measuring setup.

Using the VNAuhf

My first test investigated the performance of a ¼ wave 2 meter ground plane antenna on 2 meters and 440 MHz (70 centimeters). Since the 70 centimeter band is approximately three times the frequency of the 2 meter band, I wanted to evaluate the standard 2 meter 19 inch whip as a ¾ wave whip on 70 centimeters. Figure 7 shows the measured SWR and return loss performance. As you can see, the SWR in the repeater part of the 70 cm band is about 2.5:1. This is not too bad, and is tolerated by many dual-band transceivers. One could better optimize the antenna for both bands by using the VNAuhf to trim the 2 meter whip for resonance a bit higher in frequency. This would improve the

[2]P. Salas, AD5X, "Array Solutions VNA2180 Vector Network Analyzer," Product Review, *QST*, Mar 2011, pp 57-59.

Bottom Line

The Array Solutions VNAuhf is an accurate lab-grade instrument that covers up to 1200 MHz, yet is priced to be affordable for the sophisticated home experimenter.

Table 4
VNAuhf vs VNA2180 Key Performance Specifications

Parameter	VNAuhf	VNA2180
Frequency range	5 kHz to 1000 MHz (usable to 1200 MHz)	5 kHz to 180 MHz
Output into 50 Ω (programmable)	–13 dBm to –33 dBm	+7 dBm to –13 dBm
Impedance measuring range	5 kΩ	10 kΩ
Port B return loss	20 dB minimum	30 dB minimum
Max interference input while measuring	0.1 V RMS (–7 dBm)	1.4 V RMS (+16 dBm)
Dynamic range	90 dB/200 MHz 70 dB/500 MHz 60 dB/1 GHz	100 dB/50 MHz 80 dB/160 MHz

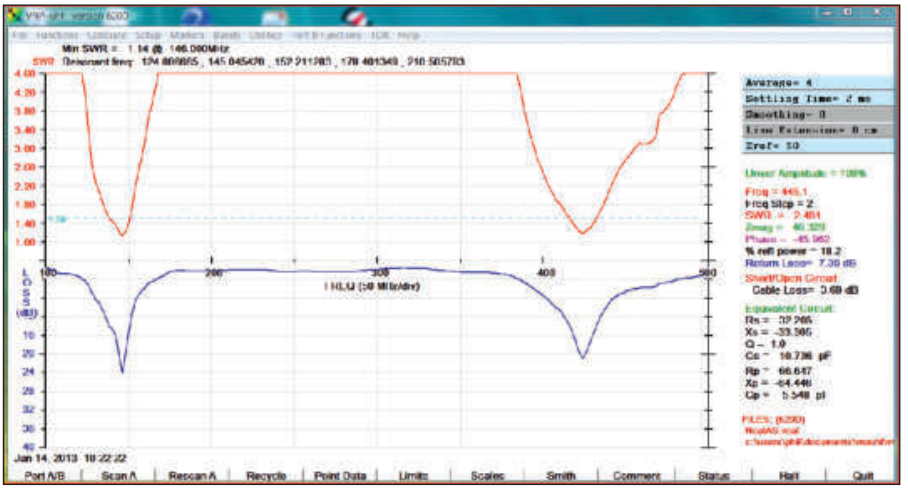


Figure 7 — SWR and Return Loss evaluation of a 19 inch whip on both 2 meters and 440 MHz.

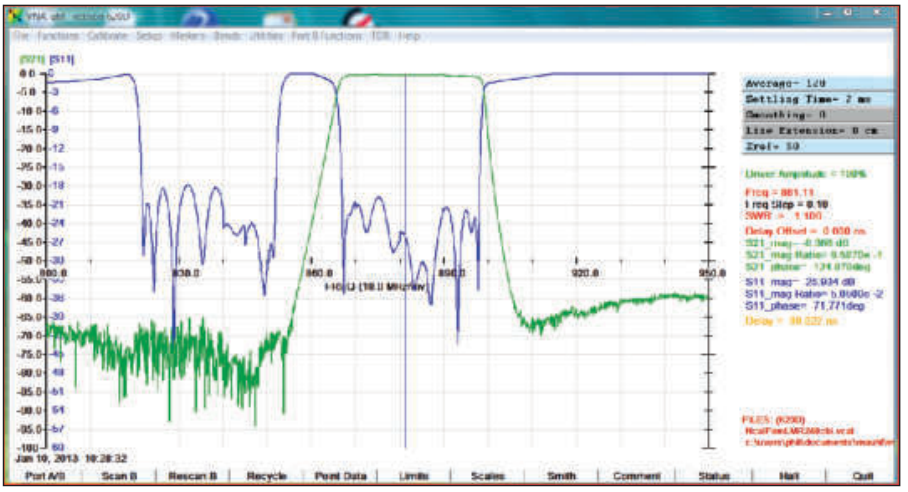


Figure 8 — Cellular duplexer performance measured by the VNAuhf.

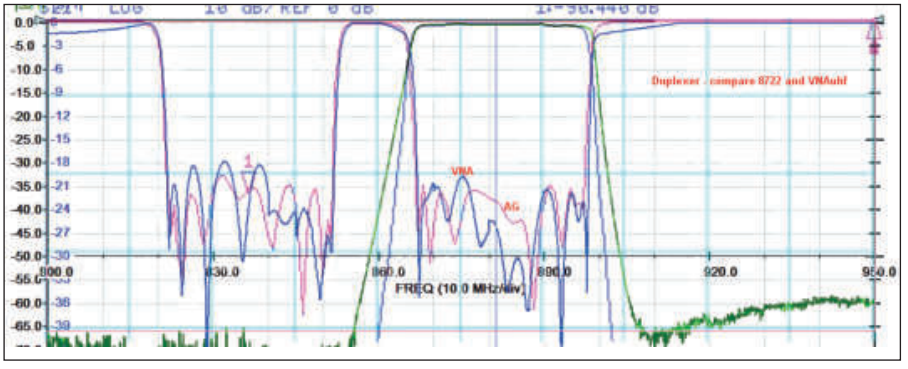


Figure 9 — VNAuhf and Agilent 8722D performance overlay

445 MHz performance while still giving good 2 meter performance.

Next I looked at a much higher frequency device to assess the extended range capability of the VNAuhf. I was fortunate to acquire an 800-900 MHz cellular duplexer, thanks to Brad Wick WØCO. I connected the duplexer antenna port to the VNAuhf PORT A and the duplexer TX port to the VNAuhf PORT B, and I terminated the duplexer receive port in the precision 50 Ω load. The VNAuhf measured performance is shown in Figure 8. The duplexer transmit and receive return loss is shown by the blue curve, and the transmit insertion loss and TR isolation is illustrated by the green curve. The actual duplexer TR isolation is much greater than that indicated, but the measurement is limited by the 60-70 dB dynamic range of the VNAuhf at these high frequencies.

Next I took the duplexer to the local microwave lab and measured it on the HP/Agilent 8722D. The difference in the TR isolation is due to the 80-90 dB dynamic range of the HP/Agilent VNA. In order to look at the difference between the VNAuhf and HP/Agilent 8722D, the two curves were overlaid as shown in Figure 9.

As you can see, the return loss and insertion loss data is very close between the two instruments. This is excellent correlation, especially considering that the Agilent 8722D setup included extremely expensive precision loads and cables (good to 40 GHz), whereas the VNAuhf utilized the Array Solutions lower-frequency loads and cables.

Of course, there are many other applications for the VNAuhf. Circuit and antenna design and evaluation are obvious. As an example, I've been using it to precisely calibrate attenuators, and characterize the directivity and coupling of UHF couplers purchased on popular online auction sites.

Conclusion

The VNAuhf is an accurate instrument suitable for both personal and industrial lab environments. Software and firmware updates are available for download at no charge. The software can be run in demo mode to get a feel for the product prior to purchasing. For additional measurements and applications, refer to the VNA2180 and AIMuhf reviews previously published in *QST*. Additional information is also available at **www.w5big.com**.

Manufacturer: Array Solutions, 2611 North Beltline Rd, Suite 109, Sunnyvale, TX 75182; tel 214-954-7140; **www.arraysolutions.com**. Price (US version): VNAuhf $1895; VNA-PC carry case, $49.

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

Magnetic Loop Antennas

Distributed Capacitance in Copper Pipe Small Magnetic Loop Antennas

Recently, there seems to be a renewed interest in the small transmitting magnetic loop antenna. I have built one and can definitely vouch for its performance. Figure 1 shows the loop I built. Often, a goal in the design is to build a single loop covering as many bands as possible. A frequent focus is 40 meters through 10 meters, since it can be achieved with smaller loop size and offers adequate efficiency. It is understood in these cases that the efficiency may be down on the lower-frequency bands but the antenna is still usable and makes for a lot of fun in experimenting with the loop.

There are many calculator tools available on the Internet, to help size the loop coil and a variable capacitor for best performance on the bands of choice. One of the best I have found is at **aa5tb.com/loop.html**. The AA5TB loop calculator is an excellent resource, and is the one I used in designing my loop. This calculator is one of the only ones that actually documents the equations used. Table 1 is taken directly from the AA5TB calculator, and are the equations found in the 15th Edition of *The ARRL Antenna Book*. Another good loop calculator tool can be found at **www.66pacific.com/calculators/small_tx_loop_calc.aspx**.

I would like to make two points about all the online calculators. First, they are almost always based on the equations developed by Ted Hart, W5QJR, in his article "Small High Efficiency Loop Antennas."[1] A partial listing of his equations from the article is shown in Table 2, and his equations and small high efficiency transmitting loop are also described in the 22nd Edition of *The ARRL Antenna Book*. Second, when observing the calculated results, the distributed capacitance should be observed when sizing both the variable capacitor and the loop coil size. Often, as in the case of Note 2, the calculator lists the "tuning capacitance," which can cause confusion as it may be perceived as the value of the variable capacitor necessary to tune the design frequency when in fact it is the tuning capacitance. Some calculators, such as given in Note 1, even designate "tuning capacitor" for the value of "tuning capacitance," which can really cause confusion. I believe this is primarily because in his article (See Note 3 and Table 2), Ted Hart's Equation 6 labeled for "tuning capacitor" is actually the "tuning capacitance," or the overall capacitance needed to tune the operating frequency. He writes, "Tuning Capacitor $C_T = 1 / 2\pi f X_L \times 10^6$." This equation does not provide the value of the capacitor needed to resonate the loop. That value would be Ted's

Figure 1 — The author's small magnetic loop antenna. A stepper motor is used to drive a vacuum variable tuning capacitor to resonate the loop at the operating frequency.

Table 1
AA5TB Calculator Equations

Radiation Resistance, Ohms:
$R_R = (3.38\times10^{-8})(f^2A)^2$

Loss Resistance, Ohms:
$R_L = (9.96\times10^{-4})(\sqrt{f})(S/d)$

Efficiency: $\eta = R_R/(R_R+R_L)$

Inductance, Henrys:
$L = (1.9\times10^{-8})S\ [7.353\ \log_{10}(96S/\pi d) - 6.386]$

Inductive Reactance, Ohms: $X_L = 2\pi f(L\times10^6)$

Tuning Capacitor, Farads: $C_T = 1/2\pi f(X_L\times10^6)$

Quality Factor: $Q = (f\times10^6)/\Delta f = X_L/2(R_R + R_L)$

Bandwidth, Hertz: $\Delta f = (f\times10^6)/Q = [(f_1 - f_2)\times10^6]$

Distributed Capacity: pF: $C_D = 0.82S$

Capacitor Potential, Volts: $V_C = \sqrt{(PX_LQ)}$

Capacitor Voltage Rating: 75,000 V/in

Where:
f = operating frequency, MHz
A = area of loop, square feet
S = conductor length, feet
d = conductor diameter, inches
η = decimal value; dB = 10 log10η
P = transmitter power, Watts

From *The ARRL Antenna Book*, 15th Edition, "Small High Efficiency Loop Antennas for Transmitting," 1988, Table 4, p 5-14.

[1]Ted Hart, W5QJR, "Small High Efficiency Loop Antennas," June 1986 *QST*, pp 33-36.

Table 2
Partial Listing of Equations from Ted Hart's June 1986 *QST* Article

$$\text{Tuning Capacitor, } C_T = \frac{1}{2\pi f X_L \times 10^6} \quad \text{[Eq 6]}$$

$$\text{Quality Factor, } Q = \frac{f}{\Delta f} = \frac{X_L}{2(R_R + R_L)} \quad \text{[Eq 7]}$$

$$\text{Bandwidth, } \Delta f = \frac{f}{Q} \quad \text{[Eq 8]}$$

Distributed Capacitance,
CD = 0.82 × Conductor Length (ft)

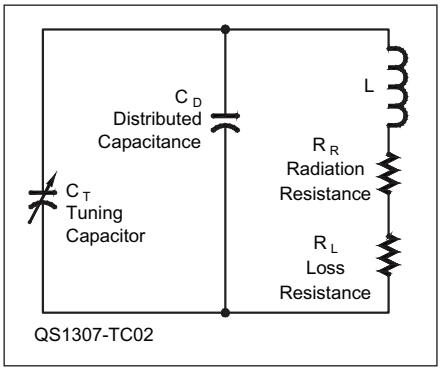


Figure 2 — A schematic representation of a small transmitting loop antenna.

C_T less the distributed capacitance of the loop. This equation is the total capacitance used in determining resonant operating frequency of the loop, $f_{res} = 1 / 2\pi \sqrt{(LC)}$.

Figure 2 shows a schematic of the magnetic loop antenna circuit. It is a tuning capacitor (C_T) in parallel with distributed capacitance (C_D), the combination then in parallel with the series loop inductance L and resistances R_{RAD} and R_L. As a circuit, the capacitance necessary to tune the loop's operating frequency to resonance given the loop's inductance L, would be the tuning capacitance $C = C_T + C_D$. At resonance, inductive and capacitive reactance are equal; $X_L = X_C$, and the resonant frequency is $f_{res} = 1 / 2\pi \sqrt{(LC)}$. Taking $X_L = X_C$ and reducing it to $X_L = 1 / 2\pi fC$ and then solving for C, we get $C = 1 / 2\pi f X_L$. Clearly, this is Ted's Equation 6, $C_T = 1 / 2\pi f X_L \times 10^6$, labeled as "tuning capacitor" but it is actually the total "tuning capacitance."

Later in the article Ted provides a hint of the mislabeling and his statement may have been overlooked by those searching for the equations to create their calculator tools. In his article, Ted states, "An equation was then empirically developed to define the distributed capacitance for any size loop. Then, by subtracting distributed capacitance from tuning capacitance, we can determine the actual value of tuning capacitor required." (See Note 3). He had actually discovered that for a copper pipe loop, an approximation of distributed capacitance could be made as 82% of the loop conductor length in feet.

Quibbling about "tuning capacitance" versus "tuning capacitor" may seem like semantics, but it is important to distinguish the difference, especially for those wanting to attempt a multiband loop, such as my desire for a 40 meter through 10 meter loop. In relation to the minimum capacitance available in most variable capacitors, the distributed capacitance of the loop coil can be quite large in these antennas. For a loop conductor length of 10 feet and ¾ inch copper pipe at 28 MHz, the tuning capacitance is ~13.2 pF and the efficiency is 95%. The efficiency is 12% at 7 MHz, but the distributed capacitance is ~8.2 pF, making the variable capacitor need a minimum of around 5 pF; this is difficult to find in a high voltage variable capacitor.

A loop antenna cannot be tuned to a capacitance lower than that of the distributed capacitance since it is inherent in the loop coil itself. Distributed capacitance gets bigger with bigger loop coil lengths, reducing the ability to get to the high frequency bands. Smaller loops have less distributed capacitance but the efficiency suffers dramatically at lower frequency bands. For a single loop to effectively achieve 40 meter through 10 meter operation, the distributed capacitance can make this terribly challenging if not impossible.

I am confident in Ted's method for approximating distributed capacitance in a copper pipe loop because it matched my loop so well. My loop is built from ⅝ inch OD soft copper pipe formed into a circle on a plywood mandrel. I chose to work with ~1 meter in loop diameter since tubing comes in 10 foot lengths. I wanted the ability to run 100 W and did not want to get into capacitor design, so I used a surplus Russian high voltage vacuum variable capacitor with a range of ~10 pF to 500 pF. I

Table 3

AA5TB Loop Calculator Results for Author's Loop Design

Input the following parameters:

Design Frequency =	28.000 MHz	
Loop Diameter =	3.296 feet	1.005 m
Conductor Diameter =	0.625 inches	15.875 mm
Added Loss Resistance =	0.000 milliohms	
RF Power =	100.000 Watts	

Calculated Results:

Bandwidth =	191.735 kHz (-3 dB points)	
Efficiency =	94.542 %	-0.244 dB
Loop Area =	8.532 ft²	0.793 m²
Radiation Resistance =	1512.437 mΩ	
Total Loss Resistance =	87.316 mΩ	
Loop Circumference =	10.355 ft	3.156 m
Wavelength Percentage =	29.477 % λ	
Loop Inductance =	2.656 µH	
Distributed Capacitance =	8.491 pF	
Q (Quality Factor) =	146.035	
Tuning Capacitor =	12.165 pF	
Capacitor Voltage =	2612.150 V	
Minimum Plate Spacing =	34.829 mils (1/1000 in)	0.885 mm

Table 4

AA5TB Calculator Results for Maximum Frequency with 18 pF Tuning Capacitance

Input the following parameters:

Design Frequency =	23.017 MHz	
Loop Diameter =	3.296 feet	1.005 m
Conductor Diameter =	0.625 inches	15.875 mm
Added Loss Resistance =	0.000 milliohms	
RF Power =	100.000 Watts	

Calculated Results:

Bandwidth =	92.261 kHz (-3 dB points)	
Efficiency =	89.716 %	-0.471 dB
Loop Area =	8.532 ft²	0.793 m²
Radiation Resistance =	690.622 mΩ	
Total Loss Resistance =	79.166 mΩ	
Loop Circumference =	10.355 ft	3.156 m
Wavelength Percentage =	24.231 % λ	
Loop Inductance =	2.656 µH	
Distributed Capacitance =	8.491 pF	
Q (Quality Factor) =	249.476	
Tuning Capacitor =	18.003 pF	
Capacitor Voltage =	3095.493 V	
Minimum Plate Spacing =	41.273 mils (1/1000 in)	1.048 mm

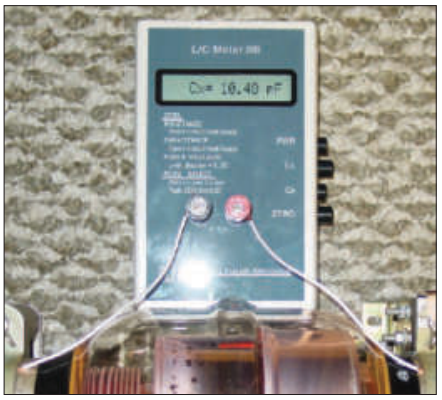


Figure 3 — The author's vacuum variable capacitor set at minimum capacitance and measured with an LC meter showed 10.48 pF.

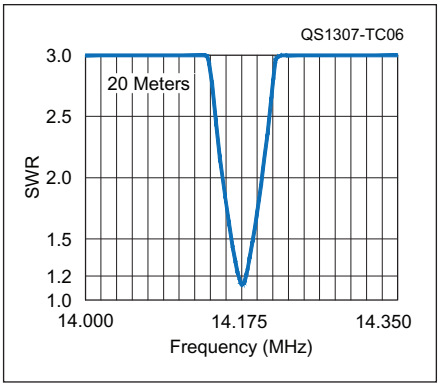


Figure 6 — Here is the measured SWR bandwidth on 20 meters for the author's loop set at mid band.

Figure 4 — Here is the loop mounted vacuum variable capacitor.

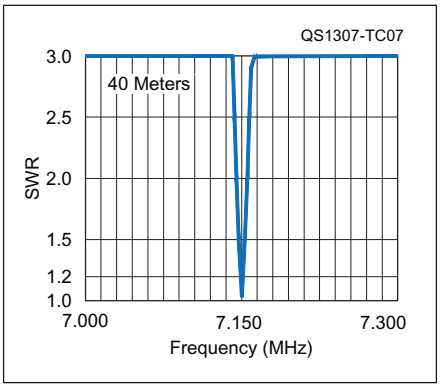


Figure 7 — This is the measured SWR bandwidth on 40 meters for the author's loop set at mid band.

Figure 5 — Antenna analyzer measurement showing the resonant frequency dip of the antenna taken at the minimum capacitor value. These readings were taken with the loop mounted at 3 feet off the ground through 75 feet of RG-8X coaxial cable. The antenna is fully matched if mounted 6 to 8 feet high.

had verified my capacitor's minimum capacitance upon receiving it by using my All Digital Electronics L/C Meter, as shown in Figure 3. Using the AA5TB calculator and desiring a high band operating frequency of 28 MHz yielded a tuning capacitor of approximately 12 pF necessary to do the job. (See Table 3.)

Upon attempting to tune my loop to 28 MHz, however, my capacitor hit rock bottom before I even got to 12 meters. It was then I realized I had been bitten by the monster, distributed capacitance. It was also when I began my search that led me to Ted's article. Looking back at the calculator, it showed the distributed capacitance to be ~8 pF. After looking at the reported values against the resonant frequency equation, I realized the 12 pF was really reporting the tuning capacitance, not the tuning capacitor value. I returned to the AA5TB tool to back calculate the resonant frequency assuming a tuning capacitance of 18 pF (8 pF distributed plus the 10 pF minimum on the variable). The calculated frequency was 23.017 MHz. (See Table 4.) When I went to check this with my antenna analyzer on my loop, that's when I had the epiphany. With the capacitor bottomed out and searching for the resonant dip, I found it at ~23 MHz. (See Figures 4 and 5.) After witnessing this, I felt I had solved my problem. I had great respect and appreciation for the work that Ted Hart performed, the work of AA5TB, and realized again just how much I enjoy experimenting in Amateur Radio and electronics. I had built a loop that worked 40 meters through 15 meters, but 12 meters and 10 meters were unreachable, I believe, due to distributed capacitance. Figures 6 and 7 show the SWR bandwidth of my antenna on 20 meters and 40 meters, respectively.

Generally, after experimenting with an online calculator and juggling design parameters, one comes to the conclusion that two loops are really needed to effectively cover 10 meters through 40 meters; or high bands versus low bands. The online calculator tools referencing "tuning capacitor" for the "tuning capacitance" should probably be updated to provide clarity in distinguishing the distributed capacitance, tuning capacitor value, and the overall tuning capacitance. To be fair, there is at least one calculator tool by OH7SV that does make this point.[2] Some people are building small magnetic loops as their only antenna, not for experimental reasons such as me. Given the time involved in building and the expense of materials, a high level of clarity is needed in the calculators to help them build the best loop they can. When designing a small magnetic loop antenna using the online calculators you are likely to focus on efficiency and bandwidth. In addition to those performance parameters, be sure to keep your eye on distributed capacitance. — *73, Paul Patterson, K4PP, 113 Samantha Rd, Huntsville, AL 35806;* **prp321@bellsouth.net**

[2]The OH7SV loop calculator is available at **www.saunalahti.fi/hohtola/ham/magnetic-loop-for-80m/magnetic-loop-for-80m.htm**.

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

Materials for this column may be sent to ARRL, 225 Main St, Newington, CT 06111; or via e-mail to **tc@arrl.org**. Please include your name, call sign, complete mailing address, daytime telephone number and e-mail address on all correspondence. Whether you are praising or criticizing a work, please send the author(s) a copy of your comments. The publishers of *QST* assume no responsibility for statements made herein by correspondents.

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

Short Haul HF Has its Special Challenges

Q William, W5VDM, asks: I would like to get a new antenna that will allow me to get into my 10 meter net in Houston, 70 miles away at 0200Z. I am currently using a ground mounted monopole that works well to both coasts, but I think it is skipping over Houston. Unfortunately, a beam at 50 feet is out of the question, but a dipole at 20 feet is within reach.

A Yes, 70 miles can be a tough shot on 10 meters! Low angle radiators, such as your vertical monopole will tend to shoot over the top if there's skip, and it is beyond the usual ground wave range.

In any case, you will need some kind of propagation mechanism to get your signals to go the distance. The most reliable path is a line of sight (LOS) shot, but that will require height and clear terrain. The distance to the radio horizon in miles is approximately 0.32 × {height (ft)}$^{0.5}$. That would mean that the antennas at both ends would need to be 703 feet high (to meet at 35 miles) or if you're at 30 feet (7 miles to horizon), the net control would have to be at a height of 2300 feet. While this is not impossible, it's not too likely. This also explains why broadcast FM and TV towers are often so high. Note that for optimum LOS operation, you want to have your antennas of the same polarization.

If you did have that beam and high power at each end, you might be able to get through by random scatter from various objects, such as meteor trails, aircraft or other mechanisms, but this may be spotty.

Since your net is likely in daylight, at least part of the year while the ionosphere may be cooperative, you might be able to reach the net area through the use of near vertical incidence skywave. This is most reliable on the 80 through 30 meter bands, but may work for you if 10 meters is *open*. That means that the maximum usable frequency (MUF) is above 10 meters, not something that happens every day, but it will happen enough in daylight with high sunspots to let you check in some fraction of the time. This requires a low horizontal antenna — optimum height is less than ½ wavelength, or about 10 to 12 feet. In addition to the usual F layer propagation, the lower E layer might also work. Perhaps half the time, and most of the time during darkness, your signals will just continue on toward deep space — 10 meters is also a satellite band, after all!

Still, a low horizontal dipole, broadside to Houston, might be the best you can do on a somewhat regular basis and it doesn't cost much. It is also possible that your current low angle signal could reach a sporadic E layer cloud and backscatter to your net control station. While this may happen, it will be sporadic, as it is called.

Q Tom, N8EUI, asks: I've added some equipment to my station and I'm rearranging my station setup as a result. I now have an HF transceiver, a linear amplifier, an in-line wattmeter, a spectrum analyzer and an antenna tuner. What is the best sequence for interconnecting them?

A The usual configuration is to connect the transceiver to the amplifier, amplifier to wattmeter, wattmeter to antenna tuner and then antenna tuner to antenna as shown in Figure 1. In that configuration, the wattmeter will read the power from the amplifier and its reflected power setting can be used to tune the antenna tuner (or check its operation if the tuner is an automatic one).

There might be times when you would want to move the wattmeter to a position between the transceiver and amplifier if, for example, you wanted to verify the amplifier drive level, or determine the amplifier input SWR, although most transceivers will indicate that on their internal meters. The typical in-line wattmeter is only designed to work in matched 50 Ω lines, so it would not give an accurate reading on the antenna side of the

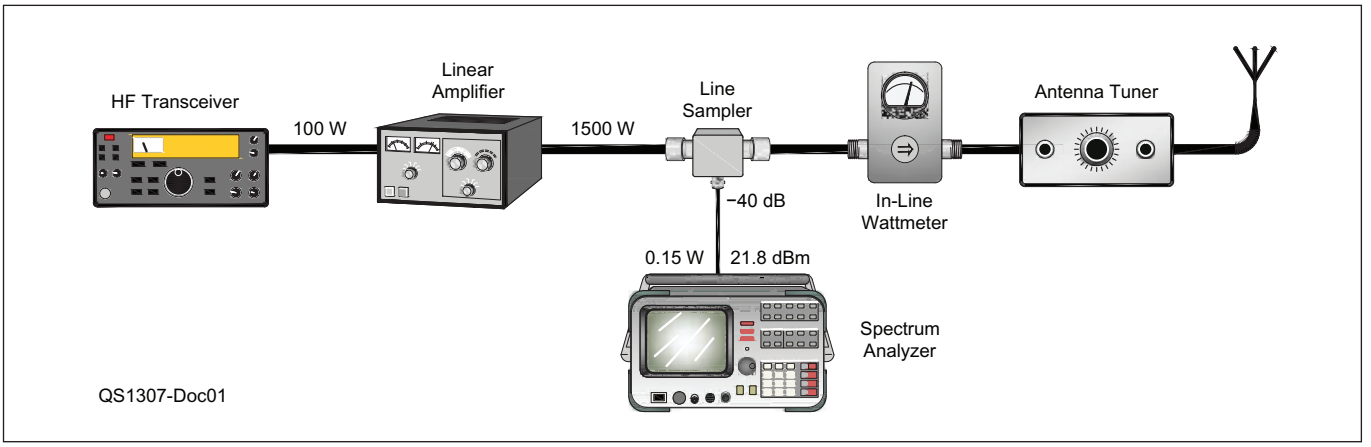


Figure 1 — Interconnection diagram for the equipment described showing typical power levels. Note that the line sampler attenuation needs to be set to provide the desired input level for the spectrum analyzer.

tuner, unless you were driving a matched load.

The spectrum analyzer likely needs a low level sample of your transmitted signal, so can't be directly connected anywhere in that configuration. I described a simple resistive line sampler in the March 2013 "Doctor" column and a better approach in the June 2013 column. You will have to adjust the values so that it will provide the correct level into your analyzer. Too strong a signal could easily destroy it.

Q Stanley, WA6LVC, notes: I enjoyed the article on propagation in the March 2013 issue of *QST*, however, I have just set up the new *WSPR AXE* on 20 meters and have been marveling at the results.[1] My question is, with real time actual propagation data available from *WSPR*, what is the role of propagation prediction?

A Well, there are different ways to operate on HF. If you want to find out what's happening now, *WSPR* may be your answer. On the other hand, if you want to plan your operation, or know when to sleep and when to operate to have the highest probability of reaching a particular station, prediction software can give you the best shot and can save a lot of nonproductive time. Of course, as with weather forecasts, propagation predictions are only correct some of the time.

Q Dan, AAØNK, asks: I recently restored an old Heathkit Warrior HA-10 linear amplifier. My question is that everyone says I should have a tuning pulser to help save the tubes. Could you tell me what a tuning pulser does, how it works and if you know of any plans for building one?

A Unlike the power amplifiers from the AM days, or even present day amplifiers intended for FM or most data modes, an SSB linear amplifier is designed to operate at a fairly low duty cycle of around 10 to 20%. This is because the power output of an SSB transmitter varies directly with the intensity of the applied speech waveform, reaching 100% of the peak power output only on rare occasions.

The implications of this show up in a couple of areas. First, if the amplifier's components are rated for the average voltage and current, some components, especially expensive power tubes, may be damaged if the amplifier is keyed for long periods while tuning.

[1]C. Luetzelschwab, K9LA, "The Sun and the Ionosphere," March 2013, pp 48-50.

The other problem is that the power supplies tend to deliver rated power only for a short interval and tend to sag if keyed for long. Typical power supplies make use of charged filter capacitors that charge to peak voltage so the high voltage will drop considerably if keyed long enough for them to discharge or sag. Thus the tuning done with the key down will not accurately predict how the amplifier will be operated during short voice peaks and the ratings are likely to be exceeded under that condition.

The problem then is — how do you properly tune such an amplifier? The typical transmit "pulse keyer," provides an on-off keyed signal at an adjustable duty cycle that can simulate operation during speech, but in a regular repeatable way. Unfortunately, the typical analog meter on your amplifier will not respond quickly enough to allow you to know what is happening as you tune. One way around this is to use an output indicator that can respond instantaneously, such as an oscilloscope connected through a line sampler as described in the June 2013 column. If that is used as an output indicator and a peak reading wattmeter is also looking at the output, the output can be peaked and you will also quickly know what the actual peak power is. In the absence of a serious pulse keyer, an electronic keyer set to high speed and with the dot contacts made will provide a 50% duty cycle, which is not exactly what you want, but it will give you an idea of how to use the method.

The good news in your case is that the Warrior amplifier uses four 811A power triodes. These tubes are quite rugged and tuning carefully at reduced power (my transceiver has a TUNE function that puts out 10 W, which is great for getting a preliminary tune) and then a very short key down and trim at full power should be safe, but this is not always safe with the more expensive and fragile tetrodes. I have had a number of 811A amplifiers and have never destroyed an amplifier or its tubes by tuning, as described above.

Q Mark, N2QT, asks: There has been an intense discussion about the spectral purity of signals observed during the recent ARRL RTTY Roundup contest. As you will no doubt remember this is similar to the key click discussions after CW contests of several years ago. The ARRL lab helped in cleaning up the CW key clicks by publicizing the problem and then adding spectral purity and keying waveforms to their equipment reviews. This helped improve the spectral purity of CW signals from new transceivers. Could a similar approach could help clean up the RTTY bands as well?

A (Thanks to Senior ARRL Test Engineer Bob Allison, WB1GCM.) The ARRL Lab is working on new tests to measure the waveform shape of internally generated frequency shift keyed (FSK) signals.

Based on my observations, the shaping of FSK waveforms is not the major cause of wide digital signals, although it should be considered. The use of sound card generated audio tones emanating from a PC into the MIC jack of an SSB transmitter makes it easy for many hams to use modes such as RTTY and other digital signaling modes. That process actually generates audio frequency shift keying (AFSK) in which the individual tones into a properly adjusted SSB transmitter should provide a transmitter output that is functionally equivalent to FSK.

Unfortunately, that method of RTTY can be troublesome, since both the sound card and the transceiver's audio chain have to be adjusted carefully, particularly in terms of signal level adjustments, to avoid distortion. We have stressed in publications to use minimal automatic level control (ALC). The microphone gain or input gain should be adjusted just high enough to result in the needed power. The ALC indicator should always be showing just the first LED/LCD bar or, if using an analog meter, just slightly higher than zero. ALC circuitry is designed for speech, not audio tones.

Sometimes a poorly designed transmitter audio chain can generate audio harmonics that widen the signal spectrum. Generally, just about all transceivers have low harmonics and do not pose this problem. It's the harmonics generated from sound cards that are being fed into the microphone jack.

One last comment — the use of noise limiters while receiving RTTY signals can cause distortion that will widen out the perceived received signal. You can observe the effect while listening to a strong CW station with the noise limiter on. The signal will have key clicks, but when the noise limiter is turned off, the clicks go away. I would hope that RTTY (and CW) operators are aware of that effect and not blame signals generated in their receiver on the station at the other end.

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

Steve Ford, WB8IMY, wb8imy@arrl.org

Comet CMX-2300 Dual SWR/Power Meter

In the CMX-2300, Comet offers a convenient solution for the ham who operates HF and VHF, yet doesn't want the hassle of wrestling with separate SWR/power meters.

The CMX-2300 provides twin cross-needle meters in a single case. Each meter has two needles: one to indicate forward power and another to indicate reflected power. The needles cross each other over a vertical nomograph where you simultaneously read the resulting Standing Wave Ratio (SWR).

The left hand meter covers 1.8 to 200 MHz at three power levels: 30, 300 and 3000 W. The right hand meter measures 140 to 525 MHz at 20, 50 or 200 W. The meters are completely independent, along with their individual power settings. There is no need to switch between one and the other when you're transmitting at HF or VHF. This is a powerful convenience factor in a multitransmitter station.

The CMX-2300 case measures 9.9 × 3.9 × 5.4 inches with the meter bezels dominating the layout for easy viewing. The meters become illuminated when you supply 11-15 V dc to the input jack on the back panel. I found the lighting to be unusual, but in a pleasant way. The meters glow in a multicolored scheme that is quite striking in a darkened room. In normal light the meters present a beige background.

The enclosure is somewhat heavy at more than 3 pounds, but I suspect this is intended to help stabilize the CMX-2300. There are four SO-239 coaxial jacks on the back panel; HF in and out plus VHF in/out. When you have four cables connected to the CMX-2300 the extra weight helps keep the meters from tilting upward. For this review I had LMR-400 cables attached to the VHF side and Belden 9913 on the HF side. For the input connections I used right-angle SO-239/PL-259 adapters because the meter was positioned next to a wall and I couldn't spare the additional room required to gently curve the cables. In this configuration the CMX-2300 was able to keep all four of its rubber feet firmly on the shelf surface.

It is interesting to note that there are two BNC connectors on the rear panel of the CMX-2300. These are ports for sampling either VHF or HF RF for use with a station monitor, frequency counter, etc. Both ports provide 30 dB signal attenuation.

In normal lighting you hardly notice anything out of the ordinary about the CMX-2300 meters. But turn down the lights and you'll see a remarkable change.

The rear of the CMX-2300. Note the BNC ports for sampling attenuated RF.

Also on the rear panel is a switch to select average or peak power reading for the meters. This switch affects the behavior of both meters. In other words, you can't have one meter reading average power and the other displaying peak power.

Using the CMX-2300

I found the CMX-2300 to be extremely simple to use. Once I had the meter connected, all I ever had to do was occasionally toggle the power switches if I happened to kick on an amplifier on either band. I enjoyed being able to monitor output power and SWR at a single glance, even after jumping from, say, a conversation on 15 meters to a little satellite work on 2 meters and 70 centimeters.

The ARRL Lab measured the accuracy of the unit used in this review and discovered some deviations from the forward/reflected power specification (+/- 10% at full scale) at the highest and lowest ends of the frequency range. On 160 meters the CMX-2300 power readings were about 25% low. On 70 centimeters the CMX-2300 reads about 30% high. Otherwise, the meter met its accuracy specifications on all other bands. Insertion loss was measured at 0.2 dB or less, except on 70 centimeters where it rose to 0.5 dB.

Since we did not perform measurements on several CMX-2300s, we can't say if this behavior is typical of all units. I performed a few tweaks of the internal potentiometers and was able to make substantial improvements using a Bird wattmeter as my reference.

Capable Convenience

The accuracy issues notwithstanding, I found the CMX-2300 to be a handy item in the shack. It is a rugged, well-built meter that adds an extra dimension of operating convenience.

Distributed in the United States by NCG Inc, 15036 Sierra Bonita Lane, Chino, CA 91710; **www.cometantenna.com**. *Available at many Amateur Radio dealers. Suggested list price: $224.95.*

Paul Wade, W1GHZ, w1ghz@arrl.org

Sun Noise — A Valuable System Measurement

The Sun makes an excellent noise source for making a detailed assessment of your system.

Even a modest microwave system is capable of detecting noise from the Sun. Measurement of the difference in noise between pointing at the hot Sun and the cold sky is an excellent indicator of system performance.

Assisting me with this column is Dave Shaffer, W8MIF, who wrote the "Microwave System Calibration Using the Sun and Moon" section of the *ARRL® UHF/Microwave Experimenters Manual*.[1]

I'd suggest reading that for a better understanding — this column will discuss some of the practical details.

Sun Noise

All objects generate and radiate radio noise (or electromagnetic radiation) in proportion to their temperature. The Sun is extremely hot, possibly 15 million K internally, but the effective surface temperature at microwave frequencies (1-10 GHz) is roughly 50,000-10,000 K, decreasing as frequency increases. This temperature varies with solar activity. Daily values of the solar radio flux from the National Oceanic and Atmospheric Administration (NOAA) Space Weather Prediction Center at frequencies ranging from 245 MHz-15.4 GHz can be found at **www.swpc.noaa.gov/ftpmenu/lists/radio.html**. In what follows, we have used the NOAA values to estimate a brightness temperature at 10 GHz of about 16,000 K (on April 15, 2013, based on an interpolated flux value of 330 units).

Most antennas have a beamwidth that is larger than the size of the Sun, which is roughly ½ degree given its diameter. For instance, a 2 foot dish at 10 GHz has a beamwidth of about 3.5 degrees. The Sun only fills $(0.5/3.5)^2$ or 1/49 of the beam — the rest is cold sky. So the temperature seen by this antenna when pointed at the Sun is Tsun = 16,000/49 or 326 K. This is further reduced by antenna efficiency and any other losses. Typical antenna efficiency is about 50%, reducing Tsun to 163 K for our example. A larger dish with narrower beamwidth would detect more noise; very large dishes can have a beamwidth narrow enough that the Sun fills the whole beam, so that the full temperature is detected.

When the antenna is pointed at the cold sky, the receiver output results from the very small background temperature of the universe (Tsky ≈ 3 K) plus any internally generated noise in the receiver, which we hams usually express as the noise figure. A modest noise figure NF = 3 dB is equivalent to a noise temperature Tr = 290 K, using the formula:

$$Tr = 290(10^{\frac{NF}{10}} - 1)$$

Since the antenna beamwidth is only seeing a small area of the sky, the actual beamwidth does not matter here.

Of course, the receiver internal noise is also present when detecting sun noise, so the difference in dB is:

$$Y = 10\log\left(\frac{Tsun + Tsky + Tr}{Tsky + Tr}\right) \text{dB}$$

For our example of a 2 foot dish at 10 GHz and 3 dB noise figure, we might expect to measure 1.9 dB of sun noise. If we improve the system noise figure to 1 dB (Tr = 75 K) with a good preamp, the sun noise would increase to about 4.9 dB.

Detecting Sun Noise

How do we accurately detect such a small difference in noise? Certainly an S meter is not up to the task. We can connect a VU meter to the receiver output and turn the AGC off

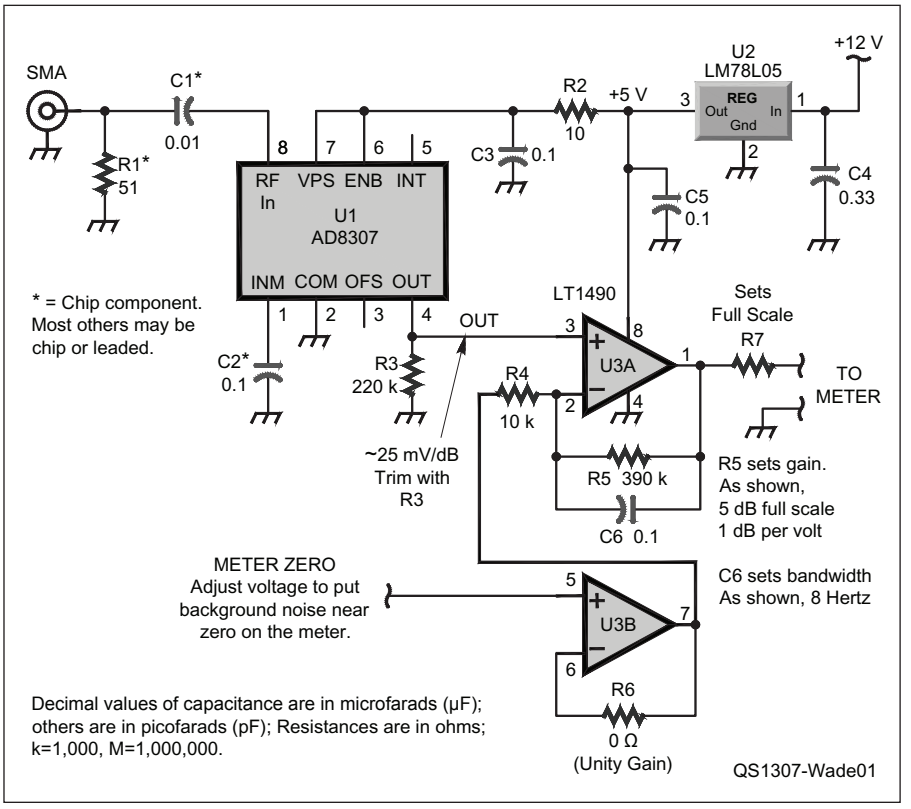


Figure 1 — Schematic diagram of the sun noise power detector with a buffer amplifier to expand the meter scale.

[1]A copy of this article is available at **www.arrl.org/qst-in-depth** as "Shaffer.pdf."

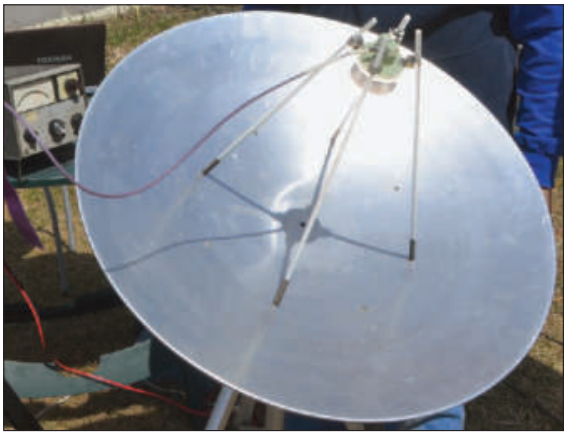


Figure 2 — This prime-focus dish is peaked on sun noise when the shadow of the feed is centered on the dish. The sun noise meter is behind dish with the sun noise reading on the meter. [Chip Taylor, W1AIM, photo]

(otherwise it will attempt to keep the noise output constant), but we will find that the meter jumps around far too much to be useful — noise is random and varies from moment to moment. We must find a way to integrate, or average, the noise output for a long enough time, perhaps 1 second, so that the meter holds still, but not so long that we cannot see a change as we move the antenna.

One possibility is a microwave power meter, for instance the HP 432, which detects heating of a small thermistor. It has a large meter that can easily resolve tenths of a dB. However, a power level in the milliwatt range is needed for a stable reading. The noise level at the antenna is on the order of –174 dBm/Hz or −140 dBm in a typical receiver bandwidth. Using a larger bandwidth of 1 MHz (even more is better) increases the level to −114 dBm, so only 110 dB of stable gain is needed for the power meter. Part of this is provided by the microwave preamplifier and transverter, but much more is needed.

At the microwave IF frequency, 144 or 432 MHz, I use a series of small amplifiers (since putting more than about 30 dB of gain in a box is asking for trouble) and filters between the amplifiers to limit the bandwidth to a few MHz. The last amplifier, the one driving the power meter, must be capable of at least 12 dB more power than the noise level, so that it can handle 99.9% of the noise peaks without clipping or saturating the amplifier. Theoretically, noise peaks may be infinite — we can't handle those, but we should be able to handle almost all the rest. A variable attenuator somewhere in the chain is useful to adjust the level for convenient meter reading.

I built such a system in the cabinet of an older defunct power meter using surplus parts. The old meter still had its large meter movement. The front panel is visible in Figure 2. To make use of the meter movement and to eliminate the need for a separate power meter that requires AC power to operate, I included a detector circuit (see in Figure 1). The detector circuit is a power detector IC whose output is a linear 25 mV per dB.

I followed the detector with an amplifier to drive the meter movement. The amplifier has enough gain so that full scale is only 5 dB. The amplifier has a very small bandwidth, or long time constant, to average the noise and keep the needle from dancing. The voltage at the METER ZERO terminal is adjusted with a potentiometer to get the noise reading on scale. An ExpressPCB file for the PC board is available at **www.w1ghz.org**.

Another choice might be to use an SDR receiver. Some of the software available will permit digital averaging for a long enough time to smooth the noise variations and the bandwidth can be set to a much larger value than a communications receiver.

Figure 3 — An offset fed dish is peaked for sun noise when the shadow of the feed is at the bottom of the dish's edge.

Measuring Sun Noise

It is best to have the sun high in the sky, well above 30 degrees. Here in Vermont, that limits us to the warm half of the year, between spring and fall equinox. Point the dish at the Sun — not as easy as it sounds, if the sky is not clear. Finding the Sun with a dish can be surprisingly difficult if you can't see a shadow. The shadow of the feed horn should be in the center of a conventional prime-focus dish, shown in Figure 2, or at the bottom edge of an offset fed dish, as seen in Figure 3. You can then adjust the meter for an on-scale reading and peak the noise by moving the dish slightly, in case the beam isn't perfectly centered. A misaligned feed or a distorted dish surface can result in an off-center beam.

Once peaked, move the dish off the Sun, far enough to avoid sidelobes and move it around for minimum noise reading. Moving the dish in azimuth, rather than elevation, will reduce changes in ground noise pickup and avoid trees. The difference between the two readings is the sun noise.

How well is your dish working? Download the *VK3UM EME Calculator* from **www.vk3um.com**. Your system may not be capable of EME, but the calculator will still provide expected sun noise. Run the calculator, update the solar flux and enter the parameters for your system. If you don't know a parameter you can estimate it, then adjust the parameters until the result matches the sun noise you measured. You may find that your dish isn't performing as well as you would like or your system temperature (Tsys) isn't as low as you had hoped. Good! Now you can make improvements. The *EME Calculator* shows all the factors that affect system temperature, which is what really counts for performance. As you make improvements to your system, you can determine their effectiveness by measuring the difference in sun noise.

Making adjustments using sun noise can be tedious — you can't just point at the Sun and adjust. A careful record of readings is necessary, going back and forth between Sun and cold sky after each modification. If readings are not all taken in one session, then adjusting for differences in solar flux might be needed.

Azimuth and Elevation Calibration

The current position of the Sun, in azimuth and elevation from any location, is easily calculated. I use *Sun-Moon* (**www.ngdc.noaa.gov/geomag/geom_util/sunmoon.shtml**) and W8MIF recommends *Stellarium* (**stellarium.org**). By peaking for sun noise, dish headings may be quickly calibrated at a portable location.

Microwave Update

The next Microwave Update will be on October 18-19, 2013, at Morehead State University, Morehead, Kentucky. This is the premier microwave gathering world-wide — put it on your calendar. **www.microwaveupdate.org**

Photos by Paul Wade, W1GHZ, except as noted.

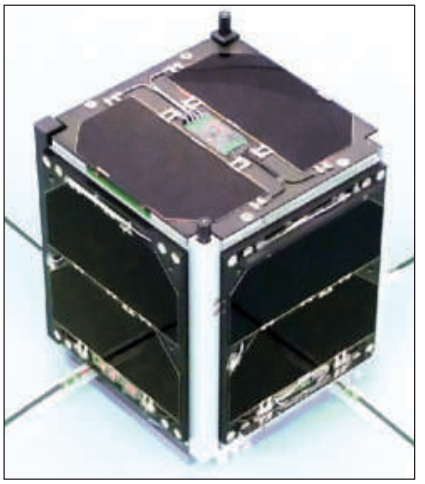
Steve Ford, WB8IMY, wb8imy@arrl.org

More Satellites on the Way!

It looks like our current dry spell of new Amateur Radio satellites may be coming to an end this year. Assuming all goes as planned — always a dangerous assumption to make in the satellite launch business — we have the following birds to look forward to this year…

- The long anticipated FUNcube-1, which will sport a 435/145 MHz linear transponder.
- The Delfi n3xT 435/145 MHz linear transponder satellite.
- Triton-1 with a 435/145 MHz single-channel FM to DSB transponder.
- Triton-2 with an intriguing 435/2408 MHz FM transponder and a 435/145 MHz FM to DSB transponder. (Time to get those 2.4 GHz satellite antennas and downconverters out of storage!)
- CPUT ZACube-1 offering a 435/145 MHz FM transponder.
- TURKSAT-3USAT with a 145/435 MHz linear transponder. (Launched at press time.)
- Ukube-1 featuring a 435/145 linear transponder.

If the fates are kind we'll end up with five linear transponder satellites for SSB/CW, bringing the operational total to *seven* (or even eight if you count the somewhat erratic AO-7). We also have the potential to add at least two FM repeater satellites, which is welcome news since we're presently down to just one: Saudi-OSCAR 50.



Flight model of the FUNcube-1 satellite. [AMSAT-UK]

Part 97 Map App for iPhone

Will Snook, KD5HQO, has released a free iPhone app that displays maps showing geographic features mentioned in the FCC Part 97 Rules including Line A, the National Radio Quiet Zone, the 33 centimeter exclusion area in Colorado and Wyoming, the 241 km zone around White Sands Missile Range, the 16 km quiet zone around the Arecibo Observatory and the 1 mile zones around various protected FCC field offices.

According to Will, "The idea for a map app came when I was carefully reading through the FCC Part 97 Rules while studying for a General class upgrade. I realized that I had no idea what the FCC meant by things like 'within 241 km of the boundaries of the White Sands Missile Range' or 'at Aberdeen, WA, running by great circle arc to the intersection of 48N, 120W.'"

You can get Will's app today in the iTunes Store. Search for "Part 97 Map."

The *Part 97 Map* app showing locations of FCC monitoring facilities.

The National Radio Quiet Zone as shown in the *Part 97 Map* app. You can zoom in on the map to see the precise borders of the zone.

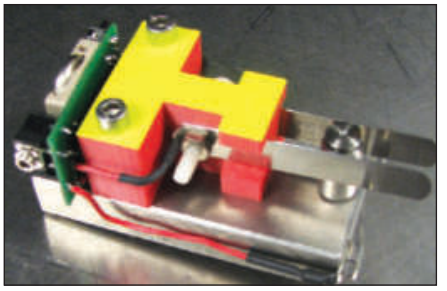
A Printed Paddle

Regular readers of this column may recall my discussion of 3D printers in the March 2013 issue. I invited any hams who were using 3D printers for their projects to send me images of their creations.

It wasn't long before I heard from Alton Chaney, W7ACX. He used a Stratasys Dimension 1200es printer to create one of the primary components of the paddle key shown in the accompanying photo.

The key uses feeler gauges for arm contacts and it includes a built-in PicoKeyer. The red and yellow printed block, which forms the core of the device, is bolted to a steel base. Tension is adjustable by changing the feeler gauges.

According to Alton, the block design was created with *SolidWorks* software. The printer required about 90 minutes to print the block.



H. Ward Silver, NØAX, n0ax@arrl.org

Experiment #126

Phasors, Part One

No, not the kind of phaser you set on stun, silly! If you passed your General exam, you learned about phase and a little bit about angular frequency. Amateur Extra class licensees (and those studying for the Extra) have even used phasor notation, although it was called by another name.

In this two-part column, we'll start by developing basic concepts to show what a phasor is and how it relates to things you already understand. Then we'll progress to examples of using phasors to describe electrical and radio phenomena, such as modulation. As ham radio begins to use more advanced types of modulation, understanding phasors will provide an important bridge between the familiar AM/SSB modulation and the future.

The Sinusoid

Like many meals in radio, this dish begins with a sine wave and is seasoned with complex numbers. (You can find these subjects in the math tutorials for the General and Extra exams listed on the ARRL website.[1]) The sine wave (or *sinusoid*) looks like a regularly increasing and decreasing wave but as Figure 1 shows, it is really related to rotation.

Imagine a point revolving counter-clockwise in a circle around the origin of the complex plane as at the left of Figure 1. If the point is one unit from the origin the coordinates for each location visited by the point are [cosθ, i sinθ], where θ (the Greek letter theta) is the angle from the positive x axis to the line from origin to the point. This circle, not surprisingly, is called the *unit circle* because the value of its radius is 1 or unity.

As the point revolves around the origin, θ steadily increases from 0 to 360° and begins again at 0° with each cycle. (Counterclockwise is considered the positive direction.) If the point always moves at the same speed, the frequency of the cycles around the origin, f, does not change and the point moves 360 × f degrees every second. That means the number of degrees a point has moved in t seconds, θ = 360 × f × t.

There are 2π radians (another unit of angular measurement) in a circle so θ = 2π × f × t. The quantity 2πf is referred to as angular frequency, ω, and you see it used in the formulas for reactance and many other electrical calculations that depend on frequency.

Tying it all back together, the coordinates for the position of the point for every point in time as it moves around the circle are [cos(2πft), i sin(2πft)] and the graph at the right of Figure 1 plots the point's y (or imaginary) coordinate versus time, creating a sine wave. If we plotted the point's x (or real) coordinate versus time, it would create a cosine wave.

Making the leap from a point moving around the circle to something more electrical, the magnitude of the point's imaginary coordinate, sin(2πft) = sin(Ωt), can also be a voltage or current or field strength. In fact, the familiar sine wave of ac power comes from the rotational motion of a generator's field coil. As the coil passes through the magnetic field in the generator, the angle between the coil and the field changes in the same way as our point moves around the origin. This changing relationship between the coil and the field creates a sinusoidal voltage in the coil.

While both sine and cosine waves are generally referred to as sinusoids, they differ from each other in an important way. Starting from t = 0, the cosine wave starts at a value of 1 + 0i and the sine wave at 0 + i. Other than starting at different values, the waves are identical. The cosine wave describes the real coordinate and the sine wave describes the imaginary coordinate.

You can also think of that difference in starting value as a difference in angle, in which the sine wave is π/2 radians (90°) ahead of the cosine wave. This difference never changes because both waves are describing the same thing — constant rotation. The position of a particular point on the wave is its phase and the amount of the difference is called the *phase angle*, 90° in this case.

This is where the following trigonometric identities come from: sinθ = cos(θ – 90°) = cos(θ – π/2) and cosθ = sin(θ + 90°) = sin (θ + π/2). Many, many more such relationships between sine and cosine waves become obvious (or at least more understandable) when viewed from the standpoint of rotation and the unit circle.

Polar Notation

So far we have used the *rectangular* form for the coordinates of our moving point: x + i y. In most engineering technical literature, the letter j is used instead of i to avoid confusion with current and from here on in the column, we'll do so, as well.

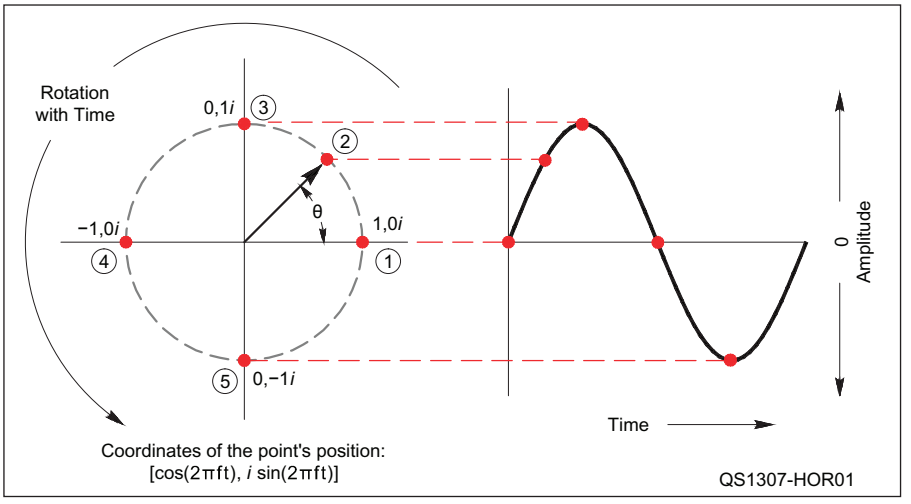


Figure 1 — The sine wave at right shows the y-axis coordinates of a point revolving around the origin, shown at left.

[1]**www.arrl.org/studying-for-the-general-license**, click on "Math Tutorials," then "Tutorials on Math for License Exams"

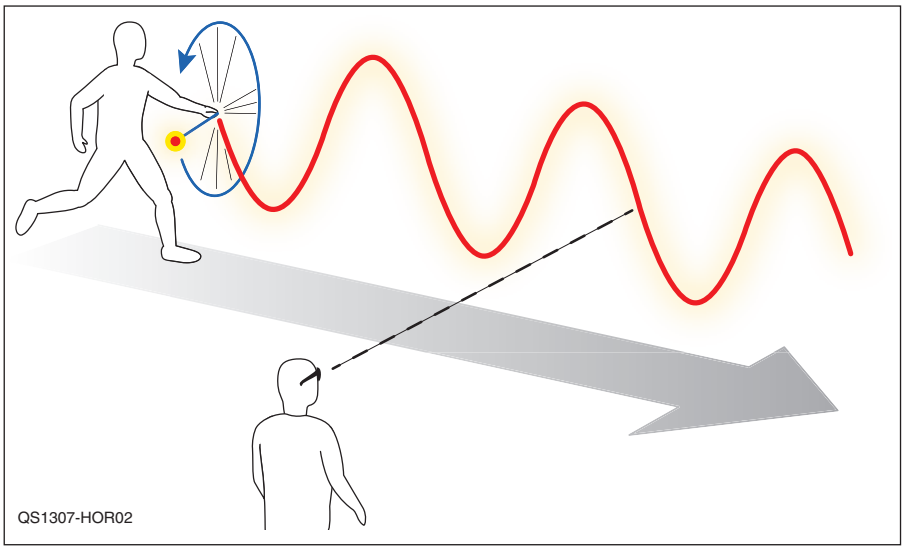


Figure 2 — Mounting a light on a spinning wheel and carrying it across a darkened room edge-on to the viewers is an effective way of demonstrating the link between rotation and sinusoids.

Imagining a Wheel

If you are having trouble visualizing how the vigorous circular motion of a point translates into the smooth undulation of a sine wave, Figure 2 illustrates a demonstration that may help: Take the front wheel off of a bicycle and tape a battery-powered light to it so you can see the light from the side of the wheel. In a large room, have a friend hold the wheel, turn on the light, and give the wheel a gentle spin — say about one revolution per second. Turn off the room lights and have the friend walk slowly and steadily across the room with the wheel edge-on to you about 10 or 20 feet away. The up-and-down motion of the light stretched out across the room traces out a sinusoid! (Note to license exam instructors — this is also a good way to demonstrate the relationship between frequency and wavelength by changing the wheel's spin rate as you walk across the room to represent a signal traveling at the speed of light.)

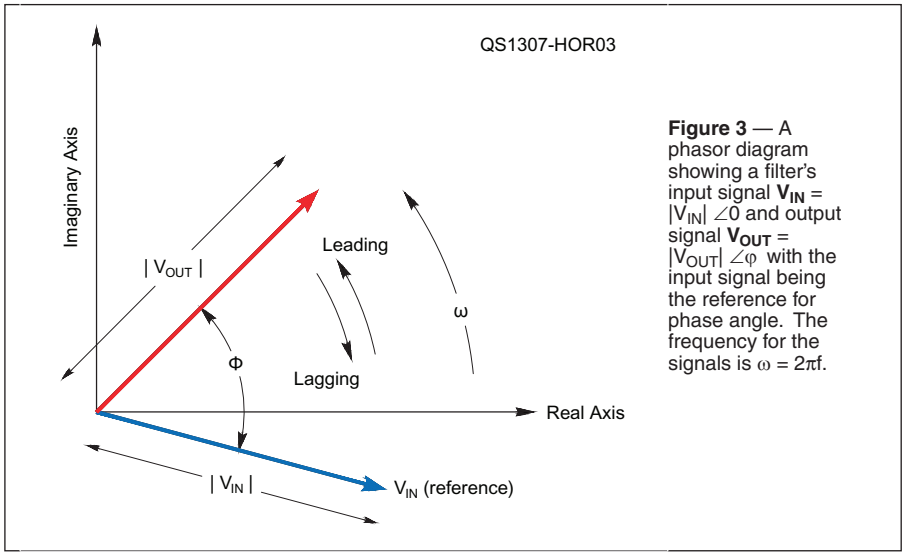


Figure 3 — A phasor diagram showing a filter's input signal $\mathbf{V_{IN}}$ = $|V_{IN}| \angle 0$ and output signal $\mathbf{V_{OUT}}$ = $|V_{OUT}| \angle \varphi$ with the input signal being the reference for phase angle. The frequency for the signals is $\omega = 2\pi f$.

Next is the form that you may have already learned (or will learn!) for your Extra class exam and that is the polar form in which the coordinates take the form of a radius and an angle: $r \angle \theta$. Polar form is read "r at (an angle of) theta." Using polar form coordinates for a point on the unit circle is easy because they're always $1 \angle \theta$. If you are describing the point's position as it whirls around the circle, you can use the equation for angular frequency we figured out earlier and the coordinates become $1 \angle (2\pi ft) = 1 \angle (\omega t)$. So this particular method is a good shorthand way of describing what the moving point is doing.

Introducing the Phasor

When dealing with RF signals and circuitry, it's often true that the frequency of the signals doesn't change. Think of an RC low-pass filter, for example: the input signal V_{IN} sin $(\omega t + 0)$ and output signal V_{OUT} sin $(\omega t + \varphi)$ have the same frequency, even though their amplitudes are different by the ratio of V_{OUT}/V_{IN} and they are offset in phase by φ.

Assuming the same frequency for both signals, our polar form can now be simplified to $V \angle \varphi$ where φ is just the phase angle between a signal and some reference signal or phase. The input signal to a circuit is usually the reference for measuring phase differences.

Hey, guess what? $V \angle \varphi$ is a phasor! A phasor is just a complex number that represents the amplitude and phase of a sinusoid and the $V \angle \theta$ polar notation is just convenient mathematical shorthand. Phasors are a type of vector – quantities that have both a magnitude and a direction. In the case of $V \angle \varphi$, the magnitude is $|V|$ and the direction is the phase angle, φ, so the more cumbersome name "phase vector" was shortened to "phasor." (As a vector, a phasor is often shortened even further and written as a single bold letter, such as $\mathbf{V}$ or $\mathbf{I}$.)

If our original sine wave is the reference signal, the phasor describing the sine wave is $\mathbf{V} \angle 0$ and the cosine wave is $\mathbf{V} \angle -90°$ or $\mathbf{V} \angle -\pi/2$. Remember, the frequency is assumed to be the same for both signals, whether 60 Hz from the power grid or 14.200 MHz on 20 meters. Figure 3 shows a *phasor diagram* for the signals at the input and output of a filter.

There is a final way to describe the signal — the *exponential form* in which it is represented as $V\, e^{j\theta}$. This form comes from the mathematics behind Euler's equation[2] in which the coordinates of our point are miraculously shown to be equivalent to $e^{j\theta} = \cos\theta + j \sin\theta$. The serious and beautiful math[3] behind this equation lies at the heart of much of electrical engineering and leads to the jaw-dropping Euler's identity: $e^{j\pi} = -1$ which unites the two most widely used transcendental numbers (e and π), imaginary numbers (j), negation and unity. Not bad for a point moving in a simple circle, huh?

[2]Nahin, Paul J., *Dr. Euler's Fabulous Formula: Cures Many Mathematical Ills* (Princeton University Press, 2006).

[3]In his *Lectures on Physics*, physicist Richard Feynman characterized the equation as "our jewel" and "one of the most remarkable, almost astounding, formulas in all of mathematics."

Steve Sant Andrea, AG1YK, hk@arrl.org

Keeping Cool, Keeping Quiet and Keeping Covered

Taking the Heat

Frequently, I find myself replacing final transistors in a rig in which they've been replaced before. I usually find far too much heat sink compound (HSC) between the transistor and the heat sink. I can only assume that the person who replaced the parts saw no visible sign of HSC and so made sure that the newly installed set had more than enough to do the job. Unfortunately, the extra compound acts as a thermal insulator, inhibiting heat transfer.

How is that possible, you ask? There are three reasons:

- Metal to metal contact transfers heat far better than any HSC.
- The HSC is *only* needed to fill in the air gaps between the component and the metal heat sink.
- The air gaps we're trying to fill are small, invisible imperfections in the metal surfaces.

The HSC is not supposed to take the place of metal to metal contact. Its purpose is to fill the air gaps between the metal surfaces with something that transfers heat better than air does.

In a perfect world, if we placed two pieces of metal together, they would have no air gaps between their surfaces. This level of smoothness can be achieved, but machining and polishing surfaces to such a high level of smoothness is expensive. An interesting side note is that, when two surfaces are machined that smooth and attached together, they almost become one. The surfaces, over time, begin to share electrons forming a bond that is extremely difficult to separate.

In our real world of electronics, this never happens because transistors and heat sinks aren't machined that precisely so there are limited points of metal to metal contact between any transistor (or resistor) and the metal heat sink surface and this limits heat transfer. The other areas are air-filled gaps that form a thermal barrier, similar to double and triple glazed windows.

The best way to increase the heat transfer in these areas is by filling them in with HSC. Metal to metal contact points are far better at transferring heat than the HSC so it is very important to keep the use of the compound to a minimum. Use just enough HSC to fill the gaps but *not* so much that it interferes with the metal to metal contact. When HSC is applied correctly, the best possible heat transfer between the two metal surfaces will occur.

Using too much compound "floats" the transistor or resistor above the metal heat sink. While better at transferring heat than the same distance of air, it is far worse than contact points actually touching, metal to metal.

The best way I've found to apply HSC is to put a small amount of it on a finger and swipe it across both the component and the heat sink. If I see ridges I've applied too much so I clean my finger and wipe the surface again until I see no excess compound (see Figure 1). At that point, the transistor/resistor is ready to mount to the heat sink.

When tightening the parts, if any HSC is forced out from between the two surfaces, there's too much HSC. The parts should be removed, cleaned and a thinner coating of HSC applied again.

A good rule of thumb is, since you can't see the air gaps you're trying to fill you shouldn't be able to see the HSC filling them either! In other words, using the minimum amount of HSC, and not a big blob, will provide better heat transfer performance. — *73, Phil Karras, KE3FL, 3305 Hampton Ct, Mount Airy, MD 21771-7201*, **ke3fl@arrl.net**.

Figure 1 — Here are three different levels of HSC on an aluminum bar. Number 1 is a big blob that will inhibit heat transfer. Number 2 is a big smear (sometimes looks like ridges), which is better but still too much for good heat transfer. Number 3 shows a correct application where the HSC is almost invisible. [Phil Karras, KE3FL, photo]

Flame Soldering

Recently, I was soldering some wire and wire lugs and my soldering iron was not getting hot enough. I couldn't finish the job properly. I thought about what I had available that might help. I ended up using a small candle. It took less than a minute to complete the job. The wire and wire lug both became hot and the solder flowed smoothly forming a good solder joint. Some of the plastic on the wire did melt and there was some soot that needed to be sanded off. If you're ever stuck in a situation where your iron won't do the job or is not available at all, try this method. — *73, Walter Schoenbach, WB8FEC, 7263 Sandy Beach Dr, Waterford, MI, 48329*, **wb8fec@att.net**.

Repairing the IC-27/37/47 Squelch

Back in 2009, I submitted a hint about replacing the defective and obsolete volume control pot in an Icom IC-37A transceiver with an outboard unit.[1] A ham friend of mine had Icom service replace his bad volume control in the 1990s. Recently, when his squelch control failed, he asked me for help repairing it.

The squelch control circuit is a "different animal" from the volume control. Where the volume control is a single 10 kΩ control, the squelch circuit uses two 10 kΩ pots ganged together. One 10 kΩ ganged pot section controls IC1's squelch gate circuitry. The set point of this pot is critical. The second 10 kΩ ganged pot section simply sets a balance level between the squelch gate circuit's two buffer amplifier stages in IC2. I found this setting is *not* critical and used that information to replace the second pot with a fixed resistance.

[1]Tony Bogusz, W9MT, "Help Your Icom IC-27/37/47 Regain Its Voice," *QST*, July 2009, p 56.

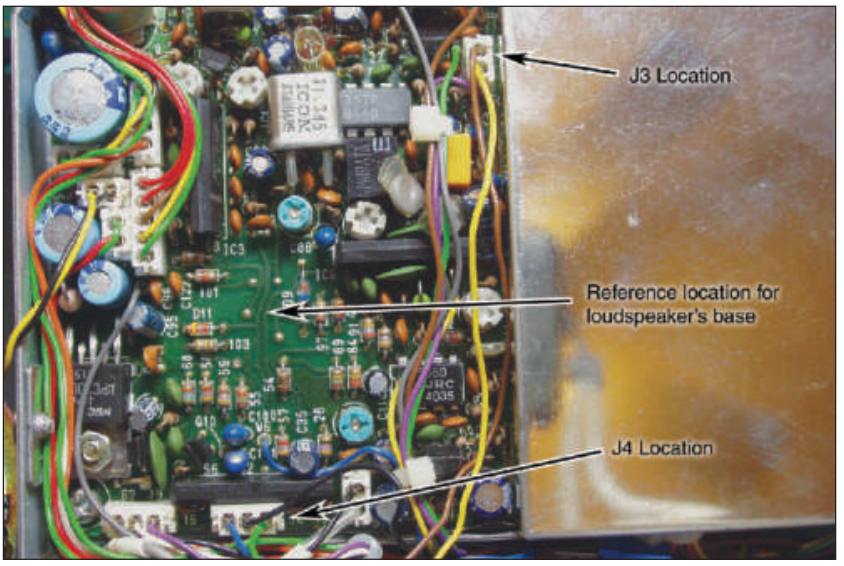


Figure 2 — A bottom view of the transceiver showing the locations of the J3 and J4 connectors. [Tony Bogusz, W9MT, photo]

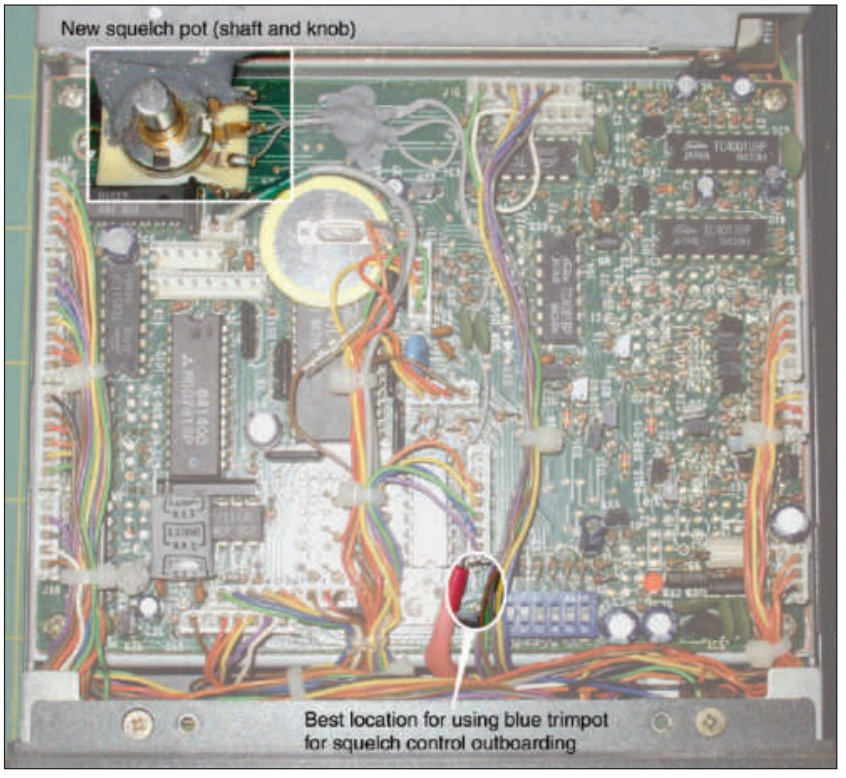


Figure 4 — A top view of the transceiver showing the mounting location for the squelch pot. The shaft extends through the case and a knob on the outside permits adjustment of the squelch level. [Tony Bogusz, W9MT, photo]

Begin the modification by finding the J3 and J4 connectors on the bottom board of your radio (see Figure 2). After unplugging them, use a small pair of diagonal cutters to clip all five wires from the original squelch control's daughter board. These are the yellow and brown wires going to J3 and the blue, green and black wires going to J4.

To find the correct set point for proper minimal squelch I connected two 10 kΩ trimpots in place of the originals. After some experimentation, I found that 7.6 kΩ was the minimum setting (for both pots) for good squelch action. Using Ohm's Law for parallel resistances, I determined that a parallel combination of 100 kΩ and 8.2 kΩ ¼ W resistors can

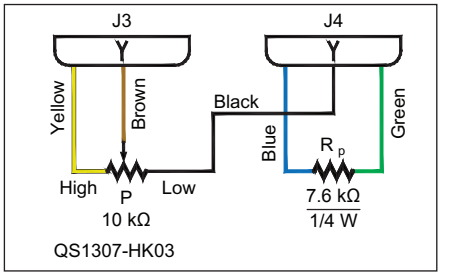


Figure 3 — The schematic diagram of the squelch modification.

replace the pot for IC2. I put these parallel resistors (R_p) inside of some shrink tubing.

Connect everything as shown in Figure 3. The R_p is connected to the green and blue wires of J4. The parallel resistors inside the shrink tubing fit nicely tucked behind the front panel of the radio. J4's black wire connects to the ground end of the new squelch pot, P. J3's brown wire connects to the wiper and its yellow wire to P's high resistance end.

If you want to stay with a trimpot for the new squelch control, a dab of silicone RTV will secure it to the top circuit board near the reset switch and scanning select switch bank under the snap cover (see Figure 4). If you want use an external knob to set the squelch, you can use a pot with shaft mounted on double stick tape with more RTV to secure it. The best location for this is where the optional voice synthesizer would normally mount. Be sure you don't short the metal body of the control to the legs of the IC just to the front of this location. Careful positioning of the double stick foam tape will prevent a short circuit. You will need to splice an extension from the black, brown and yellow wires to go the extra distance. Insulate and secure these connections well.

Squelch operation employing the single pot and fixed resistance is both smooth and reliable. No degradation of receive sensitivity or squelch action was noticed when using the fixed resistance for the IC2 buffer-follower amplifier circuit.

If you already did the volume control modification from my 2009 hint, you can probably fit two controls in the voice synthesizer area, but it's going to be crowded. It may be better to save that area for the more often used volume control replacement and use the reset switch location for a less often used squelch trimpot. In any case, your radio should now be good for another 25 years of faithful service. — *73, Tony Bogusz, W9MT, 10536 S Coyote Melon Loop, Vail, AZ 85641-2593*, **w9mt@arrl.net**.

Dollar Store Key Cover

Here is a great idea that I thought I would pass along to CW enthusiasts. If you are like

me, being a 100% CW operator, your key, paddle or bug, is usually one of the most important items in your shack. Vibroplex and other dealers offer dust covers to protect and preserve these investments, but such commercial dust covers cost $50 or more. After spending $200-300 on a key, $50 doesn't seem like much to spend to protect these high quality keys but I found this inexpensive and effective alternative.

I love to visit my local dollar stores. On one visit, in the office supplies section, I came across a transparent plastic office basket. It seemed lightweight and sturdy, and the perfect size to cover an entire key. So, for a few dollars, I purchased three of them.

Figure 5 — This small trapezoidal shaped plastic bin is inexpensive and can be easily modified to protect your key or paddle from dust, dirt or spills. [Bill Parker, KA3IXF, photo]

I set the office basket next to my paddles and estimated where to cut out for the paddles and the cable. I performed the cuts in the plastic with a box cutter knife. The plastic cut easily.

This office basket was the perfect size and is very attractive (see Figure 5). They can be purchased in a number of different colors and sizes. They keep the dust off the key while adding a bit of color to your operating table. — *73, Bill Parker, KA3IXF, 3314 Old Capitol Trail, Apt K12, Wilmington, DE 19808*, **wwjp123@comcast.net**.

SteppIR Storm Safety

With the unusually high amount of rough weather experienced in North America this past year, SteppIR antenna owners may want to start taking an extra step of caution to minimize potential storm damage. When the antenna is not in use, retracting the tapes to the "Home" position could help minimize the probability of tape damage from excessive flexing of the fiberglass tubes during high wind conditions. This also minimizes the antenna's attractiveness to lighting strikes.

Figure 6 — Signs like these can help you keep track of the status of your SteppIR and other antennas. [Don Kasten, N4DK, photo]

As a reminder of antenna status, prior to applying RF power, I use homebrewed "memory aides" fabricated by a call sign badge engraver typically found at hamfests (see Figure 6). Each of the two placards consists of two engraved call sign badges glued back to back. Simply flip the placard over when changing the antenna "Home" status to reflect the current tape position. The second plaque is used as a reminder for any other antennas that may have also been disconnected. Assigning different colors to the signs can help identify antenna status at a mere glance and from a greater distance. — *73, Don Kasten, N4DK, 2056 Six Branches Dr, Roswell, GA 30076-3029*, **n4dk@arrl.net**.

Handheld PTT

For those of us that don't use VOX, and would like a PTT switch remote from the rig, the following handheld PTT switch might be of interest. My idea was to come up with an inexpensive handheld device that would provide both momentary and on-off PTT capability in one unit.

From RadioShack I obtained a momentary switch with a black top (part number 275-0609), a SPST on-off switch with a red top (part number 275-0011) and a shielded 6 foot cable with ⅛ inch mono plug on one end and stripped wires on the other (part number 42-2434). [You may need a different connecter to mate with the accessory PTT jack on your rig. Consult your manual. — *Ed.*] Parts from the hardware store included two 1 inch PVC caps, PVC cement and 5 minute, two part, epoxy cement.

I drilled two 7⁄16 inch holes in the dome of one cap to accommodate the switches and one ⅛ inch hole in the dome of the other to accommodate the cable. I then installed the switches into the holes using epoxy because there was no room to secure them with the supplied washer and nut. I then wired the two switches in parallel, ran the stripped end of the cable through the PVC cap and soldered the two leads to the switches. I tied a knot in the cable to provide strain relief where the cable exits the PVC cap.

I used PVC cement to join the two PCV caps together to complete the project (see Figure 7). [The PVC cement will permanently attach the caps. Before sealing the ends, inspect the solder joints and test both switches to make sure they are working properly. — *Ed.*] The mono plug end of the cable plugs into the breakout box that connects with the accessory jack on my rig. The interface to the PTT input on your rig may vary.

Figure 7 — The completed PTT switch fits nicely in the palm of your hand. The black button functions as a regular PTT while the red button is a push-on, push-off type for those long ragchews. [Thomas Nolan, W3EX, photo]

The switch unit fits comfortably in my hand. Depending on the nature of my contact, I use my thumb to activate either the momentary or on-off switch. — *73, Thomas Nolan, W3EX, 624 Store Rd, Harleysville, PA 19438-2718*, **w3ex@arrl.net**.

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

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

Staying the Course

Amateur Radio operators recount their experiences at the 2013 Boston Marathon.

The Boston Marathon Amateur Radio Communications Team

More than 200 Amateur Radio operators participated in communications for the 2013 Boston Marathon. Though Marathon participants, volunteers and attendees have dealt with challenging situations in the past, this year's event will be remembered for the bombings that took place at the finish line. In the face of this heinous act, paid first responders along with American Red Cross medical volunteers and Amateur Radio operators performed magnificently.

Net Control with all repeaters active. [Bruce Tinkler, N9JBT, and Nick Weber, W3BER, photo]

Grace Under Pressure

The bombings presented a frightening and potentially chaotic situation, but the ham volunteers present were up to the challenge. "Within minutes, cell phone systems became overloaded, making it difficult to place phone calls and send text messages," said Steve Schwarm, W3EVE, Amateur Radio Course Communication Coordinator for the Boston Marathon. Steve, who is also associated with a consortium of clubs and groups known as Marathon Amateur Radio Communications (MARC), noted that Amateur Radio operators performed communication duties admirably under duress to ensure the safety of others, as well as themselves. "No Amateur Radio volunteers were injured on the course in this terrible act," he said.

Paul Topolski, W1SEX, Amateur Radio Finish Line Coordinator, was at finish line Net Control when the first bomb went off only 400 feet away. "We heard the explosion. I poked my head outside to confirm what I thought it was and saw the white smoke," he said. "We commenced a roll call of all ham operators and medical tents. Massachusetts State Police authorities initially ordered us to lock down and post a ham for security watch outside the net control trailer."

Following the explosion and roll call, the team began pulling together updates and sent the information via the Massachusetts Emergency Management Agency Web-Emergency Operations Center (EOC) software tool and provided updates via Amateur Radio. Shortly after that, both Boston Police and Massachusetts State Police gave the order for the tent area to be evacuated, at which time three amateur operators were redeployed to the Boston Marathon Course Net Control Center.

Flexible Resources

For some amateurs at the finish line, their roles changed at the discretion of the medical people they were shadowing. For example, Mike "Sparky" Leger, N1YLQ, who had paramedic training as an on-call firefighter for the Acushnet (Massachusetts) Fire Department, not only continued his Amateur Radio communications duties, but was asked to shadow one of the medical coordinators and helped treat wounded people at the discretion of the medical coordinator.

"The person I was shadowing asked me to contact the other medical tent via ham radio because they couldn't do it in other ways. This happened numerous times during the incident," Mike said.

The ARRL's Chief Operating Officer, Harold Kramer, WJ1B, was initially assigned to the medical group at the finish line. "I was assigned to shadow Boston Marathon Medical Director Chris Troyanos and relay messages between him and the Course Communications team," he said.

Harold was in Medical Tent A, right near the finish line, when the blasts went off. " The medical tent already had hundreds of doctors, nurses and other medical professionals attending to injured runners," he said. "All of the Amateur Radio operators on the scene continued to support communications. A few minutes after the blasts, all non-medical workers were asked to leave the tent so the medical professionals could have room to work. At that point, net control asked me to report to the bus communications trailer where I helped by providing communications back to net control. We were then told to evacuate the area and hand over all the communications to the first responders. Our folks did well and hung in there when needed in the most crucial moments."

Transportation and Shelter

After the bombings occurred, First Aid stations were consolidated to pool runners for pick-up and to keep them warm and hydrated. At the Heartbreak Hill First Aid station, amateur operators had a complete base station setup, including a computer, and were prepared to handle health and welfare traffic as required. Several shelters were set up along the route at churches and schools, and Amateur Radio operators from First Aid stations that had been secured went to those shelters to provide communications until runners were moved out of those locations.

Rob Macedo, KD1CY, Eastern Massachusetts ARES Section Emergency Coordinator, said, "My role at the request of Steve, W3EVE, was to shadow Kandi Finch, the Medical Coordinator for the Red Cross. It was a challenging position, but all organizers on both

the Amateur Radio side and Red Cross side said coordination went well during normal race conditions and particularly after the bombings. Kandi wanted First Aid stations collapsed into enhanced medical tents that had heat and more supplies. At one point, I had her talk third party to everyone on the frequency to assure medical coordinators along the route that instructions were indeed coming from her. This was especially important given the fact that medical supervisors were unable to call her directly due to the cell phone overload issues."

Don Rolph, AB1PH, was stationed on one of the buses, which happened to be stopped at one of the First Aid stations when he heard the report about the bombings. "Net Control requested all radio traffic stop until further notice," Don said. "About 15 minutes later, Net Control directed the buses to meet at the Boston College law campus in Newton. The bus I was on diverted to pick up runners who were stranded without shelter in cold conditions, and returned them to the Boston College law campus. At that point, approximately five vans and three school buses had arrived at that location.

"By about 5 pm, all known stranded runners had been picked up and the buses and vans were put on standby," Don continued. "At the peak of our effort, there were approximately 275 runners in Memorial Hall on the Boston College law campus. By about 6:15, the number of runners in shelters had reduced to about 75, and the police determined that they should be moved to St. Ignatius Church on the Brighton town line, where buses would then enter Boston for drop off under police escort. Vans were demobilized at about 6:30 pm."

Don noted that a significant number of runners needed shelter due to the terrorist incident stopping the Marathon and that Amateur Radio was the only reliable communications supporting the buses. The buses were a critical emergency resource in the outer ring of the event where runners were stranded, and Don commended course Net Control for doing an excellent job.

Hats Off to Net Control

At course Net Control, which was away from the bombings, ham operators controlled their nets calmly, professionally and with an appropriate level of urgency. Over a dozen amateurs at the Net Control center announced messages and kept track of changes along the course route as required. Net Control Center Coordinator, Karen Brothers, K1KEB, kept in constant contact with the Massachusetts Emergency Management Agency (MEMA), where Terry Stader, KA8SCP, was stationed. Terry became the MEMA point person at the state EOC, sorting out the sheltering plan and reception centers for runners, as well as the subsequent transport of runners from shelter locations and assisting with direction on buses and MBTA train operation.

Jim Palmer, KB1KQW, one of the net controls at the Net Control center, said nets doubled up on operators to allow one person to operate the radio while the other logged priority calls and ambulance requests, thereby creating a more efficient operation. The net Jim was running also provided a link between the Marathon course and the American Red Cross Cambridge facility, which was staffed by Amateur Radio operators Lou Harris, N1UEC, Frank O'Laughlin, WQ1O and Dan Howard, K1DYO.

Several young Amateur Radio operators from the Clay Center Amateur Radio Club, W1CLA, in Brookline, Massachusetts supported Net Control both as direct net control operators and runners for the operation. This provided a tremendous learning opportunity for these young operators both from an Amateur Radio perspective and an overall learning perspective.

Many amateur operators who volunteered along the marathon route praised Net Control's support after the bombing. David Wihl, KB1VEG, stated, "Net Control did an awesome job. The workload was busiest after 7 hours on the radio and didn't let up for another couple of hours."

Steve Schwarm, W3EVE, said, "Despite the total lack of warning in this situation, amateurs followed a creed I've preached since the 9/11 terrorist attacks and the mutual aid response to those attacks: 'blessed are the flexible for they will not get bent out of shape.' Amateurs on the course did what they had to do to assure their own safety and runner safety working with the Red Cross medical people. They did an outstanding job and I was told so by Red Cross organizers as well."

Stories From the Course

Amateurs from across the course relayed stories of their experiences. Eric Falkof, K1NUN, told of his experiences at the enhanced First Aid station near the Newton City Hall. "We kept stopping runners, who now were more likely 'fast walkers,' and brought them to the tent where they waited and were given best comfort," he said. "We had a propane heater to keep our tent warm. From the stop order to the end of the incident, we had about 25 or so people needing transport and there were 150 total runners at the Newton City Hall, which was set up as a temporary shelter."

Alan Galster, KF2TF, was at a water station in the course area but near the finish line when he heard the explosions. A runner went

Kandi Finch, Red Cross Medical Coordinator, gives instructions to Rob Macedo, KD1CY, to pass along to all First Aid stations on the course after the bombings occurred.

Young amateurs from the Clay Center Amateur Radio Club supporting Net Control. [Bruce Tinkler, N9JBT, photo]

Nick Weber, W3BER, and Ed Gustat, W1FBI, running Net Control as Jim Palmer, KB1KQW, and Marek Kozubal, KB1NCG, look on. [Bruce Tinkler, N9JBT, photo]

down at their station just after this occurred. With all ambulances being prioritized to those wounded by the bombings, Alan, a Registered Nurse (RN), was able to get nearby Boston Police officers to take the runner to the nearest First Aid station for treatment. Alan then was redeployed to the last First Aid station on the course where he utilized both his medical treatment and Amateur Radio skills to help Red Cross and public safety personnel to clear out their first aid station of patients within 30-45 minutes. "I can't say enough good things about the Massachusetts State Police, Boston Police, EMS and Red Cross" Galster said.

Tim Carter, W3ATB, gave many of his thoughts from his First Aid station location on the course. His complete story can be read at **http://w3atb.com/66-boston-marathon-2013-bombs-carnage-and-amateur-radio-operators**.

ARES Involvement

From an ARES perspective, a heightened state of awareness on the Boston Marathon event is typical, but within 15 minutes of the bombings, Eastern Massachusetts ARES Assistant Section Emergency Coordinator Carl Aveni, N1FY, issued an ARES Stand-By and requested that amateurs give availability for the next 24 hours. Within minutes, 30 amateurs made themselves available.

According to a report filed by Ed Caron, KA1RSY, Acushnet Emergency Management Communications Officer and South Shore Massachusetts ARES District Emergency Coordinator, the ARES sub-regional command center, call sign WA1EMA, at the Emergency Operations Center in Acushnet, Massachusetts, was utilized as a control point to obtain critical situational awareness of the rapidly changing situation and to monitor resource nets. A total of five Amateur Radio operators deployed to this facility. An ARES resource net was called on the 147.18 Bridgewater repeater with Byron Piette, K1YCQ, as net control. Eleven stations checked into the net.

Carl said of the support that was received, "We have amateurs within ARES who cannot get directly involved in the Marathon event, so we have a process by which we have them monitor in case of a situation like what occurred at the Marathon this year. That system paid off and facilitated a rapid response to our request for additional support."

The terrorist attack on the 2013 Boston Marathon will not be forgotten. Amateur Radio played a critical role in communications to support runner safety on the course when the marathon was stopped, to help coordinate and shut down activities on the finish line and to support medical personnel until first responders had the situation fully contained. While there will be lessons learned to improve Boston Marathon operations further from an Amateur Radio perspective, it is clear that Amateur Radio remains an important resource for this large and popular event. Thanks to all who performed so admirably that day. — *Steve Schwarm, W3EVE, Paul Topolski, W1SEX, Rob Macedo, KD1CY*

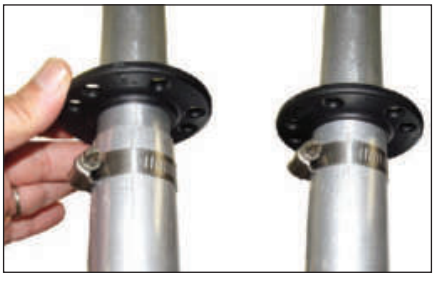
New Products

QHtenna Parabolic Dish Kits

The creator of the QHtenna turnstile antenna is now offering an aluminum mesh parabolic dish antenna kit in two sizes, aimed primarily at the 1296 MHz EME market. The 8 foot (2.2 meter) dish weighs 16 pounds, while the 12 foot (3.6 meter) dish weighs 22 pounds. The dish comes ready to assemble. The ribs/trusses are built, and you mount them to the hub and apply the mesh with tie wraps. No drilling is required; the only tools needed are a Phillips head screwdriver, a 5/16 inch wrench and a pair of snips. Approximate assembly time is said to be 8 hours. All hardware is supplied, and the dish mounts to a horizontal boom from a user-supplied elevation rotator. A Yaesu G-5500 az/el rotator is said to be sufficient to rotate the dish. The user supplies a feed assembly and two 10 pound counterbalances. The hub has a 1 ½ inch hole to accommodate the feed support. Both sizes are UPS shippable. Price: 8 foot dish, $820; 12 foot dish, $1100. For more information, or to order, contact Lyle Dysinger, N4QH, at **lylen4qh@aol.com**.

DX Engineering Guy Rings

DX Engineering DXE-GR-5P Guy Rings are intended for rope guying DX Engineering, Hustler, and other brands of aluminum tubing vertical antennas, as well as the DX Engineering telescoping fiberglass and aluminum tubing kits. The guy rings feature smoothed holes with no sharp edges, intended to protect your directly threaded ropes. Six 5/16 inch diameter attachment holes allow guy ropes to be spaced for three or four way guying systems.



The devices are made from the same black UV resistant, glass-reinforced poly-resin material found in DX Engineering's wire antenna kits and antenna insulators. The guy rings slide over their respective tubing size and seat firmly against the top of the larger tubing section below. Fits 0.75, 1.0, 1.25, 1.50 and 2.0 inch OD tubing. Price: $7.95 per set of five. For more information, or to order, visit **www.dxengineering.com**.

A Broadband Ham Network Crosses the Finish Line

A broadband ham network brings long-range video to the Big Bend 50 Ultra Marathon's finish line.

Lynn Jelinski, AG4IU

Big Bend National Park is located north of the Rio Grande River, which separates the United States from Mexico. Big Bend, which is larger than the state of Rhode Island, is a remote and dramatic wilderness located within the harsh Chihuahuan Desert.

Each year in the cool weather of January, Big Bend National Park hosts the Big Bend Ultra Run, a 50 kilometer (31 mile) marathon that is limited to 150 runners to minimize environmental impact. Athletes come from around the world to compete.

The Challenge

To support the marathon, hams from the Big Bend Amateur Radio Club, the Austin Amateur Radio Club and the San Antonio Radio Club established a race control and safety net on 2 meters. The race net had been used during previous races and had proved very effective both for coordination of race activities and runner safety. However, for the spectators, something was missing.

The friends and family of race participants couldn't watch their runners cross the finish line because they were cordoned off in an amphitheater at Rio Grande Village about 10 miles away.

The Solution — a Finish Line Cam

A group of hams from the Austin ARC (Joe Jelinski, KC2KG; Paul Kinney, KD5VRU; Mitch London, KD5HCV, and Alan Russell, KE5DTR) got the idea to deploy a high-speed multimedia mesh (HSMM-MESH) network to broadcast a live video feed from an Internet protocol video camera (similar to those used in security applications) at the finish line for spectators gathered in the remote amphitheater. The network is easy to set up, battery powered and far less expensive than a satellite link.

The Equipment

HSMM-MESH nodes are made from readily available consumer Wi-Fi routers (see **www.hsmm-mesh.org** for model numbers that are supported by the software). No internal hardware modification is needed; it's simple to re-

Figure 1 — The equipment used to establish the HSMM-MESH nodes are the Linksys router, a 12 V battery-powered UPS, signal mirror, compass and leather gloves. [Lynn Jelinski, AG4IU, photo]

Figure 2 — From the left are Mitch, KD5HCV; Joe, KC2KG, and Alan, KE5DTR, who used a compass to aim the antenna and a signal mirror to confirm the orientation. The antenna is secured with guy wires attached to 10 inch steel spikes. The cooler is to keep the battery-powered UPS warm during the night. [Paul Kinney, KD5VRU, photo]

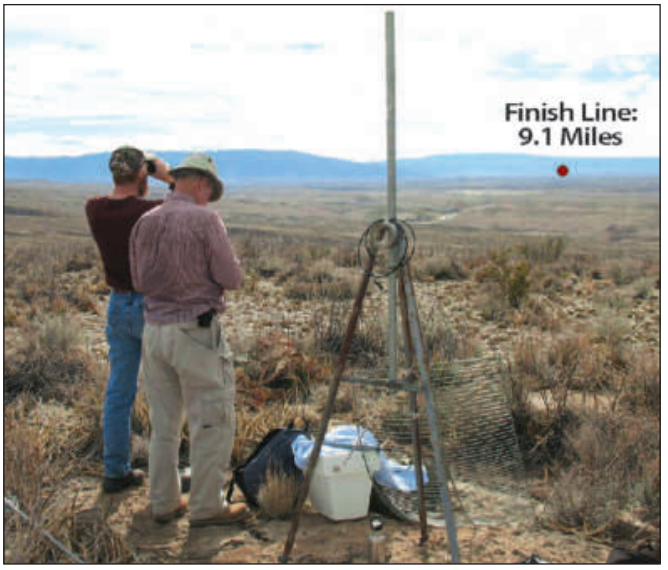


Figure 3 — Alan Russell, KE5DTR (L), and Joe, KC2KG, are looking out from the HSMM-MESH node location atop Ernst Ridge to the finish line 9.1 miles away. [Mitch London, KD5HCV, photo]

Figure 4 — Paul Kinney, KD5VRU, adjusting the video display and dealing with the bright Texas sun. [Joe Jelinski, KC2KG, photo]

program the router with free software downloaded from the site. The software converts the standard router to a microwave mesh node. [A mesh node operates within a mesh network. Each node in the mesh network can acquire data from an external device (such as a video camera) and also relay data acquired by other nodes. — *Ed.*] The converted router will still use the factory transmit power of about 80 mW.

As the nodes are powered up, the software enables each node to discover other nodes within range, form network paths and transfer data automatically.

Two of the nodes, the finish line camera node and the Ernst Ridge relay node, were in locations so remote that they didn't have electricity. We chose to use lightweight (6 lb) 12 V battery-powered uninterruptable power supplies (UPS) to power these nodes (see Figure 1).

The Amateur Radio Advantage

These routers normally deliver only household distance operation. This is where Amateur Radio comes in. Some of the 802.11B/G (2.4 GHz) channels overlap the Amateur Radio bands. If you hold a Technician class or higher license you may attach an amplifier, antenna or both to the node to increase its useful range. Remember, only the operating software (firmware) in the Wi-Fi router is changed to convert it to a mesh node.

Deploying the Network

Using microwave path analysis software, we determined we needed two nodes, one for a 9.1 mile path (see Figures 2 and 3) and another for a 1.8 mile path. For the 9.1 mile path from Ernst Ridge to the finish line, we used a 24 dB dish antenna at both locations. For the 1.8 mile path to the Rio Grande Village, we used a 12 dB omnidirectional antenna paired with a 12 dB Yagi. With these antennas and clear signal paths, we didn't need an RF amplifier.

Network Performance

Thanks to careful placement of the nodes, good antennas and the low RF noise floor at Big Bend National Park, we were able to get 100% copy. We placed backup batteries at each remote node in case we needed them, but the original batteries lasted for the entire 10 hours of the race. The batteries powering the video camera lasted for 6 hours and needed to be changed during the race.

Prior Planning and Testing Payoff

Our group spent many of our Digital Wednesday meetings planning the operation. We studied topographical maps, tested the nodes and checked the cold-temperature performance of the batteries. Having planned the antenna locations, we performed a microwave path analysis of the terrain to see how reliable the paths would be.

Once at Big Bend we validated our planning with on-site testing. We set up the network, checked antenna stability and battery integrity 2 days prior to the event. In preparation for the event each of us had climbed Ernst Ridge with heavy backpacks at least three times, clawing for handholds in the rocks while hoping the temperature was too cold for scorpions and rattlesnakes. Each ascent was the equivalent of climbing 400 stairs.

Hot Wash-up

It was dark by the time the final runner, who was by then a walker, hobbled across the finish line. Under the light of the stars we reviewed what went well and what could be improved.

The major glitch of the event was that we underestimated the intensity of the setting Texas sun. It was so bright that it overpowered the video projector. Despite our having erected a canopy over the screen, using a projection screen with a highly reflective surface and a high-powered projector, the finish line video projection was hard to see (see Figure 4). Next year we will use a TV screen or a CRT to display the live video feed.

Next Year — Audience Cam

Spectators loved seeing their runners cross the finish line, but the runners themselves didn't hear the cheers or share in their exhilaration. Next year we plan to place a second video camera in the audience — an "audience cam" — so we can provide a live video feed to the athletes at the wilderness finish line. HSMM-MESH is up to the task!

Joe Jelinski, KC2KG; Paul Kinney, KD5VRU; Mitch Lodon, KD5HCV, and Alan Russell, KE5DTR, contributed to this article.

Lynn Jelinski, AG4IU, an ARRL member, was first licensed in 2000. Lynn and her spouse, Joe, KC2KG, were members of the East Coast Waterway Net during their 11 years operating maritime mobile. Lynn helps universities write grants for research funding. Lynn and Joe can be contacted at 6406 Hopkins Dr, Austin, TX 78734, **kc2kg@earthlink.net**.

2012 Simulated Emergency Test Results

As if an earthquake and a solar flare aren't enough, this year's SET included a plague.

Steve Ewald, WV1X

Congratulations to everyone who took part in the 2012 ARRL® Simulated Emergency Test (SET). It was an exceptional opportunity to showcase and test the ability of Amateur Radio operators to provide communications when and where the need arises.

The following written summaries are only a small portion of the total effort that has made the SET a successful annual tradition across the country. These stories — and the many statistical reports that follow in this article — help to demonstrate your overall commitment to disaster communications as an individual Amateur Radio operator and the team efforts of the wider community. It also represents SET efforts by all who are active members and leaders of the ARRL Field Organization, ARES®, RACES, SKYWARN, National Traffic System (NTS) and many other allied groups.

Simulated Earthquake in Madison County

Tim Holland, KK5H, EC, Madison County

This year's SET was conducted by the Madison County (Alabama) ARES organization in cooperation with the Madison County Emergency Management Agency (EMA) and simulated an earthquake near Guntersville Dam that threatened flash flooding of the Tennessee River. The earthquake resulted in loss of power for the entire county due to inspections of the dam and the nearby Browns Ferry Nuclear Plant. As a precaution, overpasses and bridges were closed until inspections could be completed. Public communications services were extremely limited and unreliable.

The scenario resulted in the need to evacuate the river communities. The EMA requested communications to assist in facilitating evacuations. The National Weather Service requested the activation of SKYWARN. The American Red Cross requested communications assistance for three shelters. Requests for communications support came from local fire departments, police departments, hospitals and several community volunteer organizations throughout the county.

Six nets were activated to support the traffic demands including a digital net to pass information among the shelters. Forty-seven Amateur Radio operators participated in the SET serving 16 agencies in 10 communities. Twenty-nine written formal messages were passed among the served agencies including the Alabama Net. The SET duration was 3.5 hours.

Initial feedback from the served agencies has been very favorable. A few new things were tried this year, such as multiple categorical nets including a digital net. Our after action feedback yielded productive discussions and actions about what worked well and what needs improvement. The Madison County ARES team was pleased with the operation and looks forward to implementing the lessons learned from this exercise to improve our support to the Madison County EMA and its served agencies.

Bubonic Plague is Focus of SET

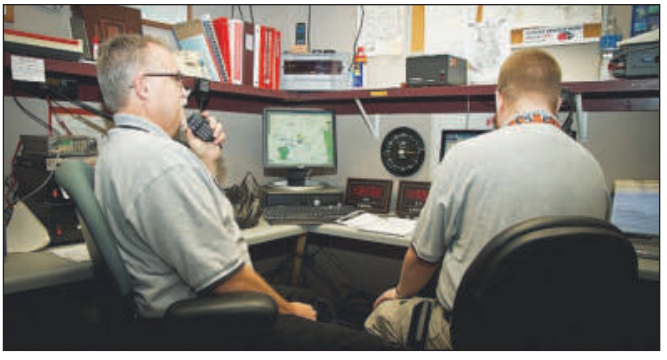
Irona Higgins and Alton Higgins, W4VFZ, EC, Towns County, Georgia

This year's "National Preparedness Month" was concluded with a SET, sponsored by the ARRL. In Towns County, Georgia, the Mountain Amateur Radio Club (MARC), in association with the Towns County American Red Cross Disaster Action Team (DAT) and various county agencies (EMS, E911, Sheriff's Office, Health Dept and Chatuge Regional Hospital) simulated an outbreak of bubonic plague.

The "test" was meant to determine the ability and effectiveness of Amateur Radio operators, County Red Cross members and county agencies to respond to a situation where a "pandemic" might occur. The drill also simulated a condition where virtually all telephones (including cell phones) and many standard emergency radio communications systems were out of service.

Should any disaster, either manmade or an act of nature, occur that results in the loss of conventional communications, Amateur Radio Operators are trained and equipped to provide emergency communications, from both fixed (base) or mobile radio stations. As members of both MARC and the Georgia Amateur Radio Emergency Service, these licensed hams have equipment that can not only reach radio "dead" spots within the county, but many also have equipment capable of sending traffic — or radio messages — to anywhere in the world.

Utilizing emergency power (generators, batteries, solar power, etc) and the Bell Mountain repeater, messages can be sent to most areas in Towns County. Traffic that needs to be sent out of the county to FEMA and Homeland Security, is sent with higher power radio systems maintained by members of MARC.



Tim Holland, KK5H, and Josh Roberson,WX4JRR, start the 2012 SET at W4HMC at the Madison County, Alabama, EOC. [Photo courtesy of Tim Holland, KK5H]

2012 SET Top Ten

Section	Points
ARES Activity	
Alabama	7032
Georgia	6606
Ohio	3785
Wisconsin	2715
Connecticut	2496
Kentucky	2031
South Texas	1671
Southern Florida	1535
Indiana	1083
Tennessee	1061

Section	Points
Section/Local Nets	
Alabama	2618
Connecticut	2454
Wisconsin	1352
Ohio	1084
Georgia	854
Michigan	630
Western New York	624
New Hampshire	512
Tennessee	403
Pacific	392

For an explanation of SET scores, log onto **www.arrl.org/public-service-field-services-forms** and click on "SET Score Card."

The Plague

During this year's Simulated Emergency Test, two "patients" (Red Cross volunteers) appeared at the Chatuge Regional Hospital with symptoms that were quickly identified as being those caused by the "bubonic plague."

Kathryn Stewart, KA4TEO, located at the hospital, quickly used a handheld transceiver to access the KI4ENN repeater and notify the Amateur Radio Net Control Operator Arthur Mott, WA5JFT. Mott notified the Health Department, the EMS Facility and E911. The duty officer at the EMS facility notified the Amateur Radio Emergency Coordinator (EC), Alton Higgins, W4VFZ, of the incident. Higgins then activated our emergency net.

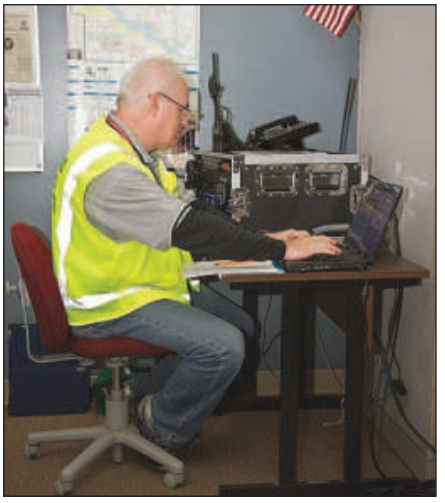
Simulating the inability to contact the Sheriff's Office, mobile operators David Bubeck, W4FED, and Duane Ledford, KJ4CFW, were dispatched to that facility where they maintained a communications link between the EMS, E911 facilities, the Sheriff's Office and the Hospital. Thus, all emergency agencies were kept in the loop by means of Amateur Radio.

During the drill, an effort was made by mobile operators Alton, W4VFZ, and Neal Dover, KI4OYK, to establish a radio relay link to the community of Tate City, Georgia. Unfortunately, it was quickly determined that more than two links were required to reach that "radio blind spot." Methods to establish the required links are being considered.

The drill was completed when the EC sent a radiogram, by a high powered Amateur Radio, over the mountains to the North East Georgia Health System in Gainesville, the central communications point for medical emergencies. In a real emergency (such as a pathogen or poisoning), this facility would then notify the Center for Disease Control in Atlanta.

Hotwash

The drill was considered a success, but also provided a "learning tool" for issues that need to be addressed to insure excellent backup communications in Towns County. A reliable communications system was demonstrated through the combined efforts of the MARC and the local Red Cross chapter, working with the local emergency agencies such as the EMS Department, Sheriff's Office, Health Department and Chatuge Regional Hospital.



Steve Smith, KM4CJ, operates the digital station at the Red Cross Center in Madison County, Alabama. [Photo courtesy of Tim Holland, KK5H]

For more information about Amateur Radio and the Mountain Amateur Radio Club, please e-mail a request for additional materials to **manmtn@windstream.net**.

Bexar County SET Evaluation

Erik Rabe, KD5YZU, EC, Bexar County, Texas

Training was the key to the success of this exercise from the Bexar County perspective. The exercise was designed to provide participants with an opportunity to pass e-mail traffic over the radio through a variety of methods. Through assessment of those capabilities, participants identified strengths, weaknesses and future training needs.

While it never hurts to have experienced traffic handlers practice moving message traffic, it was a pleasure to watch "new" traffic handlers participating in this exercise. It was gratifying to quickly troubleshoot problems and return to operations. Bexar County moved more traffic, by more means, using more trained operators than ever before.

Solar Flare Scenario

Donald Hinsman, N4VIP, DEC, Santa Fe and San Miguel Counties, New Mexico

The annual Simulated Emergency Test (SET) for the Santa Fe Amateur Radio Emergency Service (SFARES) was held on 10 November 2012 starting at 0830 and ending at 1200. The scenario was a solar flare that knocked out many utilities including power and most landline/cell phone systems in Santa Fe County. During the SET, power was also lost. This required SFARES to move to standalone power. Santa Fe County and New Mexico State EOCs requested SFARES to perform two primary tasks: Message traffic relay (locally, in-state and out-of-state) and local observation reporting.

Message traffic relay was via digital mode (MT63-500) and voice. Local messages were received via voice (FM) and transcribed to digital MT63-500. All out-of-state messaging relied on MT63 and RMS Express Winlink 2000. All outgoing in-state messaging relied on MT63 on VHF/UHF frequencies.

The Santa Fe ARES at the Sheriff's Posse Building acted as net control for both voice and digital modes using the club call sign — W5SAF. There were multiple voice traffic generators and multiple MT63 traffic generators/recipients. A special effort was made to make sure all SFARES members knew how to use the club's new FT-857 transceiver.

2013 SET on the Schedule

October 5 and 6, 2013, is the main weekend to focus on for this year's SET, although many sections and local Emergency Coordinators have the option of conducting their exercises on a different date if necessary. Please contact your local ARRL Field Organization leaders to find out specific dates, times and potential plans for the Simulated Emergency Test in your area.

ARES Activity

Area	Reporter	Points	Section Points
Atlantic Division			
Delaware			**224**
Sussex Co	KB3KYH	224	
Eastern Pennsylvania			**209**
Montgomery Co	N3FKR	192	
Philadelphia	AB3EO	17	
Southern New Jersey			**301**
Ocean Co	WX4NJ	160	
Cumberland Co	N2MHO	141	
Western New York			**530**
Chenango Co	K2DAR	302	
Onondaga Co	WA2PUU	228	
Western Pennsylvania			**723**
Bedford Co	KA3UDR	238	
Lawrence Co	KB3QLD	140	
Jefferson Co	KA3YCB	139	
Huntingdon Co	N3OGT	83	
Beaver Co	N3TN	64	
Blair Co	KA3EJV	59	
Central Division			
Illinois			**251**
Will Co	N9JH	118	
Lake Co	K9DRW	78	
Kane Co	NF9D	55	
Indiana			**1083**
Clark Co	N9WSV	301	
Vanderburgh Co	WB9EFH	272	
Howard Co	W9NWN	112	
Kosciusko Co	AB9ZA	108	
Harrison Co	W9WXN	99	
Decatur Co	KC9ELU	77	
Whitley Co	KA9LHE	76	
Clay Co	AB9WB	38	
Wisconsin			**2715**
Racine	KB9MMA	1161	
Dunn Co	KB9ULF	853	
Ozaukee Co	AB9ON	117	
Jefferson Co	KC9IKI	108	
Outagamie Co	AB9NN	106	
Waupaca Co	N9TBM	105	
Rock Co	KC9QQO	100	
Fond du Lac Co	W9GPI	97	
Pepin Co	WB9NTO	52	
Marquette Co	KG9OG	16	
Dakota Division			
Minnesota			**240**
Washington Co	KAØHYR	240	

South Dakota 263
West River Area KGØGG 263

Delta Division

Arkansas
Section wide K5KRK written

Mississippi 828
Harrison Co N9OKV 211
Jackson Co K5MOZ 206
Jasper Co WV1Q 199
Itawamba Co KB5NMB 77
Rankin Co KF5EZT 70
Tallahatchie Co W5JWW 65

Tennessee 1061
Jefferson Co W4DOD 449
Bradley Co KD5UBL 234
Sevier Co N4JTQ 197
DeKalb, Cannon Co KC4GUG 181
Great Lakes Division

Kentucky 2031
Hardin Co W8WN 547
Dist 10 KY4JLB 419
Jessamine Co KA3WOD 227
Perry Co KK4CZO 193
Johnson, Floyd, Pike Co N4KJU 155
Letcher Co KK4WH 122
Lawrence Co KJ4GRJ 111
Dist 9 N4KJU 104
Harlan Co AF4YJ 104
Henderson Co KI4GWN 49

Michigan 679
Saginaw Co KC8YVF 231
Benzie Co K8BTE 212
Grand Traverse Co K8RCT 140
Oscoda Co KD8CLM 50
Presque Is Co WB8TQZ 46

Ohio 3785
Erie Co K8HLH 512
Greene Co W8LLY 304
District 10 KD8JUF 268
Shelby N8KZL 214
Huron Co KB8DNA 209
Muskingum Co #1 KB3RDR 196
Delaware Co N8BHL 190
Guernsey Co KC8SBB 166
Coshocton Co AA8BN 165
Cuyahoga Co N8AUC 164
Montgomery Co KA5RUC 162
Jefferson Co KA3YCB 139
Darke Co KC8WHK 127
Miami Co WB8PMG 121
Lake Co KC8BTN 114
Muskingum Co #2 KB3RDR 111
Trumbull Co WB8LES 103
Clark Co N8NSD 92
Morrow Co N8EMR 77
Geauga Co N8ONI 75
Columbiana Co NN8B 64
Licking Co N8NQ 64
Belmont Co K8JRG 61
Van Wert Co WB8YIH 43
Jefferson Co N8CUX 38
Noble Co N8RAF 6

Hudson Division

Eastern New York 63
Columbia Co N2NZD 63

New York City/Long Island 372
Babylon W2HCB 189
Islip KB2SCS 183

Northern New Jersey 146
Passaic Co KO2FB 146

Midwest Division

Iowa 153
Boone Co WØBNW 96
Story Co KCØJUO 57

Kansas 103
Riley, Clay, Geary WØPBV 103

Missouri 263
Jackson Co KØUAA 164
Marion Co KDØHHN 99

Nebraska 173
Lancaster Co KØGND 173

New England Division

Connecticut 2496
Region 2 WA1SFH 726
New Milford N1CME 281
Danbury WA2IZQ 275
Region 5 K1DAV 265
Region 5, Winchester Center K1DJW 229
Windham Co SKYWARN KB1DGY 172
Region 3, SW W1VJA 122
Region 3, NW AB1LZ 102
Bethel KD1YV 96
Newtown KB1LYP 91
Brookfield W1QK 84
Winchester KA1WPM 37
Southbury W1NG 16

Maine 161
Cumberland Co WA1RB 161

New Hampshire 833
W Rockingham Co KA1UVH 343
Hillsborough Co N1MEO 202
Belknap Co N1RCQ 114
Capital Area K1PJS 97
Mt Washington Vly KB1IIR 77

Northwestern Division

Montana 112
Yellowstone Co WN7Y 112

Western Washington 840
Pacific N7CVW 460
Grays Harbor Co N7UJK 207
Skagit Co N6LB 173

Pacific Division

Nevada 106
Nye Co KC6ILH 106

Pacific 969
Hawaii State CD AH6RH 357
Windward Oahu KH7HO 168
N Hawaii Is KH6CQ 133
Maui Co KH6H 131
Oahu Co KH6OCD 180

Sacramento Valley 530
San Mateo Co W6LJB 231
Section wide KS6Z 187
Plumas Co KA6NSN 112

Santa Clara Valley 250
City of Cupertino KN6PE 135
San Benito Co W6TST 115
Roanoke Division

North Carolina 140
Moore Co N4YYL 140

South Carolina 208
Abbeville Co KL7FO 122
Anderson Co N4SZ 86

Virginia 481
Norfolk W4NMH 192
Page Co K4DPF 111
York Co, Poquoson WB4UHC 95
Isle of Wright Co W4VX 83

West Virginia 249
Dist 3 WA8LLM 249

Rocky Mountain Division

New Mexico 181
Santa Fe Co N4VIP 181

Wyoming 185
Laramie Co N7BAM 185
Southeastern Division

Alabama 7032
Jefferson Co W4JVM 2414
Shelby Co KI4YZI 847
Walker Co NR4G 628
St Clair Co W4AMG 524
Lee, Russell Co WX4AL 512
Madison Co KK5H 500
Tuscaloosa Co WS4I 506
Lowndes, Butler Co AK4NG 371
Cleburne Co W4AUB 222
Houston Co KE4GWW 197
Cherokee Co K4BMX 166
Dist 4 KD4LXU 145

Georgia 6606
Cherokee Co WW4WX 668
Crawford Co WB4NKU 618
N Fulton Co W4UOC 604
Houston Co KJ4QFF 417
Grady Co KJ4UKR 393
Thomas Co K4KXL 383
Colquitt Co W4TBJ 373
Gwinnett WB4QDX 301
Butts Co K3GWK 231
Barrow Co K4JSR 201
Cobb Co N5RCK 178
Paulding, Douglas Co KJ4KUT 172
Clayton, Henry Co AJ4GT 160
Camden Co N4TIS 156
Laurens Co K4DBN 156
Newton Co WA4UJC 147
Troup Co AD4GS 147
Bulloch Co KF4BSC 136
Carroll Co WX4BK 129
Clarke Co N4ZRA 126
Washington Co K4GK 115
Gordon Co AF4DN 114
Evans Co KJ4VIG 96
Towns Co W4VFZ 89
DeKalb Co #1 AI4UR 87
DeKalb Co #2 K5AES 76
Macon Co KI4BEO 71
Putnam Co NØCOW 69
Pickens Co K4SJR 67
Peach Co KI4YNZ 56
Fayette Co AG4ZR 55
Dodge Co KC5AVR 15

Northern Florida 227
Escambia, Santa Rosa Co KF4DVF 227

Southern Florida 1535
Broward Co KJ4AWB 521
Palm Beach Co WA4AW 496
Brevard Co N4LEM 263
Lee Co W4LWZ 255

Southwestern Division

Orange 231
Mission Viejo WA6RUZ 231
West Gulf Division

North Texas 115
Irving KA5OZC 115

South Texas 1671
Travis Co K5FX 250
Bexar Co KD5YZU 199
Orange Co N5MTX 187
Nueces Co AD5CA 177
Dist 6 W5FQA 150
Aransas Co K5BV 143
San Patricio Co K5BV 139
Burnet & Llano Co KA5GIL 127
Angelina Co WD5EFY 110
Bandera Co N4MUJ 97
Live Oak Co W5IM 92

West Texas 80
El Paso Co KB5HPT 80

Section/Local Nets

Area/Net Name | *Net Mgr* | *Points* | *Section Points*

Atlantic Division

Western New York 624
OCTEN KA2ZNZ 221
CNYTN WA2PUU 183
WDN KB2DQ 122
CARES K2DAR 98

Western Pennsylvania 183
Lawrence Co KB3QLD 100
Beaver Co N3TN 69
Blair Co KA3EJV 14
Central Division

Illinois 40
Lake Co K9DRW 40

Indiana 47
Harrison Co W9WXN 47

Wisconsin 1352
Racine KB9MMA 739
Dunn Co KA9ZAJ 209
Brown Co KC9OIS 137
JefCares KC9IKI 73
Rock Co KC9QQO 64
FDL ARES W9GPI 52
OZARES AB9ON 42
State RACES/ARES AB9NN 36

Dakota Division

South Dakota 88
Tri State Weather KØDEU 88

Delta Division

Mississippi 64
Jasper Co, SKYWARN WV1Q 64

Tennessee 403
JCARES W4DOD 152
DeKalb, Cannon Co KC4GUG 151
Sevier Co N4JTQ 100

Great Lakes Division

Michigan 630
MI VHF AC8AR 152
NW OH ARES N8TNV 144
Saginaw Co KC8YVF 108
QMN K8AE 83
MI Digital Traffic N8FVM 46

Ohio 1084
OSSBN WB8SIQ 506
FARA N8FMJ 207
Huron Co KB8DNA 119
COTN KD8EEK 111
Shelby Co KC8CFI 101
Benzie Co K8BTE 97
Geauga Co N8ONI 40

Hudson Division

Eastern New York 122
CDTN K2HAT 68
Hudson Valley N2JBA 54

Northern New Jersey 101
NJ2PC KO2FB 101
Midwest Division

Kansas 167
KSN/KPN NØKFS 167

Missouri 84
Jackson Co KØUAA 84

Nebraska 212
E Neb 2 Mtr KNØRKY 212

New England Division

Connecticut 2452
WCTN KB1NMO 502
Nutmeg KB1RGQ 403
Reg 1 Central W1GIG 271
CPN N1DIO 186
Scottish Rite W1VJA 134
Reg 2 Resource K1EIC 118
ARES SET N1FNE 104
Reg 2 Simplex WA1SFH 99
Reg 2 Tactical #1 K1EIR 94
Reg 2 Tactical #2 WA1SFH 66
Reg 2 Tactical #3 WA1SFH 63
Reg 2 Traffic #2 WA1SFH 59
Reg 3 NW ARES KB1VBB 54
ECTN W1MCT 46
Reg 2 Resource #1 WA1SFH 42
Reg 2 Resource #2 WA1SFH 40
Reg 2 Tactical WA1SFH 40
Reg 2 Simplex #2 WA1SFH 39
Reg 3 NW Simplex KB1VBB 30
Reg 2 HF WA1SFH 28
Reg 2 Resource WA1SFH 18
Reg 2 10 m HF WA1SFH 16

Maine 161
Maine Emergency K1HZU 95
Cumberland Co K1GAX 66

New Hampshire 512
CA-ARES W1INC 245
W Rockingham Co KA1UVH 128
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ARES N1RCQ 52
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Northwestern Division

Alaska
Section wide AL7N written

Western Washington 16
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Pacific Division

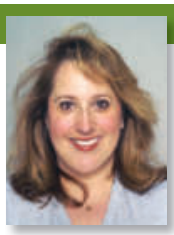
Pacific 392
Oahu KH6OCD 143
HI State CD, VHF AH6RH 105
HI State CD, HF AH6RH 99
Windward Oahu KH6OM 45

Southeastern Division

Alabama 2618
Jefferson Co W4LHQ 679
Lee-Russell Co WX4AL 292
St Clair Co W4AMG 254
Madison Co WX4JRR 245
Shelby Co KI4YZI 242
Jim Bell Wireless WA4BO 207
Smith Dam Failure NR4G 193
AEN U WS4I 181
Cleburne Co W4AUB 100
Houston Co KE4GWW 92
Randolph Co KD4LXU 62
Cherokee Co SKYWARN K4BMX 36
Alabama Section Net WA4ZPZ 35

Georgia 854
Georgia Statewide HF K4GK 772
Washington Co ARES K4GK 61
Peach Co KI4YNZ 21

Southern Florida 341
Palm Beach Co KG2BX 341



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

Radiating Well Pump Leads to FCC *Citation* for Interference to Amateur Radio

The FCC finds that an underground well pump acted as an incidental radiator, causing harmful interference on the 160 meter band.

The FCC issued a *Citation and Order* to Ruben D. Lopez Jr of Pomona Park, Florida on April 23, in response to several complaints about a well pump at Lopez's residence that was acting as an incidental radiator, causing harmful interference to a local radio amateur.

In July 2010 and February 2011, the FCC received complaints from a local ham regarding interference on the MF and HF Amateur Radio bands. Upon investigation, the FCC found that a well pump at Lopez's residence was causing the interference, and advised Lopez of the complaints and of the rules regarding interference to licensed radio services. The FCC instructed Lopez to resolve any interference.

According to the *Citation*, in October 2012 — in response to another interference complaint — FCC agents "used direction finding equipment to identify Mr Lopez's well pump as the source of transmissions on the frequency 1800 kHz. The agents…confirmed that Mr Lopez's well pump was the source of the interference by conducting on/off tests — the interference ceased when the well pump was turned off. The agents informed Mr Lopez that he must cease operating his well pump until the interference could be resolved. After the October 2012 inspection, the [FCC's] Tampa Office received information that Mr Lopez tried to eliminate the interference by replacing the A/C line filter for the well pump, but the new filter did not resolve the interference."

Lopez was found by the FCC to be in violation Section 15.5(b) and (c) of the FCC's rules by operating an incidental radiator and causing harmful interference. He was instructed by the FCC to "take immediate steps to ensure that he does not continue to cause harmful interference, including repairing or replacing his well pump and associated control circuitry." The FCC advised Lopez that if he continues to violate the Communications Act or the FCC's rules, it "may impose monetary forfeitures of up to $16,000 for each such violation, or in the case of a continuing violation, up to a maximum forfeiture of $112,500 for any single act or failure to act. In addition, violation of the Communications Act or the [FCC's] rules also can result in seizure of the equipment through *in rem* forfeiture actions, as well as criminal sanctions, including imprisonment."

Lopez had until May 23 to respond to the *Citation*, either through an in-person meeting with the FCC office in Tampa, or via a written statement, if he so desired. The written statement should detail any actions Lopez has taken "to ensure that he does not violate the Communications Act or the [FCC's] rules governing the operation of incidental radiators in the future."

President Obama Nominates Financier and Former Telecom Executive Tom Wheeler as FCC Chairman

On May 1, President Barack Obama announced that he has nominated Tom Wheeler to be the new Chairman of the Federal Communications Commission. If the Senate confirms the nomination, Wheeler will replace Julius Genachowski who announced his resignation from the FCC in March. Pending Wheeler's confirmation, FCC Commissioner Mignon Clyburn — the agency's soon-to-be senior Democrat — will serve as the Commission's acting chairman. No date has been set for Wheeler's confirmation hearings as of press time.

Wheeler, 67, has served as an informal adviser to Obama in recent years and has been a major fundraiser for his political campaigns. He has a background as a venture capitalist and as a lobbyist for the communications industry. He is the former President of the National Cable Television Association (now known as the National Cable & Telecommunications Association) and former Chief Executive Officer of the Cellular Telecommunications & Internet Association. Currently, he is a Managing Director at Core Capital Partners, a venture capital firm in Washington, DC.

Obama said that Wheeler "has been at the forefront of some of the very dramatic changes that we've seen in the way we communicate and how we live our lives. He was one of the leaders of a company that helped create thousands of good, high-tech jobs. He's in charge of the group that advises the FCC on the latest technology issues. He's helped give American consumers more choices and better products."

Tom Wheeler, President Obama's nominee for next FCC Chairman.

As technology continues to shape the way that Americans do business and communicate, Obama said that Wheeler will help the FCC fulfill a very important mission: "[Wheeler will give] businesses and workers the tools they need to compete in the 21st century economy, and making sure we're staying at the

cutting edge of an industry that again and again we've revolutionized here in America."

Currently, Wheeler is Chairman of the FCC's Technological Advisory Council and Chairman of the State Department's Advisory Committee on International Communications and Information Policy. Wheeler was a fund-raiser for Obama during both his 2008 and 2012 campaigns. In 2009, Wheeler led the Obama-Biden Transition Project's Agency Review Working Group that was responsible for the science, technology, space and arts agencies. Wheeler has served on the President's Intelligence Advisory Board since 2011.

Wheeler is the author of *Mr. Lincoln's T-Mails*, a book on Abraham Lincoln's use of the telegraph. "Mr Wheeler has experienced the revolution in telecommunications as both a policy expert and advocate, as well as a businessman," states the author page for *Mr. Lincoln's T-Mails*. "As an entrepreneur, he started or helped start multiple companies offering new cable, wireless and video communications services. As a policy expert he has been intimately engaged in the development of the government's telecommunications policy at both the legislative and regulatory level."

FCC Commissioner Robert McDowell — a Republican — also announced his resignation in March. There has been no announcement by the White House as to who will be nominated to replace McDowell, although it is not unusual for nominations to fill Republican and Democrat vacancies to be paired, smoothing their way through the confirmation process.

ARRL Public Relations Committee Sponsoring "I Am the ARRL" Video Contest

As part of the ARRL's Centennial Celebration in 2014, the ARRL's Public Relations Committee is sponsoring an "I am the ARRL" video contest. The Committee is looking for pairs of short video clips featuring ARRL members. One clip should show the radio amateur on the radio, while the other should show the amateur in his or her work setting saying "I am (*name*). I like (*radio activity*) and I am the ARRL."

ARRL Public Relations Manager Allen Pitts, W1AGP, explained further: "For example, a car mechanic in coveralls working over an engine looks at the camera and says 'I am Henry Smith, NØXCC. I like to talk to people in exotic countries and I am the ARRL.' This clip would then be paired with a shot of him at home talking on the radio. You may be a lab technician in a white coat, a doctor with a stethoscope, a teacher in a classroom, a cook in a kitchen — whatever represents your profession. We're looking for videos that communicate that you are that 'guy or gal down the street' and you are the ARRL."

According to Pitts, clips will be assembled into one video that will be shown at the 2014 ARRL National Centennial Convention, scheduled for July 17-20, in Hartford, Connecticut. "We will draw names of all who submitted these videos and offer prizes," Pitts said. "The top prize is a mini-library of major League publications, such as the *ARRL Handbook*, the *Antenna Book* and more."

Both clips should be shot in 9:16 format (widescreen) and 720 or higher definition; MP4 or .mov files preferred. No VHS tapes, please. The ARRL will have the full rights for all video clips submitted. Entrants may submit more than one pair of clips. All adults in the videos must sign the ARRL's adult model release (**www.arrl.org/adult-picture-release-form**); parents or legal guardians must sign the ARRL's child model release for their children who appear in the videos (**www.arrl.org/child-picture-release-form**). Videos submitted without model releases will not be considered.

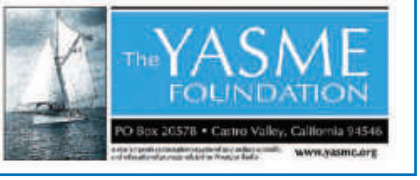
Entries must be postmarked by December 31, 2013. Burn your videos to a CD or DVD using the appropriate software and mail it to: "I am the ARRL" Video Contest, 225 Main St, Newington, CT 06111, Attn: Allen Pitts, W1AGP. Do not attempt to send videos via e-mail, as our e-mail system cannot accommodate large files. Please contact Pitts via e-mail at **w1agp@arrl.org** with any questions.

Ward Silver, NØAX, Elected President of Yasme Foundation

At its annual meeting in April, the Yasme Foundation's Board of Directors elected Ward Silver, NØAX, as its new President. Silver will replace Wayne Mills, N7NG, who has resigned. Mills, founder of DX University, was named as the new DX editor of *CQ* magazine earlier this year. In recognition of Mills' many years of service to the Yasme Foundation and DX University, the Yasme Board of Directors made a contribution to DX University in support of the goals shared by the two organizations.

"I'm thrilled and grateful to be following Wayne Mills, N7NG, as President of the Yasme Foundation," Silver told the ARRL. "Our founders — Lloyd, W6KG, and Iris Colvin, W6QL — saw DXing as a motivator for technical and operating excellence. As ham radio accelerates into its second century, we hope to continue supporting forward-looking projects and awards around the world that encourage international operating and enable innovation. Yasme has always been a kind of 'mystical' name to me, as I came on to the DXing scene just as the Danny Weil, VP2VB, and Colvin era was winding down. To not only have been invited to join the Board, but to now lead it, is very exciting. It's a special connection from the fabled days of DX to the future, and I'm delighted to be along for the ride!"

The Yasme Foundation is a not-for-profit corporation organized to conduct scientific and educational projects related to Amateur Radio, including DXing and the introduction and promotion of Amateur Radio in developing countries.



FCC and GAO Release Recommendations on Receiver Performance; Comments Invited

In early 2012, FCC Chairman Julius Genachowski tasked the FCC's Technological Advisory Council (TAC) to study the role of receivers "in ensuring the efficient use of spectrum and to provide recommendations on avoiding obstacles posed by receiver performance to making spectrum available for new services." On April 22, 2013, the FCC released a *Public Notice* (Docket No. ET 13-101), detailing the recommendations of the TAC's working group on Receivers and Spectrum in a white paper called *Interference Limits Policy — The use of harm claim thresholds to improve the interference tolerance of wireless systems*. On May 1, President Obama nominated TAC Chairman Tom Wheeler as his pick for FCC Chairman.

In addition to the work of the TAC, the Government Accountability Office (GAO) was tasked by Congress in the *Middle Class Tax Relief and Job Creation Act of 2012* to study spectrum efficiency and receiver performance. The GAO report — titled *Further Consideration of Options to Improve Receiver Performance Needed* — was recently published and references the TAC white paper. The GAO report recommends that the FCC "consider small-scale pilot tests and other methods to collect information on the practical effects of various options for improving receiver performance." Comments on the both the TAC's white paper and the GAO's report are now being accepted.

According to the *Public Notice*, the TAC white paper said that "an interference limits policy approach may not be appropriate in all cases. Are there other policy approaches that should be considered? Moreover, the GAO report identifies the lack of incentives for manufacturers or spectrum users to incur costs associated with using more robust receivers, and the difficulty of accommodating a changing spectrum environment, such as when spectrum is repurposed for a new use."

The white paper also noted that "interference being experienced is widely distributed both geographically and temporally. This would be the case when, for example, widely deployed consumer devices like television sets or handheld wireless devices receiving signals 'over the air' are interfered with by, say, geographically dispersed private land mobile radio, amateur radio transmitters or other wireless devices operating in an adjacent band. Thus the base case would exclude resolution of interference that arises when multiple radio systems (i.e., transmitters and receivers) are co-located at a single antenna site, or on a single tower, or even share a single antenna on a tower." The ARRL is studying all the documents in this proceeding and expects to file comments.

The FCC's Office of Engineering and Technology is now seeking comments on whether and how the FCC should implement a policy that "incentivizes improved interference tolerance of wireless systems. Specifically, should the FCC adopt a policy of employing interference limits in certain cases of neighboring bands and services? Should the FCC adopt specific rules for establishing interference limits that are recommended by one or more multi-stakeholder groups? Should the FCC develop a compliance model [where]…there is industry-led establishment of standards and solutions and the Commission would get involved only via special petition?" Comments are due June 21; reply comments are due July 8. Information on how to file comments and reply comments can be found on page 4 of the *Public Notice* at **apps.fcc.gov/ecfs/document/view?id=7022305447**.

Ham Radio Editor and Noted DXer Joe Schroeder, W9JUV (SK)

Joseph J. Schroeder Jr, W9JUV, of Glenview, Illinois, passed away April 30. He was 83. An ARRL Life Member, Schroeder was on the editorial staff for *Ham Radio* magazine from August 1974-July 1990, penning almost 400 articles that ran the gamut from FCC actions to Field Day to licensing issues. Schroeder was also the founding editor of *HR Report*, a newsletter published by *Ham Radio*.

Schroeder was one of only three radio amateurs who had 394 confirmed DXCC entities, placing the trio at the top of the DXCC standings. Schroeder had missed only seven entities, all of which are now deleted.

Schroeder is survived by his wife Janet, N9LGI, two children and three grandchildren. A memorial service is planned for a later date.

Joe Schroeder, W9JUV, in Curacao for the 2006 ARRL SSB International DX Contest. [Chad Kurszewski, WE9V, photo]

Section Manager Election Notice

To all ARRL members in the Alabama, Alaska, Delaware, East Bay, Kansas, Michigan, New Mexico, Santa Barbara, Tennessee, and Western Massachusetts 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 sections concerned. It is advisable to have a few more than five signatures on each petition. A sample nomination form is available on the ARRL website at **www.arrl.org/section-terms-nomination-information**. Nominating petitions may be made by facsimile or electronic transmission of images, provided that upon request by the Membership and Volunteer Programs Manager, the original documents are received by the Manager within 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 September 6, 2013. If more than one member is nominated in a single section, ballots will be mailed from Headquarters on or before October 1, 2013, to full members of record as September 6, 2013, which is the closing date for nominations. Returns will be counted November 19, 2013. Section Managers elected as a result of the above procedure will take office January 1, 2014.

If only one valid petition is received from a section, that nominee shall be declared elected without opposition for a two-year term beginning January 1, 2014. If no petitions are received from a section by the specified closing date, such section will be resolicited in the January 2014 *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*

Call for Nominations for ARRL Director and Vice Director

Attention: Full ARRL members in the Pacific, Rocky Mountain, Southeastern, Southwestern and West Gulf divisions! You have the opportunity and duty to choose a Director and a Vice Director to represent you for three-year terms beginning January 1, 2014.

The ARRL is governed by its Board of Directors. A voting Director is chosen by ballot by the full (licensed) members in each of the 15 ARRL divisions. Vice Directors, who serve in the absence of the Director from a Board meeting and succeed to the position of Director should a vacancy occur, are chosen at the same time. Elections are held in five divisions per year. It only takes 10 full members in a division to nominate a candidate for either office.

This year ARRL members in divisions where there are contested elections **will be able to vote electronically**. Members with valid e-mail addresses in their membership profiles will be sent instructions on how to vote by e-mail. Members without e-mail addresses or whose e-mails bounce, or who request a paper ballot, will be sent a ballot by postal mail as in the past.

Qualifications

The eligibility of nominees for the positions of ARRL Director and Vice Director will be reviewed by the Ethics and Elections Committee, composed of three Directors not subject to election this year: Greg Widin, KØGW (chair), Cliff Ahrens, KØCA, and Dennis Bodson, W4PWF. A nominee must be at least 21 years old and must have been licensed and a full member of the ARRL for a continuous term of at least four years immediately preceding nomination. Each nominee must provide information concerning his or her employment, ownership and investment interests, and other financial arrangements so the Committee can determine whether the nominee has a pervasive and continuing conflict of interest that would render him or her ineligible to serve (see Article 12 of the ARRL Articles of Association and Bylaw 45, available at **www.arrl.org/general-information**).

The qualifications for Director and Vice Director are identical. All the powers of the Director are transferred to the Vice Director in the event of the Director's death, resignation, recall, removal outside the division or inability to serve.

Nomination Procedure

Step 1: Obtain official nominating petition forms. Any full member residing in a division where there is an election may request an official nominating petition package. The request must reach the ARRL Secretary *no later than noon EDT on Friday, August 9, 2013*. If you are seriously considering running or nominating someone to run, don't wait until the last minute to request the forms; the deadline for submitting a completed petition form is just one week later.

Step 2: Obtain signatures and complete questionnaire. ***Only the official form may be used.*** The petition form has two sides. To be valid, a nominating petition must name the candidate and must bear the signatures of 10 full members of the division. The candidate must complete the other side, providing the information required to determine eligibility, certifying its accuracy, and agreeing to assume the office if elected.

Step 3: Submit petition form. The completed form must reach the Secretary *no later than noon EDT on Friday, August 16, 2013*. The submission may be made by facsimile or electronic transmission of images (i.e. a PDF or JPEG attachment to an e-mail) provided that upon request, the original documents are received by the Secretary within seven days of the request. A person who is nominated for both Director and Vice Director may choose to decline the nomination for Director; otherwise the nomination for Director will stand and that for Vice Director will be void.

On Monday, August 19, 2013, the Secretary will notify each candidate of the name and call sign of each other candidate for the same office. Candidates then will have until Friday, August 30, 2013 to submit 300-word statements and photographs, if they desire these to accompany the ballot, in accordance with instructions that will be supplied.

Balloting

If there is only one eligible candidate for an office, he or she will be declared elected by the Ethics and Elections Committee. If there is more than one eligible candidate for an office, the full members in that division who are in good standing as of September 10, 2013 will have the opportunity to cast ballots. Balloting will begin no later than October 1, 2013 and will conclude at noon Eastern Time Friday, November 15, 2013. The candidate receiving the most votes will be declared the winner.

Members who are eligible to vote and for whom the ARRL has a valid e-mail address will be sent instructions on how to vote electronically. All other members who are eligible to vote will receive ballots by USPS. The election will be conducted by Survey & Ballot Systems of Eden Prairie, Minnesota, which has more than 20 years of experience with association elections. Whether cast electronically or on paper, all votes will be by secret ballot. A representative of the Ethics and Elections Committee will be present to observe the tabulation of results.

Absentee Ballots

A full member who is residing temporarily outside his or her home division, including overseas, may arrange to vote in the home division by notifying the Secretary prior to September 10, 2013, giving their current mailing address as reflected in the ARRL membership records (i.e. *QST* mailing address) and the reason why another division is considered home. Members with overseas military addresses should take special note of this provision; in the absence of information received to the contrary, ballots will be sent to them based on their postal addresses.

The Incumbents

The incumbent Directors and Vice Directors, respectively, in the five divisions in which elections will be held this year are:

Pacific: Bob Vallio, W6RGG and Jim Tiemstra, K6JAT

Rocky Mountain: Brian Mileshosky, N5ZGT and Dwayne Allen, WY7FD

Southeastern: Greg Sarratt, W4OZK and Jim Millsap, WB4NWS

Southwestern: Richard Norton, N6AA and Marty Woll, N6VI

West Gulf: Dr David Woolweaver, K5RAV and John Robert Stratton, N5AUS

For the Board of Directors:
May 10, 2013
David Sumner, K1ZZ
Secretary

Rick Palm, K1CE, k1ce@arrl.org

Heartbreak Hill

Hams recount their tales of the attack at the Boston Marathon.

Once just the name of a demanding stretch of the Boston Marathon course, the ascent near Boston College known as Heartbreak Hill took on new meaning as my hometown's heart was broken over the events of Monday, April 15, 2013. Upon hearing that terrorists had bombed the finish line area in downtown Boston, my first thought was of my old friend Eliot Mayer, W1MJ, who would be working the event as a radio operator on a huge Amateur Radio team that has supplied communications over the course for many years. Mayer has been involved in public service communications for events including the Marathon and the Walk for Hunger for the past 40 years.

Mayer was working the starting line operation in Hopkinton, 26.2 miles west of the finish line in Boston. He was safe, but there was little other joy at learning the news that people had lost their lives in a city so deeply woven in the American tapestry.

A broader account of the Boston Marathon bombing can be found in a feature article in this issue, but here I just wanted to add two first-person accounts of the race — one from David Titelbaum, KB1MSR, and one from Eliot Mayer, W1MJ. — *Rick Palm, K1CE*

Hams holding down Net Control are stunned by the news report of the bombings at the finish line. From the left: Bob Phinney, K5TEC, Net Control Team; Louisa Ricker, KB1LNX; Karen Brothers, K1KEB, Net Control Coordinator, and Ariel Joiner. [Bruce Tinkler, N9JBT, and Nick Weber, W3BER, photo]

Eliot Mayer, W1MJ, shown here at his home station in Belmont, a suburb of Boston, had worked the starting line operation earlier in the day. He was home safe and sound when the bombs exploded. [Photo courtesy Eliot Mayer, W1MJ]

A Great Day For a Marathon

This year's Patriot's Day, April 15, looked to be a great day for the 117th running of the Boston Marathon; the weather was shaping up to be cooler than it was last year, when many runners succumbed to the heat and needed to be transported to the local hospitals. I have worked many Boston Marathons, both as an Emergency Medical Technician (EMT) on an ambulance at Heartbreak Hill in Newton, as a bus rider/amateur communicator out on the Bus Net and as an amateur communicator at the finish line.

I had all of my gear ready to go early on Sunday, having reprogrammed two portable radios and one mobile radio, and packed the laptop and cables into my backpack for any support that might be needed. Then it was off to bed at a decent hour in order to make the planned 0630 (local) arrival time at the Amateur Radio Operators Assembly Point in the John Hancock Building downtown. My son Max, KB1QKF, and many members of our local radio club, the North Shore Radio Association (NSRA), were among the hundreds of amateurs providing communications and/or medical support for the Red Cross at various First Aid stations along the 26.2 mile linear route, while other NSRA club members were stationed at the Course Radio Net Control.

My assignment this year was to shadow one

of the Boston Athletic Association (BAA) finish line Team Captains, which made my tactical radio call "Captain Delta." The shadow's role is to follow the Team Captain and, like the character Radar O'Reilly from the movie and TV show *M*A*S*H* did, provide communications support for the Team Captain back to the BAA finish line Coordinator, sometimes before they realize that they needed it.

As an aside, the finish line Net Control, located near Medical Tent A, was coordinated via a three page ICS-205 (Incident Radio Communications Plan) and a dizzying organizational chart. Finish line Net Control managed a Bus Net to coordinate the retrieval and transportation of runners and supplies from throughout the course, a Medical Net managing supplies and personnel, and a Medical Sweep and Logistics Net managing wheelchairs, medical supplies and EMS assistance. It also interacted with the Course Network and various other information feeds.

The marathon was progressing smoothly until two bombs exploded at the finish line along Boylston Street at approximately 1450. Our area of responsibility was away from the actual finish line so we were not directly affected by the carnage that ensued during the explosions. There was much speculation, some on the finish line tactical channels, and among the families, runners and spectators as to what had just transpired. As an added difficulty, cell phone service in the immediate area was overloaded.

Soon thereafter, finish line Net Control transmitted word that they were being directed to evacuate from their location. While various BAA Sweep Team volunteers and amateur communicators also evacuated the area, the BAA Medical Sweep Coordinator and his shadow Marc Kazigian, KA2WMX, remained operational in support of the BAA volunteer "boots on the ground" with Marc stepping up as the Net Control on our tactical channel. As the afternoon progressed, Marc and I worked with our BAA principals to facilitate an orderly finish line Medical Sweep Team shutdown of the remaining volunteers in the immediate area. It wasn't until approximately 1645 that all remaining finish line BAA volunteers and radio amateurs were finally released.

While walking out of the finish line area to my vehicle, I was able to make a cell phone call to my son. He had been concerned and was elated to finally hear my voice, as we had not spoken during the day. His team had been relocated to the St Ignatius Chapel at Boston College in Newton along the race course. This was one of three locations where runners were redirected after the race was stopped. There the runners were provided with food, medical services and shelter while the race officials worked out plans to reunite them with their families.

Mike "Sparky" Leger, N1YLQ, shows us a typical ham's marathon equipment: radio, badges and a marathon jacket. [Mike Leger, N1YLQ, photo]

I switched over to the Course Network and received clearance to transit to the St Ignatius Chapel to provide communications support to my son's team. Forty-five minutes and many closed roads later, I arrived in Newton and was able to navigate into the parking area at the chapel. As I exited my truck, my son stepped up to me and the next thing I remember was having the wind squeezed out of me. Three years earlier Max had been deployed with his National Guard unit to Afghanistan and with each news report of an explosion or attack, my stomach would sink and I would await that phone call or e-mail saying "Hey Dad, I'm OK." Today our roles were reversed, as I was the one in the "hot zone" and he had been unable to reach me.

Amateur Radio brings people together from around the world and around the corner. In our case, it has brought father and son closer together. — *David Titelbaum, KB1MSR, Peabody, Massachusetts*

Taking Precautions

Before 2013, the only time I was actually close to the runners was at the 1980 Marathon, the year that Rosie Ruiz cheated to win the women's category and was eventually caught. I shadowed a Boston Athletic Association (BAA) official at Mile 15 and was told to help him spot the bib numbers of the first male and female runners. The first female we spotted was Jacqueline Gareau, who eventually became the real women's first place winner.

I didn't work at the marathon for some years after that, until Patriot's Day became a paid holiday at my workplace. Then I was stationed at Course Net Control for some years — which made for mundane work at times, but on especially hot marathon days we got a lot of ambulance calls. The Red Cross was with us at Net Control and would dispatch the appropriate ambulance for the location of the fallen runners. For 2011 and 2012 I was at Bus Net Control. We dispatched the buses that bring runners who can't finish the race back to the finish line. After the bombing this year, I listened in on the Bus Net. The people there did a great job of adapting to the emergency situation. I heard the Net Control stations staying calm even when they didn't know where to send the buses. Eventually, a plan solidified. I heard them organize a meeting place first at Newton City Hall and later at Boston College, and finally at a safe location in Boston.

This year, wanting a change of scenery, I worked at the starting line from 0515 until 1100. I spent much of that time just waiting around. Then, just before each group of runners started, a group of us radio amateurs who were spread out along the beginning of the route, called in to report if the route was clear of dogs, children, etc. With 9000 runners in each starting wave, this was an important safety job. I got home early, took a nap and then woke up to the bad news.

In hindsight, recalling the dogs I saw at the starting line gave me pause. I had asked an official what their job was and was told that they sniff for bombs and drugs. At that time their presence seemed like excessive caution. Later that day I would be less naive. — *Eliot Mayer, W1MJ, Belmont, Massachusetts*

Worried Looks and Anxious Spectators

ARRL® Eastern Massachusetts Section Manager Phil Temples, K9HI, said "I wasn't a participant, but of course as Section Manager, I've debriefed many others who

were. I snapped a photo along the course on Commonwealth Avenue near Boston College at approximately 1455. I didn't know why at the time but the photo shows worried looks and anxious spectators glued to their smartphones. When I came out of the office a half hour later, I was amazed to see Commonwealth Avenue completely devoid of runners."

Temples summed up his section's response: "I'm very proud of the actions of the section's ARES® members and other Marathon Amateur Radio Communications consortium participants during the marathon bombings. When the stuff hit the fan, amateurs shifted seamlessly from public service event support to full blown emergency operation. We were in a strategic position to assist first responders — especially near the finish line, where cellular telephone infrastructure was at serious risk of collapse. The fact that amateurs are able to adapt quickly to a new game plan underscores the fact that our services will always be in demand."

ARES in the Classroom: DHS Auxiliary Emergency Communications Course

By now the vast majority of active ARES members have worked under, or are at least familiar with (thanks to FEMA online training courses, **training.fema.gov/IS**), the government's ubiquitous Incident Command System (ICS) — the "standardized, on-scene, all-hazards incident management" template. System goals are: integration of facilities, equipment, personnel, procedures and communications within a common organizational structure and a coordinated response among various jurisdictions and functions (read *Interoperability*) — both public and private.

The ICS has five major functional areas: Command followed by Finance/Administration, Logistics, Operations and Planning (I remember them by the acronym *FLOP*). The Communications Unit is the primary platform for our work as ARES and other response communicators and is found under the Logistics Section (and Service Branch). The COML is the All-Hazards Communications Unit Leader. Since late 2008, the Department of Homeland Security's Office of Emergency Communications (OEC, **www.dhs.gov/about-office-emergency-communications**) has hosted COML courses across the nation, resulting in more than 5000 trained emergency responders. The All-Hazards Communications Unit Technician (COMT) was added to provide trained experts on practices and procedures common to radio communication technicians during emergency operations. Training of COMLs and COMTs is rigorous and demanding.

A Workshop for ARES

Now there is a workshop designed to train Communications Unit Auxiliary Emergency Communicators (AEC), with students from groups like ARES and Radio Emergency Associated Communications Teams (REACT) who would volunteer their services under this umbrella to work side by side with the professional public safety radio operators. Nearly all states have incorporated participation of Amateur Radio auxiliary communications operators into their Statewide Communications Interoperability Plan (SCIP).

The course focuses on auxiliary communications interoperability, emergency operation center etiquette, on-the-air etiquette, FCC rules and regulations, auxiliary communications training and planning, certification and accreditation, and emergency/disaster scene deployment. It is intended to supplement and standardize an operator's basic knowledge of emergency Amateur Radio communications in a public safety context.

Prerequisites for attendance include: Completion of the FEMA online courses IS-100, IS-200, IS-700 and IS-800 prior to the workshop; a General class FCC license or above; past experience in auxiliary emergency communications, and a desire to learn how to work with the Communications Unit Leader in the NIMS/ICS environment.

The workshop is an intensive 2 day, 20 hour weekend course with facilitated lecture and student exercises. Each workshop is limited to 30 attendees. The course covers:

- The Communications Unit and the Emergency Operations Center (EOC)
- AEC Roles and Responsibilities
- Interoperable Communications
- Incident Communications
- Incident Radio Communications Plan
- Incident Communications Center
- Team management and accountability
  - Resources
  - Intrastate and interstate radio networks
  - Final exercise exam

A course was conducted in Northern Florida by the DHS' Office of Emergency Communications at the Alachua County Sheriff's Office in Gainesville on November 6-7, 2012. Jeff Capehart, W4UFL, Alachua

Jeff Capehart, W4UFL, was impressed by the training he received in the AUXCOMM communications course. [Rick Palm, K1CE, photo]

County ARES emergency coordinator (EC) and RACES officer (RO), took that course. He said "Think of it as the ARRL's *Introduction to Emergency Communications* training course (EC-001) without the ARRL radiogram/ARES/NTS and other ARRL specific information, but instead with a focus on the COML, the Communications Unit of the ICS, related ICS forms such as the 205, 217, 214 and so forth."

Capehart reported that a good source for an overview of the AUXCOMM course is **publicsafetytools.info/start_index_v2.php** (click on the AUXCOMM training course button). The overview covers positions within the Communications Unit; responsibilities of positions within the Communications Unit, including AEC volunteers; the planning cycle; other agencies/organizations responsible for coordination and providing assets, and the functions of an EOC.

In a telephone interview, Capehart said the main benefits for him as an EC and RO were the lessons on terminology, etiquette, protocols and just plain habits of the professional public safety communicators so that "we could walk their walk and talk their talk;" that is, to act like them and be like them. "It's not enough to listen to scanners to learn these aspects," Capehart said.

Susie Westfall, KK4GIC, communications commander for the Alachua County Combined Communications Center (dispatch and public safety communications), was a driving force who brought the DHS to Gainesville to conduct the course. It was taught by DHS/OEC staff out of Atlanta, Georgia, including Randy Kerr, KD4KHO.

Contest Corral – July 2013

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

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

Start - Finish Date-Time		Date-Time		Bands HF / VHF+	Contest Title	Mode	Exchange	Sponsor's Website
1	0000Z	1	2359Z	1.8-28 / 50-144	Canada Day Contest	Ph CW	RS(T), Province/Territory or serial	www.rac.ca/service/contesting
1	0000Z	7	2400Z	28 / -	Ten-Ten Spirit of 76 QSO Party	Ph CW Dig	Call, name, member number, S/P/C	www.ten-ten.org
4	2300Z	5	0300Z	1.8-28 / 50	MI QRP July 4th Sprint	CW	RST, S/P/C and QRPMI number or power	www.miqrp.org
6	8 PM Local	7	2 AM Local	7 / -	070 Club Firecracker PSK31 Sprint	Dig	RST and S/P/C	www.podxs070.com
6	0000Z	7	2400Z	1.8-28 / -	Venezuelan Indep Day Contest	Ph CW Dig	RS(T) and serial	www.radioclubvenezolano.org/concurso.htm
6	1100Z	7	1059Z	3.5-28 / -	DL DX RTTY Contest	Dig	RST and serial	www.drcg.de
7	1100Z	7	1700Z	28 / -	DARC 10-Meter Digital Corona	Dig	RST, serial	www.darc.de/referate/ukw-funksport
7	2000Z	7	2359Z	1.8-28 / -	QRP ARCI Summer Homebrew	CW	RST, S/P/C, QRP number or power	www.qrparci.org/contests
9	0200Z	9	0400Z	3.5-28 / -	ARS Spartan Sprint	CW	RST, S/P/C, and power	www.arsqrp.blogspot.com
9	1600Z	9	See website	3.5 / 50, 144	OK1WC Memorial Contest	Ph CW	RS(T) and serial	www.hamradio.cz/ok1wc
10	1300Z	11	See website	1.8-28 / -	CWops Monthly Mini-CWT Test	CW	Name and member number or S/P/C	www.cwops.org/onair.html
12	0230Z	12	0300Z	1.8-14 / -	NS Weekly Sprint	CW	Serial, name and S/P/C	www.ncccsprint.com
12	2000 EDT	12	2400 EDT	3.5-28 / -	FISTS Summer Sprint	CW	RST, S/P/C, name, FISTS number or pwr	www.fists.org/operating.html#sprints
13	**1200Z**	**14**	**1200Z**	**1.8-28 / -**	**IARU HF World Championship**	**Ph CW**	**RST and IARU zone**	**www.arrl.org/contests**
13	1200Z	14	2359Z	1.8-28 / 50	Straight Key Weekend Sprintathon	CW	RST, QTH, name, member nr if member	www.skccgroup.com
13	1800Z	14	2359Z	- / 50+	VHF+ Alaska QSO Party	Ph CW Dig	Call sign and 4-char grid square	www.kl7yk.us/akqso.htm
14	2000Z	14	2159Z	14 / -	CQC Great Colorado Gold Rush	CW	RST, serial, category, CQC member nr	www.cqc.org/contests
18	0030Z	18	0230Z	3.5-14 / -	NAQCC Monthly QRP Sprint	CW	RST, S/P/C, and NAQCC mbr nr or power	naqcc.info
20	1200Z	21	1200Z	3.5-28 / -	DMC RTTY Contest	Dig	RST and serial	www.digital-modes-club.org
20	1600Z	20	1800Z	28 / -	Feld-Hell Ten Meter Sprint	Dig	RST, S/P/C, Feld-Hell member nr	sites.google.com/site/feldhellclub
20	1800Z	21	2100Z	- / 50,144	CQ WW VHF Contest	Ph CW Dig	4-char grid square	www.cqww-vhf.com
20	**1800Z**	**21**	**0600Z**	**3.5-28 / -**	**North American QSO Party RTTY**	**Dig**	**Name and S/P/C**	**ncjweb.com/naqprules.php**
21	0900Z	22	See website	3.5-7 / -	RSGB Low Power Contest	CW	RST, serial, power	www.rsgbcc.org
22	0100Z	22	0300Z	1.8-28 / -	Run For the Bacon	CW	RST, S/P/C, Flying Pig nr or power	www.fpqrp.org
27	0000Z	28	2400Z	- / 144	144 MHz Digital EME Championship	Dig	TMO or RST and R	www.DUBUS.org
27	1200Z	28	1200Z	3.5-28 / -	RSGB IOTA Centenary Contest	Ph CW	RS(T), serial, IOTA number if island	www.rsgbcc.org
27	1400Z	27	See website	3.5-28 / -	MARAC US Counties QSO Party	Ph CW	RS(T), state and county or "DX"	www.marac.org
27	1600Z	28	2000Z	3.5-28 / 144	New Jersey QSO Party	Ph CW	RS(T) and NJ county or S/P or "DX"	www.njqp.hamshack.info
28	1700Z	28	2100Z	7-28 / -	Flight of the Bumblebees	CW	RST, S/P/C, Bumblebee nr or power	adventure-radio.org

All dates refer to UTC and may be different from calendar dates in North America. Times given as AM or PM are local times and dates. No contest activity occurs on the 60, 30, 17 and 12 meter bands. Serial = Sequential number of the contact. S/P/C = State, Province, DXCC Entity. XE = Mexican state. Publication deadline for Contest Corral listings is the first day of the second month prior to publication date (May 1 for July *QST*) — send information to **contests@arrl.org**. Listings in blue indicate contests sponsored by ARRL or *NCJ*. The latest time to make a valid contest QSO is the minute listed in the "Finish Time" column.

2013 ARRL January VHF Contest Results

New year, new categories!

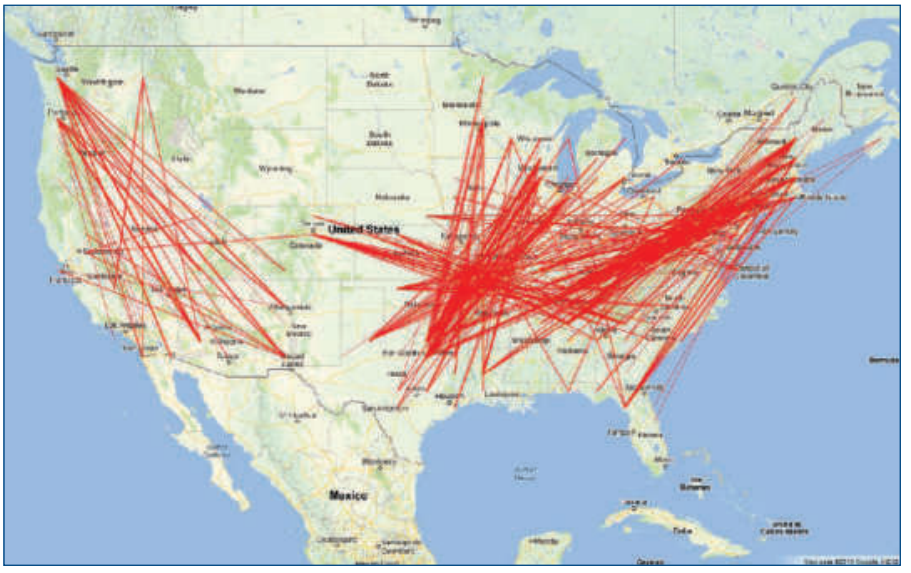
John (JK) Kalenowsky, K9JK, hamk9jk@ameritech.com

The first ARRL VHF radiosport event of the New Year rang in with two new entry categories: Single Operator, Three Band (SO3B) and Single Operator, FM Only (SO-FM). Those new categories gathered a total of 100, 77 and 23 log submissions, respectively. While the total number of logs submitted for 2013 slipped slightly to 721 from 2012's count of 767 (about 6%), approximately the same percentage (about 60%) are made up of Single Operator entries using low power. Congratulations to the first-time winners of the two new categories, Rich, KV2R, for SO3B and Ev, W2EV, for SO-FM!

Logs submitted in the new categories contained numerous comments indicating that this was their first contest or first January contest, such as N2SLO's "My first January contest, now with 432 MHz operation. My new 15 element Yagi with 50 watts is a small footprint, but worked above my expectations. Six meters opened up at 0200 on Saturday night, with KØHA worked in EN10 from Long Island."

Not to ignore the other categories, congrats to Roger, W3SZ, for topping the "classic" Single Operator, Low Power (SOLP) entrants, and to Jeff, K1TEO, in a very familiar spot for him as leading scorer among this year's 134 Single Operator, High Power category entrants. Single Operator, Portable can be a challenge in January, especially in the northern latitudes, yet Richard, N2SPI, prevailed as the top scorer among the 10 category entries and from the Western New York section, no less. The teams at N3NGE and W3SO lead the competition in the Multioperator (MO) and Limited Multioperator (LM) categories (59 and 22 entries, respectively). Roving in January can also be a challenge, yet 63 rover logs were submitted in 2013. Wayne, N6NB, topped the 29 "classic" Rovers. John, K9JK, teamed up with Mike, WB8BZK, to lead the 30 Limited Rovers (RL) and Harry, WØBL, bested the four Unlimited Rover (RU) entries.

Besides the 721 call signs for which logs were submitted, over 3500 other call signs appeared in the more than 63,000 QSOs that were included in the submitted logs. Ten logs crossed the 500 QSO barrier with the N3NGE multiop team actually topping 1000 QSOs with their effort.



Map showing 6 meter propagation enhancement on Saturday of the contest.

Fireworks in 2013?

While not as widespread or lengthy as in 2012, there was enhanced 50 MHz propagation this year. On Saturday, the count of 50 MHz QSOs exceeding 600 km from about 0100 through 0500 UTC (even though it was Sunday in UTC) was almost 2900 with the peak of over 1200 QSOs in the 0300-0400 hour. Saturday's enhancement included much of the country (see map above). On Sunday, the two hours from 2300 UTC through 0100 UTC (Monday UTC) each netted over 900 QSOs (1885 total) on 50 MHz that indicated paths longer than 600 km, though Sunday's conditions were much more favorable to the eastern half of the country. The extended version of this article at **www.arrl.org/contest-results-articles** has separate maps for each of the four hours on Saturday, showing the progression of propagation paths over time, as well as a map of Sunday's propagation paths.

The ionosphere was not the only method of making longer QSOs. A number of stations bounced signals off of that passive reflector that orbits our planet approximately ¼-million miles away to make intracontinental and intercontinental QSOs. On 144 MHz K1JT, K5QE, KL7UW, NC2V, W4AS, W9GA, W9JN, WA3QPX and WB2RVX reported such QSOs. K5QE and W7MEM report EME QSOs on 432 MHz in their logs and W3HMS reported a couple of EME QSOs on 1296 MHz. The log from K5QE also shows a 222 MHz QSO with W6MYC that was likely to have been via EME, even though it was not over as long a path as EME QSOs completed on other bands.

Regional Spotlight

The Northeast region, which includes the Atlantic, Hudson and New England Divisions along with the eastern reaches of Canada, was the source of more than 40% of the logs submitted with 303. The Atlantic Division alone provided over half of those (165) and the Eastern Pennsylvania Section (EPA) provided the highest count from any single section with 82. EPA actually tied the log totals from the entire New England Division (which is comprised of seven sections). The next highest count of logs from any single division was the 58 from the Central Division. With so many stations active in the area, many of the overall Top Ten by Category listings contained only stations from the Northeast region. The initial

Affiliated Club Competition

	Logs	Score
Unlimited Club Category		
Mt Airy VHF Radio Club	65	2,601,071
Medium Club Category		
North East Weak Signal Group	20	589,759
Nacogdoches ARC	5	584,300
Florida Weak Signal Society	11	407,792
Potomac Valley Radio Club	31	405,921
Contest Club Ontario	12	128,193
Badger Contesters	16	127,363
Pacific Northwest VHF Society	19	114,416
Society of Midwest Contesters	14	110,954
Northern Lights Radio Society	11	100,572
Yankee Clipper Contest Club	11	89,619
Tennessee Contest Group	4	70,490
Roadrunners Microwave Group	6	42,062
Frankford Radio Club	7	36,160
North Texas Microwave Society	4	32,240
Bergen ARA	11	18,029
Six Meter Club of Chicago	11	17,823
Florida Contest Group	6	15,421
Rochester VHF Group	6	14,232
Northern California Contest Club	9	12,087
South Jersey Radio Assn	5	10,979
Carolina DX Association	4	9,890
Rochester (MN) ARC	14	9,748
CTRI Contest Group	3	8,545
Mad River Radio Club	4	5,408
Alabama Contest Group	3	5,366
Hudson Valley Contesters and DXers	4	2,935
Georgia Contest Group	4	1,322
Contest Group Du Quebec	3	990
Minnesota Wireless Assn	4	231
Alaska VHF-UP Group	3	225
Local Club Category		
Murgas ARC	3	30,770
Bristol (TN) ARC	9	16,728
Granite State ARA	5	14,935
Raritan Bay Radio Amateurs	6	10,674
Stoned Monkey VHF ARC	3	9,087
Meriden ARC	4	7,796
DFW Contest Group	3	5,424
Contoocook Valley Radio Club	4	3,382
Burlington County Radio Club	3	3,308
Sterling Park ARC	3	2,336
Mobile Sixers Radio Club	4	2,246
Maritime Contest Club	3	347

winners of this year's new categories, Rich, KV2R, for SO3B and Ev, W2EV, for SO-FM, both operated from the region and three of the other Top Ten finishers in each of the new categories were from the Northeast. National SOLP leader, Roger, W3SZ, was joined by five other SOLP entrants from the region. Jeff, K1TEO, had more company from the Northeast, with seven other SOHP national Top Ten finishers from there (five of those from the EPA Section). Another national leader from the Northeast region was Richard, N2SPI, who was accompanied by three other Single Operator, Portable entrants. The national top scorers in the multioperator categories were also from the Northeast; the N3NGE team was joined by three other Northeasterners among the Top Ten in MO and the W3SO team led four other national LM leaders from the region. Leading rovers from the Northeast were Russ, NN3Q, (with Al, K3WGR), in "classic" Rover (accompanied by one other rover from the region), Justin, N2ZBH, in RL (also accompanied by one other from the region) and Sig, KJ1K, who was the sole RU entry from the Northeast.

The 115 logs from the Southeast region (Delta, Roanoke and Southeastern Divisions) was the next highest regional log count. In the new Single Operator categories, the SO3B top scorer was Tim, KD5CKP, with Dave, N4DW, finishing first in SO-FM. For the SOLP and SOHP categories, Todd, N4QWZ, and Mike, W3IP, were the leaders for the region and there was no entry in SO-Portable from Southeast. The region's top multioperator entries were Steve, N4JQQ (+ assistance), in MO and Don, N3MK (+ assistance), in ML. The overall "classic" Rover winner, Wayne, N6NB, operated in the Southeast region, with Ray, KD4RSL, finishing in the top spot for the region's Limited Rovers.

Log submissions from the Central region, consisting of Central and Great Lakes Divisions plus the 4 new sections of Ontario totaled 107, with Bob, VE3KZ, and Erich, KC9CUK, leading the Central region in the new SO3B and SO-FM categories, respectively. Bob, K2DRH; Paul, WØUC and Rod, KDØEBT, topped the Central SOLP, SOHP, and SO-Portable categories, respectively. Jim, KO9A, went with assistance to lead MO and a team at N8ZM (with "lots of good food" according to their Soapbox) topped ML from the region. Central's leading rovers were Russell, VE3OIL, for "classic" and James, W8ISS, for Limited.

Four divisions; Dakota, Midwest, Rocky Mountain and West Gulf; plus the Canadian provinces of Manitoba and Saskatchewan make up the Midwest region from which 103 logs were submitted. Bob, KØNR, and Tim, WD9IGX, claimed the inaugural top spots for the region in the new SO3B and SO-FM categories, respectively. Midwest's best in SOLP was Keith, WB5ZDP, and in SOHP Ron, K5LLL. Stu, WØSTU, claimed the region's top spot for SO-Portable with a mountain-topping expedition as his photos show at **www.arrl.org/soapbox/view/8567**. Rovers in the Midwest were lead by Tom, W5TV (with Ralph, WD5RAH) in "classic" Rover, your author John, K9JK (with Mike, WB8BZK) in RL and Harry, WØBL in RU.

Participants from the West Coast region; Northwestern, Pacific and Southwestern Divisions plus Alberta, British Columbia and NWT; submitted a total of 91 logs with John, K6MI, topping the new SO3B category and Terry, K6TDI, prevailing in the new SO-FM category from the region. Bob, AF6RR, and Eric, N7EPD, were the region's leaders in SOLP and SOHP, respectively. Duane, KI6QEL, was the lone SO-Portable entrant from the West Coast and also finished 2nd overall in the category. Tom, KE7SW (+ assistance), claimed the region's top spot in MO with a margin of less than 200 points over the team at AE6GE. The ML entry from the West Coast was W6QAR with this being their second foray into VHF+ contesting. Their Soapbox comment also noted that they "Had a couple of newcomers participate who should soon be licensed." West Coast rovers kept it Limited (no "classic" or Unlimited rovers from the region) with Darryl, WW7D, finishing atop the category.

Club Competition

The results table tells the story. The Mt. Airy VHF Radio Club Packrats continued their streak of winning the Unlimited Club category. Even though their log count dropped to 65 from last year's 77 (still plenty of margin above the 51-log minimum for Unlimited), their aggregate total score increased by almost 185,000.

Among the 30 entries in Medium Club, 20 members of the North East Weak Signal Group submitted their logs to claim that gavel with just 5,000 points more than the five logs

Justin, N2ZBH, sure had some great views during the contest! He roved to mountaintop locations in Eagle Rock Reservation (FN20vt), Mt. Peter (FN21uf), Nike Overlook Park (FN31ab) and Alpine Lookout (FN30aw) [Justin De Vuyst, N2BZH, photo]

Top Ten

Single Operator, High Power

K1TEO	349,305
K3TUF	263,948
WB2RVX	191,260
WA2FGK (K2LNS, op)	109,516
WA3DRC	92,272
K3IPM	76,196
K3CB	57,715
WØUC	56,848
WA2OMY	49,368
WØRSJ	47,652

Single Operator, Low Power

W3SZ	186,415
WA3NUF	128,338
N3RG	88,786
K2DRH	81,648
AF1T	76,248
WB2SIH	71,642
N4QWZ	69,750
WA3GFZ	66,663
K1KG	62,500
W2BZY	40,107

Single Operator, Portable

N2SPI	2,464
KI6QEL	1,666
WB2AMU	915
WØSTU	666
KDØEBT	270
KK6MC	252
WA3WUL	48
KC9ALX	28
W3MEO	12
KD2DCC	6

Single Operator, 3-Band

KV2R	6,368
VE3KZ	5,680
K6MI	5,145
N1IBM	4,770
AC8HU	4,465
N9TF	2,369
WB9TFH	2,160
N2SLO	2,080
W1DYJ	1,840
KD5CKP	1,679

Single Operator, FM Only

W2EV	1,080
KC9CUK	441
K6TDI	324
N9ZE	156
K2SI	128
KB1YNT	80
WD9IGX	54
KL2DN	54
K1KD	40
KB1YSK	33

Multioperator

N3NGE	575,706
K5QE	418,608
K3EOD	67,528
KBØHH	59,598
WB3IGR	27,192
KE1LI	20,945
N1JEZ	17,253
KO9A	17,136
KE7SW	15,235
AE6GE	15,050

Limited Multioperator

W3SO	116,920
K2LIM	91,440
N8ZM	30,076
W1QK	28,334
N3MK	27,456
W4NH	25,456
KØSIX	14,256
KB4BKV	9,776
K2QO	8,050
W9RVG	3,645

Rover

N6NB/R	154,440
W6TAI/R	134,310
W5TV/R	106,128
NN3Q/R	104,924
N2CEI	101,707
K1DS/R	99,162
K4SME	94,224
WB2ONA	65,681
N2CYM	60,496
W5JMC/R	47,150

Limited Rover

K9JK/R	20,880
KE5GAQ/R	18,800
WW7D/R	18,216
N2ZBH/R	13,968
K7BWH	9,509
KØMHC/R	8,736
N6ZE/R	2,882
KD4RSL/R	2,222
N2SLN/R	2,016
K6LMN/R	1,309

Unlimited Rover

WØBL/R	10,086
KJ1K/R	9,682
KRØVER/R	4,758
ABØYM/R	3,082

Division Leaders

Single Operator, High Power

Atlantic	K3TUF	263,948
Central	WØUC	56,848
Dakota	KØAWU	7,080
Delta	WB4JGG	7,614
Great Lakes	K8MD	40,848
Hudson	W2BVH	13,708
Midwest	WØKT	680
New England	K1TEO	349,305
Northwestern	N7EPD	22,506
Pacific	KC6ZWT	16,796
Roanoke	W3IP	41,412
Southeastern	W4ZRZ	9,800
Southwestern	WA7JTM	4,294
West Gulf	K5LLL	28,747
Canada	VE3ZV	16,571

Single Operator, Low Power

Atlantic	W3SZ	186,415
Central	K2DRH	81,648
Dakota	WØGHZ	13,986
Delta	N4QWZ	69,750
Great Lakes	K8WW	9,802
Hudson	WB2SIH	71,642
Midwest	NØLL	10,731
New England	AF1T	76,248
Northwestern	KD7UO	9,064
Pacific	AF6RR	10,350
Roanoke	WB8TFV	12,505
Rocky Mountain	KKØQ	3,920
Southeastern	W2BZY	40,107
Southwestern	K6TSK	3,944
West Gulf	WB5ZDP	15,504
Canada	VA3ST	39,483
DX	XE2JS	4

Single Operator, Portable

Atlantic	N2SPI	2,464
Central	KDØEBT	270
Hudson	WB2AMU	915
Pacific	KI6QEL	1,666
Rocky Mountain	WØSTU	666

Single Operator, 3-Band

Atlantic	KV2R	6,368
Central	N9TF	2,369
Dakota	ABØBW	174
Delta	KD5CKP	1,679
Great Lakes	AC8HU	4,465
Hudson	N2SLO	2,080
Midwest	KØJQA	88
New England	W1DYJ	1,840
Northwestern	K7VIT	768
Pacific	K6MI	5,145
Roanoke	WA4LDU	768
Rocky Mountain	KØNR	1,311
Southeastern	W4ETN	1,485
Southwestern	WB6HYH	800
West Gulf	AE5P	48
Canada	VE3KZ	5,680
DX	XE1AY	627

Single Operator, FM Only

Atlantic	W2EV	1,080
Central	KC9CUK	441
Dakota	WD9IGX	54
Delta	N4DW	22
Great Lakes	KT8D	24
New England	KB1YNT	80
Northwestern	KL2DN	54
Pacific	N6AJR	30
Roanoke	KK4MIN	10
Southeastern	N5EEO	1
Southwestern	K6TDI	324
West Gulf	KC5FM	3

Multioperator

Atlantic	N3NGE	575,706
Central	KO9A	17,136
Dakota	NYØA	378
Delta	N4JQQ	13,356
Great Lakes	K8GDT	11,712
Hudson	K2ZD	12,768
Midwest	NØAC	6
New England	KE1LI	20,945
Northwestern	KE7SW	15,235
Pacific	AE6GE	15,050
Roanoke	W4YCC	1,653
Rocky Mountain	WØRIC	1,898
Southeastern	K1KC	3,003
Southwestern	K9PY/7	70
West Gulf	K5QE	418,608
Canada	VA7FC	546

Limited Multioperator

Atlantic	W3SO	116,920
Central	W9RVG	3,645
Dakota	KØSIX	14,256
Great Lakes	N8ZM	30,076
Hudson	W2GH (W2JSJ, op)	440
Midwest	WØAO	54
New England	W1QK	28,334
Roanoke	N3MK	27,456
Southeastern	W4NH	25,456
Southwestern	W6QAR	1,725
West Gulf	WD5IYF	2,652

Rover

Atlantic	NN3Q/R	104,924
Central	W9FZ/R	20,400
Dakota	KCØP/R	4,320
Delta	N6NB/R	154,440
Great Lakes	NE8I	7,344
New England	AA1I/R	4,061
Roanoke	W5JMC/R	47,150
Southeastern	N2CEI	101,707
West Gulf	W5TV/R	106,128
Canada	VE3OIL/R	36,646

Limited Rover

Atlantic	N2SLN/R	2,016
Dakota	WA2VOI/R	672
Delta	KD4NOQ/R	290
Great Lakes	W8ISS	264
Hudson	N2ZBH/R	13,968
Midwest	NØJK	182
New England	WA1T/R	880
Northwestern	WW7D/R	18,216
Roanoke	KD4RSL/R	2,222
Rocky Mountain	KD7WPJ/R	54
Southeastern	N4TZH/R	480
Southwestern	N6ZE/R	2,882
West Gulf	K9JK/R	20,880

Unlimited Rover

New England	KJ1K/R	9,682
Rocky Mountain	WØBL/R	10,086

from the Nacogdoches ARC (about 1% difference). Though not in contention for the gavel, the aggregate scores of the 3rd and 4th place Medium clubs were less than 2,000 points apart (under ½% difference) with the Florida Weak Signal Society sneaking in just ahead of the Potomac Valley Radio Club.

Twelve clubs vied for the Local Club gavel with the Murgas ARC claiming it. Three Murgas members submitted their logs to finish just over 14,000 points ahead of the total score from the nine logs received from members of the Bristol (TN) ARC.

Summary

Welcome to the new Single Operator, Three Band and Single Operator, FM Only categories. Thanks as well to pioneering operators who chose to explore these new paths and to the many who entered in the "classic" categories. It would have been quite interesting had similar propagation occurred in 2013 as was experienced in 2012, but that is part of the sport of radio: Like Forrest Gump's box of chocolates, you never know what you're going to get. So what flavor of propagation will be found in 2014? Make your plans to participate and find out first-hand January 18-20!

The Opening Continues Online!

Read even more stories and analysis in the Expanded Results article online at **www.arrl.org/contests**.

2012 ARRL 10 Meter Contest Results

"You just never know what 10 meters is going to serve up!" — Jim, WX3B

Scott Tuthill, K7ZO, k7zo@cableone.net

The 40th annual ARRL 10 Meter Contest was held December 8-9, 2012. After an amazing 2011 the faithful all over the world were awaiting a repeat. As late as December 1, National Oceanic and Atmospheric Administration's (NOAA) Space Weather Prediction Center flux forecasts were in the range of 130 for the contest period, which would lead to outstanding propagation. Right in line with 2011! The Sun had other plans, though, and conditions took a sudden, unexpected dive the week before the contest. In the days leading up to the contest, flux was in the high 90s and barely climbed above 100 over the contest weekend. Sadly, those hoping for a repeat were left wanting. In particular, inter-continental east-west propagation paths were severely depressed compared to 2011. Still, participation was high with 3,050 operators submitting logs. Those who did get on the air found plenty of folks to work, proving once again that the ARRL 10 Meter Contest is a great time!

Propagation

Part of the thrill of 10 meters is that low power and small antennas generate contacts far and wide. Whether operating for competition or recreation when 10 meters is open it is a great place to hang out. And, during 2012 10 meters was still a good place to make intra-continental contacts as well as look for DX on north-south paths.

Though the usual DX short paths were not cooperating, many lucky operators caught amazing long path openings. On both Saturday and Sunday morning long path openings erupted from the eastern US to Asia. As Ken, WM5R, related in his post contest soapbox comment:

"I experienced something that never fails to thrill me just a little. On both mornings, I managed to work other Amateur Radio stations in southeast Asia by pointing my antennas to my southeast. In our morning most of the planet between Texas and southeast Asia on the short path is in darkness. The long path, on the other hand, was mostly in sunlight at that time and for a brief moment, conditions are just right. I made contact with other radio stations over a distance more than halfway around the planet. No wires, no networks — just two radios with some aluminum stuck high up in the sky, enjoying one of the fleeting wonders of nature."

The People Behind the Numbers

Of course any event like the ARRL 10 Meter Contest is really the result of operators worldwide making the effort to turn on their station and get on the air. The people make the contest. The Sun and the ionosphere just provide a pathway for everyone's journey. In any contest there are full-bore operations meant to place first in their category, there are operations just about enjoyment, maybe along with some friends and family, and there are operators who go make extra special efforts just to get on the air.

One perennial story line is the battle for the top spot among DX Multioperator, High Power stations. In 2011 D4C managed to beat out 2008, 2009 and 2010 victor CW5W and set a new all-time record in the process. CW5W team leader Jorge, CX6VM, certainly noticed this and was committed to regaining their top spot in 2012. As Jorge says their drive to be #1 *"...is a commitment that grows each year..."* CW5W was successful and reclaimed their crown atop the DX Multioperator, High Power category. That makes it four out of the last five for Jorge and his team — a dynasty in the making?

Similarly in the US, several traditional heavyweights battled for the top Multioperator, High Power spot, but it was the team led by Dave, K1WHS, an energetic newcomer to HF contesting, that pulled out the win. The K1WHS team was one of the ones to catch the long path openings to Asia on Sunday which resulted in some great multipliers. *"We had the rig on at 1200Z Sunday morning, and worked our first EU station then, fully an hour earlier than on Saturday. Then Dennis, W1UE, got the surprise of the weekend when JG1ILF called him on CW. He worked seven JAs, plus VR2CB, BD7LMD, XV1X, BU2AV, HSØZIA and 9V1YC. Our last long path QSO was at 1541 with 9V1YC in Singapore."*

Beyond competition, the 10 Meter Contest is always a good contest to share with family and friends give operators a chance to try contesting for the first time. Rich, NØHJZ, took an opportunity during the contest to introduce his 12-year-old nephew David to Amateur Radio and contesting. As Rich relates, *"He'd call and I'd log. He'd even push the buttons on the keyer. He loves radio contesting and all the countries he can talk to. He's got a license manual under the Christmas tree!"* What a great way to introduce someone to the hobby and then follow up on their interest.

Likewise the group at K4WP used the weekend to create a "hands-on" contest training session for members of their local radio club. Sponsored by Bill, K4WP, and Jere, KT4ZB, they exposed nine operators to the contesting experience. Their lesson plan included topics such as "Read the rules" and "Learn about the logging program,"

There are not many locations where you can operate adjacent to saltwater and be 500 miles from the ocean. Dave, WX7G, found one — the Great Salt Lake in Utah! [Dave Cuthbert, WX7G, photo]

which are probably good lessons for even the most experienced contesters. To top things off they even arranged for a VE session for one of the attendees resulting in Anne, KK4ICS, becoming KK4ICS/AE. Well done, Bill and Jere!

There are always a few operators who, without a permanent fixed station to use, have to make special effort just to get on the air. David, WX7G, operated in his car with a TS-480 into a Tarheel 40A screwdriver antenna. Being creative and wanting a low takeoff angle he parked at the Great Salt Lake in Utah as you can see in the photo. The Great Salt Lake is also not the most comfortable place to be the first weekend in December. As they say: "The only thing between there and the North Pole is some barbed wire."

Activity

The 2012 contest still proved to be quite popular though not quite like last year when 5,361 logs were submitted. The 3,050 logs entered for the 2012 contest were good enough for third all-time, just behind the 3,119 submitted at the peak of the last cycle in 2002. For further comparison, the 2012 ARRL DX Phone contest set its all-time mark with 3,527 logs submitted. The average log contained 181 QSOs this year compared to 363 QSOs last year and 153 in 2010. The Single Operator, Low Power categories continue to be the most popular, making up just under half of all log submissions.

In 2011 the big category news was the creation of the Multioperator, Low Power (MOLP) category. Filling dual roles as both a true Multioperator category as well as a Single Operator Unlimited, Mixed category it continues to be quite popular with 287 logs submitted worldwide.

Looking around the world, logs were received from more than 221 different DXCC entities and W/VE/XE sections, only a slight reduction from the 230 in 2011. The ARRL 10 Meter Contest remains a truly a global event. More logs were received once again from those quintessential contesters in Japan, with 165, than any other location. They were closely followed by Brazil with 123 logs and European Russia with 95 logs. Total logs submitted from Europe fell 65% in 2012 from 2011. Maybe Europe did see the worst of the propagation. As Darrell, GØHVQ, said in his post contest write-up *"I wondered if I'd overslept by several years and woke up at solar minimum!"*

Looking for the most active W/VE/XE sections, honors go to Ohio with 67 logs received followed by Minnesota with 64. It is notable that Minnesota has less than half the ham population of Ohio so they were out in force. Continuing this perspective, the US states with the highest percentage of the licensed hams submitting a log were: New Hampshire, Minnesota, Rhode Island, Massachusetts and Delaware. In Canada, top honors go to Northwest Territories followed by Saskatchewan.

Activity in Asia held up fairly well. Overall logs submitted fell 42% from 550 in 2011 to 317 in 2012 which was just slightly less than the overall drop of 43%. After Japan the most active countries were Asiatic Russia with 68 logs submitted and China with 28. Though logs from China dropped, the number exceeds that from many stalwart European countries such as France, Sweden, England and Portugal.

Who were the most energetic and active contesters? Which operators sat down, kept their butts in the chair and made a large number of contacts? Looking at those entities with five or more logs submitted, 2012 honors go to Uruguay. The seven logs submitted from Uruguay averaged 1,160 QSOs each: A great effort from CV5K, CW5W, CX1DX, CX2BR, CX4SS, CX5BW and CX5TR! In second place were the 57 logs from Argentina, which averaged 511 QSOs followed by the 10 logs from the Canary Islands with averaged 457 QSOs each and the 21 logs from Chile that averaged 427 QSOs each.

Hard-Earned New Records

Coming off an amazing 2011 in which almost 1 in every 12 logs contained a record score and 1 in every 5 DXCC and W/VE/XE records were set, breaking a record was certainly tougher in 2012. The record opportunities created from the 32 new XE multipliers and new MOLP category have largely been taken advantage of. Yet, even with the overall poorer conditions than 2011, hard-working operators managed to set 88 new records in 2012. Fifty-one of these were DXCC entity and 37 were W/VE/XE records. Additionally, 21 first-time, and thus all-time, records were set by operators in the newly split Ontario sections in Canada (GTA, ONE, ONN and ONS). Thanks to the efforts of Ken, WM5R, a full set of all-time ARRL 10 Meter Contest records is available at **www.arrl.org/contests**.

Of these 88 records, there were 18 High Power records, 61 Low Power records (34 of these being in the still relatively new MOLP category) and 9 QRP records. In W/VE, 15 of the 18 records set in 2012 were in the MOLP category and the other 3 were QRP. No new Single Operator, Low Power or High Power section records were set in W/VE in 2012, other than the first-time records in the new Ontario sections. This also means no one successfully knocked off either of the two section records still existing from the 1970s, now the oldest ones on the books in W/VE/XE. Who will take the challenge next year and set new records for: Northern Territories, Single Op, High Power, Mixed set by VE8AW in 1978, and Idaho's Single Op, High Power, Mixed set by K7LR in 1979? 2013 and 2014 may be the last chance during this solar cycle.

Within W/VE/XE a total of 5 new division records were set in 2012, down from 50 in 2011. In the MOLP category, new records were set by K8WW in Great Lakes, W8KA in Southwestern, and N5DO in West Gulf. Additionally, XE2AU's Single Op, Low Power, Mixed and XE2B's Multiop, High Power operations set new all-time Mexican records.

Affiliated Club Competition

	Score	Entries
Unlimited Category		
Potomac Valley Radio Club	9,125,998	84
Florida Contest Group	5,736,078	58
Yankee Clipper Contest Club	5,635,480	65
Minnesota Wireless Assn	4,247,762	56
Medium Category		
Northern California Contest Club	4,625,828	49
Southern California Contest Club	3,887,018	24
Society of Midwest Contesters	3,606,330	41
Arizona Outlaws Contest Club	3,465,884	30
Frankford Radio Club	2,671,234	26
Western Washington DX Club	2,021,048	16
Contest Club Ontario	1,852,496	24
Carolina DX Association	1,736,694	18
Alabama Contest Group	1,608,428	19
Central Texas DX and Contest Club	1,454,322	10
Maritime Contest Club	1,453,882	11
Tennessee Contest Group	1,410,054	27
Georgia Contest Group	1,187,746	12
Grand Mesa Contesters of Colorado	990,312	12
DFW Contest Group	971,434	15
ORCA DX And Contest Club	723,816	7
Mad River Radio Club	683,582	14
Willamette Valley DX Club	668,432	8
Northern Rockies DX Association	636,006	4
South East Contest Club	619,592	14
Louisiana Contest Club	591,708	7
Order of Boiled Owls of New York	568,648	7
Hudson Valley Contesters and DXers	499,384	11
Texas DX Society	485,534	4
North Texas Contest Club	478,896	4
CTRI Contest Group	475,486	7
Hampden County Radio Assn	466,188	11
Mississippi Valley DX/Contest Club	395,630	3
North Coast Contesters	343,728	10
Western New York DX Assn	324,024	6
Saskatchewan Contest Club	311,132	4
Utah DX Assn	275,456	7
Rochester (NY) DX Assn	269,878	8
Contest Group Du Quebec	133,324	7
Radio Club of Redmond	117,518	4
Six Meter Club of Chicago	37,474	7
Local Category		
Iowa DX and Contest Club	1,094,660	4
Central Virginia Contest Club	896,864	6
Mother Lode DX/Contest Club	798,808	8
Redwood Empire DX Assn	729,644	9
Lincoln ARC	395,278	3
Spokane DX Association	370,848	7
Bristol (TN) ARC	222,574	9
Midland ARC	214,976	4
Hilltop Transmitting Assn	176,352	4
Madison DX Club	154,908	3
599 DX Association	148,008	6
West Allis RAC	144,168	8
Low Country Contest Club	132,062	4
Granite State ARA	125,330	9
Delara Contest Team	121,728	6
Contoocook Valley Radio Club	115,292	3
Fort Wayne Radio Club	112,878	3
Bergen ARA	92,346	3
Badger Contesters	89,702	9
Hazel Park ARC	80,168	3
Kansas City Contest Club	77,668	4
Athens County ARA	71,934	3
West Park Radiops	43,510	3
QSY Society	37,602	5
Sterling Park ARC	35,466	3
Central Michigan Amateur Radio Club	18,236	3
Portage County Amateur Radio Service	14,212	4
Milford (OH) ARC	8,646	4
Pueblo West Amateur Radio Club	7,450	5
Falmouth ARA	7,204	3

Top Ten

US

Mixed Mode, QRP

K9OM	139,568
NA4CW	126,594
WA6FGV	101,340
N1CC	48,828
KC0MO (K0OU, op)	47,302
N6MA	44,756
KT8K	34,736
N2XP	34,720
WB2AMU	28,160
N9JR	26,962

Mixed Mode, Low Power

K6AM	502,016
KT0K	371,178
WD5K	362,202
K2PS	342,166
N7LOX	337,040
W9XT	328,098
K0TT	244,378
N6ZFO	230,454
AC0W	215,424
K7SS	187,916

Mixed Mode, High Power

N8OO	1,067,844
W6YX (N7MH, op)	948,192
N8II	917,670
K6LL	777,920
NQ4I (K4BAI, op)	777,096
K0EJ	737,104
WB9Z	621,300
WR9D (KB9UWU, op)	541,748
AA6PW	462,534
N2NC	461,472

Phone Only, QRP

KE2OI	49,528
W6QU (W8QZA, op)	28,900
N8MWK	16,836
KB5KYJ	9,450
WW0WB	8,184
N8XA	7,896
AA4JI	7,396
N9FRY	6,536
ND0C	6,474
KK0Q	4,200

Phone Only, Low Power

W3PAW	120,048
AC5O	99,138
N7XS	92,950
W4GKF	84,870
W2TF	54,612
N7CKJ	51,260
W1TJL	50,688
N6KP	48,112
K4DMR	44,352
WA8QYJ	38,700

Phone Only, High Power

K4XS	455,576
W5PR	342,240
NR5M	336,232
K5TR (WM5R, op)	277,992
K4NV	257,260
W3EP	202,160
WA5OYU	121,030
K1KNQ	115,830
N7UQ	113,848
K6HNZ	113,174

CW Only, QRP

K3RR	98,272
W6JTI	94,916
N0UR	93,984
N7OU	74,256
K0LUZ	50,952
K3TW	43,264
KS4YX	39,984
AA1CA	35,960
N4DSP	35,828
K4CIA	35,700

CW Only, Low Power

N4WW (N4KM, op)	322,400
K7QQ	276,696
N4TB	240,720
W3BGN	226,204
N4IJ	223,584
WB4TDH	170,868
KU8E	169,376
WD4AHZ	161,920
K9QVB	156,240
W2EG	150,804

CW Only, High Power

W5KFT (K5PI, op)	597,640
KN5O	554,496
KD4D	548,640
K1TO	545,020
NY3A	446,656
K2SSS	439,456
N2MM	401,288
W6PH	312,480
K6NR	295,560
N9RV	289,428

Multioperator, High Power

K1WHS	1,312,722
NX5M	1,119,472
K1LZ	1,035,440
N6DZ	926,640
K9CT	890,358
AA1JD	860,274
W4UH	842,490
WX3B	798,720
K4FJ	788,322
AA2A	776,058

Multioperator, Low Power

KD2RD	496,164
W7TVC	457,588
N5DO	249,426
K4ZGB	208,610
K2DFC	205,936
N0HJZ	168,392
K7XC	168,036
W3ZGD	165,792
K8WW	141,456
WA1F	125,832

Canada

Mixed Mode, QRP

VA3KRM	1,408

Mixed Mode, Low Power

VE6BMX	139,958
VE5ZX	121,152
VE5KS	77,700
VE3TW	57,038
VE3FH	32,262
VY2LI	31,248
VE2EBK	27,504
VA3AR	24,752
VE9ML	18,400
VE3VSM	10,360

Mixed Mode, High Power

VE3KZ	446,708
VY2TT (K6LA, op)	407,550
VE5UF	160,888
VE3CX	131,516
VE4VT	33,744
VE1JS	17,812
VA5LF	12,150
VE3JM	5,984
VE3AAQ	1,680

Phone Only, QRP

VE1ZA	13,072

Phone Only, Low Power

VE8GER	46,864
VA3MTT	17,992
VA7IR	10,320
VE6EC	6,474
VE2HIT	6,336
VE7EMI	5,040
VE7VAW	5,040
VA7AM	4,048
VA3WU	2,684
VE6KAD	1,470

Phone Only, High Power

VA6UK	31,482
VA6NJK	31,440
VA3PC	8,600

CW Only, QRP

VY2OX	36,300
VE3MGY	1,548
VE3FAL	1,196
VE2KOT	24

CW Only, Low Power

VE1RGB	119,132
VE3FGU	61,248
VA2WA (VA2WDQ, op)	58,240
VE7CV	54,288
VE7JKZ	50,940
VE3OM	47,628
VE3IAE	34,600
VA7MM	29,376
VA3KAI	13,860
VA3EC	7,168

CW Only, High Power

VY2ZM	601,392
VE7JH	394,200
VE7XF	284,488
VE9AA	261,508
VE9HF	171,720
VO1TA	157,440
VA7ST	76,896
VE2EZD	20,468
VE7WO	17,248
VE3EY	15,600

Multioperator, High Power

VE3MMQ	327,564
VE6WQ	217,728
VE1OP	216,300
VE3YAA	204,724
VE3EJ	201,488
VE3AD	138,840
VE6AO	129,420
VE7SQ	59,388
VE3XAT	48,640
VE7IO	41,412

Multioperator, Low Power

VA7BEC	245,436
VA7DZ	162,330
VE6AX	21,576
VA7XB	18,352
VE2AXO	14,168
VE3/KD2HE	1,672

Mexico

Mixed Mode, QRP

No entrant

Mixed Mode, Low Power

XE2AU	130,536
XE1FRF	64,780
XE2O	16,744
XE2ML	2,496

Mixed Mode, High Power

XE1GRR	63,190
XE1J	44,220
XE2CQ	37,320

Phone Only, QRP

No entrant

Phone Only, Low Power

XE2AA	36,816
XE1ZTW	7,980
XE2JA	7,252
XE1E	6,728
XE2JUM	3,240

Phone Only, High Power

XE1B	205,478
XE2HUQ	78,520
XE1EE	8,584

CW Only, QRP

No entrant

CW Only, Low Power

XE2HQI	88,200
4A7L	59,708
XE1CT	31,360
XE2YWH	6,076
XE3WMA	792

CW Only, High Power

XE1MM	181,116

Multioperator, High Power

XE2B	472,926
XE1OGG	40,960
XE2X	33,696
XE2ST	1,932

Multioperator, Low Power

XE1HG	69,440
XE2FGC	20,868
XE1RCQ	11,088
XE1AJ	7,826
XE3N	2,736

DX

Mixed Mode, QRP

PY2NY	40,606
JR3RWB	26,700
EI4II	22,344
RT4W	10,880
JH7UJU	7,820
7K1CPT	7,592
JR1UJX	6,804
DL8LR	5,742
PY7AHA	4,522
JK1TCV	3,300

Mixed Mode, Low Power

LU8EOT	1,024,716
ZS6WN	472,940
PY9MM	436,272
HQ2N (JA6WFM, op)	254,320
LW3DG	154,880
JG1AVO	131,840
PY2MC	91,176
CX5TR	79,310
ZS2NF	77,812
NP3CW	59,064

Mixed Mode, High Power

HK1R	1,805,320
P40CX	1,381,632
XQ1KZ	693,056
EA7KW	626,232
ZS1EL	562,380
EF5Y (EA5GTQ, op)	462,726
OM2VL	173,862
RT4RO	159,790
DH8BQA	129,360
RX4W	102,700

Phone Only, QRP

TG9ANF	61,452
LU7VCH	14,592
VK4ATH	3,720
R7NA	2,856
PY2BI	1,462
PU5UAI	896
JA2MWV	672
PU2EBR	352
ON3TO	340
PY2BN	270

Phone Only, Low Power

PU5FJR	467,520
EA8AH	311,454
EA8MT	269,312
FY8DK	258,656
YY4DNN	224,976
LW7DUC	202,320
ZZ2T (PY2MNL, op)	181,608
PU2LEP	164,016
LR1F (LU5FD, op)	123,336
ZV2K (PY2SHF, op)	118,332

Phone Only, High Power

PP5JD	579,672
LP1H	552,000
CE3CT	393,262
YN5ZO (K7ZO, op)	326,976
LS6VI	198,440
PT9ZE	165,648
CR6K (CT1CJJ, op)	159,238
CE1TT	151,940
OA4SS	141,174
LU3DW	137,124

CW Only, QRP

LU7HZ	208,832
CX4SS	172,272
RV9DC	20,000
JA1YNE (JR1NKN, op)	19,840
VR2ZQZ	18,720
PP5BZ	11,616
US5VX	5,304
DJ2RG	5,152
JH6QIL	4,704
Z39A	3,956

CW Only, Low Power

PY3OZ	804,992
V51YJ	513,400
PY2WC	399,600
L33M (LU3MAM, op)	398,736
LW8DQ	301,416
NP3A	254,208
HS0ZIA	241,696
LW5HR	227,220
ZL3TE	211,344
5C5W (CN8KD, op)	206,928

CW Only, High Power

CE1/K7CA	786,420
EA6SX	324,104
KP3W	269,848
JA5FBZ	241,500
XR3A (CE3DNP, op)	236,684
IT9VDQ	202,860
JG1ILF	195,456
EA4ZK	160,160
JE1CKA	133,668
PV8ADI	130,220

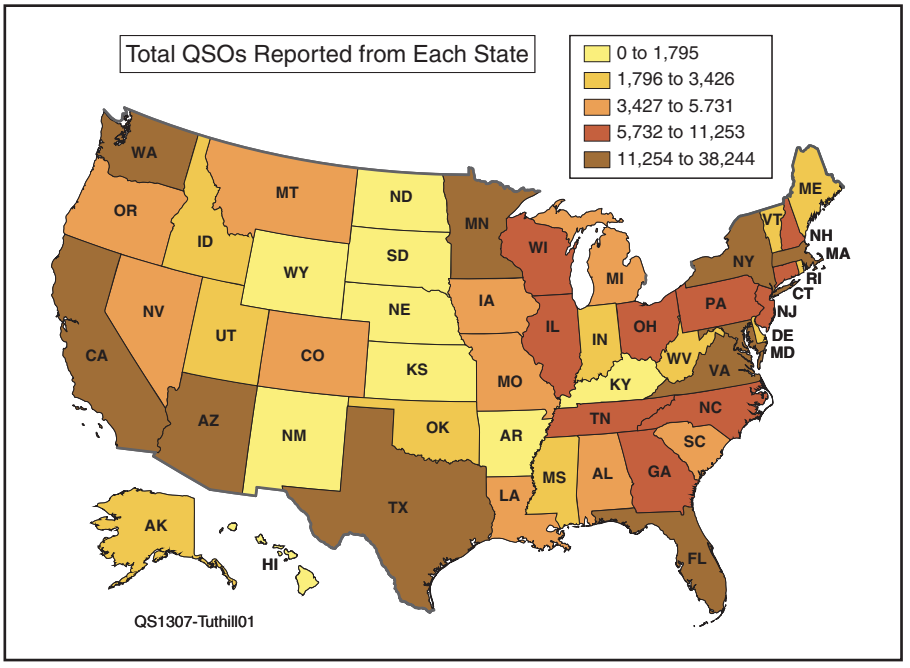
Multioperator, High Power

CW5W	3,535,974
D4C	3,118,892
LS1D	2,664,256
CX5BW	2,609,068
LU5FB	2,440,482
PY2NDX	2,178,474
PT5T	1,798,728
PJ2T	1,695,456
PS2T	1,271,806
PX2B	1,204,344

Multioperator, Low Power

PY1GQ	996,030
LU5DX	988,500
VK4WIL	593,206
LU3DAT	473,744
VP2VGG	293,454
LU1UM	247,040
HC2UA	244,494
PJ4NX	244,470
C6AKQ	232,064
LU2EE	201,984

In the 2011 10 Meter Contest Results (July 2012 *QST*, pp 80-83) KP2A (KW8N, op) was erroneously omitted as the DX winner of the Phone Only, High Power category. We regret this omission. Bob had a score of 4,436 QSOs and 152 mults for a score of 1,341,248.



On the DX front, two new continental records were set, down from 15 in 2011. ZR6DX turned in the first ever MOLP entry from Africa and found themselves in the record book. VK4WIL ground it out and just managed to knock off V63QQ's existing Oceania MOLP record and will also find their call in the all-time record list.

Club Competition

The Affiliated Club Competition is like a wide-area Multioperator effort where you can operate from your home QTH but be part of a larger team competing with others. Seventy-one clubs submitted logs for the 2012 10 Meter Contest, slightly up from the 70 last year. Even with the overall drop off in contest participation from 2011, contest clubs provided the energy and motivation for operators to get on the air. These 71 clubs submitted a combined 899 entries meaning 52% of W/VE operators were also part of a club entry!

In some states, club participation was stunning. The 58 entries from the Florida Contest Group represented 67% of all the entries from Florida: And their club boundary can't even include the whole state! The 56 entries from the Minnesota Wireless Association represented 84% of the total entries from Minnesota. To top even that, 86% of the entrants from Connecticut indicated they were part of one of the four contest clubs active in that state. Way to go, club organizers!

In the Local category, the Iowa DX and Contest Club took top honors among the 30 clubs in this category. Their four members combined for more than 1 million points, the only Local Category club to do so.

In the popular Medium category, 37 clubs fought a hard pitched battle with the clear advantage in 2012 going to clubs on the West Coast. In the end the 49 members of the Northern California Contest Club (NCCC) overpowered the 24 members from the Southern California Contest Club (SCCC) for a solid win. Even though the SCCC had a higher average score per member they could not overcome the NCCC's participation advantage.

In the "big boys" Unlimited category only four entries were received in 2012 down from six in 2011. Coming out on top again for the second year were the 84 members of the Potomac Valley Radio Club (PVRC) who bested second place Florida Contest Group by a wide margin. The PVRC not only repeated their 2011 formula for success by overwhelming their competition with sheer number of members, they also had higher average scores per member. Congratulations to all the clubs and their organizers.

Contest Planning

Questions that all contesters should ask are: "Where are all my QSOs going to come from?" and "What multipliers should I really be on the lookout for?" That way you can configure your station and plan your operating strategy accordingly. The obvious place to start is to look at a map of ham licenses in each state. Summarizing the story (see the online article for considerably more detailed analysis) is a map of total reported QSOs from each state. Some of the potential surprises here are: expect more QSOs than you think from Arizona, Minnesota, Massachusetts and Maryland. Also, work hard to make sure you get Kentucky, Arkansas, New Mexico, Nebraska and Kansas in your log.

Predictions for 2013

The 41st annual ARRL 10 Meter Contest will be held December 14 and 15. So, what might we expect this year? Cycle 24 has certainly not been up to the hopes and expectations of hams worldwide. However, Cycle 24 is not quite done yet, not by a long shot. The April 2013 forecast by NOAA's Space Weather Prediction Center for December 2013 flux levels are in the 130 to 148 range with a single predicted flux level of 139. Long-term forecasts have flux levels dropping about 16 points a year in 2014 and beyond, to around 126 in 2014, 108 in 2015, and 90 in 2016. Based on this, my advice is, if you enjoy 10 meters, plan a major effort for December 14 and 15 in 2013.

Choose your category and figure out what sort of QSO and multiplier total it will take to reach your goal. Write these down in big bold letters on a piece of paper and post it in clear sight at your operating position. Then sit down, get on the air, and don't get up until you have exceeded your goals! Even if you are not so inclined, make sure to sit down and get on the air — the 2013 contest looks like it could be a memorable one.

10 Meters is Open Online

Look to the online extended version of this article (**www.arrl.org/contest-results-articles**) for more commentary, more action photos, and the following features and analysis:

- Expanded tables of all Division, Regional and Continent winners.
- What did CW Skimmer spots tell us about propagation?
- Contest planning insights.
- Some predictions for the 2013 contest.
- Line scores and the all-time record tables.

The 2013 ARRL August UHF Contest

1800 UTC Saturday, August 3 - 1800 UTC Sunday, August 4

- The first weekend in August is the time to get active on UHF! 222 MHz and up is where contesters will be for the 2013 August UHF Contest. The exchange is your Maidenhead grid square.
- Enter as a Single Operator from home or a hilltop, activate multiple grid squares as a Rover, or get some friends together and enter the Multioperator Category!
- All entries must be received at ARRL by 1800 UTC Tuesday, September 2, 2013. E-mail electronic Cabrillo-formatted logs to **augustuhf@arrl.org**. Paper logs should be mailed to ARRL August UHF Contest, 225 Main St, Newington, CT 06111.

Complete rules and entry forms can be found at www.arrl.org/august-uhf

Scan this QR code with your smartphone to go directly to the August UHF Contest rules page.

Steve Meuse, N1JFU (front) and Stuart Olson, K1DY (rear) operate 432 and 222 MHz during the 2012 ARRL August UHF Contest at the Lebanon, ME contest QTH of Dave Olean, K1WHS in FN43. [Dave Olean, K1WHS, photo]

Sean's Picks

Sean Kutzko, KX9X, kx9x@arrl.org, ARRL Contest Branch Manager

- **State QSO Parties this month:** Alaska (VHF only), New Jersey
- **QRP Contests this month:** MI QRP July 4th Sprint (July 4), QRP ARCI Summer Homebrew Sprint (July 7), ARS Spartan Sprint (July 9), NAQCC Monthly QRP Sprint (July 18), Flying Pigs Run for the Bacon (July 22), ARS Flight of the Bumblebees (July 28).
- **Canada Day Contest (July 1):** The national event for our neighbors up north! Be sure to get on for this one and help them celebrate their national day.
- **DL DX RTTY Contest (July 6-7):** Plenty of RTTY fun to spread around! Everybody works everybody and the exchange is RST and serial QSO number. This event features entry categories where "only dipole or groundplane antennas are permitted."
- **IARU HF World Championship (July 13-14):** The biggest HF contest of the summer! Choose from high, low or QRP power, as well as Phone, CW or both modes. Tons of IARU Member Society stations to work!
- **CQ WW VHF Contest (July 20-21):** The focus is on 6 and 2 meters near the end of the summer sporadic E season. Go on a trip to a rare grid square and enjoy the pileups!
- **North American QSO Party, RTTY (July 20-21):** Summertime, and the Baudot is easy. A good event to get your feet wet in RTTY; simple stations can do well and your Sunday is free for other things!
- **MARAC US Counties QSO Party (July 27-28):** How many US counties can you work in one weekend? Alternatively, how many US counties can you operate from in a weekend? You may be a short drive away from a rare county and big pileups.
- **IOTA Contest (July 27-28):** Sponsored by the RSGB, island groups all over the world become the sought-after prize for the Islands on the Air program. Many an operator has discovered the fun of setting up a station in an IOTA group for this event; you can, too!

July 2013 W1AW Qualifying Runs

W1AW Qualifying Runs are held at 10 PM EDST on Wednesday, July 10 (0200 Z, July 11) and at 9 AM EDST (1300Z) on Friday, July 26. The West Coast Qualifying Runs will be transmitted by station K6YR at 3590 kHz at 9 PM PDST on Wednesday, July 17 (0400Z July 18). Unless indicated otherwise, sending speeds are from 10 to 35 WPM.

Bernie McClenny, W3UR, w3ur@arrl.org

A History of the DXCC Honor Roll

Seventy-six years of recognizing the pinnacle of DXing.

The DX Century Club (DXCC) program was originally introduced to Amateur Radio operators in September 1937. Once a DXer had contacted 75 countries he or she was listed and tracked in *QST*; at the "full 100," which constituted "the 100 countries mark," he or she was awarded a certificate. In May 1940 the concept of the DXCC Honor Roll (HR) was announced:

"Starting with this issue, individual calls and totals are listed only for those with country totals of 116 or more. For totals of 115 or less, the country total is given, followed by a list of all calls of members at that level. Sixty five DXCC members have totals of 116 or more in this list. Since these top 65 have been given more prominence in the listing, they are, in a sense, members of an 'Honor Roll.'" — *Jim Maxwell, W6CF*

After World War II a new DXCC was begun for contacts made November 15, 1945 and thereafter. Everyone had to start from scratch. By November 1947 the League once again introduced the HR; this time it was for the "top ten DX men in a Century Club." It was a monthly listing in the "Operating News" section of *QST*. The first HR listing in November 1947 showed the late Charlie Mellen, W1FH, at the top with 168 countries and in 10th place at 122 was Dave Brown, ZL1HY. Next the HR grew to include the top 10 country count level, which meant there could be several DXers at each country count level; thus more than 10 DXers were listed.

Deleted Entities

With a growing number of countries that were no longer meeting DXCC criteria, as of April 1962 the deleted countries were no longer being counted in the DXCC HR qualifications. Starting with the April 1962 issue of *QST*, DXers were listed with both their current total and their total including deletes. Jayme de Campos Freixo, PY2CK, was at the top of the HR with 306/318 confirmed at the ARRL® DXCC Desk in West Hartford. The last monthly listing of the HR was in January 1966; after that it was listed biannually, at that time in the June and December issues. Eventually the DXCC HR criteria were defined by the total number of current countries and the next nine spots, with the bottom of the HR at X − 9. For example, if there were 315 "current" countries then the bottom of the HR would be 315 − 9 or 306.

A DXCC Honor Roll lapel pin was first proposed at the January 1972 ARRL Board of Directors meeting. A year later the HR plaque was available to those who made the grade. The DXCC #1 Honor Roll plaque was introduced to DXers in 1975. Unlike the Phone DXCC HR, which dates back to November 15, 1945, the CW DXCC HR was not introduced until June 1976.

To get a feeling for what it was like to make the HR back in the '70s, Larry Foord, VE3FLE, now VE3LR, wrote an article with an interesting perspective entitled "The HR: Not for the Faint-Hearted."[1] During this time there was also a growing a movement to remove countries for lack of activity. The DX Advisory Committee reviewed this concern and "…rejected deletion of countries for honor roll purposes on the basis of no amateur activity in 10 or 15 years; deletion of countries with no official licensed amateurs…"[2]

Currently the DXCC HR runs in the August issue of *QST*. There are HRs for Mixed, SSB, CW and Digital. The Mixed listing includes approximately 3000 members, of which about 1300 are in the # 1 position with all countries worked and confirmed. You can also view the DXCC HR listing, which is updated daily, at **www.arrl.org/dxcc-standings**.

The Value of Rarity

Every so often a DXer will voice something along the lines of "such and such country has not been active for more than X number of years and should be deleted." Per the DXCC country rules "An Entity may be deleted from the List if it no longer satisfies the criteria under which it was added." There is no rule (and I hope there never is) to delete a country for lack of activity.

Two such countries, which had not been active while I was heading for the DXCC HR, were China (BY) and Albania (ZA). China had been inactive for close to 40 years and Albania for more than 20 years. This inactivity is what makes the rarest ones the rarest ones! Believe it or not, rarity adds value to the DXCC program and the award.

To obtain the DXCC Mixed HR it typically takes approximately 10-15 years. Larry's, VE3FLE, article mentions this. I made the HR in 1992, having been first licensed in 1977, so in my case it took slightly less than 15 years. Currently there are 340 DXCC Entities, which means one has to have 331 or more countries in order to qualify for the DXCC HR. The top nine countries on the list that have been inactive for the longest amount of time are KP1, VKØ/H, KH5/K, E3, VP8/S, CEØX, KH1, FT/T and P5, with North Korea the most recently inactive (see Table 1). So if someone has worked P5 and every country on the DXCC list except those eight, theoreti-

Here Dean Straw, N6BV, presents Rich Holoch, KY6R, with his ARRL DXCC Honor Roll Plaque at the Visalia International DX Convention. Rich has been a ham since 1973 but he did not become interested in DXing until July 2001. Between sunspot cycles 23 and 24, 11½ years later, he made it on to the HR. [Photo courtesy of Rich Holoch, KY6R]

[1] L. Foord, VE3FLE, "The Honor Roll: Not for the Faint-Hearted," *QST*, Feb 1978, p 80.
[2] "Moved and Seconded...Minutes of the 1978 Second Meeting of the ARRL Board of Directors," *QST*, Sep 1978, p 48, Minute 28.

Table 1
Inactive Countries List

Prefix	Country	Call Sign of Last DXpedition	Date of Last Activation
KP1	Navassa Island	W5IJU/KP1, NF6S/KP1, NH2S/KP1, KH2W/KP1	April 2, 1993
VKØ/H	Heard Island	VKØIR	January 25, 1997
KH5/K	Kingman Reef	K5K	October 31, 2000
E3	Eritrea	E3ØOA	December 2, 2001
VP8/S	South Sandwich	VP8THU	January 22, 2002
CEØX	San Felix Island	XRØX	March 28, 2002
KH1	Baker & Howland	K1B	May 7, 2002
FT/T	Tromelin Island	FR5ZU/T	July 1, 2002
P5	North Korea	P5/4L4FN	November 20, 2000

cally he or she could be on the DXCC HR in just over 10 years.

The DXCC List

The DXCC list was first introduced in 1937 shortly after the groundwork was laid by Clinton B. DeSoto's, W1CBD, October 1935 article entitled "How to Count Countries Worked: A New DX Scoring System."[3] After reading the article one will quickly understand how it took many years to come up with an agreed-upon list of countries. As quickly as a list was released, political and geographical changes would render it obsolete. Since the DXCC 2000 rules revision the situation has become more stable.

It's this editor's opinion that the DXCC program is a lifetime accomplishment. Along the journey, while waiting for the next new one, one can stay active by participating in the individual mode and band DXCC awards as well the DXCC Challenge (**www.arrl.org/dxcc-challenge**). Outside of the League's awards there are hundreds of other awards and challenges such as contests to keep one's attention for those long dry spells between working all time new ones.

6 Meter DX News from Around the Globe

By the time you read this column we should be at the height of the 6 meter summer sporadic E (E_s) season in the Northern Hemisphere. The best period for the past 10 years or so has been from about June 24-July 7, although we can get E_s more than 30 days before or after this time frame. Veteran 6 meter DXpeditioners know this is the perfect time for some radio globetrotting and have given us their DXpedition details below.

FP — Saint Pierre and Miquelon Islands

Eric, KV1J, is heading back to Miquelon Island (NA-032) where he will be QRV on 160-6 meters mostly on SSB and RTTY with some CW, PSK-31 and Feld Hell, July 6-16. This will include a mixed mode effort in the IARU HF World Championship. Full details are at **www.kv1j.com/fp/July13.html**. QSL via his home call either direct, via the bureau or LoTW.

KG4 — Guantanamo Bay

Terry, K4RX, Ken, AC4TO, and Tip, N4SIA, will be operating from Club Gitmo (FK29kv) as KG4RX, KG4TO and KG4AS, respectively, June 22-29. They will have a K3 transceiver and PR6 preamp along with a KPA500 amplifier using a 6M5XHG Yagi on 50 MHz. There will also be some HF activity. KG4RX and KG4TO will be posting their logs to Club Log. QSL KG4RX via K4RX, KG4TO via AC4TO and KG4AS via N4SIA.

V3 — Belize

Six meter operators will be looking for Jimmy Treybig, W6JKV, to be QRV as V31IV from San Pedro (EK67), Belize for his annual 6 Meter Sporadic E DXpedition. He will be operating from "a good location for Europe and USA" from June 21-July 1. QSL via W6JKV.

VP2V — British Virgin Islands

Once again Dave, W9DR, will be active as VP2V/W9DR. He'll be operating from the northern shore of Anegada Island June 14-28. He'll be on 6 meters only with SSB activity expected on 50.115 MHz and on CW, including a CW beacon, on 50.1156 MHz. QSL direct via W9DR.

HF DX News from Around the Globe

FT5ZM — Amsterdam and St Paul Islands

In early April of this year, veteran southern Antarctic DXpedition and *CQ* DX Hall of Famer Ralph Fedor, KØIR, announced a multinational DXpedition to Amsterdam Island in January of 2014. This one ranks # 6 on Club Log's Most Wanted List as it has not been on the air since late 2002. This one definitely needs the support of DX foundations, clubs and individuals as the budget is well north of $400K. The website is **www.amsterdamdx.org**.

IARU HF World Championship

During this year's International Amateur Radio Union's (IARU) HF World Championship members of the Potomac Valley Radio Club will be holding a battle of the beltway as they host NU1AW/3 on the northern end and W1AW/4 from the southern end. NU1AW/3 (IARU) will be led by Frank, W3LPL, and W1AW/4 (ARRL) headed by Steve, NR4M. Plans are to be QRV on all 12 bands/modes each from six stations within W3 and W4. QSL NU1AW/3 and W1AW/4 via their call book addresses.

OJØ — Märket Reef

OJØV is expected to be the only Märket Reef DXpedition this summer by ON8VP, ON6QO, ON4CCP, ON4LEM and ON5JT. This one is planned for June 30-July 5. They will operate on 30, 20, 17, 15, 12, 10 and 6, on CW, SSB and "some digital experiments possible." They will have several rigs, FT990, Icom 7600, FT-897D transceivers, some SPE amplifiers, Ultrabeam verticals, an inverted V and a 3 element Yagi for 6. QSL via ON4CCP. This will be the only DXpedition allowed on Märket Reef this summer due to some restoration work being done there.

VQ9 — Chagos Islands

Jim, ND9M, has been back at Diego Garcia and active as VQ9JC since mid-March. During May he was operating special event station VQ975FOC for the 75th anniversary of the First Class CW Operators' Club (FOC). Jim will also be using special call VQ93JC from June 22-July 7. Since the club station has been shutdown, he'll be operating "Field Day style" from a picnic table with single band dipoles. He'll typically be active 1200-1600Z and as early as 0830Z on Fridays. QSL all three of Jim's calls via ND9M.

Wrap Up

A special thanks to FOC, KV1J, NN3W, ON8VP, W1JR, W6JKV, W9DR and *The Daily DX* for helping to make this month's column possible. Don't forget to send your DX news, photos, club newsletters and whatnot to **w3ur@arrl.org**. Until next month, see you in the pileups! — *Bernie, W3UR*

[3]Clinton DeSoto, W1CBD, "How to Count Countries Worked: A New DX Scoring System," *QST*, Oct 1935, pp 40-41.

Jon Jones, NØJK, n0jk@arrl.org

The 4 Meter Band — A New Challenge for VHFers?

With TV broadcasting moving to digital, a 4 meter band might be just around the corner.

Between the 6 and 2 meter amateur bands is the 4 meter band at 70 MHz. An e-mail from Rob, PE9PE, prompted me to have a look at this band, which is mostly unknown to North American VHFers. The international allocations at 4 meters are mostly in Europe, the Middle East and South Africa. This band is very popular in Europe but is not currently available in the United States or Canada.

Impressive DX has been worked on it via transequatorial propagation (TEP) from Italy and Spain to South Africa. Propagation on the 4 meter band includes TEP, sporadic E (E_s), meteor scatter, tropospheric refraction, aurora and aurora E_s. EME would also be feasible, but F2 would be very rare. Multihop E_s occurs, though less frequently than on 6 meters. Last summer on June 8, CT1HZE in Portugal heard the experimental WF9XRU/b (FM07) in Virginia on 70.005 MHz via E_s. Four meters is also good for mobile operating as the fading is not as severe as on 2 meters or 70 centimeters and antenna efficiency is often better than on 6 meters.

The fact that the 4 meter band is not in widespread use around the world (especially not in the USA and Japan) means that there is practically no commercially built amateur equipment for the band. Consequently everyone on it uses either homebrew or modified equipment. This means that 4 meter operators generally have more of an interest in the experimental aspects of the hobby than others on the VHF bands. Antennas are also mostly homebrew. Trident Antennas in the UK sold a nice 4 meter Yagi, but their website is no longer active.

Transverters are a popular way to get on the 4 meter band. Spectrum Communications of Dorchester, UK manufactures a range of products for the VHF bands. Since 1988 they have been producing 4 meter transverters in kit and ready-built form. Tony, IØJX, has modified the TEN-TEC 6 meter transverter for 4 meters. Information on how he did it is at **www.qsl.net/i0jx/tentec_e.html**.

Noble Radio just announced a new 6 and 4 meter transceiver designed and manufactured in the USA: the Noble Radio NR-6N4 two band VHF transceiver. The transmitter is rated at 20 W PEP SSB and CW. The price is anticipated to be around $800 US. More information about it can be found at **www.southgatearc.org/news/april2013/noble_radio_nr_6n4.htm**.

Why don't we have the 4 meter band in North America? One big reason is it overlaps with NA VHF low channel 4 TV, which is 68-72 MHz. But with the migration of North American TV to digital, an allocation at 4 meters may be possible in the future. In 2010 Glen Zook, K9STH, filed a petition with the FCC to grant a US 4 meter allocation. So far his request has not been granted. If there is interest in the 4 meter band, perhaps VHF radio clubs, organizations such as the Southeast and Central States VHF societies or interested individuals could file their own petitions or support K9STH's. The time is now for 4 meters!

Meteor Scatter for Newbies

Roger, VE1SKY, sent me a PDF and PowerPoint presentation of a talk he gave to the Halifax Amateur Radio Club regarding getting started in meteor scatter. It is an excellent review of what meteor scatter is, the equipment and techniques needed including the digital WSJT and IsCAT modes, what DX you may work, and a YouTube link to an actual digital meteor scatter contact Roger made with K2MO. The references are hyperlinked. If you are interested in meteor scatter, this is a great source of information to get you on your way. You can access Roger's presentation at **www.halifax-arc.org/sites/default/files/MeteorscatterVHFComms.pdf**.

John Butrovich, W5UWB, SK

It is with sadness that I report that John, W5UWB, passed away April 13. John had just set a new 222 MHz meteor scatter record with William Ockert, NDØB, on December 10, 2012 at 2177 km. He was active until days before his passing.

I worked John several times on 2 meter E_s and meteor scatter, and 23 centimeter tropo from Kansas. Back in April 2000 I worked him on 6 meters from American Samoa. John was one of the pioneers in investigating FAI (Field Aligned Irregularities) propagation on 2 meters.

Chuck, W7CS, knew John well and had these words to say:

> I first worked and got to know John when he was in the Navy and stationed at a Navy Logistics Base near Sacramento, California, I believe in the 1960s. I was living in the San Francisco Bay Area then.
>
> Later when he retired from the Navy and was working in the oil fields of western Texas, we worked many times on 2 meters and via many modes, even by FAI, from my QTH in Northern California.
>
> I also recall the many random 2 meter EME CW contacts that we had over several years. John at that time was only using a 15 foot long Cushcraft Jr Boomer and a Henry 1 kW HPA. He was able to take advantage of ground gain over that flat west Texas territory. He was the epitome of what a VHF pioneer could be, with minimal antenna gain and moderate RF power.
>
> I always looked forward to VHF conferences the 6 meter get-togethers, when I could visit with John again and reminisce about our previous contacts. I'll be thinking about him at every one I attend in the future.

On the Bands

50 MHz. A major F2-TEP opening occurred March 30-31 for stations in North America to South America and even to Africa — EA8 — from Florida! Six meters was open for F2 and TEP for stations in the Gulf Coast, South Texas and Florida from 1900 UTC to after 2300 UTC. Ken, AC4TO, worked LU5XP in Tierra del Fuego (FD66) at 1944 UTC. Ken observed "for a while it was a 'vanilla' opening to South America with many of the usual stations, but then

suddenly below the strong SSB on 50.110 MHz from a few GF05 area LUs came a weak CQ on CW: LU5XP IN TIERRA DEL FUEGO IN FD66! After a bit we were able to make the contact through the bedlam on 50.110 just above us at 1944 UTC. Soon after, I saw N3LL post a skew-path contact with EA8, so I started calling CQ on 50.095 at 130 degrees and had EA8AK call me almost immediately with a loud signal via skew! That was the first time I have worked EA8 via skew path.

Suddenly below the strong SSB on 50.110 MHz from a few GF05 area LUs came a weak CQ on CW: LU5XP IN TIERRA DEL FUEGO IN FD66!

"The back scatter footprint was amazing for a long period of time; I worked V31AE and KP3W via back scatter. Without really trying much, I worked 9 DXCCs in the opening (CE, CX, EA8, HC, KP4, LU, OA, PY and V3) and heard other DXCCs I could have worked too. With the SFI so low it seems the disturbed conditions really helped us out and made it an especially fun day."

I got an e-mail from Osvaldo, LU5XP, and he runs 100 W with a Yagi only 10 feet up: "Very happy to work the FD grid field finally!" LU5XP is not that far from the sub-Antarctic islands such as 3YØ, CE9, HFØ, etc. Dave, N9HF (EL99) heard EA8BPY at 2029 UTC while he was working HC3AP. Around 2230 UTC HC1MD (FI09) handed out Ecuador to many. After the South American stations faded, the band shifted to the South Pacific. Fred, KH7Y, worked LU5FF at 2358 on the 30th, then K5RK in Texas via side scatter at 0004 UTC March 31. Fred was beaming 110 degrees toward HK. N5DG spotted Fred at 0015 UTC. FK8CP appeared and worked stations in W4, W5, W6 and W7. Chuck, NA6XX, worked FK8CP at 0042 UTC with heavy QSB. K5BG in EM12 noted Remi was "59" on SSB at 0101 UTC. E_s were noted as well by NWØW (EM47) to XE2O/b (EL05) at 2328 UTC March 30 and W4HLR (EM56) to XE2JS (DL68) at 0046 UTC the 31st. The E_s helped create links for those in the right places to work the South Pacific. The DX propagation even stretched north to Colorado.

Bruce, KØYW, heard Jack, OA4TT, at 0235 UTC on March 31:

> After a frustrating couple of hours of watching beacon reports from the Pacific, FK8CP, KH7Y and KH6SX with no joy, I heard Jack, OA4TT, pop in on 50.105 at 0235Z calling CQ with a good signal 559. The Arizona gang, Pete, WA7JTM; Tommy, W7RV, and Tom Brown, N7AMA, as well as some of the Tucson gang were already working him. I answered his CQ with 50 W while waiting for my amplifier to warm up and got a couple of QRZs from him. The amplifier did the trick and our contact finished at 0247.
>
> He built over the next 15 minutes, peaking to a solid 579 on the meter. Since he had worked a lot of the Arizona gang there weren't many takers. I called Arne, N7KA, in Albuquerque, who promptly worked him with 100 W for a new one (#61). I could tell he was a lot louder as the latitude decreased! Arne is at 35° with 5 dB less antenna and was copying Jack with the same signal that I was. W6XI at 32° was hearing him a solid speaker rattling 599 on peaks. Jack sounded really happy! Jack was still in here until 0315. Other than weak back scatter from some of the Arizona guys, no other DX signals were heard here. Jack was right on his heading of 149° with little fading and a bit of TEP flutter.

The opening concluded with KH7Y working OA4TT "nothing but loud" at 0327 UTC. The following afternoon (March 31) Dennis, K7BV, worked KP4EIT, KP4BAI and NP3XF via E_s. A little E_s can go a long way in March.

A DXpedition was active on 6 meters from Easter Island the first week of April — Pipe, CE3SX, as XRØYX. Ed, N5DG, worked XRØYX on April 1 at 0255 UTC for "a new one." Ed notes W5UN and K5RK also worked Easter Island. These may be the first Easter Island to stateside 6 meter contacts since Arliss', W7XU, DXpedition as CEØY/W7XU in 2001. On April 2, Fred, KH7Y, logged Pipe at 0630 UTC. Easter Island is a near perfect distance from the geomagnetic equator for TEP to Hawaii. Fred heard the KH9 beacon for over 6 hours!

On April 3, XRØYX worked EA8AK at 2344 UTC. This is a "long path" TEP contact, similar to many Arliss made from Easter. Dave, PJ4VHF, worked XRØYX on the 9th. Dave uses an IC-756-ProIII transceiver to 6M5X Yagi at 28 feet and is an engineer for TRW. Eric, T6MO, logged FR1GZ, ZS6AYE and ZS6NK around 1450 UTC April 5. Eric uses a FT-857D and a RadioWavz 40-10 meter off center fed dipole on 6 meters at 30 feet. NA6XX worked CE2AWW on the 7th at 2030 UTC with 339 signals "pure TEP." KØHA (EN10) and NWØW also spotted Dale at 2200 UTC. K4QI (FM06) heard the OA4TT/b on the 8th for a few hours. April 9 found Dave, N9HF, working EA8CK at 1916 UTC. KH7Y had a great evening from the Big Island with "KG6, JA and VKs — about 75 QSOs" on the 12th.

A rare South American opening for stations in the Pacific Northwest and British Columbia to CE2AWW took place April 13. K7CW, VA7FC (CN79), VE7XF and VE7DAY (CO70) were among those working Dale, CE2AWW, around 2140 UTC. Paul, K7CW, worked CE2AWW for his DXCC #100 on 6 meters. "I had just gotten home from town and took a look at the chat on the ON4KST Region II page. I saw the red traces reaching from CE to VE7 and turned on my amplifier as fast as I could. I tuned down to 50.102 and there was CE2AWW at 599 plus. Dumped my call once and got him. This contact with CE brought me to 100 entities on 6 meters. Dale and I have been good friends for something like 45 years, so it was especially nice to have him be the 100th country for DXCC." Probably an E_s link to afternoon TEP opening. NA6XX noted E_s clouds over Utah and California — the right place for a link. Dale's, CE2AWW, log:

> W7FI (worked first), K7WIA, K7OFT, VE7DAY, VE7XF, VE7SL, VA7FC, N7CW, KI7JA and K7CW (worked last).

Dennis, K7BV, found HC2UA on April 14, 2002 UTC with 599 signals. Dennis thinks it was direct F2. The geomagnetic field was disturbed from a minor CME impact the day before. Jim, W7OUU (DM22), worked LU9EHF (FF95) at 2133 UTC on the 14th. Jim said he was "camping" on 50.130 MHz and the LU "just popped out of the noise" for a new one. Probably an E_s link for Jim as the NØLL/b (EM09) had been spotted by K7WLF (DM22) a few minutes earlier.

From April 21-23, KH7Y worked Oleg, UR5FA/mm, in grid QI51 near P29. Oleg uses a Windom antenna and FT-817 transceiver! Eric, T6MO, worked 3B8MM via TEP at 1430 UTC via TEP on the 21st. Eric says he is just getting "schooled" in how TEP works. Lance, W7GJ, worked TJ3SN via EME on the 21st at 0102 UTC for his DXCC #185. He believes this is the first Cameroon to USA 6 meter contact.

A minor aurora occurred April 24. N8JX in EN64 heard the KØKP/b 50.073 MHz via aurora at 0015 UTC. Joel, KG6DX, worked a really rare Nepal 9N7SZ (JA9LSZ) grid ML94 on the 28th at 1200 UTC. KH7Y worked BV2DQ and P29NO "for a new one" on the 29th around 0900 UTC. 9N7SZ worked many in Japan on April 30. I am receiving reports of several big E_s-TEP openings for North America to South America May 2-4 as I write this. I'll fill in the details next month.

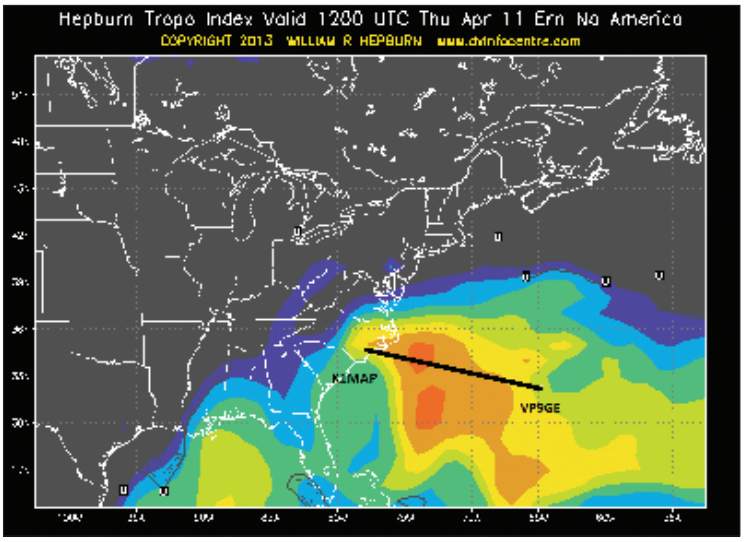


Figure 1 — Hepburn tropo map for April 11 showing the conditions during the 2 meter SSB contact Ed, VP9GE (FM72), had with K1MAP (FM14) at 1152 UTC. The contact path goes right across the predicted strong tropo ducting on the map. [William Hepburn, map]

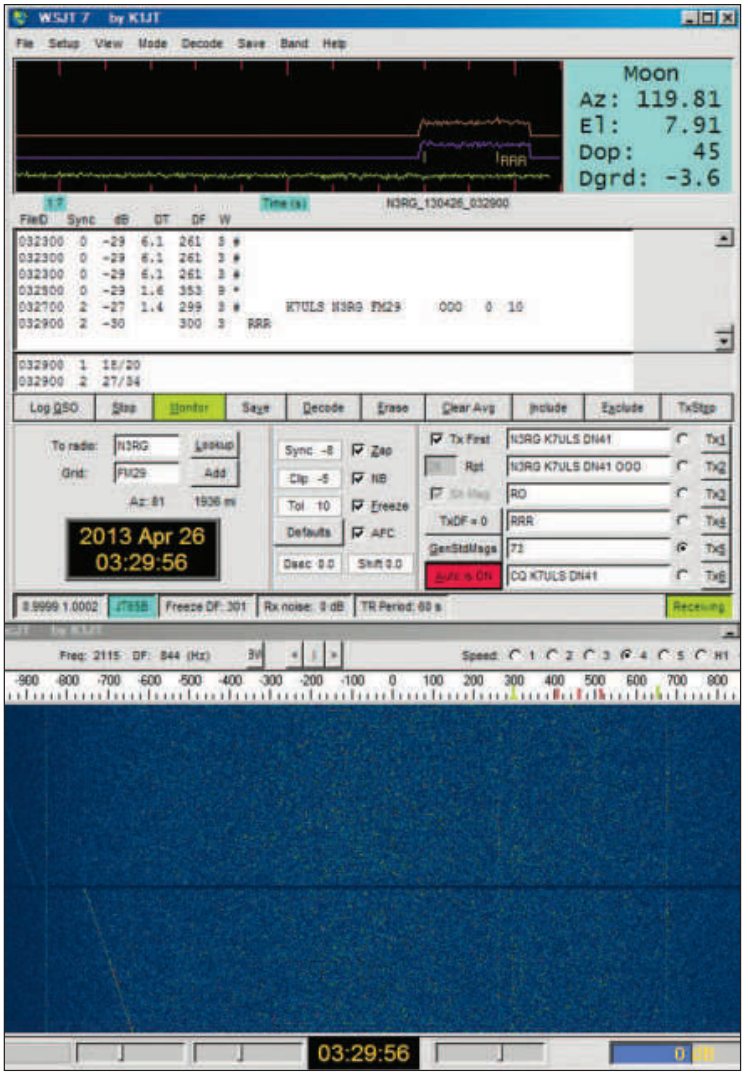


Figure 2 — Screen shot of a JT-65 2 meter EME contact between N3RG (FM29) and K7ULS (DN41) in Utah. The contact took place on April 26 at 0329 UTC. K7ULS was running just 350 W to a single M² 7 element Yagi! [Raymond Golley, N3RG, photo]

144 MHz. Ed Kelly, VP9GE (FM72), caught a rare tropo opening to the East Coast April 11. He worked K1MAP (FM14ux) at 1152 UTC on 144.200 MHz at around 1000 km. Hepburn's tropo map prediction (see Figure 1) shows enhanced conditions between Bermuda and North Carolina that morning. On the 14th, Rick, WØRT (EM27), worked Chad, NØYK (DM98), on tropo at 1455 UTC.

Sam, K5SW (EM25), worked K5YG (EM50) on April 17. Steve, NN4X (EL98), also worked K5YG (EM50) on 144.200 MHz tropo at 1129 UTC April 18 with S2-S7 signals. Fred, KH7Y, worked 9G5EME on April 23 via EME. Also on EME, K7ULS (DN41), worked N3RG (FM29) on the 26th. Mike, K7ULS, ran just a 7 element M² Yagi (see Figure 2)!

222 MHz. John, KFØM (EM17), worked K5SW (EM25), WØKAN (EM28) and KØDOK (EM48) in the 222 Spring Sprint. N6ZE made 13 contacts from DM04 in the Sprint. Peter uses a FT-736 with a 100 W brick and a 9 element M² Yagi.

432 MHz. Peter, N6ZE, made 27 contacts in the 432 MHz spring sprint from DM04. His best DX was 138 km. N4PZ (EN52) has upgraded his 50 W beacon to two "big wheel" antennas at 70 feet on a 200 foot hill on 432.320 MHz.

902, 1296 MHz and Up. A new 23 cm beacon — K5PJR/b on 1296.137 MHz — has generated a lot of interest in the Midwest. It is on Boat Mountain, Arkansas at 2280 feet elevation, near Harrison. The grid square is EM36lc. JD, NØIRS, in EM29 hears it regularly at 364 km.

Here and There

Eric, K9GY/T6MO, is back in the states now. He is planning to be in Bermuda August 8-15 and will be operating from Ed's, VP9GE, shack. He plans to be active on 6 meters.

Eric, KV1J, will be on from Saint Pierre and Miquelon, FP, July 6-16. This is primarily a HF operation but he will have 6 meters.

Tom, KCØW, will be active as HH5/KCØW from the extreme northern tip of Haiti July 6-25. Activity will be 80-6 meters using CW only. He will use a vertical antenna placed directly over salt water.

I would encourage our African colleagues to look for E_s-TEP links to North America this fall. CE2AWW, FK8CP, OA4TT and others have shown what is possible with good stations and astute operating.

At the Foundation

Mary M. Hobart, K1MMH, k1mmh@arrl.org

Calvin Darula, KØDXC, Awarded 2013 Goldfarb Scholarship

The 2013 William R. Goldfarb Memorial Scholarship has been awarded to Calvin P. Darula, KØDXC, of St. Bonifacius Minnesota. Calvin, a senior at Waconia High School, carries a 3.4 GPA and is an ARRL member. His accomplishments include Academic Honor Roll in his freshman and sophomore years, service on the Student Council in his senior year and second place in the Voice of Democracy VFW Constitution speech competition, also in his senior year. He participated on his high school baseball teams all four years of high school. Calvin's community activities include the Fellowship of Christian Athletes, Conservation Club, International Club and the Waconia Amateur Radio Club (KCØVIS) through four years of high school with service as the club's Vice President.

Calvin's interests in Amateur Radio include contest operations at superstations including K3LR, K1LZ and 6Y1V. He has broken world records in the CQ WPX Contest and the CQWW SSB Contest from station K1LZ. In 2008 he was voted WØ Young Ham of the Year. He was recruited as a 2010 USA High Speed Telegraphy Team member and has served as Youth Assistant Section Manager. He was the keynote speaker at the 2010 Dayton Hamvention Contest Forum, speaking on CW contesting. He has had several articles published in the *National Contest Journal*, *CQ* Magazine and the *FISTS* CW Journal.

Calvin will attend St. John's University where he will pursue studies in business management and economics. His plans include a career in the business world, where he can build on his experience as a young entrepreneur who started his own Internet marketing company at the age of 14. His goal is to be involved in business to help make changes that will provide a stable, thriving economy for future generations.

The application period for the 2014 ARRL Foundation Scholarships opens October 1, 2013 and closes promptly at midnight on January 31, 2014. Complete information about the more than 80 annual scholarship awards and the prestigious William R. Goldfarb Memorial Scholarship for high school seniors can be found on the web at **www.arrl.org/scholarship-program**. Inquiries about the scholarship program should be sent to **foundation@arrl.org**.

Special Events

Maty Weinberg, KB1EIB, events@arrl.org; www.arrl.org/special-event-stations

Contact these stations and help commemorate history. Many provide a special QSL card or certificate!

Jun 10-Jun 24, 0000Z-2359Z, K1A, Pittsfield, NH. Sky Is No Limit Amateur Radio Club and Contoocook Valley Radio Club. Aerospace Fest. 21.252 14.252 7.252 3.852. Certificate & QSL. Fred Reed, KK1KW, 103 Berry Pond Rd, Pittsfield, NH 03263. **www.qrz.com/db/ka1sky**

Jun 15, 1600Z-2200Z, W6SVS, Simi Valley, CA. Simi Settlers Amateur Radio Club. Simi Valley History Days at Strathearn Park. 14.270 14.045 7.270 7.045. QSL. Rick Galbraith, 4790 Alamo St, Simi Valley, CA 93063. **simisettlers.org**

Jun 29-Jun 30, 1317Z-1421Z, W2W, Hillsboro, IL. Montgomery County Amateur Radio Emergency Corps Inc. Honor America Days. 14.260 7.270. QSL. MCAREC-W9BXR, 1515 Seymour Ave, Hillsboro, IL 62049. *Remembering all those who served in the Armed Forces and those who endured and sacrificed on the home front to keep our nation free during WW II. Please share memories: short ones on air, longer ones when you QSL.*

Jun 29-Jun 30, 1600Z-2359Z, WØNOZ, DeSmet, SD. Huron Amateur Radio Association. Laura Ingalls Wilder Pageant. 18.155 14.265 7.265. Certificate & QSL. Huron ARA, Inc, PO Box 205, Huron, SD 57350. **www.huronarc.info**

Jun 30-Jul 7, 1100Z-0100Z, W1G, East Berlin, PA. WO4L. 150th Anniversary of the Battle of Hanover and Gettysburg. 24.950 21.350 14.250 3.780. Certificate & QSL. Bob Hess/W1G, 74 Curtis Dr, East Berlin, PA 17316. **www.qrz.com/db/wo4l**

Jul 1-Jul 5, 1200Z-1200Z, K2B, Cedar Bluff, VA. 13 Colonies. 14.213 7.313. Certificate & QSL. Danny Starling, 2262 Bandy Rd, Cedar Bluff, VA 24609. **www.13colonies.info**

Jul 1-Jul 6, 1200Z-2359Z, N3S, Morrisville, PA. The Southern Legion. 150th Anniversary of the Battle of Gettysburg. 14.250 7.200 3.700. QSL. Bryan D. Boyle, 102 Juliet Rd, Morrisville, PA 19067. **www.n3s.org**

Jul 1-Jul 7, 1300Z-0400Z, WM3PEN, Philadelphia, PA. Holmesburg Amateur Radio Club. 13 Colonies Special Event Bonus Station. 14.263; HF 10, 15, 20, 40, 80. QSL. Holmesburg Amateur Radio Club, 3341 Sheffield Ave, Philadelphia, PA 19136. **www.harcnet.org**

Jul 1-Jul 7, 1400Z-2359Z daily, W3KGN, Gettysburg, PA. Adams County Amateur Radio Society. 150th Anniversary of the Battle of Gettysburg. 145.63 14.263 7.1863 3.863. Certificate. Perry Wood, 255 Chapel Road, Gettysburg, PA 17325. *From the reenactment site.* **www.w3kg.org**

Jul 4, 1600Z-2300Z, W7PX, Missoula, MT. Hellgate Amateur Radio Club. Independence Day at Fort Missoula. 21.310 14.260 14.070 14.030. QSL. HARC, PO Box 3811, Missoula, MT 59806. **www.w7px.org**

Jul 4-Jul 6, 1400Z-2200Z, W8TNO, Davisburg, MI. Oakland County Amateur Radio Society. Oakland County Fair. 14.270 14.070 14.050 7.230. Certificate & QSL. Joe Miller, KJ8O, 6928 Forest Park, Troy, MI 48098. **www.qsl.net/w8tno/indexa.html**

Jul 6, 1600Z-2359Z, W3LRC, Laurel, MD. Laurel Amateur Radio Club. Fourth of July. 28.350 21.400 14.325 147.54 FM simplex. Certificate & QSL. Laurel Amateur Radio Club, PO Box 146, Laurel, MD 20725. **www.larcmd.org**

Jul 6, 0800Z-1200Z, K4S, Ashland, KY. River Cities Amateur Radio Association. Summer Motion. 28.400 14.240 7.240. Certificate. Vernon Leeper, PO Box 612, Ashland, KY 41105. **www.rcara.site90.com**

Jul 6, 1400Z-2200Z, K4F, Smithville, TN. DeKalb/Cannon County Amateur Radio Club. 42nd Annual Smithville Tennessee Fiddlers Jamboree & Craft Festival. 14.280 14.045 7.275 7.045. QSL. DeKalb/Cannon County Amateur Radio Club , 288 Dogwood Cir, Smithville, TN 37166. **www.dccarc.org**

Jul 9-Jul 14, 0000Z-2300Z, W3P, Philipsburg, PA. Philipsburg Amateur Radio Association. Philipsburg Heritage Days 2013. 14.260 7.050 3.970. QSL. Philipsburg Amateur Radio Association, PO Box 207, Kylertown, PA 16847. **www.philipsburg-ara.org**

Jul 10-Jul 14, 0600Z-2359Z, KØY, Fulton, MO. Callaway Amateur Radio League LLC. Callaway County Youth Expo. 14.270 14.070. Certificate & QSL. Scott Buckholz, 9306 Know Pl, New Bloomfield, MO 65063. **callawayamateurradio.wordpress.com**

Jul 12-Jul 14, 1700Z-1700Z, K8BXQ, Wauseon, OH. Fulton County Amateur Radio Club. Delta Chicken Festival. 14.270 7.270; 14.070 PSK31; 147.195. Certificate. FCARC, PO Box 521, Wauseon, OH 43567. **k8bxq.org**

Jul 13, 1300Z-2100Z, K2Z, Savona, NY. Keuka Lake Amateur Radio Association. 1941 Historic Aircraft Group — Geneseo Air Show. 21.340 14.250 7.250. Certificate. Joel Fiske, 6839 Rt 226, Savona, NY 14879. **kc2vaw@fiskefamily.net**

Jul 13, 1400Z-2200Z, W8VP, Cambridge, OH. Cambridge Amateur Radio Association. 150th Anniversary of Morgan's Raid through Guernsey County. 14.260 7.235. Certificate & QSL. Cambridge Amateur Radio Association, PO Box 1804, Cambridge, OH 43725. *7th Special Event in CARA's year-long 100th Birthday Celebration. Work all 12 of CARA's monthly 2013 Special Events for certificate.* **www.w8vp.org**

Jul 13, 1600Z-2100Z, WE7GV, Sahuarita, AZ. Green Valley Amateur Radio Club. 50th Anniversary of Titan Missile Site Activation. 14.246 14.244 14.242. Certificate & QSL. Green Valley Amateur Radio Club, 601 N La Canada Dr (SAV), Green Valley, AZ 85614. **gvarc.us**

Jul 13, 1600Z-2300Z, NI6IW, San Diego, CA. USS *Midway* (CV-41) Museum. Independence Day. 14.320 7.250 PSK31 14.070 D-STAR 012C. QSL. USS *Midway* Museum Radio Room, 910 N Harbor Drive, San Diego, CA 92101.

Jul 13-Jul 14, 0900Z-1700Z, N4C, Chattanooga, TN. Chattanooga Amateur Radio Club. 150th Anniversary of the Battle of Chattanooga/Lookout Mountain. 144.220 50.115 14.260 7.275 3.977. QSL. Chattanooga Amateur Radio Club, PO Box 23121, Chattanooga, TN 37422. **www.w4am.org**

Jul 13-Jul 14, 1500Z-2100Z, N2B, Winona, MN. Winona Amateur Radio Club. 10th Annual Great River Shakespeare Festival. 14.265 7.265 7.030. Certificate. N2B, PO Box 1264, Winona, MN 55987. **w0ne.org**

Jul 13-Jul 15, 0000Z-2359Z, K7S, North Bend, WA. Pacific Northwest QRP Group. pQRPSalmoncon VIII. 28.060 21.060 14.060 7.030. QSL. Bob Stephens, 7829 Center Blvd SE #198, Snoqualmie, WA 98065. *Operating near usual QRP frequencies on many bands.* **www.pqrp.org**

Certificates and QSL cards: To obtain a certificate from any of the special event stations offering them, send your QSO information along with a 9 × 12 inch self-addressed, stamped envelope to the address listed in the announcement. To receive a special event QSL card (when offered), be sure to include a self-addressed, stamped business envelope along with your QSL card and QSO information. *Note: Some clubs may ask for a nominal fee to cover the cost of the certificate or QSL. Request will be made on air during the event or on the club's website.

Special Events Announcements: For items to be listed in this column, use the ARRL Special Events Listing Form at **www.arrl.org/special-events-application**. A plain text version of the form is available at that site. You may also request a copy by mail or e-mail. Offline completed forms can be mailed, faxed (Attn: Special Events) or e-mailed.

Submissions must be received by ARRL HQ no later than the 1st of the second month preceding the publication date; a special event listing for **Sep** *QST* would have to be received by **Jul 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 May 10. You can view all received Special Events at **www.arrl.org/special-event-stations**.

Jul 14, 1700Z-2200Z, KI4CVU, Kingsport, TN. Kingsport/Bays Mountain Amateur Radio Club. 33rd Kingsport Fun Fest and 2nd Maker Faire. 28.420 21.280 14.280 7.251. QSL. Tom Price, 1517 E Sevier Ave, Kingsport, TN 37664. **ki4cvu@gmail.com** *or* **www.w4trc.org**

Jul 15-Jul 24, 1700Z-1200Z, K2BSA, Mount Hope, WV. Boy Scouts of America, K2BSA Amateur Radio Association. National Scout Jamboree — K2BSA Operation. 21.360 18.140 14.290 7.190; SSB PSK EchoLink node 4566 conference *JOTA-365* D-Star Reflector 033A. QSL. Jim Wilson, K5ND, 1325 W Walnut Hill Ln, Irving, TX 75038. *Complete frequency listing at* **www.scouting.org/jota/operators_guides.aspx**. **www.k2bsa.net**

Jul 19-Jul 21, 1300Z-2200Z, K4H, Noblesville, IN. Hamilton County RACES. Hamilton County Indiana 4-H Fair. 14.270. QSL. Special Event Station K4H, Hamilton County EMA, 18100 Cumberland Rd, Noblesville, IN 46060. **www.qsl.net/hcares**

Jul 20, 1400Z-1800Z, NC4MC, Candor, NC. Montgomery Amateur Radio Society. 17th Annual North Carolina Peach Festival. 14.250 14.030 7.250 7.030. Certificate. Don Grady, KG4ZRH, 120 Woodline Dr, Troy, NC 27371.

Jul 20-Jul 21, 0101Z-0100Z, WØVFW, Wichita, KS. VFW Post 3115. Kansas Veterans and Family Reunion. 18.140 14.265 7.229 MHz (MRCA) 3.865. QSL. Dwight Holtzen, 795 N McComas, Wichita, KS 67203. *From El Dorado Lake*. **www.kvfr.us**

Jul 20-Jul 21, 1500Z-2100Z, WØWIT, Forest City, IA. WIT Radio Club. Winnebago-Itasca Travelers Grand National Rally. 14.268 7.253 147.27+. QSL. Attn: Lois Maas, 3700 S Westport Ave #2242, Sioux Falls, SD 57106. **www.orgsites.com/ia/witcars**

Jul 21-Jul 31, 1607Z-1607Z, W7C, Bandon, OR. Western Country Cousin Net. 49 Year Anniversary. 14.265 3.970. QSL. WCCN, c/o Roy Dickinson, 204 Rainbow Dr #10459, Livingston, TX 77399. **www.wccnet.us**

Jul 22-Jul 28, 2300Z-2200Z, W9IMS, Indianapolis, IN. Indianapolis Motor Speedway Amateur Radio Club. W9IMS Brickyard 400 Special Event. 21.350 14.245 7.240 3.840. Certificate & QSL. IMS ARC, PO Box 30954, Indianapolis, IN 46230. **w9ims.org**

Jul 26-Jul 27, 0200Z-0400Z, K3NQT, Bedford, PA. Bedford County Amateur Radio Society. Bedford County Amateur Radio Awareness Days. 146.580 28.450 14.260 7.260. Certificate & QSL.* For certificate: see URL; for QSL: John Hoganmiller, KB3DFZ, 300 Cumberland Rd, Bedford, PA 15522. **www.bcars.org**

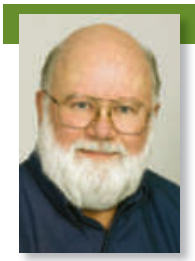
Jul 26-Jul 27, 0500Z-1100Z, K9J, Hartford City, IN. MAG Royal Rangers Radio Club. Royal Rangers Ranger Fest. 28.435. QSL. Jerry Barnes, 601 Spring St, Madison, IN 47250. **ka9pij@frontier.com**

Jul 26-Jul 27, 1300Z-2000Z, W9A, Berne, IN. Adams County Amateur Radio Club. Swiss Days. 14.270 14.070 7.270 7.070. QSL. Wayne Steury, N9EGT/W9A, 817 W Main, Berne, IN 46711. **n9egt@arrl.net**

Jul 26-Jul 28, 0000Z-2359Z, W7AZ, Kennewick, WA. Tri-Cities Amateur Radio Club. 48th Running of the Columbia Cup Unlimited Hydroplane Race. 14.070. QSL. Ed McLaughlin, W6OLA, 3815 S Green St, Kennewick, WA 99337. *Club will be operating 80 40 20 17 15 12 10 6 2 meters and 70 cm, SSB, CW, digital and FM.* **www.w7az.org**

Jul 27, 1200Z-1800Z, W8MAA, Holt, MI. Central Michigan Amateur Radio Club. CMARC Outdoor Hamfest. 21.325 14.250 147.420 simplex. QSL. Al Wright, 4586 Sycamore, Holt, MI 48842. **twowrights@comcast.net**

Jul 31-Aug 3, 1700Z-1500Z, W7GRA, La Grande, OR. Grande Ronde Radio Amateurs Association. Union County Fair. 28.350 21.290 14.250 14.070. QSL. GRRAA, 2110 Aries Ln, La Grande, OR 97850. **w7gra.org**



John Dilks, K2TQN, k2tqn@arrl.org

The "Murphy Bench"

A "Murphy Bed" workbench saves space and is spouse-approved.

When we built our home 38 years ago, we built as much home for our four kids as we could afford. This did not include either a cellar or garage, nor did it include a ham shack. We did add a utility room for the freezer, washer and dryer. Later, since we didn't have a freezer, I decided to take over that corner and use it as my ham shack. It was big enough for my radios, but not for an added workbench. The dining room table sufficed as a workspace until my spouse's patience wore thin. I suspect many of us have been in that position.

Later, I realized the space above the washer and dryer was vacant. I decided to build a workbench to utilize this space. To be spouse-approved, it had to look nice and not be in the way. The workbench had to be usable in between washdays, but out of the way on washdays as we had a top loading washer. The design I came up with uses a folding work surface that retracts into a storage cabinet. On washdays, the workbench is folded up out of the way.

Then, this past winter, the washer started to walk and groan and bang a lot. It was time for a new one. I suggested a pair of the new front loading types. Washday problem solved.

I had to raise the workbench as the new machines were a little taller than the old ones. As I remounted the workbench, it occurred to me that others might have the same limited space problems as I do, so I decided to share my project. I hope you will send me photos of your "Murphy bench," if you build one.

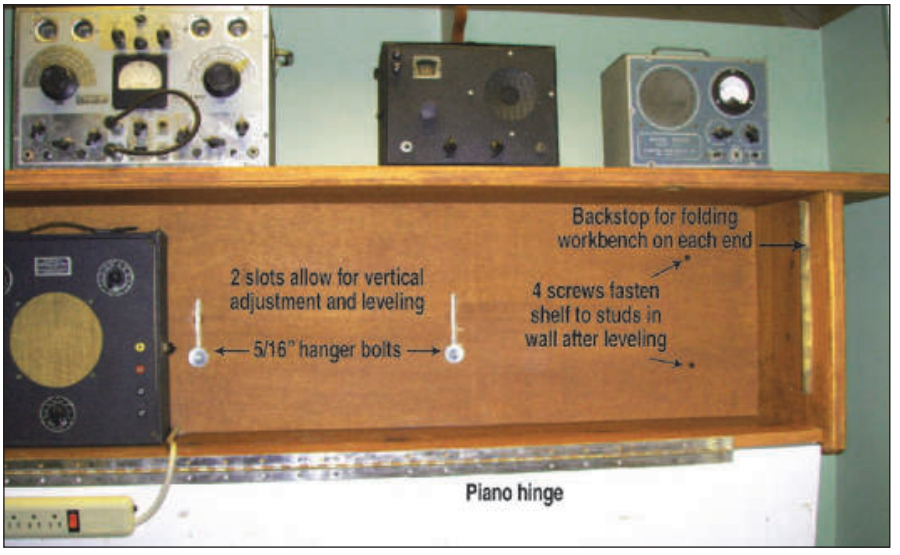


Figure 1 — This is the mounting arrangement. The slots are for leveling, the screws for support and the backstops to protect your test equipment stored in the cabinet area. The shelf space on top of the unit a nice bonus!

Workbench Materials List

The materials I used to construct my "Murphy bench" are listed in Table 1. The dimensions shown are those that worked for my space. They should serve to guide your own design when adapted to the dimensions of the space you have available.

Figure 2 — Here, the "Murphy bench" is in its closed position. Note the towel placed over the washer and dryer to protect them from scratches.

Figure 3 — Here I am opening the door. The front section of the workbench top is visible.

Figure 4 — Here I am lowering the door. The workbench top is closed against the back of the door.

Figure 5 — The door is in its open position and I am extending the workbench top.

Figure 6 — The "Murphy bench" is ready to go. Note the power strip below the piano hinge.

Figure 7 — A nice work surface. Power, test equipment and tools are all at the ready.

Assembly Instructions

During the course of assembly, keep checking that everything is square. If you are uncomfortable doing woodwork, find an experienced friend to help.

1. Router the edges of the top shelf. Shape and router the sides as desired.

2. Cut the plywood pieces.

3. Sand and pre-stain or paint the pieces as desired.

4. Dry fit the pieces to ensure that everything fits correctly.

5. Pre-drill the holes for screws to prevent wood splitting.

6. Use the back as a base to start assembly and attach the sides. Next, attach the top shelf to the sides and back. Glue and fasten these with wood screws. (The back is inside top and sides.)

7. Attach the bottom shelf to the "inside edge" of the back, approximately 14⅜ inches from the bottom of the top shelf. Then fasten the sides to the shelf using glue and wood screws. (This makes a box with the inside dimensions of 14⅜ high × 60 wide × 9¼ inches deep.)

8. Let it sit while the glue dries. Use this time to decorate the front side of the door.

9. Attach the door to the bottom shelf with the first piano hinge. Before putting in all the screws, check that it fits when closed. (Make sure you orient the door correctly if you painted a sign or decorated the front side.)

10. Attach the two plywood pieces together with the second piano hinge to form the workbench top; make sure the hinge is centered and the joint is tight.

11. Flip the workbench top over and attach the edge of the workbench top to the inside of the door with the last piano hinge. Check that it will fold up correctly before putting all the screws in.

12. Add two backstops, one on the interior of each side to prevent the workbench top from hitting your test equipment. These should be about 10 or 12 inches long and wide enough to work.

13. Install two latches to keep the door closed. I spaced mine wide enough apart to thwart small climbing grandchildren from opening the workbench. A lock could also be installed.

Table 1
Workbench Parts List

- *¾ inch pine board, knot free, 11⅜ inch wide*
  1 pc 7 feet long (top shelf)
  2 pcs 18½ inches long (sides)
- *1 inch pine board, knot free, 9¼ inches wide*
  1 pc 60 inches long (bottom shelf)
- *¾ inch Interior plywood, good both sides*
  1 pc 14¼ x 60 inches long (back)
  1 pc 14¾ x 59¾ inches long (door)
- *½ inch interior plywood, good both sides*
  2 pcs 11 x 14¾ inches long (workbench top)
- *24 inch of wood molding for two 10 or 12 inch backstops,* size as needed
- *¾ inch piano hinge (1½ inch total width opened)*
  3 pcs 48 inches long
- *5⁄16 or ⅜ inch hanger bolts (a lag bolt with machine threads, instead of a hex-head)*
  2 pcs 4 or 5 inches long or as needed
- *Washers and nuts for hanger bolts* as needed
- *Door latches*
  2 pcs as needed
- *Miscellaneous screws, wood glue and stain or paint* as needed

Mounting Instructions

1. Locate the 2 × 4 studs in the wall. Determine which studs will have the hanger bolts installed. Measure — and measure again — then install the hanger bolts. Find the relative locations on the back of the workbench, then cut slots long enough to allow the whole unit to be adjusted up and down so the workbench is completely level when unfolded on the washer and dryer (see Figure 1). Allow for a towel to be placed in between the cabinet and the washer/dryer to prevent scratches. You want the workbench as level as possible to prevent screws and parts from rolling off. Tighten the nuts with washers on the hanger bolts.

2. After everything is level and double checked, add at least four long screws, two near either end through the back and into the studs in the wall. This will make for a solid installation.

3. A power strip can be added to the workbench side of the door, located near the top. (Check for clearance with the bottom shelf and the workbench top when folded up.) Run the cord through the bottom shelf, near the rear. Most washing machines have a handy duplex outlet on the wall. When opening the workbench top the handy power strip is ready to go.

All photos by Alexis Dilks.

A Different Approach to Poor Propagation

OSCAR could help compensate for poor propagation and antenna restrictions.

Mike Herr, WA6ARA

I have good news and bad news. The good news is that Solar Cycle 24 is finally showing some activity. It seems like it's been years since the solar flux was above 100. That's the good news. The bad news is that many solar scientists are predicting that this cycle will be a poor one — one of the lowest observed. In addition, there are some projections that Solar Cycle 25 will be even lower! It's very possible that we have entered an era of low solar activity that could last for a generation or two. Unfortunately, there is nothing we can do about the Sun's low output or the poor propagation that results — it will be what it will be.

It's very possible that we have entered an era of low solar activity that could last for a generation or two.

A related issue is the turn for the worse that has occurred regarding antenna zoning. Most of us thought PRB-1 would solve most of our concerns, but recent court rulings indicate otherwise. The courts are taking a unique, and for HF, dangerous stand on the subject of accommodation. How this will play out is anyone's guess.

These two subjects — low solar activity and restrictive antennas — are connected. HF antenna restrictions, along with poor propagation, will limit our abilities on HF, especially for DX. A solution to both problems is completely within our control. That solution is the Amateur Radio satellites or OSCAR, which can provide DX opportunities as well as reduce the need for large and obtrusive antennas.

We presently have a number of working OSCARs in orbit. Unfortunately, they are in low earth orbit and they provide communication capability for a limited time and range. The operation of the satellites is very similar to a 6 meter sporadic E contact — short and sweet. The advantage over sporadic E is that we know exactly when and where a satellite pass will occur. The Amateur Radio community has successfully orbited high earth orbit satellites that provided worldwide DX and hour long communication paths. AO-10, AO-13 and AO-40 were such satellites. Unfortunately, none of them remain operational.

The operation of the satellites is very similar to a 6 meter sporadic E contact — short and sweet.

Imagine a scenario in which an amateur wishes to chase a little DX. He grabs his simple tripod antenna, only about 5 feet tall, from the garage and in a few minutes he has it set up in the backyard. He makes a quick connection to his rig inside, or if the day is nice, outside and he is on the air. Using simple tracking programs he locates the satellite and suddenly the passband sounds like 20 meters on a good day. That rare DX station is located and worked, followed by a casual contact with a European, then a ragchew round table. All of this is possible. Once done for the day, the ham puts everything away in 15 minutes and no one has an issue. Even the ham living in a condominium can participate with a very simple and small antenna on the balcony. Portable operation? DX operation? Absolutely! Satellite capable equipment is now commonly available and satellite capability is included in many modern rigs. Satellite operation is no longer limited to a few high tech hams but is open to all of us.

We, the Amateur Radio community, should begin by funding one or more high earth orbit satellites. With AMSAT and the ARRL working together, we must formulate a through and complete plan. We need to decide on the satellite's capabilities, prepare a design and then raise the funds needed. This should be a long term plan that includes replacement satellites on a 5 year cycle, to ensure continuous availability of orbiting communications platforms.

Once a real, working plan exists, we would need to initiate a funding campaign using techniques from traditional building campaigns to crowdsourced funding. Certainly the prospect of a new communications path with HF-like worldwide propagation, that could be used with limited space antennas at both ends, should be worthy of funding. We do not have to be victims of the Sun's fickle nature nor the twists and turns of the court system. But, it will take money. The primary cost now is not the satellite but rather launching it — and these costs are substantial. Let's stand up to the challenge and make it happen!

Mike Herr, WA6ARA, an ARRL member, has been a licensed ham since 1970 and currently holds an Amateur Extra class license. His main interests are satellites, CW, low power operating and homebrewing.

Mike has a BS in Mechanical Engineering and is retired from his job as a civilian employee of the US Navy, where he conducted design and development of aircrew escape systems. Mike was also involved in NASA related work and he continues consulting efforts with NASA in between his ham radio activities.

Mike, along with his wife Paula, N6VGW, make their home in the high desert of California at the QRP Ranch. You can reach him at 613 N Rebel Road, Ridgecrest, CA 93555, **wa6ara@gmail.com**.

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.

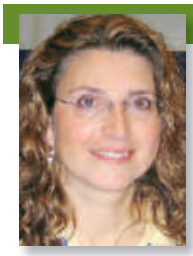
4) Articles containing statements that could be construed as libel or slander will not be accepted.

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).



Maria Somma, AB1FM, VEC Manager, ab1fm@arrl.org

Stats, Resources and Amateur Extra Certificates

The ARRL VEC is by far the largest Volunteer Examiner Coordinator (VEC) group in the country, coordinating approximately 70% of all Amateur Radio exams. In 2012, the number of ARRL-sponsored exams increased by 8%. This translates to 6831 exam sessions administered in 2012 compared to 6352 in 2011. The number of exam elements given also increased slightly; 42,473 in 2012 versus 41,096 in 2011. The number of applicants served at ARRL sessions grew from 32,187 in 2011 to 32,866 in 2012.

Over the years, the ARRL VEC has grown to become more than just an exam administrator. ARRL is one of five FCC-authorized 1×1 Special Event Call Sign Coordinators and has processed nearly 90% of the 9297 Special Events authorized and documented in the 1×1 database since the program's inception in September 1997. We have also issued or renewed more than 1400 International Amateur Radio Permits (IARPs) since the program was established in June 1999. IARPs grant US Amateurs instant operating authority when traveling to participating Central and South American countries.

As one of three FCC-authorized Club Station Call Sign Administrators, ARRL VEC processed and transmitted more than 1100 club licenses for the FCC in 2012. In addition, we processed and electronically transmitted nearly 7000 address changes and license renewals to the FCC for ARRL members in 2012.

ARRL Volunteer Examiners

Since 1984, ARRL VEC has been busy meeting the needs of the Amateur Radio community. Thanks to our Volunteer Examiners (VEs), scores of hams have upgraded their licenses or obtained new ones. VE ranks are growing to meet the demand with the ARRL VEC adding 2108 new VEs in 2012. In fact, the total number of Accredited VEs in our program has reached an all-time high of 36,682. This number continues to grow slightly each year. Table 1 lists the numbers of ARRL VEs by ARRL division.

Table 1
ARRL VEs by Division

ARRL Division	VE Count
Atlantic	3051
Central	2465
Dakota	837
Delta	2326
Foreign	792
Great Lakes	3419
Hudson	1498
Midwest	1921
New England	2134
Northwestern	2589
Pacific	2052
Roanoke	2836
Rocky Mountain	1543
Southeastern	3664
Southwestern	2538
West Gulf	3017
Total	**36,682**

The ARRL VEC website makes it possible to view statistics showing the number of ARRL VEC sponsored exam sessions that each VE has served. The VE Session Counts page at **www.arrl.org/ve-session-counts** recognizes the accomplishments of our VEs and it's a fun way for VEs to keep track of their session-participation totals. The listings are in alphanumeric call sign order according to VE location by state (as determined by the VE's address in ARRL VEC records). A few days after a session is transmitted to FCC, the participating VEs records are updated on the web.

Considering that each session requires an average time commitment of 2 to 4 hours or more, the thousands of hours these VEs have invested represents extraordinary dedication! We applaud the volunteers whose service and dedication help make the VEC program successful.

Web Resources for ARRL VEs

The ARRL VEC VE support page at **www.arrl.org/resources-for-ves** offers helpful resources for ARRL VEs. Almost everything a VE would need can be found here.

In addition, ARRL VEs can register Amateur Radio exam sessions and order exam supplies via our interactive web forms. Registration is quick and easy at **www.arrl.org/register-an-amateur-radio-license-exam-session**.

ARRL VE Teams that have been formally field-stocked with exams by the ARRL VEC may restock their exam supplies via the on-line VE team restock form at **www.arrl.org/field-stocked-ve-teams**.

The three exam question pools and other useful information pertaining to the pools can be viewed on the ARRL website at **www.arrl.org/question-pools**. The current pools are valid for the following periods:

- Technician class (Element 2) – July 1, 2010 through June 30, 2014
- General class (Element 3) – July 1, 2011 through June 30, 2015
- Amateur Extra class (Element 4) – July 1, 2012 through June 30, 2016

No question pool updates or releases are scheduled for 2013.

A list of ARRL VEC Exam Booklet designs can be viewed on the ARRL website at **www.arrl.org/vec-exam-booklets**. All exam designs must be based on the current question pools. Check your inventory and contact us immediately if your ARRL VEC Exam Booklets are not up to date.

Have You Earned Your Amateur Extra License?

If so, you can proudly display your accomplishment with an attractive certificate from the ARRL VEC Department. This certificate acknowledges the success of newly licensed Amateur Extra operators, as well as those who made the grade long ago. The 8½ × 11 inch certificate is suitable for framing.

To order a certificate, you must include your name as you would like it to appear, your call sign and the issue date of your Amateur Extra license. You'll find instructions and an order form on the ARRL website at **www.arrl.org/extra-class-program**.

2013 ARRL National Exam Day Weekends

ARRL sponsored national exam day weekends are held annually on the last full weekends of April and September. Fall national exam day weekend is September 28-29, 2013. We thank you for your support of these events!

Convention and Hamfest Calendar

Gail Iannone, giannone@arrl.org; www.arrl.org/hamfests-and-conventions-calendar

Abbreviations
Spr = Sponsor
Tl = Talk-in frequency
Adm = Admission

Alabama (Cullman) — Jul 27 D F H R S V
8 AM-2 PM. *Spr:* Cullman ARC. Cullman Civic Center, 510 5th St SW. *Tl:* 145.31 (100 Hz). *Adm:* $5. Charles McBrayer, WB4PED, 256-708-1000; **cmcbrayer@corrwireless.com**; **cullmanarc.webs.com**.

Arizona (Williams) — Jul 19-21
D F H Q R S T V
Friday and Saturday dawn-5 PM; Sunday Train Trip. *Spr:* AR Council of Arizona. Williams Rodeo Grounds, 800 Rodeo Rd. T-Hunt, balloon launch, Grand Canyon Railroad Trip, Saturday BBQ Dinner. *Tl:* 146.78 (91.5 Hz). *Adm:* Free. Mark Kesauer, N7KKQ, 602-881-2722; **arcafest@arca-az.org**; **www.arca-az.org**.

Colorado (Monument) — Jul 27 D F H R V
8 AM-1 PM. *Spr:* Pikes Peak RAA. Lewis Palmer High School, 1300 Higby Rd. *Tl:* 146.97 (100 Hz). *Adm:* $5. Dan Scott, WØRO, 719-635-0871; **treasurer@ppraa.org**; **www.ppraa.org**.

Florida (Fort Pierce) — Aug 10
D F H Q R S V
8 AM-1 PM. *Spr:* Fort Pierce ARC. Indian River State College (KSU Bldg), 3209 Virginia Ave. *Tl:* 147.345. *Adm:* $5. Pete Amar, KD4SPW, 772-465-5204; **kd4spw@aol.com**; **fparc.weebly.com/**.

Florida (Milton) — Jul 12-13 D H R T V
Friday noon-8 PM; Saturday 8 AM-2 PM. *Spr:* Milton ARC. Santa Rosa County Auditorium, 4530 Spikes Way. 18th Annual Hamfest. *Tl:* 145.49 (100 Hz). *Adm:* $5. Robert Perry, W5CL, 850-390-1665; **W5CL@att.net**; **www.miltonarc.org**.

Georgia (Covington) — Jul 20 D F H R T
8 AM-1 PM. *Spr:* Newton County RC. Legion Field, 3183 Mill St. *Tl:* 146.925 (88.5 Hz). *Adm:* Free. Ronnie Pittman, KK4CDB, 678-521-1355; **GaNatureMan@aol.com**; **NCRCGA.org**.

Illinois (Aurora) — Jul 14 D F H Q R S T V
8 AM-1 PM. *Spr:* Fox River Radio League. Aurora Central Catholic High School, 1255 N Edgelawn Dr. *Tl:* 147.21 (103.5 Hz). *Adm:* advance $6, door $8. Dawn Williams, KC9LQS, 630-531-1670; **hamfest@frrl.org**; **frrl.org**.

CENTRAL STATES VHF CONFERENCE

July 25-27, Elk Grove Village, IL
D H R S

Thursday 3-9 PM, Friday and Saturday 9 AM-8 PM. *Spr:* Central States VHF Society. Elk Grove Village Holiday Inn, 1000 Busse Rd (Rte 83). Antenna Range (Friday 7 AM-noon), noise figure measurements, technical presentations, Saturday eve banquet (6 PM; special guest speaker Dave Sumner, K1ZZ, ARRL CEO and Secretary), hospitality suites. *Tl:* 146.52. Registration: advance $50, door $55. Kermit Carlson, W9XA, 630-879-0983; **w9xa@yahoo.com**; **www.csvhfs.org**.

Illinois (Peotone) — Jul 21
D F H Q R S T V
6 AM. *Spr:* Kankakee Area Radio Society. Will County Fairgrounds, 710 S West St. *Tl:* 146.94 (107.2 Hz). *Adm:* advance $8, door $10. Craig Cahan, N9FD, 815-474-2237; **karsfest@gmail.com**; **w9az.com/karsfest.html**.

Illinois (Quincy) — Aug 10 D F H Q R T V
8 AM-2 PM. *Spr:* Western Illinois ARC. Eagle's Alps, 3737 N 5th St. *Tl:* 147.03 (103.5 Hz). *Adm:* advance $4, door $5. Michael Nowack, NA9Q, 217-224-8526; **na9q@arrl.net**; **www.w9awe.org**.

Indiana (Indianapolis) — Jul 13
D F H R S T V
6 AM-3 PM. *Spr:* Indianapolis ARA. Marion County Fairgrounds, 7300 E Troy Ave. *Tl:* 146.76. *Adm:* advance $6, door $8. Bill Akin, K9YDO, 317-261-6658; **k9ydo@comcast.net**; **www.indyhamfest.com**.

Iowa (Cedar Rapids) — Aug 4
D F H Q R S T V
8 AM-1 PM. *Spr:* Cedar Valley ARC. Teamsters Hall, 5000 J St SW. *Tl:* 146.745. *Adm:* $6. David Wilson, KBØDW, 319-393-3776; **krk9840@msn.com**; **cvarc.rf.org**.

Coming ARRL Conventions

June 28-30
Rocky Mountain Division Convention, Estes Park, CO*

July 6
Eastern Pennsylvania Section Convention, Harrisburg, PA*

July 19-21
Montana State Convention, East Glacier, MT

July 25-27
Central States VHF Society Conference, Elk Grove Village, IL

July 26-27
Oklahoma State Convention, Oklahoma City, OK

August 2-3
Texas State Convention, Austin, TX

August 2-4
Pacific Northwest DX Convention, Spokane Valley, WA

August 3
Great Lakes Division Convention, Columbus, OH

August 9-11
New Mexico State Convention, Albuquerque, NM

August 17
West Virginia State Convention, Weston, WV

August 17-18
Alabama State Convention, Huntsville, AL

August 18
Kansas State Convention, Salina, KS

August 25
Western Pennsylvania Section Convention, New Kensington, PA

August 31-September 1
North Carolina Section Convention, Shelby, NC

September 6-8
Southwestern Division Convention, Ventura, CA

*See June *QST* for details.

Louisiana (Leesville) — Aug 10
D F H R S V
7:30 AM-2 PM. *Spr:* West Central Louisiana ARC. First United Methodist Church of Leesville, 202 N 5th St. 36th Annual Hamfest. *Tl:* 145.31 (203.5 Hz). *Adm:* $5. Lonnie Jacobs, W5LPJ, 337-239-0734; **w5lpj@arrl.net**; **www.wclarc.com**.

Louisiana (Slidell) — Jul 20 D F H R S V
8 AM-2 PM. *Spr:* Ozone ARC. John Slidell Park Gymnasium, 105 Robert Blvd. *Tl:* 147.27 (114.8 Hz). *Adm:* $5. Ron Riviere, WB5CXJ, 985-640-5858; **wb5cxj@live.com**; **w5sla.net**.

Maine (Milo) — Aug 10 D F H R S T V
8 AM-noon. *Spr:* Piscataquis ARC. Joseph P. Chaisson American Legion Post 41, 18 W Main St. Foxhunt. *Tl:* 147.21 (71.9 Hz); backup 147.105 (103.5 Hz). *Adm:* $5. George Dean, WA1JMM, 207-441-6112; **wa1jmm@roadrunner.com**; **k1pq.org**.

Maryland (West Friendship) — Jul 21
F H R T V
6 AM. *Spr:* Baltimore RA Television Society. Howard County Fairgrounds, 2210 Fairground Rd. *Tl:* 147.03. *Adm:* advance $5, door $6 (under 12 free). Shane Longo, K2GZL, 814-429-9355; **hamfest@bratsatv.org**; **bratsatv.org/hamfest**.

Massachusetts (Cambridge) — Jul 21. Nick Altenbernd, KA1MQX, 617-253-3776 (9 AM-5 PM); **w1gsl@mit.edu**; **www.swapfest.us**.

Michigan (Escanaba) — Aug 3 D F H R S
9 AM-2 PM. *Spr:* Delta County ARS. Bay de Noc Community College, 2001 N Lincoln Rd. *Tl:* 147.15 (100 Hz). *Adm:* $5. John Anderson, WD8RTH, 906-399-4490; **wd8rth@dcars.org**; **www.dcars.org/hamfest**.

Michigan (Lansing) — Jul 27
D F H R S T V
8 AM-1 PM. *Spr:* Central Michigan ARC. Holt Christian Church, 2424 S Washington Rd. *Tl:* 145.39 (100 Hz). *Adm:* $3, under 15 free. Donald McLain, KB8RAD, 517-694-0812; **kb8rad@arrl.net**; **www.centralmiarc.com**.

Michigan (Midland) — Jun 15
D F H Q R S T V
8 AM-noon. *Spr:* Midland ARC. Salvation Army Building, 330 Waldo Ave. *Tl:* 147.0 *Adm:* $5. Mark Rodgers, KC8GRQ, 517-672-1060; **kc8grq@yahoo.com**; **w8kea.org**.

Michigan (Utica) — Jul 20 D F H T
8 AM-noon. *Spr:* GM ARC. Trinity Lutheran Church, 45160 Van Dyke Ave. *Tl:* 443.075 (123 Hz). *Adm:* $5 per carload. Bobby Corr, N8CY, 248-346-2733; **n8cy@arrl.net**; **www.GMARC.org**.

Minnesota (St Paul) — Jul 13 F R
8-11 AM. *Spr:* Magic Repeater Group. Terry's (NØGOI) QTH, 37 Hatch Ave. Yard Sale. *Tl:* 145.17 (100 Hz). *Adm:* Free. George Lavallee, NØSBU, 651-429-5948; **n0sbu@arrl.net**; **www.magicrepeater.net**.

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

Missouri (Warrensburg) — Jul 20
D F H R V
8 AM-1 PM. *Spr:* Warrensburg Area ARC. Y.E.S. Building, 128 S Hwy 13. *Tl:* 146.88 (107.2 Hz). *Adm:* $5. Keith Raihala, NØVJ, 660-864-1911; **n0vj@arrl.net**; **www.waarci.org**.

Missouri (Washington) — Jul 21
D F H R S T V
8 AM-1 PM. *Spr:* Zero Beaters ARC. Washington Elks Hall, 5th St and Grand Ave. ARES Regional Meeting. *Tl:* 147.24. *Adm:* advance $6, door $7. Bruce Serbus, KDØKCF, 314-954-3199; **kd0kcf@sbcglobal.net**; **www.zerobeaters.org**.

MONTANA STATE CONVENTION

July 19-21, East Glacier
D F H Q R S T V

Sunup-sundown. *Spr:* Great Falls Area ARC. Glacier Meadows RV Park, Mile Marker 191.5 (Hwy 2). 79th Annual Glacier-Waterton International Peace Park Hamfest, transmitter hunts, W7G Special Event Station, camping (406-226-4479; **stay@glaciermeadowrvpark.com**); Saturday eve potluck and barbeque dinner (bring a dish to share with everyone and bring your own meat to grill). *Tl:* 146.52. *Adm:* $23. George Forsyth, AA7GS, 406-868-2212; **aa7gs@arrl.net**; **gwhamfest.org**.

Nebraska (North Bend) — Jul 20 D F H R V
9 AM-12:30 PM. *Spr:* Pioneer ARC. St Charles Parish Center, 8th and Locust Sts. 16th Annual Flea Market. *Tl:* 146.67. *Adm:* $2. Rich Mehaffey, KBØARZ, 402-652-3410; **4randjme@futuretk.com**; **www.k0jfn.com**.

New Jersey (Absecon) — Jul 20
D F H R S T V
9 AM-3 PM. *Spr:* Southern Counties ARA. Holy Spirit High School, 500 N New Rd (Rte 9). *Tl:* 146.745 (146.2 Hz). *Adm:* Free. Lynn Fogle, KC2ZJW, 609-338-2251; **KC2ZJW@yahoo.com**; **jerseyshorehamfest.com**.

New Jersey (Augusta) — Jul 14
D F H Q R T
8 AM. *Spr:* Sussex County ARC. Sussex County Fairgrounds, 37 Plains Rd. *Tl:* 147.3 (151.4 Hz). *Adm:* $7. Dan Carter, N2ERH, 973-948-6999; **Hamfest@Scarcnj.org**; **www.sussexhamfest.org**.

New Jersey (Bergenfield) — Aug 3
D H R S V
8 AM-3 PM. *Spr:* Boy Scout Troop 139/Venture Crew 7373. Conlon Hall, 19 N William St. *Tl:* 146.955 (141.3 Hz), 146.52. *Adm:* $5. Gordon Beattie, W2TTT, 201-314-6964; **w2ttt@arrl.net**.

NEW MEXICO STATE CONVENTION

August 9-11, Albuquerque
D F H Q R S T V

Friday 3-9 PM, Saturday 9 AM-1 AM (next day), Sunday 8 AM-1 PM. *Spr:* New Mexico Hamvention Committee. Hotel Albuquerque at Old Town, 800 Rio Grande Blvd NW. "Duke City Hamfest;" Friday Eve Mixer (special guest speaker Gordon West, WB6NOA); SKYWARN Class; Satellite Communications Demonstration; high altitude balloon launch, Saturday Eve Banquet (special guest speaker ARRL President Kay Craigie, N3KN). *Tl:* 145.33, 444.0 (both 100 Hz). *Adm:* $3. Bill Ripley, KY5Q, 505-980-8353; **KY5Q@arrl.net**; **dukecityhamfest.org**.

New York (Alexander) — Jul 20
D F H R T V
7 AM-2 PM. *Spr:* Lancaster ARC. Alexander Firemens' Grounds, 10708 Alexander Rd (Rte 98). *Tl:* 147.285 (141.3 Hz). *Adm:* $5. Luke Calianno, N2GDU, 716-481-5747; **luke48@gmail.com**; **gbhamfest.hamgate.net**.

New York (Cicero) — Jul 14 F H R T V
8 AM-2 PM. *Spr:* Radio Amateurs of Greater Syracuse. American Legion, 5575 Legionnaire Dr. *Tl:* 147.3. *Adm:* $5. Viv Douglas, WA2PUU, 315-698-4558; **ragsonline@hotmail.com**; **ragsinreview.com**.

New York (Frankfort) — Jul 20 D F H R T V
8 AM-1 PM. *Spr:* Utica ARC. Herkimer County Fairgrounds, Cemetery St. RadioComm 2013. *Tl:* 146.76. *Adm:* $6. Martin Benedict, W2MVB, 315-866-5924; **w2mvb@arrl.net**; **uticaarc.org**.

New York (Rome) — Aug 3 D F H S T V
8 AM-noon. *Spr:* Rome RC. Erie Canal Village, 5789 Rome-New London Rd. *Tl:* 146.88. *Adm:* $5. Brian Pratt, KD2AKA, 315-281-7769; **kd2aka@windstream.net**; **www.romeradioclub.com**.

New York (Trumansburg) — Aug 3
D F H R T V
7 AM-noon. *Spr:* Tompkins County ARA. Trumansburg Fairgrounds, 2150 Trumansburg Rd. *Tl:* 146.97 (103.5 Hz). *Adm:* $5. Bill Klinko, KC2OYN, 607-738-4694; **whk2@cornell.edu**; **tcarc-ny.org/hamfest.htm**.

North Carolina (Cary) — Jul 20
D F H R T V
8 AM-2 PM. *Spr:* Cary ARC. Harold Ritter Park, 301 W Lochmere Dr. *Tl:* 146.88. *Adm:* $4. Herb Lacey, W3HL, 919-467-9608; **infoman@bellsouth.net**; **www.qsl.net/n4nc**.

North Carolina (Fayetteville) — Aug 3 F R V
8 AM-noon. *Spr:* Cape Fear ARS. Cumberland County Shrine Club, 7040 Ramsey St. 15th Annual Swapfest. *Tl:* 146.91 (100 Hz). *Adm:* Free. David Cowart, KR4OE, 910-624-1394; **kr4oe@nc.rr.com**; **www.cfarsnc.org**.

North Carolina (Waynesville) — Jul 27
D F H R S T V
8 AM-4 PM. *Spr:* Western Carolina ARS. Haywood County Fairgrounds, 758 Crabtree Rd. *Tl:* 146.91 (91.5 Hz), 147.39 (94.8 Hz). *Adm:* advance $5, door $7. Jeff Weller, KJ4TEI, 828-275-3297; **weller_j@bellsouth.net**; **wcars.org**.

North Dakota (Dunseith) — Jul 13-14
F H R S T V
Sunrise-sunset. *Sprs:* US and Canada Hamfest Committee. The Lodge, International Peace Gardens, US/Canada border. 50th International Peace Garden Hamfest. *Tl:* 146.52. Dean Summers, NØND, 701-226-8722; **n0nd@arrl.net**; **www.mts.net/~holderr/ihf.htm**.

GREAT LAKES DIVISION CONVENTION

August 3, Columbus, OH
D F H Q R S T V

8 AM-2 PM. *Spr:* Voice of Aladdin ARC. Aladdin Shrine Center, 3850 Stelzer Rd. 23rd Annual Columbus Hamfest. *Tl:* 146.97 (123 Hz). *Adm:* $5. Barry Mertz, KC8SXG, 614-876-3099; **kc8sxg@arrl.net**; **www.columbushamfest.com**.

Ohio (Elyria) — Jul 20 D F H R T
8 AM-1 PM. *Spr:* Northern Ohio ARS. Lorain County Community College, Spitzer Conference Center, 1005 N Abbe Rd. *Tl:* 146.7 (110.9 Hz). *Adm:* $6. Darlene Ohman, KA8VTS, 216-398-8858; **dohman@roadrunner.com**; **www.noars.net**.

Ohio (Randolph) — Jul 28 D F H R S T V
8 AM-2:30 PM. *Spr:* Portage ARC. Portage County Fairgrounds, 4215 Fairgrounds Rd. *Tl:* 145.39. *Adm:* advance $5, door $6. Joanne Solak, KJ3O, 330-274-8240; **kj3o@hotmail.com**; **hamfair.com**.

Ohio (Van Wert) — Jul 21 D F H R T
8 AM. *Spr:* Van Wert ARC. Van Wert County Fairgrounds, Rte 127 S. *Tl:* 146.85. *Adm:* $5. Stephen Kouts, WA8WKF; **techserv@embarqmail.com**; **w8fy.org**.

OKLAHOMA STATE CONVENTION

July 26-27, Oklahoma City
D F H Q R S V

Friday 3-7 PM, Saturday 8 AM-3 PM. *Spr:* Central Oklahoma Radio Amateurs. Bricktown Hotel and Conference Center (**new location**), 2001 E Reno Ave. 40th Annual "Ham Holiday 2013," technical and non-technical programs. *Tl:* 146.82 (151.4 Hz). *Adm:* advance $8, door $10; under 16 free with paying adult. Bill Wilburn, N5NUK, 405-841-2626 (days) or 405-841-2640 (eves); **n5nuk@sbcglobal.net**; **www.hamholiday.com**.

Oregon (North Bend) — Jul 20 D F H R S V
10 AM-2 PM. *Spr:* Coos County RC. North Bend Middle School, 1500 16th St. *Tl:* 146.61 (110.9 Hz), 146.28 (146.2 Hz). *Adm:* $4. Zane Albertson, WA7OXM, 541-404-6908; **zane.albertson@gmail.com**.

Pennsylvania (Allison Park) — Jul 6
D F H R T V
8 AM-2 PM. *Spr:* North Hills ARC. Parkwood United Presbyterian Church, 4289 Mt Royal Blvd. 28th Annual Hamfest. *Tl:* 147.09 (88.5 Hz). *Adm:* $5. John Fowler, KB3YBS, 412-366-3133; **johnr.fowler@gmail.com**; **www.nharc.org**.

Pennsylvania (Erie) — Jul 13 F H R T V
7:30 AM-noon. *Sprs:* Wattsburg Wireless and Union City Wireless Assns. Greene Township Municipal Bldg, 9333 Tate Rd. *Tl:* 146.7 (186.2 Hz). *Adm:* advance $4, door $5. Richard Quinn, KB3ZVH, 814-838-3118; **quinnr49@msn.com**; **www.wattsburg-wireless.us/hamfest.htm**.

Pennsylvania (Sinking Spring) — Aug 10
D F H R T V
8 AM. *Spr:* Reading RC. Heritage Park of the Sinking Spring Area Historical Society, 992 Clematis St. *Tl:* 146.91 (131.8 Hz). *Adm:* $1 (nonham spouses, under 18, and VE exam only free). Harry Hoffman, W3VBY, 610-678-8976; **harryhoffmanjr@juno.com**; **readingradioclub.org**.

TEXAS STATE CONVENTION

August 2-3, Austin
D F H R S T V

Friday 6-9 PM, Saturday 8 AM-5 PM. *Sprs:* Austin ARC and Texas VHF-FM Society. Crowne Plaza Austin, 6121 N IH-35. Austin Summerfest 2013. *Tl:* 146.94 (107.2 Hz). *Adm:* advance $8, door $10. Joe Makeever, W5HS, 512-345-0800; **w5hs@arrl.net**; **www.austinsummerfest.org**.

Texas (Texas City) — Jul 13 D F H R S T V
8 AM-2 PM. *Spr:* Tidelands ARS. Doyle Convention Center, 2015 21st Ave N. *Tl:* 147.14 (167.9 Hz), backup 442.025 (103.5 Hz). *Adm:* advance $4, door $5. Joe Wileman, AA5OP, 409-945-6794; **aa5op@yahoo.com**; **www.tidelands.org**.

Virginia (Berryville) — Aug 4
D F H Q R T V
6 AM-4 PM. *Spr:* Shenandoah Valley ARC. Clarke County Ruritan Fairgrounds, Business Rte 7. 63rd Annual Berryville Hamfest. *Tl:*

146.82. *Adm:* $6. John Cottrell, WD4GEK, 540-436-3818; **BerryvilleHamfest@gmail.com**; **w4rkc.org/hamfest**.

Washington (Chehalis) — Jul 27
D F H R S T V
9 AM-1 PM. *Spr:* Chehalis Valley ARS. Southwest Washington Fairgrounds, 2555 N National Ave. *Tl:* 147.06 (110.9 Hz). *Adm:* $3. John Ellingson, K7OSK, 360-273-5929; **radiokids@comcast.net**; **www.cvars.org**.

PACIFIC NORTHWEST DX CONVENTION

August 2-4, Spokane Valley, WA
D Q S
Friday 2 PM-midnight, Saturday 8 AM-midnight, Sunday 8-11 AM. *Spr:* Spokane DX Assn. Mirabeau Park Hotel and Convention Center, 1100 N Sullivan Rd. 58th Annual Pacific Northwest DX Convention; Hospitality suites; special guest ARRL MVP Manager Dave Patton, NN1N; Saturday banquet; Sunday breakfast. Registration: advance $85, door $90. Randy Foltz, K7TQ, 208-874-3333; **rbfoltz1@frontier.com**; **pnwdx.org**.

West Virginia (Huntington) — Aug 10
D F H Q R S V
8:30 AM-1 PM. *Spr:* Tri-State ARA. Christ Temple Church Life Center, 2400 Johnsontown Rd. *Tl:* 146.76 (131.8 Hz). *Adm:* $6. Judy Taylor, WD8EOP, 304-525-4237; **W8VA@arrl.net**; **www.orgsites.com/wv/taraclub**.

West Virginia (Morgantown/Star City) — Jun 15 F H R
8 AM-1 PM. *Spr:* Mon County ARC. St. Mary's Catholic Church Outdoor Pavilion, 3344 University Ave. *Tl:* 147.075 (103.5 Hz). *Adm:* $2. Alexander Lugo Jr, KD8NZX, 304-319-0412; **alex.lugojr@mail.wvu.edu**; **www.moncarc.org**.

Wisconsin (Chippewa Falls) — Jul 20 T
8 AM-noon. *Spr:* Chippewa Valley ARC. Eagles Club Parking Lot, 2588 State Hwy 53. *Tl:* 147.375 (110.9 Hz). *Adm:* $5. Jim Linstedt, W9ZUC, 715-456-4814; **jlinstedt@charter.net**; **www.w9cva.org**.

Wisconsin (Lyons) — Aug 3 F H V
7 AM-noon. *Spr:* Lakes Area ARC. Lyons Town Hall, 6339 Hospital Rd. 3rd Annual Freefest. *Tl:* 146.865 (127.3 Hz). *Adm:* Free. Michel Bartolone, NX9A, 262-210-8652; **MBartolone@wi.rr.com**; **sites.google.com/site/laarcradioclub/**.

Wisconsin (Sturtevant) — Aug 10 D F H R
7 AM-1 PM. *Spr:* Racine Megacycle Club. Fireman's Park, 9600 Charles St. 6th Annual Racine Megacycle Freefest. *Tl:* 147.27 (127.3 Hz). *Adm:* Free. Paul Giannoni, KC9PG, 262-456-0357; **kc9pg@yahoo.com**; **www.w9udu.org**.

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 **July 1** to be listed in the **September** issue. Information in this column is accurate as of our deadline; contact the sponsor or check the sponsor's website for possible late changes, for driving directions and for other event details. Please note that postal regulations prohibit mention in *QST* of games of chance such as raffles or bingo.

Promoting your event is guaranteed to increase attendance. As an approved event sponsor, you are entitled to special discounted rates on *QST* display advertising and ARRL web banner advertising. Call the ARRL Advertising Desk at 860-594-0207, or e-mail **ads@arrl.org**.

W1AW Schedule

W1AW's schedule is at the same local time throughout the year. From the second Sunday in March to the first Sunday in November, UTC = Eastern US Time + 4 hours. For the rest of the year, UTC = Eastern US Time + 5 hours.

PAC	MTN	CENT	EAST	UTC	MON	TUE	WED	THU	FRI
6 AM	7 AM	8 AM	9 AM	1300		FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
7 AM-1 PM	8 AM-2 PM	9 AM-3 PM	10 AM-4 PM	1400-1600 1700-1945	VISITING OPERATOR TIME (12 PM-1 PM CLOSED FOR LUNCH)				
1 PM	2 PM	3 PM	4 PM	2000	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
2 PM	3 PM	4 PM	5 PM	2100	CODE BULLETIN				
3 PM	4 PM	5 PM	6 PM	2200	DIGITAL BULLETIN				
4 PM	5 PM	6 PM	7 PM	2300	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
5 PM	6 PM	7 PM	8 PM	0000	CODE BULLETIN				
6 PM	7 PM	8 PM	9 PM	0100	DIGITAL BULLETIN				
6^{45} PM	7^{45} PM	8^{45} PM	9^{45} PM	0145	VOICE BULLETIN				
7 PM	8 PM	9 PM	10 PM	0200	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
8 PM	9 PM	10 PM	11 PM	0300	CODE BULLETIN				

♦ Morse code transmissions: Frequencies are 1.8025, 3.5815, 7.0475, 14.0475, 18.0975, 21.0675, 28.0675 and 147.555 MHz.

Slow Code = practice sent at 5, 7½, 10, 13 and 15 WPM.

Fast Code = practice sent at 35, 30, 25, 20, 15, 13 and 10 WPM.

Code bulletins are sent at 18 WPM.

♦ W1AW Qualifying Runs are sent on the same frequencies as the Morse code transmissions. West Coast qualifying runs are transmitted by K6YR and other West Coast stations on 3590 kHz and other frequencies. See "Contest Corral" in this issue. Underline one minute of the highest speed you copied, certify that your copy was made without aid, and send it to ARRL for grading. Please include your name, call sign (if any) and complete mailing address. Fees: $10 for a certificate, $7.50 for endorsements.

♦ Digital transmissions: Frequencies are 3.5975, 7.095, 14.095, 18.1025, 21.095, 28.095 and 147.555 MHz.

Bulletins are sent using 45.45-baud Baudot, PSK31 in BPSK mode and MFSK16 on a daily revolving schedule.

Keplerian elements for many amateur satellites will be sent on the regular digital frequencies on Tuesdays and Fridays at 6:30 PM Eastern Time using Baudot and PSK31.

♦ Voice transmissions: Frequencies are 1.855, 3.99, 7.29, 14.29, 18.16, 21.39, 28.59 and 147.555 MHz.

♦ Notes: On Fridays, UTC, a DX bulletin replaces the regular bulletins. W1AW is open to visitors 10 AM to noon and 1 PM to 3:45 PM Monday through Friday. FCC licensed amateurs may operate the station during that time. Be sure to bring your current FCC amateur license or a photocopy. In a communication emergency, monitor W1AW for special bulletins as follows: voice on the hour, teleprinter at 15 minutes past the hour and CW on the half hour.

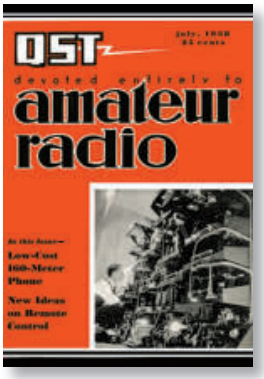
W1AW code practice and CW/digital/phone bulletin transmission audio is also available real-time via the *EchoLink Conference Server* W1AWBDCT. The conference server runs concurrently with the regularly scheduled station transmissions.

During 2013, Headquarters and W1AW are closed on New Year's Day, Presidents' Day (February 18), Good Friday (March 29), Memorial Day (May 27), Independence Day (July 4), Labor Day (September 2), Thanksgiving and the following day (November 28 and 29), and Christmas (December 25). For more information, visit us at **www.arrl.org/w1aw**.

75, 50 and 25 Years Ago

Al Brogdon, W1AB

July 1938



- The cover photo shows work going on behind the front panels of the multiple-rack W1AW equipment.
- The editorial discusses how television may one day become part of the amateur's arsenal of techniques. Currently, experimental television signals are being broadcast from New York City and Los Angeles, although very few people have the equipment to see the broadcasts.
- Kenneth Warner, W1EH, and Paul Segal report on "The Battle of Cairo," in which American amateurs retain all their frequencies, despite attacks by the governments of other countries. Alas, European broadcasting will invade the 7-Mc. band late next year.
- In "Look for Me on - - - Kc.," Ed Tilton, W1HDQ, and Glenn Browning describe a simplified all-band, all-frequency exciter that covers 160 to 5 meters.
- "CQ de W1ØXDA," by Clifton Foss, W2OJ, describes the adventures he experienced on board the *Morrissey* during its 1937 trip to the far North. Two photos with the article show W1ØXDA in action and "Mrs. Foss, W2JZJ," manning the W2OJ station to keep in contact with her faraway husband.
- Fred Sutert, W8QBW, modifies a popular midget homebrew transmitter to put "The 'QSL Forty' on 14 Mc."

July 1963

- The cover photo shows an unidentified ham waving from a tower, amid a multiplicity of nice-looking Yagis.
- The editorial is a continuation of the discussion of reinstating incentive licensing.
- B. R. Hatcher, K1SAW, discusses "Simplified Transmission-Line Calculations" that use graphical solutions to easily solve matching problems
- Michael Neidich, K2ENN, tells us about a useful and very compact accessory for S.S.B. testing, a "Two-Tone Test Oscillator Using Transistors."
- William Sabin, W4YFA, tells us how to modify commercial receivers to provide "Automatic Gain Control for C.W. Reception."
- "A 50-Mc. Double-Conversion Transistor Receiver," by William Noreth, W4GEB, describes a small portable unit with good performance.
- Gus Browning, W4BPD, has become famous in the ham radio world by mounting so many DXpeditions to out-of-the-way places. John Troster, W6ISQ, amuses us by poking a little good-natured fun at "The Gus-Watchers."
- Larry Kleber, K9KLA, presents "The 4-1000A in Grounded Grid," a fairly compact final that will provide 1 Kw of power.

July 1988

- The cover photo shows Dick Stevens', W1QWJ, small but powerful final amplifier, described in this issue.
- The editorial discusses some recent FCC actions that are patently unconstitutional — imposing operating restrictions on hams because of their interference to consumer electronics equipment — when the improperly designed equipment, not the ham, is at fault.
- Don Kirk, WD8DSB, tells us about his "Orator," which connects to his station's wattmeter to provide "A Talking Wattmeter."
- In "Joe Ham versus VCR RFI," Doug DeMaw, W1FB, discusses one of the more common RFI problems in today's consumer electronics units.
- George Hart, W1NJM, tells the story of "The W1AW Fire" that took place on October 14, 1953, severely damaging the station and its equipment.

Field Organization Reports

April 2013

Public Service Honor Roll

This listing recognizes radio amateurs whose public service performance during the month indicated 70 or more points in six categories. Details on the program can be found at **www.arrl.org/public-service-honor-roll**.

557 WB8RCR
540 KT5SR
510 W5KAV
393 WB9FHP
376 KØIBS
355 K8RDN
350 KK5NU
345 WM2C
330 KT2D
280 KB2ETO
260 KJ4G
256 N9WLW
255 K7EAJ N7CM
239 W2MTA
227 W4SEE
220 K7BFL
215 KA2ZNZ
212 WB8R
210 K2HAT
204 KC7ZGG
202 WS6P
201 KC8EO
195 K2ABX WD8USA
190 N5NVP
185 VE7GN
182 WA2BSS
180 N1UMJ
178 N8OSL
176 KB2KOJ
174 KK4BVR
173 W7FQQ
172 KK7DEB
170 W9BGJ W5DY N8IO
165 KJ6PCC K7OAH WE2G
164 KJ6GYL
163 W7JSW
160 KGØGG AG9G W4DNA
155 N9VC KB8QKC WK4P KB8RCR
153 KE7QPV
150 N5TMC KB5SDU NX8A
149 N8FVM
146 KJ6IJJ
145 KB2BAA KC2QVT KE4CB
142 NA9L KC8QWH KC8EIA
140 WV8CH KB2RTZ WA8EZN KØLQB KK3F WB6UZX WA4STO
139 KF7PDV
138 WB8YYS
136 W3CB
135 NX9K WB9WKO KF5IOU W3YVQ
134 W9WXN
131 KA8ZGY
130 KØVTT K6FRG W8DJG K6JT KC5OZT KW1U K4IWW W12G
127 AB9ZA
125 KB8VXE KE5HYW KJ4JPE N2JBA
121 K4BEH
120 NN7H K6HTN N3RB NM1K KB1RGQ WØLAW K4BG K4GK KA4FZI KD7THV N1IQI WB4ZIQ NA7G WB8WKQ KD8CYK K2TV N2WGF
118 KB1YNE
116 W7YV
115 K9LGU KF5TTN KØPTK AK4RJ
113 K4JUU
110 KB5KKT W7GB WA5LOU WA2NDA K7BDU W7QM N8CJS WA4BAM KK7TN N7XG N7YSS KA1G N9MN K1YCQ W2EAJ N2WKT N7IE
109 K7MQF
108 K8CSI
106 N2VC
105 KF7GC N1TF
104 KB1UAU
102 KK4LSL NS7K
100 WØCLS NØMEA WAØVKC WA1STU N9VT W8CPG N1JX K4SCL K5AXW AA2SV N3SW WB8SIQ WG8Z WD8Q W8MAL N5MBQ KB3LNM AA3SB WB4FDT NU8K W4TTO WO2H K8VFZ WB8TQZ
98 W2CC KB1NMO
97 K4VWK KB1WXC
96 KD5RQB N1LKJ
95 N2GJ N8SY NØYL WAØCGZ
93 K1PJS
92 N7EIE K2GW WDØGUF
90 N3KB KB2QO N5RL K1HEJ KB8HJJ N8IBR N8YXL
WB4BIK KE5YTA K3IN N3ZOC W3GQJ KJ4HGH W8IM WB4Y KC8BW
89 WØRJA N2DW KB8UIH
88 KC2EMW
87 KC2UMX K7FLI
83 N2RTF
82 KJ7NO
80 KØDEU NIØI NØMHJ KFØXO KCØZDA WA9QIB WB7RVF K8KV WB4RJW WK4WC KZ8Q K8ED
79 KB9KEG
78 N2GS
77 N9EXM KC5MMH WB3FTQ KD8HPG
75 KB3LFG KC4PZA
73 KC2SFU
72 K4MSG
71 W5XX KC8YVF
70 K6RAU KØDLK NØDUW NØDUX WØFUI KDØNJH N3NTV KDØAYN KØPTK KØRXC KD7ZUP N2YJZ

The following stations qualified for PSHR in previous months, but were not recognized in this column yet. (Mar) WA4STO 140, KØPTK 115, KE7QPV 73. (Oct, 2012) AC6C 490. (Sept, 2012) AC6C 470.

Section Traffic Manager Reports

The following Section Traffic Managers reported: AK, AL, AR, AZ, CT, EB, EMA, ENY, EPA, EWA, GA, ID, IL, IN, LA, LAX, MDC, ME, MI, MN, MO, MS, NC, NE, NFL, NLI, NNJ, NNY, NTX, UT, OH, OK, OR, ORG, SD, SFL, SJV, SNJ, STX, TN, VA, WCF, WMA,

Section Emergency Coordinator Reports

The following ARRL Section Emergency Coordinators reported: DE, ENY, EWA, GA, IA, IN, KY, MDC, MI, MN, MO, NC, ND, NH, NM, NTX, OH, OK, STX, SV, WTX.

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.

KK3F 2491, WA4STO 1582, WB9FHP 1263, K6HTN 1183, KW1U 1030, NS7K 919, N1IQI 881, K6FRG 856, K7BDU 807, N9VC 727, WD8Q 650, WØRJA 613, WA4BAM 516.

The following stations qualified for BPL with Originations plus Deliveries: KA8ZGY 141, NM1K 116, K8LJG 103, W5KAV 102. (March) WA4STO 138.

Silent Keys

Silent Keys Administrator, sk@arrl.org

It is with deep regret that we record the passing of these amateurs:

WB1AFI **Frennier**, Robert E., Hilton Head Island, SC
N1BBH **Dion**, Warren E., Bristol, CT
N1CBJ **Cunningham**, Philip W., Waldo, ME
W1CWC **Child**, Craig W., Merrimack, NH
K1EEB **Malinowski**, Joseph S. Jr, Franklin, NH
♦K1EHO **Klock**, Stanley W., Mesa, AZ
W1FBO **Hair**, Robert R., Trumbull, CT
W1GAN **Bilodeau**, John J., Salem, MA
♦K1IIF **Barber**, Ruth J., Federal Way, WA
W1KUI **Badger**, Guy W., Charlestown, RI
N1LAJ **Skribiski**, John, Hudson, NH
N1LJA **Sheldon**, Paul M., Riverside, RI
K1LMC **Anthony**, David N., Vinton, IA
W1LUN **Hamlin**, Theodore C., Rehoboth, MA
N1MWR **Robinson**, Ronald F. W., West Seneca, NY
K1NXR **Byrne**, Robert G. Jr, Brookfield, NH
WD1O **Gist**, David, Norfolk, VA
K1OGY **Byther**, James E., Winslow, ME
KB1OUW **Doucette**, Rene "Ray" F., Stow, MA
K1RCS **Sullenberger**, Robert C., Venice, FL
WA1RKO **Moore**, Russell L., Hudson, MA
KB1RWW **Taylor**, James, Saunderstown, RI
WA1RXA **Beck**, Joseph, Norwalk, CT
K1SCM **Stebbins**, Howard A., North Haven, CT
♦W1SR **Wood**, George R., Medfield, MA
W1TAP **Phillip**, Richard M., Danville, PA
K1TCI **Haley**, Arthur, East Kingston, NH
WA1ZFH **Danforth**, Jean R., South Berwick, ME
N1ZK **Hibbard**, Robert E., Sun City Center, FL
WB2AXJ **Deitz**, Allan F., Guilderland, NY
K2BQW **Cowperthwaite**, Rollin C., Cherry Hill, NJ
KB2CPR **De Paul**, Gregory A., Bayville, NJ
W2CYA **Ferebee**, John B., New York, NY
WA2DYA **Seitz**, Charles H., Tannersville, PA
W2EOJ **Rosenberg**, Robert J., Brighton, NY
KA2EYA **Brodie**, William W., Hyde Park, NY
AA2FO **Platteter**, George, Rochester, NY
WB2GHK **Agostinelli**, Joseph G., Rochester, NY
WA2GUP **Wilcox**, Lester J., Alamogordo, NM
KC2IFM **Conto**, Joseph, Schenectady, NY
KC2IFN **Conto**, Michael A., Schenectady, NY
N2IYQ **Leach**, Joyce A., Tonawanda, NY
♦WA2JVK **Somers**, Kenneth J. Jr, Lebanon Township, NJ
W2KFU **Snyder**, Sherwood M., Aventura, FL
KA2LFJ **Andersen**, Norman N., West Brighton, NY
K2LJM **Mannino**, Lawrence J., Westfield, NJ
♦K2LKH **St Louis**, Roland A. Jr, Geneva, NY
K2LV **Weierich**, Jimmy, Vestal, NY
♦W2NAQ **Quinlan**, Lawrence A., Monroe Township, NJ
KF2NS **Kuzminski**, Joseph A., Belvidere, NJ
N2OGF **Bogdanow**, Robert A., Fair Lawn, NJ
♦KC2OO **Wesline**, John J. III, Rochester, NY
KB2QQP **Romanowicz**, John S., Central Square, NY
N2RFH **Viglietta**, Benedict P., Clinton, NY
WA2RQV **Switalski**, James E., Cuba, NY
WB2SBN **DelloRusso**, Nicholas, Brick, NJ
N2SUD **Barnett**, Harold A. Jr, Scotia, NY
♦K2UCO **Mellen**, Harold A. Jr, Oneida, NY
WA2UKS **Pike**, John W., Owego, NY
WB2WTS **James**, Clinton "Sid" R., Scio, NY
KB2WU **Bullington**, John R., Pennsville, NJ
N2XSM **Thuma**, Theodore E., Fayetteville, NY
WB2YGX **Boyd**, John E., Princeton Junction, NJ
KE2ZG **Lincoln**, Alvin E., Grand Island, NY
W3CCI **Williams**, Kenneth J., Glenelg, MD
KB3CH **Kellner**, George D., Tamaqua, PA
K3CZ **Van Aller**, Willem H., White Hall, MD
ex-WB3DDA **Cain**, Ocie "Paul," Du Bois, PA
W3DHN **Shisler**, William D., Fort Pierce, FL
N3EDL **Byer**, Edward D. Sr, Clarks Summit, PA
WA3EEN **Williams**, Robert L., Middletown, PA
AA3FD **Smith**, Wendell M., Seminole, FL
WA3FJF **Hatfield**, James E., Stafford, VA
W3FVJ **Whitlock**, Roger S., Weaverville, NC
KA3GMS **Ernst**, Joseph "Ernie" N., Harleysville, PA
W3GOU **Koonce**, Robert L., Odenton, MD
WB3HFU **Chesney**, Gilbert P., Plains, PA
WA3ISD **Baker**, Howard J., York, PA
KB3JPX **Shimp**, Gene, Reading, PA
KB3JXC **Mcnulty**, Edward T., Glen Burnie, MD
N3KYK **Blizzard**, Brian T., Dunkirk, MD
W3LSG **Wilke**, David J. Sr, York, PA
KB3MLU **Barner**, Bruce L., Jenkins Township, PA
W3MPK **Hughes**, Francis M., Pittsburgh, PA
N3NFO **Fletcher**, John R., Harpers Ferry, WV
♦W3ODJ **Thompson**, Richard F., Waldorf, MD
W3PVK **Kaschok**, Albert N., Cherry Hill, NJ
W3PWO **Swanson**, John H. Jr, Baltimore, MD
K3QAY **Brown**, Powell A., Erie, PA
W3RDE **Brigo**, Louis, Allentown, PA
W3RSR **Bell**, William L., Springdale, PA
W3TG **Haynes**, Robert E., South Daytona, FL
KB3USV **Derda**, Dennis C., Natrona Heights, PA
♦W3UY **Clifford**, Lawrence J., Blue Bell, PA
W3VVP **Clough**, George E., Cordova, MD
W3ZSA **Kipe**, Alan E., Hagerstown, MD
K4AHM **Vaughn**, Leard F., Chesnee, SC
KM4BI **Ward**, Ralph D., Chattanooga, TN
AC4BK **Bencini**, Franco L., Pompano Beach, FL
W4BVX **Clinton**, William H., Jacksonville, FL
KA4CFS **Finney**, Roy P., Weeki Wachee, FL
N4CGG **Maloney**, Florine C., Pompano Beach, FL
WA4CMU **Newman**, Danny M., Nashville, TN
KG4EGD **Hurd**, Douglas B., Clyde, NC
♦WB4GAA **Parker**, William D., Ocala, FL
♦KB4GH **Nicholls**, E. A. "Bob," Alcoa, TN
WA4GIH **Mass**, Harry L. Sr, Beverly Hills, FL
KD4HEU **Smith**, Fred "Gene" E., Mount Holly, NC
WB4HFK **Bergman**, Manuel, Pembroke Pines, FL
K4IJA **Campbell**, Thomas H., North, SC
WB4JCX **Howell**, Garland A., Norfolk, VA
W4JKV **Harmon**, Charles R., Belmont, NC
N4JPT **Westmoreland**, Edgar, Gaffney, SC
N4JQS **Moore**, Ronald, Arden, NC
K4KKY **Macklin**, A. L., Winston-Salem, NC
W4KSY **Smith**, Benjamin K. Jr, Springfield, VA
KE4KX **Pilafian**, James, Lutz, FL
N4LML **Alviani**, Angelo "Al" E., Sarasota, FL
KB4LPP **Klinefelter**, Jack A., Hague, VA
W4LSG **Karangelen**, Nicholas Jr, Norfolk, VA
KA4MFB **Crosa**, James R., Miami, FL
N4MRQ **Segreto**, Joseph P., Warner Robins, GA
W4NHV **Mac Leod**, James B., Lumberton, NC
KB4NOV **Cooper**, Claud P., Opelika, AL
W4NQW **Wolitzer**, Bernard, Charleston, SC
KB4OFA **Trapani**, Gasper P. Jr, New Orleans, LA
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K4PX **Fundis**, George B., Palm Bay, FL
N4QIM **Yearwood**, Joan, Knoxville, TN
W4REB **Beverly**, Ralph E., Louisville, KY
N4RL **Mc Cann**, Robert J., Warrenton, VA
W4SWP **Bradley**, Lewis L. Jr, Alexandria, VA
WA4TFK **Wilson**, Leo A., Clermont, FL
KD4TIN **Gasaway**, Frank B., Bryson City, NC
W4ULD **Griffith**, Andrew S., Morehead City, NC
W4UOL **Bennett**, Roy D., Bladenboro, NC
KD4VAA **Carter**, Bennett C., Vero Beach, FL
KJ4VS **Curlee**, Lewis E., Etowah, NC
N4VVX **Pistole**, Bruce M., Chester, SC
K4XRM **McCray**, Randy W., Durham, NC
W4ZIP **Scheller**, Russell F., Deland, FL
KC4ZKT **May**, George P., Lawrenceville, GA
WA4ZRR **Whelan**, James L., Louisville, KY
KI4ZUT **Butler**, Bruce B., Stockbridge, GA
KA4ZWG **Gorowitz**, Harold, Tamarac, FL
KK4ZY **Moore**, Edward C., Lake Placid, FL
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W5DD **Nielsen**, William B., Conway, AR
AF5E **Mace**, Thomas C., Gulfport, MS
WV5E **Lambdin**, Thomas T., Midland, TX
K5GCH **Davis**, Jerry G., Shawnee, OK
N5GHX **Sevin**, Richard P., Zachary, LA
K5HAG **Whitehurst**, Winford "Chuck," Fort Worth, TX
KM5ILO **Sandburg**, Milo, Conroe, TX
♦K5JHR **Ashby**, Robert C., Plano, TX
KC5JK **Moratto**, Paul W., League City, TX
ex-N5KEQ **Conatser**, Billy J., Kennedale, TX
W5KKD **Lewis**, John J., Plano, TX
W5LEL **Lafargue**, Laurent Ed, Hammond, LA
WD5MJ **Jordan**, Dwight M., Pelahatchie, MS
N5OAJ **Dill**, William T., Ferris, TX
W5PHD **Day**, Pamela H. L., Fort Worth, TX
W5PML **Cash**, Cecil C., Sheridan, AR
KA5PPX **McAdams**, Robert, Valley View, TX
W5QY **Landry**, Joseph B., Saint Martinville, LA
KA5RXU **Field**, Joe L., Carlsbad, NM
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W5VBP **Clute**, Neil O., Teague, TX
K5VEC **Barnett**, Halbert "Sonny" D., Hughes Springs, TX
K5VVD **Brewer**, Larry K., Choctaw, OK
ex-WB5WIC **Smith**, William J., San Antonio, TX
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K5ZV **Moore**, Joseph B. III, Alvin, TX
W5ZZO **Haptonstall**, Jerry D., Fayetteville, AR
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WA6CSL **Fjelstrom**, Martin E., Ogden, UT
KE6DJ **Olsen**, Russell K., Eugene, OR
AF6DR **Ertman**, Karen, Fresno, CA
AA6HJ **Queen**, Albert T., Lafayette, CA
KB6HRB **Sheen**, William M. Jr, Clovis, CA
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K6KES **Scott**, Kevin Edward., Newbury Park, CA
N6KIW **Lipstone**, Jane N., Los Angeles, CA
K6LGA **Apple**, Lloyd G., Washington, UT
♦N6ND **Craig**, Raymond "Rick" D., Ramona, CA
WA6PAC **Rice**, Chester T., Kentfield, CA
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KC6RLU **Blumer**, William S., Fullerton, CA
N6UD **Bjur**, Wesley E., Carmichael, CA
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KB6WXF **Contreras**, Paul A., Gold Canyon, AZ
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W6YTB **Zern**, Charles H., Ben Lomond, CA
KG6ZMB **Brossart**, Shawna M., Valley Center, CA
WB6ZSQ **Frazier**, Donald C., Sacramento, CA
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WA7BWT **Engelbrecht**, Bruce W., Glide, OR
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KD7GMP **Poulsen**, Ernest G., Sonoma, CA
KE7GQO **Jackson**, Anita E., Mount Vernon, WA
W7GUE **Armstrong**, Ray G., Roseburg, OR
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W7LGB **Brown**, Lyle R., Prescott, AZ
ex-KB7LTD **McArthur**, Charles G., Okachobee, FL
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KC7OC **Harrod**, Brian E., Louisville, KY

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WA8BPH **Ingalls**, Almon O., Flushing, MI
KD8CKB **Wilson**, Lowell G., Mason, MI
K8CYJ **Pirkle**, Rex W., Denison, TX
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KB8HXM **Wynkoop**, Richard B., Delaware, OH
KB8IDY **Brewer**, Jerry W., Cable, OH
W8KID **Hathaway**, Richard G., Whitehall, MI
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W9HVJ **Clark**, Walter J., Naperville, IL
K9LHN **Polzin**, Kenneth O. Sr, Bassett, WI
W9LOY **Smith**, Loy R., Plymouth, MI
WB9MDL **Fields**, Michael C., Hobart, IN
ex-W9MOT **Eggert**, Kenneth W., Brookfield, WI
N9NDX **Putz**, Richard J., Goshen, IN
N9NTG **Harris**, Boyd G., Peoria, IL
W9OQI **Zehr**, Richard S., Flanagan, IL
KT9P **Mather**, Dale F., Caledonia, IL
K9POP **Baker**, James R., Sebring, FL
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NØOOT **Schumi**, Joseph, Saint Paul, MN
WØOQC **Briles**, William H., Derby, KS
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WAØTFC **Koppelman**, Karl J., Cleveland, MN
NØVHE **Mullins**, George H., Downing, MO
WØXZ **Leupp**, Herbert R., Mercer, ND
NØYL **Thorson**, Edna M., Robbinsdale, MN
KWØZ **Culli**, Melvin Roger, Wright City, MO
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VE3ABO **Skitch**, Brydon, St Catharines, ON, Canada
VE3AIH **Andrew**, Irwin, Windsor, ON, Canada
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DJØJV/E73N **Abadzic**, Nusret E., Munich, Germany
PAØLSK **Leisink**, Leo, Grave, NB, Netherlands

♦ Life Member, ARRL

Note: Silent Key reports must confirm the death by one of the following means: a letter or note from a family member, a copy of a newspaper obituary notice, a copy of the death certificate, or a letter from the family lawyer or the executor. Please be sure to include the amateur's name, address and call sign. Allow several months for the listing to appear in this column.

Many hams remember a Silent Key with a memorial contribution to the ARRL Foundation or to ARRL. If you wish to make a contribution in a friend or relative's memory, you can designate it for an existing youth scholarship, the Jesse A. Bieberman Meritorious Membership Fund, the Victor C. Clark Youth Incentive Program Fund, or the General Fund. Contributions to the Foundation are tax deductible to the extent permitted under current tax law. Our address is: The ARRL Foundation Inc, 225 Main St, Newington, CT 06111.

Strays

Public Service in Lithuania

Last September amateurs in Vilnius, Lithuania recruited a multi-generational team to provide communications for a marathon. Note the word "savanoris" on their shirts. That translates to "volunteer" in Lithuanian.

From left to right:

First row: Laimonas Januška, LY1WS; Natas, LY4NS; Oleg Sokolov, LY3UE and Mindaugas, LY1MT.

Second row: Kostas, LY1KL; Laima, LY1LG; Karolis, LY1KG; Romualdas, LY8X and Zilvinas, LY1ZL.

Third row: Zbigniev Valentinovich, LY2XC; Saulius, LY1VP; and Rolandas Mikalauskas, LY4Q, the President of Lietuvos Radijo Mėgėjų Draugija, the national Amateur Radio association in Lithuania.

QST Congratulates...

Derek Brown, W4DTB, winner of the 2011 ARRL Hiram Percy Maxim award, who received his award plaque at the 2013 Carolina DX Association banquet at Afton Tavern in Concord, North Carolina. The award is given to an ARRL member under the age of 21 as a tangible reward to those deserving young amateurs who contribute their time, skills and energies daily through their commitment to Amateur Radio. Derek is shown receiving his plaque from Dennis Bodson, W4PWF, ARRL Roanoke Division Director.

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These 68 foot tall, high-performance, full size antennas have rugged base sections (2", 3" or 4" diameter) made from aircraft-grade aluminum tubing. The VA-1 requires simple guying. The VA-2 and VA-3 models are very stout and don't require guying.

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Using DX Engineering's innovative structural design and high strength tubing, these antennas are built to our rigid specifications for the best wind ratings in the industry. Extra strong UV-protected Extren® insulators give you high power handling ability, and each antenna is built using precise machining and uses stainless hardware for unmatched reliability. These antennas give you an incredible 2:1 bandwidth up to 500 kHz. VA-2 and VA-3 antennas also include a Heavy Duty Plus Stainless Pivot Base which lets you easily tilt your antenna up and down.

Super Duty Tilt Bases also offered separately, visit DXEngineering.com for more products and available configurations.

DXE-7580FS-VA-1	Vertical Antenna, Standard Duty, 2" O.D. Base	**$379.50**
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DXE-VRW-1 Manual Winch

A great option, this winch allows one person to easily raise or lower a VA-2 or VA-3 vertical antenna.

DXE-VRW-1 Manual Winch..... **$169.99**

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Start operating digitally! Powered by your computer's USB port, this unit is compatible with both PCs and Macs, and works with virtually every radio. The SignaLink supports all sound card digital and voice modes, including PSK-31, SSTV, CW, RTTY, MT63 and Echolink®. It's easy to install and set up, and software is included.

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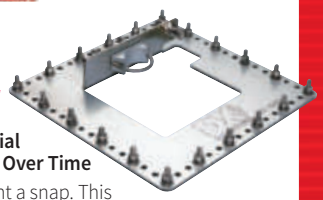
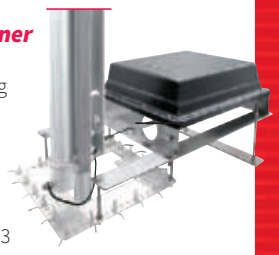


Not Aluminum!
Guarantees Best Radial System Conductivity Over Time

Make radial attachment a snap. This plate fits 3" pipe, 4x4 and 6x6 posts and you can use up to 120 radials. It's made from .125" thick 304 stainless steel, not cheap aluminum and uses a patented high current coax-to-radial connection. This ensures excellent, lasting radial connectivity.

DXE-RADP-3	Complete with 20 Stainless Bolt Sets	**$54.50**
DXE-RADP-1HWK	20 Sets of 1/4" Stainless Hardware	**$7.50**
DXE-SSVC-2P	Stainless Saddle Clamp for to 1" to 2" O.D. Steel Tube	**$11.95**

MFJ-998RT Remote Tuner Mounting System



This Remote Tuner Mounting System lets you mount your MFJ-998RT tuner to any quarter-wave vertical antenna. It's ideal for the full legal limit power DXer. The ATU-2 mounts securely to the DX Engineering RADP-3 Radial Plate.

Using stainless steel brackets and specialized connectors and hardware, the DXE-ATU-2 ensures maximum power transfer to antenna without arcing. The DXE-MBV-ATU-2 is a complete package that bundles the DXE-ATU-2 with a bias tee power injector and the MFJ-998RT remote IntelliTuner.

DXE-ATU-2	Remote Tuner Mounting System	**$64.50**
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Continued from page 110

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These stainless steel clamps include flat washers, lockwashers, nuts and bolts. They have corrosion-resistant aluminum saddles with a rough finish for a secure grip. They are also available with black powder-coated saddles. See the entire selection at DXEngineering.com.

U-Bolt Cast Saddle	Tube O.D.	Thread Bolt Size	Price
DXE-SAD-050A	0.50"	1/4"-20	**$5.25**
DXE-SAD-075A	0.75"	1/4"-20	**$5.65**
DXE-SAD-100A	1.00"	1/4"-20	**$6.05**
DXE-SAD-125A	1.25"	1/4"-20	**$6.85**
DXE-SAD-150A	1.50"	1/4"-20	**$7.75**
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DXE-SAD-200A	2.00"	5/16"-18	**$10.05**
DXE-SAD-200B	2.00"	3/8"-16	**$11.25**
DXE-SAD-250A	2.50"	5/16"-18	**$12.05**
DXE-SAD-250B	2.50"	3/8"-16	**$13.55**
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V-Bolt Cast Saddle	Tube O.D.	Thread Bolt Size	Price
DXE-CAVS-1P	0.50"-1.75"	1/4"-20	**$10.25**
DXE-CAVS-11P	0.50"-1.75"	5/16"-18	**$10.75**
DXE-CAVS-2P	1.00"-2.00"	5/16"-18	**$12.25**
DXE-CAVS-3P	2.00"-3.00"	3/8"-16	**$15.25**

U-Bolt Black Powdercoated Saddle	Tube O.D.	Thread Bolt Size	Price
DXE-PSAD-050A	0.50"	1/4"-20	**$10.80**
DXE-PSAD-075A	0.75"	1/4"-20	**$10.95**
DXE-PSAD-100A	1.00"	1/4"-20	**$11.05**
DXE-PSAD-125A	1.25"	1/4"-20	**$11.85**
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DXE-PCAVS-1P	0.50"-1.75"	1/4"-20	**$10.90**
DXE-PCAVS-2P	1.00"-2.00"	5/16"-18	**$12.95**

V-Bolt Stainless Steel Saddles

The saddles feature serrated edges to grip hard pipe surfaces. These clamps include stainless steel V-bolts, and can be ordered with a tab and 1/4" hardware for grounding applications.

V-Bolt Stainless Saddle	Pipe Size	Ground Lug	Price
DXE-SSVC-1P	1/2"-3/4"	No	**$6.95**
DXE-SSVC-1PG	1/2"-3/4"	Yes	**$7.95**
DXE-SSVC-150P	1"-1 1/2"	No	**$9.95**
DXE-SSVC-150PG	1"-1 1/2"	Yes	**$10.95**
DXE-SSVC-2P	1"-2"	No	**$11.95**
DXE-SSVC-3P	2"-3"	No	**$14.95**

Super Duty Saddle Clamps

Super Duty Saddle Clamps are designed for maximum clamping strength to control large or unbalanced loads. They feature an A356-T6 cast aluminum saddle, with rough, as-cast finish for a secure grip. The clamps include a cast stainless reinforcement plate; armor coated bolt sets are available separately.

Part Number	Tube O.D.	Price
DXE-SDS-200P	2.00"	**$34.00**
DXE-SDS-250P	2.50"	**$41.00**
DXE-SDS-300P	3.00"	**$51.00**

Resin Support Blocks

Securely mount tubing to any flat surface. These blocks have an insulated mount between the tubing and plates, ideal for antenna construction and electrical applications.

Block Part Number	Tube O.D.	Reinforcement Plate Required	Price
DXE-RSB-I02500	1/4"	DXE-RSB-DP-1	**$2.65**
DXE-RSB-I03125	5/16"	DXE-RSB-DP-1	**$2.85**
DXE-RSB-I03750	3/8"	DXE-RSB-DP-1	**$2.65**
DXE-RSB-I05000	1/2"	DXE-RSB-DP-2	**$2.90**
DXE-RSB-I06250	5/8"	DXE-RSB-DP-2	**$2.90**
DXE-RSB-I03400	3/4"	DXE-RSB-DP-3	**$3.10**
DXE-RSB-I10000	1"	DXE-RSB-DP-3	**$3.15**
DXE-RSB-I11250	1 1/8"	DXE-RSB-DP-4	**$4.70**
DXE-RSB-I12500	1 1/4"	DXE-RSB-DP-5	**$4.70**
DXE-RSB-I11500	1 1/2"	DXE-RSB-DP-5	**$4.70**
DXE-RSB-I13400	1 3/4"	DXE-RSB-DP-6	**$7.30**
DXE-RSB-I20000	2"	DXE-RSB-DP-6	**$7.30**
DXE-RSB-I22500	2 1/4"	DXE-RSB-DP-6	**$7.95**

Coaxial Cable Grounding Brackets

These stainless steel brackets have two holes for chassis- or bulkhead-mount connectors (not included). Each bracket comes with a stainless steel V-bolt and hardware.

DXE-CGB-150 Bracket for 0.50" to 1.50" O.D. Tube.....**$15.95**

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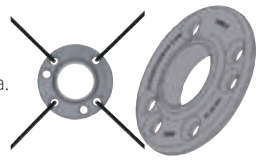
Guy Rings



Use DX Engineering's Guy Rings to secure your rope guys and stabilize your aluminum vertical antenna. They work with three- and four-way guying systems and are a great complement to our tubing kits. These guy rings are super strong, virtually impervious to the elements and fit 0.75", 1.0", 1.25", 1.50" and 2.0" O.D. tubing.

DXE-GR-5P Set of 5 Guy Rings **$7.95**

Telescoping Antenna Tubing Kits

Available in either fiberglass or aluminum, these kits contain several tapered sections of DX Engineering tubing and stainless steel band camps, allowing you to build your own vertical antenna. You can design, experiment and create an adjustable setup tailored specifically to your specs. The tubing telescopes smoothly and comes in larger sizes and wall thicknesses.

DXE-FTK50 Fiberglass Antenna Tubing Kit, 50' Max. Length **$138.00**

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These compact amps are perfect for Field Day and DXpeditions, and they're also perfect for your shack. The 1K2 is the smallest 1,200 watt amplifier ever offered and it weighs a mere 13 pounds. Adding the built-in switching power supply brings the total weight to just 20 pounds. These amplifiers use a single LDMOS FET rated at an incredible 1,250 Watts, able to handle a 65:1 SWR.

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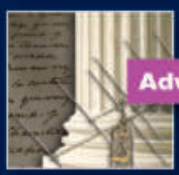

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Bulk Cable	Impedance	Length	Price
Low-Loss Mini-8 Cable			
DXE-8X	50 Ω	per foot	**$0.31**
DXE-8X-1000	50 Ω	1,000'	**$259.99**
Low-Loss Cable			
DXE-213U	50 Ω	per foot	**$0.89**
DXE-213U-500	50 Ω	500'	**$409.99**
DXE-11U	75 Ω	per foot	**$0.52**
Premium Low-Loss Cable			
DXE-400MAX	50 Ω	per foot	**$0.82**
DXE-400MAX-500	50 Ω	500'	**$364.99**
Low-Loss Foam Cable			
DXE-8U	50 Ω	per foot	**$0.79**
DXE-8U-500	50 Ω	500'	**$359.99**
Highly Flexible Cable			
DXE-58AU	50 Ω	per foot	**$0.29**
Flooded Jacket Cable			
DXE-F6-CTL	75 Ω	per foot	**$0.19**
DXE-F6-1000	75 Ω	1,000'	**$149.95**

Multi-Conductor Control Cable

The ideal cable to control your rotator or antenna switch, this color-coded stranded copper cable is reliable and flexible. A vinyl jacket shields it from the elements and it is available by the foot and in bulk spools. Find all the details at DXEngineering.com.

Part Number	Conductors (Gauge)	Description	Price/ Foot
COM-CW3	3 (20 AWG)	Standard	**$0.25**
COM-CW4	4 (20 AWG)	Standard	**$0.28**
DXE-CW8	2 (18 AWG) 6 (22 AWG)	Standard	**$0.48**
DXE-CW8-HD	2 (16 AWG) 6 (18 AWG)	Heavy Duty	**$0.89**
DXE-CW9	9 (24 AWG)	Cat5e	**$0.32**
DXE-CW9S	9 (24 AWG)	Shielded	**$0.36**

DXE-8X BNC Jumper Cables

These male BNC jumper cables use secure, crimped connectors and tube-shrink seals, which make them impervious to the elements. They are Hi-Pot and high voltage tested. In addition to these 50 Ω assemblies, 75 Ω cables are available as well.

DXE-8XDB002 2' Length.....**$14.25**
DXE-8XDB003 3' Length.....**$14.75**
DXE-8XDB006 6' Length.....**$15.75**
DXE-8XDB012 12' Length.....**$17.75**
DXE-8XDB025 25' Length.....**$21.75**

Phasing Cables

DX Engineering provides precision, electrically-tuned phasing lines for your 50 or 75 Ω applications. Choose from pre-manufactured four-square and two-antenna array cables or contact us with your custom application.

Multi-Conductor Heavy Duty Tinned Copper Flat Braid

A critical part of any grounding system, this Flat Braid is made with terminals for quick, easy installation. See more sizes and grounding solutions at DXEngineering.com.

Part Number	Length	Price
7 AWG Braid Rated at 85 Amps 1" Wide, for a 1/4" Stud		
DXE-TCB10-RT01	1'	**$5.75**
DXE-TCB10-RT03	3'	**$8.75**
DXE-TCB10-RT05	5'	**$12.75**
DXE-TCB10-RT10	10'	**$18.75**
10 AWG Braid Rated at 53 Amps 1/2" Wide, for a #10 Stud		
DXE-TCB05-RT01	1'	**$4.75**
DXE-TCB05-RT03	3'	**$5.75**
DXE-TCB05-RT05	5'	**$6.75**
DXE-TCB05-RT10	10'	**$9.75**

DX Engineering is the Best Place to Get Coax, Here's Why:

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- Your Coax Cable Order is Shipped FREE Anywhere in the Contiguous 48 States
- Weatherproof: Adhesive Shrink Tubing Seals Connections
- Silver-plated PTFE-insulated Connectors
- Hand Crafted by Top Techs

Made in USA

Black PVC Jacket

DXE-8U Low-Loss Foam Dielectric Cable

- .405" high-flex PVC jacket

Attenuation per 100 feet	Power Rating	Efficiency
0.3 dB @ 5 MHz	5.4 kW	93%
0.5 dB @ 10 MHz	4.1 kW	90%
0.9 dB @ 30 MHZ	2.2 kW	81%
1.2 dB @ 50 MHz	1.8 kW	77%
2.2 dB @ 150 MHz	1.0 kW	60%

Pre-cut Cable with Connectors		
Part Number	Length	Price
DXE-8UDU002	2'	**$13.25**
DXE-8UDU003	3'	**$13.75**
DXE-8UDU006	6'	**$16.75**
DXE-8UDU025	25'	**$41.75**
DXE-8UDU050	50'	**$64.75**
DXE-8UDU100	100'	**$117.75**

UV-Resistant, Non-Contaminating, Black PVC Jacket

DXE-213U MIL-Spec Cable

- .405" Type II UV-resistant jacket is non-contaminating and suitable for outdoor use

Attenuation per 100 feet	Power Rating	Efficiency
0.4 dB @ 5 MHz	4.9 kW	90%
0.6 dB @ 10 MHz	3.4 kW	87%
1.0 dB @ 30 MHz	2.0 kW	79%
1.3 dB @ 50 MHz	1.5 kW	73%
2.4 dB @ 150 MHz	0.9 kW	57%

Pre-cut Cable with Connectors		
Part Number	Length	Price
DXE-213UDU003	3'	**$14.75**
DXE-213UDU006	6'	**$18.75**
DXE-213UDU012	12'	**$24.75**
DXE-213UDU025	25'	**$39.75**
DXE-213UDU050	50'	**$68.75**
DXE-213UDU075	75'	**$95.75**
DXE-213UDU100	100'	**$118.75**
DXE-213UDU150	150'	**$171.75**

UV-Resistant, Black PE Jacket

DXE-8X Low-Loss Foam Dielectric Cable

Known as RG-8X or Mini-8

- Very flexible; ideal for short, in-shack jumper cables
- .242" Type II jacket is non-contaminating and UV-resistant
- Direct-bury

Attenuation per 100 feet	Power Rating	Efficiency
0.6 dB @ 5 MHz	3.0 kW	86%
0.9 dB @ 10 MHz	2.2 kW	81%
1.4 dB @ 30 MHz	1.2 kW	69%
2.0 dB @ 50 MHz	0.9 kW	62%
3.8 dB @ 150 MHz	0.4 kW	42%

Pre-cut Cable with Connectors		
Part Number	Length	Price
DXE-8XDU003	3'	**$11.75**
DXE-8XDU006	6'	**$12.75**
DXE-8XDU012	12'	**$16.75**
DXE-8XDU025	25'	**$21.75**
DXE-8XDU050	50'	**$32.75**
DXE-8XDU075	75'	**$43.75**
DXE-8XDU100	100'	**$53.75**
DXE-8XDU150	150'	**$74.75**

UV-Resistant, Non-Contaminating, Black PVC Jacket

DXE-400MAX Low-Loss Cable

- Gas-injected foam, polyethylene dielectric bonded tape foil covered by a braided copper shield
- .405" low-density UV-resistant polyethylene jacket is ideal for outdoors
- Direct-bury

Attenuation per 100 feet	Power Rating	Efficiency
0.3 dB @ 5 MHz	6.9 kW	93%
0.5 dB @ 10 MHz	4.8 kW	90%
0.8 dB @ 30 MHz	2.8 kW	83%
1.1 dB @ 50 MHz	2.1 kW	79%
1.8 dB @ 150 MHz	1.2 kW	65%
3.3 dB @ 450 MHz	0.7kW	47%

Pre-cut Cable with Connectors		
Part Number	Length	Price
DXE-400MAXDU003	3'	**$16.75**
DXE-400MAXDU006	6'	**$18.75**
DXE-400MAXDU018	18'	**$35.75**
DXE-400MAXDU025	25'	**$43.75**
DXE-400MAXDU050	50'	**$66.75**
DXE-400MAXDU075	75'	**$99.75**
DXE-400MAXDU100	100'	**$119.75**
DXE-400MAXDU150	150'	**$179.75**

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Purchase an S9v 43', 31' or 18' antenna and fill out the included form. Mail it to LDG Electronics, and we will send you either a 200 watt balun or unun, your choice!

S9v43 $199.99
80-6 meters *Fixed Operation*

The S9v 43' is a high-performance lightweight telescoping fiberglass vertical. The best value in high-performance 'tall' verticals!

S9v31 $99.99
40-6 meters *Fixed or Portable Operation*

S9v18 $49.99
20-6 meters *Fixed or Portable Operation*

The S9v 31' and 18' are tapered, ultra-lightweight fiberglass vertical antennas. Friction-locking sections and high-tech polymer tube rings allow the antenna to be quickly and safely deployed in practically any environment without tools!

S9rp $39.99
Aluminum Radial Plate
Includes 20 sets of stainless steel nuts & bolts

Designed to handle the higher power of the Tokyo Hi Power HL-45B.

NEW! Z-817H
The ultimate autotuner for QRP radios including the Yaesu FT-817(D) with addition of the Tokyo High Power HL-45B. Interfaces to the CAT port (ACC) on the back of the radio with the provided cable. One button push on the tuner and the Z-817H takes care of the rest. Will also function as a general purpose antenna tuner with other QRP radios or QRP radios with up to 75 watt HF amps. Powered by four AA internal Alkaline batteries (not included). 2000 memories cover 160 through 6 meters.
Suggested Price $159.99

- ***RF Sensing***
- ***Tunes Automatically***
- ***No Interface Cables Needed***

AT-200ProII
The AT-200ProII now includes LEDs to show antenna position and if the tuner is in bypass. A two position antenna switch stores 2000 memories per switch. Handles up to 250 watts SSB or CW on 1.8 to 30 MHz and 100 watts on 54 MHz. Rugged and easy to read LED bar graphs simultaneously show RF power and SWR. Includes a six foot DC power cable. ***Suggested Price $259.99***

AT-1000ProII
LDG Electronics' new flagship 1KW tuner features: 5 to 1,000Watts PEP; RF Sensing; Auto and Semi Tuning Modes; 1.8 to 54 MHz range; 6 to 800 ohm range (15 to 150 on 6M); simplified operation; and an optional external 4.5" analog meter. With the two position antenna switch, there are 2,000 memories that store tuning parameters for almost instantaneous memory recall whenever you transmit on or near a frequency you've used before. Includes six foot DC power cable. ***Suggested Price $539.99***
Optional M-1000 external analog meter $129.99

IT-100
Matched in size to the IC-7000 and IC-706, for either manual or automatic tunes, and status LEDs. Control the IT-100 and its 2000 memories from either its own button or the Tune button on your IC-7000 or other Icom rigs. For your Icom radio that is AH3 or AH-4 compatible.
Suggested Price $179.99

YT-100
For Yaesu FT-857, FT-897 and FT-100 (and all D models) an integrated tuner, powered by the interface. Press the tune button on the tuner, and everything else happens automatically.
Suggested Price $199.99

KT-100
For AT-300 compatible Kenwood transceivers (except TS-480HX). The KT-100 actually allows you to use the Tune button on the radio. 2,000 memories for instant recall of the tuning parameters for your favorite bands and frequencies.
Suggested Price $199.99

YT-450
Designed for Yaesu's newest 100 watt radios. Interfaces directly with the Yaesu FT-450 and FT-950 radios. Press the tune button on the tuner and the rest happens automatically. It will quickly match nearly any kind of coax fed antenna with an SWR of up to 10:1. 2000 memories recall settings in an instant! Seamless connection to a PC. ***Suggested Price $249.99***

YT-847
YT-847 Autotuner is an integrated tuner for the Yaesu FT-847. An included CAT/Power cable interfaces with your FT-847. Just press the tune button on the tuner and everything else happens automatically! ***Suggested Price $249.99***

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LDG ELECTRONICS

radio not included

AT-897Plus
for the Yaesu FT-897

If you own a Yaesu FT-897 and want a broad range automatic antenna tuner, look no further! The AT-897Plus Autotuner mounts on the side of your FT-897 just like the original equipment and takes power directly from the CAT port of the FT-897 and provides a second CAT port on the back of the tuner so hooking up another CAT device couldn't be easier. ***Suggested Price $199.99***

NEW! AT-600ProII

Building on the success of the AT-600Pro, we refined and expanded the model with an optional external 4.5" analog meter. The new AT-600ProII keeps many of the same features of the previous model, but simplifies the operation. With the two-position antenna switch, there are 2,000 memories that store tuning parameters for almost instantaneous memory recall whenever you transmit on or near a frequency you've used before. Includes six-foot DC power cable.
Suggested Price $369.99
Optional M-600 external analog meter $129.99

Z-100Plus

Small and simple to use, the Z-100Plus sports 2000 memories that store both frequency and tuning parameters. It will run on any voltage source from 7 to 18 volts; six AA batteries will run it for a year of normal use. Current draw while tuning is less than 100ma. The Z-100Plus now includes an internal frequency counter so the operating frequency is stored with tuning parameters to make memory tunes a blazingly fast 0.1 seconds; full tunes take an average of only 6 seconds. Includes six foot DC power cable. ***Suggested Price $159.99***

• RF Sensing
• Tunes Automatically
• No Interface Cables Needed

AT-100ProII

This desktop tuner covers all frequencies from 1.8 – 54 MHz (including 6 meters), and will automatically match your antenna in no time. It features a two-position antenna switch with LEDs, allowing you to switch instantly between two antennas. The AT-100ProII requires just 1 watt for operation, but will handle up to 125 watts. Includes six foot DC power cable.
Suggested Price $229.99

Z-11ProII

Meet the Z-11ProII, everything you always wanted in a small, portable tuner. Designed from the ground up for battery operation. Only 5" x 7.7" x 1.5", and weighing only 1.5 pounds, it handles 0.1 to 125 watts, making it ideal for both QRP and standard 100 watt transceivers from 160 - 6 meters. The Z-11ProII uses LDG's state-of-the-art processor-controlled Switched-L tuning network. It will match dipoles, verticals, inverted-Vs or virtually any coax-fed antenna. With an optional LDG balun, it will also match longwires or antennas fed with ladder-line. Includes six foot DC power cable. ***Suggested Price $179.99***

radio not included

Z-817

The ultimate autotuner for QRP radios including the Yaesu FT-817(D). Tuning is simple; one button push on the tuner is all that is needed - the Z-817 takes care of the rest. It will switch to PKT mode, transmit a carrier, tune the tuner, then restore the radio to the previous mode! 2000 memories cover 160 through 6 meters. The Z-817 will also function as a general purpose antenna tuner with other QRP radios. Just transmit a carrier and press the tune button on the tuner. Powered by four AA internal Alkaline batteries (not included), so there are no additional cables required.
Suggested Price $129.99

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HAM-IV

HAM-IV **$649.95**

The most popular rotator in the world! For medium communications arrays up to 15 square feet wind load area. *New* 5-second brake delay! *New* Test/Calibrate function. *New* low temperature grease permits normal operation down to -30 degrees F. *New* alloy ring gear gives extra strength up to 100,000 PSI for maximum reliability. *New* indicator potentiometer. *New* ferrite beads reduce RF susceptibility. *New* Cinch plug plus 8-pin plug at control box. Dual 98 ball bearing race for load bearing strength and electric locking steel wedge brake prevents wind induced antenna movement. North or South center of rotation scale on meter, low voltage control, max mast size of $2^{1}/_{16}$ inches.

HAM IV and HAM V Rotator Specifications	
Wind Load capacity (inside tower)	15 square feet
Wind Load (w/mast adapter)	**7.5 square feet**
Turning Power	800 in.-lbs.
Brake Power	**5000 in.-lbs.**
Brake Construction	Electric Wedge
Bearing Assembly	**dual race/96 ball bearings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	26 lbs.
Effective Moment (in tower)	**2800 ft.-lbs.**

TAILTWISTER SERIES II

For large medium antenna arrays up to 20 sq. ft. wind load. Available with *DCU-1 Pathfinder* digital control (T2XD) or standard analog control box (T2X) with *new* 5-second brake delay and *new* Test/Calibrate function. Low temperature grease, alloy ring gear, indicator potentiometer, ferrite beads on potentiometer wires, *new* weatherproof AMP connectors plus 8-pin plug at control box, triple bearing race with 138 ball bearings for large load bearing strength, electric locking steel wedge brake, North or South center of rotation scale on meter, low voltage control, $2^{1}/_{16}$ inch max. mast.

T-2X **$799.95**

T-2XD **$1229.95** with DCU-1

TAILTWISTER Rotator Specifications	
Wind Load capacity (inside tower)	20 square feet
Wind Load (w/ mast adapter)	**10 square feet**
Turning Power	1000 in.-lbs.
Brake Power	**9000** in.-lbs.
Brake Construction	Electric Wedge
Bearing Assembly	**Triple race/138 ball brngs**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	31 lbs.
Effective Moment (in tower)	**3400 ft.-lbs.**

CD-45II

CD-45II **$449.95**

For antenna arrays up to 8.5 sq. feet mounted inside tower or 5 sq. ft. with mast adapter. Low temperature grease good to -30 F degrees. *New* Test/Calibrate function. Bell rotator design gives total weather protection, dual 58 ball bearing race gives proven support. Die-cast ring gear, stamped steel gear drive, heavy duty, trouble free gear train, North center scale, lighted directional indicator, 8-pin plug/socket on control unit, snap-action control switches, low voltage control, safe operation, takes maximum mast size to $2^{1}/_{16}$ inches. MSLD light duty lower mast support included.

CD-45II Rotator Specifications	
Wind load capacity (inside tower)	8.5 square feet
Wind Load (w/ mast adapter)	**5.0 square feet**
Turning Power	600 in.-lbs.
Brake Power	**800 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/48 ball brings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	22 lbs.
Effective Moment (in tower)	**1200 ft.-lbs.**

HAM-V

HAM-V **$1099.95** with DCU-1

For medium antenna arrays up to 15 square feet wind load area. Similar to the HAM IV, but includes *DCU-1 Pathfinder* digital control unit with gas plasma display. Provides automatic operation of brake and rotor, compatible with many logging/contest programs, 6 presets for beam headings, 1 degree accuracy, auto 8-second brake delay, 360 degree choice for center location, *more!*

AR-40

AR-40 **$349.95**

For compact antenna arrays and large FM/TV up to 3.0 square feet wind load area. Dual 12 ball bearing race. Automatic position sensor never needs resetting. Fully automatic control -- just dial and touch for any desired location. Solid state, low voltage control, safe and silent operation. $2^{1}/_{16}$ inch maximum mast size. MSLD light duty lower mast support included.

AR-40 Rotator Specifications	
Wind load capacity (inside tower)	3.0 square feet
Wind Load (w/ mast adapter)	**1.5 square feet**
Turning Power	350 in.-lbs.
Brake Power	**450 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/12 ball bearings**
Mounting Hardware	Clamp plate/steel bolts
Control Cable Conductors	**5**
Shipping Weight	14 lbs.
Effective Moment (in tower)	**300 ft.-lbs.**

HDR-300A

HDR-300A **$1499.95**

King-sized antenna arrays up to 25 sq.ft. wind load area. Control cable connector, *new* hardened stainless steel output shaft, *new* North or South centered calibration, *new* ferrite beads on potentiometer wires reduce RF susceptibility, *new* longer output shaft keyway adds reliability. Heavy-duty self-centering steel clamp and hardware. Display accurate to 1°. Machined steel output.

HDR-300A Rotator Specifications	
Wind load capacity (inside tower)	25 square feet
Wind Load (w/ mast adapter)	**not applicable**
Turning Power	5000 in.-lbs.
Brake Power	**7500 in.-lbs.**
Brake Construction	solenoid operated locking
Bearing Assembly	**bronze sleeve w/rollers**
Mounting Hardware	stainless steel bolts
Control Cable Conductors	**7**
Shipping Weight	61 lbs.
Effective Moment (in tower)	**5000 ft.-lbs.**

ROTATOR OPTIONS

MSHD, $109.95. Heavy duty mast support for T2X, HAM-IV and HAM-V.
MSLD, $49.95. Light duty mast support for CD-45II and AR-40.
TSP-1, $34.95. Lower spacer plate for HAM-IV and HAM-V.

Digital Automatic Controller

DCU-1 **$749.95**

Automatically controls T2X, HAM-IV, V rotators. 6 presets for favorite headings, 1° accuracy, 8-sec. brake delay, choice for center of rotation, crisp *plasma* display. Computer controlled with many logging/contest programs.

AR-303 Rotator/Controller

AR-303 **$89.95**

For UHF, VHF, 6-Meter, TV/FM antennas. Includes automatic controller, rotator, mounting clamps, mounting hardware. 110 VAC. One Year Warranty.

RBD-5 **$29.95**

NEW! Automatic Rotator Brake Delay

Provides automatic 5-second brake delay -- insures your rotator is fully stopped before brake is engaged. Prevents accidentally engaging brake while rotator is moving. Use with HAM II, III, IV, V, T2Xs. Easy-to-install. Includes pre-assembled PCB, hardware.

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MFJ-259B *World's* most popular Antenna Analyzer is super easy-to-use!

MFJ-259B
$289.95

The MFJ-259B is the world's most popular Antenna Analyzer and the easiest to use! Just select a band and mode. Set frequency. Your measurements are instantly displayed!

Handheld Antenna Lab

Owning the MFJ-259B is like having an entire antenna lab in the palm of your hand!

Measure SWR quickly or make sophisticated measurements such as Return Loss, Reflection Coefficient, Resonance, Complex Impedance (R+jX), Impedance Magnitude (Z) plus Phase in degrees. Covers 1.8 to 170 MHz -- no gaps.

Coax Analyzer

Determine coax cable velocity factor (Vf), loss in dB, coax length, distance to open or short plus detect wrong coax impedance.

Frequency Counter

Measure frequency of external signals using the separate BNC counter input.

Signal Generator

Use as a signal source 1.8-170 MHz with digital dial accuracy for testing and alignment.

Inductance and Capacitance

Measure Inductance (uH) and Capacitance (pF) at RF frequencies not at audio frequencies used by most L/C meters.

Digital and *Analog* Meters

A high-contrast backlit LCD gives precision readings and *two* side-by-side *analog meters* make antenna adjustments intuitive.

Smooth, Stable Tuning

Velvet-smooth reduction drive tuning and precision *air-variable capacitor* makes setting frequency easy and stable.

Battery Saver & More

Battery-saver, low-battery warning, battery voltage meter and charger are all built in. Use ten Alkaline, NiCad or NiMH AA batteries (not included) or 110 VAC with MFJ-1312D, $15.95. 4Wx6¾Hx2D inches.

Here's What You Can Do

Find true antenna resonant frequency
Tune *antenna quickly for minimum SWR*
Match complex loads to your feedline
Adjust *mobile whips without stressing finals*
Determine safe 2:1-SWR operating windows
Adjust *tuners without generating QRM*
Find exact location of shorts and opens
Cut *stubs and phasing lines accurately*
Check cable for loss and contamination
Find *value of unknown coils and caps*
Test RF transformers and baluns
Troubleshoot *filters and networks*
Find self-resonance and relative Q
Check *patterns and compare gain*
MFJ-259B does all this and more!

MFJ Analyzer Accessories

MFJ-29C, $24.95. Tote your MFJ-259B anywhere with this *genuine* MFJ custom carrying case. Special foam-filled fabric cushions blows, deflects scrapes and protects knobs and meters from harm. **MFJ-39C, $24.95.** Like MFJ-29C, but for MFJ-269.

MFJ-66, $24.95. Plug-in coils turns any MFJ Antenna Analyzer into a sensitive and accurate *band switched* dip meter. 2 coils.

MFJ-92AA10, $29.95. Ten MFJ *SuperCell*™ Ni-MH AA rechargeable batteries.

MFJ-99B, $88.90. ***Save $7!*** MFJ-259B Deluxe Accessory Pack: MFJ-29C Pouch, 10 Ni-MH batteries, dip coils, AC adapter. **MFJ-98B, $88.90.** Like MFJ-99B but for MFJ-269.

MFJ-99, $60.85. ***Save $5!*** Like MFJ-99B, less batteries, for MFJ-259B. **MFJ-98, $60.85.** Like MFJ-99 but for MFJ-269.

MFJ-99C, $40.90. ***Save $5!*** AC Adapter and 10 Ni-MH batteries for MFJ-259B/269.

MFJ-917, $29.95. Current balun lets you make balanced line antenna measurements on HF with your MFJ Analyzer. **MFJ-7702, $3.95.** MFJ-917 to MFJ Analyzer adapter.

MFJ-731, $99.95. Tunable RF filter allows accurate Antenna Analyzer measurements in presence of strong RF fields. 1.8-30 MHz.

MFJ-5510, $9.95. Cigarette lighter cord.

MFJ-269 ...1.8-170 MHz and 415-470 MHz plus 12-bit A/D!

The MFJ-269 does everything the MFJ-259B does - and much more!

Expanded Frequency Coverage

MFJ-269 adds UHF coverage from 415 to 470 MHz -- right up into the commercial band. With it, you can adjust UHF dipoles, verticals, Yagis, quads and repeater collinear arrays with ease -- plus construct accurate phasing harnesses and timed cables. Also use it as a signal source to check UHF duplexers, diplexers, IMD filters and antenna patterns.

Much Better Accuracy

New *12-bit* A/D converter gives much better accuracy and resolution than common 8-bit A/D converters -- *an MFJ-269 exclusive!*

Complex Impedance Analyzer

Read Complex Impedance (1.8 to 170 MHz)as series equivalent resistance and reactance (Rs+jXs) or as magnitude (Z) and phase (degrees). Also reads *parallel* equivalent resistance and reactance (Rp+jXp) -- *an MFJ-269 exclusive!*

MFJ-269
$389.95

CoxCalculator™

Lets you calculate coax line length in feet given electrical degrees and vice versa for any frequency and any velocity factor -- *an MFJ-269 exclusive!*

Use any Characteristic Impedance

You can measure SWR and coax loss with *any* characteristic impedance (1.8 to 170 MHz) from 10 to over 600 Ohms, including 50, 51, 52, 53, 73, 75, 93, 95, 300, 450 Ohms -- *an MFJ-269 exclusive!*

Logarithmic Bar Graph

Has easy-to-read LCD *logarithmic* SWR bargraph and SWR meter for quick tuning.

Uses instrumentation grade N-connector to ensure minimum mismatch on all frequencies. Includes N to SO-239 adapter.

MFJ-269*PRO*™ *Analyzer*

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.

Free MFJ Catalog

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MFJ . . . The World Leader in Amateur Radio!

MFJ-989D 1500 Watt *legal limit* Tuner

World's most popular 1500 Watt Legal Limit Tuner just got better -- much better!

MFJ-989D
New, improved MFJ-989D *legal limit* antenna tuner gives you better efficiency, lower losses and a new *true* peak reading meter with no price increase. Easily handles *full* 1500 Watts SSB/CW over 1.8-30 MHz. **$389.95**

New dual 500 pF *air variable capacitors* give you twice the capacitance for more efficient operation on 160 and 80 Meters.

New, improved *AirCore™ Roller Inductor* gives you lower losses, higher Q and handles more power more efficiently.

New TrueActive™ peak reading Cross-Needle *SWR/Wattmeter* lets you read *true* peak power on all modes.

New high voltage *current balun* lets you tune balanced lines at high power -- 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.

MFJ *Differential-T™* 1.5kW Tuner

MFJ-986
$349.95
Simple two knob tuning makes antenna tuning foolproof and easier than ever! Handles 1.5 kW PEP SSB/CW amplifier output, 1.8-30 MHz. *AirCore™* roller inductor, *Differential-T™* capacitor, lighted peak/average Cross-Needle SWR/Wattmeter, Six position antenna switch, balun. $10^{3}/_{4}$Wx$4^{1}/_{2}$Hx15D".

MFJ *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, Six position antenna switch, balun, Lexan front panel, 1.8-30MHz. $10^{3}/_{4}$x$4^{1}/_{2}$x$10^{7}/_{8}$ in.

MFJ *Fully Balanced* 1.5 kW Tuner

MFJ-976
$499.95
MFJ-976 is a *fully balanced* wide range (12-2000 Ohms) antenna tuner that gives you *superb* current balance. Handles *full* 1.5kW SSB/CW, 1.8-30 MHz. Tunes *all* balanced lines -- 600 Ohm *open wire* line, 450/300 Ohm *ladder* lines, 300/72 Ohm *twin lead*. Also tunes wires/coax fed antennas. Cross-Needle meter.

MFJ 2500 Watts *ContinuousCarrier™* Tuner

Silver plated Edge-Wound Roller Inductor . . .1000/500 pF Variable Capacitors . . . Antenna Switch . . . 4-Core Balun . . . true Peak Cross-Needle Meter . . . Dummy Load . . . Extremely Wide Matching Range . . .

The MFJ-9982 ContinuousCarrier™ antenna tuner handles 2500 Watts continuous carrier output on all modes and all HF bands into most unbalanced antennas -- even on 160 Meters where even the best antenna tuners fail!

MFJ-9982
$699.95

The MFJ-9982 gives you every feature you'll ever want in a high power tuner -- wide matching range, 1.8 to 30 MHz coverage, 6-position antenna switch, 4-core balun, dummy load, true peak/average lighted SWR/Wattmeter, 6:1 reduction drives with detailed logging scales, 3-digit turns counter, extra large knobs.

New Components, New Technologies

The *Heart and Soul* of the MFJ-9982 is its roller inductor and variable capacitors.

MFJ's high power, high-Q *continuous current AirCore™* roller inductor is no ordinary roller inductor! It's edge wound from thick .06-inch *silver-plated* solid copper strap.

It can carry huge circulating RF currents and withstand tremendous heat that'll melt or burn up ordinary roller inductors.

Self-insulating construction reduces stray capacitance -- keeps self-resonant frequencies high and out-of-the-way. Dual, *silver-plated* compression wheels give ultra low-resistance contacts. New fast-tune crank knob.

High-current, *high-capacitance* 1000 pF and 500 pF air variable capacitors have low minimum capacitance and are self-insulating.

These newly developed air variable capacitors give you *very high efficiency* on 160/80 Meters *and* MFJ's patent pending innovation gives you *extremely wide matching range* on 10/12/15 Meters at 2500 Watts -- a feat *only* the MFJ-9982 has achieved.

Hi-Voltage/Current Antenna Switch

The antenna switch is completely isolated to handle high-voltage, high impedance antennas. High-current, low impedance antennas are handled by parallel sets of high-current contacts of *two* ceramic switches.

New 4-Core Balun

Powerful balun -- Four $2^{1}/_{2}$ inch cores, 12-gauge *Teflon™* wire. Run balanced lines at full 2500 Watts SSB/CW continuous, 24/7.

New Balanced Line Feed-Thru Insulator

Allows massive transmitter currents to flow directly to the antenna without passing through lossy screws or bolts.

TrueActive™ Peak Reading Circuit

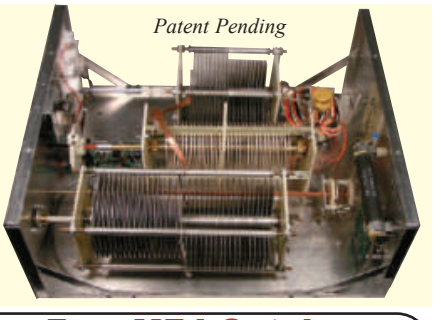
New TrueActive™ circuit reads *true* peak or average power on all modes. *Cross-Needle* meter reads SWR/forward/reflected power.

1500 Watt Dummy Load

1500 Watt air-cooled non-inductive 50 Ohm resistor. 100W/10 min., 1.5kW/10 sec.

New Cabinet maintains high Q

New roomy cabinet maintains high Q. Vent holes. Heavy gauge, .08 inch aluminum braced chassis. Vinyl cover, non-stripping PEM nuts, heavy 10-gauge and copper strap wiring throughout. $13^{3}/_{4}$Wx7Dx$16^{1}/_{4}$D inches. 15 pounds.



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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-993B 300 Watt *IntelliTuner*™

The World's Best Selling Automatic Antenna Tuner!

The MFJ-993B *IntelliTuner*™ lets you tune any antenna -- balanced or unbalanced -- *automatically* and *ultra fast*.

It's a comprehensive automatic *antenna tuning center* complete with SWR/Wattmeter, antenna switch for two antennas and 4:1 current balun for balanced lines.

MFJ's exclusive *IntelliTuner*™, *Adaptive Search*™ and *Instant Recall*™ algorithms give you *ultra fast* automatic tuning with over 20,000 *VirtualAntenna*™ Memories.

Select 300 Watt SSB/CW power level and match 6-1600 Ohm antennas ***Or . . .*** select **150 Watt** SSB/CW power level and match *extra wide-range* 6-3200 Ohms!

You get a highly efficient L-network, 1.8-30 MHz cover-

age, Cross-Needle *and* digital meters, audio SWR meter, *backlit* LCD, remote control port, radio interface, heavy-duty 16 amp/1000V relays.

MFJ-993B **$259.95**

The MFJ-993B automatically tunes for minimum SWR and remembers your frequency and tuner settings. The next time you operate on that frequency and antenna, these tuner settings are instantly restored and *you're ready to operate in milliseconds!* 10W x2¾ Hx9D". Use 12-15 VDC/1 amp or 110 VAC with **MFJ-1316, $21.95**. Radio interface cables, remote control available. See ***www.mfjenterprises.com***

for 600 Watt amps

AL-811/ALS-600/ALS-500

For 600 Watt amps like Ameritron AL-811/ALS-600/ALS-500M. Matches 12-800 Ohms. 10,000 *Virtual Antenna*™ memories. Cross-Needle SWR/Wattmeter. 10Wx2¾Hx9D inches.

MFJ-994B **$359.95**

No Matter What™ Warranty

Every MFJ tuner is protected by MFJ's famous one year *No Matter What*™ limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

1500 Watt *Legal Limit*

for Ameritron AL-1500/1200/82 amps

Roam the entire HF spectrum 1.8-30 MHz *hands-free* with full *1500 Watt* legal limit on SSB/CW and near-perfect SWR! Lighted LCD/Cross-Needle Meter.

MFJ-998 **$699.95**

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

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-1778 **$44.95**

MFJ-1778M, $39.95. G5RV Junior. Half-size, 52 ft. 40-10M with tuner, 1500 Watts.

200W...Weather-sealed

for Remote/Outdoor/Marine

Fully *weather-sealed for remote Outdoor/Marine use*! Tough, durable, built-to-last the elements for years.

MFJ-926B **$279.95**

200 Watt...Remote

Coax/Wire Ant, No pwr cable needed

Weather protected fully automatic *remote* auto tuner for wire ***and*** *coax* antennas -- an MFJ exclusive. Powers through coax -- No separate power cable needed.

MFJ-927 **$259.95**

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10 Bands: 80-2 Meters

$299.95 MFJ-1799

- ***10 Bands: 75/80, 40, 30, 20, 17, 15, 12, 10, 6, 2 Meters including 75/80M***
- ***Handles 1500 Watts PEP SSB/CW***
- ***No ground or ground radials needed!***
- ***Low radiation angle for great DX, omni-directional, automatic bandswitching***

Only 20 feet tall! Mounts anywhere!

Self-supporting and just 20 feet tall. Mounts easily from ground level to tower top -- small lots, backyards, apartments, condos, mobile homes, roofs, tower mounts.

Highly Efficient End-Loading

No lossy traps! *End-loading*, the most efficient loading known -- gives you highly efficient performance, excellent bandwidth, low angle radiation and automatic bandswitching.

High-Q loading coils are wound on tough, low loss fiberglass forms with *Teflon*(R) wire where needed.

Entire Length Radiates

End-loading results in uniform current distribution and the *entire length radiates*. This puts the radiating elements up high giving you more QSOs.

No Feedline Radiation/Distorted Pattern

MFJ's center-fed *balanced* halfwave vertical dipole design is decoupled and isolated from the feedline with MFJ's *AirCore*™ high power balun. It can't saturate, no matter how high your power.

This gives you consistently high performance by killing feedline radiation, pattern distortion, SWR shifts, RFI, noise pickups.

Easy to Tune!

Tuning to your favorite part of one band does not affect other bands and is done at the *bottom* of the antenna by simply adjusting a length of the capacitive hat.

Built-to-Last!

Incredibly strong *solid* 1 1/4 inch diameter fiberglass center insulator and 1 3/8 inch diameter 6061 T6 aircraft strength aluminum tubing will make it the only antenna you will ever need.

MFJ 6-Band Halfwave Vertical Antenna

MFJ-1796 **$229.95**

MFJ-1796, like MFJ-1799, but for 6 bands: 40, 20, 15, 10, 6 and 2 Meters. 12 foot high, 24 inch foot print, mounts anywhere. No ground, no radials, self-supporting.

MFJ's Super High-Q Loop™ Antennas

MFJ's *tiny* 36 inch diameter loop antenna lets you operate 10 through 30 MHz *continuously* -- including the WARC bands!

Ideal for limited space -- apartments, small lots, motor homes, attics, or mobile homes. Enjoy DX and local contacts mounted vertically. Get both low angle radiation for excellent DX and high angle radiation for local, close-in contacts. Handles 150 watts.

Super easy-to-use! Only MFJ's super remote control has *Auto Band Selection*™. It auto tunes to desired band, then beeps to let you know. No control cable is needed. Fast/slow tune buttons and built-in two range Cross-Needle SWR/Wattmeter lets you quickly tune to your exact frequency.

All welded construction, welded butterfly capacitor with no rotating contacts, large 1.050 inch diameter round radiator -- *gives you highest possible efficiency*.

Each plate in MFJ's tuning capacitor is welded for low loss and polished to prevent high voltage arcing, welded to the radiator, has nylon bearing, anti-backlash mechanism, limit switches, continuous no-step DC motor -- smooth precision tuning. Heavy duty thick ABS plastic housing has ultraviolet inhibitor protection.

Cover 40-15 Meters. MFJ-1788, $469.95. Like MFJ-1786 but covers 40 - 15 Meters continuous. Includes remote control.

6-Band, 40-2 Meters *Rotatable* Mini-Dipole

Low profile 14 feet . . . 7 ft. turning radius . . . 40, 20, 15, 10, 6, 2 Meters . . . 1500 Watts . . .

MFJ-1775 is inconspicuous and low profile -- not much bigger than a TV antenna and is easily tuned by a lightweight rotator like Hy-Gain's *AR-35*.

It's no Wimp! Its directivity reduces QRM/noise and lets you *focus* your signal in the direction you want -- work some real DX.

You can operate 6 bands -- 40, 20, 15, 10, 6 and 2 Meters -- and run *full 1500 Watts* SSB/CW on all HF bands!

Features automatic band switching and uses highly efficient end-loading with its *entire length* always radiating. With 6 and 2 Meters thrown in, you have ham radio's most versatile *rotatable* dipole!

Each HF band uses a separate, efficient end-loading coil wound on fiberglass forms with *Teflon*™ wire, and capacitance hats at each end (no lossy traps). 6 and 2 meters are *full-length* halfwave dipoles.

Built-to-last -- incredibly strong solid rod fiberglass center insulator and 6063 T6 aircraft strength aluminum tubing radiator. Assembles in an afternoon. Adjusting one band has little effect on other bands.

MFJ-1775W, $249.95. WARC band version for 12, 17, 30, 60 Meters only.

MFJ *G5RV Antenna*

MFJ-1778 **$44.95**

Covers all bands, 160-10 Meters with antenna tuner. 102 feet long. Can use as inverted vee or sloper. Use on 160 M as Marconi. 1500 Watts. Super-strong fiberglass center/feedpoint insulators. *Glazed ceramic* end insulators. All hand-soldered connections. Add coax, some rope and you're *on the air!*

MFJ-1778M, $39.95. G5RV Junior. Half-size, 52 ft. 40-10M with tuner, 1500 Watts.

Free MFJ Catalog

Visit: http://www.mfjenterprises.com or call toll-free 800-647-1800

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Prices and specifications subject to change.

MFJ . . . the world leader in ham radio accessories!

MFJ Off-Center Fed Dipoles

No antenna tuner needed!

OCFDs professionally engineered for 40/20/10/6; 60/30; 80/40; 160/75 Meters with wide bandwidth, ground-reinforced gain, balun, matching network!

How good are these MFJ *Off Center Fed Dipoles*?
http://www.eham.net/reviews/detail/8917 for reviews by real users.
Visit ***http://www.mfjenterprises.com/ocfd/*** *for more information.*

New MFJ wideband Off-Center Fed Dipoles (OCFD) deliver ground reinforced gain that more expensive multiband verticals can't match. Plus, on second harmonic bands the clover-leaf pattern doubles signal intensity yet again! The MFJ-2010 and MFJ-2012 can even quadruple your signal on the higher bands!

No Tuner Needed!

MFJ's computer modeling determined a feedline offset that gives the *same* feedpoint impedance on every band. MFJ's exclusive *ExactRatio*™ broadband RF transformers convert this impedance to 50 Ohms to give you low SWR on *all* bands.

Use as Dipole, Vee, Sloper

Use as dipole, inverted Vee or sloper. Horizontal mounting up 35-70 feet is ideal. Feed block has attachment points for tower or tree support.

Stealthy -- Low Profile

The single wire radiator and compact matching network are virtually invisible in the air.

Built-in Current Balun

OCFDs *require* excellent current baluns to eliminate feedline radiation. *Built-in* Guanella current-balun has 30-dB of *measured* common-mode rejection 80-10 Meters. Kills feedline radiation, pattern distortion, SWR shifts, RFI, noise pickup.

Best SWR at Typical Height

Feedpoints are compensated for ground proximity at typical backyard mounting height to ensure best SWR at your location.

98 Percent Efficient

MFJ's unique matching network delivers 98% of every watt you apply directly into the antenna's full-sized dipole radiator for unparalleled efficiency.

Handles 1500 Watts

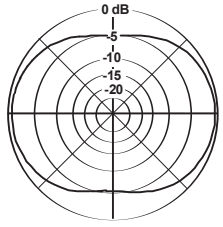
The MFJ-2012/2014/2016 feature heavy-duty high power components to handle 1500 Watts PEP SSB/CW.

Built-to-Last

Rugged 14-guage 7-strand copper antenna wire, porcelain end insulators. Pull-tested to 200 lbs. UV-resistant, stainless-steel hardware, *Teflon*® SO-239 connector -- *built-to-last*.

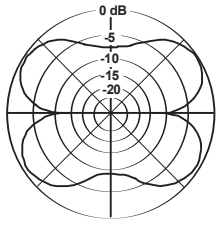
Modeled Azimuth Radiation Patterns, Measured SWR for MFJ-2012/2010*

160M/MFJ-2016, 80M/MFJ-2014, 60M/MFJ-2013, 40M/MFJ-2012/10



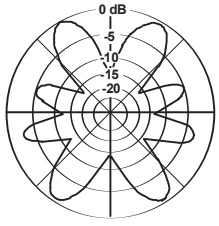
Outer Ring 6.5 dBi

80M/MFJ-2016, 40M/MFJ-2014, 30M/MFJ-2013, 20M/MFJ-2012/10



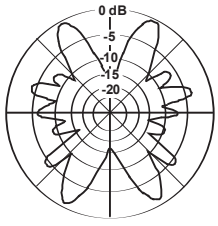
Outer Ring 9.1 dBi

10M/MFJ-2012/MFJ-2010



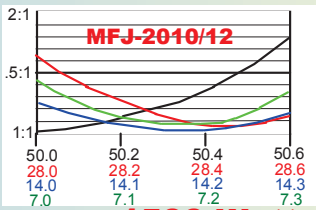
Outer Ring 9.8 dBi

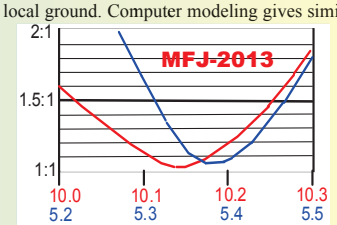
6M/MFJ-2012/MFJ-2010

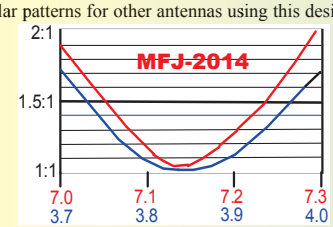


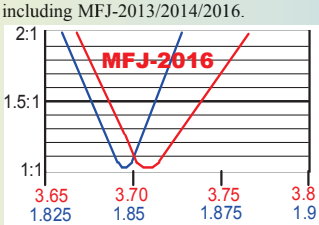
Outer Ring 11.5 dBi

*All models made at 50 feet over local ground. Computer modeling gives similar patterns for other antennas using this design including MFJ-2013/2014/2016.









1500 Watt OCFD Models

MFJ-2012
$79.95
40, 20, 10, 6M

MFJ-2012, $79.95. For 40, 20, 10 and 6 Meters. Day or night, there's always DX on one of these bands. If you hear it, you'll work it -- even QRP! MFJ-2012 is 66 feet long.

MFJ-2014, $99.95. DX-Caster for 75 and 40 Meters: Replace your old 75-Meter dipole and add 9-dBi of power-house coverage on 40 Meters for superb DX. 122 feet long.

MFJ-2014
$99.95
75, 40 Meters

Normally, a OCFD cut for 3.85 MHz resonates on 7.7 MHz. The frequency compensated MFJ-2014 resonates at *mid-band* on both 75 and 40!

MFJ-2016, $129.95. For 160 and 75 Meters. Covers low end of 160 Meters plus delivers 9-dBi gain in 75 Meter SSB DX window. MFJ-2016 is 240 feet long with strong porcelain end insulators.

300 Watt OCFD Models

MFJ-2010, $59.95. For 40, 20, 10 and 6 Meters. Perfect for low-profile set-ups, portable, QRP, and DX-peditions.Weighs less than two pounds, tucks easily into a backpack and pulls high in the air with lightweight cord. The 66 foot wire element and compact matching network are virtually invisible in the air.

MFJ-2013, $79.95. For 60/30 Meters. Get full halfwave dipole performance on 60-Meters plus up to 9-dBi of globe spanning gain on 30M. Brings a whole new meaning to 30-Meter QRP. 86 feet long.

MFJ-2010
$59.95
40, 20, 10, 6 Meters

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MFJ . . . The World Leader in Amateur Radio!

MFJ G5RV Antennas

Operate all bands 10 thru 160 Meters with a single wire antenna!

MFJ-1778
$44.95

***The** famous G5RV antenna is the most popular ham radio antenna in the world!* You will transmit and receive strong signals day and night.

And it's no wonder . . . it's an efficient, *all band* antenna that's only 102 feet long -- shorter than an 80 Meter dipole. Has 32.5 foot ladder line matching section ending in SO-239 connector for your coax feedline.

Use as Inverted Vee or Sloper and it's even more compact and needs just one support.

With an antenna tuner, you can operate all bands 80 Meters through 10 Meters and even 160 Meters with a ground.

MFJ's fully assembled G5RV handles 1500 Watts. *Ceramic* end and fiberglass center insulators. *Hang and Play™* -- add coax, some rope to hang and you're on air!

MFJ-1778M, $39.95. *Half-size*, 52 foot *G5RV JUNIOR* covers 40-10 Meters with tuner. Handles full 1500 Watts.

MFJ All Band Doublet

MFJ-1777
$59.95

MFJ-1777 is a 102 foot *all band* doublet antenna that covers 160 through 6 Meters with a balanced line tuner. Super strong custom fiberglass center insulator provides stress relief for ladder line (100 ft. included). Authentic *glazed ceramic* end insulators. Handles full 1500 Watts.

MFJ *Dual Band* 80/40 *or* 40/20M Dipoles

MFJ-17758
$89.95
80/40 Meters

MFJ-17758 is a short *dual band* 80/40 Meter dipole antenna that is only 85 feet. *Full-size* on 40 Meters with ultra-efficient end-loading on 80 Meters. Full 1500 Watts. Super-strong injection-molded center insulator with *built-in* SO-239 connector and hang hole. Solderless, crimped construction. 7-strand, #14 gauge hard copper wire. Connect your coax feedline directly, *no tuner needed.*

MFJ-17754, $59.95. Short *dual band* 40/20 Meter dipole antenna is only 42 feet. *Full-size* on 20 Meters, ultra-efficient end-loading on 40 Meters. 1500 Watts. Center insulator with SO-239 connector and hang hole.

MFJ *Single Band* Dipole Antennas

Ultra high quality center fed dipoles will give you trouble-free operation for years. Custom injection-molded UV-resistant center insulator has built-in coax connector and hanging hole. Heavy duty 7-strand, 14-gauge hard copper antenna wire. Extremely strong solderless crimped construction. Authentic *glazed ceramic* end insulators. Use as horizontal or sloping dipole or inverted vee. Handles full 1500 Watts. Simply cut to length for your favorite frequency with cutting chart provided.

MFJ-1779A **$69.95** 160M, 265 ft.
MFJ-1779B **$49.95** 80-40M, 135 ft.
MFJ-1779C **$29.95** 20-6M, 35 ft.

True 1:1 Current *Balun & Center Insulator*

MFJ-918
$24.95

True *1:1 Current Balun/ Center Insulator* forces equal antenna currents in dipoles for superior performance. Reduces coax feedline radiation and field pattern distortion -- your signal goes where *you* want it. Reduces TVI, RFI and RF hot spots in your shack. *Don't build a dipole without one!* 50 hi-permeability ferrite beads on high quality RG-303 *Teflon*® coax and *Teflon*® coax connector. Handles full 1.5kW 1.8-30 MHz. Stainless steel hardware with *direct* 14 gauge stranded copper wire connection to antenna. 5x2 inches. Heavy duty weather housing.

RF Isolator

MFJ-915
$29.95

MFJ-915 *RF Isolator* prevents unwanted RF from traveling on the outside of your coax shield into your transceiver. This unwanted stray RF can cause painful RF "bites" when you touch your microphone or volume control, cause your display or settings to go crazy, lock up your transceiver or turn off your power supply. In mobile installations, stray RF could cause your car to do funny things even blow your car computer. Clear up these problems, plug an MFJ-915 between your antenna and transceiver. 5x2 in. Handles full 1500 Watts. Covers 1.8-30 MHz. **MFJ-919, $59.95.** 4:1 current balun,1.5 kW. **MFJ-913, $29.95.** 4:1 balun, 300 Watts.

Antenna Switches

MFJ-1704
$79.95
4-Positions

MFJ-1704 heavy duty *antenna switch* lets you select 4 antennas or ground them for static and lightning protection. Unused antennas automatically grounded. Replaceable lightning surge protection. Good to 500 MHz. 60 dB isolation at 30 MHz. 2.5 kW PEP. Less than .2 dB insertion loss, SWR below 1.2:1. SO-239 connectors. Handy mounting holes. 6¼Wx4¼Hx1¼D in.

MFJ-1702C
$39.95
2-Positions

MFJ-1702C Like MFJ-1704, but for 2 antennas. 3Wx2Hx2D"

MFJ-1700C
$99.95

MFJ-1700C *Antenna/ Transceiver Switch* lets you select one of six antennas and one of six transceivers in any combination. Plug in an antenna tuner or SWR wattmeter and it's always in-line for any antenna/transceiver combination. Has lightning surge protection. Handles 2 kW PEP SSB, 1 kW CW, 50-75 Ohm loads. Unused terminals are automatically grounded. 1.8 to 30 MHz. SO-239 connectors. 4¾W6½Hx3D inches.

MFJ-1701
$69.95

MFJ-1701 *Antenna Switch* like MFJ-1700C but lets you select one of six antennas only. 10Wx3Hx1½D inches.

33 ft. Telescoping fiberglass Mast

3.8 feet collapsed, 3.3 lbs.

MFJ-1910
$79.95

Super strong fiberglass mast has huge 1¾ inch bottom section. Flexes to resist breaking. Resists UV. Put up *full size* inverted Vee dipole/vertical antenna in minutes and get *full size performance!*

Make your own antennas

Dipoles, G5RV, Random Wire, Doublets, Beverage Antennas, etc.

MFJ-16C06, $4.56. 6-pack authentic *glazed ceramic* end/center antenna insulators.
MFJ-16B01, $19.95. Custom injection-molded UV-resistant center insulator has built-in coax connector and hanging hole.
MFJ-18G100, $24.95. 100 ft. of flexible, 7-strand, 14-gauge solid copper antenna wire.
MFJ-58100X, $49.95. 100 ft. 50-Ohm RG-8X with PL-259s on each end.
MFJ-18H100, $34.95. 100 feet, 450 Ohm ladder line, 18 gauge copper covered steel.

Lightning Surge Protectors

Ultra-fast gas discharge tube shunts 5000 amps peak. Less than 0.1 dB loss. Up to 1000 MHz. SO-239s. **MFJ-270, $29.95.** 400W PEP. **MFJ-272, $39.95.** 1500W PEP.

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MFJ Big Stick™

18 Foot *Portable* Telescoping Antenna

Only 28 inches collapsed . . . Covers 40-6 Meters -- No gaps!

MFJ-2286
$99.95

The MFJ BigStick™ antenna is for the on-the-go Ham who is hungry for the next great QSO anywhere or anytime!

Full Size Performance

For top portable performance, carry a *Big Stick* for the loudest, strongest on-the-go signal on the band!

MFJ's extra long 17 foot stainless-steel telescoping whip gives you *full-size antenna* for full size performance 20 to 6 Meters but collapses to just 28 inches.

An ultra low loss, high-Q adjustable *air-wound* loading coil gives you highly efficient operation 30 and 40 Meters.

This extra long radiator and ultra low loss loading coil is a winning combination that stands head and shoulders above shorter backpack antennas.

True Backpack Portability

Antenna is over 18 feet long fully extended, but disassembles and collapses to 28 inches in seconds. Fits into most backpacks or suitcases! And at just over 2 pounds you'll hardly know you are packing it!

True General Coverage

Tapped loading coil covers 7.0-55.0 MHz without gaps. Great for Ham Bands and outstanding for image-free shortwave broadcast!

Everything you need

Everything is included for instant operation. Pipe/Mast mount quickly and easily mounts to any pipe or mast up to 1/2 inch. SO-239 for coax. 3/8-24 antenna connector.

Counterpoise kit included: Ensures low SWR, high efficiency.

Rugged Construction

All aluminum, stainless steel construction ensures years of excellent performance. *One Killowatt rated* components guarantee electrical safety.

40-2 Meters Apartment Antenna

MFJ-1622
$99.95

MFJ-1622 universal mount/clamp lets you attach it to window frames, balconies and railings. Works great indoors mounted to table/bookshelf. It's not a 5-element yagi, but you'll work your share of exciting DX! Highly efficient air wound *"bug catcher"* coil, telescoping 4½ foot radiator. Collapses to 2½ feet for easy storage and carrying. Includes coax, choke balun, counterpoise wire, safety rope. Operating frequency adjusted by moving "wander lead" on coil and adjusting the counterpoise for best SWR. ***Optional DX-Getter,*** MFJ-1977, $44.95. Stainless-steel 12-ft whip, 26 inches collapsed.

MFJ *BigEAR™*

8-Band Portable Dipole

34 feet Radiators, 7-55 MHz

For hams on-the-go!

Operate anywhere, anytime with a strong QSO grabbing signal!

34-Feet stainless steel radiator gives you *full-size dipole* performance on 20-6 Meters and highly efficient ultra *low loss* loaded dipole performance on 30/40 Meters. Collapses to 27 inches to fit into any suitcase or backpack. No ground or counterpoise needed.

True general coverage -- tunes up with low SWR on any frequency 7-55 MHz. Handles QRP to full killowatt PEP.

Ultra low loss high-Q *air-wound* loading coil. Built-in Guanella current balun kills feedline radiation, pattern distortion, RF shifts, RFI and noise pickup.

Distinctive V-shaped elements are set 45 degrees from the horizon to keep element tips high in the air. This maximizes radiation, minimizes ground loss and prevents hazardous contact.

MFJ's heavy-duty *NoTool*™ mast lock lets you easily and quickly mount on any tripod or mast up to 7/8 inches. SO-239 for coax. With fewer parts to assemble, set-up and tune-up is much faster!

18 foot Telescopic Fiberglass Mast with Tripod

MFJ-1919EX, $139.95.

***Put your antennas anywhere and get them up high with this super-strong* 18 foot telescoping fiberglass mast and heavy-duty steel MFJ-1919 tripod.**

QuickClamps™ easily collapses mast to 5 feet. Mast has thick 1/8 inch wall, .75 inch diameter top, 1.5 inch bottom. 15 lbs.

All tripods are black heavy-duty steel with braced triangle base, non-skid feet and mast lock.

MFJ-1918EX, $89.95. MFJ-1918 *tripod with super strong 9.5 foot telescoping fiberglass mast.* Collapses to 3.8 feet. *QuickClamps*™. Mast has thick 1/8" wall, ¾ inch top, 1 inch bottom. Weighs 6.5 lbs.

Tripods Only

MFJ-1919, $89.95, *Large tripod*. Supports 100 lb. antenna. Built-in 1.4 inch diameter mast extends 7.8 feet. Collapses to 4.5Hx.5D feet. Triangle base spreads to 4.8 feet on a side. Weighs 9.75 lbs.

MFJ-1918, $49.95, *Smaller tripod*. Supports 66 lbs. 1 inch diameter mast extends 6 foot. Collapses to 3.2Hx.3D feet. Triangle base spreads to 2.75 feet. Weighs 6.75 lbs.

17 foot *Stainless Steel* Telescoping Whip

MFJ-1979, $59.95. Super-strong, super long *17 foot stainless steel* telescoping whip. 27 in. collapsed. 10 sections. 3/8-24 threaded base. **MFJ-1977, $44.95**/12ft;**MFJ-1796, $39.95**/10ft **MFJ-1974, $34.95**/8ft;**MFJ-1972,** $14.95/4½ft

Single-band Rotatable *mini*-Dipoles

Use these inexpensive, lightweight, *isolated* mini-dipoles when space is limited for temporary or permanent installations. Rotate to null QRM/noise and to focus your signal. Coax choke balun, mast not included. For 40/30/20/17/15/12/10/6 Meters. Order **MFJ-22XX** (insert band in "XX") **$44.95**. 75/60 Meters, $49.95 each. Total length 14 feet. For mounting masts up to 1.25" OD.

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MFJ *Switching* Power Supplies

Power your HF transceiver, 2 meter/440 MHz mobile/base and accessories with these highly reliable 15, 22, 30, 40 or 75 Amp MFJ Switching Power Supplies!

No RF hash . . . Super lightweight . . . Super small . . . Volt/Amp Meters . . .

MFJ's adjustable voltage switching power supplies do it all! Power your HF or 2M/440 MHz radio and accessories.

MFJ's *MightyLites*™ are so light and small you can carry them with one hand! Take them with you anywhere.

No more picking up and hauling around heavy, bulky supplies that can give you a painful backache, pulled muscle or hernia.

These babies are clean . . . Your buddies won't hear *any* RF hash on your signal! *None* in your receiver either! These super clean *MightyLites*™ meet all FCC Class B regulations.

Less than 35 mV peak-to-peak ripple under 25 or 45 amp full load. Load regulation is better than 1.5% under full load.

You won't burn up our power supplies! MFJ Power supplies are *fully protected* with Over Voltage, Over-temperature and Over Current protection circuits.

MFJ *MightyLites*™ can be used anywhere in the world! They have switchable AC input voltage and work from 85 to 135 VAC or 170 to 260 VAC. Replaceable fuse.

A whisper quiet internal fan efficiently cools your power supply for long life.

22 Amp Continuous

MFJ-4125 **$84.95**

Ham Radio's smallest and lightest 22 Amp continuous power supply is also its best selling!

22 Amps continuous/25 Amps max at 13.8VDC. 5-way binding posts on front, 5A quick connects on back. 85-135/170-260 VAC input. 2.9 lbs. 5¾Wx3Hx5¾D".

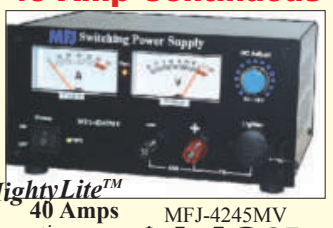
MFJ-4125P, $94.95. Adds 2-pairs *Anderson PowerPoles*™.

22 Amp Continuous

MFJ-4225MV **$99.95**

22 Amps continuous, 25 Amps maximum. Like MFJ-4125 but adds Volt/Amp meters, cigarette lighter plug. Adjustable 9-15 VDC Output. 5¼Wx 4½Hx6D in. Weighs 3.7 lbs. Use 85-135 VAC or 170-260 VAC input. Replaceable fuse.

40 Amp Continuous



MFJ-4245MV **$149.95**

40 Amps continuous, 45 Amps max. Adjustable 9-15 VDC output. Volt/Amp meters, cigarette lighter plug, front 5-way binding posts, two rear quick connects. 5.5 lbs. 7½Wx 4¾Hx9D inches. Use 85-135 VAC or 170-260 VAC input. Replaceable fuse.

70 Amp Continuous

MFJ-4275MV **$249.95**

75 Amps maximum and 70 Amps continuously. Adjustable voltage 4.0-16 VDC. Short circuit, overload and over-temperature protection, 10.5 lbs. 9¾Wx5½Hx9½D". Great for Ameritron's ALS-500M mobile amplifier!

High Current Multiple DC Power Outlets

Power multiple Transceivers/accessories from a* single *DC power supply . . . Keeps you neat, organized and safe . . .Prevents fire hazard . . . Keeps wires from tangling up and shorting . . . Fused and RF bypassed . . . 6 foot, 8 gauge color coded cable . . .

Versatile 5-Way Binding Posts

MFJ-1118, $84.95. 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. 8 pairs binding posts, 15A total.Voltmeter, on/off switch.

MFJ-1112, $44.95. 6 pairs binding posts, 15 Amps total.

MFJ-1117, $64.95. Powers *four* transceivers simultaneously (two at 35 Amps each and two at 35 Amps combined). 8x2x3 inches.

***All PowerPoles*™**

MFJ-1128, $104.95. 3 high-current outlets for transceivers. 9 *switched* outlets for accessories. Mix & match included fuses as needed (one-40A, one-25A, four-10A, four-5A, three-1A fuses installed). 0-25 VDC *Voltmeter*. *Extra* contacts, fuses. 12Wx1¼Hx2¾D".

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.

***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

MFJ-1118 **$84.95**

MFJ-1116 **$59.95**

MFJ-1112 **$44.95**

MFJ-1117 **$64.95**

MFJ-1128 **$104.95**

MFJ-1126 **$84.95**

MFJ-1129 **$114.95**

MFJ-1124 **$64.95**

(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. 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*.

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As of 4/1/13, the IC-7100 has not been approved by the Federal Communications Commission.
This device may not be sold or leased, or be offered for sale or lease, until approval of the FCC has been obtained.
*Frequency coverage may vary. Refer to owner's manual for exact specifications.

ICOM®

QST QuickStats

sta·tis·tics (st-tstks) n.
1. (used with a sing. verb) The mathematics of the collection, organization, and interpretation of numerical data, especially the analysis of population characteristics by inference from sampling.
2. (used with a pl. verb) Numerical data.

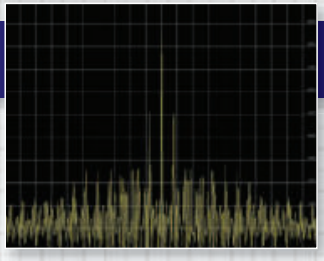
www.arrl.org/QuickStats

Online QuickStats Poll Results for April 3 through May 7, 2013.

Get on the web and vote today at **www.arrl.org/quickstats**!

Where is your primary HF vertical antenna installed?

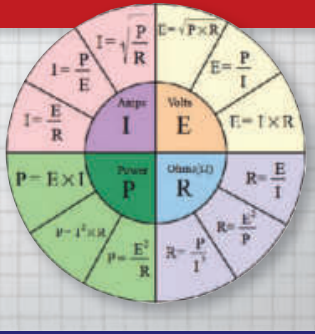
- At ground level **27%**
- Above ground on a pole or mast **15%**
- On or near a roof **8%**
- On a balcony or deck **3%**
- On a tower **5%**
- Other location **5%**
- I don't own a vertical antenna **37%**



What is your favorite voice mode?

- SSB **71%**
- AM **1%**
- FM **14%**
- Digital **6%**
- I don't operate voice **8%**

How long has it been since you've used Ohm's Law to help design a circuit or solve a problem?



- Within the past week **24%**
- Within the past month **23%**
- At least once in the past year **22%**
- It has been several years **20%**
- Never **11%**

Does your home antenna system include any type of lightning protection?

- Yes **62%**
- No **34%**
- I don't have an antenna system at home **4%**

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- 522 Alphanumeric Memory Channels
- One Touch Reply Function
- Digital Voice/GPS (Optional UT-123 Required)
- Low Speed Data (Optional OPC-1529R Required)

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- Free Programming Software![†]

[†] *www.icomamerica.com/amateur/DSTAR for details about free software*

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D-STAR ready

- 10 Watt on 23cm (FM, DV, DD)
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- 100 Alphanumeric Memory Channels
- USB Rig Control, Ethernet Plug for DD
- Black Box Operation
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- PC Software Included

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- RX: 0.495–999.990MHz*
- 1052 Alphanumeric Memory Channels
- Li-ion Battery
- Free Programming Software[†]

[†] *www.icomamerica.com/amateur/DSTAR for details about free software*

IC-92AD
2m + 70cm MILITARY RUGGED AND SUBMERSIBLE

D-STAR ready

- 5/2.5/0.5/0.1 Watt Output
- RX: 0.495–999.990, 118–174, 350–470MHz*
- 1304 Alphanumeric Memory Channels
- Optional GPS Speaker Mic (HM-175GPS)
- IPX7 Submersible

ID-31A
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D-STAR ready

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- RX: 400–479MHz*
- 1252 Alphanumeric Memory Channels
- Built-in GPS Receiver
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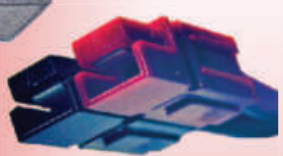

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Memory Channels: 199 channels
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Operating Voltage: 7.4V
Waterproof: IP 55,
Standard SMA antenna connector
FCC Certified

TYT TH-UVF1A Dual Band HT
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Connector: PL-259

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Frequency (MHz): 144/430
Max.Power(W): 60
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Weight(g): 135
Connector: PL-259

P-800 External Speaker
Speaker Max Power: 5 Watts
Cord: 4M
Plug: 3.5mm mono
Size: 90x85x35MM

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Max.Power(W): 150
V.S.W.R: <1.5
Length (M): 1.04
Weight(g): 350
Connector: PL-259

WP-115
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Z (ohms): 50
Max Power: 10W
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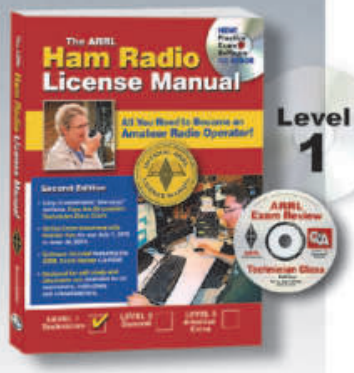

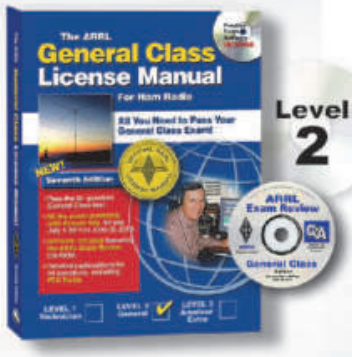

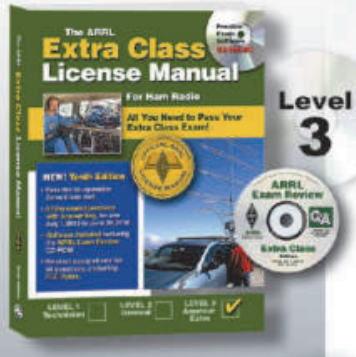

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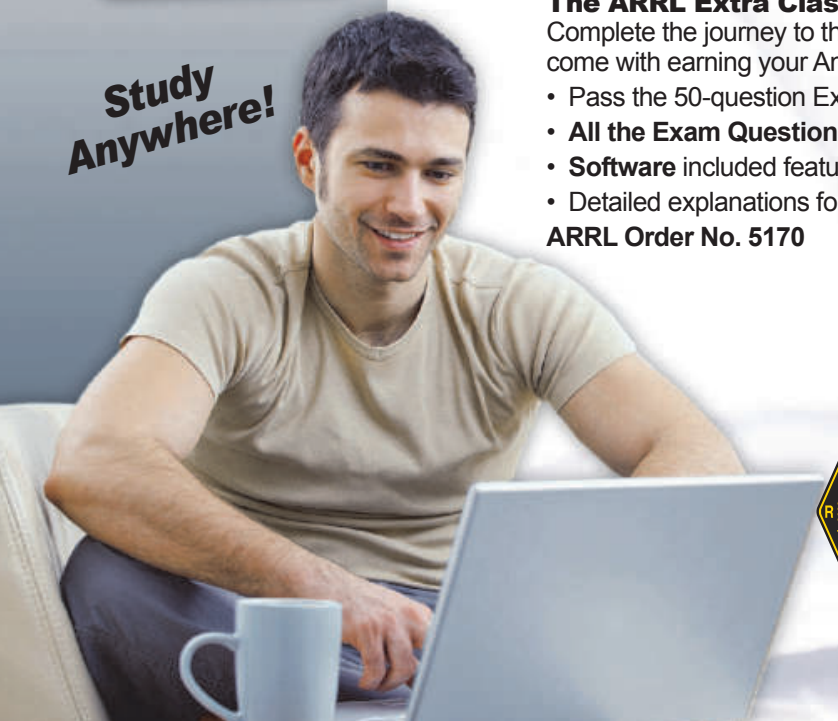

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Please contact the
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1. Advertising must pertain to products and services which are related to Amateur Radio.

2. The Ham-Ad rate for commercial firms offering products or services for sale is $2.25 per word. Individuals selling or buying personal equipment: ARRL member 1.00 per word. Non-ARRL member $1.50 per word. **Bolding** is available for $2.50 a word. Prices subject to change without notice. You may pay by check payable to the ARRL and sent to: Ham-Ads, ARRL, 225 Main St., Newington, CT 06111. Or, you may pay by credit card sending the information by fax to 860-594-4285 or via e-mail to hamads@arrl.org. The credit card information we need is: the type of credit card, the exact name that appears on the credit card, the credit card number, the expiration date and the credit card billing address.

3. Remittance in full must accompany copy since Ham-Ads are not carried on our books. Each word, abbreviation, model number and group of numbers counts as one word. Entire telephone numbers count as one word. No charge for postal Zip code. No cash or contract discounts or agency commission will be allowed. Tear sheets or proofs of Ham-Ads cannot be supplied. Ads submitted in writing should be typed or printed clearly on an 8 1/2" X 11" sheet of paper.

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5. No Ham-Ad may use more than 200 words. No advertiser may use more than two ads in one issue. A last name or call must appear in each ad. Mention of lotteries, prize drawings, games of chance etc is not permitted in *QST* advertising.

6. New firms or individuals offering products or services for sale must check with us to determine if a production sample (which will be returned) should be submitted for examination. Dealers are exempted, unless the product is unknown to us. Check with us if you are in doubt. You must stand by and support all claims and specifications mentioned in your advertising.

The publisher of *QST* will vouch for the integrity of advertisers who are obviously commercial in character and for the grade or character of their products and services. Individual advertisers are not subject to scrutiny.

The American Radio Relay League does not discriminate in its advertising on the basis of race, color, religion, age, sex, sexual orientation, marital status or national origin. The League reserves the right to decline or discontinue advertising for any other reason.

7. AN IMPORTANT NOTICE TO ALL HAM AD POSTERS AND RESPONDERS, FROM THE ARRL ADVERTISING DEPARTMENT Greetings from ARRL HQ! Please note that we have received reports from many ARRL members who have placed classified ads in these listings, and have received responses from individuals proposing "creative" payment schemes. These particular instances involved offers of overpayments for goods by bank check, followed by instructions to deduct the cost of your item from the overpayment, and to transfer the overage back or to another individual. This is a well-known scam. Unfortunately, we have no control over this and other scams of this type. Once your email address is posted, you are vulnerable to those individuals seeking to provide you with questionable information.

QST Ham Ads on the Web
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QST Advertising Deadlines:

Issue	Reservation Date	Materials Due Date
August 2013	Wednesday, June 12, 2013	Friday, June 14, 2013
September 2013	Wednesday, July 17, 2013	Friday, July 19, 2013

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HD9-60/HD9-80	$2109/3129
HD11-80/HD11-90	$3559/4189
HD12-70/HD12-80	$2899/3579
HD16-60/HD16-80	$2569/3799
HD21-50/HD21-60	$1989/2619
HD21-70/HD35-40	$3239/1859

GUY HARDWARE

3/16"EHS, 500 / 1000'	$139/259
1/4"EHS, 500' / 1000'	$159/329
3/16" / 1/4" Big Grip™	$7/8
5/16" Thimble	$1.35
3/8" Thimble	$1.45
3/8x6" EE Turnbuckle	$16
3/8"x6" EJ Turnbuckle	$19
1/2"x9" EE Turnbickle	$25
1/2"x9" EJ Turnbuckle	$28
1/2x12" EE Turnbuckle	$29
1/2"x12" EJ Turnbuckle	$32
#502 Strain Insulator	$8
#504 Strain Insulator	$10

GLEN MARTIN

H2 Hazer (12 sq. ft.)	$609
H3 Hazer (8 sq. ft.)	$459
H4 Hazer (16 sq. ft.)	$589
RT-424, 4.5' (6 sq. ft.)	$319
RT-832, 8' (8 sq. ft.)	$469
RT-936, 9' (18 sq. ft.)	$779
RT-1832, 17.5' (12 sq. ft.)	$1029
RT-2632, 26' (9 sq. ft.)	$1709

PHILLYSTRAN

HPTG-1200I	$.49/ft.
HPTG-2100I	$.75/ft.
HPTG-4000I	$1.05/ft.
HPTG-6700I	$1.45/ft.
PLP-2738 Big Grip™	$9
PLP-2739 Big Grip™	$12
PLP-2755 Big Grip™	$18

ROHN

25G, Middle Section	$119
25AG2, Sleeve Top	$189
25AG4, Flat Top	$239
AS25G, Rotor Shelf	$65
BPC25G, Base Plate	$69
BPH25G, Hinged Base	$279
HB-25AG/BG/CG	$119/129/149
GA25GD, Guy Assembly	$179
SB25G, Short Base	$79
SB25G5, Short Base (5')	$109
SBH25G, Hinged Short Base	$249
TB3, Thrust Bearing	$159

ALUMINUM

O.D.	WALL	$/FT.
6063-T832 DRAWN TUBING		
.375"	.058"	$.65
.500"	.058"	$.70
.625"	.058"	$.80
.750"	.058"	$.90
.875"	.058"	$.95
1.000"	.058"	$1.00
1.125"	.058"	$1.10
1.250"	.058"	$1.30
1.375"	.058"	$1.40
1.500"	.058"	$1.50
1.625"	.058"	$1.65
1.750"	.058"	$1.80
1.875"	.058"	$1.95
2.000"	.058"	$2.10
2.125"	.058"	$2.25

ROTOR CABLE

R62, 6-C (6#18)	$.59/ft.
R81, 8-C (2#18/6#22)	$.49/ft.
R82, 8-C (2#16/6#18)	$.79/ft.
R83, 8-C (2#14/6#18)	$.89/ft.

COAX

9913F7	$1.39/ft.
BuryFLEX	$.89/ft.
LMR-100	$.59/ft.
LMR-200	$.65/ft.
LMR-200 Ultraflex	$.85/ft.
LMR-240	$.69/ft.
LMR-240 Ultraflex	$.89/ft.
LMR-400	$.89/ft.
LMR-400 Ultraflex	$1.39/ft.
LMR-600	$1.59/ft.
LMR-600 Ultraflex	$2.49/ft.
RG-8X Mini	$.29/ft.
RG-213/U	$.79/ft.

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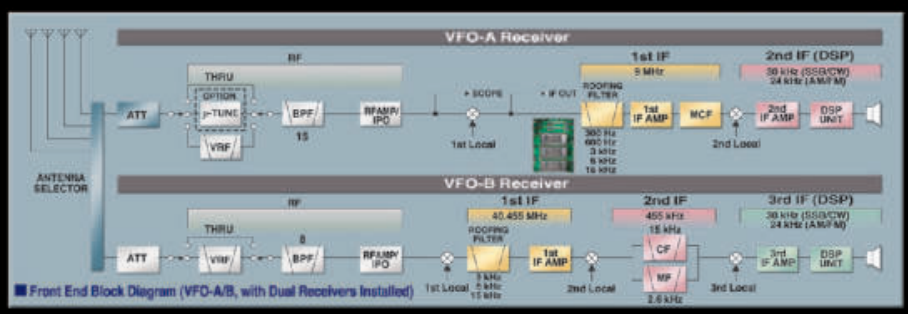
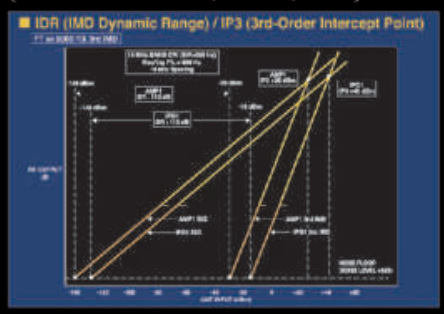


Front End Block Diagram (VFO-A/B, with Dual Receivers Installed)



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- USB, Serial and LAN ports.
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