QST

DEVOTED ENTIRELY TO AMATEUR RADIO

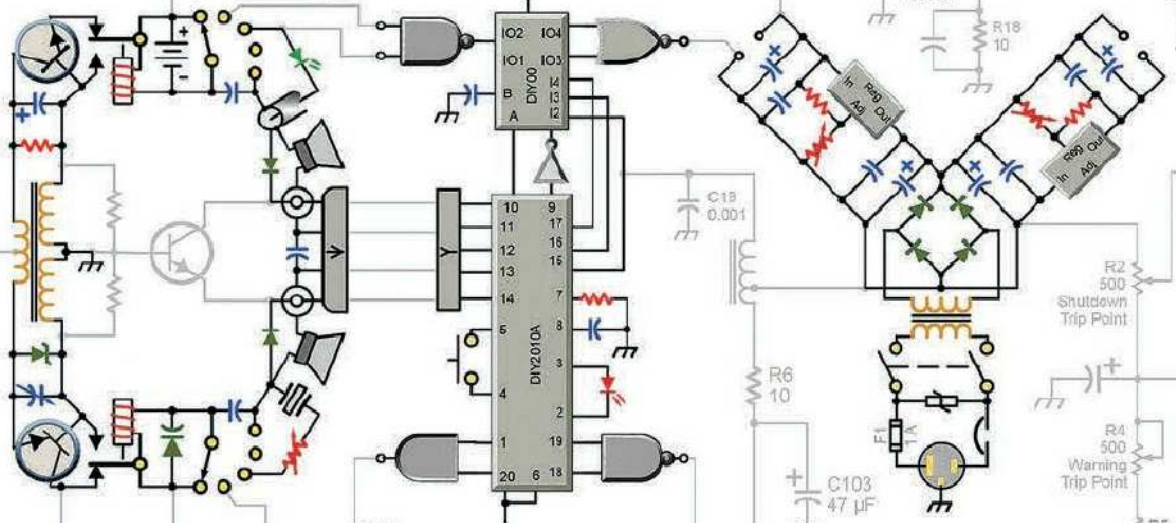
January 2015 WWW.ARRL.ORG

DIGITAL EDITION

QST reviews:

- **Beko-Elektronik HLV-1100**
  70 Centimeter Amplifier
- **MFJ-223 Vector Impedance Antenna Analyzer**
- **Portable Rotation 12PR1A**
  Ultra-Portable DC Antenna Rotator
- **Palstar SP30H**
  Ultimate Communications Speaker

Do It Yourself with Four Fascinating Projects!



DIGITAL FEATURE

100 Years of QST *1915-2015*

The radio... YAESU

FT-991

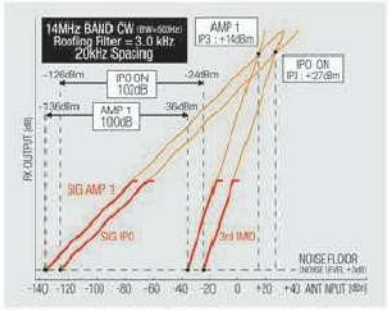
HF/VHF/UHF
ALL MODE TRANSCEIVER

New generation all-band transceiver FT-991 offers full-fledged support for all modes including HF/50/144/430 MHz in a single compact unit

- Triple conversion with 1st IF frequency of 69.450MHz for all bands
- Narrow band 3 kHz roofing filter provided in standard configuration realizes excellent adjacent multi signal characteristics
- Features the highly acclaimed FTDX series quad mixer, along with a dedicated VHF/UHF mixer
- Highly effective interference removal functions are great for stress-free QSOs on the DX and Contest scene
- Final Stage with Ample Power Reserves: 100 W for HF/50 MHz Bands and 50 W for VHF/UHF Bands
- 3.5 inch full color touch panel display for convenient viewing and operation
- Advanced Spectrum Scope Function with Waterfall Display Capability
- Advanced technologies fully utilize the potential of C4FM Digital including high-quality transmit audio, AMS, and Group Monitor functions

* Data FR mode (high speed data communication mode) is not supported therefore image send/receive by C4FM digital is not possible.

3 kHz and 15 kHz Roofing Filter



IDR (IMD Dynamic range) / IP3 (3rd-Order Intercept Point) charactenstics

C4FM Digital Communications
Clear and Crisp Voice Technology

HF/VHF/UHF 100 W
All Mode Transceiver

FT-991

(144 MHz/ 430 MHz 50 W)

YAESU
The radio

YAESU USA
6125 Phyllis Drive, Cypress,
CA 90630 (714) 827-7600

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

System Fusion

The Best Solution for the Future

System Fusion provides Total Integration of Digital and Conventional FM

FM Friendly Digital & Auto Mode Select (AMS)

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

AMS transmit

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

The Choice of C4FM Digital & New Attractive Digital Functions

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

Digital Group Monitor (GM)

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

Smart Navigation

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

Snapshot (Image Data Transmission)

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

C4FM Digital Communication Clear and Crisp Voice Technology

144/430 MHz DUAL BAND
C4FM/FM DIGITAL REPEATER **DR-1X**

System Fusion Lineup

C4FM FDMA 144/430 MHz DUAL BAND
5W DIGITAL/FM TRANSCEIVER
FT1DR *Heavy Duty Package*
(1800 mAh Li-Ion Battery FNB-102LI included)
BLACK
SILVER

C4FM FDMA 144/430 MHz DUAL BAND
50W DIGITAL/FM TRANSCEIVER
FTM-400DR

Amateur Radio Internet Linking Kit
HRI-200

YAESU
The radio

YAESU USA
6125 Phyllis Drive, Cypress,
CA 90630 (714) 827-7600

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

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.

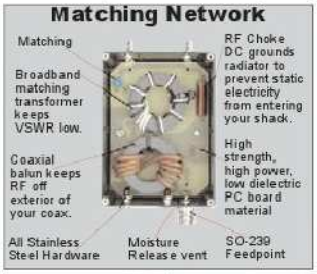
Rugged Construction: Thick fiberglass insulators, all-stainless steel hardware and 6063 aircraft-aluminum tubing is double or triple walled at key stress points to handle anything Mother Nature can dish out.

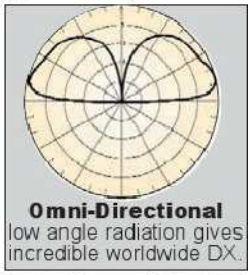
31.5 feet tall, 25 lbs. Mounting mast 1.25 to 2 inches. Wind surface area is 4 square feet.

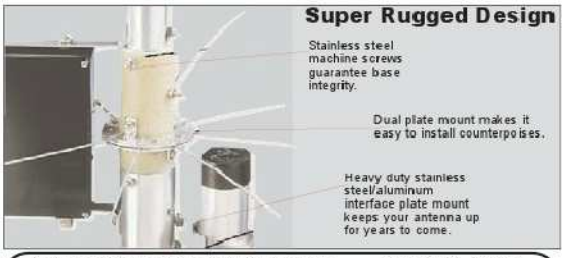
R8, $539.95. Like R9 antenna but less 75/80 Meters.

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

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







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

Cushcraft
Amateur Radio Antennas
308 Industrial Pk. Rd., Starkville, MS 39759 • 8-4:30 CST, M-F
http://www.cushcraftamateur.com

Cushcraft . . . Keeping you in touch around the globe!

C★MET®

Life is a JOURNEY. Enjoy the ride!

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

❶ ❷ ❸ ❹ ❺ ❻ ❼

Base Antennas

❶ C★MET CHA-250B BROADBAND 80M THROUGH 6M VERTICAL ANTENNA

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

❷ Maldol HVU-8 ULTRA-COMPACT 8 BAND HF/VHF/UHF VERTICAL ANTENNA

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

❸ C★MET GP-3 DUAL-BAND 146/446MHZ BASE REPEATER ANTENNA

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

❹ C★MET GP-6 DUAL-BAND 146/446MHZ BASE REPEATER ANTENNA

Wavelength: 146MHz 5/8 wave x 2 • 446MHz 5/8 wave x 5 • Max Pwr: 200W • Length: 10'2"• Weight: 3lbs. 8ozs. • Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

❺ C★MET GP-9 / GP-9N DUAL-BAND 146/446MHZ BASE REPEATER ANTENNA

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

❻ C★MET CX-333 TRI-BAND 146/220/446MHZ BASE REPEATER ANTENNA

Wavelength: 146MHz 5/8 wave x 2 • 220MHz 5/8 wave x 3• 446MHz 5/8 wave x 5 • Max Pwr: 120W • Length: 10'2" • Weight: 3lbs. 1oz.• Conn: Gold-plated SO-239 • Construction: Fiberglass, 2 Sections

❼ C★MET GP-15 TRI-BAND 52/146/446MHZ BASE REPEATER ANTENNA

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

CAA-500

1.8-500MHz SWR/Impedance analyzer

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

SO-239 connector for the low range.

N-female provides stable impedance in the high range

Install 6 AA batteries or use the 12VDC jack.

The primary tool for any antenna adjustment, trouble-shooting or installation project!

CAA-5SC

Protect your CAA-500 from moisture, shock, dents and dings!

Shoulder strap included.

Call or visit your local dealer today!

www.natcommgroup.com | 800-962-2611

C★MET®

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

Includes video
Includes audio
Additional content

In This Issue

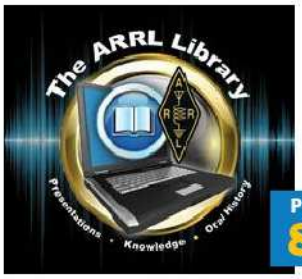
January 2015 **Volume 99 Number 1**

Technical

Page 72

Page 51

News and Features



Page 80

Our Cover
QST's Senior Technical Illustrator, David Pingree, N1NAS, whose schematics and maps appear in every issue, created the fanciful schematic on this month's cover. Hams sketch, plan, model, and experiment, yielding everything from gadgets that make time spent at the operating desk a little more comfortable, to large pieces of gear that are the centerpiece of a station. This issue contains just such a range of "DIY" projects.

Radiosport

Columns

Departments

Digital and Mobile Editions
ARRL members can access the digital edition via a link at **www.arrl.org/qst**, download our *iOS* app from the iTunes Store, and download our *Android* app from the Google Play Store.

Interested in Writing for *QST*?
www.arrl.org/qst-author-guide
e-mail: **qst@arrl.org**

January 2015
Volume 99 Number 1

QST (ISSN:0033-4812) is published monthly as its official journal by the American Radio Relay League, Inc, 225 Main Street, Newington, CT 06111-1494, USA. Periodicals postage paid at Hartford, CT, USA and at additional mailing offices.

POSTMASTER: Send address changes to: *QST*, 225 Main St, Newington, CT 06111-1494, USA. Canada Post: Publications Mail Agreement #90-0901437. Canada returns to be sent to IMEX Global Solutions, 1501 Morse Ave, Elk Grove Village, IL 60007.

US & Possessions: Membership in the ARRL, including a 1-year subscription to *QST*, is available to individuals at $39. Licensed radio amateurs age 21 and under and the eldest licensee in the household may qualify for the rate of $20. Life Membership, including a subscription to *QST* is available at $975.* Membership includes $15 per year for subscription to *QST*. Membership and *QST* cannot be separated. Libraries and institutions, $39 per year. Single copies $4.99.

International
To compensate for additional postage for mailing outside the US, the following rates apply:

Canada: Membership in the ARRL, including a 1-year subscription to *QST*, $49, payable in US funds. Life Membership, including a subscription to *QST* is available at $1225.* Libraries and institutions, $49 per year.

All Other Countries: Membership in the ARRL, including a one year subscription to *QST*, $62, payable in US funds. Life Membership, including a subscription to *QST*, is available at $1550.* Libraries and institutions, $62 per year.

Membership without *QST* is available to the immediate family of a member living at the same address, and to anyone who is legally blind, for $8 per year.

Foreign remittances should be by international postal or express money order or bank draft negotiable in the US and for an equivalent amount in US funds.

QST is available to blind and physically handicapped individuals from the Library of Congress, National Library Service for the Blind and Physically Handicapped. Call 1-800-424-8567 or go to **www.loc.gov/nls/**.

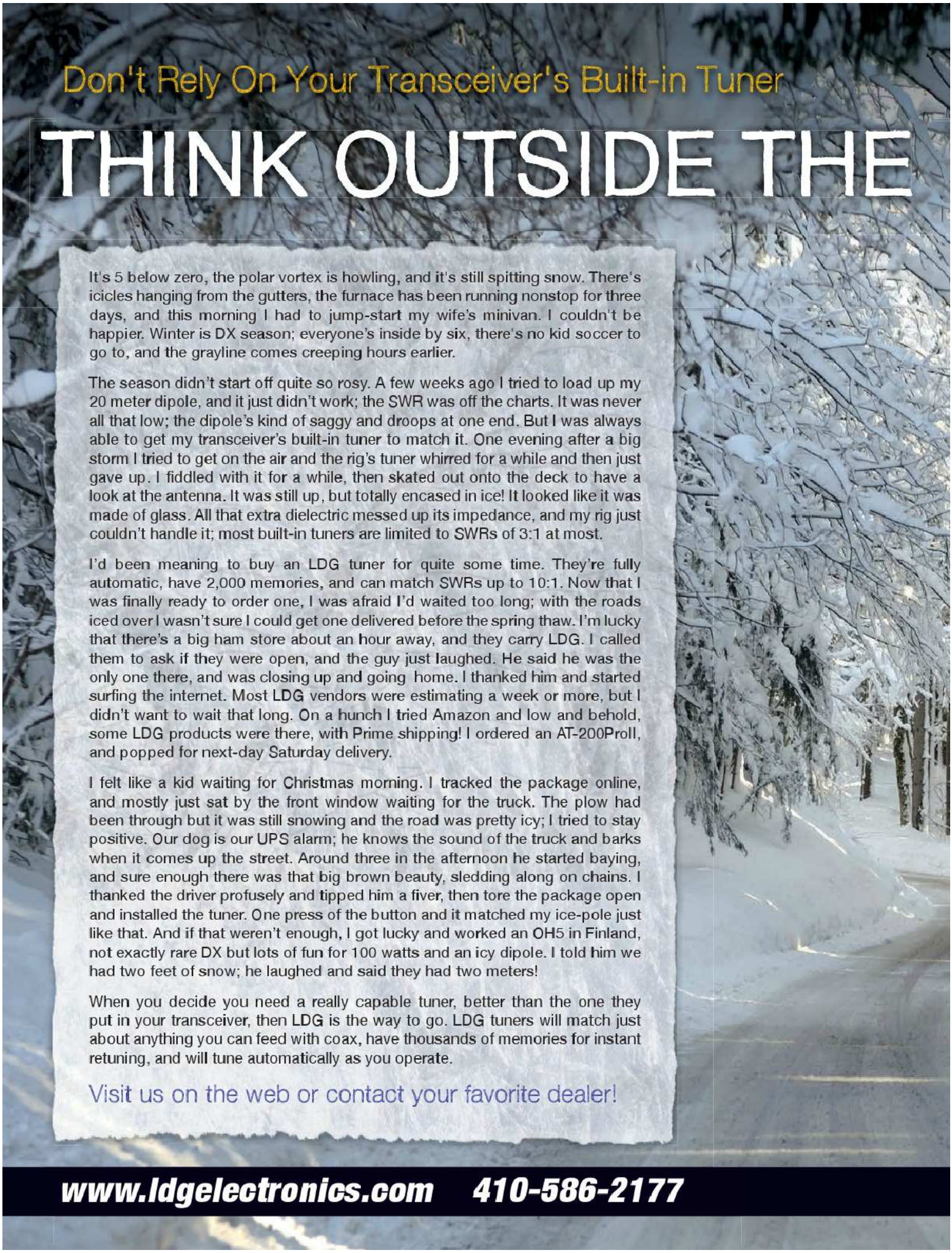
Indexed by Applied Science and Technology Index, Library of Congress Catalog Card No: 21-9421.

*Payment arrangements available. Please write for details.

In order to ensure prompt delivery, we ask that you periodically check the address information on your mailing label. If you find any inaccuracies, please contact the Circulation Department at **circulation@arrl.org** or **860-594-0200** immediately. Thank you for your assistance.

Reprints and permissions: **permission@arrl.org**

Details of our Online Privacy Policy can be found at **www.arrl.org/online-privacy-policy**.
Telephone: **860-594-0200**
Fax: **860-594-0259**



Don't Rely On Your Transceiver's Built-in Tuner

THINK OUTSIDE THE

It's 5 below zero, the polar vortex is howling, and it's still spitting snow. There's icicles hanging from the gutters, the furnace has been running nonstop for three days, and this morning I had to jump-start my wife's minivan. I couldn't be happier. Winter is DX season; everyone's inside by six, there's no kid soccer to go to, and the grayline comes creeping hours earlier.

The season didn't start off quite so rosy. A few weeks ago I tried to load up my 20 meter dipole, and it just didn't work; the SWR was off the charts. It was never all that low; the dipole's kind of saggy and droops at one end. But I was always able to get my transceiver's built-in tuner to match it. One evening after a big storm I tried to get on the air and the rig's tuner whirred for a while and then just gave up. I fiddled with it for a while, then skated out onto the deck to have a look at the antenna. It was still up, but totally encased in ice! It looked like it was made of glass. All that extra dielectric messed up its impedance, and my rig just couldn't handle it; most built-in tuners are limited to SWRs of 3:1 at most.

I'd been meaning to buy an LDG tuner for quite some time. They're fully automatic, have 2,000 memories, and can match SWRs up to 10:1. Now that I was finally ready to order one, I was afraid I'd waited too long; with the roads iced over I wasn't sure I could get one delivered before the spring thaw. I'm lucky that there's a big ham store about an hour away, and they carry LDG. I called them to ask if they were open, and the guy just laughed. He said he was the only one there, and was closing up and going home. I thanked him and started surfing the internet. Most LDG vendors were estimating a week or more, but I didn't want to wait that long. On a hunch I tried Amazon and low and behold, some LDG products were there, with Prime shipping! I ordered an AT-200Proll, and popped for next-day Saturday delivery.

I felt like a kid waiting for Christmas morning. I tracked the package online, and mostly just sat by the front window waiting for the truck. The plow had been through but it was still snowing and the road was pretty icy; I tried to stay positive. Our dog is our UPS alarm; he knows the sound of the truck and barks when it comes up the street. Around three in the afternoon he started baying, and sure enough there was that big brown beauty, sledding along on chains. I thanked the driver profusely and tipped him a fiver, then tore the package open and installed the tuner. One press of the button and it matched my ice-pole just like that. And if that weren't enough, I got lucky and worked an OH5 in Finland, not exactly rare DX but lots of fun for 100 watts and an icy dipole. I told him we had two feet of snow; he laughed and said they had two meters!

When you decide you need a really capable tuner, better than the one they put in your transceiver, then LDG is the way to go. LDG tuners will match just about anything you can feed with coax, have thousands of memories for instant retuning, and will tune automatically as you operate.

Visit us on the web or contact your favorite dealer!

www.ldgelectronics.com 410-586-2177

BOX WITH LDG ELECTRONICS

ALL TUNERS 2000 MEMORIES

NEW YT-1200

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

Suggested Price $259.99

Optional M-600 external analog meter $129.99

AT-600ProII

Building on the success of the AT-600Pro, 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.

Suggested Price $369.99

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.

Suggested Price $259.99

AT-100ProII

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.

Suggested Price $229.99

KT-100

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

Suggested Price $199.99

IT-100

Matched in size to the Icom IC-7000 and IC-706. Control the IT-100 and its 2000 memories from either its own button or the Tune button on your IC-7000 or other Icom rigs. For your Icom radio that is AH3 or AH-4 compatible.

Suggested Price $179.99

YT-100

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

Suggested Price $199.99

Your Favorite Dealer has these tuners in stock NOW! Don't Miss Out - Call or visit them TODAY!

R&L Electronics®

1315 Maple Ave HAMilton, Oh 45011
http://randl.com sales@randl.com
Local/Tech 513-868-6399
Fax 513-868-6574
(800)221-7735

IC7100

An amateur radio first! The radio control head features a large, multi-function, "touch screen" DOT-Matrix LCD display that is positioned for easy view and operation. This is an important feature as the controller display not only provides information, but is your control portal to the IC-7100's feature settings and menus.

CS7100 Windows Programming Software	39.95
HM151 Remote Control Hand Mic	109.95
MBA1 Controller Bracket	31.95
OPC589 Modular to Round Adapter	36.95
RC28 USB Remote Encoder	279.95
RSBA1 IP Remote Control Software	99.95
SM30 Desk Mic requires OPC589	149.95

IC7000

IF DSP, AGC Loop Management, Digital IF filter, 2 point manual notch filter, Digital noise reduction, Digital noise blanker, 35W output on 70cm band, High stability crystal unit, Direct digital synthesizer circuit, Compact, all in one package, User friendly key allocation, Digital voice recorder, Built-in RTTY demodulator, 2.5 inch color TFT display.

AT180 Auto Tuner	499.95
CT17 Level Converter	142.95
OPC589 Modular 8 pin mic adapter	36.95
RMK7000F1 Remote Kit	104.95
SM20 Desk Mic	209.95

IC718

The HF bands allow you to communicate over long distances covering many km even to the other side of the world. With the superior performance found in the IC-718 such as wide dynamic range, high C/N ratio, and full duty operation you will find making these contacts easy. Experience the combination of the latest RF and digital technology, along with the size and simplified operation. You will see the IC-718 will be the most practical rig you will ever own.

AH4 Auto Tuner	264.95
CT17 Level Converter	142.95
FL52A 500Hz CW filter	204.95
MB23 Carrying Handle	16.95
UT102 Voice Synthesizer	71.95

IC7410

The IC-7410 has been designed as an HF/50MHz specialized rig with excellent performance and features in this category. The IC-7410 employs high grade DSP unit and double conversion super-heterodyne system developed from the latest technology used in our higher grade rigs such as the IC-7800/7700/7600 series. In addition, the IC-7410 comes with a built-in 15kHz 1st IF filter and can accept up to two optional filters (3kHz/6kHz). When used with these 1st IF filters, narrow mode signals such as the CW and SSB modes are protected from adjacent strong signals.

ICSP23 External Speaker	189.95
JTG5RV G5RV Antenna 10-80 Meters	69.95
JTPS31MB 30 Amp Power Supply	89.95
RSBA1 IP Remote Control Software	99.95
SM30 Desk Mic requires OPC589	149.95

ICID51A

The ICID51A has a light and compact body. Weighing in at 255g. In this slim body, the ICID51A contains 5 watts of output power, VHF/UHF dual band, DSTAR and integrated GPS receiver. V/V, U/U, V/U Dual watch function. Automatic repeater list up function, uses your GPS position to automatically list the DSTAR repeaters that are near by. AM/FM broadcast band receiver. Voice memory function allows you to record up to 60 seconds. Micro SD card slot allows you to store various contents including voice memory, DV auto reply message, TX voice message, QSO log, RX history log and GPS log data. Speech function announces the received call sign, operating frequency and/or mode. Submersible construction allows the ICID51A to be used in harsh outdoor environments. 5 Watts of output power

BC202 Rapid Desktop Charger	55.95
BP271 7.4V 1200mAh Li-Ion Battery	74.95
BP272 7.4V 2000mAh Li-Ion Battery	99.95
BP273 AA Battery Case	51.95
CP12L Lighter Cable	34.95
HM186LS Compact Speaker Mic	49.95
HM75LS Remote Control Speaker Mic	74.95
LC179 Carrying Case	29.95
SJ1 Silicon Jacket Case	29.95
WCSD51 Programming Software and Cable	41.95

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

DXing: Fun or Frustration?

"DXing is one of the most alluring aspects of Amateur Radio. It is challenging, educational, and fun. But it can lead to frustration, even for non-participants."

DXing, the quest to contact distant stations, is as old as Amateur Radio itself. In the late 1920s, the measure of a station and its operator was whether Worked All Continents had been achieved. In 1937 the ARRL introduced the DX Century Club, which has evolved greatly and remains by far the most popular yardstick for personal achievement in Amateur Radio. Currently there are 340 entities, mostly independent countries or geographically separate islands, on the DXCC List. Some of them are rarely on the air, so when they are — especially if the activation is by a DXpedition that may not repeated for several years — it attracts a lot of attention on the HF bands. At times literally thousands of stations will be competing for the attention of one operator to get their call signs into the log. It's easy to see why the result is called a "pileup."

In any big pileup there will be lots of beginning DXers and those with small stations who just want one QSO for an "all-time new one." These days, though, one contact is not enough to satisfy a serious DXer. Standings in the DXCC Challenge are determined by adding up the number of current entities confirmed on 10 bands, 160 through 6 meters (60 meters excepted); there are also separate awards for each band and for phone, CW, and digital modes. Nor is the fact that they already have an entity confirmed on that band and mode enough reason to keep many DXers from joining a pileup, simply to enjoy the chase. Some DXpeditioners enjoy running up their QSO totals by encouraging everyone to work them on all available modes on every band — perhaps two dozen times.

Most of the time this is all good fun, particularly when the entity being chased isn't that rare and the stakes therefore are not too high. However, if the DXpedition is to a place that's difficult to get to or where operating permission is hard to come by the result can be intensely frustrating, not only for the operators who can't get through the pileup, but also for others whose normal operating is disrupted. Unfortunately, there are those among us who don't cope with frustration very well.

The recent FT4TA DXpedition to Tromelin Island in the Indian Ocean is a case in point. Tromelin had not been on the air in 14 years, so demand was high. The propagation paths from there to Europe, Japan, and North America are not particularly difficult and conditions were good. The resulting pileups were incredible; it's hard to imagine what the walls of noise must have sounded like at the other end. They had hardly abated even after 70,000 QSOs were in the FT4TA log.

Under these conditions it's essential for the DX station to transmit on one frequency and for those calling to keep that frequency clear and follow instructions, usually to transmit "up" the band a bit: so-called "split" operation. Sometimes the callers spread over a goodly chunk of our narrower bands, such as 17 and 12 meters. The vastly outnumbered operators on Tromelin worked hard to meet the demand and performed well under difficult circumstances. Regrettably, the same cannot be said of everyone in the audience.

It is in everyone's interest (including those who aren't interested in the DXpedition) that QSOs be made as quickly as possible. Efficiency requires discipline. Discipline means listening to the instructions of the DX operator and not transmitting except when invited. It means not ever making an unidentified transmission on the DXpedition frequency. It means not responding on the air when someone else does something stupid, deliberately or otherwise. There are a few among us who seem to delight in provoking negative reactions; don't reward them.

While some of the behavior during the FT4TA operation was pretty bad, that it occurred is far from unique and certainly not new. The reason for raising the subject now is that a DXpedition to an even rarer entity, Navassa Island in the Caribbean, is planned for the latter part of January. When Navassa was last on the air, the DXCC Challenge didn't exist, so demand for QSOs on all bands from all parts of the world will be extremely high.

Americans should be able to work Navassa with relative ease. Amateurs in other parts of the world will have a more difficult time. The Navassa operators will be looking for band openings to other areas and will need our cooperation, especially when they're listening specifically for stations outside the Americas. The fewer out-of-turn callers they have to cope with, the faster they can make contacts. Let's also exercise some restraint: if you don't need a contact on a particular band or mode, don't call.

Finally, a word to those who don't chase DX and may think all the commotion is a bit silly. Even the biggest, most sought-after DXpedition occupies just a small fraction of our spectrum resources for a limited time. Mounting a major DXpedition is an enormous undertaking involving months or years of preparation and backbreaking, potentially dangerous work on site. Simply getting to the location can be an adventure in itself. Tens of thousands of amateurs share in the adventure vicariously.

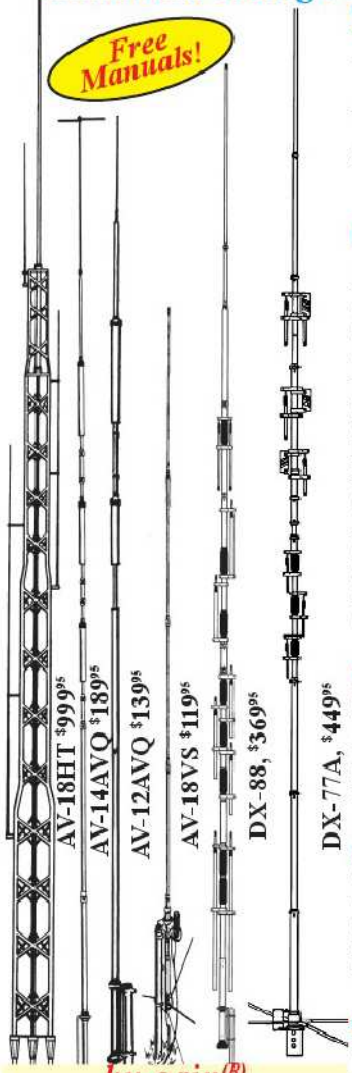
You benefit even if you don't participate. Continuing advances in equipment performance, antenna design, and our understanding of propagation are directly attributable to the quest for DX.

Competition at times may be fierce, but ultimately the shared experience strengthens the bonds within our global Amateur Radio community.

David Sumner, K1ZZ

hy-gain® HF VERTICALS

Self-supporting -- no guys required . . . Remarkable DX performance -- low angle radiation, omnidirectional . . . 1500 Watts . . . Low SWR . . . Aircraft quality aluminum tubing . . . Stainless steel hardware . . . Recessed SO-239 connect . . . Two year limited Warranty . . .



hy-gain® Classics

All hy-gain multi-band vertical antennas are entirely self supporting -- no guys required.

They offer remarkable DX performance with their extremely low angle of radiation and omnidirectional pattern.

All handle 1500 Watts PEP SSB, have low SWR, automatic band-switching (except AV-18VS) and include a 12-inch heavy duty mast support bracket (except AV-18HT).

Heavy duty, slotted, tapered swaged, aircraft quality aluminum tubing with full circumference compression clamps used for radiators.

Includes all stainless steel hardware. Recessed SO-239 prevents moisture damage.

Hy-gain verticals go up easily with just hand tools and their cost is surprisingly low.

Two year limited warranty.

AV-18HT, $999.95. (10,12,15,20,40,80 M, 160, 17 Meters optional). 53 ft., 114 lbs.

Standing 53 feet tall, the famous *Hy-Gain HyTower* is the world's best performing vertical! The AV-18HT features automatic band selection achieved through a unique stub-decoupling system which effectively isolates various sections of the antenna so that an electrical 1/4 wavelength (or odd multiple of a 1/4 wavelength) exists on all bands. Approximately 250 kHz bandwidth at 2:1 VSWR on 80 Meters. The addition of a base loading coil (**LC-160Q, $109.95**), provides exceptional 160 Meter performance. **MK-17, $89.95**. Add-on 17 Meter kit. 24 foot tower is all rugged, hot-dip galvanized steel and all hardware is iridited for corrosion resistance. Special tilt-over hinged base for easy raising & lowering.

AV-14AVQ, $189.95. (10,15,20,40 Meters). 18 ft., 9 lbs. **The** Hy-Gain AV-14AVQ uses the same trap design as the famous Hy-Gain Thunderbird beams. Three separate air dielectric Hy-Q traps with oversize coils give superb stability and 1/4 wave resonance on all bands. Roof mount with Hy-Gain AV-14RMQ kit, $89.95.

AV-12AVQ, $139.95. (10, 15, 20 Meters). 13 ft., 9 lbs. **AV-12AVQ** also uses Thunderbird beam design air dielectric traps for extremely Hy-Q performance. This is the way to go for inexpensive tri-band performance in limited space. Roof mount with AV-14RMQ kit, $89.95.

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

DX-88, $369.95. (10, 12, 15,17,20,30,40,80 Meters, 160 Meters optional). 25 ft., 18 lbs.

All bands are *easily* tuned with the DX-88's *exclusive* adjustable capacitors. 80 and 40 Meters can even be tuned from the ground without having to lower the antenna. Super heavy-duty construction. DX-88 OPTIONS: 160 Meter add-on kit, KIT-160-88, $199.95. Ground Radial System, GRK-88, $99.95. Roof Radial System, RRK-88, $99.95.

DX-77A, $449.95. (10, 12, 15, 17, 20, 30, 40 Meters). 29 ft., 25 lbs.

No *ground radials required!* Off-center-fed Windom has 55% greater bandwidth than competitive verticals. Heavy-duty tiltable base. Each band independently tunable.

Model #	Price	Bands	Max Power	Height	Weight	Wind Surv.	Rec. Mast
AV-18HT	$999.95	10,15,20,40,80	1500 W PEP	53 feet	114 pounds	75 MPH	------
AV-14AVQ	**$189.95**	**10,15,20,40**	**1500 W PEP**	**18 feet**	**9 pounds**	**80 MPH**	**1.5-1.625"**
AV-12AVQ	$139.95	10,15,20 M	1500 W PEP	13 feet	9 pounds	80 MPH	1.5-1.625"
AV-18VS	**$119.95**	**10 - 80 M**	**1500 W PEP**	**18 feet**	**4 pounds**	**80 MPH**	**1.5-1.625"**
DX-88	$369.95	10 - 40 M	1500 W PEP	25 feet	18 pounds	75 mph no guy	1.5-1.625"
DX-77A	**$449.95**	**10 - 80 M**	**1500 W PEP**	**29 feet**	**25 pounds**	**60 mph no guy**	**1.5-1.625"**

Hy-Gain 160-6 Meters Self-Supporting Vertical

Full 1500 Watts, 43 feet, includes base mount

New! AV-6160

$399.95

UPS SHIPPABLE

Operate all bands 160-6 Meters at full 1500 Watt with this self-supporting, 43 feet high performance vertical! It assembles in less than an hour and its low profile blends in with the sky and trees -- you can barely see it . . .

Exceptional Performance

The entire length radiates to provide exceptional low angle radiation 160-20 Meters and very good performance on 17-6 Meters. You can shorten it by telescoping it down for more effective low angle radiation on higher bands.

Just talk with automatic tuner!

A wide-range automatic or manual antenna tuner *at your rig* easily matches this antenna for all bands 160-6 Meters. There's no physical tuning adjustments on the antenna -- you simply put it up!

An optimized balun design allows *direct coax feed* with negligible coax loss (typically less than ½ dB 60-6 Meters and less than 1 dB 160-80 Meters with good quality, low-loss coax).

Extremely low wind loading

With just 2 square feet wind load, the AV-6160 has the lowest wind-loading and lowest visibility of any vertical antenna! The key is a six foot section of tapering diameter *stainless steel* whip that flexes in strong wind instead of stressing the bottom sections. Its 2-inch O.D.and .120 inch thick walled tubing bottom section makes it incredibly strong.

Just 20 lbs., uses super-strong *6063 aircraft aluminum tubing*. Stainless steel hardware.

Assembles in an hour

Ground mounting lets you hide antenna base in shrubbery. Requires ground system -- at least one radial. More extensive ground work better.

Stealth Operation

Low profile. Hide behind trees, fences, buildings, bushes. Use as flagpole. Easily telescopes down during the day.

Free Hy-Gain Catalog
and Nearest Dealer . . . 800-973-6572
Call your dealer for your best price!

hy-gain®
Antennas, Rotators & Towers

308 Industrial Park Road, Starkville, MS 39759 USA
Toll-free Customer Sales Hotline: 800-973-6572
• TECH: 662-323-9538 • FAX: 662-323-6551
http://www.hy-gain.com

DIAMOND ANTENNA

diamondantenna.net

When it comes to quality and performance, DIAMOND ANTENNA is the worldwide leader in VHF/UHF base and mobile antennas.

DIAMOND ANTENNAS help you get the most out of your on-air experience.

For all your base station and repeater needs, DIAMOND has an antenna that will work for you.

You've tried the rest, now own the best!

X700HNA Special Features:

- Heavy duty fiberglass radomes
- Four section assembly
- Overlapping outer shells for added strength
- Stainless steel mounting hardware & radials
- Strong waterproof joint couplings
- Type-N cable connection
- Wideband performance
- Highest gain Dual-band Base Antenna!

The Standard By Which All Others Are Judged

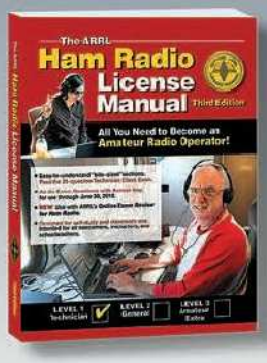
Here is a small sample of our wide variety of antennas

Model	Bands	Length Ft.	Max Pwr. Rating	Conn.
Dualband Base Station/Repeater Antennas				
X700HNA (4 section)	2m/70cm	24	200	N
X510HD (3 Section)	2m/70cm	17.2	330/250	UHF or N
X300A (2 Section)	2m/70cm	10	200	UHF or N
X200A (2 Section)	2m/70cm	8.3	200	UHF
X50A (1 Section)	2m/70cm	5.6	200	UHF or N
X30A (1 Section)	2m/70cm	4.5	150	UHF
Monoband Base Station/Repeater Antennas				
F23H (3 Section)	144-174 MHz (W/ Cut Chart)	15	350	UHF
F22A (2 Section)	2m	10.5	200	UHF
CP22E (Aluminum)	2m	8.9	200	UHF
F718A (Coax Element)	70cm	15	250	N
Dualband Mobile Antennas				
SG7900A	2m/70cm	62.2 in.	150	UHF or NMO
SG7500A	2m/70cm	40.6 in.	150	UHF or NMO
NR770H Series	2m/70cm	38.2 in.	200	UHF or NMO
MR77 Series	2m/70cm	20 in.	70	Mag Combo
AZ504FXH	2m/70cm	15.5 in.	50	UHF
AZ504SP	2m/70cm	15.5 in.	50	UHF
NR7900A	2m/70cm	57 in.	300/250	UHF
Monoband Mobile Antennas				
NR22L	2m	96.8 in.	100	UHF
M285	2m	52.4 in.	200	UHF or NMO

RF PARTS™ COMPANY

Diamond Antenna is a division of RF Parts Company

Discover the Excitement of Ham Radio
with ARRL License Manuals and Online Exam Review



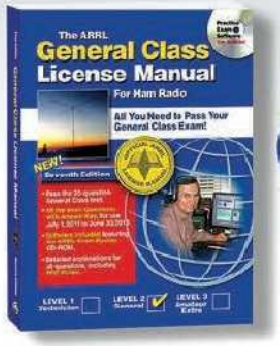
Level 1

Get your FIRST ham radio license!

The ARRL Ham Radio License Manual—Third Edition
Let ARRL guide you as you get started in Amateur Radio—as you select your equipment, set-up your first station and make your first radio contact.

- **Easy-to-understand "bite-sized" sections.** Pass the 35-question Technician Class exam.
- **Includes the latest question pool with answer key,** for use through June 30, 2018.
- **NEW!** Use with ARRL's ***Online Exam Review for Ham Radio***.
- **Designed for self-study and classroom use.** Intended for all newcomers, instructors and schoolteachers.

ARRL Order No. 0222 — $29.95*



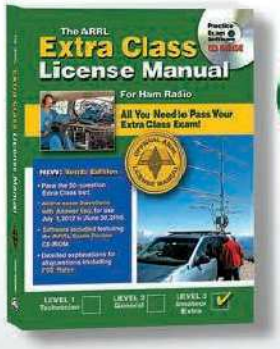
Level 2

Upgrade and enjoy more frequency privileges!

The ARRL General Class License Manual—Seventh Edition
Upgrade to General and experience the thrill of worldwide communications!

- Pass the 35-question General Class exam.
- **All the Exam Questions with Answer Key**, for use through June 30, 2015.
- **NEW!** Use with ARRL's ***Online Exam Review for Ham Radio***.
- Detailed explanations for all questions, including **FCC rules**.

ARRL Order No. 8119 — $29.95*



Level 3

Achieve the highest level of Amateur Radio licensing!

The ARRL Extra Class License Manual—Tenth Edition
Complete the journey to the top and enjoy all the operating privileges that come with earning your Amateur Extra Class license.

- Pass the 50-question Extra Class exam.
- **All the Exam Questions with Answer Key**, for use through June 30, 2016.
- **NEW!** Use with ARRL's ***Online Exam Review for Ham Radio***.
- Detailed explanations for all questions, including **FCC rules**.

ARRL Order No. 5170 — $29.95*

*plus shipping and handling

NEW! Online Review and Practice Exams
You won't have any surprises on exam day! For use with ***The ARRL Ham Radio License Manual***, ***The ARRL General Class License Manual***, *and* ***The ARRL Extra Class License Manual.***

www.arrl.org/examreview

As you complete each chapter of ARRL's license preparation study manuals, use ARRL's online **Exam Review** for Ham Radio to help prepare you for exam day. This web-based service uses the question pool to construct chapter-by-chapter reviews. Once you've finished this book, use the online service to take practice exams with the same number and variety of questions that you'll encounter on exam day. **ARRL Exam Review for Ham Radio**™ is *free*. The only requirement is that users must first set up a site login (a separate login from your ARRL website user registration).

ARRL The national association for AMATEUR RADIO®

www.arrl.org/shop

Toll-Free US 888-277-5289,
or elsewhere +1-860-594-0355

QST 1/2015

Inside HQ

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

Happy 100th Birthday, *QST*

The first issue of *QST* was published in December 1915. It's ham radio's equivalent of the Gutenberg Bible, and I actually have a copy of it in my office. *QST* Issue Number 1 is 28 pages long, and the pages are about ⅔ the size of today's *QST*. It was most likely typeset by hand using metal type. The inside pages use black ink on white paper and the covers are light blue.

The publishers — ARRL founders Hiram Percy Maxim and Clarence D. Tuska — got it right. They created a framework for *QST*'s content for the next 100 years. Many of the themes introduced in the 1915 edition are echoed almost 100 years later, here in the January 2015 issue.

Joining the Ranks

Like modern-day *QST*, Issue Number 1 has an appeal to join the newly formed American Radio Relay League. Any owner of a wireless station could apply for membership in the League by filling out a printed application. You were accepted as a member provided "that the operator has a practical working station and can receive a message." The membership application was 2 pages long and required a detailed description of the prospective member's transmitting and receiving equipment, operating skills, and availability. There were about 600 ARRL members and there was no cost to join. A subscription to *QST* was separate from membership and cost 25 cents for 3 months.

Also similar to today's *QST*, the editorial content blended both technical and operating articles that provided useful information for the radio amateur and the interests of the ARRL's members. There are pictures of members' shacks, with their scary-looking spark stations; a list of Q signals; letters to the League; a list of the latest relay stations ordered by state, name, address, and two- or three-letter call signs. These call signs were assigned by the Department of Commerce under the authority of "an act to regulate radio communication" that was approved by Congress in 1912. They contained district identifier numbers that were the beginning of our present day alphanumeric call sign area allocation system. ARRL co-founder Clarence D. Tuska wrote a technical article on "Pictured Electro-Magnetic Waves," complete with detailed technical illustrations.

A Tradition of Helpful Hams

Public Service and Emergency Communications have been a part of Amateur Radio from its inception. In *QST* Issue 1, there is a reprint of the letters that Hiram Percy Maxim wrote to the Secretary of the Navy and to the Secretary of War stating that the ARRL "respectfully offer[s] the service of our organization and its facilities" to assist in emergency and disaster communications. The reprinted replies indicated that both government officials responded positively to the offer.

Advertisements for Amateur Radio equipment have appeared in *QST* from its first issue. In Issue 1 there were ads for J.H. Bunnell & Co. of New York, who was selling a "Contact Radio Key" for $7.50. Stromberg-Carlson sold Radio-Headsets. The Manhattan Electrical Supply Company (MESCO) was selling a rotary spark-type transmitter. In 1916, *QST* featured the first ads for the new "DeForest Ultraudion Detector." It's exciting to look through these ads. They are truly a fascinating journey through the history of radio technology. The guidelines for accepting *QST* advertising, that we still adhere to today, were published in the August 1916 edition. They clearly state that "Every advertisement [in *QST*] has been accepted because we have found the apparatus to be what it ought. Every advertiser in *QST* will stand back of his claims."

Growth and Development

While there are many similarities, particularly in editorial focus, the 2015 version of *QST* is quite different from the 1915 version. Today, each issue is more than 10 times larger than the original and is printed in full color. It is assembled on computers using digital bits rather than with metal type and engravings. Along with the printed version of *QST*, there are three digital versions of *QST*: browser based, and iOS and Android apps for tablets and smartphones. The digital editions contain video and audio clips and hundreds of live website URLs. However, there are still plenty of photos of hams in their shacks, lots of call signs, well-illustrated technical articles, operating information, and engaging and informative advertising.

Because of the rapid changes occurring in the publishing business, I am not sure how *QST* will look 10 years from now, let alone 100 years from now! But I do know that, no matter what media or surfaces it is published on, *QST* will always be devoted entirely to Amateur Radio and our members' interests.

ARRL Member Services

Get Involved
www.arrl.org/get-involved

Join or Renew
www.arrl.org/join

Donate
www.arrl.org/donate

Shop
www.arrl.org/shop

Membership Benefits

Your ARRL membership includes ***QST*** magazine, plus dozens of other services and resources to help you **Get Started**, **Get Involved**, and **Get On the Air**. ARRL members enjoy Amateur Radio to the fullest!

Members-Only Web Services

Create an online ARRL Member Profile, and get access to ARRL members-only Web services. Visit **www.arrl.org/myARRL** to register.

- ***QST* Digital Edition – www.arrl.org/qst**
  All members can access the enhanced digital edition of *QST* from a web browser. Apps are available for *iOS* and *Android* devices.
- ***QST* Archive and Periodicals Search – www.arrl.org/qst**
  Browse ARRL's extensive online *QST* archive.
  A searchable index for *QEX* and *NCJ* is also available.
- **Free E-Newsletters**
  Subscribe to a variety of ARRL e-newsletters and e-mail announcements: ham radio news, radio clubs, public service, contesting and more!
- **Product Review Archive – www.arrl.org/qst**
  Search for, and download, *QST* Product Reviews published from 1980 to present.
- **E-Mail Forwarding Service**
  E-mail sent to your **arrl.net** address will be forwarded to any e-mail account you specify.
- **Customized ARRL.org home page**
  Customize your home page to see local ham radio events, clubs, and news.
- **ARRL Member Directory**
  Connect with other ARRL members via a searchable online Member Directory. Share profiles, photos, and more with members who have similar interests.

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

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

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

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

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

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

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

Programs

★ ARRL Centennial 2014

Second Century Campaign for the ARRL Endowment – **www.arrl.org/scc**
Centennial QSO Party – **www.arrl.org/centennial-qso-party**

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

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

Radiosport

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

Community

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

Licensing, Education, and Training

Find a License Exam Session – **www.arrl.org/exam**
Find a Licensing Class – **www.arrl.org/class**
ARRL Continuing Education Program – **www.arrl.org/courses-training**
Books, Software, and Operating Resources – **www.arrl.org/shop**

Quick Links and Resources

QST – ARRL members' journal – **www.arrl.org/qst**
QEX – *A Forum for Communications Experimenters* – **www.arrl.org/qex**
NCJ – *National Contest Journal* – **www.arrl.org/ncj**
Support for Instructors – **www.arrl.org/instructors**
Support for Teachers – **www.arrl.org/teachers**
ARRL Volunteer Examiner Coordinator (ARRL VEC) – **www.arrl.org/vec**
Public and Media Relations – **www.arrl.org/media**
Forms and Media Warehouse – **www.arrl.org/forms**
FCC License Renewal – **www.arrl.org/fcc**
Foundation, Grants and Scholarships – **www.arrl.org/arrl-foundation**
Advertising – **www.arrl.org/ads**

Interested in Becoming a New Ham?

www.arrl.org/newham · newham@arrl.org · 1-800-326-3942 (US)

Contact Us

ARRL, the national association for Amateur Radio®
225 Main Street, Newington, CT 06111-1494 USA
Tel 1-860-594-0200, Mon-Fri 8 AM to 5 PM ET (except holidays)
FAX 1-860-594-0259, e-mail **hqinfo@arrl.org**
website – **www.arrl.org/contact-arrl**

Facebook
www.facebook.com/ARRL.org

Follow us on Twitter
twitter.com/arrl · twitter.com/w1aw · twitter.com/arrl_pr
twitter.com/arrl_youth · twitter.com/arrl_ares
twitter.com/arrl_dxcc

YouTube
www.youtube.com/ARRLHQ

The American Radio Relay League, Inc.

The American Radio Relay League, Inc. is a noncommercial association of radio amateurs, organized for the promotion of interest in Amateur Radio communication and experimentation, for the establishment of networks to provide communication in the event of disasters or other emergencies, for the advancement of the radio art and of the public welfare, for the representation of the radio amateur in legislative matters, and for the maintenance of fraternalism and a high standard of conduct.

ARRL is an incorporated association without capital stock chartered under the laws of the State of Connecticut, and is an exempt organization under Section 501(c)(3) of the Internal Revenue Code of 1986. Its affairs are governed by a Board of Directors, whose voting members are elected every three years by the general membership. The officers are elected or appointed by the directors. The League is noncommercial, and no one with a pervasive and continuing conflict of interest is eligible for membership on its Board.

"Of, by, and for the radio amateur," the ARRL numbers within its ranks the vast majority of active amateurs in the nation and has a proud history of achievement as the standard-bearer in amateur affairs.

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

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

Officers, Division Directors, and Staff

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

Officers

Founding President (1914-1936)
Hiram Percy Maxim, W1AW

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

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

Second Vice President
Jim Fenstermaker, K9JF
129 Pendleton Way #88
Washougal, WA 98671
206-930-9372; **k9jf@arrl.org**

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

Chief Executive Officer
David Sumner, K1ZZ*

Secretary
David Sumner, K1ZZ

Treasurer
Rick Niswander, K7GM

Chief Financial Officer
Barry J. Shelley, N1VXY

Chief Operating Officer
Harold Kramer, WJ1B

Chief Development Officer
Mary Hobart, K1MMH

Chief Technology Officer
Brennan Price, N4QX

Staff

General Counsel
Christopher Imlay, W3KD

Business Services Manager
Debra Jahnke, K1DAJ

Education Services Manager
Debra Johnson, K1DMJ

Laboratory Manager
Ed Hare, W1RFI

Marketing Manager
Bob Inderbitzen, NQ1R

Diane Petrilli, KB1RNF
Membership Manager

Yvette Vinci, KC1AIM
Circulation Manager

Media and Public Relations Manager
Sean Kutzko, KX9X

Membership & Volunteer Programs Manager
Dave Patton, NN1N

Mike Corey, KI1U
Emergency Preparedness Manager

Production & Editorial Manager
Steve Ford, WB8IMY

Regulatory Information Manager
Dan Henderson, N1ND

VEC Manager
Maria Somma, AB1FM

Business Staff

Business Manager
Barry J. Shelley, N1VXY

Controller
Diane Middleton, KC1BQF

Information Technology Manager
Michael Keane, K1MK

*Executive Committee Member

Atlantic Division
www.atldiv.org

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

Vice Director: **Tom Abernethy, W3TOM**
PO Box 73, Accokeek, MD 20607
(301-272-0629); **w3tom@arrl.org**

Central Division
www.central.arrl.org

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

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

Dakota Division
www.arrldakota.org

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

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

Delta Division
arrldelta.org

David A. Norris, K5UZ
PO Box 194065, Little Rock, AR 72219-4065;
(870-613-1606); **k5uz@arrl.org**

Vice Director: **Ed B. Hudgens, WB4RHQ**
1441 Wexford Downs Ln, Nashville, TN 37211
(615-333-9859); **wb4rhq@arrl.org**

Great Lakes Division
arrl-greatlakes.org

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

Vice Director: **Thomas Delaney, W8WTD**
4632 Glenway Ave, Cincinnati, OH 45238
(513-921-7423); **w8wtd@arrl.org**

Hudson Division
www.hudson.arrl.org

Mike Lisenco, N2YBB*
1635 East 46 St, Brooklyn, NY 11234
(917-865-3538); **n2ybb@arrl.org**

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

Midwest Division
www.arrlmidwest.org

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

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

How to Find an ARRL HQ Staff Member

Can't find the department you're looking for? Call 860-594-0200 or e-mail **hq@arrl.org**. Sending e-mail to any ARRL Headquarters staff member is a snap. Just put his or her call sign (or first initial and last name) in front of **@arrl.org**. For example, to send to Hiram Maxim, First President of the ARRL, use **w1aw@arrl.org**, or **hmaxim@arrl.org**. If all else fails, send a message to **hq@arrl.org** and it will get routed to the right person or department.

New England Division
www.barc.org/nediv

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

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

Northwestern Division
www.nwarrl.wetnet.net

Jim Pace, K7CEX
PO Box 1602, Centralia, WA 98531
(360-508-8437); **k7cex@arrl.org**

Vice Director: **Bonnie Altus, AB7ZQ**
7770 Harmony Rd, Sheridan, OR 97378
(971-237-0711); **ab7zq@arrl.org**

Pacific Division
www.pdarrl.org

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

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

Roanoke Division
www.arrl-roanoke.org

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

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

Rocky Mountain Division
www.rockymountaindivision.org

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

Vice Director: **Dwayne Allen, WY7FD**
PO Box 1482, Sundance, WY 82729-1482
(307-283-3107); **wy7fd@arrl.org**

Southeastern Division
www.southeastern.arrl.org

Doug Rehman, K4AC
34646 Rust Rd, Eustis, FL 32736-2106
(352-600-2960); **k4ac@arrl.org**

Vice Director: **Michael Lee, AA6ML**
PO Box 354645, Palm Coast, FL 32135
(702-494-9066); **aa6ml@arrl.org**

Southwestern Division
www.kkn.net/n6aa

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

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

West Gulf Division
arrlwgd.org

Dr David Woolweaver, K5RAV*
PO Box 531605, Harlingen, TX 78553
(956-425-3128); **k5rav@arrl.org**

Vice Director: **John Robert Stratton, N5AUS**
PO Box 2232, Austin, TX 78768-2232
(512-282-7851); **n5aus@arrl.org**

*Executive Commitee Member

ARRL Section Managers

www.arrl.org/sections

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

Atlantic Division (DE, EPA, MDC, NNY, SNJ, WNY, WPA)

Delaware: Bill Duveneck, KB3KYH, 18682 Sunny Sky Blvd, Milton, DE 19968-2486 (302-537-4755); **kb3kyh@arrl.org**

Eastern Pennsylvania: Robert B. Famiglio, K3RF, PO Box 9, Media, PA 19063-0009 (610-359-7300); **k3rf@arrl.org**

Maryland-DC: James E. Cross III, WI3N, 16013 Dorset Rd, Laurel, MD 20707-5314 (301-725-6829); **wi3n@arrl.org**

Northern New York: Thomas Dick, KF2GC, 11 Jenkins St, Saranac Lake, NY 12983 (518-891-0508); **kf2gc@arrl.org**

Southern New Jersey: Thomas J. "Skip" Arey, N2EI, PO Box 236, Beverly, NJ 08010 (609-877-5733); **n2ei@arrl.org**

Western New York: Laura Peters-Mueller, N2LJM, 2011 E Main St, Falconer, NY 14733 (716-338-3122); **n2ljm@arrl.org**

Western Pennsylvania: John Rodgers, N3MSE, 803 S Main St, Butler, PA 16001 (724-287-0424); **n3mse@arrl.org**

Central Division (IL, IN, WI)

Illinois: Tom Ciciora, KA9QPN, 1887 Irene Rd, Sandwich, IL 60548 (815-498-4929); **ka9qpn@arrl.org**

Indiana: Joseph D. Lawrence, K9RFZ, 4624 Willard Dr, Fort Wayne, IN 46815-6759 (260-373-1986); **k9rfz@arrl.org**

Wisconsin: Gary Sorensen, W9ULK, PO Box 212, Oxford, WI 53952 (608-697-2652); **w9ulk@arrl.org**

Dakota Division (MN, ND, SD)

Minnesota: Richard H. "Skip" Jackson, KS0J, 1835-63rd St E, Inver Grove Heights, MN 55077 (651-260-4330); **ks0j@arrl.org**

North Dakota: Lynn A. Nelson, W0ND, 6940 4th St SW, Minot, ND 58701 (701-839-8200); **w0nd@arrl.org**

South Dakota: Chris Stallkamp, W0ADZ, PO Box 271, Selby, SD 57472-0271 (605-870-1784); **w0adz@arrl.org**

Delta Division (AR, LA, MS, TN)

Arkansas: Dale Temple, W5RXU, 5200 Timber Creek Circle, North Little Rock, AR 72116 (501-771-1111); **w5rxu@arrl.org**

Louisiana: Jim Molan, KD5IGG, 311 N Matthews St, Bunkie, LA 71322-1536 (318-452-5686); **kd5igg@arrl.org**

Mississippi: Malcolm Keown, W5XX, 64 Lake Circle Dr, Vicksburg, MS 39180 (601-636-0827); **w5xx@arrl.org**

Tennessee: Keith E. Miller Sr, N9DGK, 1635 Jarratt Dr, Rockvale, TN 37135 (615-631-9952); **n9dgk@arrl.org**

Great Lakes Division (KY, MI, OH)

Kentucky: Jim Brooks, KY4Z, 7099 Louisville Rd, Cox's Creek, KY 40013 (502-349-2099); **ky4z@arrl.org**

Michigan: Larry Camp, WB8R, 71 Oakdale Lane, Coldwater, MI 49036 (517-278-0406); **wb8r@arrl.org**

Ohio: Scott D. Yonally, N8SY, 258 Valley Hi Dr, Mansfield, OH 44904-9792 (419-512-4445); **n8sy@arrl.org**

Hudson Division (ENY, NLI, NNJ)

Eastern New York: Pete Cecere, N2YJZ, 329 W Saugerties Rd, Woodstock, NY 12498 (845-246-4359); **n2yjz@arrl.org**

NYC-Long Island: Jim Mezey, W2KFV, 38 Appletree Ln, Carle Place, NY 11514-1336 (516-315-8608); **w2kfv@arrl.org**

Northern New Jersey: Richard Krohn, N2SMV, 23 Sweetmans Ln, Manalapan, NJ 07726; **n2smv@arrl.org**

Midwest Division (IA, KS, MO, NE)

Iowa: Robert McCaffrey, K0CY, 1210 Noble Hills Pl, Boone, IA 50036 (515-432-2512); **k0cy@arrl.org**

Kansas: Ronald D. Cowan, KB0DTI, PO Box 36, LaCygne, KS 66040 (913-757-3758); **kb0dti@arrl.org**

Missouri: Dale C. Bagley, K0KY, PO Box 13, Macon, MO 63552-1822 (660-385-3629); **k0ky@arrl.org**

Nebraska: Matthew N. Anderson, KA0BOJ, 2342 Clay St, Ashland, NE 68003 (402-480-5515); **ka0boj@arrl.org**

New England Division (CT, EMA, ME, NH, RI, VT, WMA)

Connecticut: Betsey Doane, K1EIC, 92 Mohegan Rd, Shelton, CT 06484-2448 (203-929-7759); **k1eic@arrl.org**

Eastern Massachusetts: Tom Walsh, K1TW, 9 Wildwood Dr, Bedford, MA 01730 (781-275-5882); **k1tw@arrl.org**

Maine: Bill Crowley, K1NIT, 150 Maple St, Farmingdale, ME 04344-4809 (207-623-9075); **k1nit@arrl.org**

New Hampshire: Peter Stohrer, K1PJS, 9 Gladstone St, Concord, NH 03301; **k1pjs@arrl.org**

Rhode Island: Bob Beaudet, W1YRC, 30 Rocky Crest Rd, Cumberland, RI 02864 (401-333-2129); **w1yrc@arrl.org**

Vermont: Paul N. Gayet, AA1SU, 11 Cherry St, Essex Junction, VT 05452 (802-878-2215); **aa1su@arrl.org**

Western Massachusetts: Ed Emco, W1KT, 37 Bullard Ave, Worcester, MA 01605 (508-853-3333); **w1kt@arrl.org**

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

Alaska: Jim Larsen, AL7FS, 3445 Spinnaker Dr, Anchorage, AK 99516-3424 (907-345-3190); **al7fs@arrl.org**

Eastern Washington: Mark Tharp, KB7HDX, PO Box 2222, Yakima, WA 98907-2222 (509-965-3379); **kb7hdx@arrl.org**

Idaho: Edward Stuckey, AI7H, 2300 W Polo Green Ave, Post Falls, ID 83854-9680 (208-457-0354); **ai7h@arrl.org**

Montana: George Forsyth, AA7GS, 212 Skyline Dr NE, Great Falls, MT 59404 (406-868-2212); **aa7gs@arrl.org**

Oregon: Everett Curry, W6ABM, 1546 NE Greensword Dr, Hillsboro, OR 97124-6139 (503-522-7142); **w6abm@arrl.org**

Western Washington: Monte L. Simpson, K2MLS, 2523 N Wycoff Ave, Bremerton, WA 98312-2711 (360-373-3095); **k2mls@arrl.org**

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

East Bay: James Latham, AF6AQ, 1798 Warsaw Ave, Livermore, CA 94550-6140; (925-447-6136); **af6aq@arrl.org**

Nevada: Gary Grant, K7VY, 11040 Broken Hill Rd, Reno, NV 89511 (775-851-7840); **k7vy@arrl.org**

Pacific: Bob Schneider, AH6J, PO Box 131, Keaau, HI 96749-0131 (808-966-8146); **ah6j@arrl.org**

Sacramento Valley: Ronald D. Murdock, W6KJ, 998 Bogue Rd, Yuba City, CA 95991-9221 (530-674-8533); **w6kj@arrl.org**

San Francisco: Bill Hillendahl, KH6GJV, PO Box 4151, Santa Rosa, CA 95402-4151 (707-544-4944); **kh6gjv@arrl.org**

San Joaquin Valley: Dan Pruitt, AE6SX, 4834 N Diana St, Fresno, CA 93726 (559-779-2974); **ae6sx@arrl.org**

Santa Clara Valley: Brandon Bianchi, NI6C, 139 Seal Ct, Marina, CA 93933 (559-313-3373); **ni6c@arrl.org**

Roanoke Division (NC, SC, VA, WV)

North Carolina: Karl Bowman, W4CHX, 5509 Shimer Farm Ln, Raleigh, NC 27614-6301 (919-669-6068); **w4chx@arrl.org**

South Carolina: Marc Tarplee, N4UFP, 4406 Deer Run, Rock Hill, SC 29732-9258 (803-327-4978); **n4ufp@arrl.org**

Virginia: Carl Clements, W4CAC, 4500 Wake Forest Rd, Portsmouth, VA 23703 (757-484-0569); **w4cac@arrl.org**

West Virginia: Charles L. Hardy Jr, WV8CH, 1203 Bachman Rd, Fayetteville, WV 25840 (304-640-4630); **wv8ch@arrl.org**

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

Colorado: Jack Ciaccia, WM0G, PO Box 21362, Boulder, CO 80308-4362 (303-587-0993); **wm0g@arrl.org**

New Mexico: Bill Kauffman, W5YEJ, 1625 36th St SE, Rio Rancho, NM 87124-1719 (505-349-0460); **w5yej@arrl.org**

Utah: Mel Parkes, NM7P, 2166 E 2100 North, Layton, UT 84040 (801-547-1753); **nm7p@arrl.org**

Wyoming: Garth Crowe, WY7GC, 1206 Avalon Ct, Gillette, WY 82716-5202 (307-686-9165); **wy7gc@arrl.org**

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

Alabama: David Drummond, W4MD, 5001 Lakehurst Dr, Northport, AL 35473 (205-339-7915); **w4md@arrl.org**

Georgia: Gene Clark, W4AYK, 1604 Lynwood Lane, Albany, GA 31707 (229-888-1090); **w4ayk@arrl.org**

Northern Florida: Steve Szabo, WB4OMM, 536 Central Park Blvd, Port Orange, FL 32127-1136 (386-566-2085); **wb4omm@arrl.org**

Puerto Rico: Rene Fonseca, NP3O, HC 67 Box 15593, Fajardo, PR 00738 (939-579-4134); **np3o@arrl.org**

Southern Florida: Jeff Beals, WA4AW, PO Box 1584, Loxahatchee, FL 33470-1584 (561-252-6707); **wa4aw@arrl.org**

Virgin Islands: Fred Kleber, K9VV, PO Box 24275, Christiansted, VI 00824-0275; **k9vv@arrl.org**

West Central Florida: Darrell Davis, KT4WX, 6350 Mills Rd, Fort Meade, FL 33841 (863-245-9923); **kt4wx@arrl.org**

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

Arizona: Robert J. Spencer, KE8DM, 1831 S McKinley Ave, Yuma, AZ 85364-5114 (928-941-7069); **ke8dm@arrl.org**

Los Angeles: David Greenhut, N6HD, 5260 Darro Rd, Woodland Hills, CA 91364-1933 (818-992-5507); **n6hd@arrl.org**

Orange: Carl Gardenias, WU6D, 20902 Gardenias St, Perris, CA 92570 (951-490-2270); **wu6d@arrl.org**

San Diego: Stephen M. Early, AD6VI, 4724 Maple Ave, La Mesa, CA 91941 (619-461-2818); **ad6vi@arrl.org**

Santa Barbara: Robert Griffin, K6YR, 1436 Johnson Ave, San Luis Obispo, CA 93401-3734 (805-801-7292); **k6yr@arrl.org**

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

North Texas: Chris Brewer, N5GMJ, 8308 N Water Tower Rd, Saginaw, TX 76179-5169 (817-939-3128); **n5gmj@arrl.org**

Oklahoma: Lloyd Colston, KC5FM, 813 Canterbury Blvd, Altus, OK 73521-4903 (234-564-2775); **kc5fm@arrl.org**

South Texas: Lee H. Cooper, W5LHC, 2507 Autrey Dr, Leander, TX 78641 (512-260-7757); **w5lhc@arrl.org**

West Texas: Bill Roberts, W5NPR, 34 Sunny Glen, Alpine, TX 79830 (432-837-2741); **w5npr@arrl.org**

AMERITRON . . . 800 Watts . . . $999!

More hams use Ameritron AL-811/H amplifiers than any other amplifier in the world!

AL-811H
$999
Suggested Retail
4-Tubes, 800 Watts

AL-811
$849
Suggested Retail
3-Tubes, 600 Watts

Only the Ameritron AL-811H gives you four *fully neutralized* 811A transmitting tubes. You get absolute stability and superb performance on higher bands that can't be matched by un-neutralized tubes.

You get a quiet desktop linear that's so compact it'll slide right into your operating position -- you'll hardly know it's there . . . until QRM sets in. And you can conveniently plug it into your nearest 120 VAC outlet -- no special wiring needed.

You get all HF band coverage (with license) -- including WARC and most MARS bands at 100% rated output. Ameritron's *Adapt-A-Volt*™ hi-silicon core power transformer has a special buck-boost winding that lets you compensate for high/low power line voltages.

You also get efficient full size heavy duty tank coils, slug tuned input coils, operate/standby switch, transmit LED, ALC, dual illuminated meters, QSK with optional QSK-5, pressurized cooling that you can hardly hear, full height computer grade filter capacitors and more. 13¾Wx8Hx16D inches.

AL-811, $849. Like AL-811H, but has three 811A tubes and 600 Watts output.

Desktop Kilowatt Amplifier

AL-80B
$1595
Suggested Retail

Whisper quiet *desktop* amp plugs into 120 VAC to give *full* kilowatt SSB PEP output. Ameritron's exclusive *DynamicALC*™ doubles average SSB power out and *Instantaneous RF Bias*™ gives cooler operation. All HF bands. 850 Watts CW out, 500 Watts RTTY out, extra heavy duty power supply, 3-500G tube, 70% efficiency, tuned input, Pi/Pi-L output, inrush current protection, dual Cross-Needle meters, QSK compatible, 48 lbs. 14Wx8½Hx15½D in. **Two-year warranty.**

Near Legal Limit™ Amplifier

AL-572
$1895
Suggested Retail

Near Legal Limit™ amplifier gives you 1300 Watt PEP SSB power output for *60%* of price of a full legal limit amp! 4 rugged 572B tubes. Instant 3-second warm-up, plugs into 120 VAC. Compact 14½Wx 8½Hx15½D inches fits on desktop. 160-15 Meters. 1000 Watt CW output. Tuned input, instantaneous RF Bias, dynamic ALC, parasitic killer, inrush protection, two lighted cross-needle meters, multi-voltage transformer.

Amplifiers with *3CX800A7* tube

Suggested Retail
AL-800F
$1995
1 tube, 1250 Watts

AL-800HF
$2745
2 tubes
1.5 kW *Plus*
AL-800, $2295
AL-800H, $3345
with *Eimac*(R) tubes

These *compact* desktop amplifiers with 3CX800A7 tubes cover 160-15 Meters including WARC bands. Adjustable slug tuned input circuit, grid protection, front panel ALC control, vernier reduction drives, heavy duty 32 lb. silicone steel core transformer, high capacitance computer grade filter capacitors. Multi-voltage operation, dual lighted cross-needle meters. 14¼Wx8½Hx16½D in.

True Legal Limit™ Antenna Tuner

ATR-30
$599.95
Suggested Retail

Easily handles 1500 Watts continuous carrier even on 160 Meters. High-current edge-wound silver plated roller inductor, two 500 pF high capactiance tuning capacitors and a 3-core choke balun can handle the world's most powerful amps -- like AL-1500! Has a six position antenna switch, *true* peak reading Cross-Needle SWR/Wattmeter, 6:1 vernier reduction drives, more! 13¼Wx5⅝Hx17½D". **ATR-20, $459.95.** For AL-80B, AL-811/H.

Ameritron brings you the finest high power accessories!

ARB-704 amp-to-rig interface. . . $59.95

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

RCS-4 Remote Coax Switch. . . $159.95

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

RCS-8V Remote Coax Switch. . . $169.95

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

RCS-10 Remote Coax Switch. . . $179.95

Replace 8 coax with 1! SWR<1.3 to 60 MHz. **RCS- 10L, $219.95** w/lightning arrestors.

SDC-104 (I,K,Y) Auto Screwdriver Antenna Controller . . . $159.95

Receives frequency data from your rig and automatically tunes your screwdriver antenna.

ADL-1500 Dummy Load with oil . . . $74.95

Oil-cooled. 50 Ohms. 1500 Watts/5 minutes. SWR< 1.2 to 30 MHz. Low SWR to 400 MHz.

ADL-2500 fan-cooled Dry Dummy Load, $219.95

Whisper quiet fan, 2.5kW/1 minute on, ten off. 300W continuous. SWR< 1.25 to 30 MHz.<1.4 to 60 MHz.

ATP-100 Tuning Pulser . . . $69.95

Safely tune up for full power, best linearity. Prevents overheating, tube damage, power supply stress, component failure.

ICP-120 Inrush Current Protector

Ameritron's *Step-Start Inrush Current Protector*™ **. . . $79.95** stops damaging inrush current. Momentary high-voltage "spikes" in the AC line can cause damage to your amp. ICP-120 has built-in varistors to absorb these spikes. Works with nearly all linear amplifiers. 120V. **ICP-240, $79.95.** For 240V.

AWM-30B Precision SWR/Wattmeter . . . $149.95

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

Flat Mobile SWR/Wattmeter . . . $159.95

1⅛ inch thick, flat mounts on dashboard. Remote sensor, 25 ft. thin cable. True peak reading. Cross-needle, lighted. 1.5 kW, 1.8-30 MHz. *High-SWR* LED.

AMERITRON *full legal limit* amplifiers

AMERITRON legal limit amps use a super heavy duty Hypersil*(R) *power transformer capable of 2.5 kW!

Most powerful -- *3CX1500/8877*

AL-1500F
$3395
3CX1500/8877 Tube

AL-1500
$4195
Eimac(R) tube
Suggested Retail

Ameritron's *most powerful* amplifier uses the herculean 3CX1500/8877 ceramic tube. 65 watts drive gives you full legal output -- it's just loafing with a 2500 Watts power supply.

Toughest -- *3CX1200Z7*

AL-1200
$3995
Suggested Retail

Get ham radio's *toughest* tube with the Ameritron AL-1200 -- the *Eimac*(R) 3CX1200Z7. It has a 50 Watt control grid dissipation. What makes the Ameritron AL-1200 stand out from other legal limit amplifiers? The answer: A super heavy duty power supply that loafs at full legal power -- it can deliver the power of more than 2500 Watts PEP two tone output for a half hour.

Classic -- *Dual 3-500Gs*

AL-82
$2995
Suggested Retail

This linear gives you full legal output using a *pair* of *genuine* 3-500Gs. Competing linears using 3-500Gs *can't* give you 1500 Watts because their lightweight power supplies *can't* use these tubes to their full potential.

Call your dealer for your best price!

Free Catalog: 800-647-1800

AMERITRON®

. . . the world's high power leader!

116 Willow Road, Starkville, MS 39759
TECH (662) 323-8211 • **FAX** (662) 323-6551
8 a.m. - 4:30 p.m. CST Monday - Friday
For power amplifier components call (662) 323-8211

www.ameritron.com

Array Solutions Your Power Solutions Company

Professional Grade Equipment from Array Solutions

OM Power OM2000+ HF and 50 MHz Amplifier

OM2000+ is in Stock

Limited Time Only Package Price

Fresh from the succesful FT5ZM DXpedition, the OM2000+ adds 6 m coverage to the venerable OM2000 at full legal limit – 160 through 6 m!

Compare the OM2000+ to any 1500 W continuous power amplifier made that covers 160-6 m. We are certain you will agree that this is the one to buy for quality and price!

This is the amplifier everyone has been asking for!

$4,495.00
Introductory Price

OM2000+ and PowerMaster II
(3 kW Wattmeter with HF and 6 m coupler)
Package price is $4,770.00. Plus free shipping, a $250 savings.

PowerMaster II

- New Larger, Sharp & Fast LCD Display
- Reduced Energy consumption
- USB and RS-232 interface built-in
- Best accuracy in the market
- Fastest Display and 3 types of Alarms (SWR, High and Low Power) can save your amplifier by shutting it down fast
- Supports any mix of up to five couplers (3 kW HF, 10 kW HF, VHF, UHF)

$525.00
PowerMaster II with 3 kW F-6 m coupler

DU3500AL 3.5 kW Automatic Antenna Tuner

- Frequency range: 1.8-30 MHz
- Matching range: 5:1 SWR at 3.5 kW
- Maximum Power Handling: 3.5 kW at 5:1 SWR
- Compatibility: All automatic with common makes of radios
- Tuning time: 1s programmed memory
- Display: 480 x 272 4.3" Color TFT Display
- Capacitor: 510 pF 5 kV
- Switching: Two high power ceramic RF switches
- Antenna Switching: 5 ports plus 8 port external switch control
- DC power: 12 - 13.8 V 6 A
- Dimensions: W: 13.4" x D: 18.5" x H: 6.5"
- Weight: 17.6 lbs.

$2,650.00
Introductory Price

IN STOCK!

NEW!

Amplifiers with an Attitude

NEW!

BEKO VHF and UHF Amplifiers

MODEL	SELLING PRICE
HLV-1000 144 1 kW	$3,750
HLV-1000 222 1 kW	$3,750
HLV-2000 144 2 kW	$6,450
HLV-550 432 550 W	$3,450
HLV-1100 432 1 kW	$6,250
HLV-800 1296 23cm 800 W	$5,450
HLV-400 1296 23cm 400 W	$3,850

BEKO VHF and UHF amplifiers (2 m and higher) are now available from Array Solutions. These are considered the best solid state amplifiers in their categories and we have them!

OM2500A – Automatic Tune and OM2500HF – Manual Tune

NEW!

- Frequency coverage: All amateur bands 1.8 – 29.7 MHz
- Power output: 2.5 kW
- Fully Automatic band-switching and tune up
- Integrates with all popular transceivers

$7,995.00
OM2500A plus $395 for Remote Control

$6,995.00
OM2500HF Manual Tune

Other top-quality brands represented by Array Solutions...

RCOM · AV Technologies · Custom Metalworks · FRITZEL · BEKO Elektronik · M² · REX · OM Power · OptiBeam · PHILLYSTRAN · Pro.Sis.Tel. · AN Wireless · hofi · W3NQN

www.arraysolutions.com

Check our webpage for more new products!

ARRAY SOLUTIONS
2611 N. Belt Line Rd Ste 109
Sunnyvale, Texas USA
sales@arraysolutions.com
Phone 214-954-7140 Fax 214-954-7142

Array Solutions' products are in use at top DX and Contest stations worldwide as well as commercial and governmental installations. We provide RF solutions to the DoD, FEMA, Emcomm, UN, WFO, FAA and the State Dept. for products and installation of antennas systems, antenna selection, filtering, switching and grounding. We also offer RF engineering and PE consulting services.

ELECRAFT
KX3

The Revolutionary KX3 All-Band/All-Mode Transceiver

The KX3 is a competition-grade transceiver that literally puts the world in the palm of your hand. With its large display, rich control set, and adjustable operating angle, the ultra-compact KX3 is equally at home on your desktop, in a vehicle, or in remote field locations. It's a true software-defined radio (SDR), with dual watch, noise reduction, digital voice recorder, RX/TX EQ, VOX, speech compression, and CW keyer. The built-in PSK31 and RTTY modes work with or without a computer. Add the internal ATU, battery charger, and roofing filters for unmatched portability and performance.

NEW! **Make Your KX3 Even More Versatile With These Great New Options**

KXPA 100 Automatic Amplifier for the KX3 and Other QRP Rigs

Our compact 100-W amp is ideal for desktop or mobile use. Features fast, PIN-diode T/R switching and large convection-cooled heat sink for reliable and quiet operation. Optional internal ATU provides a wide matching range and dual antenna jacks.

PX3 Panadapter adds a visual dimension to signal hunting

The PX3 provides fast, real-time spectrum and waterfall displays, plus one-click QSY. Its small size and low current drain make it ideal for travel use. Features 2 to 200 kHz span, noise blanker, USB interface, and full integration with the KX3.

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

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

KX3 Transceiver Specifications

- 160-6 m (2 m or 4 m with optional module)
- SSB/CW/AM/FM/DATA modes
- 10 W output (100 W with KXPA100 amp)
- World-class receive performance
- Built-in advanced 32-bit DSP
- Supports PC-based remote control and logging; SDR applications via RX I/Q outputs; simple firmware updates
- Factory-assembled or easy-to-build, no-soldering kit; manual written with first-time HF users in mind
- 1.7" x 3.5" x 7.4" (4.3 cm x 8.9 cm x 18.8 cm) 1.5 pounds (less options and 8-AA cell battery pack)
- Current drain as low as 150 mA; 9-15 V DC

KXPA 100 Amplifier Specifications

- 100 W output on 160-6 m with 5 W input typical
- 13.8 VDC powered; 20 A typical current drain (11 V with lower output. 15 V max)

ELECRAFT®

For complete features and specifications, go to **www.elecraft.com** • **831-763-4211**

Steve Ford, WB8IMY, upfront@arrl.org

Two Kits Still Cruise the Airwaves...and the Skies

A lifelong love of kit building comes full circle.

Philip Brown, WE7A, we7a@arrl.net

From a very early age I sensed that something about radio was magic. Even my first AM table radio was a source of wonder, so much so that I was finally compelled to disassemble it!

At some point I was given a Heathkit catalog and, at the age of 13, I asked my folks for a shortwave radio kit for Christmas. I ended up with the model GR-91, to which I added a Q-multiplier. I loved building the GR-91 and it provided endless hours of listening enjoyment. My old GR-91 is still working today and is one of my prized possessions. Many Heathkits were to follow, including ham radios when I became licensed as WN2VOV.

From the Airwaves to the Air

As I got a little older and found some loose change in my pocket, I began to scratch another itch. My grandmother's explanations of how airplanes worked never seemed quite right, so I decided to take flying lessons. I earned that ticket in 1976 and attended my first Oshkosh, Wisconsin convention of the Experimental Aircraft Association (EAA) the same year.

I learned to fly in a Piper Cherokee. It was safe and predictable; a good trainer. Immediately after I received my private license, I transitioned to a 1941 Piper J-3 Cub. It rented for only $8 per hour (including gas) and although it was slower and noisy, it was a joy to fly.

At Oshkosh, however, I was intrigued by a little one-holer of a plane called a Pober Pixie. It had the same wing as the Cub, a Clark-Y airfoil, and it would be happy with the same engine, a Continental A-65 from the '30s and '40s. The airplane looked simple and fun, but I soon discovered something fascinating about its pedigree.

The Heathkit Airplane

When I researched the history of the Pober Pixie, I was astonished to learn that the airplane was a kit — a Heathkit! When Ed Heath founded the company back in the 1920s, his first offering was an airplane kit that sold for less than $199 (without the engine). That's about $2700 in today's dollars. Lots of kits were sold and soon a number of Heath "Parasols," as they were called, were flying.

In the 1970s, the founder of the EAA, Paul Poberezny, modified the Parasol design to bring it into the modern era and published the plans for a new version known as the Pober Pixie. It had a single efficient wing and was purely open cockpit — a direct descendant of the Heathkit Parasol. I bought a set of plans for $75.

Thirty-Seven Years in the Making

Like most builders, I started by assembling the wooden wing ribs. This was a relatively cheap start, with lots of cutting and fitting labor. I had to work up my own bill of materials from the plans and order everything. In time I finished the wings (and bought and sold houses, got married, had kids, etc) and obtained the chrome-moly steel tube for the fuselage.

Thirty-six years later I had the airframe and all the engine stuff finished. The next step was attaching the fabric cover. That consumed the 37th year.

Throughout that time, I kept up with Amateur Radio, upgrading from Technician to Amateur Extra, installing antennas and towers and helping my wife Susan, N9JOU, and son Keegan, N9KBA, get their ham licenses (and my son his pilot's license).

The author's Heathkit GR-91 receiver.

The author and his Pober Pixie.

A view inside the Pober Pixie cockpit.

The Heathkit Legacy Finally Takes Flight

After a final inspection by the FAA, my little homebuilt Pixie, tail number NX49PB, received its Special Airworthiness Certificate, Experimental Category.

On a hot July evening, *Zephyr* (as I had christened it) and I enjoyed our first, very gentle flight. Just as when you first apply power to a radio you've built yourself, the feeling of accomplishment as *Zephyr* lifted off the runway was overwhelming.

Initially, I was restricted as to what I could do with *Zephyr* — I was limited to a 25-mile radius until I "proved-out" my airplane. After working out a few bugs (like a tachometer cable that pumped engine oil onto my pants), I'm now free to fly almost anywhere, and have even flown "Zeph" to our new home in Boulder, Colorado. The trip took 3½ days, but I had no problems at all. Whether it is flying through the air at 1500 feet or cruising the airwaves at 14 MHz, I'm blessed with two passions that have both history and the present day in common.

The Elecraft K-Line

A powerful performance you won't want to miss

Elecraft's world-class trio is now complete. It all started with the K3 transceiver, which tops the charts in nearly every receive category. Then we added an exciting visual dimension with the versatile P3, our fast, full-color panadapter. And now, we're proud to introduce the KPA500: a 500-watt solid-state amp that's so well-integrated you'll think it's reading your mind.

The KPA500 features 160-6 m coverage, instant RF-based band switching with any radio, alphanumeric status display, bright LED bar graphs, and a rugged, built-in linear supply. The amp's manual band switches can be used to change bands on the K3. The K3 can even select per-band amplifier drive levels automatically when the amp is placed into operate mode, so you'll rarely need to adjust power output.

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

ELECRAFT®

Elecraft is a registered trademark of Elecraft, Inc.

www.elecraft.com • 831-763-4211

P.O. Box 69, Aptos, California 95001-0069

Connect to the Digital World

RIGblasters are the most convenient method of interfacing your computer to your radio for complete computer control!

Operate PSK31, WinMOR, RTTY, JT65, Packet, CW & more!
Utilize rig control with HRD, N1MM Logger, Fldigi & more*

* Models with rig control jack only

RIGblaster Advantage

Most Popular with Single USB Connection
Built-in sound card - isolated from PC
Rig control interfaces for CAT, CI-V or DB9 on radio

✔ Supports Yaesu, Icom, & Kenwood Rig Control

RIGblaster Plug & Play

Economical & Easy to Install
Built in CI-V/CAT Rig control
Use with PC Sound card

✔ Supports Yaesu (FT-817,857,897,100D) & Icom Rig Control

RIGblaster Blue

Safe, Secure & Hands-free operation
Use with a Bluetooth® headset for voice
Portable Rig control and Digital Modes

✔ Supports Yaesu, Icom, & Kenwood Rig Control

RIGblaster Nomic

Budget Friendly option
Simple connection from radio to PC
Ideal for Echolink® Modes

Find our full product line at your favorite dealer or on the web:

www.westmountainradio/QST115

WEST MOUNTAIN RADIO

sales@westmountainradio.com
(262) 522-6503 X 35

HRD Software Special:
Ham Radio Deluxe
Coupon with purchase
of RIGblaster Advantage
Buy One Today!

ALINCO®

Quality. Style. Performance!

Visit alinco.com for more details!

COMMUNICATIONS-GRADE SWITCHING POWER SUPPLY WITH USB PORTS

NEW

SPECIFICATIONS DM-330FXT

Input voltage	120 VAC(DM-330FXT)
Output voltage	9~15VDC variable
Output voltage variation	Less than 3%
Protection	Short-circuit, Automatic current limiting over 30A Over-temperature
Output current	30 A (max), 25 A (continuous)
Ripple	Less than 50mVp-p at rated load
Fuse	4A (FXE), 8A (FXT)
Meter	Selectable Volt / Current meter, back-lit
Size	190(W)×69(H)×181(D)mm (Projections not included)
Weight	Approx. 2.5 kgs with detachable AC cord

Specifications subject to change without notice or obligation.

* USB ports may not work for charging cell-phones/mobile phones due to special charging circuits of those devices.

This "Breakthrough" switching power supply packs a lot of features into a compact, lightweight design that features 9-15VDC variable output and delivers up to 25 amps, 30 peak. Unlike other "switchers", it's electrically quiet. But if you should find noise, don't worry! The patented Noise Offset Circuit lets you move the switching noise you might find to another frequency. Other features include a large illuminated "instrument-class" Volt/Amp meter, rear panel binding posts (30A peak), front panel cigar outlet (10A), two pairs of snap-in terminals (5A max.) and USB ports (2A max.), front panel voltage adjust, customer-defined output voltage "memory", ripple less than 50mV p-p and triple circuit protection for short-circuit, over temperature, and current limiting!

Amazing high performance, compact size, and full featured!

144/430MHz 5W FM Dualband Handheld Transceiver

DJ-500T/E NEW

T: FC IC E: CE

- High power Li-Ion battery pack, stand charger and beltclip included
- Output Power 5 / 2.5 / 1W selectable
- Large, dot-matrix, 3 color-selectable display and keypad
- Semi-Duplex dualband, V/V-U/U and FM broadcast receiver
- 200 memory channels, any mix of VHF/UHF
- RX Frequency Coverage 76-108 / 136-174 / 400-480MHz
- Alphanumeric channel labels
- Direct frequency input from keypad
- Landmobile-grade signaling features
- Variety of scanning modes
- IP54 dust/splash proof, MILSPEC vibration/shock compliant
- Wide and narrow FM TX/RX
- 12Vdc input using an optional cigar-socket adapter.
- Internal VOX and Wire cloning capability

SPECIFICATIONS

T-version : RX Freq.	136-174MHz / 400-480MHz (76-108MHz WFM)
TX Freq.	144-148MHz / 420-450MHz
E-version : TX/RX	144-146MHz / 430-440MHz (RX 76-108MHz WFM)
Modulation	F3E (FM)
Power output	Approx. 5, 2.5, 1W
Receiver system	Direct-conversion
Sensitivity	Wide -12dBu , Narrow -9dBu
AF output	1W (10% distortion)
Frequency stability	± 2.5ppm
Dimensions	59.0W×98.0H×35.0D mm or 2.32W×3.86H×1.38D inches w/o projection
Weight	Approx. 227g or 8.01 oz; includes antenna and battery pack
Temp. range	-20°C~+55°C (-4F°~+131F°)

REMTronix, Inc.
2560 Barrington Ct. Hayward, CA 94545 U.S.A.
Ph: 510-298-5100 Fax: 510-887-0314 Website: http://www.remtronix.com
Email: alinco@remtronix.com Service: alincosupport@remtronix.com

REMTRONIX

letters@arrl.org

Letters from Our Members

Collins ART-13 Brings Nostalgia

In his review of the OM2500A PA in the November 2014 issue of *QST*, Norm Fusaro, W3IZ, mentioned the Collins ART-13 autotune transmitter. This mention brought back memories of my work with this transmitter.

Soon after my graduation from the 6-month US Coast Guard (USCG) Electronics School in Groton, Connecticut, I arrived as a 3rd Class Electronics Technician at my first duty station, NMG, the 8th USCG District Primary Radio Station in New Orleans in 1963. I had been licensed since 1957. After about a week I was approached by one of the Chief Radiomen. "Come with me," he said. We have four other ETs here, and none have been able to help me with my secondary phone transmitter on our truck for a year." He escorted me to our Emergency Communications Truck and pointed to his HF secondary operating position. There on the shelf sat an AN/ART-13, completely cabled into the truck's system.

I had already had my hands on several of them. The Chief had all of the manuals for the components of the Collins system, as well as the custom 240 V ac 60 Hz power supply. He controlled the transmitter from the control head, which was connected to the transmitter with a multi-conductor cable, and terminated with multi-pin Amphenol connectors. I took the connectors apart and observed a disaster: shorts and open wires — one even had a paper clip in it. I carefully disassembled, insulated, and re-soldered all conductors in the male and female connectors, plugged them in, and watched the filaments glow. We tuned it up on several Coast Guard AM phone and CW frequencies. One call to the USCG radio station in Pongo, Virginia, brought back a "loud and clear."

After that, I went out with the 8th District Communications Truck on every mission for 2 years. This included escorting NASA rocket bodies on barges on the Intracoastal Waterway, and covering communications for two hurricanes — one east, and one just west of New Orleans. At the NMG station, I was always assigned to reset the pesky pawls in the 10 Collins Autotune heads in the AN/FRT-15B 3 KW transmitters.

Thanks to Norm, W3IZ, for the opportunity to reminisce about this piece of equipment and my work with it.

Charlie Ashcom, K8IDZ
Ann Arbor, Michigan

Logbook of The World

One of the best services ARRL provides — free to members and non-members alike — is the Logbook of The World (LoTW). I prefer to spend my radio time on the air, not doing paperwork. Postage isn't cheap these days, either. LoTW integrates with logging programs and makes secure confirmations of QSOs transparent and quick.

I recently moved halfway around the world and am starting my DX quest over from zero. This time I intend to see what I can do using LoTW as my only QSL method. If several stations are calling CQ, the one I will call is the one that my logging program marks as a LoTW member!

Join LoTW. You will be happy you did (and I will get my new DXCC faster).

Vic Rosenthal, 4X6GP/K2VCO
Rehovot, Israel

Put Out of Business by a Mouse

One night I was spinning the dial of the radio head for my remote station when the numbers stopped changing and the dial light went out. After checking everything at home, I drove over to my radio site.

As I opened the door, I noticed that a loop of power cord had been dragged through the hole in the wall where the coax and rotor cable enter. Upon further inspection, I noted that all of the lights on the LAN system were off — the power cord was cut. Apparently, a mouse had dragged the power cord out and was unsuccessful, for the wall wart prevented him from making off with it. There were only 5 volts in the power cord, and he got away unscathed.

I plugged up the hole. The next time that mouse comes around, I'll ask him what he wants to eat.

Jerry Block, K4LAP
Gig Harbor, Washington

Kerchunk-a-holics?

It's net night on the local repeater. It's 15 minutes before the net starts, and the Net Control Station (NCS) just announced that the net will start on time and invited all listening hams to participate. Immediately after the announcement, the repeater begins to experience a series of momentary keys known as *kerchunking*. The repeater works; the NCS just proved that it does. So why kerchunk?

Is it possibly a psychological phenomenon? If it is, then what would happen if all of the kerchunkers were somehow stopped? Imagine the scene in the various hams' shacks. At first the hams are waiting calmly. After a few minutes, worry begins to seep into their psyches. Is their radio working? Is the repeater still working? The worry grows. Another minute passes. By this time the kerchunking hams are beginning to shake, fighting to keep from pushing the mic button.

Finally the NCS begins speaking. For 45 seconds the NCS gives his intro to open the net. Shaking hands hover over the mic. The NCS reaches the conclusion of the opening remarks and finishes with "…Come now." The kerchunkers grab their mics to give their call signs to be the first station to check in. The squeals and such overload the repeater's input in a pileup that would make any HF contest station operator cringe, then cry for joy. The pileup lasts until the repeater times out. Into the silence that follows, a single kerchunk is heard and then the NCS says calmly, "Stations wishing to check in, please call one at a time, slowly, so that I can add you to the list of check-ins."

Maybe because of how FM capture works it can't be that bad; or can it? Next time, think about how you tie up a repeater before you kerchunk.

John P. Conlon, WB7NPF
El Paso, Texas

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

FlexRadio Systems®
Software Defined Radios

4616 W. Howard Lane, Ste. 1-150
Austin, TX 78728
Phone: 512 535 4713 / Fax: 512 233 5143
Email: sales@flexradio.com

REDISCOVER RADIO WITH THE POWER OF A FLEX-6000

FILL ALL YOUR OPERATOR NEEDS & EXCEED EVERY EXPECTATION

Rediscover Radio...

Now everyone can rediscover radio with the FLEX-6000 Signature Series transceivers with SmartSDR. Experience the excitement of radio again with a solution tailored for you both in capabilities and price. Experience multi-dimensional amateur radio as it was meant to be. From CW to the latest digital modes, FlexRadio Systems helps you rediscover your hobby like no other solution can.

Our offering includes a choice in high-performance 100W HF transceivers with feature sets tailored to your needs. You can have from two to eight simultaneous receivers, contest grade preselectors, high definition display modes, ATU, GPS and more. All running our leading edge, easily upgradeable, SmartSDR software, keeping you ahead of the curve with game changing features and functionality, including a developer's API.*

So visit ***www.flexradio.com*** and see how you can rediscover radio.

*Features/capabilities/pricing vary by model number. Refer to www.flexradio.com for more detailed information.

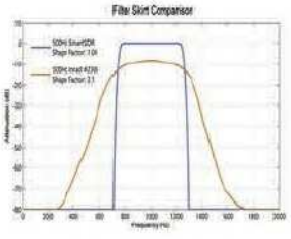
FLEX-6700 Performance*

IMD DR3	Up to 108dB	
RMDR	2kHz	116dB
	20kHz	124dB
TX Phase Noise	1kHz	-133dBc/Hz
	10kHz	-143dBc/Hz
	>100kHz	-150dBc/Hz

*FLEX-6700@14MHz
Typical as measured

CHART TOPPING PERFORMANCE

Industry leading transceiver performance specifications make the FLEX-6000 series the HF transceiver family of choice for the discerning operator.



INDUSTRY BEST DSP FILTERING

The FLEX-6000 Signature Series transceivers provide brick wall filters with 115dB ultimate rejection, virtually eliminating adjacent channel interference.

LEADERS IN VISUAL SPECTRUM DISPLAY

Dig deeper into the DX with high definition panafall and waterfall display modes to make DX chasing easier than ever.

www.flexradio.com

ALPHA AMPLIFIERS

THIS YEAR MAKE A RESOLUTION TO TX/RX IN STYLE WITH A NEW ALPHA AMPLIFIER OR TEN-TEC TRANSCEIVER

Regular Price: ~~$7,995.00~~
Sale Price: $6,995.00

ALPHA 9500

1500 W Auto-Tune Linear Amplifier

- 3CX1500A7/8877 tube
- Operates on all Amateur HF Bands – 160 M thru 10 M modifiable for MARS operation
- Operates at 1500 W average power and 100% duty cycle with no time limit!
- 4-port automatic antenna switch, any 2 antenna ports may be combined
- SWR tolerance 3:1 at full rated output
- Automatic line voltage selection from 100-250 VAC, 50/60 Hz
- Drive power 50 W nominal
- Rugged construction – built to last
- Quickly and automatically tunes to match the load impedance
- Remotely controllable – RS232 and USB port

Regular Price: ~~$5,495.00~~
Sale Price: $4,995.00

ALPHA 8410

1500 W Manual-Tune Linear Amplifier

- Uses a pair of 4CX1500B tetrodes, good for 3 kW of plate dissipation
- Operates at 1500 W average power and 100% duty cycle with no time limit!
- Operates on all Amateur HF Bands – 160 M thru 10 M modifiable for MARS operation
- SWR tolerance 3:1 at full rated output
- Drive power 50 W nominal
- Uses our custom designed, time proven 3.5 KVA transformer – built to last

SALES 1-844-73-4-HAMS

www.rfconcepts.com

TEN-TEC and ALPHA AMPLIFIERS are RF CONCEPTS companies

Ask the Ham That Owns One™

TEN-TEC

Omni VII package
588AT Transceiver with:

- Built-in Auto Tuner
- CW and Sideband filters included
- Model 707 Regal Microphone
- Model 716 Microphone Stand
- Model 707T8 Microphone Cable

Regular Price: ~~$3,381.00~~
Sale Price: $2,499.00

Eagle package
599AT Transceiver with:

- Built-in Auto Tuner
- CW and Sideband filters included
- Model 320 Noise Blanker
- Model 702 Hand Microphone

Regular Price: ~~$2,193.00~~
Sale Price: $1,499.00

Argonaut VI package
539 QRP Transceiver with:

- Convenient small size
- 10 W QRP
- CW and Sideband filters included
- Model 702 Hand Microphone

Regular Price: ~~$1,069.00~~
Sale Price: $849.00

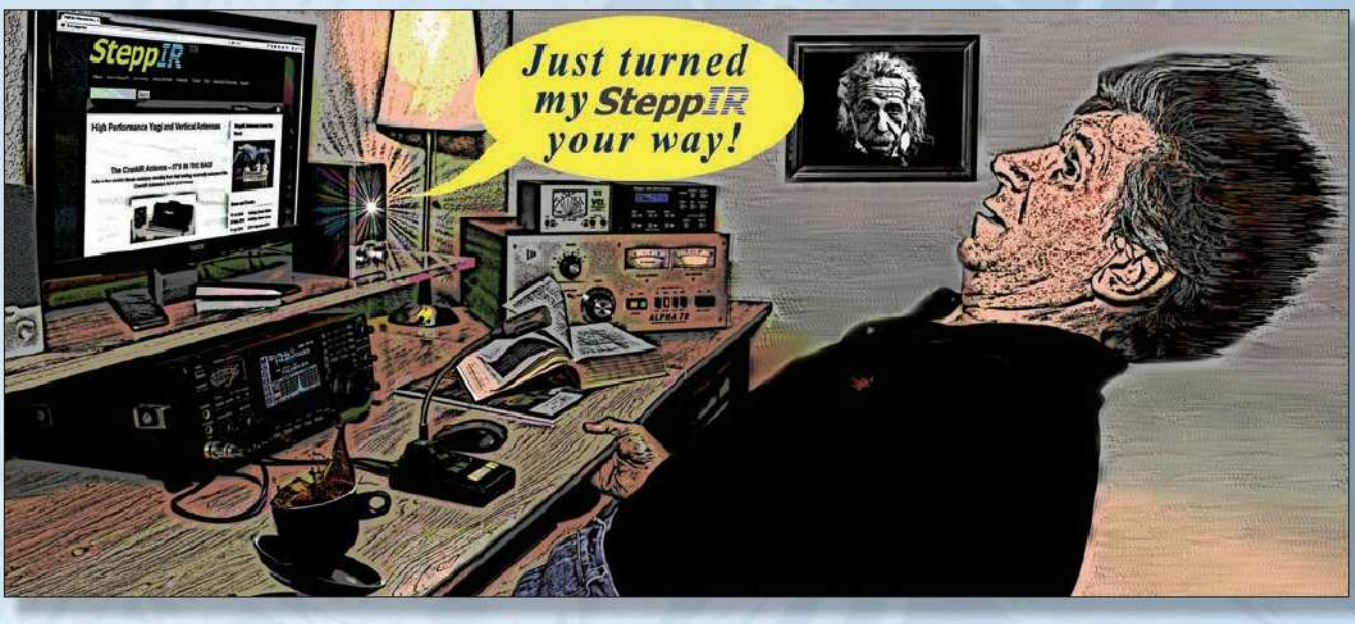
Rebel
506 Open Source QRP CW Transceiver with:

- ChipKIT Uno32 32-bit, 80MHz processor with 128K of flash memory
- DDS based VFO for no drift operation
- 100% Open Source hardware & software
- Covers 20 and 40 meter bands
- Hardware hooks for user added features

Price: $199.00

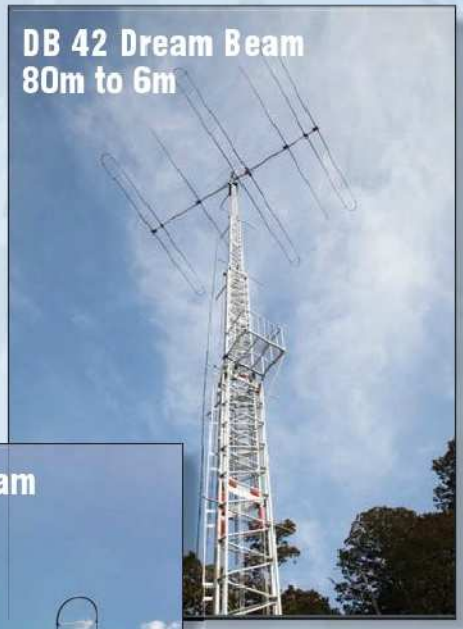
Alpha Amplifiers Office 303-473-9232 **TEN-TEC Office** 865-453-7172

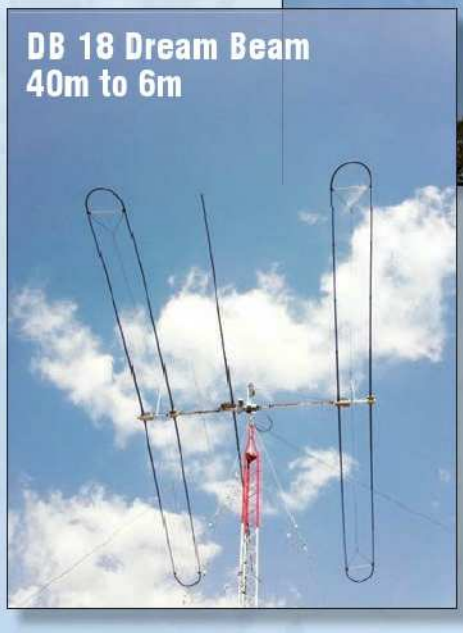
Prices subject to change without notice.



With a nod of respect to our friends at Alpha for their original 1970's ad concept, there's one thing that hasn't changed with time. In Amateur Radio it's good to be LOUD!! At SteppIR Antennas, we design our products with the goal of providing you the highest performance multi-band antennas in the world. Our "frequency-agile" remotely tuned yagi antennas provide unparalleled monoband gain and front-to-back performance on EVERY frequency the antenna covers. Perfect SWR on every frequency means no more lossy antenna tuners are needed. Features like very fast 180 degree beam reversal and Bi-directional modes puts you in total control. The benefits to you?? YOU hear them first, YOU work them first, and YOU generate the pileups. But don't just take our word for it, the next time you work someone using a SteppIR, ask them to rate its performance for you…you'll like what you hear.

For more information on which of our extensive line of antennas is right for you, visit our website or contact our knowledgeable and friendly sales and technical staff.





SteppIR™
Antenna Systems

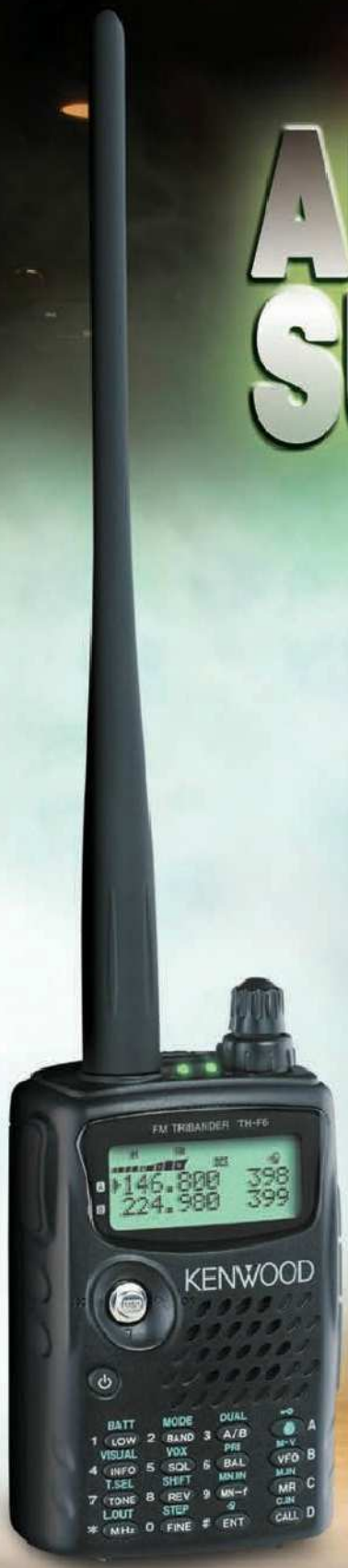
2112 116th Ave NE
Bellevue, WA 98004
Tel: (425) 453-1910

No Traps. No Tricks.
No Compromises.

www.SteppIR.com

Hear and Be Heard

AIRWAVE SUPERIORITY



Never before has a compact HT offered as many features, and such high powered performance as the TH-F6A. Arm yourself with one today and gain your own airwave superiority.

- Triband (144/220/440 MHz)
- Receives 2 frequencies simultaneously even on the same band
- 0.1~1300MHz high-frequency range RX (B band)[1]
- FM/FM-W/FM-N/AM plus SSB/CW receive
- Bar antenna for receiving AM broadcasts
- Special weather channel RX mode
- 435 memory channels, multiple scan functions
- 7.4V 1550mAh lithium-ion battery (std.) for high output[2] and extended operation
- 16-key pad plus multi-scroll key for easy operation
- Built-in charging circuitry for battery recharge while the unit operates from a DC supply
- Tough construction: meets MIL-STD 810 C/D/E standards for resistance to vibration, shock, humidity and light rain
- Large frequency display for single-band use
- Automatic simplex checker
- Wireless remote control function
- Battery indicator • Internal VOX • MCP software

[1]Note that certain frequencies are unavailable. [2]5W output

TH-F6A
TRIBANDER

KENWOOD

Customer Support: (310) 639-4200
Fax: (310) 537-8235

www.kenwood.com/usa

ISO9001 Registered

ADS#43314

A Five-Way Remote Antenna Switch

Microprocessor-controlled master and slave units with bias Ts enable a single coax feed line from the shack to serve five remote antennas and power a remote antenna tuner.

Ken R. Ginn, G8NDL

I have a single run of neatly installed coax from the shack to my antenna "farm" in the rear yard, which consists of two more-or-less permanent antennas, plus other experimental designs that come and go. I have no desire to go through the trouble and expense of installing more coax or adding a control cable run. To make the most of the single coax feed line, a microprocessor-controlled remote antenna switch selects one of up to five antennas to be connected to the coax. The remote antenna switch and a remote antenna tuner are powered by dc imposed onto the coax with a bias T circuit.[1, 2] Control signals to the remote switch are sent by modulating the dc voltage level supplied to the bias T. Figure 1 shows an overview of the entire system.

Next we'll look at the circuit design, and then conclude with construction details and a few usage notes.

Circuit Design

The key feature of this antenna-switching system is that a single coax cable from the shack to the collection of antennas in the rear yard is made to serve three functions: first and most obvious is the conveyance of RF signals, second is the provision of dc power to the remote antenna switch (also termed the "slave" unit) by means of a circuit known as a "bias T," and third is the transmission of serial control signals from the shack's "master" unit to the slave unit's antenna switch.

Bias T

The bias T circuit is used to impose a dc voltage on to a coax cable carrying an RF signal and recover the dc voltage at a remote point while causing minimal disturbance to the RF signal. There are similar bias T circuits associated with both the master and slave units. The nomenclature used here refers to the bias T that is part of the master unit. (The schematic for this is located in the lower right corner of the master unit schematic diagram shown in Figure 2.)

The maximum RF power through the RF ports essentially depends upon the three 2 kV Murata 0.01 µF capacitors C9 – C11, connected in parallel between the signal pins of J1 and J2. My system is only capable of 100 W, but the three paralleled capacitors should be capable of running up to 1 kW. The loss through the two RF ports over the HF band was measured at only 0.1 dB.

The dc current capacity from the dc port to one of the RF ports depends primarily upon the gauge of the wire in the windings of L1 and L2, which are wound with #24 AWG enameled copper magnet wire.

For my application, a current rating of 500 mA was adequate for both the slave unit and an automatic antenna tuner located near one of the permanent antennas. My remote SG-239 antenna tuner with its own bias T draws the bulk of the current at 380 mA with only 85 mA required by the slave unit. The dc voltage drop through 100 feet of RG-213 cable was measured at 500 mV (including both bias tees). The RF signal loss from the rig to the antennas, including the cable and equipment, was estimated to be a maximum of 1.5 dB at 30 MHz.

Master Unit

The master unit is built around a PIC16F628 microcontroller. [Software is available on the *QST* in Depth web page.[3] — *Ed.*] The purpose of the microcontroller is to poll its five input lines to determine which one of five remote antenna inputs to connect to the coax feed line, and then send a serial pulse stream indicative of the active input line to the slave unit. Figure 2 shows the master unit schematic.

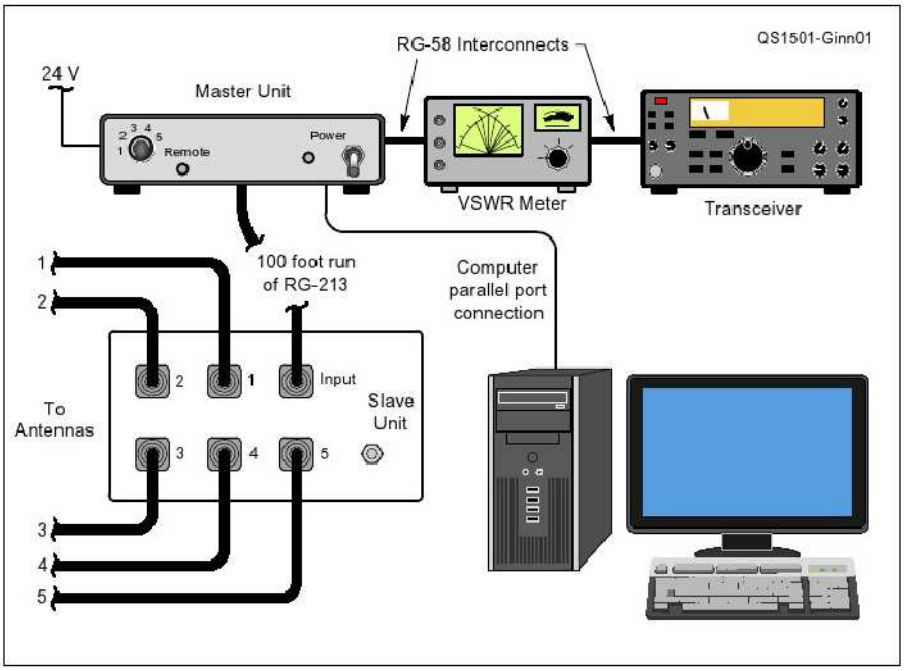


Figure 1 — System block diagram.

[1]Notes appear on page 35.

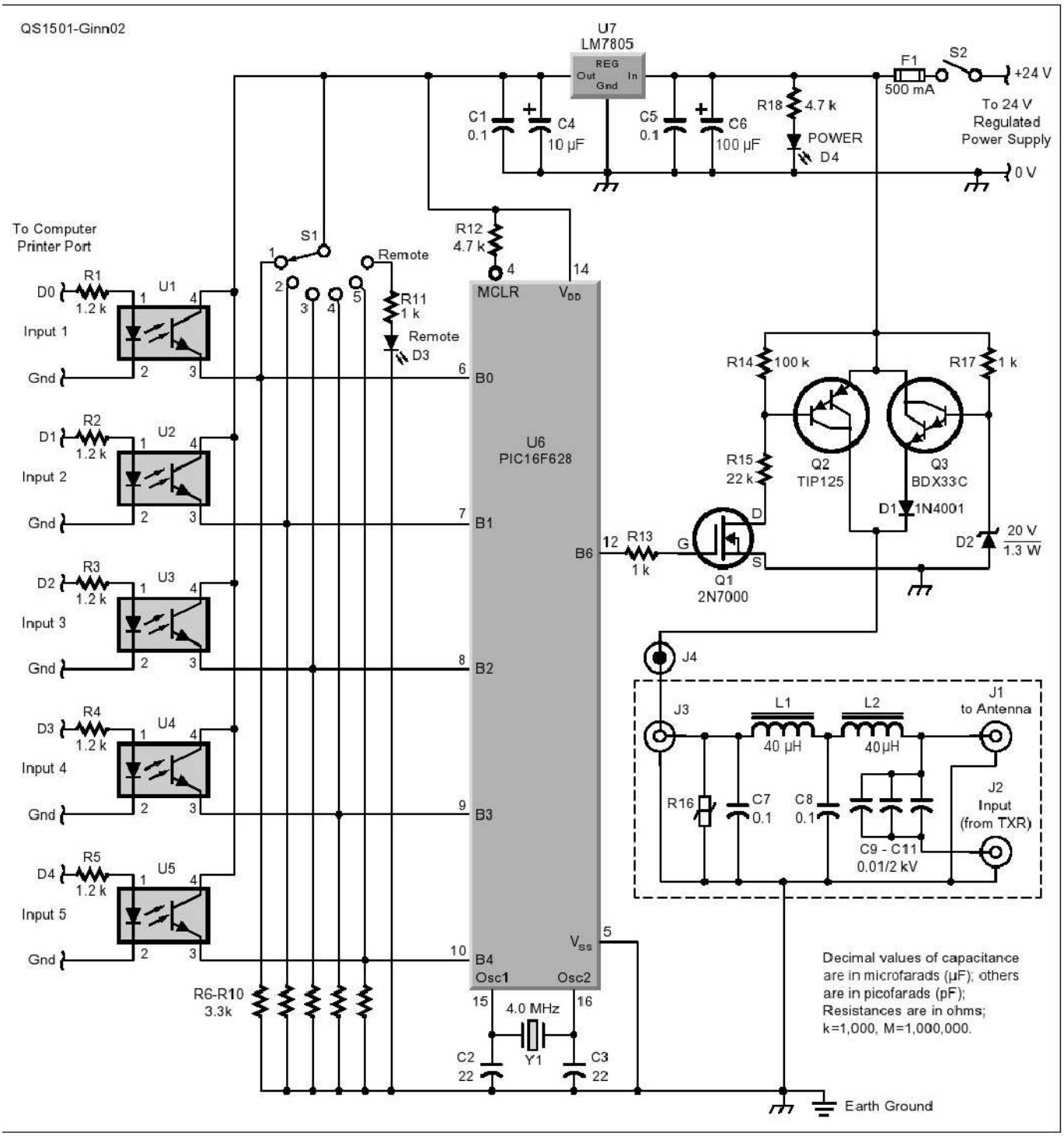


Figure 2 — Master unit and bias T schematic diagram.

C1, C5, C7, C8 — 0.1 µF ceramic capacitor
C2, C3 — 22 pF ceramic capacitor
C4 — 10 µF 16 V electrolytic capacitor
C6 — 100 µF 35 V electrolytic capacitor
C9 – C11 — 0.01 µF 2 kV ceramic (Murata part number: DEBE33A103Z)
D1 — 1N4001 diode
D2 — BZX85C20 20 V 1.3 W Zener diode
D3 — 5 mm green LED
D4 — 5 mm red LED
F1 — 500 mA fuse
L1, L2 — 40 µH (see text)
J1, J2 — Type N connector
J3, J4 — Mating SMA connectors
Q1 — 2N7000 FET
Q2 — TIP125 Darlington PNP transistor
Q3 — BDX33C Darlington NPN transistor
R1 – R5 — 1.2 kΩ (all resistors are ¼ W unless noted otherwise)
R6 – R10 — 3.3 kΩ resistor
R11, R13, R17 — 1 kΩ resistor
R12, R18 — 4.7 kΩ resistor
R14 — 100 kΩ resistor
R15 — 22 kΩ resistor
R16 — 20 Vrms 3 J zinc oxide varistor, PN: JVR-10N330K (see also Littelfuse V05E20P, Mouser PN: 576V05E20P)
S1 — 6-way, 2 pole break before make rotary switch, one pole used
S2 — SPST toggle switch
U1 – U5 — SFH618A optocoupler or equivalent
U6 — PIC16F628 microcontroller (programmed see text)
U7 — 7805 5 V 1 A 3-terminal regulator
Y1 — 4 MHz crystal

The five input lines are connected to microcontroller U6 inputs B0 – B4. For each of the five inputs, a voltage level near 5 V is considered active and a voltage level near ground is considered inactive. Each line is a wired-or and can be pulled high either by the wiper of the manual select switch S1, which is connected to +5 V, or by one of the emitter outputs of optocouplers U1 – U5, which are under computer control. Load resistors R6 – R10 pull the voltage levels of unselected lines to ground potential. Optocoupler inputs D0 – D4 are connected to the printer port of the controlling computer.

Signaling from the master to the slave unit is done by varying the dc voltage supplied by the bias T between 18 V and 24 V. Under quiescent conditions, a continuous dc supply of 18 V is supplied. Selecting an antenna output under either manual or computer control initiates a start pulse of 3 ms. Following the start pulse, a unary code is sent, where the number of pulses (1 ms 18 V, 1 ms 24 V) represents the antenna selected. Figure 3A shows modulation of the dc voltage that selects antenna 1, and Figure 3B shows five data pulses, which selects antenna 5.

The PIC ports B0 – B4 are continuously scanned to determine the antenna to select. When the PIC detects a change in the selected port, it will wait 3 seconds for the new port number to stabilize (to compensate for spurious selections made while the switch is rotated), and then send a new start pulse, followed by the unary code of the selected antenna.

When it is initially powered on, the slave unit will immediately select position 5, actuating K5. If an output is selected on the master unit, the slave unit will then select that output after 3 seconds from switch on.

Operating the rotary switch S1 from manual selection to REMOTE will leave the selected antenna at number 5 until another antenna is selected by the parallel port.

In the master unit, NPN Darlington transistor Q3, R17, D1, and 20 V Zener diode D2 are fed with a regulated 24 V supply. These components form a crude regulated 18 V supply that is able to supply 500 mA with minimal voltage drop throughout the whole load variation. This 18 V supply feeds the dc port of the master bias T. The function of D1 is to protect Q3 during signaling.

The output port B6 from the PIC U6 feeds the 2N7000 FET Q1; this has the effect of turning on PNP Darlington transistor Q2 and effectively shorting the collector/emitter of Q2 and also the collector/emitter of Q3, which will raise the output voltage from 18 V supplied in the quiescent state to 24 V for signaling. Both Q2 and Q3 share a common heat sink, and are isolated with insulating kits. Q3 will dissipate a maximum of 3 W in use while drawing 500 mA.

Slave Unit

Like the master unit, the slave unit is built around a PIC16F628 microcontroller. [Software is available on the *QST* in Depth web page.[4] — *Ed.*] The slave unit schematic is shown in Figure 4. The bias T in the slave unit receives RF and dc to power the unit.

Signals to the slave that are imposed on to the dc level are recovered by optocoupler U1. The 1 kΩ 2 watt resistor R6 provides a current path from the master to the slave unit, and ensures the master's signal generation provides a clean square wave from when the system is initially switched on. When the dc voltage rises above 19 V, the two series Zener diodes D1 and D2, along with the optocoupler's photo diode, will conduct, which in turn will cause the optocoupler outputs to conduct and bring the PIC's B0 input close to +5 V.

The five outputs from the slave PIC U2 feed the five active-high inputs of a Darlington relay driver U5. Each driver is connected to one of the antenna selection relays K1 – K5. The output from U2 will remain active until another antenna is selected either by computer control or by the master rotary switch S1.

I included an optional gas discharge tube GD1 to limit the power handled by the slave circuit. The minimum flash over voltage of the tube is about 190 V, which is adequate for my 100 W transceiver.

Construction Details

The antenna switch system is comprised of three separate components: the master bias T bolted to the back of the master control unit, the master control unit located in the shack, and the remote slave unit located near the antennas.

Master Bias T

Even though the circuits for the master and slave bias Ts are identical, the master bias T is built into a diecast box (see Figure 5), which provides better isolation between the RF and dc ports. The slave bias T is contained within the weather-resistant diecast box that houses the slave unit, which minimizes box intrusions and connections exposed to weather.

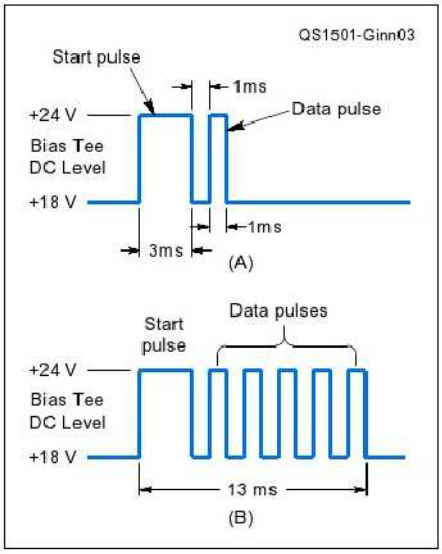


Figure 3 — Timing diagram of master unit to slave unit signaling by modulation of the dc level imposed on the coax by the master bias T. At (A) the pulse stream that selects antenna 1. At (B) the pulse stream that selects antenna 5.

The RF connectors J1 and J2 are Type N and the dc connectors are a mating SMA pair J3 and J4. Capacitors C9, C10, and C11 are mounted between the center terminals of J1 and J2. Identical inductors L1 and L2 are wound with 30 turns of #24 AWG enameled copper magnet wire onto a Micrometals T50-52 core. An aluminum shield is positioned between L1 and L2 and also supports both inductors (see Figure 6). The ground end of C7 is connected to a solder terminal attached to one of the shield's mounting points. Solder terminals are provided at J3 for C8 and varistor R16.

Master Unit

The circuitry for the master unit is housed in a two-piece equipment enclosure with the master bias T bolted to the rear panel. Also on the rear panel are the connector to the printer port, the fuse F1, and the primary power input connector. The front panel holds the ON/OFF power switch S2, POWER indicator LED D4, and the six position REMOTE selector switch S1 with REMOTE indicator LED D3.

The circuitry for the prototype was built

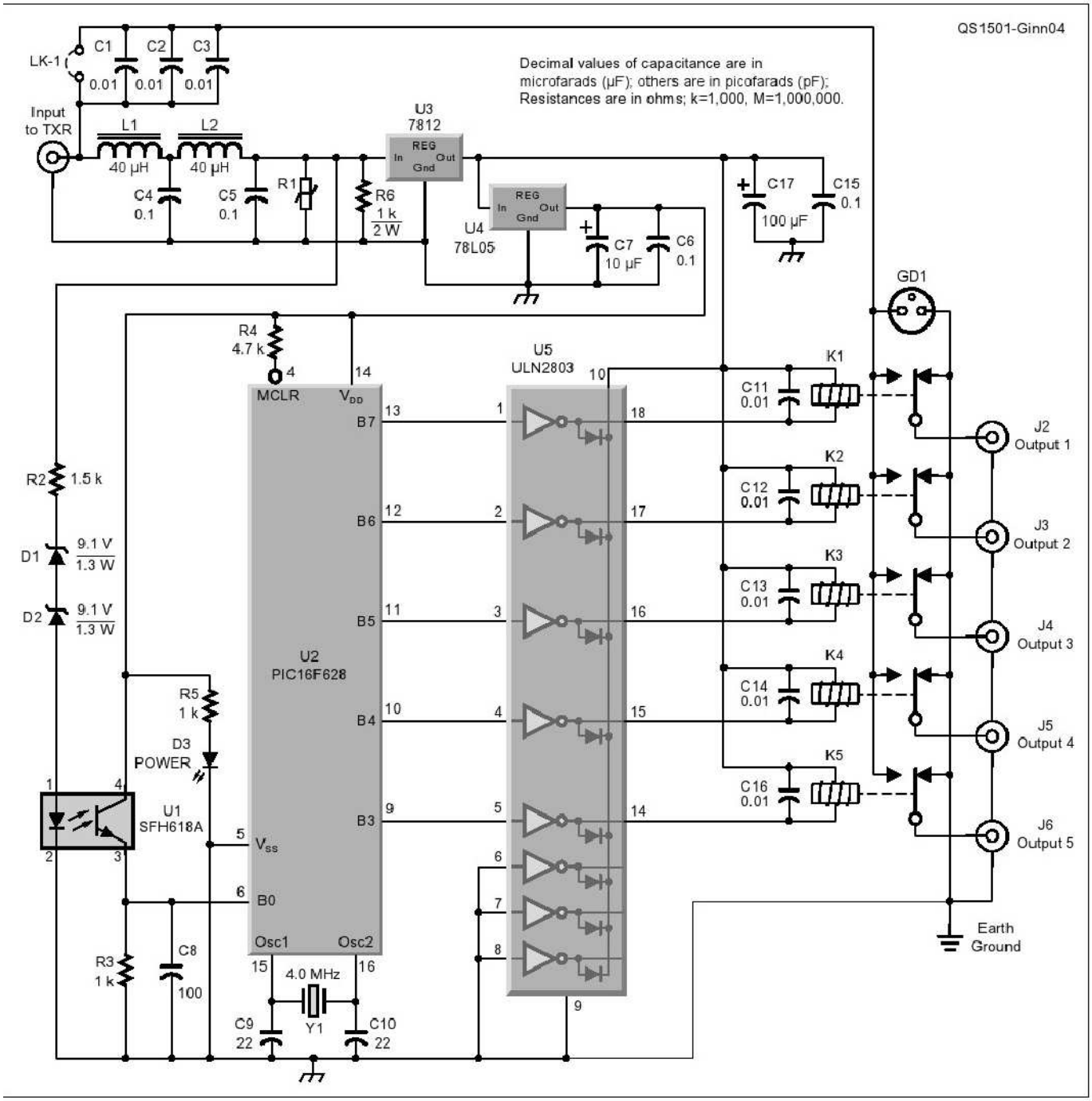


Figure 4 — Slave unit schematic diagram.

C1 – C3 — 0.01 µF 2 kV ceramic (Murata part number: DEBE33A103Z)
C4, C5 — 0.1 µF ceramic capacitor
C6, C15 — 0.1 µF polyester capacitor
C7 — 10 µF 16 V electrolytic capacitor
C8 — 100 pF ceramic capacitor
C9, C10 — 22 pF ceramic capacitor
C11 – C14, C16 — 0.01 µF ceramic capacitor
C17 — 100 µF 25 V electrolytic capacitor
D1, D2 — BZX85C 9v1 1.3w 9.1v Zener diode
D3 — 3mm LED
GD1 — Gas discharge tube (Littelfuse CG2230LSN, Mouser PN: 576- CG2230LSN)
L1, L2 — 40 µH (see text)
J1 – J6 — Type N connector
K1 – K5 — SPDT or DPDT relay 12 V dc 220 Ω coil 16 A contacts
R1 — 20 Vrms 3 J zinc oxide varistor, PN: JVR-10N330K (see also Littelfuse V05E20P, Mouser PN: 576V05E20P)
R2 — 1.5 kΩ (all resistors are 1/4 W unless noted otherwise)
R3, R5 — 1 kΩ resistor
R4 — 4.7 kΩ resistor
R6 — 1 kΩ 2 W carbon or metal film resistor
U1 — SFH618A optocoupler
U2 — PIC16F628 microcontroller (programmed see text)
U3 — 7812 12 V 1 A 3-terminal regulator
U4 — 78L05 5 V 100 mA 3-terminal regulator
U5 — ULN2803 Darlington transistor array with clamping diodes
Y1 — 4 MHz crystal

Figure 5 — Master unit bias T mounted on the rear of the case.

Figure 6 — Master unit bias T internal view.

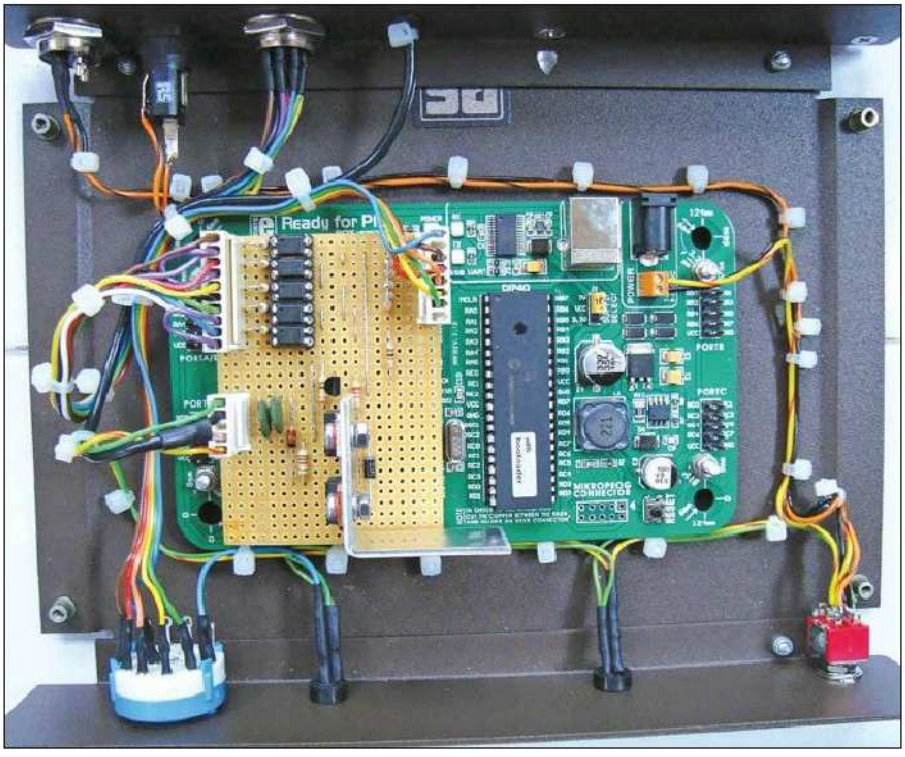


Figure 7 — Master unit internal view.

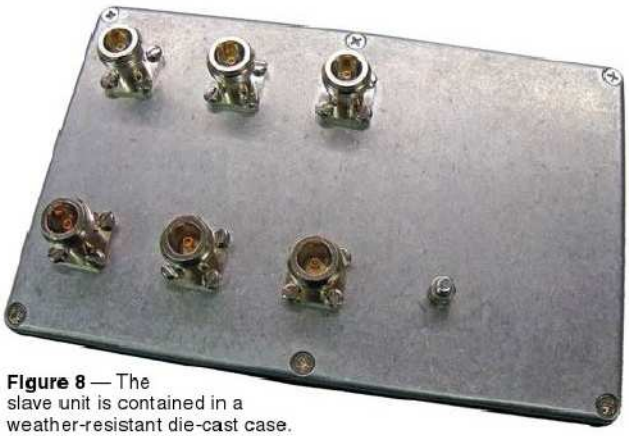


Figure 8 — The slave unit is contained in a weather-resistant die-cast case.

Figure 9 — Slave unit internal view.

onto a PIC microcontroller development board. Additional circuitry using strip board was built onto development board and attached with a plug and socket arrangement (see Figure 7).

Slave Unit

The slave (remote) unit is built into a weather-resistant diecast box (see Figure 8). The circuitry was built onto a double-sided fiberglass printed circuit board (PCB), which also includes the bias T (see Figure 9). I felt that a PCB would lend itself to easier construction and better performance than a strip board design.

I used the PCB as a template to mark the holes for the Type N connectors J1 – J6 in the diecast box lid (see Figure 10). Each connector was mounted with four screws, one of which was extra long to serve as a stand-off support for the PCB as shown in Figure 11. Nuts on the stand-off screw above and below the PCB secure it and provide a ground connection between the connectors and the circuit board.

The ground stud is connected to the PCB

Figure 10 — Slave unit Type N connectors internal view.

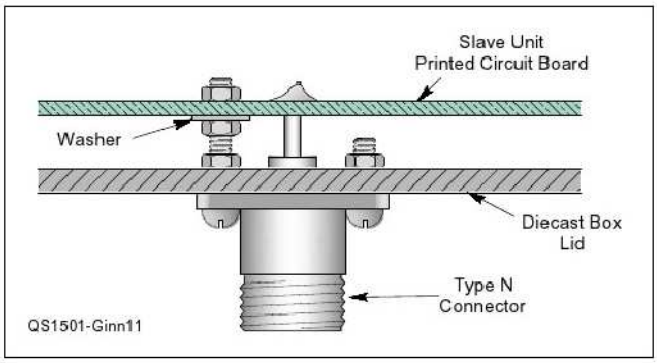


Figure 11 — Slave unit printed circuit board mounted on connector screws.

and the front panel. Five washers were used to pack the PCB away from the aluminum case. The remainder of the stud is proud of the front panel by at least half an inch for connection to a suitable ground point.

Usage Notes

Setting S1 to REMOTE (LED D3 will light up) enables computer control through the optocoupler interface. Manual selection and computer selection should not be used simultaneously.

I have included an option to have the non-selected antennas grounded or open circuit; the present design grounds unselected antennas. The slave PCB can be adapted to leave non-selected antennas ungrounded by drilling out the vias marked A to E on the PCB (see *QST* in Depth[5]).

Notes

[1]P. Salas, AD5X, "Build a Legal Limit Bias T that Covers 1.8 to 230 MHz," *QST*, Jan 2013, pp 46 – 48.
[2]P. Salas, AD5X, "Remote DC Power Through Your Coax," *QST*, Jul 2004, pp 35 – 37.
[3]**www.arrl.org/qst-in-depth**
[4]Ibid. 3
[5]Ibid. 3

Photos by the author.

RSGB and ARRL member Ken Ginn, G8NDL, has been licensed since 1977 and holds an Amateur Radio Full License in the UK. Ken lives just outside of London in the county of Kent and is a forensic engineer with the police department. Outside of work he enjoys radio and electronic design and writing magazine articles about his designs. Ken was recently awarded the Ostermeyer Trophy by the Radio Society of Great Britain (RSGB) for his article in *RadCom*, which described a digital voltage standing wave radio (VSWR) meter that he designed. His current interests include compact HF antenna design and operating with different digital modes. Ken's website, **www.skunkworx.co.uk/**, describes some of his other projects. You can reach Ken at 8 Kettlewell Court, Swanley, BR8 7BP, Kent, UK or by e-mail at **g8ndl@aol.com**.

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

New Products

Yaesu FT-991 HF/VHF/UHF Transceiver

The FT-991 from Yaesu covers the 160 meter through 70 centimeter bands (except 1.25 meters) and includes SSB, CW, FM, C4FM digital, AM, RTTY, and PSK modes. Power output is 100 W except for 2 meters and 70 centimeters, which are 50 W. The display is a 3.5-inch color TFT touch screen, and a spectrum scope is built in. Other features include 3 kHz and 15 kHz roofing filters, high accuracy oscillator, IF width and shift controls, digital noise reduction, contour and IF notch controls, and an audio peak filter. An automatic antenna tuner for 160 – 6 meters is also included. Pricing to be announced. For more information, visit your favorite dealer or **www.yaesu.com**.

Feedback

■A few errors crept into the "Hands-On Radio" column by Ward Silver, N0AX, in the October 2014 issue of *QST*. In Figure 3, the + and – inputs to the input amplifier are reversed. "Input" should connect to Pin 2 (the non-inverting input) and "V_{REF}" through R1 to Pin 3 (the inverting input). This will result in the output of U1A being zero when Input and V_{REF} are equal. V_{REF} and Input must both be ground-referenced. In addition, Pin 4 of U1 should be connected to V– (a negative voltage) and not ground as shown. The supply should be at least ± 6 V as indicated in the text.

■Ralph Crumrine, N0KC, author of "A 1500 W Centennial Amplifier for the 80 – 6 Meter Bands," published in the December 2014 issue of *QST* (page 30), advises that two versions exist of the Ohmite Model 111 tap switch used for the band selector switch, S301A. Old stock might be ceramic; new stock will be plastic. The ceramic bodied part *must* be used. The Model 212 switch is ceramic only and might be a useful substitute.

Hybrid HF Transmitter

This single-band design mixes solid state circuitry with vacuum tube final amplifiers.

Yosef Pinhasi, 4Z1VC

The single sideband (SSB) transmitter shown on the left side of Figure 1 is a hybrid of solid state devices and two vacuum tubes in the RF power stage, designed to operate upper SSB phone in the 20 meter band. You can easily modify it to work in another band and to add lower SSB. I kept the design simple and compact by using integrated devices and direct coupling. Each printed circuit board has its own power supply and voltage regulation circuitry. For electromagnetic compatibility, I separated the RF power stages from the VFO and receiving sections (the cabinet on the right side of Figure 1).

Figure 1 — Hybrid transmitter (left) and VFO/receiver (right). The transmitter knobs upper row (left to right) are Band Selector (optional), and Microphone Level; knobs lower row (left to right) are Load Capacitor, Plate Capacitor, Metering Selector (optional); switches (left to right) are Tone, 12 V, TR, 500 V, 250 V, Power off/on; input jacks are Auxiliary (left), and Microphone (right).

Figure 2 shows a block diagram of the entire transceiver incorporating the transmitter described here, and identifies signal connections A – D, which are referenced in the schematics. The receiver (not described in detail) is a single conversion superheterodyne design based on the SA605 mixer. This article focuses on the transmitter section. The transmitter consists of the Motorola MC1496 balanced modulator, which generates a double sideband signal at the 455 kHz IF, a band-pass SSB filter, upconversion SA602 balanced mixer, pre-driver transistors, 12BY7A driver pentode, and 6146B power beam tetrode final, producing 25 to 30 W PEP. The transmitter and receiver share a DDS VFO. *You should be very careful and take all necessary precautions due to the dangerous high voltages involved.*

Balanced Modulator

The modulator schematic diagram (Figure 3) uses a Motorola MC1496 balanced modulator IC.[1] A photo of the modulator board and additional relevant photos can be found on the *QST* in Depth web page.[2]

Audio signals from microphone, external auxiliary line or internal tone generator are combined in operational amplifier U103. The MICROPHONE signal feeds Q105, enabling use of a standard 600 Ω dynamic or an electrostatic microphone. The gain of the microphone pre-amplifier can be adjusted by R114, which sets the modulation level. Phase-shift oscillator Q106 generates a tone of approximately 1 kHz. This TONE oscillator can be switched ON (S101) for transmitter testing and tuning. Trimmer R133 sets the tone modulation level. An AUXILIARY input allows signals from an external audio device, such as a computer line-out. The impedance is 47 kΩ, similar to that of standard audio inputs. The voltage gain of U103 is four, producing 500 mV peak to the signal input of balanced modulator U102.

Modulator U102 generates a DSB suppressed-carrier signal centered on 452 kHz (3 kHz below the mid frequency of the SSB filter). Since this is the lower edge of the piezoelectric ceramic band-pass filter Y102 (mounted on a small PC board on the modulator board), the lower sideband is removed, resulting in the upper sideband at A.

BFXO Q101 produces the 452 kHz subcarrier. I used a common 455 kHz ceramic resonator and warped its frequency with capacitor pair C101 and C102. Find the appropriate value of C102 that lets C101 adjust the oscillation frequency to 452 kHz. Two stage amplifier Q102 and Q103 buffers the BFXO output and delivers a 100 mV peak 452 kHz IF sine wave to the balanced modulator. The BFXO buffer and balanced modulator U102 are switched on only during transmission when 12 V dc from the power amplifier TR circuitry appears at point C, the base of Q104. This mutes the RF signals during reception. Adjust trimmer R128 for best carrier null at the output. The peak voltage of the SSB signal at the filter output A is 500 mV.

[1]Notes appear on page 39.

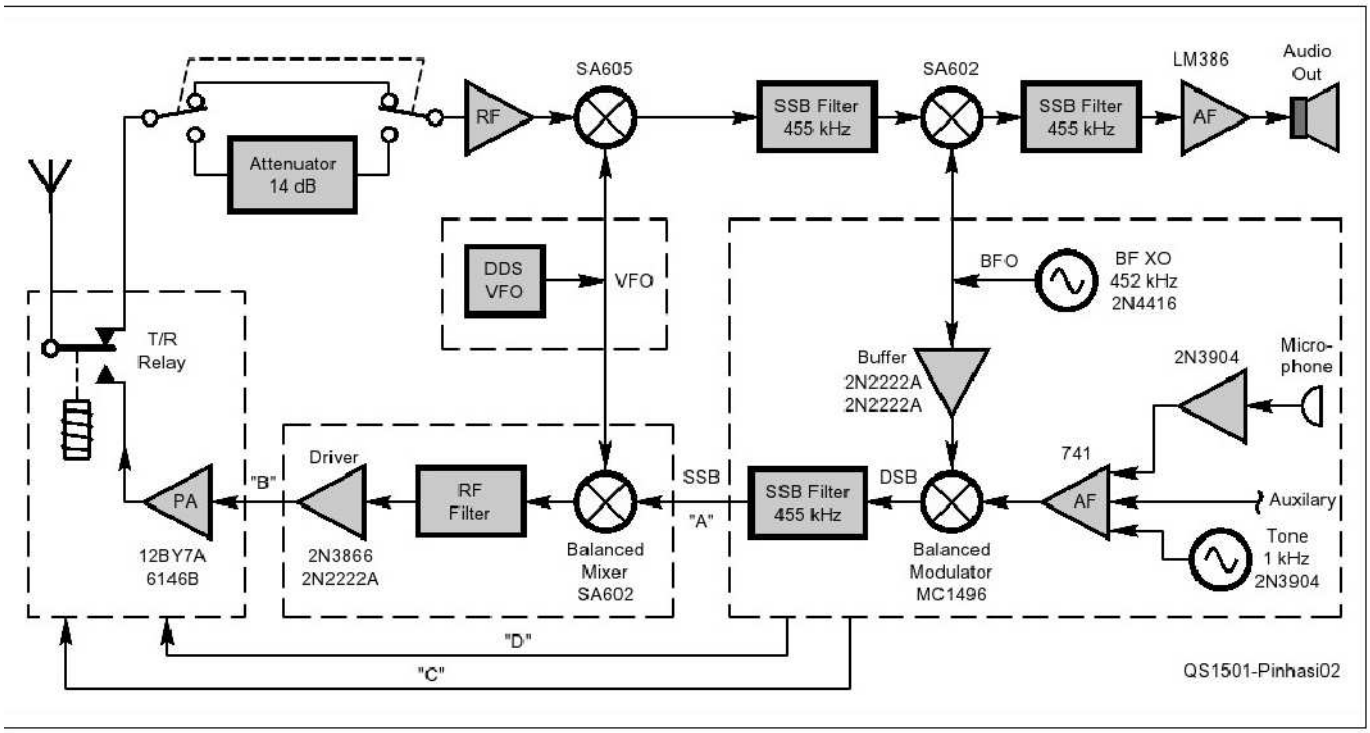


Figure 2 — Block diagram of the transceiver showing circuit block connections. The transmitter includes (lower right to left) the audio section; the BFO, buffer amps, and balanced modulator; SSB filter; DDS VFO, balanced mixer with RF filter and driver; and the tube RF power amplifier with TR switch.

Upconversion Mixer

U202 (Figure 4) supplies 6 V to the upconversion double-balanced mixer U201.[3] The SSB, suppressed-carrier signal A from Y102 feeds Pin 1 of U201 via C202 and R202. U201 has an internal local oscillator, but my attempts to build a VFO around it led to frequency instabilities and drift.[4] Instead, I used the DDS-2 kit from D. C. Pongrance, N3ZI, as the transceiver VFO.[5] After amplification, it produces a 1 V P-P pure sine wave at the difference between the radio frequency and the 452 kHz intermediate frequency. The DDS signal feeds Pin 6 of the upconversion mixer U201 via C201 and R201. Adjust trimmer R204 for best carrier null at output B. The band-pass network following the mixer output is centered at 14.128 MHz.

Power Amplifier

The RF power amplifier stage shown in Figure 5 is based on pentode driver V301 followed by beam power tetrode V302. Here, the plate voltage is set to 250 V and the screen voltage is regulated to 150 V by 5 W Zener diode D306, resulting in a total cathode current of about 30 mA.

The 30 – 40 V peak RF signal from driver V301 feeds the grid of V302 through a parallel resonant network tuned to the center of the band. The high Q of the circuit helps remove the image products from the upconversion mixer, and suppresses parasitic oscillations that may result from instabilities. Neutralization was not necessary in this design. The resonant frequency of the parallel LC circuit (C310 and L303) is set to the center of the 20 meter amateur band. Set the GRID trimmer capacitor C310 for maximum amplitude of the driving signal when the V302 is installed, but the transmit switch is OFF.

V302 operates as a class AB_1 linear power amplifier. The dc plate voltage can be set either to 250 V for low level 2 – 5 W output or to 500 V for 30 W PEP. The screen voltage is 200 V regulated by 5 W Zener diode D307. The grid bias is fixed to –48 V, resulting in about 20 – 30 mA cathode quiescent current. The output Pi network converts the 50 Ω load to the impedance required by V302. For the 20 meter band, tank inductor L305 is seven turns of #16 AWG enameled wire on a 3.6 cm diameter plastic cylinder. It can be seen up against the front panel in Figure 6. High voltage is supplied to the anode of V302 through RF choke L302, which must handle at least 250 mA. The parasitic suppressor L306 is wound on 1 W resistor R307.

V302 cathode current is measured by a 1 mA dc milliammeter connected in parallel with R309 cathode resistor via R310, producing a maximum scale reading of 200 mA.

I placed my transmitter chassis in a ventilated cabinet made of a transparent thermoplastic. [You may wish to use a ventilated metal enclosure to minimize RF leakage and to reduce exposure to RF. — *Ed.*]

TR Relay

Transmit/receive relay K301 is controlled by voltage signal D from the modulator board (the upper board seen in Figure 6). During transmission, signal D from Q104 to opto-coupler Q301 activates relay K301, connecting the antenna to the output of the power amplifier and shorting the receiver connection to ground. Opto-coupler Q302 drives an open collector transistor Q303 to produce a TR indicator for the receiver (or for an external high power linear amplifier). The TR circuit is mounted on the mixer PC board (lower board seen in Figure 6) and uses the same 12 V regulator U203.

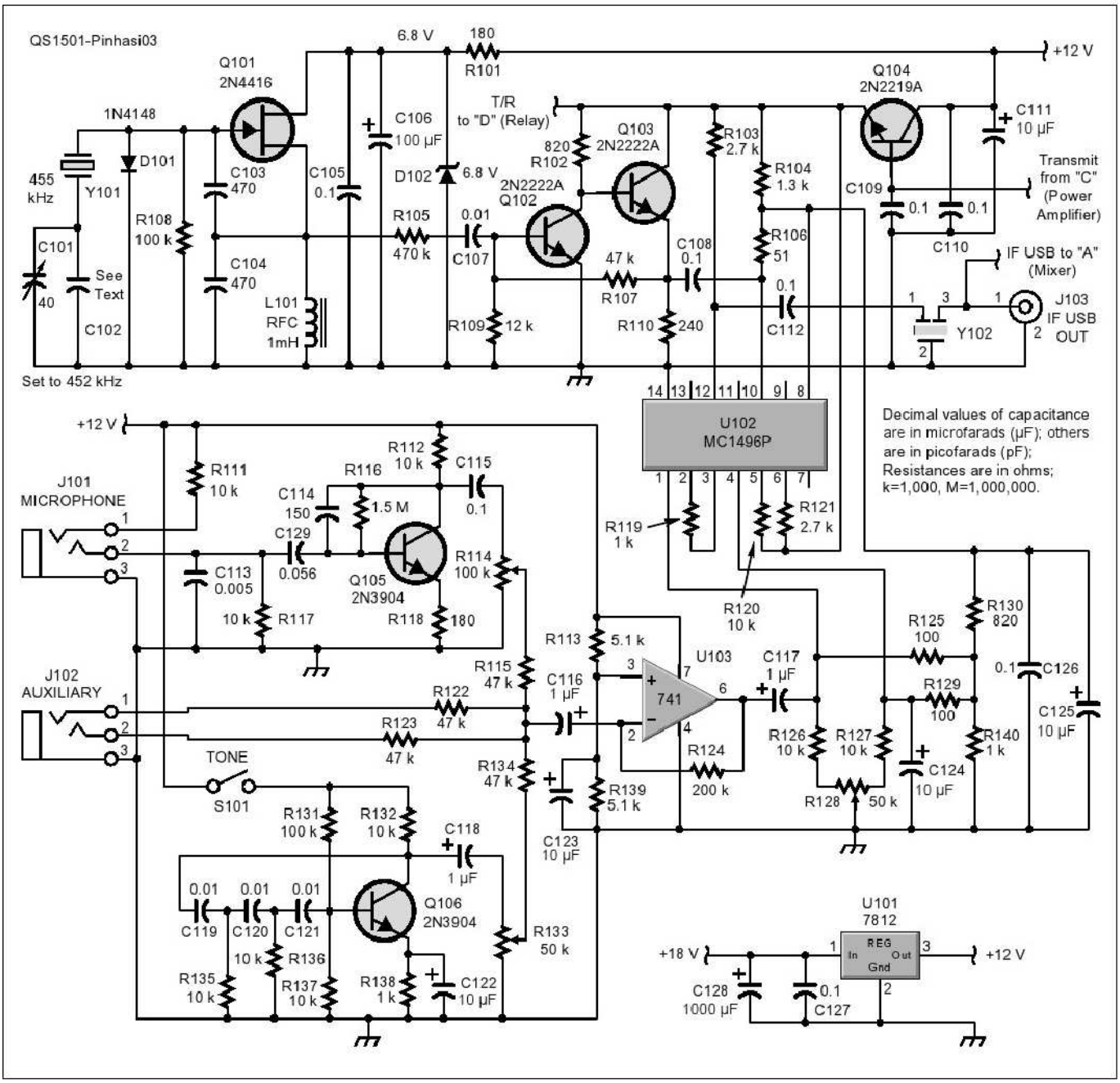


Figure 3 — Audio input, beat frequency oscillator, balanced modulator, and SSB filter schematic.

C101 — 40 pF variable capacitor
C102 — (see the "Balanced Modulator" section of the text)
C103, C104 — 470 pF capacitor
C105, C108 – C110, C112, C115, C126, C127 — 0.1 µF capacitor
C106 — 100 µF capacitor
C107, C113, C119, C120, C121 — 10 nF capacitor
C114 — 150 pF capacitor
C116, C117, C118 — 1 µF capacitor
C122 – C125 — 10 µF capacitor
C128 — 1000 µF capacitor
C129 — 56 µF capacitor
D101 — diode, 1N4148
D102 — Zener diode, 6.8 V
J101 — microphone jack
J102 — auxiliary jack
J103 — RCA jack
L101 — 1 mH RF choke
Q101 — 2N4416 transistor
Q102, Q103 — 2N2222A transistor
Q104 — 2N2219A transistor
Q105, Q106 — 2N3904 transistor
R101, R118 — 180 Ω resistor
R102, R130 — 820 Ω resistor
R103, R121 — 2.7 kΩ resistor
R104 — 1.3 kΩ resistor
R105 — 470 kΩ resistor
R106 — 51 Ω resistor
R107, R115, R122, R123, R134 — 47 kΩ resistor
R108, R131 — 100 kΩ resistor
R109 — 12 kΩ resistor
R110 — 240 Ω resistor
R111, R112, R117, R120, R126, R127, R132, R135 – R137 — 10 kΩ resistor
R113, R139 — 5.1 kΩ resistor
R114 — 100 kΩ potentiometer
R116 — 1.5 MΩ resistor
R119, R138, R140 — 1 kΩ resistor
R124 — 200 kΩ resistor
R125, R129 — 100 Ω resistor
R128, R133 — 50 kΩ potentiometer
S101 — SPST switch
U101 — regulator, 12 V, 7812
U102 — balanced modulator, MC1496P
U103 — op amp, 741
Y101 — 455 kHz resonator
Y102 — SSB filter, ceramic 455 kHz, Murata CFWLA455KJFA-B0 (**www.murata.com/products/comm_filter/pickup/index.html#lf**)

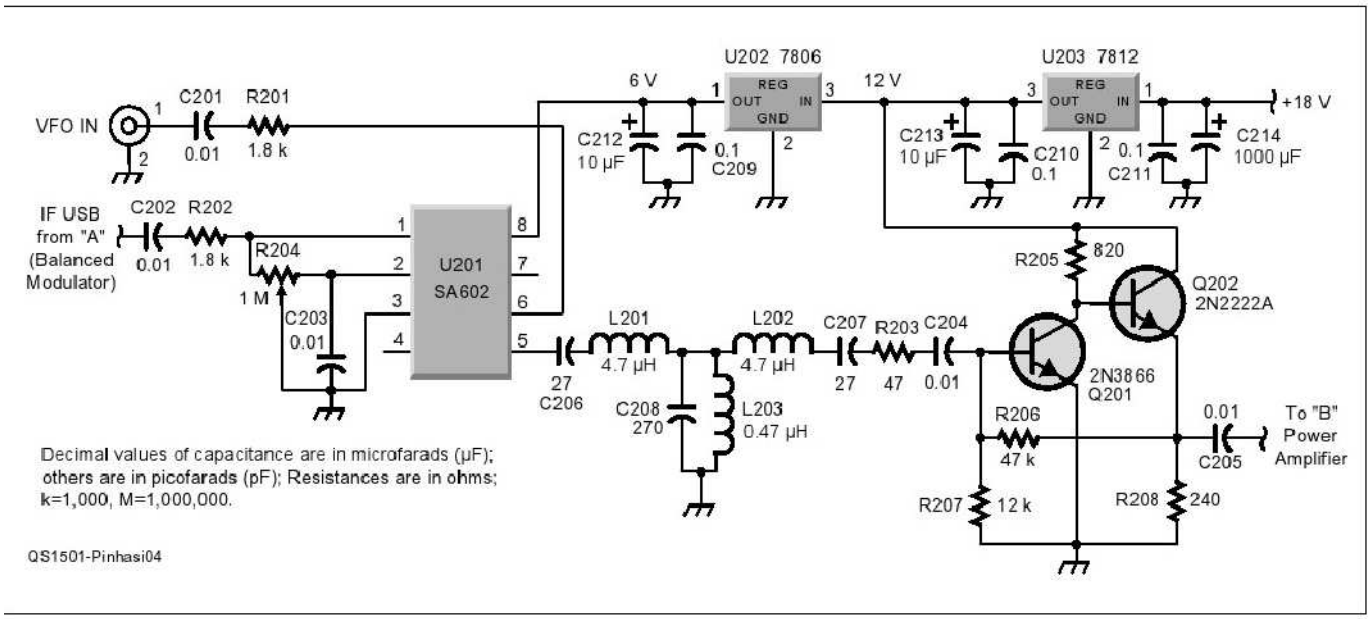


Figure 4 — Upconversion balanced mixer, RF filter, and driver amplifier.

C201 – C205 — 10 nF capacitor
C206, C207 — 27 pF capacitor
C208 — 270 pF capacitor
C209 – C211 — 0.1 µF capacitor
C212, C213 — 10 µF capacitor
C214 — 1000 µF capacitor
L201, L202 — 4.7 µH inductor
L203 — 0.47 µH inductor
Q201 — 2N3866 transistor
Q202 — 2N2222A transistor
R201, R202 — 1.8 kΩ resistor
R203 — 47 Ω resistor
R204 — 1 MΩ potentiometer
R205 — 820 Ω resistor
R206 — 47 kΩ resistor
R207 — 12 kΩ
R208 — 240 Ω resistor
U201 — balanced mixer, SA602
U202 — voltage regulator, 6 V, 7806
U203 — voltage regulator, 12 V, 7812

Power Supply

Figure 7 shows a schematic of my power supply, which is based on a 220 V ac power source. The 250 V and 500 V dc are supplied by a 360 V ac center-tapped 400 mA transformer (on the lower left in Figure 6) via a full wave rectifier D401A-D and filter. Bleeder resistors R401 and R402 discharge capacitors C401 – C404 after the power supply is turned off. It takes approximately one minute until the capacitor voltages decrease to safe values. *Be very careful not to touch hazardous high-voltage terminals during operation.*

A voltage multiplier connected to the 6.3 V ac generates an unregulated 18 V dc for the solid state circuitry. Regulator U401 supplies 5 V to the transmitter cooling fan (visible in Figure 1). The fixed negative bias voltage for V302 tube is obtained by using a small reverse-connected low current 220 V to 12 V transformer. Its 12 V secondary is connected to the 6.3 V ac, attaining above 100 V at the primary. Half-wave rectifier D404 and 47 V Zener diode D406 in series with LED D405 produce –48 V dc. Initially, set the slider of trimmer R403 to ground potential.

Operation

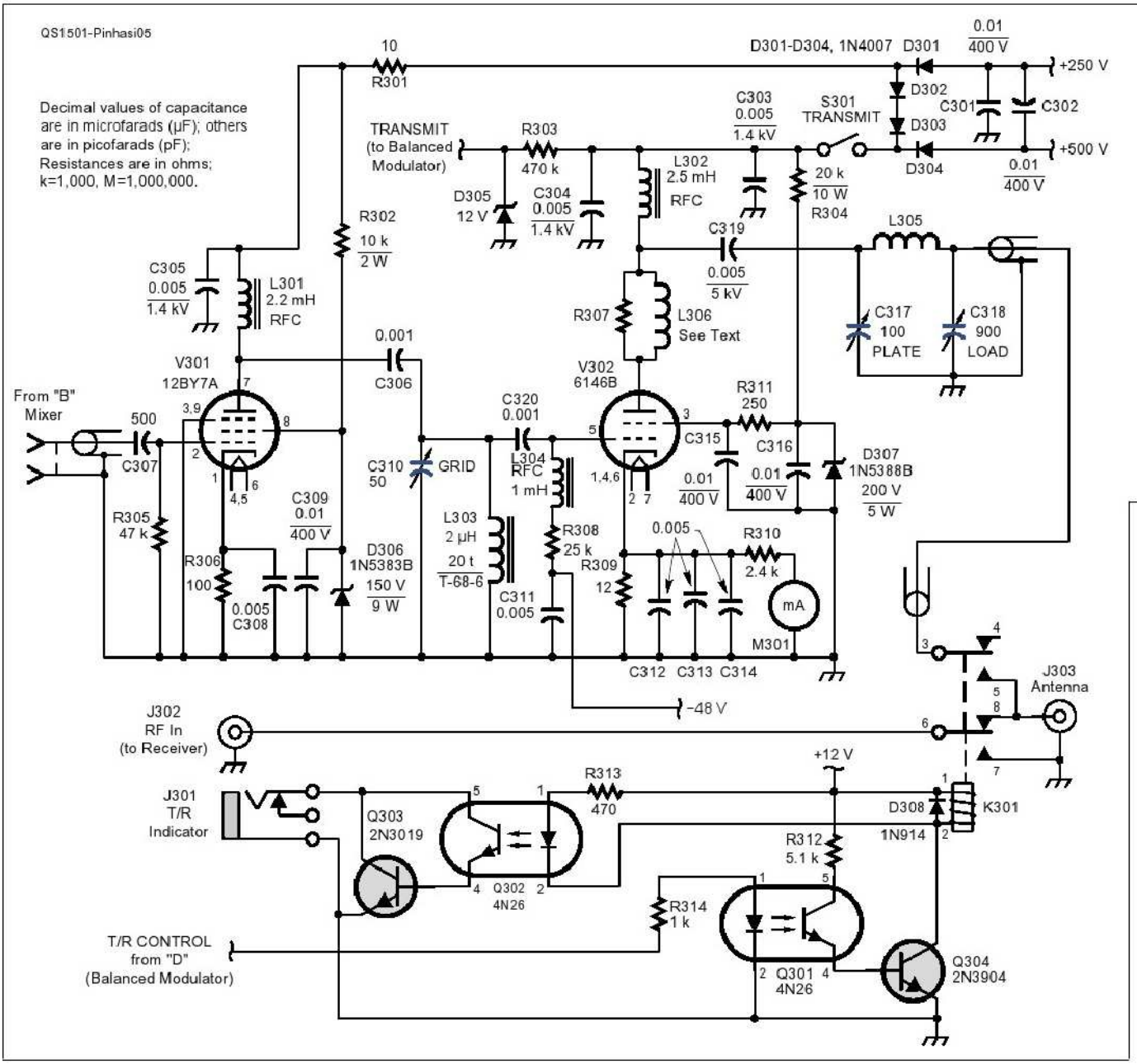
Turn all the switches OFF. Connect the DDS-VFO and attach a power meter and a dummy load rated for at least 50 W to antenna connector J303 of the transmitter. Turn ON the power mains switches of the transmitter. Allow at least a minute for the tube filaments to warm up. Carefully change the position of bias trimmer R403, raising the voltage until LED D405 lights up. Do not increase the voltage any further. D405 and Zener diode D406 ensure that the voltage is fixed to –48 V and the LED light indicates that the tube is biased properly. Using a voltmeter, verify that the bias of the final power tube grid is stable at the required –48 V.

Supply 250 V (S403) to the driver and 12 V (S404) to the mixer. Tune the VFO to the middle of the 20 meter phone portion of the band (14.230 MHz) and switch ON (S101) the tone oscillator. Rotate the PLATE capacitor to the middle and the LOAD capacitor to the maximum capacitance. Switch ON the transmission (S301) and trim GRID capacitor C310 to obtain the maximum reading on the power meter. Tune the PLATE capacitor to obtain a dip in the cathode current. Then change the LOAD capacitor to bring the cathode current to a maximum. Readjust C310 to maximum power. In this setting, the output power will be approximately 5 W.

Now turn on the 500 V switch (S402). Slightly readjust the GRID, PLATE and LOAD capacitors to obtain maximum output power. The expected RF output power will be 25 – 30 W PEP, resulting in a 100 – 120 mA cathode current in V302. You do not need to trim C310 anymore, just the PLATE and LOAD. Turn OFF the tone and connect a microphone. During transmission, adjust the modulation level for a maximum PEP at the output without signal clipping.

Notes

[1]R. Motorola Semiconductors, Hejhall: "MC1496 Balanced Modulator," Application Note AN531/D, Jan 2002.
[2]**www.arrl.org/qst-In-depth**
[3]Philips Semiconductors, "High sensitivity applications of low-power RF/IF integrated circuits," Application Note AN1993, Aug 2007.
[4]Philips Semiconductors, "Reviewing key areas when designing with the SA605," Application Note AN1994, Nov 2007.
[5]D. C. Pongrance: "N3ZI DDS 2," **www.pongrance.com/super-dds.html**.



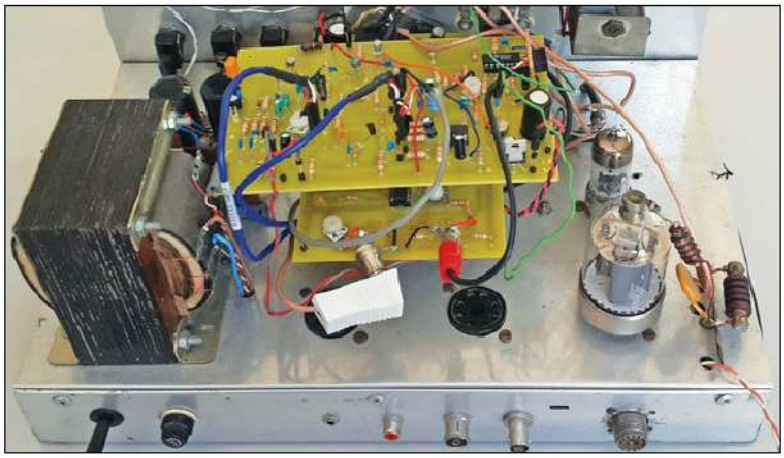


Figure 6 — Transmitter interior and rear view. The rear connections are (right to left): SO239/antenna, BNC to receiver, VFO input, IF upper SSB, TR to receiver.

Figure 5 — The transmitter power amplifier and TR switch schematic.

C301, C302, C309, C315, C316 — 10 nF 400 V capacitor
C303 – C305, C308, C311 – C314 — 5 nF 1.4 kV capacitor
C306, C320 — 1 nF 1.4 kV capacitor
C307 — 500 pF 500 V capacitor
C310 — 50 pF variable capacitor
C317 — 100 pF variable capacitor
C318 — 900 pF variable capacitor
C319 — 5 nF 5 kV capacitor
D301 – D304 — 1N4007 diode
D305 — 12 V Zener diode
D306 — 150 V 5 W Zener diode, 1N5383B
D307 — 200 V 5 W Zener diode, 1N5388B
D308 — diode, 1N914
J301 — phone jack
J302 — BNC female connector
J303 — SO239 female connector
K301 — DPDT relay
L301 — 2.2 mH RF choke
L302 — 2.5 mH RF choke
L303 — 2 µH coil, 20 turns #24 AWG on T-68-6 core
L304 — 1 mH RF choke
L305 — 7 turns of #16 AWG enameled wire on a 3.6 cm diameter plastic cylinder
L306 — 5 turns of #18 AWG enameled wire wound on R307
M301 — meter, dc 1 mA full scale
Q301, Q302 — opto-isolator, 4N26
Q303, Q304 — transistor, 2N3019
R301 — 10 Ω resistor
R302 — 10 kΩ 2 W resistor
R303 — 470 kΩ resistor
R304 — 20 kΩ 10 W resistor
R305 — 47 kΩ resistor
R306 — 100 Ω resistor
R307 — 47 Ω 1 W resistor, use as coil form for L306
R308 — 25 kΩ resistor
R309 — 12 Ω resistor
R310 — 2.4 kΩ resistor
R311 — 250 Ω resistor
R312 — 5.1 kΩ resistor
R313 — 470 Ω resistor
R314 — 1 kΩ resistor
S301 — SPST switch
V301 — miniature pentode vacuum tube 12BY7A
V302 — power tetrode vacuum tube 6146B

Photos by the author.

ARRL member Prof Yosef Pinhasi, 4Z1VC, is the Dean of the Faculty of Engineering at the Ariel University of Samaria. He investigates utilization of electromagnetic waves in a wide range of frequencies for various applications such as communications, remote sensing, and imaging. The space-frequency approach, which he developed, is employed to study propagation of wide-band signals in absorptive and dispersive media in broadband communication links, and wireless indoor and outdoor networks as well as in remote sensing radars operating in the millimeter and Tera-Hertz regimes. He is a member of the Israel Amateur Radio Club (IARC) and can be reached at the Faculty of Engineering, Ariel University, P.O. Box 3, Ariel 40700, Israel, or **yosip@ariel.ac.il**.

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

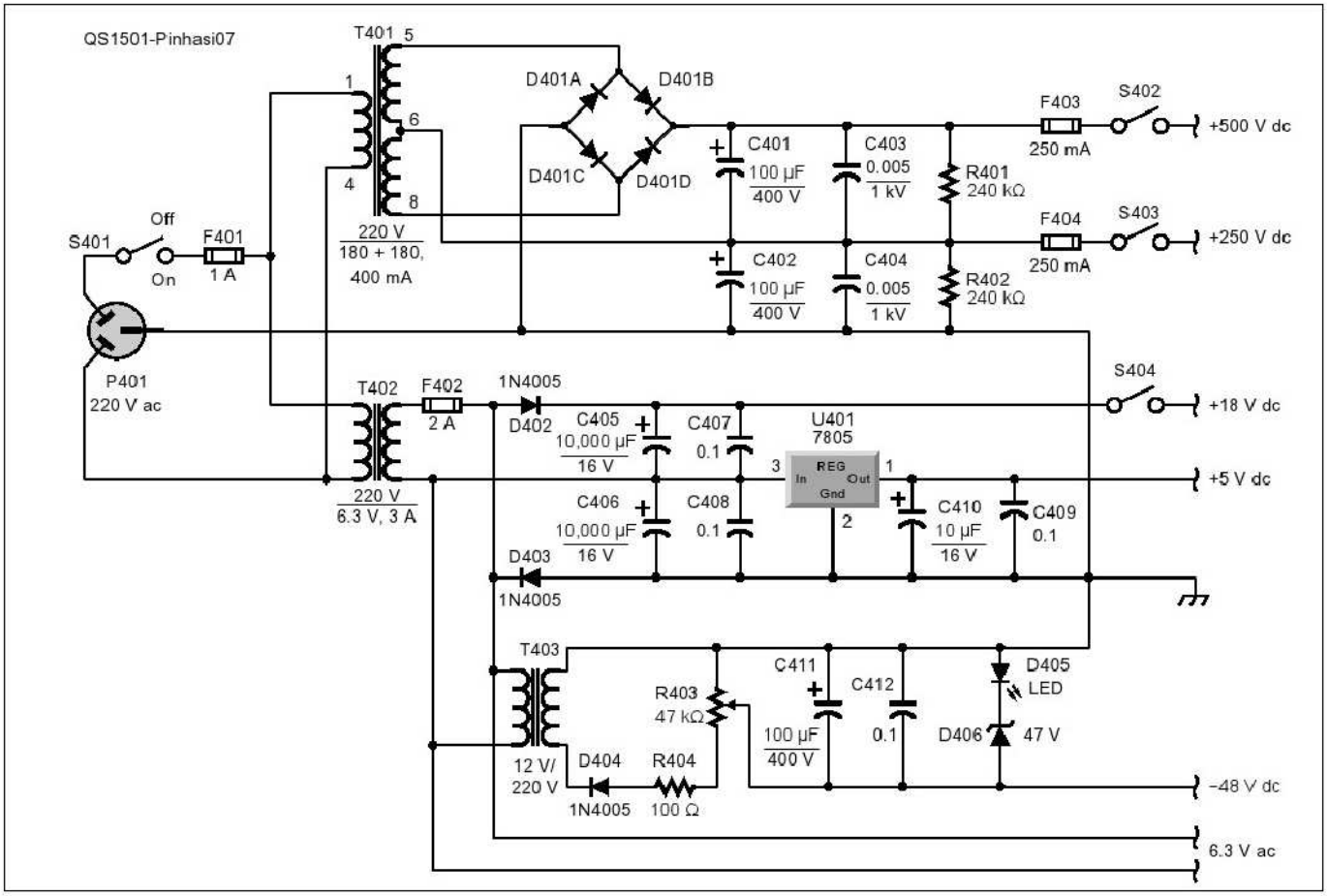


Figure 7 — The power supply.

C401, C402, C411 — 100 µF, 400 V capacitor
C403, C404 — 5 nF, 1 kV capacitor
C405, C406 — 10,000 µF, 16 V capacitor
C407 – C409, C412 — 0.1 µF 100 V capacitor
C410 — 10 µF, 16 V capacitor
D401A-D401D — full wave diode bridge, or four 1N4007 diodes
D402-D404 — diode, 1N4005
D405 — LED
D406 — Zener diode, 47 V
F401 — fuse, 1 A
F402 — fuse, 2 A
F403, F404 — fuse, 250 mA
P401 — male plug, 220 V ac
R401, R402 — 240 kΩ resistor
R403 — 47 kΩ potentiometer
R404 — 100 Ω resistor
S401 – S404 — switch, SPST
T401 — transformer, pri. 220 V ac, sec. 360 V ac center tapped
T402 — filament transformer, pri. 220 V ac, sec. 6.3 V ac, 3 A
T403 — transformer, pri. 12 V ac, sec. 220 V ac
U401 — voltage regulator, 5 V, 7805.

A Solid State 1.25 kW Linear Amplifier

This single-cabinet homebrew amplifier covers 160 – 2 meters. Here's how it came to be.

Andrew J. Buckler, K2OP

This project began 2 years ago due to a mix of interests. One was my nascent interest in Earth-Moon-Earth communication (EME), which I knew would require high power at high frequencies (typically 2 meters). I was also taken with software defined radio (SDR) and I wanted to explore 6 meters, with its varied propagation characteristics that have led to it being nicknamed "The Magic Band." However, I wanted to go at it with more power than the 5 W that my QRP SDR set could provide. Initially, I also thought to add in 10 meters, but as the project progressed, I wanted to work the HF bands down to 160 meters with more or less full legal power behind me whenever I needed it. And, as if all this were not enough, I wanted the high-power linear amplifier for all of these activities to be housed in a single box.

A search of commercial products revealed that there was no single kilowatt-plus linear amplifier available that could handle the frequency range I was interested in. Rather than compromise with multiple boxes, I decided to homebrew my own amplifier.

A Starting Point

As luck would have it, just as I decided to go it on my own, Jim Klitzing's article on a solid state 1 kW linear amplifier for 2 meters was published in *QST*.[1,2] The article described a Class AB amplifier built around a Freescale MRFE6VP61K25HR6 power MOSFET with the characteristics that I was looking for. The amplifier has plenty of gain and is easily driven by very low power levels.

With this as inspiration, the germ of the idea was to use multiple RF modules (often called *decks* by linear amplifier aficionados) that would share a common power supply, cooling fans, and heat sink.

Final Two-Deck Design Evolves

After consulting with Freescale designers and studying reference designs posted on its website, **www.freescale.com**, I was left with the impression that a separate deck was needed for each band.[3] I then came across a *QEX* article by Helge Granberg,

[1]Notes appear on page 46.

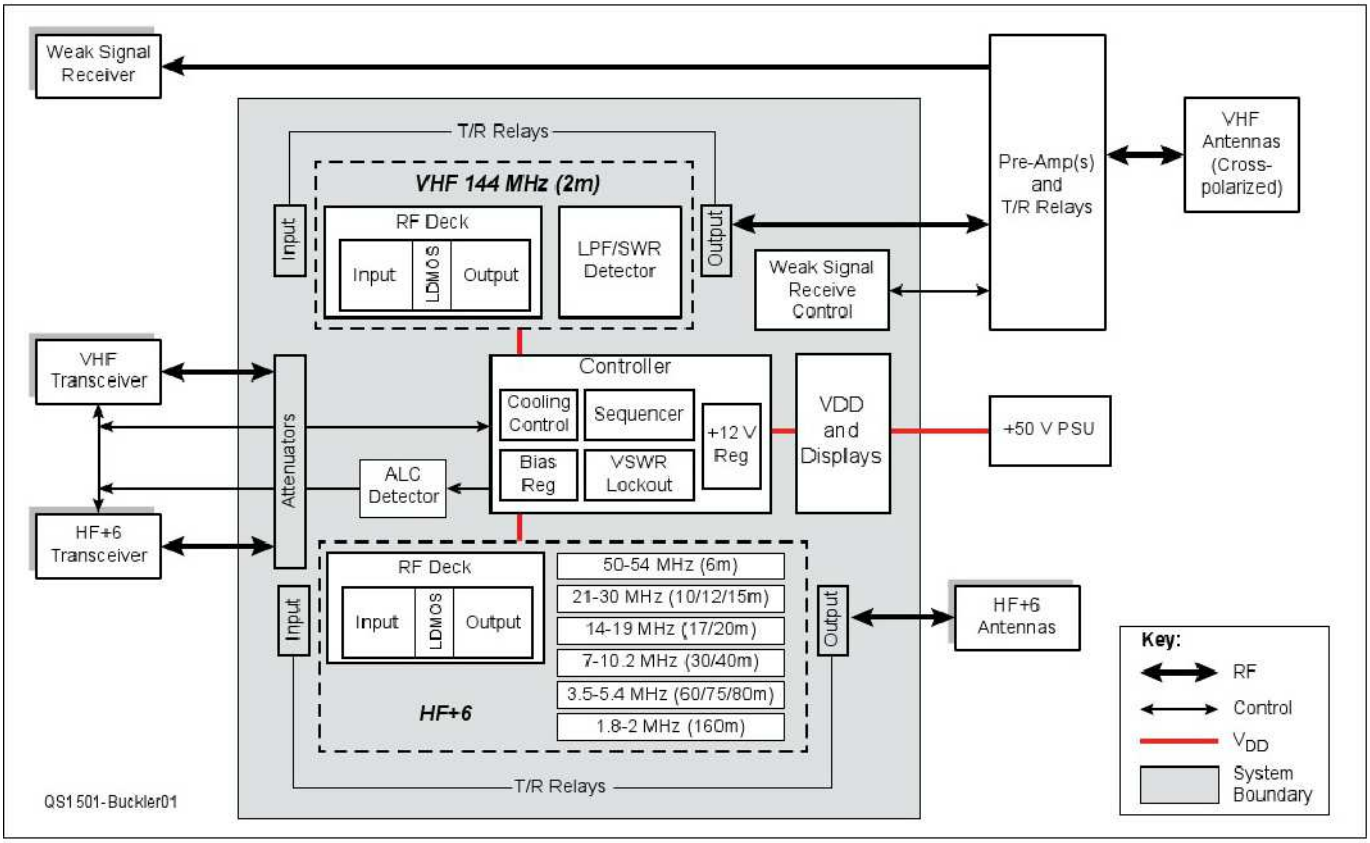


Figure 1 — High-level system block diagram. Key features include: common controller for both decks; sequencer for integration with external dual channel EME preamplifiers; front panel switching for transmit polarization; fully integrated diplexer harmonic filtering for HF; safety monitoring of temperature, load failure, and diplexer HPF outputs, and ALC feedback for driver.

Figure 2 — Linear amplifier power output of the 2 meter deck as a function of the drive power at its input.

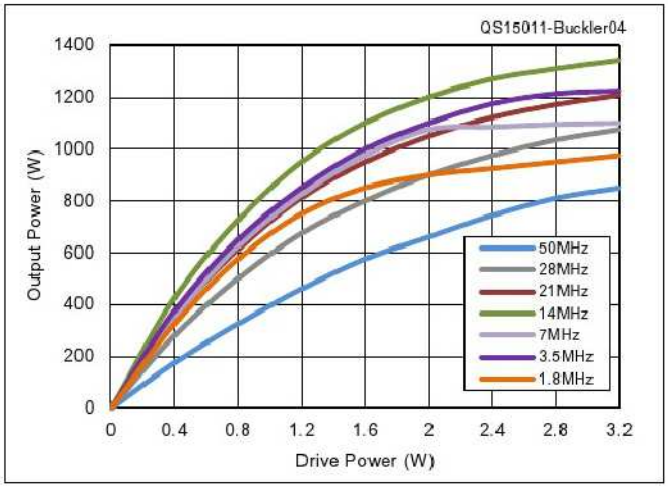


Figure 4 — Amplifier power output curves as a function of drive power for the seven bands from 160 meters to 6 meters.

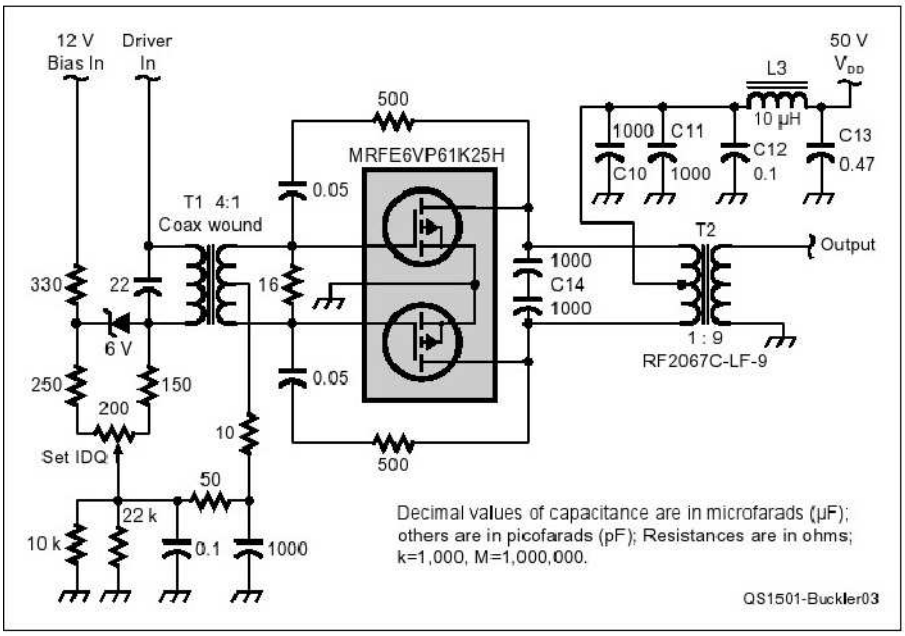


Figure 3 — Schematic of the HF+Six deck as it exists today.

K7ES (SK), which described a solid state linear amplifier built around Motorola MOSFETs.[4] Helge's article really opened my eyes — the Freescale designs suggested a reference need for separate decks for 10 and 6 meters, but the article made apparent to me that I could use a single deck from 6 meters *all the way down* to 160 meters. That sure expanded my thinking.

Freescale's 27 MHz reference design seemed to use a basic approach (though I still don't know why it's presented as a narrow-band design), and Communication Concepts, Inc. (**www.communication-concepts.com/**) had various components and subsystems associated with the base design.[5] The MOSFETs used in these designs were older and more expensive than the Freescale device, and I didn't see why the Freescale part couldn't be substituted on a single-device board using transformers rated for the correct power level. More specifically, if I could use elements from the W6PQL 2 meter deck, but with input and output transformers as well as RF capacitors appropriate for the lower frequencies, I would have a single deck that would not only span 28 – 54 MHz, it would in fact extend all the way down to 1.8 MHz.

The final design had two separate decks: one for 2 meters and one for everything else, which I termed "HF+Six." The block diagram is shown in Figure 1. Using the components W6PQL provided regulated and temperature compensated bias, separate V_{DD} feeds to the output transistor drains to keep high dc currents out of the RF transformers, and the same machined copper heat spreader and heat sink as the 2 meter deck (in fact, I was able to share the entire heat sink). So it met my leverage goals.

The 2 Meter Deck

I started with the W6PQL components for the 2 meter deck in a "kit" form, building it myself with a lot of help from Jim. The initial considerations were mechanical issues such as where and where not to use solder, screws, and heat sink compound between the boards, the copper heat spreader, and the aluminum heat sink.

The power test was carried out with two wattmeters — one placed before and one placed after the main RF deck. Figure 2 shows the linear amplifier power output as a function of the drive power at the input to the RF deck. I was quite pleased with it as it shows excellent gain, easily reaching the 1.25 kW design output I had hoped for EME operation at high duty cycle.

The HF+Six Deck

The schematic of the HF+Six deck as it exists today is shown in Figure 3. More "invention" was needed here, and the design underwent several changes along the way, including the addition of degenerative feedback after a "smoke in the cockpit" incident

Table 1
ARRL Lab Test Results

Band (meters)	Harmonic Suppression (dB)	3rd Order IMD Products (dB)
160	51	–31
75	48	–31
40	56	–32
30	66	–32
20	62	–32
17	60	–32
15	60	–33
12	60	–33
10	62	–34
6	64	–35
2	66	–36

after about 350 contacts had been made. Amplifier power output curves as a function of drive power for the seven bands from 160 meters to 6 meters are shown in Figure 4. [Discussions of technical details and a "behind the scenes" look at the amplifier development are available in the author's Development Notebook on the *QST* in Depth web page.[6] — *Ed.*]

Controller, ALC, and Attenuators

The W6PQL controller board is fully described in Jim's article and on his website, so I'll not discuss it here except to say it is one of the major reasons that I succeeded with the project. Its elegant design covers many functions and safety issues that are of primary importance.

I also used Jim's automatic level control (ALC) detector board. ALC back to the radio accomplishes three things: first, the control board uses it to keep the driving power minimal until my low noise amplifier (LNA) gets out of the way. Second, it prevents hot-switching of the input relay (driver power). Third, it is used as a safety to control drive level.

I also wanted to support a variety of input drive levels, so I built three attenuators into the amplifier: one for 10 dB, supporting input levels of up to 35 W; one for 13.3 dB, supporting input levels up to 75 W, and one for 15.5 dB, for input levels up to 125 W. I got these from Jim too, but as with all of the other components, of course I needed to determine where and how to mount them, as well as deal with the cabling. This was not the most difficult part of the design, but neither was it free of challenges. In particular, I needed to make decisions on internal coaxial cable specs, connectors, etc. I ended up using RG316 for the input side, and RG142 for the output side. RG316 is easier to handle due to its smaller size and higher flexibility, and it mates well with SubMiniature version A (SMA) bulkhead cables/jacks. The RG142 is able to handle the power despite the fact that its cross-section is also rather small, but it is much less flexible than the RG316.

Output Filtering

The output signal of a class AB amplifier contains harmonic components that must be filtered out in order to comply with FCC regulations. This is typically done with a low-pass filter because the harmonics are all at higher frequencies than the primary output signal. For the 2 meter deck, a single 144 MHz low-pass filter was adequate. However, for the HF+Six deck, it wasn't so easy. In fact, this was one of the major hurdles to overcome in the project. I knew I needed some help to figure it out and was pleased to receive assistance from Joel Hallas, W1ZR, and Ward Silver, N0AX.

The measurements showed fairly low second harmonic components due to the push-pull nature of the amplifier stage. But the real issue was the third harmonic, which was only 10 dB down generally and on some bands only 8 dB down! Some authors, such as William Sabin, W0IYH, favored the diplexer design for solid state amps in the HF range, because reflecting all that energy back into the output of the field effect transistors (FETs) risked driving the oscillations I had worried about in the detailed design of the power deck.[9] Two other options also seemed promising, one by Granberg, K7ES, and the other by Edward Wetherhold, W3NQN.[7, 8] Both seemed like they would work, but I didn't want to risk the oscillations, so I chose to implement the diplexer for all banks except 6 meters since its third harmonic wasn't so bad. Ultimately I settled on a design that supports all the bands in six banks. Having six banks is reasonably common, but few of the designs stretch it to 6 meters and support the WARC bands too. Splitting the bands into six banks ended up as follows: 160 meters, 80/75/60 meters, 40/30 meters, 20/17 meters, 15/12/10 meters, and 6 meters.

Beyond the question of how to approach the harmonic filtering was the issue of implementing the forward and reverse power measurements to drive the front panel and provide standing wave radio (SWR) protection signal for the controller. One strategy was to have a filter that cuts out above 54 MHz and also integrates the power measurement, and then switch in additional filters for the bands below 6 meters to shift the cutoff frequency lower as needed. This idea seemed the most cost effective and compact.

The amplifier was tested at the ARRL Lab and the results are summarized in Table 1.

Construction and Mechanical Details

Removal of the intense heat generated by the laterally diffused metal oxide semiconductor (LDMOS) output transistors gives rise to some unique mechanical details. Rather than mounting the output transistors directly to a heat sink, they are first flow soldered to a thick copper heat spreader, which is then mounted to the heat sink. The efficient heat conduction of the copper and its large surface area reduces the thermal impedance of the path from the transistor to the heat sink and thus reduces the temperature rise of the transistor. Two copper heat spreaders are clearly visible in Figure 5: one under the unassembled HF+Six RF deck at the top of the photo and the other under the assembled 2 meter RF deck at the center of the photo. Both heat spreaders are mounted with thermal paste to a large aluminum heat sink that extends beyond both decks.

Further inspection of Figure 5 reveals the three attenuator banks mounted on the heat sink between the two RF decks. At the edge of the heat sink, next to the 2 meter RF deck, is its high-current dc switch. The large circuit board mounted on the side of the heat sink is the controller board with the LNA switch to its left.

Each RF deck is comprised of an input board, a module containing a pair of LDMOS transistors (white rectangle), and an output board, all mounted to a copper heat spreader. The components on the input and output boards are soldered using surface mount techniques first and then mounted to the copper heat spreader to which the LDMOS module has been

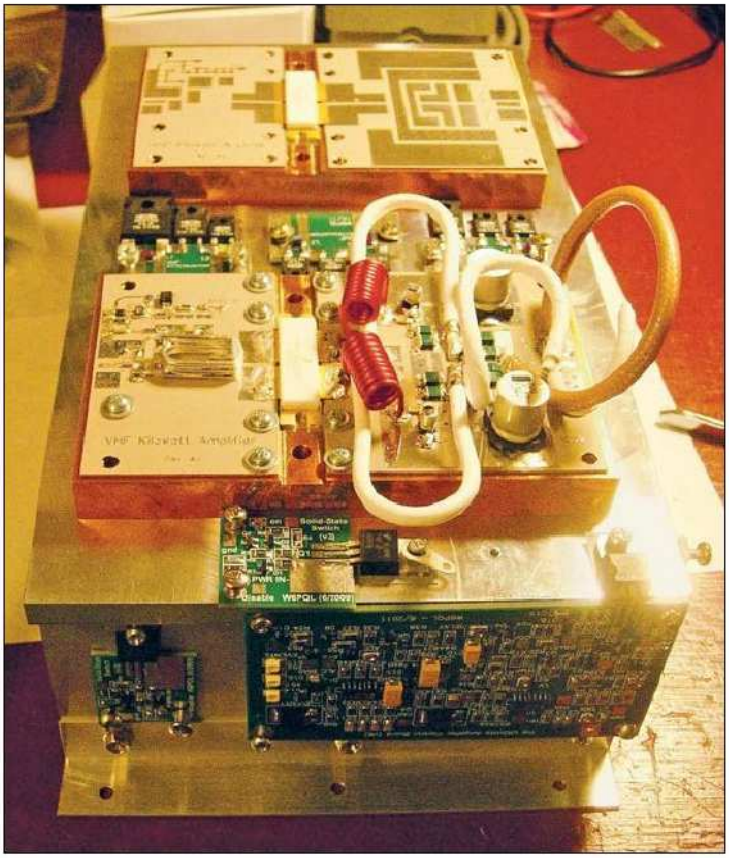


Figure 5 — The partially completed unit.

Figure 6 — Inside the completed unit.

flow soldered using a heat plate. Coupling on both input and output sides are through transformers; the output side of 2 meter deck uses TC-12 coax (white) and a RG142 balun (loop far right). The position of the connection point at the drain trace is critical as it affects the match. The backsides of the boards have a ground plane bolted to the spreader without requiring soldering.

Figure 6 shows the interior of the assembled amplifier and an oblique view of the front panel. The toroidal coils and grey rectangular relay at the right side of the unit comprise the output diplexers. The HF+Six RF deck is to the left of the diplexer board and to its left is the 2 meter RF deck. In front of the barely visible yet massive heat sink are three fans and to its rear are five fans. The white cylinder at the left rear is the dc power input socket.

Figure 7 shows the front panel of the completed amplifier with band select switch at the far right. Above the band select switch are the amplifier current and voltage meters. Forward and reflected power is shown by a pair of LED bar graph displays. The cabinet is 18 inches wide, 7 inches high, and 10 inches deep.

Figure 8 shows a rear view of the amplifier where five cooling fans are a prominent feature. Power input to the unit is through the socket at the upper right.

Conclusion

For a pudding, the proof is in the eating, and for a project like this, it is in making contacts: 10 months after starting the project, I made my first EME contacts on July 4, 2013, and a few months later, in October, I made my first HF contacts. Since then, I have made over 2000 contacts across every Amateur Radio band, from 160 meters through 2 meters using, variously, AM, CW, SSB, and JT65 modes. The cost of the project was about $4500.

Acknowledgments

I'm especially grateful for the help and tutelage that I've received from Jim Klitzing, W6PQL. Thanks are also due to Rodger at Communication Concepts, Joel Hallas, W1ZR, and Ward Silver, N0AX. Bob Allison, WB1GCM, of the ARRL HQ Lab provided super support in spectrum analyzer measurements, even when visiting here at the shack, which was an unsought but substantial pleasure. I had great help

Figure 7 — Front panel.

Figure 8 — Rear view of the amplifier.

from Dave Brainerd, WB6DHW, on the HF diplexers. I am also thankful for the earlier solid state linear amplifier work of Helge Granberg, K7ES (SK). Last, but not least, I would like to thank my daughter Mary for her encouragement and physical help throughout the project, including much of the building, and for sharing in the excitement of what we've been able to do together.

Notes

[1]J. Klitzing, W6PQL, "Solid State 1 kW Linear Amplifier for 2 Meters," *QST*, Oct 2012, pp 32 – 36.
[2]**www.w6pql.com/**
[3]**www.freescale.com/webapp/sps/site/prod_summary.jsp?code=MRFE6VP61K25H**
[4]H.O. Granberg, K7ES/OH2ZE, "A Compact 1-kW 2 – 50 MHz Solid State Linear Amplifier," *QEX*, Jul 1990, pp 3 – 8. (Also available as a reprint in Motorola application note AR347.)
[5]**www.communication-concepts.com/**
[6]**www.arrl.org/qst-in-depth**
[7]H.O. Granberg, K7ES/OH2ZE, "MOSFET RF Power — An Update," *QST*, Jan 1983, pp 30 – 33. (See Figure 5.)
[8]E. Wetherhold, W3NQN, "Second-Harmonic-Optimized Low-Pass Filters," *QST*, Feb 1999, pp 44 – 46.
[9]W.E. Sabin, W0IYH, "Diplexer Filters for an HF MOSFET Power Amplifier," *QEX*, Jul 1999, pp 20 – 26. (A copy was found at **www.qsl.net/wm5z/qex199907.pdf**.)

Photos by the author.

Amateur Extra class holder and ARRL member Andrew Buckler, K2OP, has been licensed for nearly 40 years. He is President of Elucid Bioimaging Inc., a product development and contract research firm in quantitative medical radiology. In addition to his Amateur Radio hobby, Andy has devoted time to the Boy Scouts, church mission trips, and learning to play the harpsichord. He enjoys the challenges of operating in different modes. Andy's current goal is to use his new linear amplifier to complete contacts necessary for a Five Band DXCC certificate, complete the DXCC Challenge Award given for working 1000 DXCC band entities, and log 100 countries with EME. You can contact Andy at 13 Larch Row, Wenham, MA 01984 or by e-mail at **andrew.buckler@elucidbio.com**.

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

New Products

Icom IC-7850 HF/6 Meter Transceiver

The Icom IC-7850 is a limited edition top-tier transceiver to commemorate the company's 50th anniversary. Only 150 units will be available worldwide. New features include a 1.2 kHz roofing filter, a new local oscillator (LO) design and enhanced spectrum scope. The IC-7850 uses a new low-noise local oscillator (LO) with phase noise rated at –150 dBc/Hz at 10 kHz offset and –140 dBc/Hz at 1 kHz offset. The spectrum waterfall display is similar to that used in the latest IC-7700 and IC-7800 models. The high-resolution waterfall screen shows the changing amplitude of frequencies over time and can be operated with a PC mouse via a USB port. A dual scope function shows simultaneous activity in a second band. Availability date and pricing to be announced. For more information, visit your favorite dealer or **www.icomamerica.com**.

An Easy WSPR 30 Meter Transmitter

With your computer, the right software, and this low-power transmitter, you can be heard around the world.

George R. Steber, WB9LVI

Some of today's highly sophisticated radio modes permit communication to the far corners of the world using very little power. Special modulation techniques and software that can reliably decode signals near the noise threshold make this possible. One of these modes, WSPR, the "weak signal propagation reporter," is a good way to learn more about this technology. Joe Taylor, K1JT, and Bruce Walker, W1BW, described it in their *QST* article.[1] WSPR provides practical information on radio propagation paths for all to see on **WSPRnet.org**.

This WSPR transmitter employs a no-tune local oscillator, and uses mainly off-the-shelf parts.

With a transmitter, a sound card, and a computer running *WSPR* software, you can participate and view real-time results on the WSPRnet world map. Teachers, students, and SWLs routinely report their receptions. Amateur Radio operators will likely find that using a transmitter as described here is fun and provides more targets for the receivers.

The WSPRnet world map in Figure 1 shows all the stations that reported receiving my signal over a period of just a few hours. My transmitter was running less than 1 W into a quarter wavelength wire antenna raised just 7 feet off the basement floor!

This WSPR transmitter employs a no-tune local oscillator, and uses mainly off-the-shelf parts. I used through-hole components exclusively. Power ranges from 1 to 2 W into a 50 Ω antenna, depending on power supply voltage and audio input level. The transmitter runs on an 8 to 12 V dc supply and requires 500 to 800 mA. You need only a volt-ohm meter (VOM) for final adjustment. So homebrew your own transmitter and get started with the worldwide WSPR network of low-power stations probing radio propagation paths.

WSPR Transmitter Background

A WSPR signal is 4-FSK, so it does not require amplitude linearity. This allows the use of inexpensive MOSFET switching transistors. But this also mandates the use of a pretty good output filter to remove harmonics.

The WSPR signal 6 Hz bandwidth fits into a tiny 200 Hz segment on a given band. For the 30 meter band, this segment is centered at 10.140200 MHz. Because the WSPR audio from the computer sound card is approximately 1500 Hz, a very stable local oscillator of 10.138700 MHz mixed with this audio puts the upper sideband right in the middle of the WSPR band. In keeping with our simple design philosophy, we opted for a double sideband (DSB) transmitter. This simplifies construction immensely and removes the need for fancy testing equipment.

With 2 W or less, we can use a smaller power supply and smaller components for coils and transistors. You can build our "Easy WSPR" transmitter for around US $50, depending on your parts inventory, and you don't need extraordinary skill with RF circuits. The transmitter does have some limitations, but it produces good results for WSPRing.

Transmitter Design

During the design phase, we evaluated a bipolar junction transmitter (BJT) and a MOSFET transmitter using LTspice

Figure 1 — WSPRnet map shows receptions of WB9LVI from around the world. [Map data copyright 2013 Google, INEGI, Maplink]

[1]Notes appear on page 50.

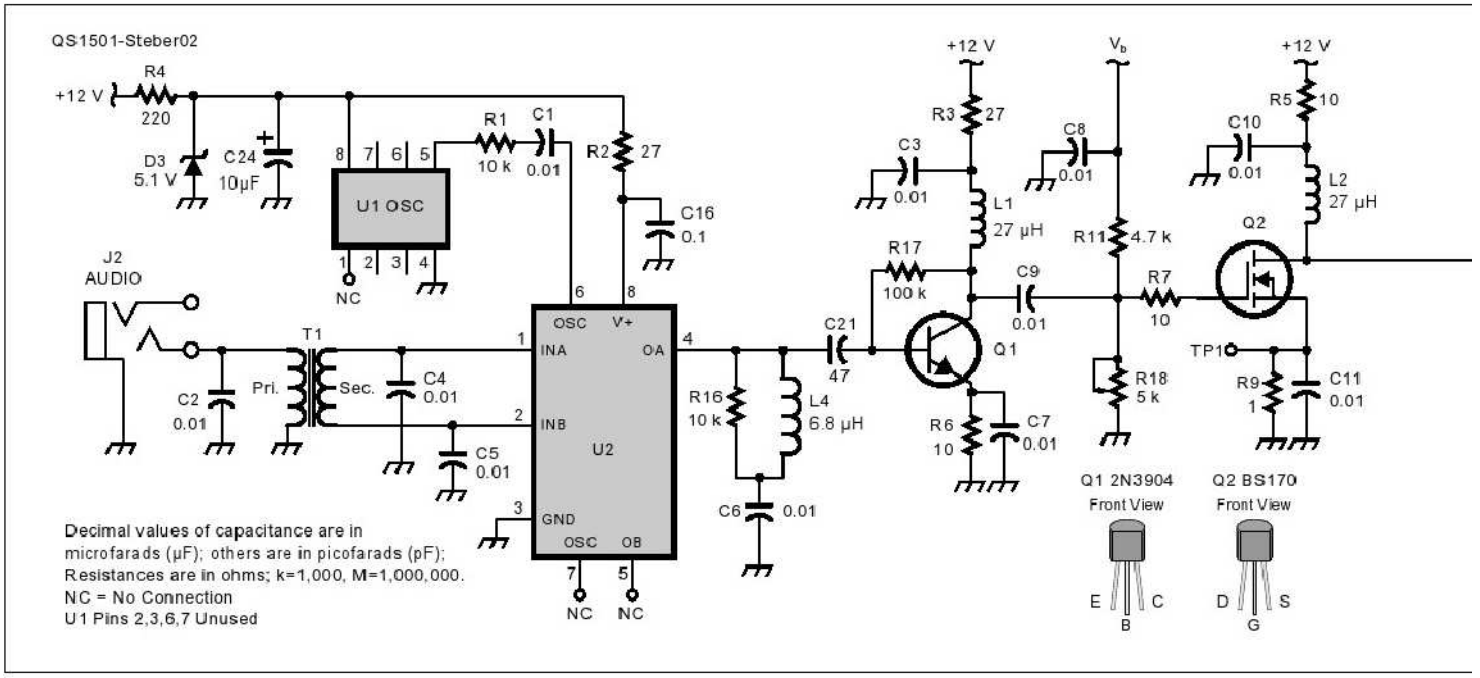


Figure 2 — Schematic diagram of the "Easy WSPR" 30 meter transmitter. Digi-Key parts from **www.digi-key.com**, Mouser parts from **www.mouser.com**.

C1 – C15 — 0.01 µF ceramic capacitor, bypass
C16, C22 — 0.1 µF mono capacitor
C17, C18 — 220 pF ceramic capacitor, NPO or C0G
C19 — 560 pF ceramic capacitor, NPO or C0G
C20 — 68 pF ceramic capacitor, NPO or C0G
C21 — 47 pF ceramic capacitor, NPO or C0G
C23, C24 — 10 µF electrolytic capacitor
D1 — Diode 1N4001
D2, D3 — Zener Diode 5.1 V, 1N5231B
DS1 — Green LED
J1 — DC power jack, 3.5 mm
J2 — Audio jack, 3.5mm stereo
J3 — Antenna, 2 terminals
L1, L2, L3 — 27 µH choke, (Mouser 542-77F270-RC)
L4 — 6.8 µH choke, (Mouser 542-77F6R8-RC)
L5 — 0.61 µH inductor, 13 turns T37-6 core
L6 — 1.05 µH inductor, 17 turns T37-6 core
Q1 — 2N3904 NPN Transistor
Q2 — BS170 MOSFET, see text
Q3 — IRF510 MOSFET and heat sink
R1, R16 — 10 kΩ ¼ W 5% resistor
R2, R3 — 27 Ω ¼ W 5% resistor
R4 — 220 Ω ¼ W 5% resistor
R5-R8 — 10 Ω ¼ W 5% resistor
R9, R10 — 1 Ω ¼ W 5% resistor
R11, R12 — 4.7 kΩ ¼ W 5% resistor
R13, R14 — 1 kΩ ¼ W 5% resistor
R15 — 270 Ω ¼ W 5% resistor
R17 — 100 kΩ ¼ W 5% resistor
R18, R19 — 5 kΩ Small PCB mount trimmer resistor
T1 — Audio transformer, 10 kΩ to 600 Ω (Mouser TL019)
U1 — Programmable oscillator, see text (Digi-Key SGR-8002DC-SHB-DC
U2 — SA612, RF mixer, (Mouser 771-SA612AN/01)

and various other design programs.[2] Ultimately we chose the MOSFET design because of cost and parts availability considerations. The detailed schematic in Figure 2 has some unusual aspects. We use a programmed oscillator, U1, for the local oscillator, which removes any need to adjust the frequency. It is low in cost and can be programmed by the vendor for the center of the WSPR band or any spot nearby. To put the upper sideband in the center of the WSPR band, the oscillator should be programmed for 10.138700 MHz. But you could also program it from 10.138600 MHz to 10.138800 MHz and still be heard in the 30 meter WSPR band.

The oscillator feeds the RF mixer U2 via R1 and C1. The SA612 mixer provides gain and removes the carrier frequency leaving a double sideband signal at Pins 4 and 5. The audio WSPR signal is introduced to mixer Pins 1 and 2 via transformer T1, which reduces the voltage to the mixer by a 5-to-1 step down ratio, and provides isolation from ground currents.

Network L4 and C6 matches the mixer output signal to Q1, a BJT amplifier. MOSFET Q2 dissipates around 220 mW and will feel hot to the touch. If you are concerned about the heat you can glue a small iron washer or other piece of metal to the flat side of the device as a heat sink.

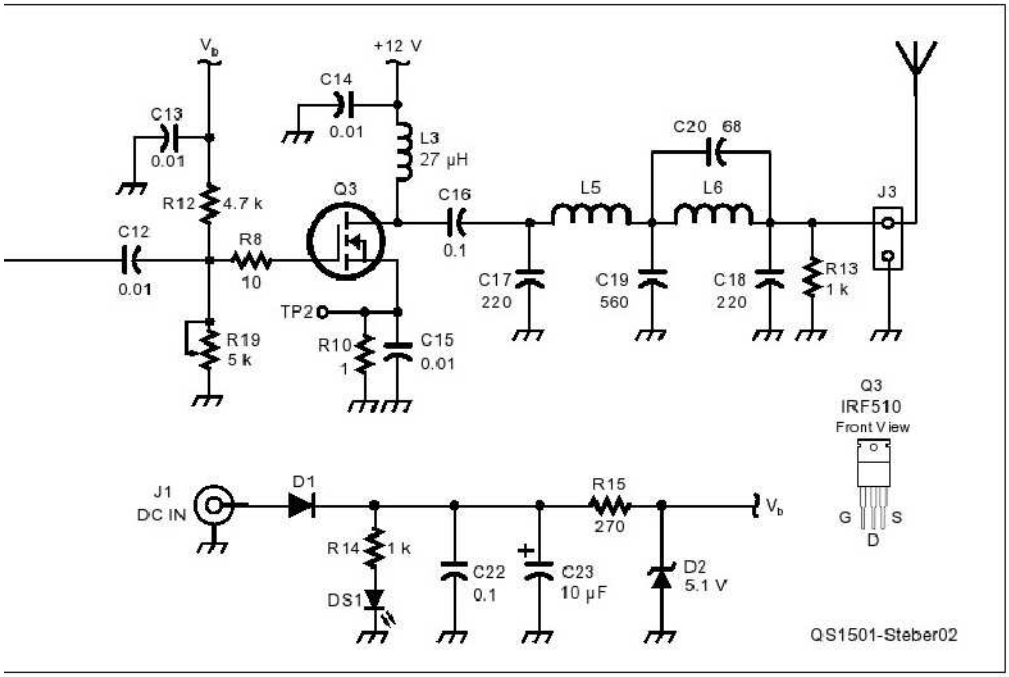
A WSPR signal is 4-FSK, so it does not require amplitude linearity.

The last stage Q3 uses an IRF510 MOSFET switching transistor. It dissipates one to several watts, depending on the power supply voltage and therefore needs a heat sink. Its output feeds the antenna through an impedance matching Pi network filter. For L4 wind 13 turns on a T37-6 core. For L5 wind 17 turns on a T37-6 core. The output filter provides more than 45 dB of harmonic attenuation. The 1 kΩ resistor at the end of the filter provides some protection in case your antenna is not connected.

Use your own ingenuity, along with good RF techniques to build the transmitter.[3] Watch out for RF feedback paths to the early stages that can cause oscillation. I constructed my breadboard on a simple PCB and placed it inside a metal case without any problems.

Transmitter Adjustments

Set up the transmitter by adjusting the proper audio level to the mixer, and setting bias levels for the transistors. With the 12 V dc power off, connect the audio from the PC sound card to jack J2. Send a 1500 Hz tone to the transmitter using the WSPR program. Using your VOM on the ac volts setting, adjust the PC sound volume control to get 0.2 V rms between TP3 and ground. Most VOMs display rms values. An oscil-



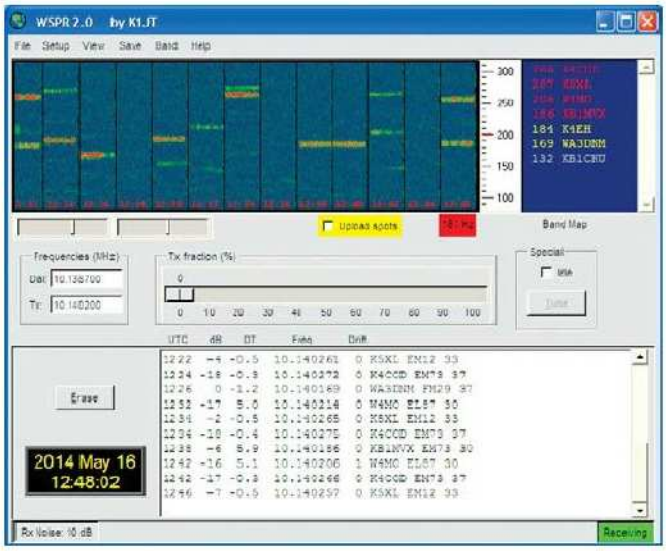


Figure 3 — Main window of the *WSPR* program.

loscope will show 0.56 V peak to peak. Note the position of the PC volume slider control so you can return to this setting if it is changed. This level, while not absolutely critical, should be in the range of 0.14 to 0.24 V rms. This adjustment can be used to increase or decrease the power output of the transmitter over a small range.

Next, with audio signal removed and 12 V dc power off, adjust both bias potentiometers R18 and R19 for 0 Ω to ground. Switching type MOSFETs do not have precisely specified gate voltage thresholds. Typically they vary from 2 to 4 V. Hence, the bias for each MOSFET needs to be set separately. Starting at zero bias will ensure that the MOSFETs are off initially. Then increase the bias voltage to the point where they are just barely conducting. Here is the simple procedure.

First connect a 50 Ω RF load resistor across the antenna terminal. Connect your VOM (dc mV setting) between ground and test points TP1 and TP2 in turn to monitor for the onset of conduction of each of the MOSFETs. With audio signal removed, turn on the 12 V dc to the transmitter. Adjust R18 for a 1 to 2 mV reading at TP1 on the VOM. This corresponds to about 1 to 2 mA of current in Q2. Now move your VOM to TP2 and adjust R19 for 2 to 3 mV. A higher setting will reduce IMD, but transistors will get hotter. Your WSPR transmitter is ready to go.

WSPR Setup

You will need a PC or laptop running *Windows*, and an internal sound card or external USB sound card. I prefer external USB sound cards that use the Texas Instruments sound chip because they require no driver installation. Examples include the Behringer UCA-202 and ADS RDX-150.

Set your computer clock to UTC within 1 second. This is necessary because WSPR transmits on even-numbered minutes (0, 2, 4, etc). Correct UTC can be found on the Internet at **www.usno.navy.mil/**. Otherwise, a time clock synchronized to the National Institute of Standards and Technology (NIST) radio station, WWV, works well. You don't have to be connected to the Internet to transmit WSPR. But to see where you are being received you need to check **WSPRnet.org**, enter your call sign, and view the map that looks like the one shown in Figure 1.

WSPR Software

You can download and install the free *WSPR* software from the WSPR site.[4] The software displays a black window for error messages and a main screen shown in Figure 3. Click SETUP and enter your call sign, power level, sound card setting, and Maidenhead grid location. Connect your audio cable, dc power source, and antenna, and you are ready to go. The position of the horizontal slider in the main WSPR screen controls how often you transmit. Each WSPR transmission is full duty cycle and lasts for 2 minutes. To share spectrum, please reduce your total transmissions to 50% or less. This will allow others to use the frequency and also gives your transistors time to cool down.

Final Whispers

"Easy WSPR" works well in this low power application despite its simplicity. With a bit of luck, a few of these transmitters may find their way to remote regions of the globe to provide more propagation

paths to study. I enjoyed constructing and using this transmitter, and I hope that you will as well. While WSPRing is fun, it is also educational. You can observe open propagation paths, and demonstrate low power radio technology to your local ham club or possibly at your local high school's science class as an outreach tool. Demonstrating radio technology to high school students can be very rewarding.

Please let me know when you get your "Easy WSPR" transmitter working. With agreeable propagation, your signal will be copied in the far regions of the world.

Notes

[1]J. Taylor, K1JT, and B. Walker, W1BW, "WSPRing Around The World," *QST*, Nov 2010, pp 30 – 32.

[2]LTspice, **www.linear.com/designtools/software/**

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

[4]WSPR Software Download, **www.physics.princeton.edu/pulsar/K1JT/**

George R. Steber, PhD, is Emeritus Professor of Electrical Engineering and Computer Science at the University Of Wisconsin-Milwaukee. He is now semi-retired following 35 years of service. George, WB9LVI, has an Advanced class license, is a Life Member of ARRL and IEEE, and is also a professional engineer. He previously wrote "An Experimenter's RF Spectrum Analyzer," which appeared in the October 2008 issue of *QST*. George has worked for NASA and the USAF and keeps busy with various projects at the university. He is currently involved in cosmic ray research and hopes to launch a new program to study cosmic rays on a global basis. In his spare time he enjoys reading, racquetball, astronomy, Amateur Radio, music, and playing his trumpet. You may reach George at **steber@execpc.com** with "Easy WSPR" in subject line and e-mail mode set to text.

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

Radio Tips

Picking a Microphone — Dynamic or Electret Element?

The *dynamic* mic was the low-impedance (needed for modern radios) champ for some time, and is now still the basis of many high quality mics in all configurations. The dynamic mic element is essentially constructed in the manner of a dynamic speaker — a paper or plastic cone receives and vibrates with the incoming acoustic wave front. The moving cone results in an attached coil sliding up and down on a permanent magnet to generate an electrical signal that follows the acoustic input. Some hams have even been known to fabricate their own dynamic mics from small loudspeakers. Dynamic mics can work very well and are generally well matched to the input of modern radios.

In recent years, the most frequently encountered mic element type has to be the *electret*. These are subminiature condenser mic elements that are paired with an integrated amplifier, with the result that they can be quite small, making them perfect for headsets, for example, but equally appropriate to be used in larger desktop structures in place of a dynamic element.

Electrets Need Power

The one drawback of an electret mic is that it needs an operating voltage, typically in the range of 5 – 8 V dc, at low current. Dynamics, on the other hand are self powered, just make sure your radio doesn't apply dc to the mic leads if you use one. Many radios include an operating voltage for electrets right at the MIC connector. If not, it is usually fairly simple to provide an adapter, but make sure you know what you are getting. — *Joel Hallas, W1ZR*

Clocks and UTC

Every station needs a large, easy-to-read clock that can display time in the 24-hour format (what some people call "military time"). This is because the Amateur Radio standard for timekeeping is 24-hour format *Coordinated Universal Time*.

The official abbreviation for Coordinated Universal Time is *UTC*. This abbreviation arose from a desire by the International Telecommunication Union and the International Astronomical Union to use the same abbreviation in all languages. English speakers originally proposed *CUT* (for "coordinated universal time"), while French speakers proposed *TUC* (for "temps universal coordonné"). The compromise that emerged was *UTC*.

UTC is actually a global timekeeping standard in many fields, not just Amateur Radio. The aviation industry, for example, relies on UTC.

The point of UTC is to establish a single time reference that everyone can agree upon, no matter where they are located. The time in any given time zone is either a positive or negative offset of UTC. For American amateurs, the following time zone offsets apply:

Time Zone	*Hours Behind UTC*
Eastern	5
Central	6
Mountain	7
Pacific	8
Alaska	9
Hawaii	10

For example, 2300 UTC is 1800 Eastern Time (UTC – 5 = Eastern Time). Of course, if your area observes Daylight Saving Time, you'll have to subtract 1 hour from the offset during those months.

As you can probably guess, figuring out the correct UTC time by adding the proper offset to your local time is inconvenient and prone to error. That's why it makes sense to have a UTC station clock. Once you set your station clock to UTC, you'll never have to guess or calculate again. When it is time to log a contact or fill out a QSL card, just glance at your UTC station clock and you'll always know the correct UTC time. Best of all, UTC never changes. You may have to change your household clock to adjust for Daylight Saving Time, but your UTC station clock will never need to be reset.

However, when logging or filling out a QSL card don't forget that UTC *date* may apply as well. For instance, if you make a contact at 10 PM Eastern Time on December 10, you need to log the date as December 11 because 10 PM EST is 3 AM UTC *the next day*. — *Steve Ford, WB8IMY*

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

Beko-Elektronik HLV-1100 70 Centimeter Amplifier

A solid state kilowatt for our most popular UHF band.

Reviewed by Jeff Klein, K1TEO
QST *Contributing Editor*
wa2teo@aol.com

A couple of years ago I was asked to do a *QST* Product Review of a high-power, solid state 144 MHz amplifier. It was a real eye-opener for someone used to running tube amplifiers with high voltage supplies and noisy fans, amplifiers that generate lots of heat in my shack. When asked to do another review of a high-power solid state amplifier, I jumped at the chance for another test drive.

This time the amplifier came from Beko-Elektronik, a German manufacturer that offers a lineup of VHF, UHF, and microwave solid state amplifiers in several power ranges. This review focuses on the Beko HLV-1100 for 70 centimeters (430 – 440 MHz), a kilowatt-class amplifier that includes built-in power supply and transmit-receive (TR) relays. It's basically a plug-and-play high-power amplifier for 70 centimeters that can be used with any of the popular transceivers or transverters delivering 20 W or so. The HLV-1100 uses MOSFET devices to generate the high power, and they run from an internal 50 V, 40 A dc power supply. Given all it contains, the unit weighs just 33 pounds and its dimensions are modest — 10.5 × 17.5 × 18.5 inches.

As a serious VHF/UHF DXer and contest operator, I have enjoyed running relatively high power on 432 MHz for many years. For the last 20 years or so, I have been using an old K2RIW designed amplifier sold by Arcos that was state-of-the-art 30 or more years ago. It uses a pair of 4CX250 tubes and continues to put out 500 W on the band reliably. The availability of high-power, solid state amplifiers is still a relatively new option for UHF operators, offering an alternative to a variety of tube units that have been the only way to obtain QRO power levels in the past. I was very interested to see how my Arcos amp compared with a modern amplifier in operating capability and for convenience.

Setup

The HLV-1100 is essentially ready to go and similar to adding a linear amplifier to an HF station. The amplifier can be set up for either 240 V or 120 V operation. At the lower voltage level, the amp should run a maximum of 600 W output (per the instructions). At 240 V, it is capable of full output, and that's how I set up the review unit. The power cord is detachable.

The amplifier has all TR relays built in, so the rest of the setup is easy. The rear panel (Figure 1) is very simple. There is a phono jack labeled PTT and simply grounding the center conductor switches the amplifier into transmit. There is also an AUX (auxiliary) phono jack that can be used to key a transceiver's PTT input (more on this later). Most modern 432 MHz transceivers or transverters should be able to key this amplifier.

Bottom Line

The Beko-Elektronik HLV-1100 is well made and reliably provides 1000 W of clean RF on 70 centimeters for SSB, CW, WSJT, and other long-distance modes.

Once the 240 V and PTT lines are ready to go, all that remains is to hook up a coaxial jumper from the driver to supply RF input and another from the output of the amplifier to the antenna. Both the input and output use Type N female connectors. (You'll need appropriate coaxial jumpers — standard RG-8 is only rated for about 500 W at this frequency.) There are two internal relays so that no additional relays are needed unless you use a mast mounted preamp. At my station, once I reached this point I was ready to go. From start to finish took a matter of minutes given the straightforward steps for getting things set up.

Remote Operation

The HLV-1100 offers a couple of options that I did not take advantage of. First, the amplifier can be set up for remote operation if you like. Sometimes the heat generated by an amplifier is a concern, and remote operation keeps the shack cooler. More on this later, but I found the HLV-1100 to generate the least amount of heat in any high-power amplifier I have run.

Another common reason to operate an amplifier remotely on 432 MHz is to reduce feed line losses — they can be very high at this frequency if the run is long or the cable is not designed for use at UHF. I run low-loss ⅞-inch Andrew Heliax coaxial cable from my station to the antennas, so reducing losses was not a significant factor for my setup. Others may choose to move

Figure 1 — The HLV-1100 uses Type N connectors for RF input and output, and a phono jack for PTT control. The CONTROL jack allows for remotely mounting the amplifier.

Table 1
Beko-Elektronik HLV-1100, serial number 140513

Manufacturer's Specifications	Measured in ARRL Lab
Frequency range: 430 to 440 MHz.	As specified.
Power output: 1000 W at 1 dB compression; 600 W maximum with 120 V ac supply.	Key down, CW mode: *Input (W)* *Output (W)* 2 240 5 500 10 760 12 875 15 950
Driving power required: 20 W maximum.	
Spurious and harmonic suppression: 70 dB.	68 dB. Meets FCC requirements.
Third order intermodulation distortion (IMD): Not specified.	3rd/5th/7th/9th: 34/43/60/>60 dB below PEP.
TR switching time: Not specified.	Amplifier key to RF output: 103 ms; amplifier un-key to RF power off: 80 ms.
Standby insertion loss: Not specified.	0.2 dB.
Primary power requirements: 110 – 130, 180 – 260 V ac 50/60 Hz (600 W max output with 120 V).	
Size (height, width, depth: 6.3 × 11.7 × 18.9 inches (including protrusions); weight, 33 lbs.	
Price: $6250.	

the amplifier closer to the antennas to increase the signal level actually delivered to the antenna.

The remote capabilities are accessed through the seven-pin CONTROL connector on the rear of the unit. Connection points are available for PTT, resetting the amplifier if it faults, and control of a preamp. There are also connection points to monitor any protection circuit alarms and to monitor power output via measured voltage as well. This is a very nice option for those wanting to run the amplifier remotely.

TR Sequencer

Another feature I chose not to use is the built-in TR sequencer — my station is already configured for proper TR sequencing. A sequencer is helpful on bands such as 432 MHz, where it is common to run external preamps, often tower mounted, to optimize noise figure and receive capability. A common issue with remote preamps is blown devices if great care is not taken to sequence TR switching correctly to ensure that the preamp is switched out of the line before transmission begins. Small amounts of RF introduced before isolation relays kick in will often take out the sensitive GaAsFET devices typically used in low-noise preamps.

A related issue is making sure that the TR relays in the amplifier have fully closed and settled before RF is applied to the input. If the relays are not closed when RF is applied (called "hot switching"), relay contacts can be damaged from the high power present. Table 1 shows how long it takes for the amplifier to switch between receive and transmit. Ideally, at the beginning of each transmission, first you would switch the preamp out of the line, then switch the amplifier TR relays, then turn on the transmit signal (and the sequence is reversed to go from transmit back to receive).

Some modern transceivers have an adjustable delay between TR switching and RF output. If your radio can't be adjusted for the correct timing, you can either use an external TR sequencer or take advantage of features built into the HLV-1100.

In addition to the PTT jack described earlier, the HLV-1100 has an AUX jack. When the HLV-1100 is placed in transmit, the AUX jack is switched to ground after a delay. So, to avoid hot switching the amplifier relays, you can key the amplifier PTT jack with a mic PTT switch, foot switch, or other device, and have the amplifier key the transceiver via the AUX jack to ensure that the amplifier switches before the transceiver does.

On the receive side, you can use the HLV-1100 to control a mast-mounted preamp. One of the pins in the CONTROL jack supplies 15 V to power an external preamplifier from the built-in sequencer. It can be used to switch off the preamp before the amplifier starts transmitting, and turn it back on when the amplifier is finished transmitting, all with the delays needed to protect a preamp. This built-in feature offers simple protection capability without the need for an external sequencer.

Front Panel

You can't miss the prominent wattmeter on the amplifier's front panel. Its size allowed easy monitoring of power levels even from a distance. Testing with my own external Bird wattmeter and in the ARRL Lab indicated that the amplifier's wattmeter is accurate. The wattmeter measures forward power only, so those who want to monitor SWR will need an external wattmeter.

Large and sturdy switches on the front panel turn on the POWER, switch the amplifier in or out of line (STAND BY), and RESET the amplifier if any of the protection circuits are activated (more on this

later). The final switch is PREAMP in or out that will power an amplifier through the sequencer. A nice feature is that the sequencer can be used even if the amplifier is in standby, allowing users to protect their preamplifiers. Each switch has an indicator light above to show status.

Amplifier Protection

With expensive MOSFETs involved, it is important to know that the amplifier is likely to survive if problems are encountered or mistakes are made. Red LEDs on the front panel light if any of the protection circuits are activated, placing the amplifier in standby. One is labeled ANTENNA and comes on for high SWR. That circuit will kick in at 1.8:1 or greater SWR to protect the MOSFETs. An OVERDRIVE indicator lights if input levels are exceeded, and a TEMPERATURE LED lights if the amplifier gets too warm and needs to move into standby mode. During my testing period, I did experience the OVERDRIVE protection activating. In addition to the LED lighting, an audible alarm sounded and I easily heard its steady tone with headphones on. Pressing the RESET button on the front panel returns the amplifier to operation after a protection circuit trips.

For remote operation, voltage on one of the control jack pins can be monitored to determine if there is a fault. Another pin can be grounded to reset the amp.

I used the amp for several months, and despite some significant continuous operating in contests, I never triggered the temperature protection. Likewise, my antennas system withstood the high power levels and I did not set off SWR protection. The SWR protection is always helpful, especially at these power levels on 432 MHz where any slight issue in coax and antenna connection points can cause SWR spikes that can damage the amplifier. As detailed in the next section, I did activate the overdrive protection and found that it triggered consistently as soon as I surpassed the threshold.

Conservative Overdrive Protection

The instructions indicate that the amplifier will provide approximately 17 dB of gain. While there are clear warnings that the MOSFETS will be damaged with more than 75 W of drive, maximum power output can be achieved with far less and the amplifier is specified at 20 W input.

During initial testing, I found that the overdrive protection would kick in with more than 12 W of drive from my Kenwood TS-2000 transceiver, far less than the specified 20 W. As soon as I dialed in more than 12 W, the HLV-1100 would shut down. While 12 W of input (per the TS-2000's digital power setting) provided significant output, I wanted to see if I could run closer to the amplifier's high end potential. The Beko documentation includes a schematic showing the adjustment points on the HLV-1100's control board. However, there are clear warnings indicating that the warranty will be voided if any adjustments are made to the trimmer potentiometers that change the protection circuitry's factory settings. I wondered if I could set the overdrive threshold higher and if this would be a safe thing to do.

Figure 2 — Inside the HLV-1100's well-shielded cabinet. The protection circuit trimmer potentiometers are on the PC board behind the front panel on the top.

We e-mailed Array Solutions (the US distributor), explained the issue, and within 24 hours had a solution from Bernhard Korte of Beko-Elektronik — and this was on a weekend! Bernhard provided instructions that were clear and easy to follow, and taking the top cover off allowed easy access to the adjustment points (Figure 2). Less than 5 minutes later I had the amplifier set to trip at 15 W drive per my TS-2000 setting, and I was seeing about 950 W output on both the amplifier's wattmeter and my external Bird wattmeter. Access to the other trimmers to adjust temperature and SWR protection were easily accessible as well, though not needed.

As before, as soon as the drive level exceeded 15 W the overdrive protection would kick in and shut the amplifier down, with both a warning light and the audio alarm activated. This was an effective way to avoid overdriving the amplifier.

If I had one minor beef with the amplifier, it would be the conservative overdrive protection setting from the factory and lack of detailed adjustment information in the instructions. Of course the manufacturer wants to make sure the settings are not misadjusted in the field, creating a possibility that the protection does not to kick in at the right levels. However, as I experienced, a minor change from the factory settings allowed me to reach the expected power output and the adjustment was not difficult.

Using the Amplifier

The HLV-1100 is about as easy to operate

as any amplifier I have ever used. Simply pushing the POWER switch allows for immediate operation — no waiting for a warm-up period.

The HLV-1100 is capable of running 1000 W or more output, and during the testing period I needed to be careful not to stress any other parts of my overall system. For example, I use a power divider to feed my four antennas, and it is rated at 1000 W, so I tried to keep the amplifier at 950 W to leave some margin and avoid creating any issues up on the tower.

Most of the time, when I used the amplifier, the only way to know it was powered on was to observe the green indicator light that showed it was powered up. My shack can be very noisy when all of my amps for the VHF, UHF, and microwave bands are on simultaneously, as they are during contests. The HLV-1100 is a notable exception, as its cooling fans come on only when needed. During casual operation, they rarely engaged. During extended continual operation, such as a 432 MHz sprint contest, the fans did kick in to cool the amplifier. The instructions say that they create minimal noise and that is an accurate description. Even with an hour straight of heavy-duty operation at nearly full output, the amplifier was barely warm to the touch. In summary, it was a pleasure to operate with so little added noise and heat in my shack compared to my own 432 MHz tube amplifier.

During the review period, I operated mostly using CW and SSB modes. With consistent drive levels, output was the same in either mode. I did try the amplifier on digital modes as well to see how it performed, making several contacts using WSJT.

The instructions note in bold lettering that the unit is not to be operated at 100% duty cycle with full output. As a precaution, I backed the output down to 750 W while on digital, though I did not see any problems with the approximately one minute transmission cycle while using WSJT. Another warning in the manual cautions that the amplifier should not be used nonstop in transmit for more than 3 minutes. This was not an issue for my operating requirements but may be for those who would like to ragchew. For intense 432 MHz operating including contests, EME, and WSJT, the duty cycle should not be an issue.

On the VHF and UHF bands, during contests or band openings it's common to be listening for very weak signals with very loud local stations operating within a few kilohertz. Interference is minimized if everyone uses clean transmitters that are properly adjusted. I don't want to cause anyone heartburn, so I ran a number of tests with nearby stations to determine how the unit sounded on the air. All reports were very complimentary and no issues were reported. Testing with locals comparing the driver only versus with the HLV-1100 inline indicated no difference in signal quality — exactly as it should be. As shown in Table 1, ARRL Lab testing indicates IMD products are suppressed 34 dB or more, better than the IMD products generated by transceivers.

Summary

Having a chance to use the HLV-1100 for my 432 MHz operating for a few months was a terrific experience. Having kilowatt level power immediately available was great — more power than I have ever used on the band, and instant-on to catch those fleeting band openings. Having a quiet and cool amplifier was a nice change of pace from the many tube amplifiers I have used in the past.

The HLV-1100 is attractive, easy to set up and use, and performs exactly as claimed. It was a lot of fun to get more than the usual number of "boy, you're loud" comments while operating, and equally nice to have compliments about how great my signal sounded (credit here to the TS-2000 driver too).

Overall, this amplifier is an excellent addition to any serious 432 MHz station whether for general, contest, EME, or digital operating. It has a serious price tag, but all indications are that you will get what you paid for!

Manufacturer: BEKO-Elektronik, Am Längenmoosgraben 1a, D-85221 Dachau, Germany; **www.beko-elektronik.de**. Distributed in the USA by Array Solutions, 2611 North Beltline Rd, Suite 109, Sunnyvale, TX 75182; **www.arraysolutions.com**.

High Power at UHF

When considering a high-power amplifier for 70 centimeters or other UHF bands, it's important to evaluate the rest of your station. As noted in the review, all of the components following the amplifier must be able to handle the rated power (1000 W in this case) at 432 MHz.

Standard RG-8 or RG-213 is rated for only about 450 W at 400 MHz. Even the short interconnection cables in your station will need to be made from ⅜ or ½ inch hardline or one of the larger specialty cables such as the Times LMR series that can handle the power.

All coax connections need to be very solid. At these frequencies and power levels, you will definitely find the weak link in any coax connections — poor soldering, low-quality adapters, and so on. If you're not careful, you will heat them up or melt them in no time. The amplifier uses Type N connectors because they can handle the power at this frequency and also have a constant impedance.

If you use an external preamp, check the ratings of any relays and be sure they provide adequate isolation to protect the preamp. Check the power rating of your antenna and of power dividers if you are using an array of several antennas.

This is also a good time to review RF exposure guidelines. Check out the many resources at **www.arrl.org/rf-radiation-and-electromagnetic-field-safety**.

Click here for a video overview of the Beko-Elektronik HLV-1100 70 Centimeter Amplifier.

MFJ-223 Vector Impedance Antenna Analyzer

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

The MFJ-223 is MFJ's latest entry in the antenna analyzer market. Its TFT multicolor display offers a large amount of information on a very compact screen, yet it is extremely easy to read. A single-frequency display or a variety of swept frequency ranges may be viewed. Information provided includes SWR, unsigned complex impedance magnitude (|Z|), resistance (R), and reactance (X). Unsigned means that it does not indicate inductive loads (+*j*X) or capacitive loads (–*j*X), only the absolute value. The MFJ-223 comes with a UHF female to BNC male adapter.

Table 2 shows the MFJ-223's basic performance measurements. The frequency accuracy was excellent and drift was undetectable, but the harmonic output did not quite meet all specifications. The output level remains constant (±1 dB) over the full frequency range, making the MFJ-223 accurate enough for receiver sensitivity testing when used with a good step attenuator. The 100 Hz minimum tuning step is fine enough for performing most receiver narrow filter measurements.

Table 3 displays the MFJ-223's open-circuit output impedance. This gives an indication of the impedance magnitude you can measure accurately as a function of frequency. This is important when using the impedance measurement to determine the value of an inductor or capacitor. You want to use a measuring frequency such that the component reactance is well below the MFJ-223's output impedance for best accuracy. As the MFJ-223 maximum reading is 999.9 Ω, the output impedances on the lower frequencies were determined using parallel resistance calculations.

Table 4 tabulates the output power level versus frequency. The MFJ-223 meets its 5 dBm ±1 dB typical specification across the full frequency range.

Table 5 displays the MFJ-223's impedance, reactance and SWR measurements compared to measurements made on an Array Solutions VNA2180 vector network analyzer. The loads are PL-259 connectors with internal resistors connected to the supplied UHF-to-BNC adapter. As you can see, the accuracy of the MFJ-223 mostly suffers at low impedances that result in SWR greater than 2:1. Low impedance SWR readings of 2:1 SWR or better, and high impedance readings up to 10:1 SWR are pretty accurate.

Power Requirements

The MFJ-223 is powered by an internal

Figure 3 — MFJ-223 single-frequency display.

Bottom Line

The MFJ-223 is a compact, easy-to-use antenna analyzer that will satisfy most antenna measuring and adjusting needs from 160 through 6 meters.

Table 2
MFJ-223, serial number n/a

Manufacturer's Specifications	Measured Performance
Frequency range: 0.5 – 60 MHz, continuous.	As specified.
SWR measurement range: 1:1 – 9.9:1 (99.99:1).*	As specified.
Frequency steps: 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz.	As specified.
Impedance range: R = 300 Ω (999.9 Ω)* X = 300 Ω (999.9 Ω)*; Z = 300 Ω (999.9 Ω)*.	See text and Table 3.
Output power: +5 dBm, ±1 dB typical.	As specified. See Table 4.
Impedance and SWR accuracy: Not specified.	See Table 5.
Drift: Not specified.	See text.
Harmonic and spurious suppression: >20 dB	3.5 MHz: 2nd –15 dB, 3rd –19 dB. 14 MHz: 2nd –18 dB, 3rd –21 dB. 28 MHz: 2nd –20 dB, 3rd –27 dB. 50 MHz: 2nd –20 dB, 3rd –25 dB.
Power requirements: Internal 3.7 V 1800 mAh LiPo battery.	
Size (height, width, depth): 3.5 × 2.7 × 1.0 inches including protrusions; weight (incl batteries): 5.1 oz.	
Price: $350.	

*The parameters in parentheses are the specifications given in the MFJ-223 internal Help menu. They differ from the printed specifications.

Table 3
MFJ-223 Open Circuit Output Impedance

Frequency	Output Impedance
3.5 MHz	4000 Ω
14 MHz	2000 Ω
24.9 MHz	885 Ω
28 MHz	767 Ω
50 MHz	480 Ω

3.7 V rechargeable Lithium-Polymer (LiPo) battery. A standard micro-USB A/USB A cable (not included) attached to your computer or any standard USB charger is required for charging. The MFJ-223 internal smart charger sets the charge rate (50 – 500 mA) and mode (constant current or constant voltage) depending on the state of the internal battery. A red LED charge indicator turns green when charging is complete. After a full charge, the MFJ-223 will operate for several hours before recharging is required. A menu enabled auto-off feature powers off the unit after 10 minutes of inactivity.

Using the MFJ-223

Turn on the MFJ-223 by depressing the rotary encoder for about 3 seconds. After a series of beeps, a start-up display will let you select a HELP menu, the system menu, or single or swept menus — all from soft keys. The HELP menu permits you to select a variety of topics and review the MFJ-223 specifications. The SYSTEM menu permits setting a start-up message (I used my call sign), enables or disables the auto-off feature, and displays the MFJ-223 software version and battery voltage. I found the well-written 19-page printed manual easier to use than the on-screen menus. I found most functions to be very intuitive. Further, as you change functions, soft key labeling changes as well and helps guide you through the settings.

The single-frequency display (Figure 3) will normally be used when checking or adjusting an antenna. Set the desired frequency by pushing the rotary encoder to select the tuning increments, and then turn the encoder to select the desired frequency. Pressing the RUN/STOP soft key starts a continuous reading of the antenna parameters. The actual measurements of SWR, |Z| (impedance), R (resistance), and X (reactance) are displayed at the bottom of the screen. The bar graphs make it easy to make antenna adjustments as you can adjust the antenna while watching them change dynamically.

Finally, you'll notice the S-ANTENNA bar graph. This is a unique feature of the MFJ-223. When the DDS signal source is on (measurements are being made), this typically shows an S6 to S8 level. However, when the DDS source is off, this also gives an indication of external RF signals that can distort accuracy (greater than S2)

Table 4
MFJ-223 Output Power vs Frequency

Band (meters)	160	80	40	20	15	10	6
Power (dBm)	5.45	5.40	5.21	4.78	4.40	4.00	4.00

Table 5
Impedance and SWR Measurements

Load (SWR)*	Freq (MHz)	MFJ-223 SWR/Z/R/X**	VNA2180 SWR/Z/R/X†
50 Ω (1:1)	3.5	1.03/49.2/49.1/1.5	1.01/49.6/49.6/–0.28
	14	1.04/49.1/49.1/1.7	1.02/49.6/49.6/–0.89
	28	1.05/48.9/48.9/2.5	1.04/49.7/49.7/–1.8
	50	1.08/48.6/48.5/3.6	1.07/49.7/49.6/–3.1
5 Ω (10:1)	3.5	100/5.1/0.0/5.1	10.30/4.9/4.8/0.1
	14	100/5.3/0.1/5.3	10.28/4.9/4.9/0.4
	28	19/5.9/2.6/5.3	10.27/4.9/4.9/0.8
	50	33.9/7.6/1.5/7.5	10.14/5.1/4.9/1.4
10 Ω (5:1)	3.5	11.74/10.2/4.4/9.3	5.13/9.75/9.7/0.2
	14	9.22/10.3/5.5/8.6	5.11/9.81/9.8/0.6
	28	6.4/10.4/7.9/6.7	5.10/9.87/9.8/1.1
	50	7.4/11.6/6.9/9.3	5.07/10.0/9.9/2.1
12.5 Ω (4:1)	3.5	6.86/12.9/7.6/10.4	4.01/12.5/12.5/0.3
	14	6.93/13.0/8.7/9.6	3.98/12.6/12.6/1.0
	28	4.69/13.2/10.8/7.5	3.94/12.8/12.7/1.7
	50	5.18/14.4/10.0/10.3	3.89/13.2/12.9/2.9
16.6 Ω (3:1)	3.5	4.36/17.1/12.1/12	2.98/16.8/16.8/0.0
	14	3.98/17.1/13.1/11	2.97/16.8/16.8/0.2
	28	3.40/17.1/15.1/8.1	2.97/16.8/16.8/0.5
	50	3.59/17.6/14.5/10.0	2.95/17.0/16.9/1.0
25 Ω (2:1)	3.5	2.28/25.5/23.1/10.8	1.98/25.3/25.3/0.1
	14	2.21/25.5/23.6/9.7	1.98/25.3/25.3/0.2
	28	2.04/25.5/24.8/5.7	1.97/25.4/25.4/0.4
	50	2.09/25.9/24.6/8.0	1.96/25.5/25.5/0.7
100 Ω (2:1)	3.5	2.03/98.8/97.0/18.8	1.99/99.2/99.2/–1.2
	14	2.03/98.6/96.9/18.2	1.99/99.1/99.0/–5.1
	28	1.99/96.7/94.9/18.7	1.99/98.8/98.3/–9.8
	50	2.00/92.1/87.6/28.3	2.00/97.6/96.3/–16.9
200 Ω (4:1)	3.5	4.04/194.3/187.6/50.8	3.99/199.2/199.1/–6.1
	14	4.01/191.9/184.3/53.4	3.98/197.5/196.0/–24.3
	28	3.95/177.9/162.4/72.4	3.99/193.1/187.7/–45.2
	50	3.94/148.4/116.8/91.5	4.00/181.9/167.7/–70.5
300 Ω (6:1)	3.5	6.13/283.1/262.6/105.7	6.01/300.2/299.9/–13.1
	14	6.12/270.5/240.6/123.5	6.01/295.1/290.2/–53.5
	28	5.96/232.2/184.2/141.5	6.01/282.1/265.7/–94.8
	50	5.91/176.6/110.7/137.6	6.01/252.1/213.9/–133.5
400 Ω (8:1)	3.5	8.21/371/336/157	8.01/399/398/–27
	14	8.09/339/286/182	7.98/386/374/–96
	28	7.93/263/178/194	7.99/355/317/–160
	50	7.88/183/90/160	7.97/293/219/–195
500 Ω (10:1)	3.5	10.3/441/377/228	9.89/493/491/–39.5
	14	10.1/391/304/246	9.85/470/449/–139
	28	9.86/284/167/230	9.81/418/358/–217
	50	9.67/192/80/174	9.75/330/226/–240

Notes:
*The loads were measured on an Array Solutions VNA2180 by the reviewer.
**The MFJ-223 does not indicate inductive loads (+*jX*) or capacitive loads (–*jX*).
†The VNA2180 was calibrated with an N to BNC adapter and precision BNC calibration loads (open/short/50 Ω) so the calibration reference plane is the same for the VNA2180 and the MFJ-223.

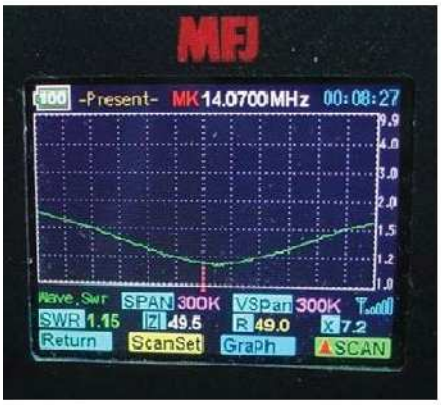


Figure 4 — Single band (20 meter) antenna scan.

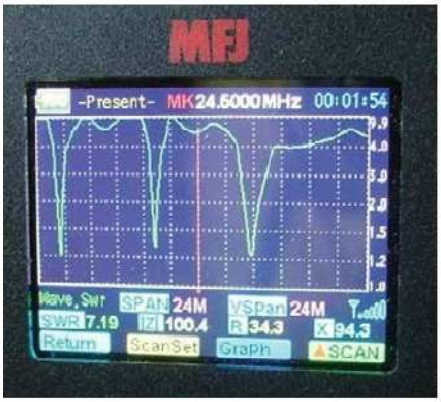


Figure 5 — 20/15/10 meter trap dipole scan.

or even damage the MFJ-223 (greater than S+20).

The scan mode is convenient for looking at individual band SWR centering, and even permits multiband antenna resonance checks. You can select only fixed swept bandwidths of 300 kHz, 600 kHz, 1.2 MHz, 2.4 MHz, 6 MHz, 12 MHz, 24 MHz, and 48 MHz. The digitally displayed data corresponds to the center frequency of the display as selected by the rotary encoder. Figure 4 shows a 300 kHz sweep of the 20 meter band where I adjusted my tri-band dipole for lowest SWR at 14.07 MHz. This gave me a reasonably low SWR in the CW (my preferred mode) portion of the band, as well as in the lower part of the phone band. Figure 5 shows a broader (24 MHz) scan indicating the antenna resonances on the 20, 15, and 10 meter bands.

One nice feature of the swept display is that the last display is saved in memory when you turn off the MFJ-223. This permits you to recall your last scan display for review if desired.

Conclusion

The MFJ-223 is a very compact, easy-to-read antenna analyzer. It works well, but some inaccuracy at low impedances should be kept in mind. In addition to providing single frequency information typically available from antenna analyzers, the MFJ-223 also provides swept graphical displays. Its ease of operation makes it very convenient for most antenna work from 160 meters through 6 meters.

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

Click here for a video overview of the MFJ-223 Vector Impedance Antenna Analyzer.

Portable Rotation 12PR1A Ultra-Portable DC Antenna Rotator

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

One of the greatest joys of Amateur Radio is being able to operate outdoors. Whether it's on a mountaintop, on the beach, or on the top level of a high-rise parking garage, getting away from the shack allows us to find new ways to enjoy our hobby. For some of us, operating portable is the only way we can get on the air because of our housing arrangements.

When I operate portable, I've found myself in several situations where I could have brought a directional antenna with me, such as a small Yagi for HF or VHF. If it's light enough, rotating a Yagi can be done with the Armstrong method, but it is often very inconvenient to do so. Perhaps you don't want to leave the rig behind while you go outside to adjust the antenna toward that weak station, or perhaps you're in a tent and it's dark out there.

Bottom Line

The Portable Rotation 12PR1A offers a convenient way to rotate small antennas in the field without draining a portable battery supply.

A Battery Powered Rotator

Portable Rotation has developed a solution to these problems. The 12PR1A is an antenna rotator (Figure 6) that functions on 9 to 14 V dc. At 12 V, the unit is specified to draw 40 mA idle current and 200 mA or less while the antenna is turning. It can be powered from the battery used to run a typical portable station. While the control head (Figure 7) will function with as little as 6 V, a minimum

Figure 6 — The rotator motor unit has a 6-inch stub mast for attaching the antenna.

Figure 7 — The control box has buttons for clockwise and counterclockwise rotation and displays beam heading on an LCD. You can program your call sign in the top line.

Figure 8 — The author's portable station fits in a backpack.

of 9 V is required to activate the rotator motor. The rotator is designed for 12 V and will turn only very small antennas with a 9 V power source.

The manual indicates that the rotator can handle antennas that weigh up to 8 pounds (the Portable Rotation website says 10 pounds), which covers portable antennas such as the Buddipole or Super Antennas portable dipoles, or most small VHF/UHF Yagis. The website also says the rotator will handle a Super Antennas YP3 portable Yagi, which is specified to weigh 12 pounds.

The package includes the rotator with a built-in 6-inch mast for attaching antennas, 50 feet of control cable, and a small controller. It has a USB interface (so it can be controlled with your PC) and the entire package weighs just under 4 pounds. Options include an adapter for Buddipole antennas, a carrying bag, and a 50-foot control cable extension.

The 12PR1A does have some limitations. It's not designed for permanent installations in harsh or extremely wet conditions. Although the 12PR1A is weather resistant, the manufacturer recommends not turning the antenna if it is raining because water might pass by the seals and get into the rotator. The manual informs us that the built-in 6-inch antenna mast is not to be extended, or it could damage the rotator bearings. The manual also advises us to make sure the antennas are well balanced at the rotator attachment point.

Setting Up in the Field

I took the 12PR1A rotator out to one of my favorite portable operating sites, a field behind a grade school about a half mile from my West Hartford, Connecticut apartment, and used it in one of my standard portable operating configurations: an all-mode QRP transceiver with a 7 Ah (amp-hour) sealed lead-acid battery, a 20-foot telescoping aluminum mast with tripod, and a foldable two-element 6 meter Yagi. Figure 8 shows my gear. With the exception of the mast, everything fit easily into my 3-day backpack, with room to spare. I didn't notice the extra weight of the rotator.

Setting up this configuration usually takes me about 20 minutes; the inclusion of the rotator added fewer than 5 additional minutes of setup time. It was incredibly straightforward and easy right out of the box. The rotator-to-mast brackets can accommodate a mast up to 1.5 inches, and the mast clamps have wing nuts to secure the rotator. No tools are needed. The bottom of the rotator falls flush on the top of the mast and locks down smoothly. The four-conductor control cable can be attached to the bottom of the rotator easily, and it attaches to the control box in a similar fashion.

I unfolded my two-element 6 meter Yagi, attached it to the built-in rotator mast, and raised the mast up section by section. I was on the air in less than half an hour. Figure 9 shows the antenna, mast, and rotator.

Using the Rotator

One of the nice features of the 12PR1A is "Any-Direction Calibration." You can erect your beam without trying to get it oriented to true north immediately. After the antenna is in the air, you can tell the 12PR1A

Figure 9 — The 12PR1A rotator installed on a temporary mast with a two-element 6 meter Yagi.

what direction the antenna is pointing and calibrate the controller from there, which saves a lot of time.

The 12PR1A is designed to rotate through north (0 degrees), meaning that it will stop when oriented to 180 degrees (due south). If you are pointed west at 270 degrees and want to change the antenna to beam southeast, say 130 degrees, the antenna will rotate clockwise, passing through north. If you keep turning the antenna clockwise past 130 degrees, when you reach 180 degrees the control head will display a MAX TURN message. An arrow will appear on the display, indicating counterclockwise as the only direction in which you may turn the antenna.

As with many other antenna rotators, the 12PR1A allows you to rotate the antenna manually by holding down the CW (clockwise) or CCW (counterclockwise) buttons. You can also use AUTO TURN MODE to enter a numeric beam heading and having the rotator automatically adjust to the desired direction. You enter the heading by repeated pressings of the CW, CCW, and MODE buttons to scroll to the desired setting. When you are done turning the antenna, you can turn off the controller to save battery power.

In either manual or automatic mode, after you stop turning the antenna, there is a pause of 3 seconds before you can start turning again. This allows the antenna to come to a full stop.

Once I had the antenna and rotator in the air, I called Matt Wilhelm, W1MSW, to work him on 6 meter CW over a path of about 40 miles straight north. Once we established communication, I rotated the beam manually to the west and listened as Matt's signal dropped as I turned away from him. I then entered the heading "000" into the control box and the rotator swung the beam back north with no difficulty.

Two rotation speeds are available — normal speed and half speed (for antennas that require more precise adjustment, such as a high-gain UHF Yagi). The manual says the rotator will make one 360 degree rotation in about 1 minute, and in the field, I found this to be about right at normal speed. Of course, lower voltages from your battery will affect rotation time.

The 12PR1A comes with a built-in sensor that will disable the rotator if rotation is blocked for more than 1 second, such as if an antenna element hits a tree branch. The message ANT JAM! will appear on the control head's display. Once the obstruction has been dealt with, you can either rotate the antenna in the opposite direction or power-cycle the control head to clear the ANT JAM! message.

I didn't try this feature, but the manual includes a section on remotely controlling the 12PR1A using software that supports the Yaesu GS232A/B Rotator Control Protocol. The controller connects to a computer via a USB jack on the front panel.

Final Thoughts

I found the Portable Rotation 12PR1A to be a welcome addition to my portable field operation. If you're looking to turn your club's six-element tribander during Field Day, this rotator isn't for you. However, this rotator packs a lot of operating convenience into a small package. It's ideal for weekend trips to a rare grid square for VHF/UHF operating, a short-term public service event, or any other portable operation where having a light-duty rotator in the middle of nowhere saves effort and maximizes operating ease.

Manufacturer: Portable Rotation, 4010 Foothills Blvd, Ste 103 #118, Roseville, CA 95747, tel 800-366-9216; **www.portablerotation.com**. Price: $329.95; Buddipole Adapter Kit, $29.95; carry bag, $29.95.

Palstar SP30H Ultimate Communications Speaker

Reviewed by Joel R. Hallas, W1ZR
QST *Contributing Editor*
w1zr@arrl.org

Palstar is a company well known to readers of these pages as a manufacturer of high-quality antenna tuners, but that's not all they do. We have reviewed other Palstar products, including an antenna analyzer and a communications receiver. We reviewed an earlier version of their current R30A receiver some years back and they have since offered a pair of external speakers designed to complement that offering. Their first speaker was a compact unit designed to sit next to the R30, the 5 W rated SP30B.

Palstar now also offers a larger unit that can handle more power and provide a wider frequency response — the SP30H. The SP30H measures 8¼ × 11 × 10 inches (HWD) and weighs about 11 pounds. The smaller unit is still available at about half the price. Both speaker models are enclosed in a wooden cabinet that can be ordered with either a cherry finish or a black finish that matches the face plate. Both finishes are the same price.

What it Does

The SP30H is specified to handle up to 20 W RMS over the frequency range 45 to 8000 Hz. Since the typical SSB signal provides components from around 300 to 2700 Hz, you may wonder why you might want to cover a wider range. There are a number of potential reasons that this might make sense for you, including:

- If you like to listen to AM broadcasts on our domestic medium frequencies, or on international shortwave bands, the typical speakers in equipment can be quite restrictive in limiting the available bandwidth. While few international signals will come through with high-fidelity quality, that is not the case with many nearby AM broadcast stations.
- Some hams enjoy generating voice signals of broadcast quality and the audio quality on the receiving end should match.
- Using a speaker that can handle more audio power than the receiver can comfortably output helps avoid distortion during noise or audio peaks that can happen.
- Many of us just enjoy the rich sound that can come out of a speaker like this — even if the numbers can't explain it!

This speaker does sound much better than any internal speaker I've encountered, and better and fuller than any external one from a radio manufacturer that I can remember.

Hooking it Up

The audio input connections are provided by a pair of spring terminals that can accept wire ends, a phono jack, and a 3.5 millimeter phone socket. This makes it easy to connect the speaker to your radio with available premade cables, or just using a piece of zip cord, depending on the external speaker connections available from your radio.

Bottom Line

The Palstar SP30H is a fine sounding loudspeaker that will make most radio gear sound better. If your space is tight, the smaller SP30B may be worth considering.

How it Plays

I used this speaker on both my usual HF transceiver and on two early vacuum tube communications receivers. In all cases, the speaker provided more pleasant sound than the speakers I had been using. For the transceiver, that included its internal speaker as well as a small "high fidelity" speaker that was plugged into the rear SPKR jack. This speaker would have made a fine companion to both the Collins 51J4 with its 6 kHz AM mechanical filter and the wider bandwidth IF system of the HQ-129X. In the process of these tests, I also confirmed the operation of each of the speaker's three connection arrangements.

It's important to note that while the speaker comfortably passed my subjective "live on-air" tests with various program sources, the ARRL Lab does not have the required facilities to measure the audio response of loudspeakers.

Documentation

The unit comes with a two-page instruction sheet that describes the speaker functionality and its specifications. It is hard to imagine that more information or instructions will be needed.

Manufacturer: Palstar Inc, 9676 N Looney Rd, Piqua, OH 45356; tel 800-773-7931; fax 937-773-8003; **info@palstar.com**; **www.palstar.com**. Price $199.95.

New Products

Morse Express 2014 Christmas Key

The 2014 Christmas Key from Morse Express is a fully functional miniature telegraph key commissioned by Morse Express and made by GHD Telegraph Key in Sendai City, Japan. The Morse Express 2014 Christmas Key is fully adjustable, with precision pin bearings at the trunnion, and it has two miniature binding posts. Lever tension is provided by a compression spring that is located forward of the trunnion post. The contacts are hard silver, the base is mahogany, and the knob is hand-turned ebony. It measures 1¼ ×2¼ inches at the base, is 1½ inches tall, and weighs just over 1½ ounces. Price: $89.95 plus shipping/handling. For more information, or to order, visit **www.morseexpress.com**.

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

A Low Yagi Can be Better than No Yagi

Q Mark, KG1Q, asks: I'm just returning from a trip to Newfoundland where I used, with some success, a three-element 80 meter inverted V wire Yagi beam antenna. I have the elements 50 feet apart for an overall boom length of 100 feet. The director was 116 feet in length, the driven element 124 feet in length, and the reflector around 129 feet long. The height of the driven element feed point was around 40 feet, with the wires sloping downward to form the V. The director and reflector were both constructed in the same manner.

I know that many people cannot get their 80 meter horizontal antennas very high, resulting in high takeoff angles most suitable for medium range near vertical incidence skywave (NVIS) propagation. Since I'm well under a quarter wavelength high, are the director and reflector on my Yagi effective at all and worth the trouble to put up?

A Well, your three-element inverted V Yagi does indeed have some benefit over a single element. The single inverted V over typical ground has its elevation peak at 90° with a straight up intensity of 5.45 dBi (see Figure 1) as predicted by *EZNEC*.[1] Since you are talking about a beam, I would guess you are interested in a particular destination, perhaps looking for DX at low angles. At 10° elevation, the single inverted V with apex at 40 feet (ends at 25), has an intensity of –7.3 dBi.

Your three-element inverted V Yagi will have its elevation peak at 49° and an intensity in the peak of 6.55 dBi. While the improvement in peak gain is not too impressive, the intensity at 10° is –2.7 dBi, an improvement of 4.6 dB, close to an S unit or a power increase of a factor of almost 3:1 (see Figure 2). In addition, instead of being omnidirectional, the Yagi will have a front-to-back ratio (F/B) of almost 7 dB, perhaps important to reduce the receive level of North American stations, if the antenna were pointed toward Europe. Of course, this assumes that you are interested in working stations in that particular direction.

Another useful comparison might be to my two-wire 80 meter ground plane with two elevated radials pointed at the edges of Europe. This antenna has the base 8 feet off the ground and has a modeled peak intensity of +1 dBi at an elevation of 26°. While the peak is lower than either of the horizontal antennas under consideration, the intensity at 10° is –1.5 dBi with a front-to-back of 3 dB. So this single element has a higher amount of low angle radiation than the three-element Yagi, and less high angle response to closer stations. Of course, a vertical Yagi is yet another possibility.

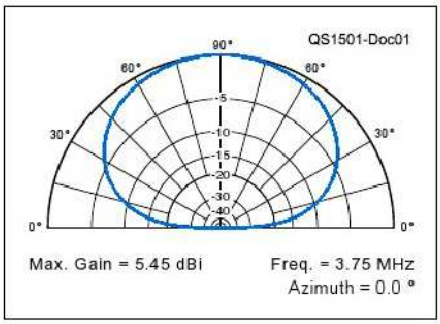


Figure 1 — The *EZNEC* elevation plot of a single element 80 meter inverted V antenna 40 feet above typical Earth (conductivity 0.005 S/m, dielectric constant 13). Note that the peak radiation is directly upward — excellent for NVIS propagation.

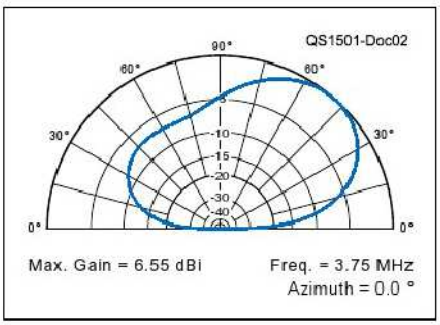


Figure 2 — The elevation plot of the antenna of Figure 1 with the addition of a parasitic reflector and director element. Note that, while much of the radiation is still at high angles, there is also a directive effect that provides additional gain at low angles.

Q Hal, W8HMK, asks: In the August 2014 column, you responded to a question dealing with having a fuse in the negative line of a mobile radio's power supply cable. I have a follow-up question. If the fuse in the negative line is only there to protect against a failure of the ground cable in an automobile, should those of us who use our transceivers exclusively as base stations remove the fuse in the negative line and replace it with a solid conductor?

A There's really no particular reason not to — except it probably isn't causing any problems, and who knows when the radio will show up in a car; perhaps after you sell it.

Having said that, I will mention that my main mobile activity is HF CW and at one point I was getting reports of a chirp. A bit of investigation indicated that the problem was resistance in the fuses or their contacts that caused a few volts drop at key down (15 – 20 A). I replaced the original-equipment cartridge fuses with some US-made Buss fuses and the problem went away. Clearly, half as many fuses means half as much drop and less likelihood of chirp.

This is probably not a frequently encountered problem, but that's not to say it can't happen. I believe the current crop of "blade type" automotive fuses have less contact resistance and are less likely to exhibit this problem.

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

Q Steve, AG1YK, asks: One of the participants in my ARES net has an antenna situation he needs help resolving. He has two U/VHF verticals mounted on his tower, one on the north side and one on the south. Each antenna works great for coverage on its respective side of the tower, but is deaf to signals coming from the other side. To operate, he has to continually switch between the antennas.

What would be the best way to connect the two antennas together so that he wouldn't have to switch between them? He would like to have a solution he can install in his shack, if possible.

A What we want to do here is to have the power divide and drive each antenna simultaneously on both bands. If the antennas were matched to start with, connecting them both to a coax T connector forms a parallel combination that will have an impedance of 25 Ω, a 50 Ω SWR of 2:1, depending on how close the antenna systems were to 50 Ω to start. If the antenna systems are of the same impedance at the T, the power will divide equally between the two antennas. Any small difference will just favor one a bit compared to the other.

If your friend is an optimist, he could try connecting the output of the T directly to the radio. If there is a length of coax between the T and the radio, the coax loss will reduce the SWR. For example, 20 feet of regular RG-58 between the T and the radio should get the SWR down to 1.6:1 at the radio.

If his radio doesn't like the match, a simple ¼ wave (on 2 meters), and ¾ wave (on 70 centimeters) transformer can be made, as shown in Figure 3. As shown, the transformer makes use of two ¼-wave sections of 75 Ω coax such as RG-59 in parallel using two more T adapters. This makes a 37.5 Ω transmission line that will transform 25 Ω to 56.25 Ω, a 1.1:1 SWR. Note that the matching section should be hooked directly to the T connector, since any coax between the parallel antenna connection and the matching section will change the impedance.

For standard solid polyethylene dielectric coax such as RG-58 or RG-213, the length of each line should be about 13.3 inches. For foam dielectric coax, such as RG-8X the length should be somewhat longer, depending on the density of the foam — typically about 17 inches. With the parallel connection, there should now be good signals, at least to and from the north and south directions.

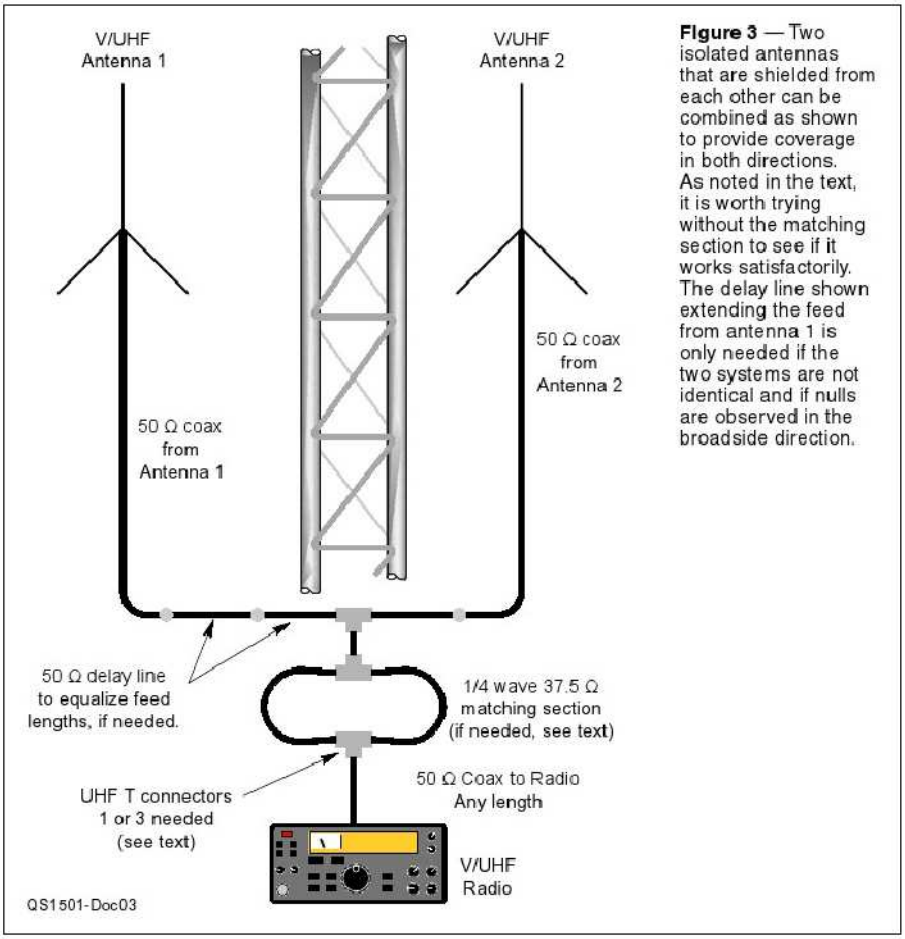


Figure 3 — Two isolated antennas that are shielded from each other can be combined as shown to provide coverage in both directions. As noted in the text, it is worth trying without the matching section to see if it works satisfactorily. The delay line shown extending the feed from antenna 1 is only needed if the two systems are not identical and if nulls are observed in the broadside direction.

How about the signals to east and west? In this case, both antennas will likely be in play, especially if they are both similar. If they are identical and the two transmission lines are exactly the same length, the signals to the east and west should be in phase so that they are comparable to, or a bit stronger than, the signal from either antenna previously. On the other hand, if Murphy has anything to do with it, the two systems will not be quite identical.

In the worst case, if the lengths are different by an odd multiple of ½ wavelength, the signals to the two antennas will be out of phase and there will be a null going to the sides. Note that this won't bother the signals going north or south, they will work fine as independent antennas — it will just be a problem in the directions that will see both antennas. Of course, in a real-world antenna, the tower legs will result in some scattering that may confuse the situation. Even so, the situation should be close to that described.

If he finds that it doesn't work to the sides, he can insert (or cut) an electrical half wave (twice the above lengths) from one (not both) feed lines, and all should be well. If it works fine on 2 meters, but not well to the sides on 70 centimeters, an electrical half-wave on that band should shift things around. There may also be nulls at intermediate angles, and a bit of cut and paste with different lengths of coax in just one side should yield a delay line length that gets everything in phase and working all around.

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

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

Experiment #144

The Myth of the RF Ground

Sooner or later, just about every ham who builds an HF station — whether it's at home, in the car, at Field Day, or for portable operation — experiences the rite of passage called an *RF burn*. Although painful, it rarely creates a physical mark, just a certain wariness on the part of the burn-ee. What's happening here?

You just had an exciting encounter with a high-impedance point on your antenna system. Impedance being the ratio of voltage to current, when power is applied, a high RF voltage will be present at these points. Who says you can't feel RF? "But wait," you exclaim, "the antenna is up in the air and connected to the antenna tuner! I'm not touching my antenna system!"

Oh yes, you are! Unless your station is built inside an RF-tight metal enclosure or is otherwise isolated from the antenna and feed line, every coax shield, every enclosure, every unshielded wire...anything connected to the transmitter directly or indirectly should be treated as part of the antenna system. That includes *you* when touching any of those conductors! Take a look at Figure 1, which shows a typical home station. Everything in that figure is part of the antenna system of that station.

If the station is operating on 10 meters, at least one potential hot spot is never more than about 8 feet away. Why? Consider the wavelength at 28 MHz. It's 33.4 feet and ¼ wavelength is approximately 8.3 feet. When a conductor is excited by RF, either directly from a signal source or by picking up radiated energy, a pattern of peaks and nulls for both voltage and current is created. Peaks are ½-wavelength apart and so are the nulls, with peaks and nulls offset ¼-wavelength apart. Whether the conductor happens to be a wire, the outer surface of a coax shield, an equipment enclosure, or a "ground" wire makes no difference. It's all a conducting surface as far as the RF is concerned, regardless of what we call it.

While less dramatic than "getting bit," one has to watch out for RF currents, too. Any time the voltage "over here" is different than the voltage "over there," current will flow. When the current flows on the outside of an enclosure or coax shield, it's generally not a big problem. The fun begins when it finds a way into the electronics via an unshielded connection (like a power cord) or an improperly connected shield that conducts the current inside an enclosure instead of keeping it outside. RF that's where it shouldn't be can wreak havoc with a circuit's operation: audio gets garbled, keyboards stop working, control interfaces stop controlling.[1]

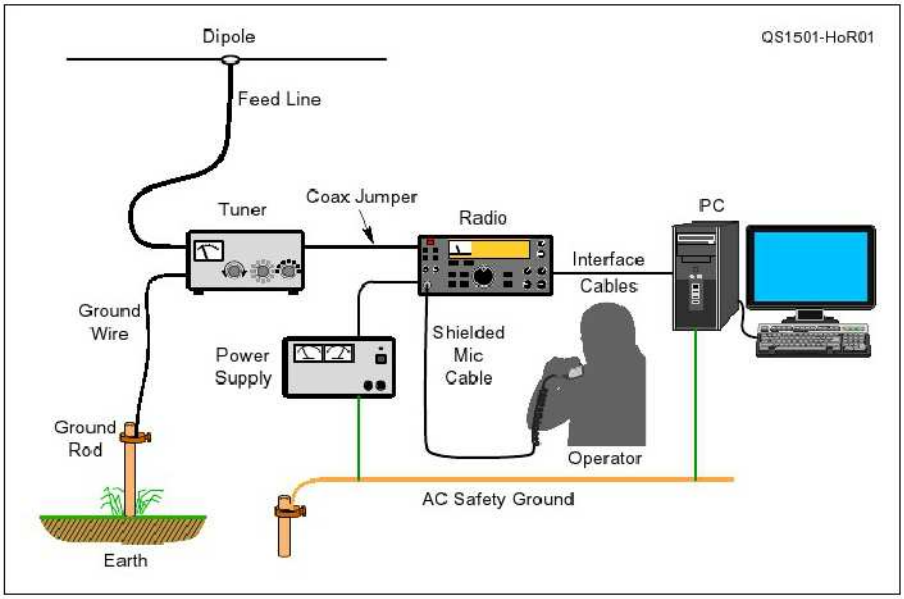


Figure 1 — The complete antenna system for a typical shack. Everything conductive, including the operator holding a microphone, is part of the antenna system.

The situation gets particularly interesting when instead of a coax-fed dipole, the antenna wire itself is connected directly to the antenna tuner. This type of connection is often used for portable operating as an "end-fed" or "random wire" antenna with a "counterpoise" (a piece of wire laid on the ground or floor) replacing the ground rod. In this case, the antenna itself consists of everything from the end of the counterpoise to the end of the wire in the air. The equipment and operator are thus all connected to the feed point of the antenna. Imagine the feed point of the dipole in Figure 1 being connected right at the output of the antenna tuner and you get the idea. This also explains why the results of using these directly fed antennas can be inconsistent, because there is so much variation in what the antenna system actually consists of.

Obviously, we would like to control the RF voltages and currents so they don't cause our equipment to malfunction or burn our fingers. The natural tendency is to think, "I'll just ground everything and it will be at zero volts — problem solved!" Not so fast! You're partly right, but we have a failure to communicate, as they say.

Grounding and Bonding

There are grounds and then there are grounds. Consider the actual ground, the

[1]Poorly shielded connections and equipment will radiate RF from internal electronics, too. This creates on-the-air interference.

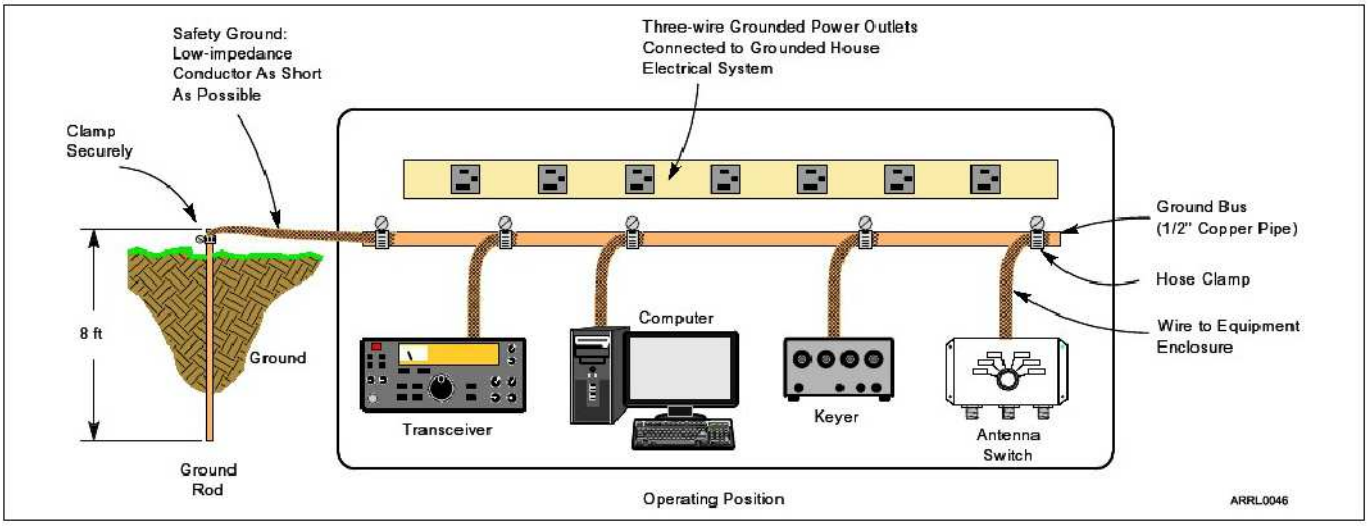


Figure 2 — The ground bus shown in this figure provides effective bonding between the various pieces of equipment at RF. The ac safety ground is also connected to the ground bus, but is of limited effectiveness at RF.

soil itself. The Earth acts as a "zero voltage reference" for ac power and low-frequency systems. The *ac safety ground* in your home consists of the power wiring's ground wire (bare or with green insulation), which is connected to the Earth through a ground rod that is connected to the main circuit breaker panel. The ac neutral of a typical two-phase home is also connected to this same ground. (See the *National Electrical Code* and your local building codes for a complete description of what is required in your particular circumstances.)

Any exposed conductive enclosure of an appliance or machine — including your radio equipment — should be connected to the ac safety ground to conduct *fault* or *leakage current* away from you and back to the Earth. It is this current flow that trips Ground Fault Circuit Interrupter (GFCI) circuit breakers.

The purpose of the ac safety ground has nothing to do with RF and it should never be expected to act as any kind of voltage reference above a few hundred kilohertz. That means even if all of your equipment is properly grounded for ac safety, you still have no control over RF voltages and currents. In fact, as Figure 1 illustrates, the ac safety wiring is a part of your antenna system, too.

What if you install a ground rod outside the station and run wide copper strap to it like all the literature tells you? There is another word for ground connections and that is "antenna!" Any ground connection longer than about 1/10 of a wavelength begins to act like an antenna, including transmission line-like effects. If the electrical length is close to ¼ wavelength (or any odd number of ¼ wavelengths) the impedance of the wire becomes very high, effectively becoming a resonant open circuit.

Back in the days when most amateurs operated below 15 MHz, a few feet of wire was electrically short enough to serve as a common connection. As operation at shorter wavelengths became more common, the connection to a ground rod got electrically longer and less effective. Hams with shacks on an upper floor had (and have) the same problem at any frequency.

The solution is to stop looking for the elusive "zero voltage connection" at RF. The Earth is not a magic drain into which all of our unwanted RF can be poured via a wire. An electrically long connection to the Earth is useless at RF and often causes RF-related problems. Let's go back to what the problem really is: we have places in the shack where high RF voltage exists and RF voltage differences that cause RF current to flow. These problems can be addressed by *bonding*.

Bonding sounds heavy-duty (and expensive) but all it really consists of is connecting equipment enclosures together with short conductors so they have the *same* voltage. This is partially taken care of by the low-impedance connection provided by shields of coaxial cables between equipment.

However, accessories, computers, and power supplies generally aren't connected together with coax, so we have to provide another path. A common solution (shown in Figure 2) is to provide a wide, flat common *ground bus* at the back of or even under the shack equipment. Each piece of equipment, including computers and other non-radio electronics, is then connected to the bus with a short wire or strap.[2] To accomplish the purpose of RF bonding, no other connections are required.

It is a good idea to add a connection to the ac safety ground from the ground bus or to use it as part of a lightning protection system, but the effect of that connection at RF will be unpredictable due to the configuration of the entire antenna system, as discussed earlier. From an RF perspective, keeping all of the equipment as close as possible to the same voltage is the important thing.

Bonding will *not* result in there being zero RF voltage on the equipment. Bonding does keep all of the equipment at about the *same* voltage, so RF current flow between pieces of equipment is greatly reduced with the added benefit of reducing the effect of lightning-caused voltage surges that affect the station ground connection.[3]

Next month we will talk about shielding, both of devices and of cables, and how this affects resistance to RFI.

[2]Avoid using coax braid as an RF connection. Once removed from the protection of the confining jacket, the braid's individual strands begin to loosen and corrode, increasing the impedance at RF. Use heavy wire or solid strap, such as copper flashing, for best results.

[3]W. Ronald Block, KB2UYT, "Lightning Protection for the Amateur Radio Stations, Parts 1-3," Jun, Jul, and Aug 2002, *QST*.

Paul Wade, W1GHZ, w1ghz@arrl.org

Microwaves — The DIY Bands

DIY skills are mandatory for working the microwave bands, but modern components simplify construction.

At lower frequencies, Do It Yourself (DIY) is a choice, but for microwaves, it's a necessity. There are almost no out-of-the-box radios available, except a limited number for 1296 MHz. For all other microwave bands we must rely on some DIY to assemble a station.

When we say DIY, it might mean completely homebrewing the equipment from scratch or it might mean acquiring functional modules and connecting them to create a working system. An example of microwave homebrew is the 3456 MHz transverter in Figure 1, with MMIC (Monolithic Microwave IC) amplifiers and pipe-cap filters soldered on a PC board. This board has printed traces, but some hams have been successful on the microwave frequencies by simply wiring the components together "dead-bug" style on a bare copper board.

Some of us enjoy building from scratch, while others find it daunting. The alternative is to acquire modules with the hard-to-find parts inside and connect them. Most of the required functional modules are available from amateur suppliers like Down East Microwave (**www.downeastmicrowave.com**) and DB6NT (**www.kuhne-electronic.de**), or from surplus sources. Surplus items are usually not designed for the ham bands, so some modification may be required. If you are lucky, someone has already figured out what is needed and a search on microwave-related information can provide the proper modifications.

An example of the modular approach is the 10 GHz transverter in Figure 2. I chose the modules to make a compact system. The heart of the system is a 10 GHz transverter module from DB6NT, capable of perhaps 200 mW output. To enhance performance, I added a power amplifier and a receive preamplifier. To complete the system, I added some homebrew modules: a driver amplifier, a sequencer, and a small board containing a negative bias voltage supply and an RF power indicator. Some specialized microwave components, like the coax relay and isolators, were surplus finds at hamfests. All the RF interconnections use semi-rigid coaxial cable with SMA connectors.

Figure 1 — Top and bottom views of a 3456 MHz transverter that uses pipe-cap filters.

Figure 2 — Bottom view of a modular transverter for 10 GHz. Note the semi-rigid coax and SMA connectors linking the various modules.

The semi-rigid coax provides low loss with reliable performance at microwaves — the most common type is 0.141-inch in diameter, sometimes designated RG-402 or UT-141. Ordinary flexible cable has higher loss and braid connections can be unstable at microwave frequencies, particularly if the equipment is bounced around in portable operation. Semi-rigid cable has a Teflon dielectric with a thin copper tube for the outer conductor, providing a solid shield. It can be bent to desired shapes using a fixture or just a thumb, but is more difficult to unbend, so surplus pieces that are pre-bent can be a problem.

Cable assemblies of semi-rigid coax with SMA connectors on both ends are fairly common hamfest items. Their prices are reasonable and I have amassed a box of them over the years. Whenever possible, I try to find one close to the desired length and shape, but most of them are either too long, too short, or are bent the wrong way. In less critical applications, extra length can be folded up — a few of these may be seen in Figure 2 — but for critical locations, before the preamp and after the power amplifier,

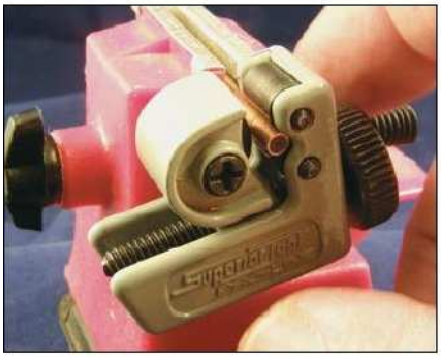


Figure 3 — Start preparing the semi-rigid coax by scoring with a miniature tubing cutter.

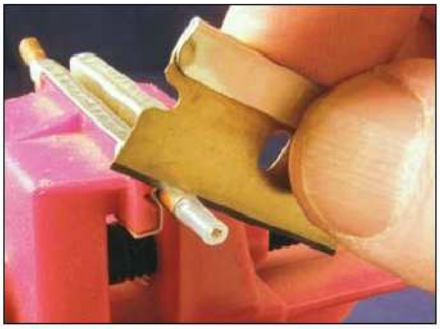


Figure 4 — With the copper jacket removed, trim the Teflon dielectric square with a razor blade.

it's best to minimize length and loss. For these locations, sometimes it is necessary to install SMA connectors on the semi-rigid cable. It's not hard — you can Do It Yourself.

SMA Connector Assembly

While the SMA connectors for semi-rigid coax are fairly common at hamfests, they are inexpensive and readily available from suppliers like Digi-Key (**www.digikey.com**). A good brand is Emerson, which was formerly E. F. Johnson, a once-famous ham manufacturer. You can download the data sheet from the Digi-Key catalog page for a copy of the assembly drawings.

Because most modules have female SMA jacks, the cable needs to have male SMA plugs. Male plugs have two pieces: a connector body that solders onto the copper outer conductor of the coax and a coupling nut that threads onto the female jack. The center conductor is simply the protruding center conductor of the coax. The coupling nut is often held in place by a snap ring, which can be a problem to install — a better version simply threads the coupling nut onto the body.

To prepare the semi-rigid cable for connector installation, first make a clean, square cut to remove the copper outer conductor. Many years ago, a salesman showed me an excellent technique for this; the copper is scored with a miniature tubing cutter, as shown in Figure 3. After scoring, it should snap off cleanly. It takes a bit of practice to find the right scoring depth — too shallow and it won't snap cleanly, while too deep forces the copper into the Teflon dielectric — but learning only wastes a couple of inches of cable.

With the jacket scored, snap off and remove

Figure 5 — Solder the SMA connector to the semi-rigid coax. Work as quickly as possible to prevent excess heat from damaging the Teflon dielectric.

the end. The Teflon dielectric is then cut off square with the end of the copper jacket using a razor blade (see Figure 4). When removing the Teflon, be careful not to nick the center conductor. With the Teflon removed, cut the center conductor to 0.085 inches. Finally, bevel the end to a dull point with a file. It's better if the length is a hair on the long side, rather than too short.

Once the cable is prepared, it is time to assemble the connector. First, slide the coupling nut onto the cable, making sure it is facing in the correct direction. Now insert the cable into the connector body with the end of the body flush with the end of the copper jacket. I like to put just a hint of paste flux on the cable before inserting it, to help solder flow.

When soldering the connector body to the cable, use the minimum amount of heat needed to get a good solder joint. Too much heat can damage the dielectric (see Figure 5). I use a 50 W iron with a ¼-inch tip that is temperature controlled at 600 °F to solder connectors. This size iron quickly delivers enough heat to complete the job with the least impact on the Teflon. I use the same iron with a 1/16-inch tip for soldering surface mount components.

If the Teflon expands during soldering and protrudes from the cable's end, trim it flush with the razor blade. Finally, thread the coupling nut over the connector body and then connect it to a female jack to make sure everything fits.

If the fit is good, repeat the process on the other end. I usually make a short cable by cutting the desired length off a long cable assembly so I only have to attach one connector.

A Cautionary Tale

The 10 GHz system in Figure 2 had an intermittent problem for several years — it would work fine at home, but the receiver would fail in the field. I would take it apart on the bench, resolder any questionable connections, and it would work again — until it was back on a hilltop.

This year, it failed again during the first weekend of the ARRL® 10 GHz and Up contest, so I tried to repair it again for the second weekend. As I was removing modules, my finger brushed over the end of one of the SMA connectors, but I didn't feel the center pin. When I looked more closely, the pin appeared to be a little shorter than the others. I suspect that the center conductor contracted enough at low temperatures (on mountaintops) to lose contact — a problem I've seen before. After replacing the cable, the system worked flawlessly for several days and throughout the second contest weekend.

I recommend brushing your finger over the end of each connector before using a cable and comparing pin length with a quality adapter.

SMA Connector Torque

In a microwave laboratory, SMA connectors are installed and tightened with a special torque wrench to about 8 inch-pounds. This allows the connectors to be connected many times without damage. However, in equipment used for portable operation, SMA connectors can become loose from vibration. I've seen many contacts missed due to loose connectors. When everything is tested and I am not planning on taking the connection apart again, I tighten the connectors much tighter than the laboratory specification so they stay put.

Give DIY a try. Get some modules and, now that you know how, prepare some cables to string together something interesting.

All photos by Paul Wade, W1GHZ.

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

The NVIS Myth — A Modeling Study

An Exercise in Antenna Modeling

There has been a lot of talk over the past few years about the advantages of the Near Vertical Incidence Radiator (NVIR) for local HF communications. This is just a dipole strung low to the ground, for which the maximum radiation is straight up. Because local coverage requires a high (near 90°) takeoff angle, it is suggested, therefore, that a low dipole will outperform a high dipole in local (< 200 mile) communications. As we shall see, this is unlikely to be true.

When we model a horizontal half-wave dipole in free space, we see a null along the wire and a maximum at right angles to the wire, which includes the high angles required for local communication.[1] At 3.7 MHz, as we bring this model dipole toward a *MININEC* ground, we find that the 0° maximum becomes a partial null around 130 feet, but at 60 feet we have a smoothly rounded pattern pointing straight up. If we do the modeling using a *MININEC* ground simulation, the 90° performance appears to continue to increase as the antenna is lowered. (I stopped the simulation at 10 feet, as a practical limit for safety reasons.) Figure 1 (open circles), shows this behavior. What could be better?

But *MININEC* ground models neglect ground losses, and these losses are considerable when the antenna is as close to ground as this (10 feet is 0.04 λ at this frequency). The High Accuracy Ground model does a better job of accounting for these losses, and gives a very different picture. With this model (Figure 1, filled circles) the highest signal strength at 90° is from a dipole around 50 feet above ground; this will be at least 6 dB (an S unit) better than the same dipole at 10 feet above ground. Above 60 feet, a null reappears in the center of the pattern, but these heights are impractical for most amateurs, especially for emergency work.

Any of these antennas will have much greater radiation at 90° than a vertical antenna. For comparison, I modeled a 72-foot vertical over four ¼ λ radials, using the high-accuracy ground, and plotted it against the dipole at 10 feet, the worst of the dipoles. At 90°, the vertical has (theoretically) no radiation, and, as seen in Figure 2, at any angle above 30° the dipole performs better than the vertical. This, as much as antenna inefficiency, may account for the poor signals from mobile radios at this frequency.

Therefore, if you desire the strongest signal from your real dipole at "cloud warmer" angles, use a dipole between 40 and 60 feet above ground. Going higher than this is counterproductive, as well as expensive.

If you can't get to 40 feet, go as high as you can. Isn't this what most of us have been doing all along, anyway? — *73, George Kidder, W3HBM, 509 Norway Dr, Bar Harbor, ME 04609:* **gkidder@mdibl.org**

No Spectrum Analyzer? No problem!

Recently I was trying to track down a

[1]Roy W. Lewallen, W7EL, *EZNEC* v. 5.0.58.

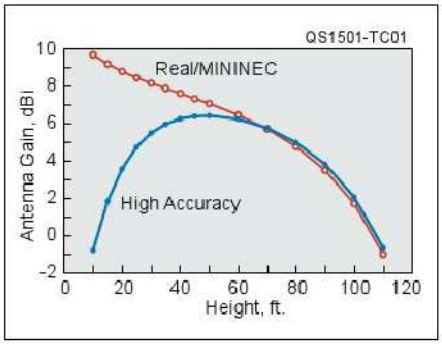


Figure 1 — Gain at 90° (straight up) of a dipole cut for 3.7 MHz at different heights above ground, for *MININEC* ground and Real High-Accuracy Ground. In each case the ground model assumes a conductivity of 5 mS and a dielectric constant of 13; "good average soil." Filled circles are the real, high-accuracy ground; open circles are the *MININEC* ground. The good *MININEC* results at lower heights are because *MININEC* neglects ground losses. Over real Earth, a height of 40 to 60 feet seems to be optimal, and only at greater heights is there any disadvantage to using a high dipole for local coverage.

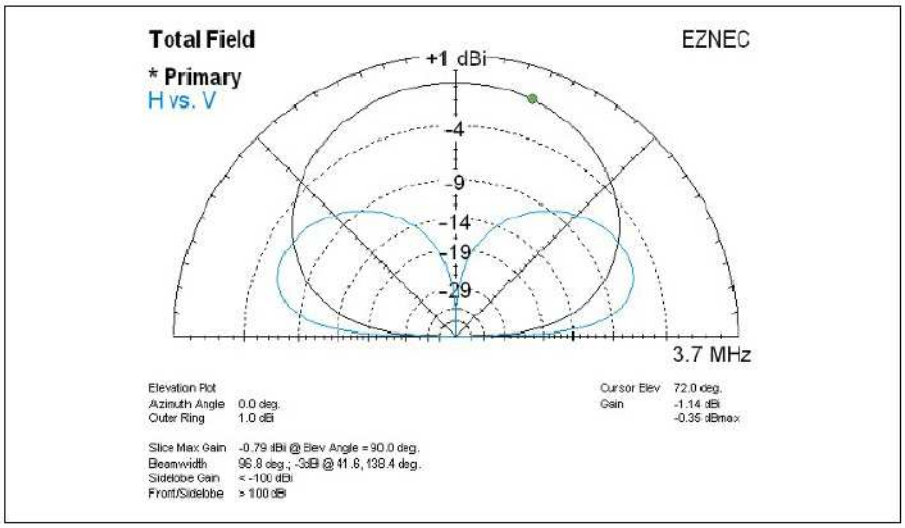


Figure 2 — Comparison of computed patterns over high-accuracy ground for a dipole at 10 feet (black) and at 70 feet vertical (blue). Even at this low height, the dipole greatly outperforms the vertical at all elevations above 30°.

source of noise that was S9 or higher over all the bands up to 15 meters. Having eliminated power lines as the source of the noise, I thought that a spectrum analyzer might be helpful to possibly identify the source.

While I didn't have a spectrum analyzer, or have access to one, my transceiver (a Yaesu FT450D) had broadband receive capability and could be controlled by my computer. It was a simple task to write a short *Python* program that would choose a frequency at random between 2 and 30 MHz, set the rig to that frequency, wait 2 seconds for the rig to settle, and then read the S meter. Setting up a loop to continue this for 15 minutes gave me a sample of the noise level across the HF spectrum. (I kept the sample time short to allow for changing band conditions.) By running the program at different times of the day, I could see if there was any change in the character of the noise (there wasn't).

Selecting frequencies randomly, rather than simply scanning up or down across the specified frequency range, also helps to minimize the effects of changing band conditions while the program runs. The idea is to better characterize the noise over the entire HF range.

My *Python* program listing is available for download from the *QST* in Depth web page.[2] The program should run on any computer that can run *Python*; only the commands to set the frequency and read the S meter, and the number of the serial port need to be changed to accommodate any rig that can be similarly controlled by a computer.

Figure 3 shows a plot of the combined data of the S-meter readings versus frequency from four separate runs over a 24-hour period. With appropriate modifications to the program, the same technique can be used to scan a narrower band of frequencies. — *73, David Birnbaum, K2LYV, 8515 Acorn Ridge Ct, Tampa, FL 33625;* **dbirnbau@gmail.com**

Too Much Wire in the Air? Or Is the Loop Skywire too Sensitive?

For a number of years I have used a homebrew "Mini Super Loop" antenna as my go-to antenna from 80 through 10 meters, and it worked very well. When it came down last year I looked for a replacement that would also be an outstanding performer and still handle 80 through 10 meters. My search through *The ARRL Antenna Book* and the Internet led me to the Loop Skywire. The 80 meter version calls for a loop of wire 272 feet long, fed by ladder line to the tuner in the shack. Since I am fortunate enough to have a plot of land with mature trees 60 feet and taller, it seemed like a perfect complement to my three-element quad, which covers 20 through 10 meters.

I erected this antenna last summer with few problems, using 14-gauge insulated copper wire, fed by 450 Ω ladder line to a 4:1 balun, 6 feet from my second floor shack. I used good 50 Ω coax to my rig. When I tested it with my antenna analyzer, it showed good SWR for all the ham bands; about 3:1 or better. The tuner in my Kenwood TS-590 transceiver had no problem tuning it on all bands. So, I *thought* this would be the perfect antenna for my station. Then I started listening. Every ham band — each *entire* band — had 20 to 40 dB over S9 noise day and night, every day, every hour of the day!

I connected my quad antenna to the radio, and there was no noise from 20 through 10 meters. I also have a Carolina Windom up about 40 feet, and it had no noise on any of the ham bands. My previous mini super loop never had a noise problem either. What to do?

I thought that I might be hearing RFI from my utility company. I walked my neighborhood with a portable radio tuned to the bottom end of the AM broadcast band. I found some noise at the pole that has the underground drop to my home and figured that could be the problem.

Eventually the utility company came to my house to investigate my noise complaint. They found that the noise at the pole was from the phone company drop at the same pole and they could find no noise from their equipment, even after carefully driving all through the neighborhood.

In some desperation I turned to an "Elmer" in the person of Stanley Briggs, K8SB. Stan, first licensed in 1953, taught electronics at Henry Ford Community College in Dearborn, Michigan until his retirement. He held several ARRL Michigan Section positions over the years. Stan came to my shack with a portable HF receiver and a portable oscilloscope. He began listening to the noise on my Kenwood TS-590, and switched the mode to AM. He asked me to bring him a battery-powered AM radio and quickly found the source of the noise. It was a local AM broadcast station on 1130 kHz. He then explained that the AM station was causing a plethora of intermodulation products generated in the front end of the receiver, which resulted in wide band noise throughout all the ham bands. When Stan turned on the TS-590 radio's attenuator, the noise vanished. My search was now for a filter that would suppress the broadcast band but still allow me to transmit through it.

I purchased a Dunestar Model 400-HPF broadcast filter (**www.dunestar.com**) and the noise is gone without having to use the attenuator. I am able to transmit through this filter without any problems. — *73, Don Novak, K8THU, 18375 Meridian Rd, Grosse Ile, MI 48138;* **k8thu@arrl.net**

[2]David Birnbaum's *Python* program listing (**K2LYV-Python.zip**) is available for download from the *QST* in Depth web page at: **www.arrl.org/qst-in-depth**.

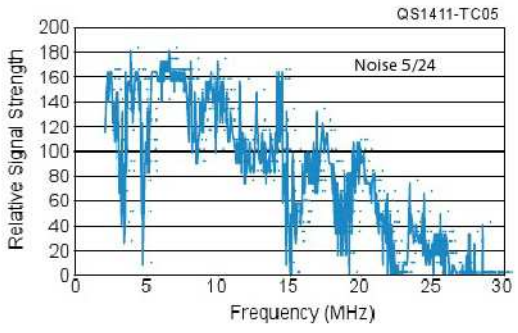


Figure 3 — S-meter readings versus frequency taken with a *Python* program used to control a Yaesu FT450D transceiver on April 24, 2014.

Steve Ford, WB8IMY, wb8imy@arrl.org

Analog to Digital at 400 Gigabits *Per Second*

IBM researchers in Switzerland recently unveiled the prototype for an analog-to-digital converter (ADC) that enables data sampling as fast as 400 gigabits per second. To put that kind of speed in perspective, it is about 5000 times faster than any fiber optic Internet connection available to US households today. If your Internet were that fast, you could download a 2-hour-long ultra high definition movie in the blink of an eye.

This innocent looking chip has the potential to revolutionize the digital world. [Photo courtesy of IBM.]

They plan to put the chip to work in the Square Kilometer Array in Australia and South Africa. This fantastic radio telescope system will peer hundreds of millions of light years into space in high detail. When it is online in 2024, scientists expect it to gather more than one *exabyte* of data every day. That's one *quintillion* (10^{18}) bytes.

As this chip and its cousins migrate to amateur Software Defined Radio (SDR) technology, the implications for hams may be staggering. ADCs are critical to SDR because they are one of the chief limiting factors when it comes to receiver coverage. With ADCs like these available to hams, saying that your transceiver has "dc to daylight" coverage will no longer be witty hyperbole!

Hawaii to California Above 50 MHz

Amateurs on the West Coast have been working Hawaii, and vice versa, on the VHF and UHF bands for decades. As a result, a number of West Coast hams routinely monitor propagation beacon frequencies, listening for the moment when the band bursts wide open to paradise.

You can see and hear the KH6MHE propagation beacons at 2 meters and 70 centimeters, as received at N6NB, on YouTube at **http://youtu.be/Uucyw8YO9s0**.

It's unlikely that I will ever get to enjoy this kind of astonishing propagation. The idea of working someone on 70 centimeters over a 2500 mile path is mind blowing to me. However, thanks to the Internet, and the video site YouTube in particular, I can at least enjoy a taste of what it must be like to experience those spooky conditions first hand.

Check out the YouTube video at **http://youtu.be/Uucyw8YO9s0**. What you're hearing is the chirpy CW of a KH6HME propagation beacon at about 432.310 MHz as received at the station of Wayne Overbeck, N6NB, in Tustin, California at 1200 UTC on July 5, 2014. At the 30-second mark the video (and radio) switches to 144.277 MHz where KH6HME 2-meter beacon is heard as well.

Wayne has been exploring the world above 50 MHz for a long time, but I'm sure he would be the first to say that radio magic like this is never "routine."

Satellites and 2 Meters

I've been hearing a number of complaints lately about hams carrying on simplex chats between 145.800 and 146.000 MHz, which is a portion of the 2-meter bandplan allocated to OSCAR satellite operations. There is nothing illegal about enjoying Earth-bound communication within this frequency range, but it has the potential to cause serious grief to satellite operators.

For example, a couple of hams camped on 145.850 MHz probably don't realize that Saudi-OSCAR 50 is listening on the same frequency. If the bird happens to zip by when they are enjoying a conversation, there is a good chance that they will cause substantial interference to the uplink, making it difficult, if not impossible, for others to use the satellite.

"But I'm just running 50 W to a ground plane antenna on my roof, they may say "How can I be interfering with a spacecraft?"

Even though low-orbiting Amateur Radio satellites are hundreds of kilometers away, you'd be surprised at how sensitive they can be. When OSCAR 51 was active, I routinely made contacts using 25 W and a ¼-wavelength mag-mount whip antenna on my car!

The amateur satellite community is simply asking their fellow hams to respect the 2 meter bandplan and take their simplex communications to an appropriate frequency. If you'd like to browse the current bandplans, go to **www.arrl.org/band-plan**.

Steve Sant Andrea, AG1YK, hk@arrl.org

Watching Your Voltage, Winding Your Wire, and Mobile Mount Maintenance

A Handy Digital Voltmeter

Take a quick look around your shack. How much of your equipment runs on batteries or a dc power supply? If you're like most of us, the answer is most of it. You probably also have a multimeter for checking these power sources. So why would you need another meter? An extra voltmeter can be quite handy for monitoring the condition of those rechargeable batteries you keep around for emergency power or the performance of your solar energy system.

The EZ-Volt is an accurate digital meter you can construct in just a couple of hours. It's based on the Surmen V20D LED digital voltmeter module (**www.universal-radio.com/catalog/meters/0794.html**). This module uses only 10 – 20 mA and can be powered by the circuit it's measuring or a separate power source.

The EZ-Volt meter will directly measure any dc source from 4 – 30 V (four volts is the minimum required to operate the meter's electronics). The schematic is quite simple, as shown in Figure 1. The dc power from the device being measured is applied to the Vcc and GND terminals of the meter module through D1, a 1N914 switching diode, which protects against accidental polarity reversal. The meter module reads the dc voltage placed on the Sense terminal, which is connected to the dc input through R1, a 1000 Ω, ¼ W fixed resistor, which provides additional polarity reversal protection.

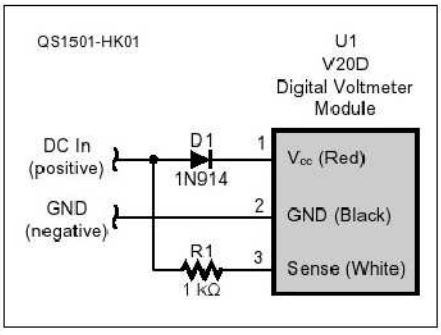


Figure 1 — Schematic of the EZ-Volt Digital Voltmeter.

Figure 2 — The interior of the EZ-Volt. [Tom Wheeler, N0GSG, photo]

Construction

I constructed this meter in about an hour's time. There's nothing critical here — just make sure to insulate your wiring with heat shrink tubing or electrical tape before final assembly. Figure 2 is the inside view of the meter that I built in a small RadioShack plastic project box. This small DVM module lends itself to a variety of other mounting arrangements. The diode and resistor are within the black shrink-wrapped Y connection that feeds the red and white meter module wires. An Anderson Powerpole connector provides the dc input connection. All the components are simply hot-glued in place.

Operation

Simply connect the meter's leads to any dc source between 4 and 30 V and the display will show the voltage. The display only updates about twice a second, so this meter can't be used for checking rapidly changing voltages. — *73, Tom Wheeler, N0GSG, 10724 Horton, Overland Park, KS 66211*, **tom.n0gsg@gmail.com**.

Antenna Wire Winder

I had an idea to help simplify the task of winding wire antennas without being troubled by kinky antenna wire. It's been a help to me over the years to keep the antenna from wrapping itself around my legs while I'm climbing a ladder to hoist them in place. One would think that a wire antenna would be coiled up on spools, but homebrew antennas typically have traps or coils that don't take well to being bent.

This winder is made from a cardboard carton that measures about 1 foot square and about 4 inches deep. To make the winder, simply use a sharp knife or a large pair of scissors and cut two V-shaped notches, one on each side of the carton; such that there are two notches on opposite sides (see Figure 3). The width of the V should be about 4 or 5 inches.

Using this tool you can coil up your antenna, leaving the traps and coils just hang-

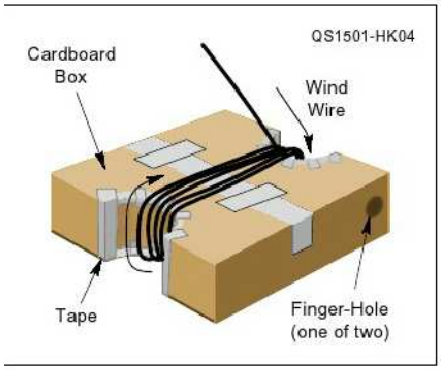


Figure 3 — A cardboard box can be easily converted into a wire antenna holder that will prevent tangles when storing or transporting the antenna to its mounting location. [Arthur McAlister, KD6SF, photo]

Figure 4 — The thick black ground wire was added when the original VHF antenna was replaced with the ATAS-120A. This functioned well on all bands except 15 meters. [John Wittmann, N1YV, photo]

Figure 5 — The black ground wire and additional grounding braids were needed for the ATAS-120A to operate on the HF bands. [John Wittmann, N1YV, photo]

ing on the sides of the carton as you climb the ladder. When starting the winding process, start at the end-insulator and work yourself toward the center of the antenna (for a dipole configuration). In use, the antenna wire tends to stay pretty much grouped together. The end-insulators can be stuffed into an open end of the carton. I find it helpful to use some duct tape to temporarily hold the wire in place until you're prepared to unwind it.

To assist winding and unwinding, punch some finger holes in the ends of the carton. Using those holes, you can wind or unwind the wire just as if it is on a windlass.

Once in place, you and your helper can unwind the wire. Start at its center and, using the finger holes, rotate the carton and the antenna wire will fall off your "spool" as you (and your helper) move toward the mounting masts. It takes longer to describe the use of the carton than it takes to prep your "spool." — *73, Arthur McAlister, KD6SF, 7570 Dartmouth Ave, Rancho Cucamonga, CA 91730-1534.*

K400 Mount Problem

During the installation of a new Yaesu FT-857D transceiver and a Yaesu ATAS-120A screwdriver antenna on my friend Joe Goodell's, W1GC, vehicle, a problem was encountered. We found a solution that could be of use to others.

The problem was that the radio and antenna combo would not tune on 15 meters. The radio would pass through the low SWR position of the antenna and keep searching for a 15 meter low SWR, until eventually stopping at an incorrect position.

The hood-mounted Diamond K400 mount had been previously installed for an existing dual-band FM radio. A separate ground from the barrel hex screw used for the mount's vertical adjustment (see Figure 4) to the chassis along with multiple braided ground straps from the hood to chassis ground (see Figure 5) were added for the new antenna installation. The Diamond mount was retrofitted with a new connector to match the ATAS-120A. The base of the mount, on the lip of the hood, was not altered.

After attempting a factory radio reset, per Yaesu Technical Support's direction, the problem persisted. Vehicle engine noise was also higher than expected on several HF bands, in spite of all of the grounding.

Figure 6 — In addition to all the added ground wiring, the setscrews of the K400 mount must be in contact with bare metal for the ATAS-120A to tune across all the HF bands. [John Wittmann, N1YV, photo]

The Diamond installation sheet states that some antennas may require that the setscrews under the mount (see Figure 6) be in direct contact with the metal of the vehicle. This was never an issue with the previous dual-band FM radio but proved critical for the new Yaesu HF rig. We scraped paint away so the setscrews were in contact with metal. As a result, the antenna tuned correctly and the engine noise was reduced as well.

I made a follow-up call to Yaesu to let them know what was discovered. The Yaesu technician cautioned that the setscrews under the SO-239 receiving mount on the Diamond K400 can loosen over time and this has caused eventual intermittent tuning issues with the ATAS-120A antenna. An inspection of your mobile mount is something that should be added to your regular maintenance list. — *73, John F. Wittmann, N1YV, 1 Brentwood Rd, New Milford, CT 06776-2603,* **n1yv@arrl.net** and *Joe Goodell, W1GC, 16 Carriage Dr, New Milford, CT 06776,* **joegoodell@yahoo.com**.

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

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

K9W — Remembering "The Forgotten 98"

A DXpedition to Wake Atoll in memory of the 98 civilian construction workers who died there during World War II.

John Miller, K6MM, and Lou Dietrich, N2TU

The 2013 K9W DXpedition to Wake Atoll was unique in that its purpose wasn't just to put a rare one on the air, but to commemorate an important event in history, an event that took place in a part of the United States that most Americans will never see: Wake Island — one of the most beautiful and isolated coral atolls in the world.

Over the last 30 years, there has been limited Amateur Radio activity from Wake Island. The last DXpedition was in 1998. Since then, activity from this rare DXCC entity has been intermittent, mostly from military personnel on temporary assignment. In October 2012, the Club Log Most Wanted List ranked Wake Island as #14 and *DX Magazine* had it at #21.

Wake Atoll Overview

Wake is a wishbone-shaped atoll, consisting of three islands (Peale, Wake, and Wilkes) surrounded by a coral reef enclosing a central lagoon. It's situated in the northern Pacific Ocean about 2300 miles west of Hawaii (see Figure 1). Wake occupies an area of 2.8 square miles. Its surface consists of disintegrated coral with boulders, trees, and shrubs. The beautiful beaches are a combination of white coral sand and jagged coral rocks.

There is a 9800-foot-long runway but no ports, although two offshore anchorages exist for large ships. The atoll lies 19° north of the equator with a tropical climate similar to Hawaii. Because Wake is located west of the International Date Line, it is 1 day ahead of US continental time. Because of defense-related activity there, Wake is a highly restricted airbase overseen by the United States Air Force (USAF).

The Role of Wake in World War II

Wake was first settled in 1935 by Pan Am Airways to service transpacific "China Clipper" flights between San Francisco and Hong Kong.

Figure 1 — Location of Wake Island.

As the storm clouds of World War II gathered in late 1940, the US Navy began construction of a military base and airfield. On August 19, 1941, the first garrison landed. Less than 4 months later, on December 7, 1941, the Japanese attacked Pearl Harbor and Wake Island simultaneously. The small garrison held their position. On December 23, Wake Island succumbed to further Japanese attacks and remained occupied until the end of the war.

All US military and civilians were sent to POW camps in Asia, except for 98 civilian contractors, who became known as "The Forgotten 98." For almost 2 years as POWs, the 98 civilians constructed barricades, bunkers, tunnels, ditches, and runways. Unfortunately, all 98 contractors lost their lives on October 7, 1943.[1] The famous "POW Rock" (see Figure 2), a 4-foot-high piece of coral that sits at the edge of the lagoon, features an inscription carved by one of the 98. This unknown POW escaped the camp long enough to carve "98 US P.W. 5-10-43" into the rock before being captured once again.

With the end of the war, Wake Island returned to US control. In 1966, a Marine Memorial was erected to honor those lost in that December 1941 "Battle of Wake Island" (see Figure 3). Wake was designated a National Historic Landmark in 1985.

Getting Approval

The idea for this DXpedition began when Team Leader Lou Dietrich, N2TU, saw a Wake Island documentary on the History Channel that summarized the fate of The Forgotten 98. Lou's goal was to use the DXpedition to commemorate the sacrifices of these men on the 70th anniversary of their death, October 7, 2013.

Lou then began a lengthy process seeking permission to conduct a DXpedition on Wake Atoll. Initial correspondence with the USAF, the Department of the Interior, and Department of Insular Affairs in October 2012 was less than encouraging. Undaunted, Lou continued to seek permission to travel to Wake, which required securing USAF signatures at several levels in the

Figure 2 — Lou, N2TU (left), and John, K6MM, visit POW Rock, where one of the 98 who escaped the Japanese chiseled the inscription "98 US P.W. 5-10-43" before being recaptured.

[1]Notes appear on page 74.

Figure 3 — The Marine Memorial erected in 1966 in honor of those lost in the Battle of Wake Island.

Pentagon, including General Hawk Carlisle (Commander, Pacific Air Forces).

The purpose and scope of the trip had to be clearly defined; medical forms approved, background checks completed, and an approved budget finalized. Finally on October 28, 2013, we received our travel orders. Although the team missed the October 7 anniversary, we were nevertheless excited about implementing this commemorative DXpedition.

The team selected for the DXpedition consisted of Joe, AA4NN; John, K6MM; Craig, K9CT; Mike, K9NW; Ralph, K9ZO; Lou, N2TU; Jim, N9TK; Mark, NA6M; Dick, W3OA; Joe, W8GEX; Hal, W8HC, and Jerry, WB9Z. In addition, an off-island support team was assembled to handle logistics, fund raising, equipment testing, propagation plans, and pilot communications.

On March 1, 2013, the first press release was issued announcing the DXpedition and dedicating it to The Forgotten 98. Financial support began arriving from major clubs, foundations, and individuals. Elecraft and SteppIR provided transceivers, amplifiers, and antennas, all of which were thoroughly pretested before shipment. Equipment was shipped to Kimo, KH7U, in Hawaii and stored at his home until it could be transported to our departure point, Hickam Air Force Base (AFB).

Who Were The Forgotten 98?

In February 2013, the K9W DXpedition website was launched.[2] Since the DXpedition's main purpose was to honor the memory of The Forgotten 98 civilian contractors, information about the 98 was included on the website.

Ranging in age from 18 to 50, most were highly skilled workers representing all the trades: carpenters, masons, electricians, plumbers, pipefitters, heavy equipment operators, welders, mechanics, etc. Living in the Depression Era, they sought better paying jobs. Unfortunately, history would show that they were truly in the wrong place at the wrong time.

Shipping Out

The K9W team assembled for the first time in Hawaii on October 31. After dinner, the team prepared for the shuttle bus trip to Hickam at 1 AM. Hickam is a restricted airfield immediately adjacent to Honolulu International Airport. While waiting to depart, Lou conducted his first team meeting, where we discussed our primary DXpedition goals.

We departed Hickam AFB at 4 AM on a charter flight and landed on Wake Atoll 5 hours later. Our hosts, Don Davis and Colin Bradley, met us on arrival. They are both civilian employees of Chugach Alaska Corporation. Colin, licensed as WA2YUN, became a good friend and a valuable resource. Our other host was Captain Charlie Taylor, the on-site commander for the USAF — also a strong supporter of our efforts on Wake Atoll.

Sites and Setups

After checking in, we headed back to the airfield to gather our equipment pallets, which had been previously shipped to Wake by Kimo, KH7U. Everything had arrived safely and after loading the truck, we were on our way to set up the stations. The USAF offered us two locations: an abandoned chapel near the airfield that

Figure 4 — This abandoned chapel near the ocean became the location for the two CW stations.

was 500 feet from the Pacific Ocean, and "the Shack" — a small beach house on the lagoon side of the island. The chapel was assigned to the CW team (see Figure 4) and the lagoon Shack to the SSB/RTTY team.

Inside the chapel, the CW team set up two stations using Elecraft K3 transceivers and KPA500 amplifiers together with laptops. K3-KPA500 gear was chosen because they are lightweight, easy to ship, and together offer a great ergonomic solution (ie, low fatigue factor, controls within easy reach). Colin had arranged for 220 V supply for the Expert Amplifier 2K-FA 1500 W linear, which was used exclusively on 160 meters.

Two SteppIR BigIR verticals were set up, one with the 80 meter coil. The team also erected a 50-foot Battle Creek Special vertical, which was used primarily for 160 meter CW. Largely because of pretesting and preplanning, the set up went very smoothly. Just 12 hours after our arrival, Craig, K9CT, made the first contact with JA1ADN on 30 meter CW.

Meanwhile, the SSB/RTTY team was setting up in the Shack. This open-air structure overlooking the beautiful lagoon was large enough for three K3-KPA500 stations (see Figure 5). SSB#1 and SSB#2 used a second pair of BigIR verticals. SSB#3 used either a TransWorld vertical dipole placed near the lagoon or an eight-element 6 meter Yagi on a hand-rotatable 20-foot mast.

The BigIR with the 80 meter coil was located next to the lagoon and several radials were actually slipped into the water. The

Figure 5 — The spacious, open-air Shack was home to the three SSB/RTTY stations, being manned by (from left) Lou, N2TU; Dick, W3OA, and Hal, W8HC.

second BigIR vertical was located on the other side of the Shack in a clearing.

BigIR verticals were used at both locations because these 33-foot vertical antennas are easy to assemble and guy, are tunable to an SWR of 1:1 on each band, and provide outstanding performance, especially near salt water. They worked flawlessly at both sites.

Tribute to the 98

On November 10, the K9W DXpedition conducted an on-air tribute to the Forgotten 98. Because the 98 were employed by Morrison-Knudsen from Boise, Idaho, a 15 meter schedule was arranged with Boise operator Don Clower, KA7T. Local television station KBOI taped the event in Don's shack and a few relatives of the 98 listened in, as K9W team leader Lou, N2TU, read a eulogy and the names of all The Forgotten 98 contractors over the air [Go to **www.kboi2.com** and search "Wake Island" to see the video. — *Ed.*]. The next day, November 11, 2013 — Veteran's Day — our team attended the flag raising ceremony along with Air Force personnel and local Thai workers.

One Last Push

Our last full day of operation was November 14. The next morning the CW and SSB teams broke down the stations and carefully packed the equipment for the return flight to Honolulu. While the guys were starting to relax, John, K6MM, waited patiently for the last upload to Club Log. Our total number of contacts was 99,865. John smiled as he wrote down the number and headed back toward the Shack. Walking toward him were Jerry, WB9Z; Joe, W8GEX, and Hal, W8HC. John held up the scribbled number and in almost total silence the group immediately turned around and went back to the Shack.

They unpacked the TransWorld vertical dipole, a spare Icom IC-706 transceiver and power supply. Running just 100 W, Hal, W8HC, called CQ on 10 meter SSB while John, K6MM, paper-logged 92 contacts. After dinner, Jerry, WB9Z, and Mark, NA6M, took the IC-706 to Colin Bradley's shack. Using his Yagi, they paper-logged another 74 contacts on 20. The final contact count for the K9W DXpedition: 100,031. Amazingly we later discovered that 48 of those 166 contacts were "first timers."

On November 16, 2013, the team boarded their return flight to Honolulu, carrying with them the memories of a lifetime. The team was grateful for the opportunity to put a rare DXCC entity on the air and for the privilege to highlight a special piece of history.

Acknowledgments

We'd like to thank the US Air Force and the Pentagon for giving us permission to put Wake Atoll on the air and also our gracious hosts while on the island: Don Taylor, Colin Bradley, Captain Charlie Taylor, and Dr Scott Kennedy.

Critical to our success was our strong off-island support team of Hiroo, JA1WSX; Kevin, K6TD; Stu, K6TU; Stan, KH6CG; Kimo, KH7U; Col, MM0NDX; Don, N1DG; Tom, ND2T; Valerie, NV9L; Janet, W8CAA, and Margarett Blackwell.

This DXpedition would not have been possible without the strong financial support of many worldwide clubs, foundations (especially NCDXF and INDEXA), and individual donors, as well as our equipment sponsors, especially Elecraft and SteppIR.

Finally, a special thanks to Bonnie Gilbert, author and historian, who provided much valuable advice in her personal quest to bring closure to the families of The Forgotten 98 by working with the Joint POW/MIA Accounting Command.[5]

Notes

[1]**https://www.cia.gov/library/publications/the-world-factbook/geos/wq.html**

[2]K9W website, **wake2013.org**.

[3]"A Report: To Returned CPNAB POW Heroes and Their Dependents;" 1945; The Pacific Island Employees Foundation, Inc.; Boise, ID.

[4]Additional Post-DXpedition stats are on Club Log: **secure.clublog.org/charts/?c=k9w#r**.

[5]B. Gilbert, "Building for War" at **bonitagilbert.com**.

All photos courtesy of the authors.

John Miller, K6MM, an ARRL® member, was first licensed as WV2BQJ in 1958. In 1976, John's career took him to Silicon Valley, where he reconnected with Amateur Radio in the late '90s. For the past decade, John has focused heavily on DXing, contesting, and recruiting new operators into the hobby. He was a member of the 2010 PJ7E Sint Maarten DXpedition.His DXCC total stands at 330 confirmed. John can be reached at 6349 Slida Dr, San Jose, CA 95129-3948, **k6mm@arrl.net**.

Lou Dietrich, N2TU, an ARRL member, was originally licensed as WV2RNW in the early '60s during his high school years. He upgraded to WA2RNW, but allowed that call to lapse. He got back on the air as KA2MBC in 1981, upgraded to Amateur Extra class as NN2G, and finally obtained the vanity call N2TU. Lou is an avid DXer who is currently listed on the DXCC Honor Roll and Ten Band DXCC. He was a member of the 2012 Swains Island DXpedition and the Team Leader for the K9W Wake 2013 Commemorative DXpedition. He can be reached at 200 Broadbill Dr, Mooresville, NC 28117-9196, **n2tu@arrl.net**.

Strays

QST Congratulates ...

- Dr Allan H. Ropper, WA1DX, on the publication of his new book *Reaching Down the Rabbit Hole*. It is available online at **us.macmillan.com/reachingdowntherabbithole/**. The book offers a behind-the-scenes glimpse of life at the Harvard Medical School's neurology unit to show how a seasoned diagnostician faces down bizarre, life-altering afflictions.

- Roger A. Wendell, KB0JFH, who recently received the "Young Scientist of the Physical Society of Japan" award for 2015. Roger is a particle physicist who works at the University of Tokyo.

Kids Day 2014

On Kids Day, "playing radio" takes on a whole new meaning.

Ric Morton, WO4O

When I was a kid, I imagined making friends all over the world and playing games with them. My neighbor Dave, WT8W, introduced me to the magic of Amateur Radio and I found my dream coming true.

Nowadays, Kids Day is a way to introduce young people to Amateur Radio by getting them on the air. It is the brainchild of Larry "Tree" Tyree, N6TR, and the Boring Amateur Radio Club in Oregon. Kids Day was started in 1997 and proved so popular that in 1999 the ARRL® was asked to take over the event.

I share my passion for Amateur Radio by hosting a Kids Day event, in the hope that some of these kids may develop an interest. As an adult ham, you can host a Kids Day event, too.

Planning for Play

For my Kids Day event, I decided I could manage three kids taking turns at the microphone. Each child would be assisted by a parent or grandparent. While we did experience the anticipated short attention spans, butterflies, and some surprises; overall I consider my Kids Day event a success. Admittedly, I did offer an incentive in the form of three monetary prizes: $10 for first prize, $5 for second, and $2 for third, based on the total number of two-way contacts.

Each child took a turn at the microphone. After exchanging the basic information, the child could choose to pass the contact to another child, or end it. This made the dynamics of the game more interesting. If the contact was shared, then at least two, and sometimes all three kids would be tied and the prizes would be determined by a random drawing. However, if one of the kids chose to end the contact, that would be to his advantage when adding up the total number of contacts. This was designed to include a lesson about the decisions we make when competing with one another.

To make logging simple and easy, we used the *N3FJP Kids Day Log* from **www.n3fjp.com/**, which has a special free module for Kids Day.

Kids Day Worldwide

Kids Day events aren't limited to the US. From Switzerland, unlicensed 9-year-old Nini operated with her dad Bodo, DF8DX, at the controls of HB9Q. Nini, who speaks fluent English, began calling CQ at 8 PM local time. A voice from the United Kingdom came back to her. That nice contact was followed by another one with a British accent. Then she received a call from the US. It was 10-year-old Abby, KC1BKR, in Maine. After 13 contacts, Nini was very happy with her first Kids Day.

Bodo said that by Nini joining him in the radio station, "she learned a few more things," which "is much better than just sitting at the computer or watching TV." Bodo has taught Nini the NATO phonetic alphabet. She has learned important abbreviations such as CQ, DX, QSO, QSL, and QTH, and also how to give a report. Bodo considers Kids Day a "fantastic chance for kids to get actual experience on the radio." He added that "unlike adults who like running a pileup, kids just want to talk to another kid about kid stuff."

Every Day's a Radio Day

Joe, W0IW, and his wife Linnea, K0QLT, live in Parkersburg, Iowa with their kids, Joey and Shelby. They play ham radio with their kids every day. Joe says:

> Linnea, K0QLT, and I make up fun radio activities. One of our kids' favorite games is "Little Weather Spotters." One of us is net control and the kids all have Family Radio Service (FRS) radios and fictitious call signs, such as, K0JOEY or K0SHELBY.
>
> The game teaches the kids about different cloud types, weather radar, and spotting nets, which can be exciting and fun for them. We have purchased inexpensive wind and temperature gauges that the kids use to report the temperature and wind speed over their FRS handhelds. Teaching and learning all about ham radio are the goals here — and to demonstrate that ham radio can be very exciting.
>
> Another game we play is called "Morse Code Simon Says." I send a Morse code letter. Each kid is asked to listen, copy the sounds, and decode them using a copy of the Morse code.
>
> These are just two examples of many games that we use to show off Amateur Radio to technically savvy kids.
>
> During Kids Day, we worked close to 40 stations and everyone was very nice to our kids. Shelby even worked W1AW/KL7 through a pileup and was complimented on her radio skills. The kids enjoyed telling the other kids all about their favorite things, such as spaghetti being their favorite food; that their dog is named Buckley, and they are 6 and 7 years old, "over."

With licensed operators mentoring kids, our hobby has a better chance of surviving and thriving for many more years. Get ready to participate in the next Kids Day. For information go to **www.arrl.org/kids-day**.

Ric Morton, WO4O, an ARRL member, was first licensed in 1969 and is currently an Amateur Extra class operator. He is the cofounder of the Tennessee Contest Group and the owner of an e-commerce business, **www.bettersunshine.com**. You can reach him at 12902 Honey Blossom Dr, Grand Island, FL 32735-8949, **wo4o.radio@gmail.com**.

Lead photo: Nini shows off the Kids Day crib sheet she used to make her 13 contacts. [Photo courtesy of Bodo Fritsche, DF8DX.]

In 2015, QST's centennial year, each issue will feature an article from a past issue of QST. A day after the December 7, 1941 Japanese attack on Pearl Harbor, the Federal Communications Commission suspended all Amateur Radio operations in the continental US. In response, ARRL Secretary K. B. Warner, W1EH, authored this special insert for publication in the January 1942 issue of QST.

WAR COMES!

We Take Our Posts in the Country's Defense

In time of emergency, amateur radio steps forward and applies its specialized knowledge to the task of replacing and restoring and supplementing the normal communications system. That is our traditional responsibility — a tradition we have ourselves built and a responsibility we have ourselves sought. War is the gravest emergency of all, and it is now our duty to discharge that traditional responsibility in the war emergency with discipline and patriotic devotion.

Since December 7th, amateur radio has been operating under wartime controls. Eight hours after the first bomb fell in Pearl Harbor, amateur radio as we have known it in peacetime was suspended for the duration. In its place, in the past five days, the volunteer communication system upon which the civilian defense of these shores will be built has begun to take form.

FCC's order suspending normal amateur radio, with its hamming and chewing, should be examined simultaneously with its announcement of a mechanism under which amateur stations whose operation is essential to national defense are being returned to the air:

ORDER NO. 87

At a session of the Federal Communications Commission held at its offices in Washington, D. C., on the 8th day of December, 1941;

Whereas a state of war exists between the United States and the Imperial Japanese Government, and the withdrawal from private use of all amateur frequencies is required for the purpose of the National Defense;

IT IS ORDERED, that except as may hereafter be specifically authorized by the Commission, no person shall engage in any amateur radio operation in the continental United States, its territories and possessions, and that all frequencies heretofore allocated to amateur radio stations under Part 12 of the Rules and Regulations BE, AND THEY ARE HEREBY, WITHDRAWN from use by any person except as may hereafter be authorized by the Commission.

By order of the Commission:

— *T. J. Slowie, Secretary.*

FEDERAL COMMUNICATIONS COMMISSION
Washington, D. C.

December 8, 1941

NOTICE TO ALL AMATEUR LICENSEES

All amateur licensees are hereby notified that the Commission has ordered the immediate suspension of all amateur radio operation in the continental United States, its territories and possessions. Under this action all amateur radio operation in the continental United States, its territories and possessions is prohibited until further notice. In any instances where amateur radio operation is deemed to be required in connection with the national defense, appropriate authorization to engage in such operation will be issued but only upon application by a duly authorized federal, state, or local official made to the Defense Communications Board.

Pay particular attention to the language in the latter portion of the notice: *The way is open for every amateur whose services are desired by proper officials to get back on the air and help.* We should perhaps say "desired and needed," because hams aren't going to be able to get back on the air simply because they want to or because they are "willing to help" or even because they can get some small-fry or "unofficial" official to certify them. Chiseling is definitely discouraged and there must be a bona-fide defense need to be served. But once there is, the route is open. Our situation, then, is that rather than being off the air we are being resifted in what amounts to a species of relicensing under DCB whenever it is apparent that a competent official needs our help. Already, as we write, numerous amateur groups and nets have been activated and returned to the air for a purely defense purpose. It's a new kind of amateur radio but it is still the familiar picture of amateurs and their gear and their traditional skill and loyalty.

SPECIAL AUTHORIZATION

Here is some practical information on the mechanism that is permitting defense activities to retain the services of amateur radio — although we should emphasize that in a

rapidly-changing situation the information we have to-day may not be entirely reliable by the time this is in print. (Suggestion: Check official broadcasts from W1AW.)

When an authorized public official, such as a governor or a mayor, wires or writes DCB or FCC a description of his proposed communication plan and a statement of why he has to have it, together with the names, calls and addresses of the amateurs he desires to serve in it, he may reasonably expect to receive a prompt response to the effect that the named amateurs are authorized to work in his system until further notice, as an exception to Order 87, for communications directly connected with national defense activities primarily relating to the defense work in his charge. A copy of that authorization will be sent to each individual amateur concerned and will be his operating credentials.

Note carefully that no authorizations are issued direct to an amateur or simply because an amateur wishes to offer his services. Application for the activation of amateurs may be made only by a duly-authorized federal, state or local official, and must spring from a need. Moreover, that official cannot be given a blanket authorization to permit operation by any amateurs he wishes. He must first explain his plan and show that the requested operation is necessary to perform a special national-defense function, and then he must name the individual amateurs concerned — not only their calls but their names and addresses as well. One reason for this is that Washington and the monitoring services must have a record of who has been authorized; another is that authorization from DCB must be sent to each individual amateur.

It will be noted that no stipulations of frequencies are required. The thought at the moment is that it is proper and desirable to permit the use of any band needed by an authorized official. Therefore when operation is authorized it is subject to all the usual FCC regulations and the special orders that have recently governed us, but all the usual amateur bands are made available. Most of the nets that have been authorized these last few days have been voice systems on 2½ and 5 meters but some are 80-meter c.w. operation and some are 160-meter and 75-meter 'phone nets, with or without connecting u.h.f. networks at each city.

While it is not permitted the individual amateur to get back on the air solely under his own auspices, there is of course no objection to amateurs, groups, nets and clubs explaining the present mechanism to competent officials who have need of amateur assistance; or to their doing some of the manual work of typing the requests for the signature and certification of the official. Certification, by the way, is not confined to any stated language: when a proper official asks authorization and asserts that he needs a certain amateur arrangement for a specified defense purpose, that is sufficient certification. There is no standard form, and requests may be telegraphic or by mail. The state defense systems are better known and better organized than many of the local ones and in some states OCD organization is not very far advanced. If there is room for any doubt about the recognition that DCB would give some particular local coördinator of civilian defense, it would be better if the request came from the mayor of the town, or from the chief of police if that is a proper function of the latter in the local plans.

A word here about DCB. Under an Executive Order recently signed by the President, all the latter's wartime powers over communications are lodged with DCB. It is at the very top of the wartime communications picture. But DCB is a board, not a commission with extensive personnel, and much of its work will be done for it by FCC personnel. Net result is that the applications we are talking about may be filed with either the Defense Communications Board or the Federal Communications Commission at Washington.

Headquarters urges that all League officials who have contact with authorities who are using amateurs, or who ought to be using them, bring to their attention the mechanism whereby amateur stations may be reactivated and assist them in making requests in proper form. We urge all amateurs to develop an association with a defense activity that will permit them to be returned to the air for that purpose, and then to do their best in the discharge of such duties. Radio amateurs are needed — in some places desperately. We believe we can count upon the amateurs of the country to see their duty, to devote themselves to patriotic service, and willingly to get back on the air for that purpose in large numbers.

SOME CAUTIONS

THE nation is at war. Complete Naval censorship of outgoing international correspondence was instituted December 7th. Ama-

teurs in defense work are on their honor to censor themselves similarly. *The permits now given amateurs rigidly confine them to defense operation.* No ragchewing will be tolerated and the fellows who engage in it will fare much worse than simply to lose their permits. The NDO monitoring service daily receives lists of the amateurs whose return to the air has been authorized and it is a safe bet that FBI will walk in pretty promptly on any gatecrasher who is not specifically certified for defense operations. As we value our return to the air, let there be no monkey business about this. If we are undisciplined or just playing around, or are incautious in our remarks, the War Department is practically certain to wash us up promptly and permanently and we would thereby forfeit our one chance to be on the air. They can't take chances with us if we don't show ourselves to be absolutely trustworthy. We'll all have a serious purpose but we mustn't even be careless, not even for a moment.

It is also emphatically worthy of notice that the suddenness of the emergency has given us tasks that were not originally contemplated for us, so that we are in the presence of our one big chance to make good. Let no careless amateur spoil this!

There are no specified details on what a net or group may or may not do. The agency for whom the group is authorized is in charge of its operation. If that agency says there may be no closing of switches until there is traffic of that agency to be handled, then there is no closing of switches. If that agency orders daily or hourly testing of the net, that testing is proper. If mayors or other proper local officials handling civilian protection work say that u.h.f. rigs must be installed and tested, that makes it proper for authorized amateurs to do so. But testing means disciplined testing and there must be *no idle gossiping and chewing the fat.*

Let it also be clearly understood that the amateur regulations are in full effect on those who are put back on the air. That means, among other things, that only licensed amateur operators may control the equipment; that the required log must be kept; and that great care must be taken to prevent unauthorized persons from having access to the apparatus.

CIVILIAN PROTECTION

WHEN war came, OCD's planning for civilian protection in air raids was still incomplete. Naturally this work is now being accelerated tremendously, particularly on the seaboards. Within a few weeks it may be expected that every vulnerable community will have its organization well in hand. We learn that each local coördinator of civilian defense is being called upon to appoint a competent communications administrator with the duty of creating and managing the community communications plan. It is under this official that we amateurs will participate in the ARP work. Thinking over the communications facilities that exist in cities with which we are familiar, it seems to us that the only systems that satisfy the need for the primary network are the wire telephones and the municipal signaling systems. Other facilities inevitably will be pretty random and catch-as-catch-can. It is imperative that the community possess a secondary system to go into operation whenever the primary one is interrupted — or, for that matter, whenever it begins to near its capacity, so that there may be retained in it some elasticity for the traffic of higher priorities. The backbone of this secondary system necessarily is amateur radio with its u.h.f. Thousands of us are needed with our home-built low-powered gear, to aid the communities in which we have lived and worked. Our job will be to bridge the gaps that occur in the primary system, to deal with critical overloads, and to provide portable or mobile service for incident officers, wardens and so on.

OCD is according definite recognition to amateurs. Instructions are being sent the local volunteer enrollment centers that will soon make it possible for all radio amateurs reporting locally for registration to be "earmarked" exclusively for communications work. In the meanwhile, we repeat that all amateurs interested in the protection work in their community should register themselves with the local ARRL Emergency Coördinator, which is our only way to have a group spokesman to represent us until the time the communities open amateur enrollment and appoint the local communication aide to the CD chief. Our Emergency Coördinators have now been instructed by the League to report at once to the local coördinators of civilian defense to arrange *something* to serve during the critical period until organization can be perfected, or to lay the facilities of our gang before the mayor or chief of police in cities where OCD work is not yet sufficiently advanced. See pages 7 and 8 of this issue for more information.

In the current situation no city in America can feel itself entirely safe and some are definitely anything but immune. We can see our job: if trouble comes to our home town, we'll be needed, for we are the only ones who can help when the wires go dead. We must build movable self-powered u.h.f. sets after the general prescriptions of *QST* — build them by the thousands! We must enroll for operating work with our gear — temporarily with our own ECs, later through the volunteer centers. We must help our communities in the actual job of organizing and lend them aid in securing the required special authorization for amateur communication assistance.

DISASTER RELIEF

ALL the foregoing arrangements relate to defense communications in the *military* emergency. At the moment of writing, no provision exists for the usual amateur aid in the event of interruption of communications by *natural* disasters such as floods, hurricanes or earthquakes. The activation of a defense net for this purpose would seem to be unauthorized unless the agency for whom the net was organized could establish that the disaster was also imperiling national defense.

Officials of the League are urgently endeavoring to obtain government approval of a formal plan whereunder amateurs may maintain their time-honored duties in this field, in the knowledge that Nature is no respecter of military emergencies. Should a disaster occur before such a plan is put into effect, the League will urge FCC to broadcast special authority to *all* hams in the affected area to get on the air and help. If this occurs, we can do the usual job, but it will be no excuse for a clambake and again we must confine ourselves strictly to the job in hand. Meanwhile all amateurs must distinctly understand that unless they do receive some such authority they may not come on to the air for this purpose, even though communities are suffering.

WATCH FOR W1AW

THE regulatory situation is likely to change from day to day, hour to hour. New rules may come out at any time. By special federal authority, our headquarters station W1AW is remaining indefinitely on the air, conveying government announcements to amateurs and watching over our bands. Whenever there are new needs or new rules affecting the amateur in defense work or disaster work, it may be expected that W1AW will bring you the news faster than any other means. Keep an ear out for it.

TEARS AND CHEERS

IF WE had the time, in our rush to get these special pages to press, we'd pause to shed a tear over the fact that for the first time in over twenty-two years the fun and camaraderie and rough-house of the amateur bands are stilled. Instead, we have a call to arms. If we could afford the luxury of a more leisurely mood, there are some deep-down-in-the-heart remarks we might make about that situation, and some pointed ones we'd like to get off on the cause of it all. But *QST* is basically the medium of our particular art and we are already a group of people schooled in industry, patience and conscientious application to our responsibilities. In the position of America to-day, Headquarters sees no need for flag-waving when it addresses the membership of the American Radio Relay League. We are a mature group and our emotions toward our country need no artificial stimulus. The field of the League is amateur radio and we have here confined ourselves to practical considerations in the application of that skill to the nation's needs. The dear glad days are necessarily gone for a while and there is no time or place for tears. Instead of the old kind of amateur radio, our actions are now directed solely to the assistance of the defense of the nation, at the urgent request of competent officials. Our stations, our operating ability, our devotion are being summoned for innumerable communications tasks of the sort that only we are prepared to discharge. We are now engaged — all of us — in the traditional duty of amateurs: supplying all-essential communication in an emergency. Let it be our high resolve that we shall never be found wanting!

December 12, 1941 K. B. W.

Strays

For the first time since conscription began, it is now possible to enlist in the Signal Corps. The Army needs operators — many of them. Any licensed amateur or commercial operator who presents his license to an Army recruiting officer will be permitted to enlist and will be assured of radio work.

The ARRL Library: A New Online Resource

Contribute your content for use by amateurs worldwide.

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

At its January 2014 meeting, the ARRL Board of Directors voted to create an online repository of instructional and educational material — including material created and submitted by ARRL members — to be used by Amateur Radio clubs to help the ARRL's mission "to promote and advance the art, science, and enjoyment of Amateur Radio." To that end, ARRL is pleased to announce the creation of the ARRL Library, as part of **arrl.org/library**. The Library, which will feature two major areas, will go live in early January 2015.

Contents of the ARRL Library

The first area will be a collection of user-submitted *PowerPoint* presentations on a wide variety of topics. Audio and video materials will be added at a later date. If there's a topic related to Amateur Radio that you feel would make a good club presentation — technical, instructional, historical, operating, you name it — you are welcome to create the presentation and submit it for consideration. The ARRL Public Relations Committee is responsible for reviewing submitted material and determining which presentations should be included in the Library. Decisions of the Committee are final.

The second area of the ARRL Library will be for oral histories. The ARRL Historical Committee recognizes the need to record the stories of operators who can tell all of us, first-hand, their own perspective of Amateur Radio's history and role in their lives and communities. There are as many stories about Amateur Radio as there are licensees. Everybody has their perspective, and we are interested in hearing from as many ARRL members as possible, to help build our understanding of the history of the Amateur Radio hobby and service, and to share these perspectives with future generations of hams. Interviewing your local radio amateurs is an excellent club activity, and allows you to preserve the stories and memories of your fellow club members.

PowerPoint Submission Tips

If you would like to submit a *PowerPoint* presentation, here are a few suggestions to consider:

Use conversational language. Use words your audience knows. For example, if you are creating a presentation for newcomers, keep ham radio jargon to a minimum. Craft the presentation in the same way that you talk, and let your personality and experience shine through.

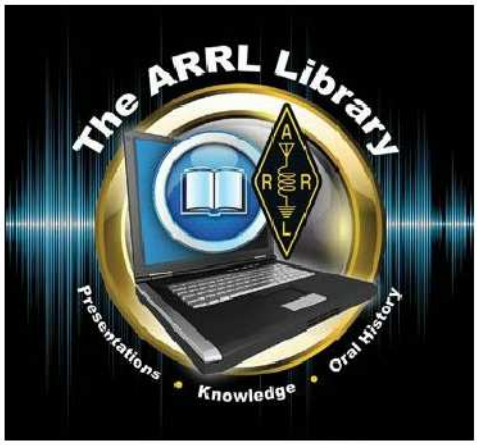
Use active language. Specific, active verbs will engage the viewer and keep the presentation moving. Find and use action pictures too. For example, a picture of four people *raising* a Yagi is a lot more interesting than a picture of four people standing in front of a Yagi.

Make technical presentations benefit-oriented. When you present technical material, your audience wants to know: (A) what they can learn from your presentation, and (B) how your presentation can help solve their problems. This isn't the place to tell your life story, your ham history, and so on.

Keep sentences short. When readers see presentations with long sentences, long paragraphs, and no bullet points or subheads, they stop reading. Lists and bullet points can help keep the screen from seeming full of text.

Front-load your point. Making your readers wade through paragraph after paragraph to get to the point will cost you their attention. Get to the point in the first few slides, then go step by step in later slides, informing the audience about important background.

PowerPoint submissions must be on the ARRL *PowerPoint* background, which will be available for download at the ARRL Library.



Oral History Guidelines

If you're interested in doing an oral history interview with one of your club members, here are some guidelines:

1) Keep your audio files to WAV or MP3 format.

2) Record your interview in a quiet place without a lot of extra noise or distractions, so you can stay focused.

3) Place your microphone so that both the interviewer and interviewee can be well heard. Do a "test run" first, before you begin your interview so that you can ensure both people can be heard and understood.

4) Be sure to start your oral history recording with the names and call signs of people heard in the recording, the date/month/year, and the location where the recording was made.

5) Try to keep your oral history interview to no more than an hour or so. If you only have 30 minutes of material, that's fine. Keep the recorder running the entire time; an oral history is more conversational than a produced and edited radio show.

Complete information on how to submit material to us for consideration will be on the ARRL Library site. Please note that by uploading material to ARRL for consideration to the Library, you are granting the American Radio Relay League (ARRL) the non-exclusive right to use the images in any and all of its publications, whether for promotional or commercial purposes, including electronic media or any other media yet to be invented, without payment or any other consideration.

ARRL encourages all members to share their skills and stories for the betterment of all of Amateur Radio.

QST Centennial Photo Contest

Send us your photos and earn worldwide fame — and $250!

Steve Ford, WB8IMY
QST Editor
sford@arrl.org

We celebrated the centennial of the ARRL in 2014, but *QST* magazine's centennial year is *2015*. In fact, the first issue of *QST* was published in December 1915. It was barely what you'd call a magazine — almost a pamphlet — and the cost to print and mail it was paid directly out of the pockets of ARRL founders Clarence Tuska and Hiram Percy Maxim.

To help celebrate *QST*'s centennial year, we've made a few changes, which you've probably noticed in this issue. However, we want *you* to participate in the celebration as well.

QST Managing Editor Becky Schoenfeld, W1BXY, appears in this example of a well-composed photo. [Sean Kutzko, KX9X, photo]

Imagine Your Photo as a *QST* Cover

It all begins with an invitation for you to send us your best photos. The editorial staff will evaluate the images and select the best ones to grace the covers of several issues of *QST* throughout the year. Those lucky photographers will receive cash prizes of $250, not to mention the pleasure of seeing their photos on the covers of the most popular Amateur Radio magazine in the world!

What We're Looking For

We're happy to consider almost anything, but images that have the best chances of becoming winners are those that are well composed with good lighting, color, and contrast. Make sure your camera is set up to shoot in high resolution (sometimes referred to as "high quality"). If the image is lower resolution with a file size less than 1 MByte, we won't be able to consider it.

If your camera has a "date stamping" feature — one that prints the date on all images — please turn it off. We will automatically reject any images that include dates, times, or other added text.

Vertically oriented images are especially prized because those are ideal for *QST* covers. Before you shoot, however, take a careful look at the cover of any recent *QST*. Notice the big *QST* logo in the upper left corner, and the text that usually appears along the left-hand side. As you compose your shot, keep those elements in mind. You wouldn't want a *QST* logo to be plastered across someone's face!

You can include people in your photos, including yourself, but if anyone younger than age 18 appears, you must obtain the permissions of their parents — in writing — before you send the photos to us.

And when you send a photo, include a description in your e-mail. Tell us a short story (just a paragraph) about the image. If people are shown, please include their names and call signs.

Contest Rules and Legalese

- *QST* will only accept photos during the official contest period, **between December 1, 2014 and August 1, 2015**.
- Images must be submitted by e-mail to **upfront@arrl.org**.
- Submit only **one photo per e-mail message**.
- Photos must be high-resolution JPG or TIF format, but file sizes must not exceed 5 MBytes. Do not send Zip files.
- Although you will retain copyrights to your images, by submitting the photos to this contest you will be granting the ARRL non-exclusive use of the images for any lawful purpose in any media now existing or yet to be invented. This applies to non-winning images as well.
- Photographers must be ARRL members.
- You can only win once during the contest period.
- The ARRL Headquarters staff is prohibited from participating in this contest.

Rick Lindquist, WW1ME, ww1me@arrl.org

ARRL to FCC: Continue Making Official Paper Licenses Available

Recent FCC proposal suggests issuing paper licenses only at the licensee's request.

The ARRL has recommended that the FCC continue to provide paper license documents to Amateur Radio licensees who want them. The League advice came in comments filed on November 5 in response to an FCC *Public Notice* (in WT Docket 14-161), proposing to cease the routine issuance of hard-copy license documents to all Wireless Service licensees, including radio amateurs. While having a paper license document from the FCC to post on the wall of the ham shack has been an Amateur Radio tradition, the Commission for several years has considered the "official" license to be the virtual document residing in its Universal Licensing System (ULS) database.

A portion of the FCC ULS licensee record page: "Set Paper Authorization Preferences" lets licensees opt in or out of paper license delivery. "Download Electronic Authorizations" lets a licensee download an official PDF version of a license for printing.

"The FCC is willing to continue to mail paper licenses to those who request them," ARRL General Counsel Chris Imlay, W3KD, has explained. "However, they are making available to licensees — starting right now — the actual license to print via the FCC ULS, and it is allowing hams now to opt out of receiving paper licenses from the FCC directly." The ULS License Manager also allows licensees to notify the FCC that they do want to receive an official paper license.

Under the FCC-proposed process, once a license application is granted, the ULS will generate an official electronic license but will no longer mail a hard-copy license unless notified that the licensee wishes to receive an official paper license document. Until new procedures are final, however, the Commission will continue to print and mail official paper licenses, unless notified by the licensee to stop.

"Should the Commission proceed with the *Notice* proposals," the League said in its comments, "it is ARRL's strong recommendation that the Commission give serious consideration to continuing a default provision for sending an initial paper license document to new licensees in the Amateur Radio Service, along with detailed, simple instructions for how to make the elections set forth in the notice relative to future modified or renewed licenses."

The ARRL pointed out that not everyone has easy access to, or is comfortable using, the ULS and that Amateur Radio licensees may occasionally need an official license document — for example, when applying for a license upgrade at a VEC exam session, or for vehicle call sign license plates.

"If there is not a license printed on distinctive license stock by the Commission, authentication issues arise and the possibility of electronic alteration of a license document is created," said the League.

The ARRL also suggested that requiring individuals to go online in order to obtain a license document may prove to be a roadblock to some applicants. "It is not acceptable to erect barriers to entry for anyone to obtain an Amateur Radio license or to modify a license," the League commented. "ARRL is concerned that there should be, especially for newcomers, an easy, intuitive path to make the election for license delivery method that does not involve ULS access at the outset."

ARRL Executive Committee Revises Mobile Amateur Radio Operation Policy

Meeting October 4 in Memphis, the ARRL Executive Committee (EC) adopted an updated *Policy Statement* on Amateur Radio mobile operation. While agreeing that concerns over driver distraction are "not unreasonable," the policy cites Amateur Radio's 70-year history of two-way mobile operation as evidence that such radio use does not contribute to driver inattention. The policy points out that Amateur Radio operation differs from cell phone communication, in part because the device need not be held to the face to listen, no text messaging is involved, and mobile ham operators only need to pick up a microphone to make "brief and infrequent" transmissions.

Prompting the policy update is the 2012 federal law "Moving Ahead for Progress in the 21st Century," or MAP-21, which requires states to enact and enforce statutes that prohibit "texting through a personal wireless

communications device while driving" in order to qualify for federal program support grants. The updated policy "encourages the use of the language in MAP-21 in state statutes and municipal ordinances dealing with mobile telephone and mobile text-messaging limitations."

Many state statutes restrict the use of cell phones and other communication devices to a greater or lesser degree, and several exempt Amateur Radio. A lot of these laws predate MAP-21, however, and because MAP-21 permits no specific exception for Amateur Radio operation, some state laws may need revision to comply with its requirements. The ARRL is urging states or localities to adopt motor vehicle codes that narrowly define the class of regulated devices, in order to exclude Amateur Radio specifically.

"Given the necessity of unrestricted mobile Amateur Radio communications in order for the benefits of Amateur Radio to the public to continue to be realized, ARRL urges state and municipal legislators considering restrictions on mobile cellular telephone operation and mobile text messaging to narrowly define the class of devices included in the regulation, so that the class includes only full-duplex wireless telephones and related hand-held or portable equipment," the League policy recommends.

The ARRL policy suggests statutory language for state and local motor vehicle codes that defines a "personal wireless communications device" as one through which "commercial mobile services, unlicensed wireless services, and common carrier wireless exchange access services are transmitted." This wording specifically excludes "two-way radio communications equipment, such as that used in the Amateur Radio Service."

For states or localities considering banning all but hands-free cell phone use, the ARRL recommended wording that would prohibit the use of a personal wireless communications device "in any manner" while driving, unless the motorist is using hands-free capability.

ARRL CEO David Sumner, K1ZZ, addressed the issue in his "It Seems to Us" editorial, "Distracted Driving Legislation: Proceed with Caution," published in the November 2013 issue of *QST*.

In other matters, a proposal aired at the July ARRL Board of Directors meetings — endorsing additional HF digital privileges for Technicians and referred to the EC for study — came in for considerable discussion during the Memphis meeting. The original motion by ARRL Southeastern Division Director Doug Rehman, K4AC, sought a *Petition for Rule Making* to the FCC seeking digital privileges for Technicians on narrow segments of 80, 40, and 15 meters.

After discussing the proposal's pros and cons, the EC put the ball back into the Board's court in a modified form: The EC recommended that the Board consider soliciting input from the membership on adding data privileges for Novices and Technicians within their existing 15 meter subband.

ARRL General Counsel Chris Imlay, W3KD. [Rick Lindquist, WW1ME, photo]

"This is *not* a proposal that the Board *adopt* data privileges for Techs and Novices on 15 meters as an objective, and it is most definitely *not* an ARRL proposal to the FCC," stressed ARRL CEO David Sumner, K1ZZ, a non-voting member of

FCC News

FCC Reverses ALJ's Decision, Revokes Convicted Sex Offender's Amateur Radio License

The FCC has reversed the decision of an Administrative Law Judge (ALJ) who had ruled in 2010 that David Titus, KB7ILD, of Seattle, Washington, could keep his Amateur Radio license in the wake of his conviction for a sex-related crime 17 years earlier. In his March 9, 2010, *Initial Decision*, ALJ Richard L. Sippel determined that Titus "has been a law-abiding member of his community for many years" and, based on evidence that Titus and witnesses on his behalf had presented, ordered that Titus's amateur license not be revoked. Sippel said the FCC Enforcement Bureau had failed to meet the burden of proof necessary for revocation. He further determined that Titus had shown remorse and been rehabilitated, and that the Enforcement Bureau had presented no credible evidence to indicate that Titus should be categorized as a high-risk sex offender. In a November 5 *Decision* in the proceeding (EB Docket 07-13), the FCC reversed Sippel's decision.

"We find that the ALJ erred in holding that the Enforcement Bureau failed to meet its burden of demonstrating that Titus is currently unqualified to remain a Commission licensee," the *Decision* said, "inasmuch as the ALJ failed to consider relevant convictions for sex offenses and failed to give appropriate deference to the judgment of local law enforcement authorities that Titus is a convicted sex offender who poses a high risk to the safety of the community."

The FCC also said Sippel should have given more weight to incidents in 2002 and 2004 that, while not resulting in conviction, "prompted the Seattle Police Department to raise Titus's assessed risk level from moderate to high."

In January 2007, the FCC issued a show-cause *Order* and designated for hearing the issue of whether Titus was qualified to remain a licensee in light of a 1993 felony conviction for "communicating with a minor for immoral purposes." The *Communications Act* provides that the FCC may revoke any license, if conditions come to its attention that would have warranted a denial of the licensee's original application. The Commission has said in the past that felony convictions, "especially those involving sexual offenses involving children," raise questions regarding a licensee's character qualifications.

"In focusing on the impact of Titus's misconduct on his qualifications to hold an Amateur Radio license," the FCC concluded, "we would be remiss in our responsibilities as a licensing authority if we continue to authorize Titus to hold an Amateur Radio license that could be used to put him in contact with children."

the EC. "That would come later, if at all, after the Board has had an opportunity to weigh membership input."

In other business, ARRL General Counsel Chris Imlay, W3KD, told the EC to expect an FCC *Notice of Proposed Rule Making* "in the next few months" that will propose eliminating the existing symbol rate limit on HF data communication. The *NPRM*, in response to an ARRL *Petition for Rule Making* filed last November, is expected to leave open for comment the specific bandwidth limitation that should replace it, and it may address additional topics.

Imlay noted there had been no action on the League's 2012 *Petition for Rule Making* to create an MF Amateur Service allocation at 472-479 kHz, nor on ET Docket 12-338, regarding implementation of the Final Acts of World Radiocommunication Conference 2007. There also was nothing new to report regarding other allocation issues, including an Amateur Service allocation at 135.7 – 137.8 kHz and upgrading 1900 – 2000 kHz to primary.

Young Ham Recognized for Navigation Aid for Visually Impaired

A young California radio amateur was one of nine *Popular Mechanics* "Future Breakthrough Award" winners. Shiloh Curtis, KK6ISM, developed a "hat-based, hands-free, haptic navigational aid for visually impaired individuals." As the publication explained, after a friend from her school's robotics club described going blind as losing "two eyes and one hand," Curtis determined to come up with a way to free up the hand that would be wielding the classic white cane. Robotics was the key.

Shiloh Curtis, KK6ISM, wearing her hat-mounted navigation aid. [Gordon Kelly Photography photo]

"A robot is blind until you put sensors on it," she told *Popular Mechanics*. "Why don't we put sensors on the blind, so they can navigate like robots?" She combined a wide-brimmed hat, vibrating motors, and a robot vacuum cleaner's laser distance sensor to come up with the wearable device that warns the wearer of obstacles through vibrations.

A junior at Laughing Thunder Academy in Sunnyvale, California, Shiloh Curtis has been recognized as the winner of California State Fair "Project of the Year" and was an Americas Regional finalist in the Google Science Fair. She is the daughter of Dave Curtis, N6NZ. — *Thanks to Ward Silver, N0AX, and Bob Wilson, N6TV*

ARRL Seeks Input on Initial VHF-UHF-Microwave Contest Rule Changes

The recently formed "Ad Hoc Subcommittee on VHF and Above Revitalization" — created by the ARRL Board of Directors' Programs and Services Committee (PSC) — seeks member input on updating various aspects of the League's VHF-UHF-Microwave and EME contest program. In the subcommittee's solicitation for input, Chairman Kermit Carlson, W9XA, said members can help the work of the committee "by providing additional insights and ideas for our consideration."

"Contest participation benefits both individual amateurs and the Amateur Radio Service as a whole," said Carlson, who is ARRL Central Division Vice Director. "Individual operators gain overall operating experience, increase their knowledge of band characteristics, test the results of changes in equipment, antennas and locations, and have incentive to add bands and modes to their station complement, all in the context of enjoyable, yet challenging, activities."

He said operating in contests also helps the Amateur Radio Service increase its pool of skilled operators and can demonstrate more intense use of our allocations, "some of which may be under threat from ever-expanding commercial and consumer services."

Subcommittee members have recommended one set of changes that would apply across all ARRL VHF-UHF-Microwave and EME contests. These include:

- Removing the current prohibition on the use of amateur and non-amateur forms of assistance for all operator categories, with such use having no impact on entry category.
- Removing the current prohibition on self-spotting for all operator categories.
- Allowing single operators to transmit on more than one band at a time.

"Unlike most HF contests, operating skill and knowledge of propagation may not be enough to find stations to work. You can't just point your antenna to Europe or Asia at the right time and find a ready supply of potential contacts," Carlson explained. "The less-predictable nature of VHF+ propagation and the necessarily higher-gain, narrow-beamwidth antennas used make finding someone to work largely a matter of chance. Indeed, most microwave contacts would never occur at all without the use of real-time coordination."

Carlson said the League's current prohibitive stance toward assistance and self-spotting "is the most often-heard complaint about our VHF contest program." He said subcommittee members believe that removing those prohibitions "will foster greater participation and result in more contacts and a more positive experience for participants without impacting the existing challenge of actually completing contacts."

Similarly, he continued, the present restriction of Single-Operator stations to one transmitted signal at a time precludes such activities as calling CQ on one band while soliciting or completing contacts using digital modes on another. "Such restriction constrains the number of potential contacts among participants while yielding no apparent benefit," he said.

The full announcement, **www.arrl.org/news/arrl-seeks-input-on-initial-vhf-uhf-microwave-contest-rule-changes**, details and explains the rationale behind the specific recommended rule changes.

"You can help us by considering the potential impact of each proposal and sharing any specific observations about it," Carlson said. "We're not tallying votes; rather, we want to be sure we have considered all foreseeable results of the proposed changes." Carlson

said that *collective* input from user groups would be more helpful and expedient than receiving multiple versions of the same position from individual group members.

The deadline has been extended to January 15, 2015. Submit all comments to **vhf-input@arrl.org**. Only comments received through that channel will be assured of reaching all the members of the Subcommittee.

Kansas Radio Amateur is ARRL McGan Silver Antenna Award Winner


Brian Short, KC0BS.

Brian Short, KC0BS, of Olathe, Kansas, is the recipient of the 2014 Philip J. McGan Silver Antenna Award. The award recognizes outstanding public relations efforts in promoting Amateur Radio to the non-ham community. Short, an ARRL Life Member, appeared on Kansas City Public Media's "Up To Date" interview program on KCUR-FM in November 2013. The show, "Exploring Ham Radio in a Digital World," highlighted Amateur Radio's value to the community and how individuals can get involved. An Amateur Radio instructor, he was the recipient of the 2009 Herb Brier Instructor of the Year Award.

"Brian has done an outstanding job of using both traditional and social media to bring the message of Amateur Radio to the public," said ARRL Midwest Division Director Cliff Ahrens, K0CA. "He is very deserving of this recognition."

The product of an Amateur Radio family, Short has been licensed since 1987, when he was 18. He is an ARRL Midwest Division Assistant Director, serves as Johnson County Amateur Radio Emergency Service (ARES) Emergency Coordinator, and is a SKYWARN weather spotter. He has been a Public Information Officer in the Kansas City area.

The ARRL Public Relations Committee recommended Short for the award, and the ARRL Board of Directors affirmed the committee's choice. As the 2014 McGan Award winner, Short will receive a plaque. The award's namesake, journalist Philip J. McGan, WA2MBQ (SK), served as the first chairman of ARRL's Public Relations Committee.

Former ARRL Staff Member Mary Lau, N1VH, SK

Former ARRL Headquarters staff member Mary E. Lau, N1VH (ex-N7IAL), of Newington, Connecticut, died October 15. She was 61 and had been suffering from ALS. Lau worked in several HQ departments from 1985 until 2005, including Field and Educational Services (F&ES), where she was projects supervisor, and as secretary of the ARRL Foundation. Lau headed the Field and Educational Services support team that produced the "Leap into Amateur Radio" brochure aimed at elementary schoolers. She also contributed technical assistance in the preparation of the *Active Club Primer*, and edited the "At the Foundation" column for *QST* while she was the Foundation secretary.

"Mary loved radio, was a hard worker, creative at finding solutions, would bull-dog things she believed in, was quite enthusiastic about learning new things, empathetic to anyone who came to her, super organized, happy to be at ARRL Headquarters, and was overall a 'glass is half full' type of person," said former ARRL Field and Educational Services Manager Rosalie White, K1STO. Survivors include her husband Zack Lau, W1VT, of the ARRL Lab, whom she met at ARRL Headquarters.

Section Manager Nomination Notice

To all ARRL members in Maryland/DC, Nevada, New Hampshire, Northern New Jersey, Rhode Island, San Joaquin Valley, Utah, and West Texas. You are hereby solicited for nominating petitions pursuant to an election for Section Manager (SM). Incumbents are listed on page 16 of this issue.

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

We suggest the following format:

(Place and Date)

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

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

(Signature____ Call Sign___ City___ ZIP___)

Any candidate for the office of Section Manager must be a resident of the Section, an Amateur Radio licensee of Technician class or higher and a full member of the League for a continuous term of at least 2 years immediately preceding receipt of a nominating petition. Petitions must be received at Headquarters by 4 PM Eastern Time on March 6, 2015. If more than one member is nominated in a single section, ballots will be mailed from Headquarters on or before April 1, 2015, to full members of record as March 6, 2015, which is the closing date for nominations. Returns will be counted May 19, 2015. Section Managers elected as a result of the above procedure will take office July 1, 2015.

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

Rick Palm, K1CE, k1ce@arrl.org

Planning and Operating Special Event Communications

Prep tips, techniques, and protocols for operators.

Providing radio communications at special events such as running races, bike-a-thons, walks for special causes, and competitions requires Amateur Radio operators to be efficient and effective at all stages, from planning and preparedness right up through providing communications services. In addition to upholding the standard of safety and security for all, radio amateurs are also cogs in the behind-the-scenes machine, with a responsibility for ensuring that officials and workers are able to communicate with one another as needed. Our reputations are also at stake, as an effective communications plan carried out flawlessly results in us being asked to return the following year, and also asked to serve in sometimes even more demanding situations, such as disaster responses. It's said that "practice makes perfect," and that applies to public service as well. Here's an example of how one ARES® group's participation in a state-wide exercise prepared them for providing effective service at an event the very next week.

Case Study in Excellence

I was recently impressed by the fine effort of the ARES operators of the Clallam County Amateur Radio Emergency Service (CCARES), on the Olympic Peninsula of Washington state, who participated in the Washington State Emergency Department's statewide "Fifth Saturday Exercise." Held on August 30, the exercise served as an opportunity for the group to assess the area, which features unique terrain over logging roads and other challenging conditions, as a dry run for an inaugural trail marathon that would be conducted the following week in the same area — an event for which this same ARES group would be providing communications. Marathon officials had provided the group with an outline of the event, concerns about lack of cell phone coverage, and the need for reliable safety and security communications.

Practice and planning will help your ARES team efficiently and successfully provide communications at public service events. Here, Joe Hamm, KC1BAQ, serves as net control at a marathon in Wallingford, Connecticut.

The exercise (a wildfire scenario) began with operators contacting the Resources net for check-in. They proceeded to a staging area where they received their instructions and safety briefing for deployment. Assignments and maps were issued to the two-person teams and, at that point, Operations took control of the exercise from Resources. The teams were then dispatched to their assigned locations.

Upon reporting arrival at their locations, teams awaited net roll calls on repeater and simplex channels. When Operations found that they could not maintain contact with all of the deployed elements from the Incident Command Post, control was passed to the only station that could. The teams assessed road conditions, and reported locations and signal strengths to the net. All of the teams then returned to the staging area for the hot-wash and were released to the Resources net control for final check-out.

The group's after-action reports — which went to government officials as well as planners of the inaugural Great Olympic Adventure Trail Marathon — included information concerning road conditions, hazards, and radio communications coverage at critical field way points. Necessary changes were made to the communications plan for the marathon, as a result of CCARES's findings in the wildfire exercise.

During the marathon, after contacting Resources, CCARES personnel deployed directly to the locations they had manned during the exercise. The Operations net received check-ins as members arrived on location. CCARES members manned the Start locations, the Finish Line, and all critical points along the trail where cell phone communications were impossible because of terrain. Aside from minor glitches, radio communications ran smoothly the entire day. CCARES members were readily identifiable, thanks to their communications vests and radios.

"Our demonstrated professionalism was not lost on event organizers, and ARES was able to practice and become familiar with our unique geography for incidents and events in the future," said a coordinator, Bruce Reiter, KD7WBM.

Analysis of a Winning Team Effort

There are many things that CCARES did right, starting with an assessment of the terrain and its related challenges to be met, in a government emergency response exercise no less, and especially communications coverage and gaps. They coordinated and planned with exercise and event officials, as well as their own leadership. An initial net took check-ins and roll call, a staging area

provided the forum for instructions and safety briefing, and two-person teams (wisely providing a back-up operator) were deployed to assigned positions, checked in to another net upon arrival. Operators were already aware of the terrain and hazards, as well as gaps in communications coverage, thanks to their participation in the previous week's exercise. The result was a professionally run, efficient, and successful communications service.

Modes and Other Matters

As far as radio modes go, some of the most interesting and innovative ones for special event communications I've seen these past few years include the use of the mesh networking model deployed in a remote area of the southwest for event participants, organizers, and a grandstand of spectators removed geographically from the finish line. The system uses modified wireless routers with custom firmware on the amateur 13 centimeter band (hence small antennas can be used), and runs all day on a car battery. The broadband capability allows for high-speed data and amateur television. The system, while used for safety communications for event organizers and participants, was also used to send television imaging of the runners crossing the finish line to TV screens at the grandstand so that family and friends could see them finish![1] You can get more information about this technology at **www.broadband-hamnet.org**.

D-STAR (Digital Smart Technologies for Amateur Radio) is also a relatively new player on the special event communications front, and certainly a viable one with its digital voice (DV) capability, slow data messaging, position reporting (with GPS coordinates), and other information reporting added as a sub-layer to the top-layer voice transmission. The main criticism of the system I've heard is its dependence on the Internet for routing messages among D-STAR repeaters, but it is totally independent of the Internet when a repeater serves just the local area, or when its simplex mode is executed: point-to-point communications are easily accomplished without the Internet, especially in the relatively small footprint of a local or even regional area special event theater of operation.

[1]L. Jelinski, AG4IU, "A Broadband Ham Network Crosses the Finish Line," *QST*, Jul 2013, pp 68 – 69.

But more traditional and conservative modes and methods are perfectly applicable and tested by time. The Automatic Packet Reporting System (**www.aprs.org**) is a good example: it's been in use for a long time, allowing special event coordinators to view a map and spot locations of operators, vehicles such as SAG wagons and ambulances, in real time. Log files of GPS coordinates can be imported into mapping software to show movement along routes during hotwashes and after-action reports that result in enhanced efficiencies for the next event.

And, of course, there are the workhorse bands, modes, and radios that remain the bedrock for special event communications: analog FM simplex and repeaters, the 2 meter and 70 centimeter bands, and the ubiquitous mobile and hand-held radios that are used on them. Repeater hardware and software systems can be hardened for demanding conditions, but they should never be relied on as the sole networking source. Backup repeaters must be incorporated in the communications plan, as well as a robust simplex network for getting messages around the horn without repeaters. The simplex network and indeed, the repeater network, must be tested and exercised for 100% coverage of the operating theater. Consider HF, also — the use of NVIS antenna configurations, for example, can add local and regional coverage.

The goal is no gaps! Murphy's Law dictates that an incident requiring immediate attention on a special event course will occur at the location of a communications failure point, guaranteed!

Work-arounds must be considered case-by-case, based on the unique operating environment of each field waypoint where operators are to be deployed. Ideally, they are discovered and planned for in advance, but can be done on the fly if necessary. A good example was the work-around engineered by the Clallam County ARES group, when they shifted net control efficiently to another operator who could hear all stations on the net. Another example is the use of the cross-band repeater function of many radios nowadays, including on my Icom ID-5100, where I can push a button, set the frequencies, and then transmit into it on one frequency in the 2 meter band, and have the signal simultaneously retransmitted on a frequency in the 70 centimeter band. An application example in the field would be if an operator was in the woods or ravine away from his vehicle and mobile transceiver, searching for a lost runner, he/she could use a hand-held to send his signal to his vehicle's transceiver at a higher elevation and having it retransmitted on another frequency monitored by the rest of the net.

More Tips, Techniques, and Protocols

Use plain language. It's readily understood by all entities supporting a special event, and thus promotes interoperability. If, however, a special event turned into a terrorist incident, such as what occurred at the Boston Marathon in 2013, tactical language is occasionally warranted.

Don't show up on time on event day — show up much earlier! Allow plenty of time to negotiate traffic, barriers, detours, and bad weather. Get to your first obligation early. Showing up late is bad form at best and, at worst, ratchets up the stress levels of your team leaders and fellow operators unnecessarily, and undermines the possibility of a good, efficient start to a long day of operating in the field. Your leader and teammates are counting on you.

Observe net protocols. Transmit only when directed to do so by net control. Keep transmissions brief for efficiency, and conservation of battery capacity. Listen carefully to net control; respond quickly to roll calls. Have at least two operators at each field location, as the Clallam group did. Switch operators for frequent relief breaks and to avoid physical and mental fatigue, which can reduce operation efficiency and effectiveness. You don't want to miss an important piece of information from net control, or worse, provide an erroneous report.

For event Amateur Radio communications planners and leaders, don't promise event organizers services you can't supply: The key is to under-promise and over-deliver. Have extra operators on standby as fill-ins when the inevitable occurs — there will be no-shows. Establish contact with other entities' leadership immediately upon arrival at the staging area for a smooth start to management of the event.

And lastly, have fun! There is no thrill in Amateur Radio like being in the field as part of a fast, efficient, and effective net of experienced operators passing messages, being led by an inspiring net control!

Contest Corral — January 2015

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
Dec 31	1300Z	1	See website	1.8-28 / -	CWOps Weekly Mini-CWT Tests	CW	Name and member number or S/P/C	www.cwops.org/cwt.html
1	**0000Z**	**1**	**2359Z**	**3.5-28 / 50+**	**ARRL Straight Key Night**	**CW**	**General QSO information**	www.arrl.org/straight-key-night
1	0000Z	1	0100Z	3.5 / -	New Years Snowball Contest	Ph CW	RST, serial, AGB number	ev5agb.com/index.htm
1	0800Z	1	1100Z	3.5-7 / -	SARTG New Year RTTY Contest	Dig	RST, serial, "Happy New Year" in your language	www.sartg.com
1	0900Z	1	1200Z	3.5-14 / -	AGCW Happy New Year Contest	CW	RST, serial, AGCW number	www.agcw.de
2	0230Z	2	0300Z	1.8-14 / -	NS Weekly Sprint	CW	Serial, name, and S/P/C	www.ncccsprint.com
3	0000Z	3	2400Z	3.5-28 / -	070 PSKFest	Dig	Call sign, RST, S/P/C	www.podxs070.com
3	1200Z	4	1200Z	3.5-28 / -	WW Peace Messenger Cities	Ph CW	RS(T) and PMC ref number or CQ zone	www.s59dcd.si
3	1500Z	3	1800Z	3.5-28 / -	QRP ARCI New Year's Sprint	CW	RST, S/P/C, QRP ARCI number or power	www.qrparci.org/contests
3	**1800Z**	**4**	**2359Z**	**3.5-28 / -**	**ARRL RTTY Roundup**	**Dig**	**RST, state/province/serial**	www.arrl.org/contests
3	2000Z	4	See website	1.8 / -	EUCW 160 Meter Contest	CW	RST, serial, club name, member nr or "NR"	www.uft.net
4	**1800Z**	**4**	**2359Z**	**3.5-28 / -**	**Kids Day**	**Ph**	**Name, age, location, favorite color**	www.arrl.org/kids-day
5	1630Z	5	1730Z	3.5, 7 / -	OK1WC Memorial Contest	Ph CW	RS(T) and serial	www.memorial-ok1wc.cz
6	0200Z	6	0400Z	3.5-28 / -	ARS Spartan Sprint	CW	RST, S/P/C, and power	www.arsqrp.blogspot.com
10	1200Z	11	1159Z	3.5-28 / -	UBA PSK63 Prefix Contest	Dig	RSQ and serial	www.uba.be/en/hf/contest-rules
10	1200Z	11	2359Z	1.8-28 / 50	Straight Key Weekend Sprintathon	CW	RST, QTH, name, SKCC member nr	www.skccgroup.com
10	**1800Z**	**11**	**0559Z**	**1.8-28 / -**	**North American QSO Party**	**CW**	**Name and S/P/C**	ncjweb.com
11	0900Z	11	1059Z	28 / -	DARC 10 Meter Contest	Ph CW	RS(T), serial, DOK code	www.darc.de/referate/dx/contest
14	2300Z	18	See website	1.8-7 / -	Linc Cundall Memorial CW Contest	CW	See website	www.antiquewireless.org
16	0130Z	16	0330Z	1.8 / -	NAQCC Special 160M Sprint	CW	RST, S/P/C, and NAQCC mbr nr or power	naqcc.info
17	0000Z	18	2359Z	1.8-28 / -	YLISSB QSO Party	Ph	Call sign, RS(T), ISSB number	www.ylsystem.org
17	0000Z	17	0400Z	3.5, 7 / -	LZ Open Contest	CW	6-digit serial and serial from previous QSO	www.lzopen.com
17	0600Z	17	1400Z	3.5-28 / -	International United Teenager Contest	Ph CW	RS(T) and age or "RT"	www.uarl.com.ua
17	1200Z	18	1200Z	1.8-28 / -	HA DX Contest	Ph CW	RS(T) and serial or HADXC member nr or HA county	www.ha-dx.com
17	**1800Z**	**18**	**0559Z**	**1.8-28 / -**	**North American QSO Party**	**Ph**	**Name and S/P/C**	ncjweb.com
17	2000Z	18	See website	1.8-7 / -	Feld-Hell Low-Down Sprint	Dig	RST, S/P/C, Feld-Hell member nr	www.feldhellclub.org
18	1400Z	19	0800Z	1.8-28 / 50, 144	Classic Exchange	CW	RST, QTH, model of rcvr and xmtr	www.classicexchange.org
19	0200Z	19	0400Z	1.8-28 / -	Run For the Bacon	CW	RST, S/P/C, Flying Pig nr or power	www.fpqrp.org
21	0200Z	21	0256Z	3.5-7 / -	Locust QSO Party	CW	Name, state or province or "DX"	www.k6vva.com/lqp
22	0130Z	22	0330Z	3.5-14 / -	NAQCC Monthly QRP Sprint	CW	RST, S/P/C, and NAQCC mbr nr or power	naqcc.info
23	2200Z	25	2200Z	1.8 / -	CQ WW 160 Meter Contest	CW	RST and S/P/C	www.cq160.com
24	0600Z	25	1800Z	3.5-28 / -	REF French Contest	CW	RST and serial or department ID	concours.ref-union.org/contest
24	1200Z	25	1200Z	3.5-28 / -	BARTG RTTY Sprint	Dig	Serial	www.bartg.org.uk
24	1700Z	25	1700Z	1.8-28 / 50+	Winter Field Day	Ph CW Dig	Category, ARRL section, local temp	www.spar-hams.org
24	**1900Z**	**26**	**2359Z**	**- / 50+**	**ARRL January VHF Contest**	**Ph CW**	**4-char grid square**	www.arrl.org/contests
24	1900Z	24	2300Z	1.8 / -	WAB Top Band Phone Contest	Ph	See website	www.worked-all-britain.co.uk/contest
25	2000Z	25	2359Z	3.5-28 / -	QRP Winter Fireside SSB Sprint	Ph	RS, S/P/C, QRP ARCI number or power	www.qrparci.org/contests
31	0000Z	31	2359Z	1.8-28 / 50	Feld-Hell WAAAEO Sprint	Dig	RST, S/P/C, Feld-Hell member nr	www.feldhellclub.org
31	1300Z	Feb 1	1300Z	3.5-28 / -	UBA Contest	Ph	RS, serial, and ON province	www.uba.be/en/hf/contest-rules

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

2014 ARRL UHF Contest Results

A family reunion on the ultra-highs.

John (JK) Kalenowsky, K9JK, k9jk@arrl.net

The first weekend of August 2014 brought the 37th running of the ARRL's UHF Contest. The presence of family teams was felt in 2014, as it was last year. The husband and wife team of Carole, W6TTF, and her husband Jan, WA6WTF, returned to rove through Southern California. The Tai sisters Carrie, W6TAI, and Marie, W1TAI, returned as well and made great efforts from the Orange Section. Another family effort was completed by the Tupis family: Ev, W2EV, involved his twin sons Ethan and Spencer to operate as N2VRI and W2AAA from Western New York.

The Wayback Machine — N6NB sent this 1978 photo of his VW camper-rover atop Mt Pinos for a VHF contest in the 1970s. Mt Pinos, elevation 8831 feet, was ruled off-limits to Amateur Radio vehicles in 1988. Now Frazier Mountain, a few miles away and 800 feet lower in elevation, is regarded as the best available VHF+ site.

The most popular entry category remained SOLP with 84 logs submitted, just over one-half of the total logs and 12 more than last year. The Single Operator, High Power (SOHP) log count grew to 47 from 2013's 40. The Multioperator entry count slipped to nine, four fewer than in 2013. The 26 Rover entrants for 2014 numbered five fewer than last year, with the subcategory split between 15 Classic, 10 Limited, and one Unlimited. This year's 26 rovers travelled farther on average than in recent years, activating a total of 168 grids, approximately 6.5 grids per rover, as compared to the recent trend of rovers averaging about five grid activations each.

The Action

Activity was reported from all 15 ARRL Divisions and from Canada. There were a number of voids as logs were received from 48 of 71 ARRL sections and five RAC sections. Western Washington led the way with 11 log submissions, but the Eastern Pennsylvania, Illinois, and Minnesota sections were close behind with 10 logs from each. On the lighter side of the section log counts, there were 15 from which only a single log was received, but that was enough to be included among the 53 active sections.

From the sent-grid side, 111 total grids were activated by stations submitting logs. Twenty-eight grids were only activated by rovers and 50 only by fixed stations. The remaining 33 grids were activated by both rovers and fixed stations. California's DM13 was the most reported sent grid, generating 394 QSOs; 238 from fixed stations and 156 from rovers. The next most-active grid was Washington's CN87 with 322 total QSOs; 301 from fixed stations (the top QSO count for fixed stations in any grid) and 21 from rovers. FN31 (largely Connecticut but also including some of New York and a little nip of New Jersey in about half of the FN31aa sub-grid) followed with 273, all of those from fixed stations. The top grid locator activated by rovers was DM04 (California) with 171 QSOs reported.

On the received-grid side, contacts were reported with 157 different grid locators. The top two reported grid locators matched the Sent Grid results; stations logged 401 QSOs with California's DM13, and 336 with Washington's CN87. FN20 (New Jersey, Pennsylvania, and a small bit of New York) edged into 3rd place among reported grid locators with 263.

The statistics aren't clear about grids in which only rovers were contacted versus those in which only fixed stations were contacted. Rovers were the only source for 20 grids, while fixed stations were the only

Top Ten

Single Operator, Low Power

K2DRH	89,712
W1TAI	34,440
W6TAI	34,440
AF1T	22,680
WB2JAY	20,727
W3PAW	20,520
N4QWZ	11,985
W9GA	7,560
KE0CO	6,699
N9DG	4,371

Single Operator, High Power

K1TEO	66,822
W0UC	48,546
W0GHZ	34,782
K8TQK	18,666
W4ZRZ	17,289
WB2RVX	17,040
WZ1V	12,720
N7EPD	12,528
KE7SW	8,448
K7ND	8,190

Multioperator

K2LIM	59,013
K3TUF	32,562
N8ZM	11,766
KO9A	8,544
AG4V	3,312
KB0HH	1,980
N3MK	660
KE7UQL	231
N2BJ	90

Rover

N6NB/R	325,080
W6TE/R	284,700
W6TTF/R	207,000
WA6WTF/R	206,700
WA3PTV/R	44,550
W9SNR/R	40,860
W0ZQ/R	26,793
K1DS/R	24,420
W3HMS/R	17,556
VE3OIL/R	12,036

Limited Rover

AC0RA/R	52,731
WW7D/R	22,464
KF2MR/R	8,346
K9JK/R	6,630
N2QIP/R	4,899
W4PH/R	1,248
N2DCH/R	957
VE3CRU/R	864
N0EDV/R	570
N6ZE/R	483

Unlimited Rover

WA3RGQ/R	30,996

Regional Leaders

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

AF1T	22,680	LP
WB2JAY	20,727	LP
W3PAW	20,520	LP
WA2VNV	3,750	LP
AC1J	2,700	LP
K1TEO	66,822	HP
WB2RVX	17,040	HP
WZ1V	12,720	HP
W1ZC	7,380	HP
WA3SRU	6,804	HP
K2LIM	59,013	M
K3TUF	32,562	M
WA3PTV/R	44,550	R
K1DS/R	24,420	R
W3HMS/R	17,556	R
WB2ONA/R	3,780	R
KF2MR/R	8,346	RL
N2QIP/R	4,899	RL
N2DCH/R	957	RL
WA3RGQ/R	30,996	RU

Southeast Region
(Delta, Roanoke, and Southeastern Divisions)

N4QWZ	11,985	LP
KX4R	3,825	LP
W4AMP	819	LP
K4FJW	792	LP
N4TWX	756	LP
W4ZRZ	17,289	HP
K0VXM	3,000	HP
WB4OMG	1,968	HP
AA4DD	210	HP
KM4ID	105	HP
AG4V	3,312	M
N3MK	660	M
W4PH/R	1,248	RL

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

K2DRH	89,712	LP
W9GA	7,560	LP
N9DG	4,371	LP
AA9D	1,800	LP
VE3DS	1,152	LP
W0UC	48,546	HP
K8TQK	18,666	HP
WV9E	7,560	HP
VA3ST	3,180	HP
K8GDT	2,574	HP
N8ZM	11,766	M
KO9A	8,544	M
N2BJ	90	M
W9SNR/R	40,860	R
VE3OIL/R	12,036	R
NE8I/R	1,911	R
K9JK/R	6,630	RL
VE3CRU/R	864	RL
N0EDV/R	570	RL

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

K0SIX	2,574	LP
KK0Q	2,340	LP
N0UK	1,230	LP
WD0BQM	315	LP
KA0RYT	252	LP
W0GHZ	34,782	HP
K0AWU	7,140	HP
WA7KYM	1,911	HP
W6OAL	1,560	HP
K5SW	855	HP
KB0HH	1,980	M
W0ZQ/R	26,793	R
WB0LJC/R	1,518	R
K0CQ/R	72	R
AC0RA/R	52,731	RL

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

W1TAI	34,440	LP
W6TAI	34,440	LP
KE0CO	6,699	LP
AF6RR	3,420	LP
K6TSK	2,376	LP
N7EPD	12,528	HP
KE7SW	8,448	HP
K7ND	8,190	HP
W7GLF	4,410	HP
KC6ZWT	4,026	HP
KE7UQL	231	M
N6NB/R	325,080	R
W6TE/R	284,700	R
W6TTF/R	207,000	R
WA6WTF/R	206,700	R
KI5WL/R	105	R
WW7D/R	22,464	RL
N6ZE/R	483	RL

Division Winners

Low Power		
Atlantic	W3PAW	20,520
Central	K2DRH	89,712
Dakota	K0SIX	2,574
Delta	N4QWZ	11,985
Great Lakes	W8RU	858
Hudson	WB2JAY	20,727
Midwest	WD0BQM	315
New England	AF1T	22,680
Northwestern	KE0CO	6,699
Pacific	AF6RR	3,420
Roanoke	K4FJW	792
Rocky Mountain	KK0Q	2,340
Southeastern	KX4R	3,825
Southwestern	W1TAI	34,440
Southwestern	W6TAI	34,440
West Gulf	AA5AM	75
Canada	VE3DS	1,152
High Power		
Atlantic	WB2RVX	17,040
Central	W0UC	48,546
Dakota	W0GHZ	34,782
Delta	AA4DD	210
Great Lakes	K8TQK	18,666
Hudson	W2BVH	1,734
Midwest	KF0M	432
New England	K1TEO	66,822
Northwestern	N7EPD	12,528
Pacific	KC6ZWT	4,026
Roanoke	KM4ID	105
Rocky Mountain	WA7KYM	1,911
Southeastern	W4ZRZ	17,289
West Gulf	K5SW	855
Canada	VA3ST	3,180
Multioperator		
Atlantic	K2LIM	59,013
Central	KO9A	8,544
Delta	AG4V	3,312
Great Lakes	N8ZM	11,766
Pacific	KE7UQL	231
Roanoke	N3MK	660
West Gulf	KB0HH	1,980
Rover		
Atlantic	WA3PTV/R	44,550
Central	W9SNR/R	40,860
Dakota	W0ZQ/R	26,793
Great Lakes	NE8I/R	1,911
Midwest	K0CQ/R	72
Pacific	N6NB/R	325,080
Southwestern	KI5WL/R	105
Canada	VE3OIL/R	12,036
Limited Rover		
Atlantic	KF2MR/R	8,346
Central	K9JK/R	6,630
Midwest	AC0RA/R	52,731
Northwestern	WW7D/R	22,464
Roanoke	W4PH/R	1,248
Southwestern	N6ZE/R	483
Canada	VE3CRU/R	864
Unlimited Rover		
Atlantic	WA3RGQ/R	30,996

source for 79 locators, leaving 58 grids where both rovers and fixed stations were contacted. At the other end of the reported grid locator totals, there were 10 with which only a single QSO was reported (seven by fixed stations and three by rovers).

Top of the Hill

Wayne, N6NB, once again led a group of rovers through Southern and Central California and claimed this year's top score in the category, 325K (also the top score overall). A very notable Limited Rover effort was put forth by Wyatt, AC0RA. Wyatt travelled through 12 grids from Iowa into Illinois with his four-band setup and achieved a final score of 52.7K.

After a 3-year absence, Jeff, K1TEO, returned to the August UHF Contest and claimed the top spot in SOHP from his seven-band station in Connecticut. Jeff's companion leader in SOLP was Bob, K2DRH, repeating his win from western Illinois. Right behind Bob were the Tai sisters (in name, suffix, and place), Carrie, W6TAI, and Marie, W1TAI, who made great efforts from the Orange Section that resulted in a "tai" for 2nd place.

In the Affiliated Club Competition, the Southern California Contest Club maintained its top spot in the Medium Club category, as did the Bristol (TN) ARC in the Local section. Welcome to two new clubs which submitted scores in 2014; Contest Club Ontario and the Rochester (NY) Amateur Radio Association.

See you next year!

If you like to get "out and about" with ham radio, the August UHF Contest is a great way to work on your UHF technique, try out a new antenna, and make some amazing contacts. The first weekend in August usually brings great weather, and as many of the regular participants have discovered, is a perfect opportunity to combine family fun with a little ham radio.

Affiliated Club Competition

	Logs	Score
Medium Club Category		
Southern California Contest Club	5	1,057,920
North East Weak Signal Group	12	127,269
Northern Lights Radio Society	12	123,372
Mt Airy VHF Radio Club	12	115,323
Society of Midwest Contesters	6	98,664
Pacific Northwest VHF Society	11	69,396
Badger Contesters	7	67,227
Potomac Valley Radio Club	3	22,155
Contest Club Ontario	5	17,652
Florida Weak Signal Society	6	6,795
Local Club Category		
Bristol (TN) ARC	3	1,134
Rochester (NY) Amateur Radio Association	3	981

Get More Online

This short article can only touch on a few high points — the complete results are available in the full-coverage online article at **www.arrl.org/contest-results-articles**. Swing your beams in that direction and pick up the whole story by K9JK!

The 2015 February School Club Roundup

1300 UTC Monday, February 9 – 2359 UTC Friday, February 13

Students of all ages will take to the airwaves the second week in February for the School Club Roundup! This week-long event showcases Amateur Radio in the classroom, but with a competitive twist.

- Separate categories for elementary school, middle school, high school, and college clubs.
- SSB and CW activity are encouraged.
- Submit scores online at **www.b4h.net/arrlscr**. All logs must be received by February 28, 2015.

Complete rules, logging sheets, and other resources can be found at
www.arrl.org/school-club-roundup

Neil Foster, N4FN, looks on as a Mill Springs Academy (Milton, Georgia) student makes a contact in the Fall 2013 School Club Roundup. [Martha Muir, W4MSA, photo]

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	1400		FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
7 AM-1 PM	8 AM-2 PM	9 AM-3 PM	10 AM-4 PM	1500-1700 1800-2045	VISITING OPERATOR TIME (12 PM-1 PM CLOSED FOR LUNCH)				
1 PM	2 PM	3 PM	4 PM	2100	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
2 PM	3 PM	4 PM	5 PM	2200	CODE BULLETIN				
3 PM	4 PM	5 PM	6 PM	2300	DIGITAL BULLETIN				
4 PM	5 PM	6 PM	7 PM	0000	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
5 PM	6 PM	7 PM	8 PM	0100	CODE BULLETIN				
6 PM	7 PM	8 PM	9 PM	0200	DIGITAL BULLETIN				
6:45 PM	7:45 PM	8:45 PM	9:45 PM	0245	VOICE BULLETIN				
7 PM	8 PM	9 PM	10 PM	0300	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
8 PM	9 PM	10 PM	11 PM	0400	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 2015, Headquarters and W1AW are closed on New Year's Day, Presidents' Day (February 16), Good Friday (April 3), Memorial Day (May 25), Independence Day (July 4), Labor Day (September 7), Thanksgiving and the following day (November 26 and 27), and Christmas (December 25). For more information, visit us at **www.arrl.org/w1aw**.

Bernie McClenny, W3UR, w3ur@arrl.org

KP1 – Navassa Island

After more than 2 decades, Navassa returns to the air.

In the last two "How's DX?" columns, KP1, Navassa Island has been mentioned and now we have many of the details of the upcoming DXpedition. Navassa is the very rarest of the DXCC Entities. It is number one on the ClubLog most wanted list and is the longest inactive DXCC Entity on the current list, with the last activation about 22 years ago!

Navassa Island is located 56 kilometers (35 miles) west of Haiti (HH), 165 kilometers (102 miles) south of Cuba (CO), and 137 kilometers (85 miles) east of Jamaica (6Y). The island measures 5.2 square kilometers (2 square miles). It is surrounded by 9 – 15 meter (30 – 50 foot) high vertical walls of coral and limestone and its highest elevation (Dunning Hill) is 76 meters (250 feet).

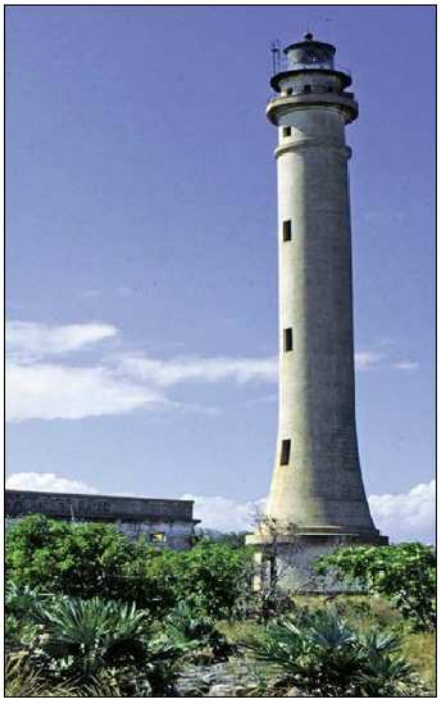
History of Navassa Island

In 1498, Navassa Island was discovered by Christopher Columbus. While stuck on Jamaica in 1504 during his fourth expedition to the new world, Columbus sent some of his men to the island of Hispaniola (current day Haiti/Dominican Republic), and along the way they stopped at Navassa Island.

Navassa lay unnoticed for 3 centuries until an American sea captain, Peter Duncan, claimed the island for the US under the Guano Island Act, on September 18, 1857 (despite the claims of Haiti, which were made in 1801). After the American claim, Haiti objected to the seizure of the disputed island. On July 7, 1858, President Buchanan issued an executive order calling for enforcement by the military. Since then the island has been an unincorporated American territory. Ultimately, the guano rights were sold to the Navassa Phosphate Company.

In 1865, after the Civil War, a larger guano mining camp was established on the island, which included railroad tracks and housing

for the employees at Lulu Town, just above Lulu Bay. In 1889 there was a heated dispute between the workers and management, which led to the death of five of the bosses. Three guano miners were accused of the crime. The case made it to the US Supreme Court, which ruled on November 24, 1890, in part, that Navassa Island be "considered as appertaining to the United States." The Navassa Phosphate Company ultimately abandoned the island and went bankrupt during the Spanish-American War. New proprietors acquired the island, but they left by 1901.



The lighthouse on Navassa Island. [USGS photo]

Due to the increase in shipping expected for the US East Coast with the opening of the new Panama Canal, the US Lighthouse Service (aka the Bureau of Lighthouses) constructed a 46-meter (150-foot) high lighthouse in 1917. Three people were required to maintain the lighthouse — a keeper and two subordinates. In 1929 the bureau automated the lighthouse, eliminating the need for lighthouse keepers. In 1939 the US Coast Guard took over the Bureau and serviced the light biannually. During World War II, the US Navy had an outpost on Navassa.

Between 1903 and 1917, the island was under the administration of the Guantanamo Bay Naval Base, then from 1917 to 1996 under the US Coast Guard, and from then to present under the US Department of the Interior (DOI). On December 3, 1999 Navassa Island was placed under the administration of the US Fish and Wildlife Service (FWS), which is an agency under the DOI.

DXCC History of Navassa Island

Navassa Island was not on the original post-World War II DXCC list. The ARRL® announced the addition of Navassa as an entity in the November 1954 issue of *QST*: "DXCC credit will be given starting January 1, 1955, for creditable confirmations dated on or after November 15, 1945."[1]

The first recorded operation from Navassa Island was by Russell Dunaja, Jr, K4NI, who was the lighthouse keeper in 1928 and

[1]"DXCC Notes," *QST*, Nov 1954, p 64.

1929. After World War II, the startup of the current DXCC program, and the addition of Navassa Island to the ARRL DXCC List, the first DXpedition was KC4AB in August 1954 by W4VZQ, W4QCW (now W4DR), and WN4HBC, who made 1300 contacts. On June 7, 1957, teenagers W2HQL/KC4 (now W1JR) and W2IWC/KC4 (now K6SSS) operated for 8 hours from the island. In March of 1958 operators from the Ohio Valley Radio Association, W2NSD, W4KVX, W8DJN (now W4QM), W8EZF, W8FGX, and W8RSW, put KC4AF on the air for 5 days, making a record 7000 contacts.

In the early 1960s, the US Coast Guard abruptly altered its policy of permitting amateur visits to the islands, causing Navassa to become rarer and rarer. During the mid '60s, a group of DXers made a "concerted effort to persuade the Coast Guard to reverse their position." An unauthorized K1IMP/KC4 DXpedition to Navassa in 1966 "only served to strengthen the Coast Guard's resolve to continue to deny permission for visits to the island." But persistence paid off for the W4s who eventually obtained the needed authorization, effective June 22, 1969: "The US Coast Guard reports that it will now give favorable consideration to a reasonable number of visits to Navassa Island (KC4) by amateurs."[2]

DXpedition activity started again in June 1969 and continued until March 1993. During that period, 11 valid DXpeditions were mounted to Navassa. In 1978, the W0RJU/KP1 and N0TG/KP1 DXpedition was the first to use the KP1 prefix. The last DXpedition to Navassa operated from March to April 1993 and included the first YL to operate from Navassa, JR4DUW.

Navassa Island QRV January 2015

On October 22, 2014, members of the KP1-5 Project (who brought us K5D on Desecheo Island — KP5 — in February 2009) announced that the US Fish and Wildlife Service granted the team authorization to conduct another DXpedition to Navassa Island in January 2015. Permission has been granted for a team of 15 operators to operate for 2 weeks from the most wanted DXCC Entity. In the team's press release they note the timing was decided because January is "the month of minimum bird nesting activity and this is the primary reason USFWS is asking that the operation be completed during that month." For safety reasons they will be getting on and off the island via helicopter, and it has been determined "as many as 10 round trips will be required at the beginning and end of the operation" from a point over 160 kilometers (100 miles) away.

K1Navassa

Due to the fact they cannot get a "real" KP1 call sign and using a home call/KP1 is much longer and promotes one specific person's call, the team has chosen the 1 × 1 call sign K1N, aka K1Navassa. Bob, K4UEE, and Glenn, W0GJ, are the co-leaders for this one and will be joined by veteran DXpeditioners George, AA7JV; Tomi, HA7RY/KT4TTT; Jorge, HK1R; Craig, K9CT; Ralph, K0IR; Bob, N2OO; Lou, N2TU; George, N4GRN; Mike, N6MZ; Mike, NA5U; Jeff, NM1Y; Gregg, W6IZT, and Jerry, WB9Z. As of press time, the exact dates for the operation were not known, but it looks like the last week of January and the first week of February.

Sponsorship

INDEXA was the first foundation to step up as a sponsor, followed quickly by Elecraft, SteppIR, Array Solutions, and DX Engineering as corporate sponsors. "The KP1-5 Project team has committed to fund up to 50% of the total cost" and "are hopeful the DX community at large will fund the remainder."

Equipment and Antennas

Plans are to have eight stations, including K3s, using green footprint technology consisting of batteries, small generators, solar, and wind power. They will have six 500 W, SGC-500 amplifiers for the high bands and will be running them in parallel pairs on 40, 80, and 160 meters. They will be using five two-element SteppIR antennas for "small footprint" and quarter wave verticals on 40, 80, and 160 meters. On 30 meters it will be a full-wave dipole.

No Leaderboards

The K1Navassa team will be using ClubLog; however, because of the rarity of this one they will not be using the "Leaderboard" feature, as their main goal is to work as many unique stations as possible. In this way they hope to give an "all-time new one" to as many stations as possible. They also want to work DXers who need KP1 on bands or modes that the DXer has *not* previously worked. The operating team kindly asks that if you have Navassa confirmed on a band/mode, please do not repeat the contact. In other words, if you have KP1 confirmed on 80 meter RTTY, please don't call them again for another 80 meter RTTY contact.

QSLing K1N

Bob, N2OO, and his crew will be handing the QSL chores for this DXpedition. The team wants to emphasize the need to use their OQRS (Online QSL Reply System), as they will be prioritizing their QSLing efforts as follows: 1. OQRS Direct; 2. Direct (postal mail) requests; 3. OQRS bureau, and last via the bureau. In fact, they don't even want your QSLs, so this is another reason to use either OQRS direct or bureau. As a reminder, a DXpedition of this scale is not cheap and they are seeking sponsorships from foundations, corporations, clubs, and individuals. Complete details can be found on the team's website at **www.navassadx.com**.

Wrap Up

That's it for this month, with thanks to K4UEE and the KP1-5 Project team for helping to make this month's column possible. Don't forget to send your DX news, photos, and club newsletters to **w3ur@arrl.org**. Until next month, see you in the pileups! — *Bernie, W3UR*

[2]"Navassa Island Open to Visitors," *QST*, June 1969, p 79.

Jon Jones, N0JK, n0jk@arrl.org

The South Pacific On 6 Meters

October brought an E-layer hotspot bridging the Pacific from Australia to the Eastern US.

A remarkable series of openings occurred between the South Pacific and North America during the month of October. It seemed that almost every evening FK8CP and others were spotted along the Gulf, West Coast, and Midwest central states. On a couple of evenings, spots appeared for Remi east to New York, Maryland, and Virginia. Stations in eastern Australia made contacts to the Midwestern states. ZL1RS made contacts as far east as Virginia on the 22nd.

Rich, K1HTV, reports that October 22 UTC:

> I was chasing W1AW/7 and W1AW/8 on the HF bands when I noticed a DX cluster spot from WZ8D in Ohio that he had just worked a New Caledonia station on 6 meters. I tuned to 50.110 MHz and there was FK8CP on CW. Remi was my 6 meter DXCC country #155. I quickly called W3LPL in Maryland, and a few minutes later Frank worked FK8CP, as did his neighbor Bernie, W3UR (*QST*'s "How's DX?" columnist), both in FM19.
>
> Remi continued calling CQ North America on both CW and SSB. His signal varied from just at the noise level to S4. Remi was last heard at my Virginia shack at 0415Z. In all, FK8CP was heard here for 55 minutes! That afternoon (still the 22nd UTC), N4DB, who also lives in Virginia, 103 miles SSW of me, heard ZL1RS for 2 minutes and worked him at 2340Z! Dave reported that he peaked briefly at S7. I only heard ZL1RS very weakly for just 10 seconds.

Dan, KF6A (EN74), worked ZL1RS as well. WA8MKY's spot for ZL1RS at 2331Z sums it up "Wow. Worked ZL on 6 meters from Michigan."

How Did This Happen?

Jim Kennedy, K6MIO/KH6, (see Figure 1) comments:

> The usual evidence, for a North America-South Pacific path being sporadic E (E_s) plus transequatorial propagation (TEP), is the mapping of the paths from the NA end down to the northern TEP lane (the northern branch of the TEP crest). The location of the needed extra skip point for the southern tier of states usually matches E_s quite well.
>
> These paths necessarily involve first-hop ground footprints that are over empty ocean. So, from the southern tier of the US, there wouldn't be any evidence of stations at the footprint of the first hop south that could conclusively confirm E_s.
>
> For links that seem to require two hops of E_s, the location of the expected first hop going south, generally lands in low population-density areas (if not the ocean), arguably with the same result.
>
> Especially in this "long" case, another factor to consider is the possibility of a first chordal E hop. This would require less ionization for the first of the two supposed E_s hops and would eliminate an intermediary ground point where other stations might be found.

I asked Jim if the link could be something other than E_s, such as direct F2? Jim said it was possible.

"Ordinary mid-latitude F2 seems unlikely, especially for the southern tier and I am not aware of any independent evidence of this sort of thing," Jim said. "So far, the evidence suggests E_s involvement, but the absence of stations at the intermediate ground points does leave the question open." Tim, NW0W, noted several times when FK8CP was heard in Missouri, he did not hear or "see" 6 meter beacons on the band or other signs of sporadic E. He can see the whole band on his band scope. So perhaps it was E_s chordal hops or something else? But conventional E_s certainly played a significant role many times.

On October 22, when K1HTV worked FK8CP on 6 meters, single-hop sporadic E DX cluster spots at about 0325Z, such as K2MUB (FN21) to N0JK (EM28), N4QWZ (EM66) to K0ZX (DM79), and WG2Z/b (FN21), K8MMM/b (EN91) by K4VVM (EM55), reveal stations via E_s present at the "intermediate ground points" for the E_s link connecting Rich to FK8CP.

On October 29 UTC, the path to the South Pacific opened again on 6 meters for stations in northern W8, W9, and W0, such as KA9FOX (EN43), who worked FK8CP at 0113Z. The same evening, Jay, W9RM (DM58), heard the 8s, 9s, and 0 stations calling and working FK8CP (see Figure 2). Jay was located at their first E_s hop and is on

Figure 1 — Jim Kennedy, K6MIO/KH6, presents an excellent talk on 50 MHz long path propagation at the W6JKV BBQ in Austin, Texas on September 27, 2014. [J. Jones, N0JK, photo]

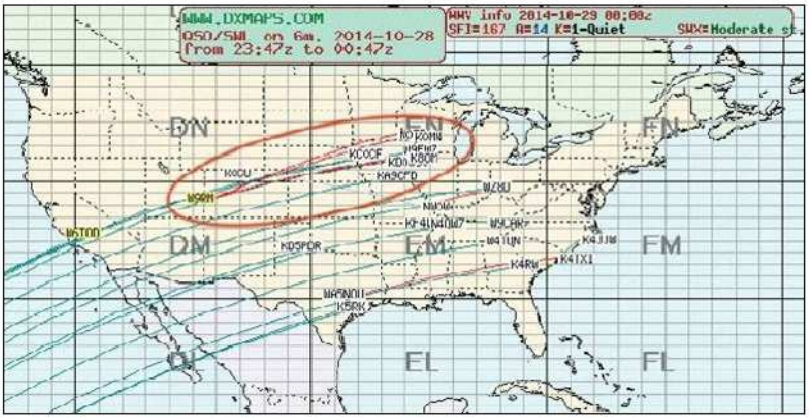


Figure 2 — Map showing spots and contacts between FK8CP and North America, October 28/29 UTC. This map shows W9RM spots (see oval) of stations in IA, IL, MN, and WI who were calling/working FK8CP via single hop E_s. The E_s cloud is over western Nebraska. W9RM was also hearing FK8CP on the great circle bearing for the W9 and W0 stations to FK8CP. The E_s spots are in red, F2 are in blue. [**dxspots.com**]

the great circle path from them to the South Pacific. Jay, K0GU (DN70), said FK8CP was "20 over S-9" in Colorado during this period and Jay worked five VK4s on this opening. Sporadic E was present many days in October. Statistically, the month of October has few E_s openings, with only March having less. High solar flux from giant sunspot 2192 surely helped by moving the 50 MHz MUF of the TEP zone farther north from the geomagnetic equator and closer to North America.

The "Missing" 222 MHz Band

FM is a low-cost way to get started on 222 MHz. Many popular radios include 50, 144, and even 432 MHz along with the HF bands, but not the 222 MHz band. One reason is the 222 MHz band is not available in Europe or Asia. This is unfortunate, as it is a great UHF band. Tropospheric conditions are often better on 222 MHz than 144 or 432 MHz. Meteor scatter, aurora, and even E_s contacts are possible on 222.

How can you get started? What radios and antennas are available? Wayne Overbeck, N6NB, has these suggestions:

> In California, most 222 MHz contesting, and even a fair amount of DXing, is on FM — precisely because low-cost, high-performance FM transceivers are readily available. There are combination 144 / 222 MHz FM transceivers available new from US dealers for about $100. I've seen importers selling them for as little as $30 on eBay. Recently, *QST* carried an ad for a 50 W 222 MHz transceiver for under $200. [On Amazon the 55 W TYT TH-9000D 222 MHz transceiver has been offered as low as $145. — *Ed.*] Alinco (**www.alinco.com**) makes a combination 222 and 902 transceiver that puts you on both of those bands for between $200 and $300.
>
> During the July 2014 tropospheric opening to Hawaii, I worked KH6HME (Fred, KH7Y, operator) over that 2500-mile path on 223.5 MHz FM and did it easily with loud signals. Nobody has spanned the Pacific on 222 MHz SSB or CW in a long, long time. There's a video of that contact on YouTube (search for "KH6HME" and "N6NB" as keywords). Yes, I was using a transverter, but I could have done it just as easily with a small, inexpensive FM transceiver.
>
> Within California, we routinely work over mountain ranges on 222 FM, with signals often better than what we're hearing on 144 MHz SSB. Granted, part of that is attributable to 222 being such a good tropo band — almost always better than 144 or 432 over rugged paths in the southwest. On my Utah DM37 DXpeditions, I have consistently seen better signals on 222 than on 144 over the years, regardless of the mode. It's no accident that during VHF contests we use 222 FM as our liaison band to coordinate long-haul SSB contacts on other bands. We use the band and mode that has proven to be the most reliable over time.
>
> My suggestion: don't sell FM short as a DX and contest mode. If you're not on 222 MHz now, buy an inexpensive FM transceiver and join the action on this amazing band. If you opt for the Alinco G29, you'll instantly be on both 222 and 902. One caveat: don't expect miracles on 902 MHz. 902 is a shared band so full of other users that the noise level can make it impossible to work stations that are easily workable on every other band from 6 meters through 10 GHz.

Another way to get on 222 MHz is with a transverter, as mentioned by Wayne. A transverter converts 222 MHz to the 28 MHz band and vice versa. Transverters have the advantage of allowing you to operate SSB, CW, and FM on 222 MHz using your HF radio. In the May 2001 issue of *QST* is an article about how to modify the TEN-TEC 1210 transverter to 222 MHz.[1] I have found 10 W, 222 MHz transverter boards for sale on eBay for around $100. Wayne's Quagi design (a hybrid of a Quad and Yagi) is an easy-to-build antenna with good gain for use on the 222 MHz band. Information about making your own Quagi can be found at **n6nb.com/quagi.htm**. M² (**www.m2inc.com**) makes a fine series of 222 MHz antennas. InnovAntennas US (**www.innovantennas.us**) offers the innovative LFA Yagi for the 222 MHz band.

On the Bands

50 MHz. Larry, N0LL (EM09), in Kansas worked FK8CP (RG34) on October 5 and put Australians VK4MA and VK4WTN in his log on the 6th around 0200Z. Larry said both FK8CP and VK4MA reported hearing his beacon! E_s was confirmed as the link when NW0W (EM47) spotted the K5AB and KF5KOI beacons in south central Texas at 0155Z during this opening. The YJ0X DXpedition reported 40 contacts on 6 meters. On his birthday, Fred, KH7Y, worked YJ0X October 6 with 59 signals. A nice present! YV4NN worked DU7/PA-0HIP at 0408Z on the 9th. Drew, K3PA (EM29), logged VK4s and FK8CP on the 10th. The next evening (October 11 UTC) K2MUB (FN21) heard FK8CP at 0056Z. On the 22nd, W4ETN worked FK8CP at 0043Z.

On October 23 Jay, K0GU (DN70), worked CT1HZE beaming direct path at 1610Z, it was possibly F2 from Portugal to Canada. Then Jay noted some weak E_s and meteor scatter present, which may have created a link. A strong F2 opening between Hawaii and North America started at 2200Z. Fred, KH7Y (BK29), worked over 300 W6 and W7 stations. "Many signals pegged the S-meter. All the W6s were in the southern part of California except for Bob, K6QXY,

[1] J. G. Botts, K4EJQ, "Get on 222 MHz With the Ten-Tec 1210 Transverter," *QST*, May 2001, pp 28 – 33.

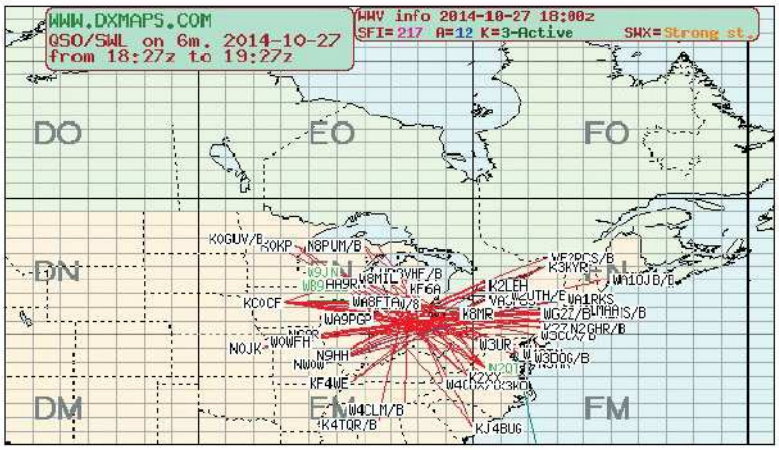


Figure 3 — Map of the October 27, 6 meter E_s opening from the Midwest to W1, W2, W3, etc. [**dxspots.com**]

(north of San Francisco) who had a rock-crushing signal. Then a few in Nevada were worked, a good number from Arizona, and a few from Texas and Oklahoma." Fred worked stations in South America, including CP6UA for a new country on 6 meters.

On October 24, a rare opening occurred between the Pacific Northwest and South America. Johnny, KE7V, relates "I started hearing CX7CO in Uruguay around 2215Z very weakly. Finally, his signal rose enough to call him at 2225Z and we worked. This is a very rare opening to us."

On the 27th, PY3PR worked 17 JA stations around 0015Z. These may be the first Brazil – Japan 6 meter terrestrial contacts of solar cycle 24. Long duration North American E_s was also recorded on the 27th (see Figure 3). Here in Kansas, New England stations were strong for over 4 hours starting around 1700Z on single hop E_s. The 8 W N2GHR/b (FN30) was solid. Ron, WZ1V (FN31), also noted strong E_s to the Midwest. Ron was 40 dB over S-9 for me at 1955Z. Earlier, Ron worked CT1HZE, CU1EZ, and VO1 via a possible E_s link to F2. KH7Y (BK29) logged 9M2IDJ with 339 signals "for a new one" on the 28th.

Dave, N9HF, reports he now has the 100 confirmations for 6 meter DXCC. "Due to a long-lost contact I had in 2007, and by using LoTW, I now have 6 Meter DXCC. In the last week of September, a LoTW confirmation came in for a country I had worked back in 2007 and made the total 100!" Thanks to K2UNK, K6UM, K7JA, K9IL, N4PZ, VE3CFK, WB8VLC, and W0WOI for their reports.

144 MHz. Sam, K5SW (EM25), in Oklahoma found tropo on October 25. "I heard a weak SSB signal on 144.200 (around 1420Z – 1430Z) as I was beaming NE. It was W9EWZ (EN52). I worked Bob, then ran with Don, WA9KRT (EN61), from IN on 144.170 and worked him 559/569."

Les, N1LF, in Alabama qualified for 2 meter VUCC, as he explains:

> For the past 6 days, I had asked my wife several times a day if the mail had come yet. Not since the days of box tops and novelty catalogs had I anticipated the arrival of the day's mail so keenly. Today, I had been distracted and missed the carrier's arrival. A few hours later, I asked my wife if anything had come for me. Abby just smiled and said, 'Yes, I left it on the arm of the chair in the living room.' There it was, the card from VA3ZDX confirming EN93.
>
> When each issue of *QST* arrived, I read the 'World Above 50 MHz' column with some interest. Reading through some back issues one day, I re-read a column from Gene Zimmerman, W3ZZ, called 'Chasing VUCC' that was all about earning VUCC.[2] I hope that Gene knows he inspired someone with his words that day. I'll be forever grateful for what he brought into my life. This one's for you, Gene.

Les achieved VUCC using attic antennas and 100 W.

222 MHz. N0IRS (EM29) heard the N8HF/b in Illinois on 222.088 MHz on October 25.

432 MHz. WB4SLM (EM82) worked KD4ESV (EL87), N4NGZ (EL98) at the office with an indoor antenna, N4TWX (EL89), and N4TUT (EL98) on tropo on October 22. "Ken, N4TUT, was absolute full scale on the meter." Jim, KH6HTV, reports a new one-way digital TV record of 70 miles on the 28th in Colorado.

1296 MHz. Vic, WB4SLM, worked N4TUT and N4TWX with strong signals October 22.

[2]G. Zimmerman, W3ZZ, "The World Above 50 MHz," *QST*, Nov 2006, pp 90 – 92.

Here and There

The KP1-KP5 project announced on October 22, 2014 that they have been chosen to activate Navassa Island for an approximately 2-week period in January 2015 (see this month's "How's DX?" column for more information). Please support the team and mention 6 meters with your donation.

Stan, KA1ZE, has restarted the 205 Morning Report on a monthly basis. A monthly "DX Dog" page will list all stations reporting contacts over the following minimums:

- 144 MHz 400 miles (390 OK)
- 222 MHz 300 miles (290 OK)
- 432 MHz 300 miles (290 OK)
- 902 MHz 200 miles

Interesting 50 MHz reports are welcome along with station and antenna pictures, etc. Send information to Stan at **ka1zenr1l@hotmail.com**. An archive can be found at **ka1ze.com**.

Roger, W8IO, has resurrected the Michigan VHF-UHF Society. If you live in the area and are interested in weak signal work at 50 MHz and above, you are invited to visit and join the Society at **www.mivus.org**. Thanks Tom, K8TB.

Chip, K7JA, says InnovAntennas America announces "North American availability of the world's highest performing VHF Yagis by boom length: the Owl G/T — optimized wideband low-impedance high gain Yagi antennas." The 144-OWL-7-GT for 2 meters lists at 13 dBi gain on a 10-foot boom. More information can be found at **www.InnovAntennas.com**.

Strays

QST Congratulates...

Ryan Ritchey, KA3ZZC, on the release of his video documentary *After the Fair — The Legacy of the 1964 – 65 NY World's Fair*. The video is available for purchase at **worldsfairmovie.com**.

Special Event Stations

Maty Weinberg, KB1EIB, events@arrl.org; www.arrl.org/special-event-stations

Working special event stations is an enjoyable way to help commemorate history. Many provide a special QSL card or certificate!

Dec 25 – Jan 5, 0000Z – 2359Z, various call signs, worldwide. First Class CW Operators Club. ***FOCUS* Magazine 25th Anniversary & 100th Issue**. 3.525 7.025 14.025; see URL for a list of all frequencies. Certificate. Gabor, S57WJ, Na Sancah 114, 2390 Ravne na Koroskem, Slovenia. *FOC members will be calling "CQ FOC25." FOCUS QSO Party operating at same time.* **www.g4foc.org**

Dec 28 – Jan 4, 0001Z – 2359Z, W2HRU, Bethpage, NY. Ham Radio University Amateur Radio Club. **Ham Radio University/NLI Section Convention**. 21.273 14.273 7.273. QSL. W2 QSL Bureau, eQSL, LoTW, or direct to Phil Lewis, N2MUN, 22 Belle Terre, West Lindenhurst, NY 11757. **www.hamradiouniversity.org**

Jan 1 – Jan 31, 0000Z – 2359Z, VG3SJAM, Kingston, ON. Kingston Amateur Radio Club. **200th Birthday of Sir John A. Macdonald**. 14.250. Certificate & QSL. Kingston Amateur Radio Club, c/o 168 McMichael St, Kingston, ON K7M 1N6, Canada. **vg3sjam@ve3kbr.com** *or* **www.ve3kbr.com**

Jan 1 – Jan 31, 0000Z – 0000Z, W9JUQ, Shelbyville, IN. Blue River Valley Amateur Radio Society. **Celebrating Amateur Radio in Shelby County, Indiana**. 14.263. QSL. John E Walker, 302 W Hendricks St, Shelbyville, IN 46176. **www.brvars.com**

Jan 1 – Dec 31, 0001Z – 2359Z, K6BB, Big Bear Lake, CA. Big Bear Amateur Radio Club. **40th Anniversary Year**. 28.440 21.340 14.340 7.240. QSL. BBARC, PO Box 790, Big Bear Lake, CA 92315. *This year-long event will be on the air at various times throughout 2015. The actual anniversary is in September.* **www.bbarc.org**

Jan 2 – Jan 31, 0000Z – 2359Z, K3Y. Straight Key Century Club. **9th Anniversary Celebration**. 28.050 14.050 7.055 3.550. QSL. Jeff Peters, K9JP, 5562 Heritage Way, Traverse City, MI 49685. *Celebrating 9 years of steady growth to over 13,000 members worldwide.* **www.skccgroup.com**

Jan 3 – Jan 5, 1400Z – 0200Z, N0J, Lake Ozark, MO. Lake of the Ozarks Amateur Radio Club. **Lake of the Ozarks Eagle Days**. 21.300 14.320 7.240. Certificate.* Glenn Commons, 103 Helinda Ln, Lake Ozark, MO 65049.

Jan 7 – Jan 11, 0000Z – 1200Z, W7D, Sonora Desert, AZ. Area Amateurs. **Camino del Diablo**. 14.260 14.070 14.030 7.260. QSL. Bob Henderson, 104 Saranac Dr, Missoula, MT 59803. *Various desert locations. PSK31, CW, SSB on the 10–40 meter bands.* **www.qrz.com/db/w7d**

Jan 10, 1400Z – 2000Z, W4FFC, Port Saint Joe, FL. Gulf Amateur Radio Society. **State of Florida Constitution Convention Commemorative Special Event**. 21.275 14.275 7.177; 14.075 digital. QSL. Norm Bixler, 2003 Cypress Ave, Port Saint Joe, FL 32456. **www.gulfars.net**

Jan 10, 1600Z – 2000Z, W0CS, Clinton, IA. Clinton Amateur Radio Club. **Eagle Watch On The Mississippi River**. 14.255 7.255 7.045 145.430 – 100 Hz PL. QSL. Clinton Amateur Radio Club, PO Box 1501, Clinton, IA 52733. **www.qrz.com/db/w0cs**

Jan 10, 1700Z – 2300Z, WA6HP, Upland, CA. Heaps Peak Radio Association. **Radio Day at Upland Memorial Park**. 28.450 14.070 7.250. Certificate & QSL. Heaps Peak Radio Association, PO Box 4468, Ontario, CA 91761. **ag6hq@arrl.net**

Jan 10, 1700Z – 2359Z, NI6IW, San Diego, CA. USS *Midway* (CV-41) Museum Ship. **Battle of Midway Exhibit Inauguration Special Event**. 14.320 7.250; PSK31 on 14.070 D-STAR REF 1C. QSL. USS *Midway* (CV-41) Museum Radio Room, 910 N Harbor Dr, San Diego, CA 92101.

Jan 24, 0700Z – 1500Z, WA4TRS, Fairview, NC. The Road Show Amateur Radio Club. **Madison County Special Olympics Polar Plunge**. 14.245 7.245. Certificate & QSL. The Road Show ARC, 57 Echo Lake Dr, Fairview, NC 28730. *This is also a USI Activation — USI 036R.* **www.wa4trs.org**

Jan 24, 1600Z – 2100Z, KS0KS, Olathe, KS. Santa Fe Trail Amateur Radio Club. **Kansas Day**. 28.320 21.320 14.250 10.115. QSL. Santa Fe Trail ARC, KS0KS, PO Box 3144, Olathe, KS 66063. Mahaffie Heritage Center, Olathe, Kansas. *Kansas joined the Union Jan. 29, 1861.* **www.sftarc.org**

Jan 24 – Jan 25, 1700Z – 1700Z, N8W, Mineral City, OH. SPAR Society for the Preservation of Amateur Radio. **Winter Field Day**. 14.210 7.050. QSL. Tom Phelps, 235 Leonard Ave NW, Massillon, OH 44646. *SSB, CW, and PSK.* **www.spar-hams.org**

Jan 31, 1300Z – 1800Z, WX4MPD/WX4EMA, Macon, GA. Macon Police Department Amateur Radio Club and Macon Bibb Emergency Management Agency. **Macon Police and Bibb County EMA**. 14.250 14.244. Certificate. Macon Police Dept ARC, 123 Kensington Cir, Warner Robins, GA 31093. *Being held with the 2015 Bibb County Communications Exercise.* **ak4df@yahoo.com**

Jan 31, 1600Z – 2100Z, WE7GV, Tubac, AZ. Green Valley Amateur Radio Club. **21st Tubac Collector Car Show Special Event**. 14.246 14.244 14.242. Certificate & QSL. Green Valley Amateur Radio Club, 601 N La Canada Dr (SAV), Green Valley, AZ 85614. *Santa Cruz Valley Car Nuts 21st annual car show.* **gvarc.us**

Certificates and QSL cards: To obtain a certificate from any of the special event stations offering them, send your QSO information along with a 9 × 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 **Mar** *QST* would have to be received by **Jan 1**. In addition to being listed in *QST*, your event will be listed on the ARRL Web Special Event page. Note: All received events are acknowledged. If you do not receive an acknowledgment within a few days, please contact us. ARRL reserves the right to exclude events of a commercial or political nature.

Special Events listed in this issue include current events received through November 7. You can view all received Special Events at **www.arrl.org/special-event-stations**.

January 2015 W1AW Qualifying Runs

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

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

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

January Qualifying Runs will be transmitted by W1AW in Newington, Connecticut at 10 PM EST on Friday, January 9 (0300 UTC January 10) and at 9 AM EST on Thursday, January 22 (1400 UTC) at 1.8025, 3.5815, 7.0475, 14.0475, 18.0975, 21.0675, 28.0675, and 147.555 MHz. The West Coast Qualifying Runs will be transmitted by K6YR on Wednesday, January 14, at 9 PM PST (0500 UTC, January 15) at 3590 kHz. Unless indicated otherwise, sending speeds are from 10 to 40 WPM.

Maria Somma, AB1FM, VEC Manager, ab1fm@arrl.org

Resources for Volunteer Examiners

ARRL VEC on the web, and information on the 2015 exam fee and question pools schedule.

The ARRL VEC VE support page, **www.arrl.org/resources-for-ves**, offers information you need to conduct exam session business, compiled in one convenient location. ARRL VEs can register Amateur Radio exam sessions and order exam supplies quickly and easily by using our interactive web forms.

Register your ARRL VEC sponsored Amateur Radio license exam sessions and order supplies at **www.arrl.org/register-an-amateur-radio-license-exam-session**. Completed online exam registration forms will automatically be sent to the VEC department for review and release to the exam search web page, **www.arrl.org/exam search.** It normally takes a couple of business days for us to upload the approved listing. Registering well in advance of the exam date ensures that the information reaches potential candidates.

ARRL VE Teams officially field-stocked by the ARRL VEC with a bulk quantity of our exam materials should check our VEC Exam Booklets page periodically at **www.arrl.org/vec-exam-booklets** to ensure your VEC printed exam booklets are up to date. Field-stocked VE teams should also be vigilant about keeping us informed of who has possession of the exam supplies. To restock exam supplies via the online VE team restock form, or to see if your team qualifies to be field-stocked with a year's supply of exam materials, visit **www.arrl.org/field-stocked-ve-teams**.

Useful Information for Candidates and VEs

On July 21, 2014, the FCC revised the Amateur Service Part 97 rules to grant partial written examination element credit to holders of expired General, Advanced, and Extra licenses. Information for VEs can be found on the VE Resources page in the section titled "New Exam Element Credit." Additional information and clarification is located on the Exam Element Credit web page, **www.arrl.org/exam-element-credit**.

To ship your completed exam session packages to ARRL, please use plain white envelopes (provided upon request) with the ARRL VEC self-adhesive First Class Business Reply Mail (BRM) labels. We ask that you no longer use Priority Mail envelopes in conjunction with the postage paid labels. Remember to include a return address on the package. We request your assistance in making the most effective use of this service by processing and shipping your sessions as soon as possible but no later than 10 days after the exam.

Our VE Resources page offers easy access to exam forms and information, question pools, FCC Rules, and much more.

2015 ARRL VEC Examination Fee Remains at $15

The ARRL VEC exam fee for 2015 will remain at $15. Remember that a $15 fee is charged to every person seeking a new license or upgrade, as listed on your ARRL VEC Candidate Roster. That one fee pays for one attempt at each of the three exam elements. If an applicant retests an exam element that was failed moments earlier, another $15 fee is charged (and another Roster entry is created).

VECs are allowed to collect an examination reimbursement fee from each candidate who takes one or more exam elements. These exam fees help the VEC recover its costs of providing its services. Per FCC Rule §97.527, VECs and VEs may be reimbursed by examinees for out-of-pocket expenses incurred in preparing, processing, administering, or coordinating an examination for an amateur operator license.

As long as the expense is warranted and has been prudently incurred, and the expense is specifically related to exam administration, then the reimbursement fee can be retained. ARRL VE teams may retain up to $7 of this fee to directly reimburse their teams' out-of-pocket examination expenses encountered in conducting their examination sessions. The team should keep a complete record of the expenses paid (with receipts) in team records for 2 years. Records must be made available to ARRL VEC upon request. Costs should not exceed the allowable reimbursement fees and may not be kept if no expenses were incurred.

Exam fee and reimbursement information for VE Teams and examinees are on the ARRL VEC exam fee page, **www.arrl.org/arrl-vec-exam-fees**.

Current Amateur Radio Question Pools

Technician class (Element 2) Pool effective July 1, 2014 is valid until June 30, 2018.

Current General class (Element 3) Pool effective July 1, 2011 is valid until June 30, 2015.

New General class (Element 3) Pool will take effect July 1, 2015 and will be valid until June 30, 2019.

Amateur Extra class (Element 4) Pool effective July 1, 2012 is valid until June 30, 2016.

All current question pools, questions withdrawn from the pools, and useful information pertaining to the pools can be viewed at **www.arrl.org/question-pools**.

2015 ARRL National Exam Day Weekends

ARRL sponsored national exam day weekends are held annually on the last full weekends of April and September.

April national exam day weekend is April 25 – 26, 2015.

Fall national exam day weekend is September 26 – 27, 2015.

We thank you for your support of these events!

From Separates to Combos to Transceivers

The transceivers we take for granted today have their roots in a design revolution that began in the 1950s.

Ron Pollack, K2RP
k2rp@arrl.net

In the beginning, there were transmitters, and there were receivers. Each was self contained, with no mutual parts or circuits, and a ham needed (at least) one of each to get on the air. This operating environment presented special challenges that are largely unknown to amateurs today.

For example, crystals were often used to control the transmitting frequencies. While some Variable Frequency Oscillators, or *VFO*s, were available for transmitters before World War II, they were not common devices until well into the 1950s. Until then, hams were often restricted to transmitting on discrete frequencies that were dictated by the crystals they owned.

Since the transmitter frequency was determined by the crystal, the common practice was to call CQ and then "tune the band" with your receiver for a response. Needless to say, this was inefficient in terms of spectrum usage because conversations would often end up occupying two separate frequencies.

Another consequence of separate frequency determining systems for transmitting and receiving was the practical inability to conduct net or "roundtable" operations on a single frequency, unless all members owned the same crystals.

Taking your station mobile was another challenge. Imagine trying to drive while dealing with the hassles of tuning and transmitting, let alone the inconvenience of trying to accommodate two sizable boxes in your car.

But mobile operating was on the rise in the postwar world. Changes in regulations, vehicles and lifestyles were driving factors (no pun intended). The transformation of automobile electrical systems from 6 V to 12 V, and the popularity of automatic transmissions and power steering soon made mobile operating easier and safer. At about the same time, changes in FCC rules made HF mobile possible on any band and mode.

All of these pressures spurred demand for a technological solution. Hams wanted radios that were frequency agile on receive *and* transmit. They also wanted rigs that combined receivers and transmitters into single enclosures that were more compact and convenient to handle — especially with mobile operating in mind.

In other words, hams wanted *transceivers*.

Early Hurdles

You'd think transceiver development would have been relatively easy, but it wasn't. One hurdle was the fact that receivers and transmitters approached frequency manipulation differently in those days — and we're not talking about just knobs and crystals.

Most transmitters generated signals at one or more of the harmonically related amateur bands by starting with a fundamental frequency and then using multiplier stages to drive the final amplifier at the desired frequency. In contrast, in "superhet" receivers, the incoming signal was mixed or "heterodyned" with a local oscillator operating on a frequency outside the desired band. This created a sum or difference known as the *Intermediate Frequency*, or IF, that would be amplified, detected, and processed to produce an audible result. The local oscillator in the receiver, and the oscillator in the transmitter, therefore, were on different frequencies because they had different design goals. As a result, the receiver oscillator couldn't work in the transmitter chain, and vice versa.

The advent of single sideband (SSB) provided a solution. In the early days of the new mode, the SSB RF signal was typically generated at 9 MHz. That may seem an odd choice until you consider that if you mixed this signal with the output of a VFO operating in a range from 5 to 5.5 MHz, you could use the heterodyne method to combine the two signals and generate an RF output on two bands.

It worked like this: When you combined the 5 to 5.5 MHz VFO signal with the 9 MHz SSB signal the *sum* was a signal between 14 and 14.5 MHz, which provided coverage across the 20 meter band. Take the *difference* instead and you get an output in the 80 meter band (3.5 to 4 MHz).

Engineers quickly discovered that with the proper application of this heterodyne sleight of hand, they could create a single circuit capable of generating *both* the trans-

A Collins KWM-1 transceiver with matching speaker/power supply. [Mark Mumaw, NU6X, photo]

mit and receive frequencies. Now a single radio, in a single box, could easily transmit and receive on the same frequency. The transceiver had been born.

The Collins KWM-1

One of the first amateur transceivers out of the gate in 1957 was the Collins KWM-1. The transceiver was light and small (relatively speaking), and was designed for easy transition between car and home, making it practical to use the same rig for both environments. The KWM-1was not the first factory-built SSB transceiver, though. That distinction goes to the *Cosmophone*, which was introduced a bit earlier, but it was not a commercial success and fewer than 100 were built.

Major advances in Amateur Radio technology are usually accepted cautiously by the ham community, but not so the SSB transceiver! When the KWM-1 was reviewed in *QST* in April 1958, the traditionally dry, unbiased reporting of features and design began instead with enthusiasm and excitement about the breakthrough. The author opined that this "...may well mark the end of one era and the beginning of another. This unit is more than another piece of ham gear; it could be a way of life."

There were, of course, some drawbacks to those early designs. The greatest of these was perhaps the fact that split frequency operation was impossible. Early transceivers lacked the dual VFOs and offset tuning that we take for granted in HF gear today. The early SSB transceivers also did not offer AM or CW capability, or at least had limited features when operating in those modes.

The KWM-1 was restricted to 20, 15, and 10 meters, upper sideband only. In the fall of 1959, Collins introduced the KWM-2 and it was an instant hit with its 80 through 10 meter coverage.

A Slow Takeoff

With such enthusiastic reviews for the new Collins transceivers, you'd think that other manufacturers would jump on the transceiver bandwagon right away, but they didn't.

The old-line manufacturers continued to produce large, heavy transmitters. Many were still plate-modulated AM; some were SSB. Perhaps the idea of "separates" was too ingrained; perhaps there was uncertainty that the market could support equipment that had limited, if any, AM capability. It is also possible that they assumed that the technical challenge wasn't worth the meager financial reward. In any case, no one immediately followed the path blazed by Collins.

It would be several years before more transceivers appeared on dealer shelves. Swan was among the first of several transceivers, with their line of single-band transceivers covering the 80, 40, and 20 meter bands.

Heathkit offered its own single-banders, which covered the same bands. They were very light, offered outstanding performance, and were easy to build on one large circuit board. They were very popular and are still heard often on the air more than 50 years later.

Multiband transceivers followed, with a number of 80-40-20-meter rigs produced by National (the NCX-3), Swan (the SW-240) and others. In time, all-band transceivers became the norm.

The First "Combo"

In November 1958, to great fanfare, Collins introduced the legendary S Line, consisting of the 75S1 receiver and 32S1 transmitter, as well as a power supply and other accessories. This equipment was unique in that the PTO, the frequency determining circuit in the receiver, could control the transmit frequency as well. With the flip of a switch, the two radios could be tuned separately, making split frequency operation a reality (early transceivers were still incapable of this feat).

Of course, the S Line was designed for SSB and CW only, with no provision for AM, but it offered a compromise to the marketplace. The radios were compact and styled to fit into a home's décor.

By the early 1960s, the success of the S Line convinced the older manufacturers that there was indeed a market for these "combo" units. Heathkit offered the SB-300 receiver and SB-400 transmitter, which closely resembled the Collins product in appearance. Unlike Collins, the SB-400 contained a built in power supply and the pair was priced at a fraction of the cost of an S Line.

Drake, who had pioneered smaller, lighter receivers with their 1-A, 2-A, and 2-B models, joined in with the R4/T4 combos. Hallicrafters, Kenwood, Yaesu, and Swan, among others, marketed similar units. Some, like the Drake 4 line and Kenwood 599 "twins," even had the ability to use the transmitter to control the receiver and vice versa.

While the features of these combo units varied, they were all designed with an emphasis on SSB use. However, many also offered narrow CW filters, break-in keying, CW sidetone, and other features attractive to CW operators. Perhaps one reason for the eventual shift to SSB as the standard in HF voice communications was the attraction of these enhanced features in the SSB-centric rigs.

The combo radios were compact, attractively styled, convenient to use and versatile. From the Collins' introduction in 1958 through the '60s and well into the '70s, the combos remained enormously popular. Many of them, notably those from Collins and Drake, are highly prized among collectors today.

Transceivers Take the Lead

Eventually, the rapid evolution of transceiver technology made the combos obsolete. Dual VFOs, split frequency operation, incremental tuning and a host of improvements eroded the advantages of separates. When radios became all solid state with broadband tuning, making "peaking the grids and dipping the plates" a thing of the past, the era of separates and combos came to an end.

A Heathkit SB-401/SB-303 combo. [Michelle Kaplow, photo]

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

QUARTZFEST CONVENTION

January 18 – 24, Quartzsite, AZ

F H S V

9 AM – 8 PM. *Spr:* Quartzfest Organizers. Roadrunner BLM Short Term Camping Area, 53rd St N. RV camping. *Tl:* 146.55. *Adm:* Free. **www.quartzfest.org**.

Arizona (Sun City) — Feb 2. A **www.westvalleyarc.org/**.

Colorado (Brighton) — Feb 8 D F H R V

9 AM – 1 PM. *Sprs:* Aurora Repeater Assn, Cherry Creek Young ARC, and Rocky Mountain Ham Radio. Adams County Fairgrounds, 9755 Henderson Rd. *Tl:* 147.15 (88.5 Hz). *Adm:* $5. **www.n0ara.org**.

Colorado (Loveland) — Jan 17 D F H R S V

8:30 AM – 2 PM. *Spr:* Northern Colorado ARC. First National Bank Building at The Ranch (Larimer County Fairgrounds), 5280 Arena Cir. *Tl:* 448.025 (100 Hz). *Adm:* $6. **www.ncarc.net**.

Florida (Arcadia) — Jan 24 D F H R T V

6 AM – 1 PM. *Spr:* DeSoto ARC. DeSoto County Turner Civic Center, 2260 NE Roan St. *Tl:* 147.18 (100 Hz). *Adm:* $5. **desotoarc.org**.

Florida (Fort Myers) — Jan 16 – 17

D F H R S T

Friday noon – 5 PM, Saturday 8 AM – 5 PM. *Spr:* Fort Myers ARC. Gulf Coast Church of Christ, 9550 Six Mile Cypress/Ben C. Pratt Parkway. *Tl:* 147.345 (136.5 Hz). *Adm:* advance $5, door $10. **www.fmarc.net**.

Illinois (Collinsville) — Jan 24 D F H R V

8 AM – 1 PM. *Spr:* St Louis & Suburban RC. Gateway Convention Center, One Gateway Dr. Winterfest 2015. *Tl:* 146.76, 146.94. *Adm:* advance $6, door $8. **slsrc.org**.

Illinois (St Charles) — Jan 18 D F H R S V

8 AM – 1 PM. *Spr:* Wheaton Community Radio Amateurs. Kane County Fairgrounds Expo Center, 525 S Randall Rd. *Tl:* 145.31, 146.52. *Adm:* advance $8, door $10. **wheatonhamfest.org**.

Kansas (LaCygne) — Feb 7 D F H R

9 AM – 1 PM. *Spr:* Mine Creek ARC. Community Building, 204 Commercial St. *Tl:* 147.285. *Adm:* Free.

Louisana (Hammond) — Jan 17

D H R S T V

8 AM – 2 PM. *Spr:* Southeast Louisiana ARC. Magnuson Grand Hotel & Conference Center, 2000 S Morrison Blvd. *Tl:* 147.0 (107.2 Hz). *Adm:* Free. **www.selarc.org/selarchamfest.htm**.

Maryland (Odenton) — Jan 25

D F H Q R T V

7:30 AM – noon. *Spr:* Maryland Mobileers ARC. Odenton Volunteer Fire Department, 1425 Annapolis Rd. *Tl:* 146.805 (107.2 Hz). *Adm:* $5. **sites.google.com/site/marylandmobileers/hamfests-1/hamfest-2**.

Michigan (Hazel Park) — Jan 11 D F H R

8 AM – noon. *Spr:* Hazel Park ARC. Hazel Park High School, 23400 Hughes Ave. *Tl:* 146.64 (100 Hz). *Adm:* $5. **hparc.org**.

Michigan (Negaunee) — Feb 7 D F R

9 AM – 2 PM. *Spr:* Hiawatha ARA. Negaunee Township Hall, 42 Hwy M-35. *Tl:* 147.27. *Adm:* $5. **www.qsl.net/k8iod/**.

MISSISSIPPI STATE CONVENTION

January 23 – 24, Jackson, MS

D F H Q R S V

Friday 5 – 8 PM, Saturday 8 AM – 4 PM. *Spr:* Jackson ARC. Mississippi Trade Mart Building, 1200 Mississippi Ave. Capital City Hamfest. *Tl:* 146.76. *Adm:* $8. **hamfest.msham.org**.

Mississippi (Poplarville) — Dec 13

D F H R V

8 AM – 3 PM. *Spr:* Pearl River County ARC. Pearl River County Emergency Operation Center, SW corner of Highways 26 and 11. *Tl:* 145.21 (136.5 Hz). *Adm:* $5. **www.w5pms.org/**.

New Mexico (Albuquerque) — Jan 31

D F H R T

Sunrise – noon. *Spr:* 146.58 Simplex Gang. Transcore-Amtech Technology Center, 8600 Jefferson St NE. 20th Annual Albuquerque Ham Radio Winter Tailgate. *Tl:* 145.33, 444.0 (both 100 Hz). *Adm:* Free.

New York (Lockport) — Jan 31 D F H R

8 AM. *Spr:* Lockport ARA. South Lockport Fire Company, 5666 S Transit Rd (use Ruhlmann Rd entrance). *Tl:* 146.82 (107.2 Hz). *Adm:* $5. **www.lockportara.us/**.

New York (Marathon) — Jan 10 D F H R V

7 AM – noon. *Spr:* Skyline ARC. Lovell Field Civic Center, 40 W Main St. *Tl:* 147.18 (71.9 Hz). *Adm:* $5. **www.skylineradioclub.org**.

Ohio (Elyria) — Feb 1 D F H R

9 AM – 1 PM. *Spr:* Northern Ohio ARS. VFW Post 1079, 500 S Abbe Rd. *Tl:* 146.7 (110.9 Hz). *Adm:* $6. **www.noars.net**.

Ohio (Nelsonville) — Jan 18 D F H R V

8 AM – 2 PM. *Spr:* Sunday Creek AR Federation. Tri-County Career Center, 15676 Ohio State Rte 691. *Tl:* 147.15. *Adm:* $6. **www.scarfarc.com**.

Pennsylvania (Harrisburg) — Jan 24

D F H Q V

8 AM – noon. *Spr:* Harrisburg RAC. Cooper Student Union, 1 HACC Dr. *Tl:* 146.76 (100 Hz). *Adm:* $3. **www.w3uu.org**.

PUERTO RICO STATE CONVENTION

January 23 – 25, Hatillo, PR

D F H Q R S T V

Friday 1 – 10 PM, Saturday 9 AM – 4 PM, Sunday 9 AM – 3 PM. *Sprs:* Puerto Rico AR League, Caribbean AR Group, and Hatillo Municipality. Francisco "Pancho" Deida Coliseum, Carr #3. *Tl:* 146.52. *Adm:* Free. **www.arrlpr.org**.

NORTH TEXAS SECTION CONVENTION

January 16 – 17, Forest Hill, TX

D F H R S T V

Friday 3 – 7 PM, Saturday 7 AM – 3 PM. *Spr:* Cowtown ARC. Forest Hill Convention Center, 6901 Wichita St. Cowtown Hamfest. *Tl:* 147.28 (110.9 Hz). *Adm:* advance $8, door $9. **cowtownhamfest.com**.

VIRGINIA STATE CONVENTION

February 7, Richmond, VA

D F H Q R S V

8:30 AM – 3:30 PM. *Spr:* Richmond Amateur Telecommunications Society. Richmond Raceway Complex, 600 E Laburnum Ave. Frostfest 2015. *Tl:* 146.88 (74.4 Hz). *Adm:* $10. **www.frostfest.com**.

A = AUCTION
D = DEALERS / VENDORS
F = FLEA MARKET
H = HANDICAP ACCESS
Q = FIELD CHECKING OF QSL CARDS
R = REFRESHMENTS
S = SEMINARS / PRESENTATIONS
T = TAILGATING
V = VE SESSIONS

To All Event Sponsors

Before making a final decision on a date for your event, you are encouraged to check the Hamfest and Convention Database (**www.arrl.org/hamfests-and-conventions-calendar**) for events that may already be scheduled in your area on that date. You are also encouraged to register your event with HQ as far in advance as your planning permits. See **www.arrl.org/hamfest-convention-application** for an online registration form. Dates may be recorded up to 2 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.

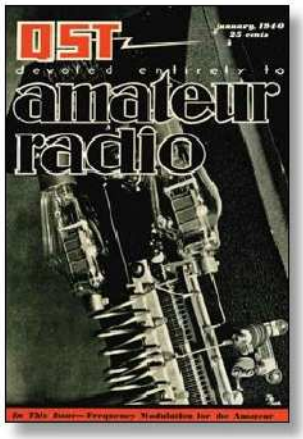
The deadline for receipt of items for this column is the **1st of the second month preceding publication date**. For example, your information must arrive at HQ by **January 1** to be listed in the **March** issue. Information in this column is accurate as of our deadline; contact the sponsor or check 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**.

75, 50, and 25 Years Ago

Al Brogdon, W1AB

January 1940



- The cover photo shows a portable wire dipole and support rope, wrapped up and ready to take on a trip.
- Gerry Sayre, W2QY, tells the tale of "Ham at 30° Below," his expedition to Greenland as OX2QY.
- "Feeding Vertical Antennas," by Arthur Lynch, W2DKJ, discusses three optional means of feeding the vertical, as well as how to use multiple verticals in a directive array.
- In "One-Half Cubic Foot of Transmitter," H. E. Rice, W9YZH, describes his small rig for both c.w. and 'phone work on all five h.f. bands.
- T. M. Ferrill, W1LJI, reports on his latest project, "A Wide-Range Audio Amplifier" that uses all push-pull stages to deliver 30 watts of audio.
- Also for the 'phone boys, Douglas Fortune, W9UVC, discusses "'Phone Splatter," pointing out that not all splatter results from overmodulation.
- HQ's By Goodman, W1JPE, tells us about "Another Method of Keying with Controlled Rectifier Tubes."
- Fellow HQer George Grammer, W1DF, writes about the "Technical Aspects of the New Regs" and what those new regulations require.
- Following the success and popularity of his small "QSL Forty" rig (*QST*, Feb 1938), Fred Sutter, W8QBW, reports on "A 'Pee-Wee' Version of an Old Favorite" — a two-tube regenerative receiver about the same size as the QSL Forty.

January 1965

- The cover photo shows W6AEE printing out his teletype-graphic Christmas greeting that features old Santa himself.
- The editorial looks at the year 1964 in review, with one of the major advances being changes to the Communications Act to allow reciprocal licensing for hams from other countries when they visit the USA.
- Douglas Blakeslee, W1KLK, used two Nuvistors to build a small super-regenerative receiver for 144 Mc. — "The 2N2 Receiver."
- The "Noise-Figure Indicator," by Thomas Sly, K2QCX, gives us a fast way to check our v.h.f. receiver's performance.
- Again helping the new hams, Lew McCoy, W1ICP, describes "The Mox-Box," a simple monitoring and control box for our stations.
- George Grammer, W1DF, presents Part I of "The Whys of Transmission Lines," discussing the terminology used and what it means.
- Peter Chamalian, W1BGD, reports on emergency ham work before, during, and after "Hurricane Hilda," noting that amateurs were "to the fore to perform the usual."
- "Low-Cost Precision Frequency Measurement," by William Skeen, K6YRQ, tells how he devised a novel system built around an electronic frequency counter.
- National Emergency Coordinator George Hart, W1NJM, writes about "Keeping Up Interest in Your AREC Group."

January 1990

- The cover looks at "The 90s: What Does the Future Hold?"
- The editorial discusses the forthcoming "WARC-92" conference, and how the ARRL is already preparing for it.
- "IARU Region 2 Finds the Magic in Orlando," by Dave Sumner, K1ZZ, reports on the recent meeting of Western Hemisphere amateurs, and what went on in that conference.
- Now that activity on OSCAR 13 is booming, Gene Marcus, W3PM, reports on his "Circularly Polarized Quagi Antennas for Space Communications."
- In Part 2 of "A QRP SSB/CW Transceiver for 14 MHz," Wes Hayward, W7ZOI, finished giving us the details on his 1 or 10 watt rig.
- Mike Angsten, WA8TXT, tells us how to get on 220 MHz via "The Elevator: A Simple 220-MHz FM Transverter."

Field Organization Reports

OCTOBER 2014

Public Service Honor Roll

This listing recognizes radio amateurs whose public service performance during the month indicated 70 or more points in six categories. Details on the program can be found at **www.arrl.org/public-service-honor-roll**.

900
KC2LIX

535
W8QAS

521
W5KAV

435
KT5SR

405
WB8RCR

355
KC5ZGG

345
W5DY
K0IBS

320
WM2C

285
KT2D

251
KW4EMG

243
KF4DVF

241
N8OSL

240
KJ6PCC
K7OAH

238
KF4DAX

236
WB8R

230
K9LGU

229
W7PAT

225
N8SY

220
WA3EZN

217
WB8YYS

215
WS6P
W4VX

210
K8RDN

209
KE5YTA

201
WB9FHP

191
W9WXN

190
N5TMC
N8FVM

185
KD8TTE

177
KB5PGY

175
KE5HYW
KB2RTZ

174
K7GJT

170
WB9WKO
W8MAL
KD5RQB
W4DNA

167
W8KWG
KC8YVF

165
N5NVP

160
WB9QPM
KE4CB
W8DJG
WK4WC
N1UMJ

157
WA2BSS

150
K1PJS

147
KB8QKC

145
KF5IOU
K7EAJ
N7CM

144
WA7PTM

142
KG0GG

140
VE7GN
KK3F
WB4ZIQ
KB8RCR

138
K3JL
W3CB

136
KJ4JPE

135
N9VC
AG9G
KM2V
K6FRG
KC5OZT
W3YVQ
KB1WXC

132
W4SEE

130
W1INC
N2JBA
W9BGJ
K6JT
NA7G
K4IWW
WD8USA
KW1U

129
KK7DEB

128
K1MLG

125
WA1STU
WB9JSR

123
KA9QWC

121
W8ARR

120
K6JGL
W0LAW
W7JSW
KB1RGQ

118
AL7N
W4CPG

115
KC9UJP
NC3F
K6HTN
N8IBR

114
N1IQI

112
KC5TGF

110
N7EIE
W1KX
NX9K
KA4FZI
KA1G
N9MN
WB4BIK
K4GK
KF5TTN
KB2QO
N1JX
WB2FTX
KB3LNM
W2EAG
K1HEJ
N7XG

109
WB8QLT

105
K5RG
AF7FT
W4OTN
K7RDB
KK7TN
N1TF

104
NA9L
KJ4G
W0PZD

103
K6RAU

101
AB1ST
KO4OL

100
K9JM
K0VTT
K0PTK
N0DUX
AB1AV
WA1MXT
KB5KKT
WA4BAM
N2DW
KC8WH
WD8Q
WB8YLO
WA0CGZ
K5KV
KA5AZK
KA2GQQ
KF7GC
WB6OTS
N3SW
AA3SB
AK4RJ
W4TTO
KB1NMO
WB8TQZ
WB8WKQ

97
K4VWK

96
KJ6IJJ

95
KC0ZDA
KB8VXE
N3RB
KC8BW

93
KB3KYH

91
KD7OED
NI2W

90
VE3GNA
WB0TSR
WA6IAF
N3KB
N5RL
WG8Z
KB8HJJ
WB8SIQ
WaWDS
KA2HZP
KC7ASA
KC7ZZ
W7FQQ
WB3FTQ
KF4OCU
K8KV

KZ8Q

89
W2CC

87
N2RTF

85
KD0NJK
N9EXM

84
AB9ZA
KA9FCU
W5XX

83
W8IM
NS7K

82
KJ6CNO
WD0GUF

80
K0DEU
KB5SDU
WA9QIB
WB4RJW
KF7PDV
K8ED

79
KL2GS
K9JAJ

78
AJ7B

76
W9EEU
N2GJ

75
KC9ZDA
KC2UMX
AC7RB

73
KR6LH

72
KY2D
KC2EMW
KJ7NO

71
W0CLS
K9DUR
WA5LOU

70
K0RXC
KD0USN
KD7ZUP
N0DUW
N0YOL
KD0UST
NI0I
N2VC
N2YJZ
KM7N
K5JAW
NF8I
NE8B

Section Traffic Manager Reports

The following Section Traffic Managers reported: AL, AK, AR, AZ, CO, CT, DE, EB, EMA, ENY, EPA, GA, IA, ID, IN, KY, LAX, MDC, ME, MI, MN, MS, NC, NFL, NH, NNJ, NTX, OH, OK, OR, ORG, SD, SFL, SJV, SNJ, STX, TN, UT, VA, WCF, WMA, WI, WPA.

Section Emergency Coordinator Reports

The following ARRL Section Emergency Coordinators reported: DE, ENY, GA, IA, ID, IN, MDC, ME, MI, MO, NFL, NLI, NM, NTX, OH, TN, SFL, SJV, SV, WTX, WV.

Brass Pounders League

The BPL is open to all amateurs in the US, Canada, and US possessions who report to their SMs a total of 500 or more points or a sum of 100 or more origination and delivery points for any calendar month. Messages must be handled on amateur radio frequencies within 48 hours of receipt in standard ARRL radiogram format. Call signs of qualifiers and their monthly BPL total points follow.

WB9FHP 3982, KK3F 2533, NX9K 1777, K6HTN 1154, KW1U 758, VE3GNA 746, N9VC 652, K6FRG 617, K6JT 546, N1IQI 500. BPL with Originations + Deliveries: W5KAV 153, NM1K 105.

Silent Keys

Silent Keys Administrator, sk@arrl.org

It is with deep regret that we record the passing of these amateurs:

KB1BFD **Salvucci**, Ideale, Brighton, MA
W1CY **Webb**, L. A., South Hadley, MA
KA1EKF **Tormey**, William E., Weymouth, MA
N1EOH **Modeen**, Douglas P., Granby, CT
♦W1EVU **Telford**, Larry E., Hinesburg, VT
W1HGE **Van Verdeghem**, Jack, New London, CT
♦K1HLZ **Carp**, Alan H., Sharon, MA
KB1IEJ **Maurais**, Jean P., Dixfield, ME
KB1IOL **Swicker**, Jack E. Jr, Waterville, ME
W1JDI **Hicks**, Charles R., Macon, GA
N1KEN **Kelly**, John F., Rotonda West, FL
♦W1MSK **Kurrelmeyer**, Herman R. III, Spring Hill, FL
N1NHO **Odom**, N. Hartley, Kissimmee, FL
W1PXA **Hacku**, Steve, Wallingford, CT
WA1QCA **Burrill**, Richard E., Ormond Beach, FL
K1RTS **Belsito**, Walter J. Sr, Waterbury, CT
KA1VWW **Fournier**, Ronald A., Holyoke, MA
♦WA2AFE **Pierce**, Jeffrey S., Roanoke, VA
WA2ARS **Cohen**, Morton, Apopka, FL
WB2BIG **Rapisarda**, Sebastian L., Edison, NJ
♦WB2BWL **Dedonatis**, Samuel J., Haddonfield, NJ
W2CYW **Heffner**, Daniel, Wickenburg, AZ
WA2GCU **DeMonstoy**, Winifred D., Painted Post, NY
W2HRB **Chandler**, George G. Jr, Lakewood, NJ
N2HX **Schroeder**, Harry R., Ewing, NJ
W2IHX **Koziol**, Chester, Olean, NY
N2ITF **Ryan**, Stephen M., Ashville, NY
W2JST **Just**, Jan K., East Syracuse, NY
K2KBT **Casazza**, Joseph J., Essex Junction, VT
N2LRP **Bottega**, Frederick A., Yorktown Heights, NY
KB2MV **Chesebro**, Chester L., Central Square, NY
WA2OQW **Keller**, C. J., Hinsdale, NY
ex-K2PMZ **Currant**, Albert, Rochester, NY
W2QKA **Lownsbury**, Charles A. Jr, Merchantville, NJ
K2RRG **Gold**, Robert R. Jr, Melbourne, FL
K2RWS **Stephens**, Rudolph W., Maryville, TN
KB3ANH **Matter**, Gottfried F., Pittsburgh, PA
KB3BZQ **Wygant**, Adelbert C., Oakmont, PA
KA3DAB **Borig**, Richard F., Bel Air, MD
N3DUN **Petrasic**, Gerald V., Camp Hill, PA
K3EMT **Minier**, Shelby K., Halifax, PA
W3FJA **Adams**, Frank J., Parlin, NJ
W3HER **Wagner**, Edward, Cetronia, PA
♦WB3HND **Duncan**, James R. Sr, Sugar Land, TX
W3JRG **Geisler**, John R., Reading, PA
K3KPE **Lafferty**, Albert F. Jr, Albrightsville, PA
N3KVR **Bongiovanni**, Robert, Churchville, PA
WB3LGA **Nagell**, Raymond H., Bethlehem, PA
KA3LVT **Marusak**, John C., Nanticoke, PA
W3MK **Justice**, Jessie Jr, Bonifay, FL
N3MKB **Prestia**, Richard, Mechanicsburg, PA
WA3NMW **Herbert**, Edward W., Minersville, PA
KA3NRH **Davis**, Charles H., Rome, PA
W4AWT **Lloyd**, Dallas L., Raleigh, NC
AC4BH **McMillan**, William, Gloucester Point, VA
♦WB4BYD **Cole**, George G., Orange, VA
W4CMB **Rich**, William G., Hayesville, NC
AF4CU **Broome**, Donald L., Stanley, NC
W4EQM **Taylor**, Gena, Birmingham, AL
N4GOT **Guthrie**, Perry W., Morris, AL
N4HAG **Borland**, Arthur K., San Antonio, TX
W4IKM **Bailey**, Henry N., Mobile, AL
K4JBH **Hoogstraten**, Bastiaan "Bob," Seminole, FL
K4JCJ **Carames**, Joseph A. Jr, West Palm Beach, FL
KI4JR **Sholtis**, John R., North Fort Myers, FL
N4KRA **Merz**, Thomas V. III, Ohioville, PA
N4KRU **Thomason**, Martha, Murrayville, GA
KK4LAF **Strub**, David P., Asheboro, NC
KI4MGO **Barnes**, Lewis D., Vanceboro, NC
W4OEL **Dunham**, R. Sheldon Jr, Mechanicsville, VA
K4OJK **Walton**, Joe R., Knoxville, TN
KE4ONS **Harbert**, Harold J., Taylorsville, NC
K4PRJ **Evans**, James B., Kinston, NC
AE4SQ **Gilliam**, David D., Spartanburg, SC
N4TSE **Fail**, Kenneth E., Murfreesboro, TN
KG4VLD **Poland**, John R., Leesburg, FL
KG4WAD **Yarbrough**, Bob, Salisbury, NC
K4WFL **Latham**, William F., Avon Park, FL
N4YIX **Walker**, Dennis S., Port Charlotte, FL
W5AB **Sharpe**, John M., Missouri City, TX
KF5ARJ **DeMeulle**, Albert L., Aransas Pass, TX
KF5BD **Page**, Jack Winfield, Albuquerque, NM
N5BEY **Adams**, James E., Denton, TX
W5DEO **Sockwell**, Curtis L., Portland, TX
KD5DRU **McConathy**, Charles G., Mesquite, TX
K5DSI **McGar**, Gregory, Metairie, LA
ND5F **Parker**, Harold, Houston, TX
WB5GJK **Bashur**, Edward, El Paso, TX
WD5IEH **Floyd**, T. David, San Antonio, TX
W5IPM **Hood**, Beatrice L., Jones, OK
W5IQ **Underwood**, John C. Jr, Jackson, MS
KC5JBO **Diedrich**, Landis A., Albuquerque, NM
K5JKD **Dezelle**, Jon K., Beaumont, TX
KD5KVQ **Gardner**, Alton G., Oklahoma City, OK
W5LRW **Wilson**, Louise R., Alexandria, LA
N5MEI **Whitlock**, Charles A., Meridian, MS
ex-W5QHS **Maag**, Louis F., Houston, TX
KF5QKO **Naylor**, Michael, Midland, TX
N5RSF **Pickle**, Robert C. Jr, Charleston, MS
W5TOP **Carpenter**, Charles G., Roanoke, TX
KK5UO **Moore**, Robert B., Houston, TX
KC5VWS **Sanders**, Robert L., Albuquerque, NM
N5WKV **Dunn**, Kenneth E., Oklahoma City, OK
N5WXR **Arton**, Dennis P, St Martinville, LA
W5YO **O'Connell**, Bill, Austin, TX
WB6ANN **Mueller**, Roseanne K., Glendora, CA
K6ASK **Mueller**, Robert L., Glendora, CA
W6ELK **Wetzel**, Frank E., San Luis Obispo, CA
♦KR6G **Alexander**, Bill G., Quincy, CA
♦K6HCP **Holladay**, Kenneth, Gilroy, CA
KJ6IOE **Reynolds**, Gerald M., Penn Valley, CA
KC6LQC **Brown**, S. Leon, Chatsworth, CA
WA6RCW **Bryant**, Patrick M., Shawnee, OK
♦W6RFF **Hill**, Jettie B., Roseville, CA
K6RVF **Anderson**, Paul E., Torrance, CA
KB6SA **Sargis**, Samuel, Modesto, CA
W6TED **Kinney**, Bruce G., San Jose, CA
K6TFG **Krizo**, Barbara D., Klamath Falls, OR
W6TUR **Faulkner**, Ronald B., San Diego, CA
K6URT **Forshager**, Kurt O., Newhall, CA
N6UYO **Stiver**, Ruth A., El Cerrito, CA
K7BDU **Thomas**, George F., Chehalis, WA
W7CAN **Newman**, Charles A., Eureka, MT
KG7CVH **Sayne**, Herbert W., Noti, OR
KB7EC **Cole**, Edwin M. Jr, Murray, UT
KA7ECX **Gunn**, Royal C., Portland, OR
NL7EX **Hagler**, Silas P., Bainbridge Island, WA
KE7GMN **Hone**, Richard C., Klamath Falls, OR
W7HPM **Hatteberg**, Leonard J., Silverton, OR
♦W7JAM **Meister**, John A., Redmond, WA
WA7LON **Mattison**, Glenn E., Kapowsin, WA
KE7MYF **Mendzer**, Moses S., Aumsville, OR
KE7SLX **Garwood**, Lester N., Eugene, OR
KL7STE **Johnson**, Michael E., Eagle River, AK
KC7TBC **Himden**, Joseph R., Mequon, WI
W7VMP **Page**, Virginia M., Salem, VA
KE7WAQ **Murphy**, Steven P., Logan, UT
KE8BV **Dalley**, James L., Beavercreek, OH
♦K8COI **Maluke**, Edward M., Hartville, OH
AF8CS **Peth**, Edwin E., La Salle, MI
KA8D **Schumann**, Gerald R., Dearborn Heights, MI
N8EZM **Hoke**, Ken, Trotwood, OH
WB8GLV **Davenport**, Clyde, Akron, OH
K8GQE **Heffken**, William E., Warsaw, OH
K8GYC **Eaton**, W. A., Greeley, CO
N8HHN **Cumberledge**, Allan K., Marietta, OH
WB8HPR **Congos**, Charles R., Madison, OH
W8HUA **Geldreich**, Edwin E. Jr, Anderson Township, OH
KF8JY **Stahl**, Robert C., Van Werth, OH
KC8KDD **Thomas**, James D., Brookville, OH
WA8KYB **Coakes**, Keith L., Owosso, MI
KD8MOB **Williams**, Sam R., Akron, OH
K8NPK **Szyperski**, Jerome R., Oregon, OH
♦KK8O **Swain**, Richard L., Galion, OH
WB8QCN **Curry**, Thomas D., Huntington, WV
AF8T **Slone**, Richard D., Middletown, OH
WA8UXN **Walters**, Jack E., Fenton, MI
WB8WKR **Trakas**, Charles C., Okemos, MI
♦N8ZR **Putman**, Steven O., Fairborn, OH
K9BCN **Brandt**, Opal C., New Albany, IN
N9FPX **David**, Joseph N., Glendale Heights, IL
W9GLA **Wittkop**, Charles F., Westminster, CO
W9HSO **Burgher**, Marcus M. Jr, Palmyra, IN
KE9I **Jendraszkiewicz**, Gerard, Medaryville, IN
W9IBZ **Zimmerman**, John F., Crown Point, IN
K9ICK **Lister**, Claude R., Danville, IN
WA9IRH **Edris**, John H. Jr, Bluffton, IN
W9JGN **Scarlette**, Carl J., Herrin, IL
N9JIU **Herschell**, Donald B., Williamsburg, VA
W9KKJ **Martin**, Earl J., Mount Carroll, IL
W9MDH **Hazelrigg**, Michael D., Round Lake Beach, IL
K9MUG **Penrod**, Darrell D., Smiths, AL
N9NQR **Sippl**, Dennis J., Wausau, WI
WU9O **James**, Darrell D., Marion, IL
N9OLG **Hook**, Larry A., Beverly Hills, FL
K9SHK **Reno**, Ruby G., Galesburg, IL
KB9SQO **Roth**, Gregory J., Pawnee, IL
K0AW **Lemons**, William C., Springfield, MO
W0CM **Wessel**, Walter A. "Pete," Liberal, KS
WT0E **Carden**, Linton F. "Bud," Overland Park, KS
K0GBZ **Keiser**, Rodger K., Quinter, KS
KC0HXS **Anderson**, A. Sanfrid, Leeds, ND
W0IYH **Sabin**, William E., Cedar Rapids, IA
W0NHF **Fortune**, William F. Jr, Pueblo West, CO
♦WA0UXO **Johnson**, Ellen M., Saint Paul, MN
VE3AJN **Worrell**, R. D., Kemptville, ON, Canada
VE5ACG **Holder**, William A., Kenaston, SK, Canada
VE5KR **McMahon**, D., Saskatoon, SK, Canada
G4ILO **Moss**, Julian, Cockermouth, Cumbria, Great Britain

♦ 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.

Special HRO Holiday Pricing!

HAM RADIO OUTLET

PLANO TEXAS STORE COMING SOON!

FTDX5000MP Limited | *200W HF + 6M Txcvr*

• Internal Power Supply • Two Totally Independent Receivers • Super Sharp "Roofing" Filters • High Performance Yaesu Custom-designed 32-bit Floating Point DSP • True Analog Meter Precision

FTDX3000 | *100W HF + 6M Transceiver*

• 100 Watt HF/6 Meters • Large and wide color LCD display • High Speed Spectrum Scope built-in • 32 bit high speed DSP /Down Conversion 1st IF **Call For Low Pricing!**

FT-991 | *HF/50MHz/2M/440 Transceiver*

• 160 M-440MHz - SSB/CW/FM/C4FM Digital/AM/RTTY/PSK • 100 W (2M/4440: 50 Watts) • 3.5" TFT full-color touch panel operation • High speed spectrum scope • Roofing filters: 3kHz & 15kHz • 32-bit high speed floating point IF DSP • 160-6 meter high speed automatic antenna tuner

FTDX1200 | *100W HF + 6M Transceiver*

• Triple Conversion Receiver With 32-bit Floating Point DSP • 40 MHz 1st IF with selectable 3 kHz, 6kHz & 15 kHz Roofing Filters • Optional FFT-1 Supports AF-FFT Scope, RTTY/PSK31 Encode/Decode, CW Decode/Auto Zero-In • Full Color 4.3" TFT Display

FT-450D | *A100W HF + 6M Transceiver*

• 100W HF/6M • Auto tuner built-in • DSP built-in • 500 memories • DNR, IF Notch, IF Shift **Call For Pricing!**

FT-857D | *Ultra Compact HF/VHF/UHF*

• 100w HF/6M, 50W 2M, 20W UHF • DSP included • 32 color display • 200 mems • Detachable front panel (YSK-857 required)

Call For Our Low Price!

FT-2900R | *Heavy-Duty 75W 2M FM Transceiver*

• Massive heatsink gurantees 75 watts of solid RF power • Loud 3 watts of audio output for noisy environments • Large 6 digit backlit LCD display for excellent visibility • 200 memory channels for serious users

FT-8800R | *2M/440 Mobile*

• V+U/V+V/U+U operation • V+U full duplex • Cross Band repeater function • 50W 2M 35W UHF • 1000+ memory channels • WIRES ready **Call Now For Low Pricing!**

FTM-400DR | *2M/440 Mobile*

• Color display-green, blue, orange, purple, gray • GPS/APRS • Packet 1200/9600 bd ready • Spectrum scope • Bluetooth • MicroSD slot • 500 memory per band

FT1DR | *144/430 5W Digital Transceiver*

• C4FM/FDMA • 1200/9600bps AX.25 APRS & GPS Recvr Built-in • Dual Band Operation w/Dual Receivers (V+V/U+V/V+U) • Wideband Receive/AM Bar Antenna/Aircraft Receive • 1266 Memory Channels w/16 Char Alpha Tagging

Also Available In Silver!

VX-6R | *2M 220/440MHz HT*

• Wideband RX – 900 memories • 5W 2/440, 1.5W 220 MHz TX • Li-ION Battery - EAI system • Fully submersible to 3 ft. • CW trainer built-in

New Low Price!

VX-8DR | *50/144/220/440*

50/144/220/440 • 5W (1W 222 MHz) • Bluetooth optional • Waterproof/ submersible (3' for 30 min) • GPS APRS operation optional • Li-ion Hi-capacity battery • Wide band Rx

FT-60R | *2M/440 5W HT*

• Wide receiver coverage • AM air band receive • 1000 memory channels w/alpha labels • Huge LCD display • Rugged die-cast, water resistant case • NOAA severe weather alert with alert scan

5 Ways to Shop!

- **RETAIL LOCATIONS – Store hours 10:00AM - 5:30PM - Closed Sunday**
- **PHONE – Toll-free phone hours 9:30AM - 5:30PM**
- **FAX – All store locations**
- **ONLINE – WWW.HAMRADIO.COM**
- **MAIL – All store locations**

YAESU
The radio

ANAHEIM, CA (800) 854-6046	OAKLAND, CA (877) 892-1745	SUNNYVALE, CA (877) 892-1749	PORTLAND, OR (800) 765-4267	PHOENIX, AZ (800) 559-7388	WOODBRIDGE, VA (800) 444-4799	PLANO, TX Coming Soon!
BURBANK, CA (877) 892-1748	SAN DIEGO, CA (877) 520-9623	NEW CASTLE, DE (800) 644-4476	DENVER, CO (800) 444-9476	ATLANTA, GA (800) 444-7927	SALEM, NH (800) 444-0047	ONLINE STORE WWW.HAMRADIO.COM

✦ Mail-in rebates expire 12/31/14. Contact HRO for promotion details. Toll-free including Hawaii, Alaska and Canada. Call will be routed to the nearest store. All HRO 800-lines can assist you. If the first line you call is busy, you may call another. AZ, CA, CO, GA, VA residents add sales tax. Prices, specifications and descriptions subject to change without notice.

Special HRO Holiday Pricing!

HAM RADIO OUTLET

PLANO TEXAS STORE COMING SOON!

IC-7850 | *HF/50MHz Transceiver*

• 1.2kHz "Optimum" roofing filter • New local oscillator design • Improved phase noise • Improved spectrum scope • Dual scope function • Enhanced mouse operation for spectrum scope • More features

IC-7700 | *HF/50MHz Transceiver*

The Contester's Rig • HF + 6m operation • +40dBm ultra high intercept point • IF DSP, user defined filters • 200W output power full duty cycle • Digital voice recorder

IC-7600 | *All Mode Transceiver*

• 100W HF/6m Transceiver, gen cov. receiver • Dual DSP 32 bit • Three roofing filters- 3, 6, 15khz • 5.8 in WQVGA TFT display • Hi-res real time spectrum scope

IC-9100 | *The All-Round Transceiver*

• HF/50MHz 144/430 (440) MHz and 1200MHz*1 coverage • 100W on HF/50/144MHz, 75W on 430 (440) MHz, 10W on 1200MHz*1 • Double superheterodyne with image rejection mixer

IC-7410 | *HF/50MHz Transceiver*

• 32-bit floating point DSP unit • Double Conversion Super-Het Receiver • Built-in 15kHz 1st IF Filter • Built-in Band Scope • Large, multi-function LCD • RTTY Demodulator/Decoder • USB for PC control

IC-7200 | *HF Transceiver*

• 160-10M • 100W • Simple & tough with IF DSP • AGC Loop Management • Digital IF Filter • Digital Twin PBT • Digital Noise Reduction • Digital Noise Blanker • USB Port for PC Control

IC-718 | *HF Transceiver*

• 160-10M* • 100W • 12V operation • Simple to use • CW Keyer Built-in • One touch band switching • Direct frequency input • VOX Built-in • Band stacking register • IF shift • 101 memories

IC-7100 | *All Mode Transceiver*

• HF/50/144/430/440 MHz Multi-band, Multi-mode, IF DSP • D-STAR DV Mode (Digital Voice + Data) • Intuitive Touch Screen Interface • Built-in RTTY Functions

IC-5100A | *VHF/UHF Dual Band Digital Transceiver*

• Analog FM/D-Star DV Mode • SD Card Slot for Voice & Data Storage • 50W Output on VHF/UHF Bands • Integrated GPS Receiver • AM Airband Dualwatch • FM Analog/DV Repeater List Function

IC-V8000 | *2M Mobile Transceiver*

• 75 watts • Dynamic Memory Scan • CTCSS/DCS encode/decode w/ tone scan • Weather alert • Weather channel scan • 200 alphanumeric memories

IC-PW1 | *HF/50 MHz Amplifier*

• Wide freq. coverage - 1 kW from 1.8 MHz to 50 MHz (amateur bands only) • Wide ALC adjustable range • Full duty cycle • Auto antenna tuner built-in • Auto AC input voltage selector is employed • Current (Ip), Voltage (Vp), temperature, SWR and output power protectors are available

IC-2300H | *VHF FM Transceiver*

• 65W RF Output Power • 4.5W Audio Output • MIL-STD 810 G Specifications • 207 alphanumeric Memory Channels • Built-in CTCSS/DTCS Encode/Decode • DMS

ID-880H | *Analog+Digital Dual Bander D-STAR*

• D-STAR DV mode operation • DR (D-STAR repeater)mode • Free software download • GPS A mode for easy D-PRS operation • One touch reply button (DV mode) • Wideband receiver D-STAR ready

IC-V80 | *HD 2 Meter FM Transceiver*

• Tough construction • 750mW loud audio • Powerful 5.5W of output power • IP54 and MIL-STD-810 rugged construction • Built-in CTCSS/DTCS • WX channel & weather alert function

IC-51A | *VHF/UHF Dual Band Transceiver*

• 5/2.5/1.0/0.5/0.1W Output • RX: 0.52–1.71, 88–174, 380-479 MHz** • AM/FM/FM-N/WFM/DV • 1304 Alphanumeric Memory Chls • Integrated GPS • D-STAR Repeater Directory • IPX7 Submersible D-STAR ready

ID-31A | *UHF Digital Transceiver*

5W Output Power • FM Analog Voice or D-STAR DV Mode • Built-in GPS Receiver • IPX7 Submersible • 1,252 Alphanumeric Memory Channels

D-STAR ready

5 Ways to Shop!

- RETAIL LOCATIONS – Store hours 10:00AM - 5:30PM - Closed Sunday
- PHONE – Toll-free phone hours 9:30AM - 5:30PM
- FAX – All store locations
- ONLINE – WWW.HAMRADIO.COM
- MAIL – All store locations

ICOM

ANAHEIM, CA (800) 854-6046	OAKLAND, CA (877) 892-1745	SUNNYVALE, CA (877) 892-1749	PORTLAND, OR (800) 765-4267	PHOENIX, AZ (800) 559-7388	WOODBRIDGE, VA (800) 444-4799	PLANO, TX Coming Soon!
BURBANK, CA (877) 892-1748	SAN DIEGO, CA (877) 520-9623	NEW CASTLE, DE (800) 644-4476	DENVER, CO (800) 444-9476	ATLANTA, GA (800) 444-7927	SALEM, NH (800) 444-0047	ONLINE STORE WWW.HAMRADIO.COM

*Except 60M Band. **Frequency coverage may vary. Refer to owner's manual for exact specs. *1 Optional UX-9100 required. ✦ Instant savings expire 12/31/14. Contact HRO for promotion details. OST DEC 2014. The Icom logo is a registered trademark of Icom Inc. 70048
Toll-free including Hawaii, Alaska and Canada. Call will be routed to the nearest store. All HRO 800-lines can assist you. If the first line you call is busy, you may call another. AZ, CA, CO, GA, VA residents add sales tax. Prices, specifications and descriptions subject to change without notice.

Special HRO Holiday Pricing!

HAM RADIO OUTLET

PLANO TEXAS STORE COMING SOON!

TS-990S | *200W HF + 6M Transceiver*

• World's first dual TFT display • 200W output on all bands • ±0.1ppm TCXO ensures both high stability and reduced power consumption • Triple 32-bit DSP's dedicated to main/sub receivers and band scope • Main receiver employs full down conversion, new mixer & narrow band roofing filters • Third order intercept point (IP3) +40dBm for highest level of RX performance (main receiver)

Call For Special Price!

TM-D710G | *2M/440 Dualband*

• V+V/V+U/U+U operation • Built-in GPS • Built-in TNC for APRS & DX-Cluster operation • 50W 2M & UHF • 1,000 memories • Dual receive • Green or amber backlight colors • Latest APRS firmware w/new features • Sky Command II remote functions

Call For Special Price!

TS-480SAT/HX | *HF + 6M Transceiver*

• 480HX 200W HF & 100W 6M (no tuner) • 480SAT 100W HF & 6M w/AT • Remotable w/front panel/speaker • DSP built-in

Call Now For Low Price!

TS-590SG | *HF/50MHz Transceiver*

• Equipped with 500 Hz/2.7 kHz roofing filter as standard • ALC derived from TS-990S eliminating spike issues • Antenna output function (shared with DRV connector) • CW - morse code decoder function • Improved 1st mixer • New PFB key with multi-function knob • New split function enabling quick setting • LED backlight with selectable color tone

TM-V71A | *2M/440 DualBand*

• High RF output (50W) • Multiple Scan • Dual receive on same band (VxV, UxU) • Echolink® memory (auto dialer) • Echolink® Sysop mode for node terminal ops • Invertible front panel • Choice of green/amber for LCD panel • 104 code digital code squelch • "Five in One" programmable memory • 1000 multifunction memory

Call Now For Your Low Price!

TH-D72A | *2M/440 HT w/extended RX*

• 5W TX, RX 118-524 MHz, VxU, VxV, UxU • APRS w/built-in 1200/9600 TNC • Built-in GPS, Built-in USB, digipeater • Echolink® compatible, • Mil-Spec STD810

Call For Special Low Price!

TH-F6A | *2M/220/440*

• Dual channel receive • .1 - 1300 MHz (cell blocked) RX • FM, AM, SSB • 5W 2M/220/440 TX, FM • 435 Memories • Li-Ion Battery

Call For Low Price!

TS-2000/2000X | *HF/VHF/UHF Transceiver*

• 100W HF, 6M, 2M • 50W 70CM • TS-2000X 10W 1.2GHz • Built-in TNC, DX packet cluster • IF Stage DSP • Backlit front key panel

Call For Special Price!

TM-281A | *2 Mtr Mobile*

• 65 Watt • 200 Memories • CTCSS/DCS • Mil-Std specs • Hi-quality audio

Call For Special Low Price!

TH-K20A | *2M Handheld*

• 2M 5.5W • VOX • CTCSS/DCS/1750 Burst built-in • Weather alert

Call For Special Low Price!

5 Ways to Shop!

- RETAIL LOCATIONS – Store hours 10:00AM - 5:30PM - Closed Sunday
- PHONE – Toll-free phone hours 9:30AM - 5:30PM
- FAX – All store locations
- ONLINE – WWW.HAMRADIO.COM
- MAIL – All store locations

KENWOOD

ANAHEIM, CA (800) 854-6046	OAKLAND, CA (877) 892-1745	SUNNYVALE, CA (877) 892-1749	PORTLAND, OR (800) 765-4267	PHOENIX, AZ (800) 559-7388	WOODBRIDGE, VA (800) 444-4799	PLANO, TX Coming Soon!
BURBANK, CA (877) 892-1748	SAN DIEGO, CA (877) 520-9623	NEW CASTLE, DE (800) 644-4476	DENVER, CO (800) 444-9476	ATLANTA, GA (800) 444-7927	SALEM, NH (800) 444-0047	ONLINE STORE WWW.HAMRADIO.COM

✦ Kenwood coupons expire 12/31/14. Contact HRO for promotion details. Toll-free including Hawaii, Alaska and Canada. Call will be routed to the nearest store. All HRO 800-lines can assist you. If the first line you call is busy, you may call another. AZ, CA, CO, GA, VA residents add sales tax. Prices, specifications and descriptions subject to change without notice.

Special HRO Holiday Pricing!

HAM RADIO OUTLET

PLANO TEXAS STORE COMING SOON!

ACOM

ACOM-1000

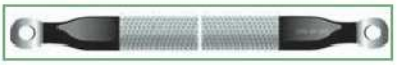
• HF and 6 Meter 1KW Amplifier • Match 3:1 SWR with No Tuner • User Friendly QSK Operation • LCD Message Display • Single 4CX800a Tube • Vacuum Antenna Relays

Call For Additional ACOM Products!

ABR INDUSTRIES

•218XATC-PL-(length) RG8x (240UF) w/PL259 Connectors Each End. Weather-Proof Heat Shrink Tubing.

- *Stranded Center Conductor.*
- 95% TC Braid + bonded 100% Foil Shield.
- *Very Flexible, Light Weight, and Smaller than RG8 sizes.*
- Non-Contaminating-UV Resistant-Direct Burial-Black Jacket.



•235-5X-(length) 1" Wide Tin-Copper w/Ring Terminals Each End. Adhesive-Lined Heat Shrink Tubing.

- *Grounding Braid Heavy Grade.*
- Construction: 38x48x18/864 7ga 85 Amps.
- *Easy termination: ¼" Stud Ring Terminals.*

REMOTE RIG

RRC-1258 MkII-S-Set

This set of interfaces allows remote control of your Amateur Radio Station via Internet in a user-friendly and cost effective way! RemoteRig gives you control of the radio coupled with crystal clear TX & RX audio and sending CW with your own Paddle!

New! Now Stereo Version for Dual Receiver radios.

Works with all Computer-controllable radios from:
Alinco - Elecraft - ICOM - Kenwood - Yaesu

For radios with detachable front panels no PC is required for:
TS-480HX/SAT; TS-2000 (RC-2000 req'd); IC-703/Plus; IC-706 series; DX-SR8T; IC-2820H; IC-R2500

Just simply insert your control box in place of your front panel interconnect cable, place the body of the radio on the remote end and you are on the air as if you are there! Extra Controller and Remote interface units sold individually for multiple sites/users.

Now includes 12V power supply, $12.95 value!

Available exclusively from all HRO locations!

US TOWER

MA-40

• 40' Tubular Tower

Call For Latest Pricing!

MA-550

• 55' Tubular Tower • Handles 10 sq. ft. at 50 mph • Pleases neighbors with tubular streamlined look

Call For Latest Pricing!

All US Towers shipped by truck; freight charges additional.

BUY FROM HRO. The World's Largest US Tower Dealer

TX-455

• 55' freestanding crank-up • Handles 18 sq. ft. @ 50 mph • No guying required • Extra-strength construction • Can add raising and motor drive accessory • Towers rated to EIA specifications • Other models available at great prices!

Revolutionary Radio Interfaces

Rig control interfaces with CAT for all popular radios. Digital modes including RTTY, PSK, CS (WinKey emulation), MFSK, MT63 SSTV, PACTOR and many more. Experience untethered connection to the computer using the new WTI-1 wireless transceiver interface.

State of the Art Antenna Analyzers

Great selection of antenna analyzers designed for testing, checking, tuning or repairing antennas and feedlines with frequency ranges and accuracy to meet the needs of even the most discriminating amateur radio operator.

RigExpert

5 Ways to Shop!

- RETAIL LOCATIONS – Store hours 10:00AM - 5:30PM - Closed Sunday
- PHONE – Toll-free phone hours 9:30AM - 5:30PM
- FAX – All store locations
- ONLINE – WWW.HAMRADIO.COM
- MAIL – All store locations

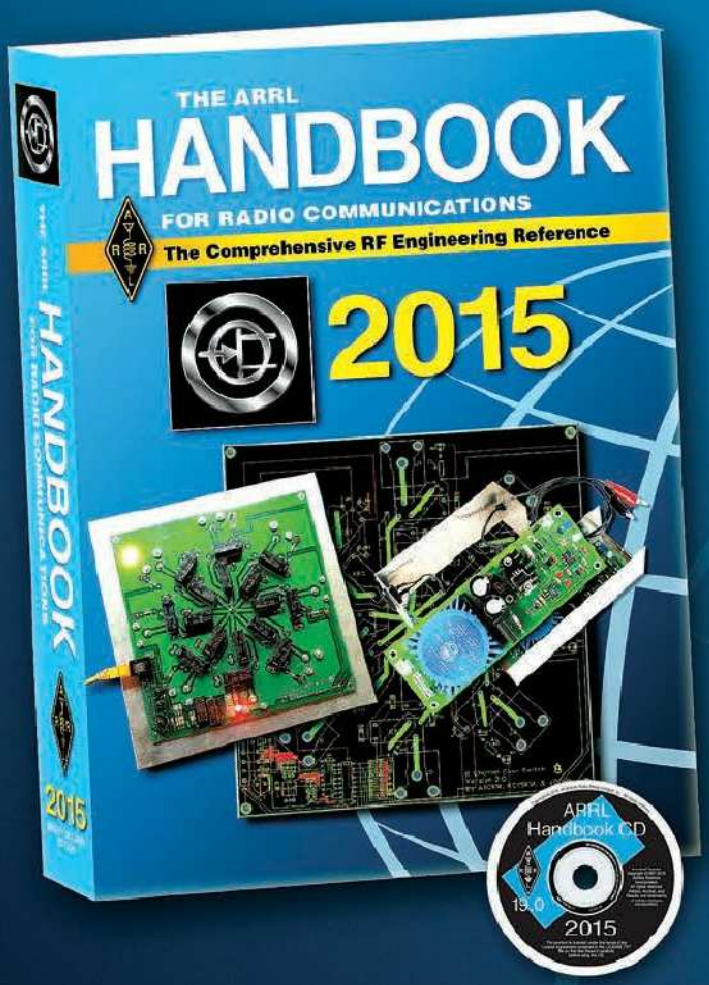
HRO is owned and operated by active hams!

ANAHEIM, CA (800) 854-6046	OAKLAND, CA (877) 892-1745	SUNNYVALE, CA (877) 892-1749	PORTLAND, OR (800) 765-4267	PHOENIX, AZ (800) 559-7388	WOODBRIDGE, VA (800) 444-4799	PLANO, TX Coming Soon!
BURBANK, CA (877) 892-1748	SAN DIEGO, CA (877) 520-9623	NEW CASTLE, DE (800) 644-4476	DENVER, CO (800) 444-9476	ATLANTA, GA (800) 444-7927	SALEM, NH (800) 444-0047	ONLINE STORE WWW.HAMRADIO.COM

Toll-free including Hawaii, Alaska and Canada. Call will be routed to the nearest store. All HRO 800-lines can assist you. If the first line you call is busy, you may call another. AZ, CA, CO, GA, VA residents add sales tax. Prices, specifications and descriptions subject to change without notice.

The ARRL HANDBOOK for Radio Communications

NEW!



2015 Edition

Discover the theory, practical information and construction details to expand your knowledge and skill as an Amateur Radio operator and experimenter.

This 92nd edition of ***The ARRL Handbook*** is at the forefront of the growing field of wireless telecommunications. The book covers not only the fundamentals of radio electronics—analog and digital—but also practical circuit and antenna design, computer-aided design, digital operating modes, equipment troubleshooting, and reducing RF interference. Many projects and construction articles are included to help enhance your station and expand your participation as an active radio experimenter. Practical applications and solutions make ***The Handbook*** a must-have for hobbyists and technical professionals, finding its way onto workbenches, operating desks, and into university libraries and classrooms.

Dozens of contributors help ensure that each edition is updated and revised to reflect the latest advances and technologies:

New Projects

- Simple Adjustable Tracking Power Supply
- Tri-Band Moxon Yagi Antenna
- A Legal-Limit Bias-T
- An Eight-Channel Remote Control Antenna Switch

New Information

- Updated material on the state of Solar Cycle 24
- Recommended parts for modifying circuit designs and fine-tuning performance
- A package of useful applications on CD-ROM from Tonne Software, including a new version of the ELSIE™ filter design program
- Annual transceiver model review

CD-ROM Inside

Includes the fully searchable text and illustrations in the printed book, as well as expanded supplemental content, software, PC board templates, and other support files.

Softcover Book and CD-ROM
ARRL Order No. 1920
Only $49.95*

Hardcover Book and CD-ROM
ARRL Order No. 0218
BONUS! Save $10.00 while supplies last
Only $49.95* (retail $59.95)

Special Offer!

The **BEST DEAL** in Amateur Radio is back! **Save $10.00** and get the **Hardcover edition** at the Softcover price, while supplies last.

*Shipping and handling charges apply. Sales Tax is required for all orders shipped to CT, VA, and Canada.
Prices and product availability are subject to change without notice.

ARRL The national association for AMATEUR RADIO®

ARRL 100 YEARS

www.arrl.org/shop

Toll-Free US 888-277-5289,
or elsewhere +1-860-594-0355

QST 12/2014

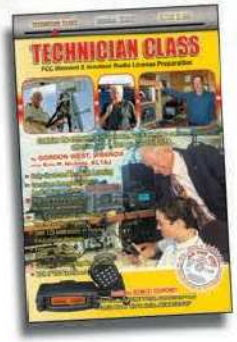
Study with the BEST!

Gordon West, WB6NOA

with Eric P. Nichols, KL7AJ and W5YI GROUP

GORDON WEST, WB6NOA ★ THE W5YI GROUP ★ HAM IT UP! ★ STUDY WITH THE BEST!

NEW for the 2014-18 Entry-Level Exam!



Technician Class Book

For the NEW 2014-2018 entry level exam! Gordo reorganizes the Q&A into logical topic groups for easy learning! Key words are highlighted in his explanations to help you understand the material for test success. Web addresses for more than 125 helpful, educational sites. Includes "On The Air!" CD demonstrating Tech privileges. **GWTM $21.95**

Technician Book & Software Package

Gordo's book with W5YI Windows software allows you to study at your computer and take practice exams. Explanations from Gordo's book are on the software – answer a question wrong and his explanation appears to reinforce your learning. Includes free Part 97 Rule Book. **NCS $29.95**

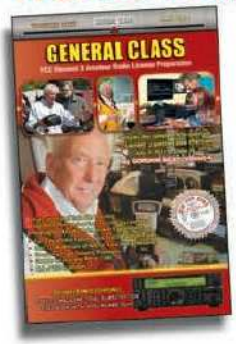
Technician Class Audio Course on CD

Welcome to Gordo's classroom! Technician audio theory course recorded by Gordo talks you through the Element 2 question pool. Follows the order of his Technician Class book, and is full of the sounds of ham radio operating excitement! An excellent study aid if you spend a lot of time in your car or pick-up! On 4 audio CDs. **GWTW $29.95**

Technician Class Book & Audio CD Value Pack

Technician Class book and Gordo's audio theory course, with free Part 97 Rule Book. **GWTP $49.95**

Upgrade to the HF Bands with Gordo & W5YI!



General Class Book

Gordo's manual for 2011-15 reorganizes the questions into logical topic groups for easier learning. His explanations include highlighted key words to help you remember the material for test success. 100 + addresses of helpful, educational websites. Bonus "On The Air!" CD introduces you to General Class HF operation fun. **GWGM $24.95**

General Book & Software Package

Study at your computer and take practice exams. W5YI Windows software includes explanations from Gordo's book, scores your results and highlights areas that need further study. Package includes Gordo's *General Class* book and free Part 97 Rule Book. **GUS $34.95**

General Class Audio Course on CD

General Theory Course recorded by Gordo is full of the sounds that bring ham radio to life! He talks you through the Element 3 theory to help you understand the material and get you ready for your upcoming exam. An excellent study aid if you spend a lot of time in your car or pick-up! On 4 audio CDs. **GWGW $29.95**

General Class Book & Audio CD Value Pack

General Class book and Gordo's audio theory course, with free Part 97 Rule Book. **GWGP $49.95**

Go to the Top With Gordo — Amateur Extra Class!

Extra Class Book

2012-2016 book includes all Element 4 questions and answers, along with Gordo's educational explanations. Full of Gordo's great memory tricks for those tough math and electronic theory questions (wait 'til you meet "Eli the Ice Man")! Bonus "On The Air!" CD highlights Extra Class operations. **GWEM $24.95**

Extra Book & Software Package

Study at your computer and take practice exams as the W5YI Windows software scores your results and highlights areas that need further study. Software includes explanations from Gordo's book. Package includes Gordo's *Extra Class* book and free Part 97 Rule Book. **ECS $39.95**

Extra Class Audio Course on CD

Extra Class Theory Course recorded by Gordo talks you through the difficult Element 4 theory to help you understand the material and get you ready for your upgrade to the top – the Amateur Extra Class! An excellent study aid if you spend a lot of time in your car or pick-up! On 6 audio CDs. **GWEW $39.95**

Extra Class Book & Audio CD Value Pack

Extra Class book and Gordo's audio theory course, with free Part 97 Rule Book. **GWEP $59.95**

Earn Your FCC Commercial Radio License!

GROL+RADAR Book

Get your FCC commercial radio licenses and add valuable credentials to your resume! GROL+RADAR includes the new FCC Element 1 question pool for the Marine Radio Operator Permit (MROP), the Element 3 pool for the General Radiotelephone Operator License (GROL), and the Element 8 pool for the RADAR Endorsement. Many employers require these licenses for jobs in marine, aero, safety, and municipal positions. Gordo and his team have written clear explanations for all the Q&A to make studying for these exams educational and fun. If you're an Extra Class ham, many of the technical/math questions will look familiar to you. Fully-illustrated to aid your learning. **GROL $49.95**

GROL+RADAR Book & Software Package

Enhance your learning experience using our practice exam software along with the GROL+RADAR book. Windows software includes answer explanations from the book – when you select a wrong answer, the explanation from the book appears to reinforce your learning. **GRSP $79.95**

ORDER TODAY! on-line at **www.w5yi.org** or call **800-669-9594**

The W5YI Group • P.O.B. 200065 • Arlington, TX 76006

Your #1 Source for Coaxial Cable and Cable Tools

DX ENGINEERING

DXE-UT-KIT4

Coaxial Cable Prep Tools for Solder-On Connectors

Using a two-step process, these prep tools are the ideal way to prepare your foam or solid dielectic coaxial cable for a solder-on connector. The tools' premium-quality, long-lasting blades and superior precision ensure that you won't damage the cable's conductor.

DXE-UT-8213	Cable Stripper for RG-8, RG-213, and Similar Sizes	$49.95
DXE-UT-808X	Cable Stripper for RG-8X, 9258, and Similar Sizes	$49.95
DXE-UT-80P	PL-259 Assembly Tool	$22.95
DXE-UT-80N	2-Piece N Connector Tool	$22.95
CNL-911	Coax Cable Cutters	$18.97
DXE-170M	Precision Shear Cutters	$7.95

The tools also come in cost-saving kits, complete with case.

DXE-UT-KIT3	Basic Coax Cable Prep Kit	$119.95
DXE-UT-KIT4	Complete Coax Cable Prep Kit	$199.95

DXE-UT-KIT3 eligible for 10 DX Bucks, DXE-UT-KIT4 eligible for 20 DX Bucks, see DXEngineering.com for details.

Amphenol® Connex

AMP-112116	BNC Male, RG-58/LMR-195	$1.59
AMP-112533	BNC Male, RG-8X/LMR-240	$1.78
AMP-172100	Type N Male, RG-58/LMR-195	$4.01
AMP-172102	Type N Male, RG-8/RG-213/RG-393	$4.35
AMP-172102H243	Type N Male, DXE-8U/ DXE-400MAX/LMR-400	$3.91
AMP-172135	Type N Male, RG-8X/LMR-240	$4.38
AMP-182100	PL-259, RG-58/LMR-240	$4.14
AMP-182102	PL-259, RG-8/RG-213/RG-393	$3.95
AMP-182115-10	PL-259, RG-8X/LMR-240	$4.50
AMP-182130-10	PL-259, DXE-8U/ DXE-400MAX/LMR-400	$4.50

DXE-UT-KIT-CRMP2

Ultra-Grip 2 Crimp Connector Hand Tool Kit

This kit includes everything you need to make professional-quality crimps on coaxial and Powerpole® connectors. The ratcheting steel crimper is designed to fit ergonomically in your hand to reduce fatigue. The kit comes with the Ultra-Grip 2 Tool, 5 crimp dies, shears, braid trimmer, Allen wrench and case. You get crimp dies precisely sized for RG-8U, LMR-400, RG-8X and LMR-240 type cables, along with specialized dies for Powerpole 15A, 30A and 45A connectors, as well as insulated and un-insulated wire terminals.

The Ultra-Grip 2 Crimp Tool, interchangeable dies and specialized carrying case are also available separately. You can expand the functionality of your UT-CRIMP and UT-CRMP2 Crimp Tool with extra crimp dies. They're made to handle various common crimp connector types in several sizes.

DXE-UT-KIT-CRMP2	Complete Kit, 5 Die Sets;	$154.95
DXE-UT-CRMP2	Crimp Tool for RG-8U/ LMR-400 Size Cable	$49.68
DXE-UT-CRMP2-8X	Crimp Tool for RG-8X/ LMR-240 Size Cable	$49.68
DXE-UT-CRMP2-PWR	Crimp Tool for Powerpole® 15, 30, 45A	$49.68
DXE-UT-DIE-INS	Crimp Die for Insulated 22-10 AWG Terminals	$19.73
DXE-UT-DIE-UNIS	Crimp Die for Uninsulated 22-8 AWG Terminals	$19.73

DXE-UT-KIT-CRMP2 eligible for 10 DX Bucks, see DXEngineering.com for details.

DXE-PL259

DXE-PP30

DXE-UG175S

DXE-UG176S

Solder-On Two-Piece Connectors

Silver plated and featuring PTFE insulation, these low-loss connectors have an extraordinarily high electrical breakdown point.

DXE-PL259	UHF Male Connector	$2.75
AML-83-1SP	Amphenol PL-259 Connector	$4.15
DXE-N1001-S	Type N Male Connector	$6.95
DXE-UG175S	Adapter for RG-58	$0.95
DXE-UG176S	Adapter for RG-8X	$0.95

Anderson Powerpole® Connectors

DXE-PP30	For 12-16 AWG, 30 Amps, 10 Pairs	$12.95
DXE-PP45	For 10-14 AWG, 45 Amps, 10 Pairs	$17.95

Dual Vertical Array

The Dual Vertical Array is an easy-to-install two-element vertical antenna phasing system that offers great HF performance. It uses a new design to increase array efficiency by eliminating the waste load port found on previous systems. The array can handle 2 kW, with a front-to-back over 20 dB and up to 3 dB of gain over a single vertical.

The DX Engineering Dual Vertical Array systems are available for the 160, 80 and 40 meter bands. More bands are coming soon.

DXE-DVA-160-P	Dual Vertical Array, 160M with Controller	$469.90
DXE-DVA-80-P	Dual Vertical Array, 80M with Controller	$454.90
DXE-DVA-40-P	Dual Vertical Array, 40M with Controller	$439.90

Eligible for 45 DX Bucks, see DXEngineering.com for details.

Receiver Guard 5000

Protect your sensitive receiver against high levels of RF from strong or nearby signals. DX Engineering's Receiver Guard 5000 is perfect if you have a receive antenna saturated with high RF levels. It is also useful for Field Day, SWL or if your neighbor generates a lot of RF.

The RG-5000's advanced design limits strong signals with minimal harmonic noise and is RF transparent at normal receiver signal levels. Designed for the world-class multi-transmitter contest station K3LR, it offers 100% protection to expensive transciever front-ends. The RG-5000 provides performance and frequency coverage superior to other devices. At a continuous input of 10 W maximum, output is only +10 dBm (83 dB over S-9), and insertion loss is under 0.15 dB from 0.5 to 50 MHz.

DXE-RG-5000	Receiver Guard 5000	$74.95

Copper Ground Rod Clamp

This clamp is the perfect mounting platform for up to six of the common coaxial protector models from PolyPhaser and Alpha Delta, sold separately. It secures to a 5/8" to 3/4" O.D. ground rod using the included stainless hardware. *The clamp is shown with optional parts.*

DXE-UCGC	Copper Ground Rod Clamp	$48.95

January 10th is MFJ Day at DX Engineering. Shake off the Winter doldrums and make some eyeball QSOs. Get super deals on open-box gear. Plus, all MFJ brands—Ameritron, Cushcraft, Hy-Gain, Mirage, MFJ, and Vectronics—will be on sale.

Highest Quality Cable and Assemblies

Always the Best Cable at the Lowest Price

- Made to DX Engineering's rigid specifications
- Available in full spools or cut to your custom length

Bulk Cable	Impedance	Length	Price
Low-Loss Mini-8 Cable			
DXE-8X	50 Ω	per foot	**$0.38**
DXE-8X-1000	50 Ω	1,000'	**$299.99**
Low-Loss Cable			
DXE-213U	50 Ω	per foot	**$0.89**
DXE-213U-500	50 Ω	500'	**$389.95**
DXE-11U	75 Ω	per foot	**$0.52**
Premium Low-Loss Cable			
DXE-400MAX	50 Ω	per foot	**$0.92**
DXE-400MAX-500	50 Ω	500'	**$399.95**
Low-Loss Foam Cable			
DXE-8U	50 Ω	per foot	**$0.84**
DXE-8U-500	50 Ω	500'	**$369.95**
Highly Flexible Cable			
DXE-58AU	50 Ω	per foot	**$0.29**
Flooded Jacket Cable			
DXE-F6-CTL	75 Ω	per foot	**$0.19**
DXE-F6-1000	75 Ω	1,000'	**$149.95**

Made in USA

DX Engineering's Revolutionary PL-259 Connector*

A "Better Mousetrap" Approach to Your Cable.

This brand new PL-259 design has a full-diameter, full-length soldered center pin, which means it will fit snugly into a well-worn SO-239. The large center pin also makes it easier to flow solder inside, further securing the conductor. The silver plated and deeply knurled shell has precise threads to promote a solid connection with the SO-239. Each of these PL-259 connectors is insulated with a PTFE dielectric for exceptional RF characteristics. You can only get this new connector design at DX Engineering.

***Patent Pending**

The New PL-259 is Used Exclusively on DX Engineering Cable Assemblies.

DX Engineering starts with the highest-performance, low-loss 8U, 213U and 400MAX coaxial cable, and then finishes each assembly with its revolutionary new PL-259 connectors. The connectors feature a machine-crimped shield that provides a 360° electro-mechanical connection. Every weather-shielded, hand-soldered assembly is hi-pot and continuity tested in the USA. They come in multiple lengths; custom lengths are also available.

DX Engineering is the Best Place to Get Coax, Here's Why:

- 100% High Voltage (Hi-Pot) Tested
- Weatherproof: Adhesive Shrink Tubing Seals Connections
- Silver-plated PTFE-insulated Connectors
- Hand Crafted by Top Techs
- See DXEngineering.com for More Connector Options

Black PVC Jacket

DXE-8U 50 Ω Low-Loss Foam Dielectric Cable

- .405" high-flex PVC jacket

Attenuation per 100 feet	Power Rating	Efficiency
0.3 dB @ 5 MHz	5.4 kW	93%
0.5 dB @ 10 MHz	4.1 kW	90%
0.9 dB @ 30 MHZ	2.2 kW	81%
1.2 dB @ 50 MHz	1.8 kW	77%
2.2 dB @ 150 MHz	1.0 kW	60%

UV-Resistant, Non-Contaminating, Black PVC Jacket

DXE-213U 50 Ω MIL-Spec Cable

- .405" Type II UV-resistant jacket is non-contaminating and suitable for outdoor use

Attenuation per 100 feet	Power Rating	Efficiency
0.4 dB @ 5 MHz	4.9 kW	90%
0.6 dB @ 10 MHz	3.4 kW	87%
1.0 dB @ 30 MHz	2.0 kW	79%
1.3 dB @ 50 MHz	1.5 kW	73%
2.4 dB @ 150 MHz	0.9 kW	57%

UV-Resistant, Non-Contaminating, Black PE Jacket

DXE-400MAX 50 Ω Premium Low-Loss Cable

- Gas-injected foam, polyethylene dielectric bonded tape foil covered by a braided copper shield
- .405" low-density UV-resistant polyethylene jacket is ideal for outdoors
- Direct-bury

Attenuation per 100 feet	Power Rating	Efficiency
0.3 dB @ 5 MHz	6.9 kW	93%
0.5 dB @ 10 MHz	4.8 kW	90%
0.8 dB @ 30 MHz	2.8 kW	83%
1.1 dB @ 50 MHz	2.1 kW	79%
1.8 dB @ 150 MHz	1.2 kW	65%
3.3 dB @ 450 MHz	0.7kW	47%

UV-Resistant, Black PE Jacket

DXE-8X Low-Loss Foam Dielectric Cable

Known as RG-8X or Mini-8

- Very flexible; ideal for short, in-shack jumper cables
- .242" Type II jacket is non-contaminating and UV-resistant
- Direct-bury

Attenuation per 100 feet	Power Rating	Efficiency
0.6 dB @ 5 MHz	3.0 kW	86%
0.9 dB @ 10 MHz	2.2 kW	81%
1.4 dB @ 30 MHz	1.2 kW	69%
2.0 dB @ 50 MHz	0.9 kW	62%
3.8 dB @ 150 MHz	0.4 kW	42%

DX Engineering Cable is Available in Pre-Cut Assemblies with Connectors.

DX Engineering Cable Assemblies are built by our techs, right here in Ohio. They're fully tested and are ready for installation in your shack. For all lengths and connector options, visit DXEngineering.com.

Pre-cut Cable, PL-259 Connectors		
Part Number	Length	Price
DXE-8UDX002	2'	**19.95**
DXE-8UDX003	3'	**$20.95**
DXE-8UDX006	6'	**$23.95**
DXE-8UDX025	25'	**$43.95**
DXE-8UDX050	50'	**$68.95**
DXE-8UDX100	100'	**$118.95**

Pre-cut Cable, PL-259 Connectors		
Part Number	Length	Price
DXE-213UDX003	3'	**$20.45**
DXE-213UDX006	6'	**$22.45**
DXE-213UDX012	12'	**$26.45**
DXE-213UDX025	25'	**$43.45**
DXE-213UDX050	50'	**$68.45**
DXE-213UDX075	75'	**$96.45**
DXE-213UDX100	100'	**$118.45**
DXE-213UDX150	150'	**$178.45**

Pre-cut Cable, PL-259 Connectors		
Part Number	Length	Price
DXE-400MAXDX003	3'	**$21.45**
DXE-400MAXDX006	6'	**$24.45**
DXE-400MAXDX018	18'	**$31.45**
DXE-400MAXDX025	25'	**$44.45**
DXE-400MAXDX050	50'	**$69.45**
DXE-400MAXDX075	75'	**$97.45**
DXE-400MAXDX100	100'	**$119.45**
DXE-400MAXDX150	150'	**$179.45**

Pre-cut Cable, PL-259 Connectors		
Part Number	Length	Price
DXE-8XDU003	3'	**$18.45**
DXE-8XDU006	6'	**$19.45**
DXE-8XDU012	12'	**$24.45**
DXE-8XDU025	25'	**$29.45**
DXE-8XDU050	50'	**$37.45**
DXE-8XDU075	75'	**$44.45**
DXE-8XDU100	100'	**$54.45**
DXE-8XDU150	150'	**$79.45**

DX ENGINEERING®

MFJ DAY AT DX ENGINEERING
1/10/15 · 9am to 2 pm
1200 Southeast Avenue
Tallmadge, Ohio
Huge Showroom Specials!

8:30 am to 7 pm ET Monday–Friday
1230 to 2300 UTC March-October
1330 to 0000 UTC November-February

8:30 am to 5 pm ET Weekends
1230 to 2100 UTC March-October
1330 to 2200 UTC November-February

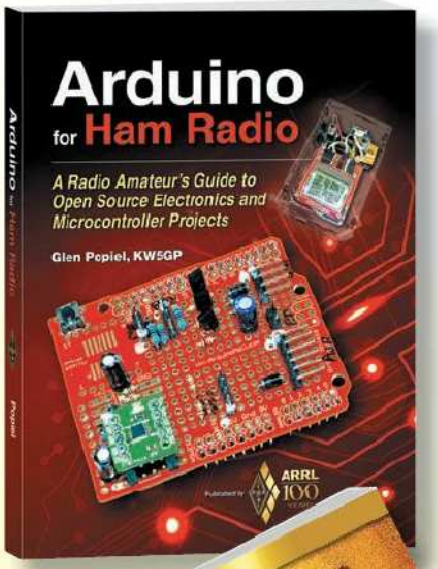
Tech: **8:30 am to 7 pm ET** 330-572-3200 M–F
Country Code: **+1** Sale Code: **1501QS**
Prices & specifications subject to change without notice.

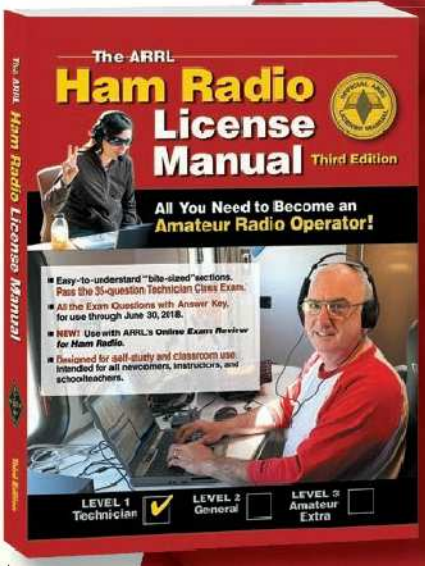
DXENGINEERING.COM
800-777-0703

Great Gift Ideas from ARRL!

The ARRL Ham Radio License Manual
Only $29.95

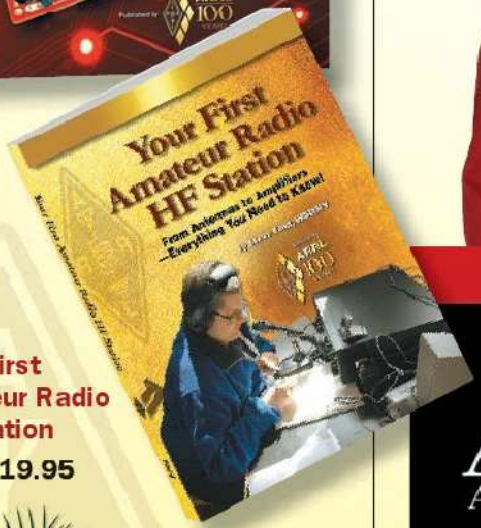
Arduino for Ham Radio
Only $29.95





ARRL Apparel
Designed specifically for ARRL Members

Your First Amateur Radio HF Station
Only $19.95



ARRL Centennial Mug
Only $14.00

2015 ARRL Calendar
Only $12.95

For more great gift ideas visit www.arrl.org/shop

Give the Gift of Membership!

ARRL Members Get It All!

- A Full Year of Membership
- 12 Issues of *QST* Magazine ***PLUS*** Digital Edition
- Members Only Publication Discounts

...And So Much More!

Includes QST

www.arrl.org/join

Membership Application

☑ Membership options (circle your choice/s)

	1 Year	2 Years	3 Years	
Regular	$39	$76	$111	Monthly *QST* via standard mail for US members
Canada	$49	$93	$132	Monthly *QST* via standard mail for Canadian members
International *QST*	$62	$118	$167	Monthly *QST* via air mail for international members
International – no printed *QST*	$39	$76	$111	Digital *QST* only
Family	$8	$16	$24	Reside at the same address as the primary member, no additional *QST*. Membership dates must correspond with primary member.

Membership includes $15 per year for subscription to *QST*. Dues subject to change without notice and are nonrefundable.

Blind and youth rates are available. Contact ARRL for more details.

Additional membership options available online at www.arrl.org/join.

Name _____ Call Sign _____

Street _____ City _____ State _____ ZIP _____

E-mail _____ Phone _____

Family Member Name _____ Call Sign (if any) _____

☑ Payment Options

☐ Visa ☐ MasterCard ☐ Amex ☐ Discover ☐ Check Enclosed

Card Number _____ Expiration Date _____

Cardholder's Signature _____

☐ Total enclosed payable to ARRL $ _____

☐ I do not want my name and address made available for non-ARRL related mailings.

Join Now

ONLINE: **www.arrl.org/join** PHONE: **1-888-277-5289 (US)**
ARRL • 225 Main Street • Newington, CT 06111-1494
Phone: 860-594-0338 • FAX: 860-594-0303

Source Code: QST 12/2014

— Yaesu System Fusion —

FT-1DRBHD 2M/440 FM HT

• TX: 2M/70cm • Wideband RX: 500kHz-999MHz (less cellular with AM/FM broadcast) • Power: 5W • Analog and Digital (12.5kHz C4FM FDMA) • Integrated GPS • CTCSS/DCS Encode & Decode • WX Receiving with WX Alert • Digital Group Monitor Function • GSM (Group Short Message) • Snapshot Function with optional Speaker Mic

NEW LOW PRICE

FTM-400DR
2M/440FM Transceiver

TX: 2M/70cm RX: 108-470/800-999MHz (cell blkd) • Power: 50W FM • C4FM FDMA w/GPS for APRS (1200/9600bps) • Packet Ready Color display • Spectrum scope • ARTS • Bluetooth • Twin RX• MicroSD slot • 12/30kHz filters • 500 memories/band

FT-450D HF/6M Transceiver

• TX: HF/6M • RX: 0.03-56 MHz • Power: 10-100W • Memories: 500 • Built-in Automatic Antenna Tuner • IF DSP • Same as the original FT-450AT with new features: Key illumination, Foot stand, Selectable 300 Hz/500 Hz/2.4 kHz CW IF Filters • Classically designed main dial and knobs • dynamic microphone

FTDX-1200 HF/6M Transceiver

• TX: HF/6M • RX: 0.03-56 MHz • Triple Conversion with 32-bit floating point DSP • Power: 100W • Built-in Automatic Antenna Tuner • 40 MHz IF with selectable 3 kHz, 6kHz & 15 kHz Roofing Filters • FM & AM Wide and Narrow modes included • Optional built-in FFT UNIT supports advanced functionality including AF-FFT Scope • RTTY/PSK31 Encode/Decode • CW Decode and CW Auto Zero-in • Full Color 4.3 in. TFT Color Display • USB port

FT-270R 2M FM HT

• TX: 144-148 • RX: 136-174 • Power: 5/2/0.5W • 200 Memories • Extra large LCD display & speaker

FT-60R 2M/440 MHz HT

•TX: 144-148, 430-450 • RX: 0.5-999 • 5 Watts RF Output • Features wideband receive from 108-520 and 700-999 MHz (Cellular Blocked) • Emergency Auto ID System • Over 1000 Memories

VX-8DR 6M/2M/440 FM HT

• TX: 50-54, 144-148, 222-225, 430-450 MHz • RX: 0.5-999 MHz (cell blocked) • 1200+ Memories • Power: 5/2.5/1/0.05W (1.5W on 220 MHz) • Optional GPS Unit FGPS-2 with either CT-136 adapter or MH-74A7A hand microphone provides APRS® data

FTDX-3000D HF/6M Transceiver

• TX: HF/6M • RX: 0.03-56 MHz • Power: 5-100W • Large TFT color display • High-speed spectrum scope • High end receiver based off of the FTDX-5000 • IPO • Built-in USB interface • Remote Control Capability • High-speed auto antenna tuner • RTTY/PSK31encode/decode included • 5 Digital voice messages

FT-2900R Heavy Duty Wide/Narrow, Deviation Section 2M FM Mobile

• TX: 144-148 MHz • RX: 136-174 MHz • Power: 75/30/10/5W • 3W of Audio for for Noisy Environments • Massive Heat Sink (No Cooling Fan Needed) • 221 Memories • Dual Watch • Versatile Scanning Capability • WX Channels with "Severe Weather" Alert • CTCSS and DCS Encode/Decode Built-in • Transmit Time-Out timer • Automatic Power Off

FTDX-5000MP *Limited*
HF/6M Transceiver

• TX: 1.8-29.7, 50-54 MHz Power: 10-200W on CW, SSB, FM, RTTY & PKT and 5-50W on AM • RX: 0.03-60 MHz • 99 Memories • Agressive 112dB range • +40dBm IP3 or 3rd-order Intercept Range • High stability ±0.05ppm OCXO • 32-bit Floating Point DSP • Variable CW Audio Peak Filter, and High/Low-Cut DSP filtering • 300 Hz, 600Hz, 3 kHz, 6kHz and 15 kHz Roofing Filters

YAESU mail-in rebates expire on 12/31/14. *Please check Web or Call for Current Promotions.*

AES
AMATEUR ELECTRONIC SUPPLY

5710 W. Good Hope Rd.
Milwaukee, WI 53223
414-358-0333
800-558-0411
fax: 414-358-3337
milwaukee@aesham.com

28940 Euclid Ave.
Cleveland, OH 44092
440-585-7388
800-321-3594
cleveland@aesham.com

621 Commonwealth Ave.
Orlando, FL 32803
407-894-3238
800-327-1917
orlando@aesham.com

4640 South Polaris Ave.
Las Vegas, NV 89103
702-647-3114
800-634-6227
lasvegas@aesham.com

1-800-558-0411
aesham.com

MasterCard VISA DISCOVER NOVUS American Express Cards

FOLLOW US ON TWITTER!
twitter.com/K9AES

TRADE UP TO YAESU
CALL NOW FOR A QUOTE!

Radios by YAESU
The radio

TH-K20A 2M FM HT

- TX: 144-148 • RX: 136-174
- Power: 5.5/1.5/0.5W • 100 Memories

TH-F6A Triband FM HT

- TX: 144-148, 222-225, 430-450 MHz
- RX: 0.1-1300 MHz (cell blkd) • Dual band RX
- FM Wide/Narrow, AM, SSB and CW receive modes
- Power: 5/0.5/0.05W • Memories: 435

TH-D72A

2M/440 FM HT with Built in GPS

• TX: 144-148, 430-450 • RX: 118-174, 320-524 MHz • Power: 5/0.5/0.05W • Memories: 1000 • USB Port • 1200/9600 bps packet TNC • SkyCommand and APRS • Stand-alone Digipeater • Built-in High Performance GPS • GPS logging - stores up to 5,000 points of track data• Echolink® ready • KISS mode protocol

TM-281A 2M FM Mobile

- TX: 144-148 MHz •RX: 136-174 MHz
- Power: 65W • 200 Memories

TM-V71A Dualband FM Mobile

• TX: 144-148, 430-450 MHz • RX: 118-524, 800-1300 MHz (cell blocked) • Power: 50/10/5W • Dual receive (V+V) (U+U) • Cross-band repeat • EchoLink® ready • Optional RC-D710 can replace the TM-V71A control panel to enable all the features of the original TM-D710A.

KENWOOD Coupons expire on 12/31/2014.
Please check Web or Call for Current Promotions.

TM-D710GA

Dualband FM Mobile with TNC AND GPS

• TX: 144-148, 430-450 MHz • RX: 118-524, 800-1300 MHz (cell blkd) • Power: 50/10/5W • Dual receive (V+V) (U+U) • Built-in TNC for APRS • GPS built into Display Head • Cross-band repeat • EchoLink® ready

TS-480HX 200W HF/6M Mobile

• TX:HF/6M • RX: 0.5-60 MHz • Power: 10-200W (with two optional 22A PS's) • Memories: 99 • IF/stage DSP on main band, AF/stage DSP on sub-band

TS-480SAT $250 INSTANT COUPON

100W with auto antenna tuner.

TS-2000 HF/VHF/UHF Transceiver

• TX: HF/6M/2M/440 MHz • RX: 0.03-60, 142-152, 420-450 MHz • Power: 10-100W (10-50W on 440 MHz) • 99 Memories • HF/6M Auto Antenna Tuner • IF/stage DSP on main band, AF/stage DSP on sub-band

TS-2000X $250 INSTANT COUPON

All the features and coverage of the TS-2000 and also includes 1.2 GHz @ 10W.

TS-590S 100W HF/6M Transceiver

Closeout

• TX: HF/6M • RX: 0.03-60MHz MHz • Power: 5-100W • 110 Memories + 10 Quick Channels • Auto Antenna Tuner • USB for PC and remote control • Down conversion receiver • Narrow first roofing filter • More!

TS-990S HF/6M Flagship Transceiver

• TX: HF/6M • RX: 0.13-60 MHz • Power: 2-200W • Built-in Auto Antenna Tuner and AC Supply • Dual TFT Display • Dual receivers • Narrow-band roofing filters • Triple DSP • Serial port, USB ports and Ethernet port

AES
AMATEUR ELECTRONIC SUPPLY

5710 W. Good Hope Rd.
Milwaukee, WI 53223
414-358-0333
800-558-0411
fax: 414-358-3337
milwaukee@aesham.com

28940 Euclid Ave.
Cleveland, OH 44092
440-585-7388
800-321-3594
cleveland@aesham.com

621 Commonwealth Ave.
Orlando, FL 32803
407-894-3238
800-327-1917
orlando@aesham.com

4640 South Polaris Ave.
Las Vegas, NV 89103
702-647-3114
800-634-6227
lasvegas@aesham.com

1-800-558-0411
aesham.com

MasterCard VISA DISCOVER NOVUS American Express Cards

FOLLOW US ON TWITTER!
twitter.com/K9AES

TRADE UP TO KENWOOD
CALL NOW FOR A QUOTE!

Radios by KENWOOD

50th Anniversary Limited Edition Available From AES

ID-51A
Dual Band Handheld

ICOM

• TX: voice memory for repeat calls • Integrated GPS receiver with GPS loggins function • Repeater search function searches up to 20 nearby repeater sites • Battery pack, BP-271 • Voice synthesizer function announces frequency, mode and call sign • Voice memory function records incoming and outgoing calls and can be used as a voice recorder • Large full dot-matrix display • DR (D-STAR repeater) mode operation makes it easy to access D-STAR repeaters • micro SD card slot for voice, log data storage and data cloning • Antenna, FA-S270C • Cloning software • Wall charger • Belt clip • Hand strap

Only 5,000 units will be available worldwide. Be sure to get your Anniversary Edition while supplies last.

$25 INSTANT COUPON

ID-5100A
144/440 MHz Mobile

• TX: 144-148 MHz • RX: 118-174 MHz • TX Power: 50 Watts • D-Star capability • LCD touch screen • Enjoy 1000 memory channels • 4 call channels • 50 program scan edges • 1200 repeater memories • Wideband receive coverage is 118-137 [AM mode], 137-174 and 375-550 MHz • HM-207 hand mic • SD card slot for voice & data storage • D-PRS enhancements • TNC/9600bps modem connectivity • built-in GPS

$75 INSTANT COUPON

IC-7410 HF/6M Transceiver

• TX: HF/6M • RX: 0.03-60 MHz • Power: 2-100W • 15kHz 1st IF Filter and optional 3kHz & 6kHz filters to protect against strong unwanted adjacent signals • Much faster DSP unit compared to the IC-746PRO • Automatic antenna tuner • USB connector for PC control

$225 INSTANT COUPON

IC-7100
HF/VHF/UHF All Mode Transceiver

• TX: HF/6M/2M/440MHz • RX: 0.03-199.999, 400-470 MHz MHz • Power: 2-100W/2-50W (2M)/2-35W (440) • Memories: 495, 900 D-Star Repeater Channels • Remote Head • Intuitive Touch Screen Interface • D-Star DV Mode • Detachable Angled Screen • SD Memory Card Slot • USB Port • Optional RS-BA1 Remote Control Software • Optional RC-28 USB Remote Encoder

$100 INSTANT COUPON

IC-7600
HF/6M Transceiver

• TX: HF/6M • RX: 0.03-60 MHz • Power: 2-100W • Memories: 101 • 5.8 inch color screen • High-resolution real spectrum scope • Automatic antenna tuner

ICOM Instant Coupons expire on 12/31/14.
Please check Web or Call for Current Promotions.

AES
AMATEUR ELECTRONIC SUPPLY

5710 W. Good Hope Rd.
Milwaukee, WI 53223
414-358-0333
800-558-0411
fax: 414-358-3337
milwaukee@aesham.com

28940 Euclid Ave.
Cleveland, OH 44092
440-585-7388
800-321-3594
cleveland@aesham.com

621 Commonwealth Ave.
Orlando, FL 32803
407-894-3238
800-327-1917
orlando@aesham.com

4640 South Polaris Ave.
Las Vegas, NV 89103
702-647-3114
800-634-6227
lasvegas@aesham.com

1-800-558-0411
aesham.com

MasterCard VISA DISCOVER NOVUS American Express Cards

FOLLOW US ON TWITTER!
twitter.com/K9AES

TRADE UP TO ICOM
CALL NOW FOR A QUOTE!

Radios by ICOM

New Ham Radio Deluxe

New Radios

New Digital Modes

New Logbook Features

New Rotators

New DX Clusters

New SDR Interfaces

Happy New Year!

Ham Radio Deluxe

http://www.ham-radio-deluxe.com

Free 30 Day Demo!

Sales: 813.434.4650
sales@hrdsoftwarellc.com

Rig Control - Logbook - Digital Master - Satellite Tracking - Rotor Control

hy-gain® Rotators

. . . the first choice of hams around the world!

HAM-IV

The most popular rotator in the world!

HAM-IV **$649.95**

For medium communications arrays up to 15 square feet wind load area. *Has* 5-second brake delay, Test/Calibrate function. Low temperature grease permits normal operation down to -30 degrees F. Alloy ring gear gives extra strength up to 100,000 PSI for maximum reliability. *Precision* indicator potentiometer. Ferrite beads reduce RF susceptibility. Cinch plug plus 8-pin plug at control box. Dual 98 ball bearing race for load bearing strength and electric locking steel wedge brake prevents wind induced movement. North/South center of rotation scale on meter, low voltage control, max mast $2^{1}/_{16}$".

HAM-VI **$749.95** with DCU-2

HAM-VII **$799.95** *with DCU-3*

TAILTWISTER SERIES II

T-2X **$799.95**

T-2XD2 **$899.95** with DCU-2

T-2XD3 **$949.95** with DCU-3

For large medium antenna arrays up to 20 sq. ft. wind load. Has 5-second brake delay, Test/Calibrate functions. Low temp grease, tough alloy ring gear, indicator potentiometer, ferrite beads on potentiometer wires, weatherproof AMP connectors plus 8-pin plug at control box, triple bearing race with 138 ball bearings for large load bearing, electric locking steel wedge brake, North/South center of rotation scale meter, low voltage control, $2^{1}/_{16}$" max mast. **MSHD, $109.95.** Above tower heavy duty mast support. T2X, HAM-IV, HAM-V, HAM-VI. Accepts $1^{7}/_{8}$-$2^{5}/_{8}$" OD.

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.

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 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 Rotator Specifications	
Wind load capacity (inside tower)	8.5 square feet
Wind Load (w/ mast adapter)	**5.0 square feet**
Turning Power	600 in.-lbs.
Brake Power	**800 in.-lbs.**
Brake Construction	Disc Brake
Bearing Assembly	**Dual race/48 ball brings**
Mounting Hardware	Clamp plate/steel U-bolts
Control Cable Conductors	**8**
Shipping Weight	22 lbs.
Effective Moment (in tower)	**1200 ft.-lbs.**

hy-gain Programmable DCU-3 Digital Rotator Controller

New!

DCU-3 **$449.95**

Hy-gain DCU-3 Digital Controller lets you program 6 beam headings! Gives you full automatic or manual control of your hy-gain HAM or Tailtwister Rotators.

Press a memory button or dial in your beam heading or let *Ham Radio Deluxe* (or other) take control. Your antenna auto rotates precisely and safely to your DX.

DCU-3 automatically jogs your antenna free and safely unlocks it before rotating begins *(great for older rotators with "sticky" brakes)* then turns off your motor before reaching its final heading. Your antenna *gently* coasts to a stop before the brake re-locks -- greatly reducing damaging overshoots and extending rotator life.

Simply press *Left* and *Right* buttons for *full* manual control and fine tuning.

Bright blue LCD shows current, dialed-in and computer controlled beam headings in one degree increments and your call.

Calibrate lets you accurately match your display to your *true* beam heading. Has USB/RS-232 ports for computer control. Adjustable LCD sleep time. Field upgradeable firmware. 8.5Wx4.3H x9D". 110 VAC. Order **DCU-3X** for 220 VAC.

DCU-2 Digital Rotator Controller

$399.95. Like DCU-3, but less programmable memories. 110 VAC. Order **DCU-2X**, for 220 VAC.

Replace your *YAESU* Rotator Controller

New!

YRC-1 **$329.95**

Hy-gain YRC-1 gives you more features and a much more robust controller that is far less prone to lightning damage. Costs less than repairing your original Yaesu controller!

Easy-to-use -- dial in your beam heading and tap *GOTO* button. *Exclusive* 180 degree *AutoReversal*™ for fast longpath operation.

Has all features of DCU-2. Bright blue LCD shows current, dialed-in and computer controlled beam headings and your call. USB port for computer control. Extra heavy-duty AC power supply.

Variable DC motor speed for minimizing damaging antenna overshoot and fast operation. Intuitive menu for calibrating, offsetting, or changing parameters. Field upgradeable firmware. Use with Yaesu G-800/1000/2800/G450/650. For AC or DC motors.

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.**

www.hy-gain.com

Nearest Dealer, Free catalog, To Order . . .

Voice: 662-323-9538 **Fax:** 662-323-6551

hy-gain®

Antennas, Rotators & Towers

308 Industrial Park Road,Starkville, MS 39759, USA

ARRL Membership Benefit

Get QST Wherever You Are!

All ARRL members have access to the digital edition of *QST*. Enjoy enhanced content, convenient access and a more interactive experience.

www.arrl.org/qst

Web Version

The digital edition is included with your ARRL membership. Access it from an Internet browser on nearly any online device, including desktop or laptop computer, smartphone, tablet and e-book reader. Download the entire issue to your computer or laptop.

QST Apps for Apple and Android devices

ARRL Members can read and download the digital edition of *QST* on an iPhone, iPad, iPod touch and Android tablets and phones. Read *QST* online or choose to download individual issues for offline reading. The *QST* apps are FREE.

GET IT ON Google play

Download on the App Store

Go Green! Go Digital-Only

ARRL Members may choose to opt-out of the mailed, print edition of *QST* at any time. Complete our online opt-out form available at **www.arrl.org/qst** or e-mail **circulation@arrl.org**.

ARRL The national association for AMATEUR RADIO® | QST | www.arrl.org/qst

AMERITRON® *automatically* tunes your screwdriver antenna as you tune your transceiver!

Super accurate tuning . . . Ultra-fast . . . Extremely Reliable . . . 88 memories . . . StallProtector™ . . . Fully RFI protected . . . Easy-to-use . . . Compact . . . Works with most screwdriver antennas and Icom, Kenwood, Yaesu, Elecraft transceivers . . .

SDC-104 (I, K, Y, E)

$159.95

Suggested Retail

Call your dealer for your best price!

New!

Ameritron* AutomaticTune™ *mode automatically tunes your screwdriver antenna for lowest SWR as you tune your transceiver!

You get super accurate, ultra-fast and extremely reliable tuning with 88 programmable memories.

You also get a *Stationary Tune*™ mode that lets you tune your transceiver *without* your antenna constantly moving -- then touch TUNE when you're ready.

Or you can use *ManualTune*™ mode by simply touching up/down buttons until you reach your desired frequency.

Precision four digit LED readout gives you antenna position, motor current and transceiver frequency -- it's so bright you can even read it in direct sunlight.

Its super compact, ergonomic design is so intuitive to use you'll never need the instruction book! 3⅝Wx3½H x1⅝D inches fits anywhere.

Fully RFI protected with RF chokes and bypass capacitors on incoming and outgoing wires and other sensitive points. All aluminum RF-tight cabinet. Completely eliminates troublesome RFI problems.

Ameritron's exclusive *StallProtector*™ prevents your expensive motor from burning out. It auto-detects motor stall and shuts off power to the motor completely. Current limit is adjustable 100 mA to 4.9A in 100 mA increments.

Menu allows change of motor direction without physically reversing wires.

Works with single/dual magnetic sensor screwdriver antennas. Includes interface cable for your transceiver, power, motor control and sensor wires. Specify Icom, Kenwood, Yaesu or Elecraft. Additional cable, $24.95 each.

SDC-102, $129.95

Program in ten favorite frequencies and simply push a button to send your antenna there! Up/down buttons easily tune to any frequency. Super bright *read-in-sunlight* LED digits tell exact antenna position. Easy-to-use. AutoPark™, StallProtector™.

SDC-100B, $109.95

Up/down buttons let you manually tune your screwdriver antenna quickly! Super bright *read-in-sunlight* LED digits tell exact antenna position with -999 to +999 digital count range. On/off switch. Reset switch lets you easily recalibrate.

AMERITRON® Mobile Solid State Amplifier

ALS-500M

$949

Suggested Retail

Call your dealer for your best price!

500 Watts PEP SSB/400 Watts CW output! Covers 1.5-22 MHz (10/12 Meters with MOD-10M, $29.95, requires FCC license).

Turn on and operate -- no warm-up, no tuning, instant bandswitching. 9Wx3½Hx15D", 7 lbs.

Virtually indestructible! *Load Fault Protection* eliminates damage due to operator error, antenna hitting branches, trucks passing by. *Thermal Overload Protection* disables/bypasses amplifier if temperature is excessive. Automatically resets.

60-70 Watts in gives full output. On/Off switch bypasses amplifier for barefoot operation. Extremely quiet fan turns on as needed. Excellent harmonic suppression, push-pull output, DC current meter. Use 13.8 VDC/80 Amps.

ALS-500RC, $49.95. Remote head gives full manual, remote control of ALS-500M.

ARI-500, $119.95. Lets your transceiver auto bandswitch your ALS-500M amplifier.

SPS-75MV, $259.95. 110/220 VAC input, 75A@13.8 VDC out. Switching power supply lets you operate ALS-500M at home.

AWM-35B *Precision* Mobile SWR/Wattmeter

AWM-35B/BH

$159.95

Suggested Retail

Just 1⅝" thick -- easily mounts on your dashboard for easy viewing. Remote sensor with 25' thin, flexible cable lets you place the sensor and coax *out-of-the-way*. Handles full 1500 Watts, 1.8-60 MHz. LED lighted Cross-Needle SWR/Watt-meter. Read *true peak* or average power in two power ranges. Has high SWR LED. Wattmeter is 5Wx3¼H x1⅝D inches. Remote is 3½Wx 2¾H x2¾D inches. Use 9V battery or 12 VDC.

AWM-35B, $159.95 has 300 Watt low, 3 kW high meter scale.

AWM-35BH, $159.95 has 100 Watt low, 1000 W high meter scale.

Call your dealer for your best price!

Free Catalog: 800-647-1800

AMERITRON®

. . . the world's high power leader!

116 Willow Road, Starkville, MS 39759
TECH (662) 323-8211 • **FAX** (662) 323-9810
8 a.m. - 4:30 p.m. CST Monday - Friday
For power amplifier components call (662) 323-8211

www.ameritron.com

AMERITRON . . . the World's High Power Leader!

MFJ

Dealer/Catalog/Manuals
Visit: http://www.mfjenterprises.com
or call toll-free 800-647-1800

• 1 Year *No Matter What*™ warranty • 30 day money back guarantee (less s/h) on orders direct from MFJ

MFJ ENTERPRISES, INC.
300 Industrial Pk Rd, Starkville, MS 39759
PH: (662) 323-5869 **Tech:** (662) 323-0549
FAX: (662)323-6551 8-4:30 CST, Mon.-Fri. *Add shipping.*

VISA MasterCard DISCOVER AMERICAN EXPRESS PayPal

MFJ-259C Analyzer, $299.95

World's best selling antenna analyzer covers 530 KHz to 230 MHz, LCD, SWR and impedance or SWR bargraph, analog meters, signal generator, freq counter.

MFJ-269C Analyzer, $399.95

Upgraded MFJ-259C has all features of MFJ-259C plus 415-470 MHz, 12-bit A/D converter, characteristic impedance 0-600 Ohms, coax calculator, parallel equivalent R/X.

MFJ-225 Analyzer, $399.95

Plots graphs on MFJ graphical analyzer. Two-port VNA measurement. Display/print on PC using IG-miniVNA freeware. DDS frequency control. 1.5-179.9 MHz.

MFJ-949E Tuner $189.95

More hams use MFJ-949E tuners than all others in the world! Large 3" cross-needle SWR/Wattmeter, 8 position antenna switch, dummy load, Match any antenna 1.8-30 MHz.

MFJ-969 Tuner $229.95

World's only 6-160 Meters 300 Watt *AirCore*™ Roller Inductor antenna tuner gives you absolute minimum SWR. 3" cross-needle meter, true peak reading meter, dummy load, 8 pos. antenna switch.

MFJ-962D Tuner $229.95

Compact *roller inductor* antenna tuner handles popular Ameritron AL-811H/811 amps. *AirCore*™ inductor, 3" Cross-Needle meter, 6-position antenna switch, 800W SSB PEP output.

MFJ-989D Tuner $409.95

Legal-limit antenna tuner has *Air-Core*™ inductor, 500pF air variable capacitors, fast-tune crank, high voltage balun, 3" meter, dummy load, ant. switch.

MFJ-929 AutoTuner $229.95

Compact 200 Watt *IntelliTuner*™ tunes any unbalanced antenna *ultra-fast!* 20,000 Virtual Memories, Antenna Switch, Efficient L-network, Matches 6-1600 Ohms from 1.8-30 MHz.

MFJ-993B AutoTuner $269.95

Select 300 Watts (6-1600 Ohms) or 150 Watts (6-3200 Ohms) with the *world's only dual power* automatic tuner. 1.8-30 MHz, 4:1 current balun, LED lighted cross meter, backlit LCD, more!

MFJ-998 AutoTuner $699.95

Full 1500 Watts SSB/CW. Digital and analog SWR/Wattmeter, 12-1600 Ohms from 1.8-30 MHz, built-in antenna switch, auto amp bypass.

MFJ-1778 G5RV $44.95

Efficient, *all band* G5RV antenna is only 102' long, has 32.5' ladder line matching section ending in an SO-239 for feedline. Operate 80-10 Meters with tuner. 1500 Watts.

MFJ-16XX HF Sticks $14.95

Rugged, sleek **6-40M** mobile *HamTenna*™ antennas, **$14.95** each band. 250 Watts, 7' extended, collapse to about 4 feet for storage. Quickly screws into any 3/8-24 female mount for quick band changing. **60-75M, $19.95.**

MFJ-2289 BigEar $179.95

7.0-55 MHz *Big Ear*™ antenna has 34 feet of radiating elements for BIG signal! Backpack portable, fast set-up/tune, 1 KW PEP SSB/CW, rugged construction.

MFJ-1786 Hi-Q Loop $419.95

10-30 MHz Super Hi-Q loop, remote control. 36" dia. all welded construction, butterfly tuning capacitor. ABS plastic housing. **MFJ-1788, $499.95.** 7-22 MHz.

MFJ-260C Dry Load $39.95

300W VHF/HF Dry Dummy Load handles full load for 30 seconds. Derating curve to 5 minutes. SWR below 1.1:1 to 30 MHz. 1.5:1 from 30-650 MHz. **MFJ-264, $74.95.** 1.5kW load.

MFJ-1702C Ant Switch $39.95

2-position antenna switch has center ground, auto grounding of unused position, 2.5 kW PEP and works to over 500 MHz. Lightning surge protection. SO-239 Connectors. **MFJ-1704, $79.95.** 4 positions.

MFJ-915 RFI Isolator $29.95

Prevents unwanted RF from traveling on your coax shield into your expensive transceiver. Prevents stray RF that cause painful RF "bites" and erratic operation. Heavy duty weather protected PVC is 2Wx5H inches. 1.5 kW. 1.8-30 MHz.

MFJ-918 4:1 Balun $24.95

High-permeability ferrite beads on high-quality RG-303 *Teflon*® coax. True 1:1 current balun/center insulator. 2" diameter by 6" long. 14 gauge stranded copper wire. Handles 1.5 kW 1.8-30 MHz.

MFJ-270 Surge Protect $19.95

Safeguard your expensive equipment. Shunts to 5000 Amps of peak impulse current harmlessly to ground. SWR less than 1.1:1, less than 0.1 dB loss. Use to 1000 MHz, 400W PEP.

MFJ-392B Headphones $24.95

Perfect for Ham Radio and shortwave listening -- SSB, FM, AM, data and CW. Super lightweight (8 oz.) padded headband and ear cushioned design. Each earphone has own volume control. 3.5mm/1/4" plugs, 9' cord.

MFJ-4230MV 30A PS $89.95

World's most compact 30A switching power supply. V/A meter. 4-16 Volts, adjustable. 5Wx2¼Hx6D inches, 3 pounds! Selectable input voltage 120/240 VAC.

MFJ-4035MV 30A PS $149.95

19.2 lb. transformer delivers 35A maximum, 30A continuous. 1-14 VDC out, 110 VAC in. Highly regulated, 1% load regulation. 1 mV Ripple. 5-way binding posts, quick connects.

MFJ-4245MV 45A PS $149.95

Switching power supply. 45A surge/40A continuous. 9-15 VDC out. 85-260 VAC in. Low ripple, highly regulated. 5-way posts, cig lighter, quick connects. 5 lbs., 7¾Wx4¼Hx9D".

MFJ-4275MV 75A PS $259.95

Switching power supply. 75A max/70A cont. Great for ALS-500M solid state amp. Adjustable 4-16 VDC. Input 110/220 VAC. Battery charger. 10.5 lbs.

Get on the air from anywhere!

Get on HF, local repeaters, IRLP, EchoLink and more from any cellphone or laptop. Plug and play remote control of your station. Control rig, rotate beam, switch antennas. **RBC-212, $499.95** and cable package **($69.95)** is remote ready! MFJ's One year limited warranty. For video demonstration, cable packages, see: ***www.mfjenterprises.com***

MFJ-868B Giant Meter $149.95

Largest HF+6M SWR/Wattmeter in the world has 6.5" diagonal scale. 20/200/2000W ranges.

MFJ-1026 Noise Cancel $199.95

Wipe out interference! 60 dB null. SSB/CW/AM/FM. BCB to lower VHF. RF sense T/R switch.

MFJ-4416B BattBoost $159.95

Keep mobile rig operational. Boosts low battery voltage. Up to 25 Amps. 7¾Wx4Hx2½".

MFJ-434B VoiceKeyer $199.95

Saves voice by saving five frequent phrases in memory. Speaker/amplifier.

MFJ-281 Speaker $12.95

Get speech fidelity you never knew existed! 3" speaker, 8W, 8 Ohms impedance, 6' cord, 3.5 mm mono.

MFJ-461 CodeReader $89.95

Decodes and displays Morse code on two-line high-contrast LCD. Just hold close to receiver.

MFJ-557 CodeOsc/Key $39.95

Practice sending Morse code. Telegraph key, code oscillator, speaker on heavy non-skid steel base. Volume/tone controls. Use 9V battery.

MFJ-564 IambicPaddles $69.95

Deluxe Iambic paddles. Tension/contact spacing adjustments, steel bearings, precision frame, non-skid feet. Chrome or Black.

MFJ-108B 24/12 Clock $21.95

Read both UTC and local time *simultaneously*. BIG 5/8 inch digits! Solid brushed aluminum frame. 4¼Wx2Hx1D".

MFJ-1724B Mobile $24.95

World's Best Selling 2Meter 440 MHz magnet mount antenna has 3.5" magnet, 19" stainless steel whip, handles 300 Watts, 15 feet coax.

MFJ-1728B Mobile $26.95

5/8 wave 2M mobile antenna gives maximum possible gain of any single element antenna. 1/4 Wave 6M. 300W, magnet mount, 12' coax, 53" whip.

MFJ-1729 Mobile $39.95

Ham radio's *most powerful* magnet mount *dual band* 2M/440 mobile. Get whopping GAIN. 300 Watts, 27.5" stainless steel whip, 12' coax.

www.mfjenterprises.com

MFJ

Dealer/Catalog/Manuals
Visit: http://www.mfjenterprises.com
or call toll-free 800-647-1800

• 1 Year *No Matter What*™ warranty • 30 day money back guarantee (less s/h) on orders direct from MFJ

MFJ ENTERPRISES, INC.
300 Industrial Pk Rd, Starkville, MS 39759
PH: (662) 323-5869 **Tech:** (662) 323-0549
FAX:(662)323-6551 8-4:30 CST, Mon-Fri. *Add shipping.*

VISA MasterCard DISCOVER AMERICAN EXPRESS PayPal

MFJ-223 Analyzer, $349.95

Pocket-size 1-60 MHz Color Graphic VNA antenna analyzer. SWR, R, X, Z swept frequency plots. Multi-parameter bargraphs at any frequency. DDS generator, field strength meter.

MFJ-266C Analyzer, $359.95

HF/VHF/UHF antenna analyzer covers 1.5-185, 220-230, 300-490 MHz. Measure SWR, Z, R, X, frequency, capacitance, inductance, field strength. Signal source. Dial lock.

MFJ-269CPRO, $419.95

Ruggedized antenna analyzer covers .53-230 MHz, 430-520 MHz. 12-bit A/D converter, characteristic impedance 0-600 Ohms, *CoaxCalculator*™, more.

MFJ-998BRT Tuner $769.95

1500 Watt SSB/CW *remote* Automatic tuner matches 12-1600 Ohms, 1.8-30 MHz. Weather-sealed. Amplifier, radio, tuner protection. Output is lightning induced surge protected.

MFJ-994BRT Tuner $399.95

600 Watt *remote* automatic antenna tuner matches 12-800 Ohms 1.8-30 MHz. Fully weather sealed for outdoor use. Tough, durable built-to-last cabinet. Includes MFJ-4117 BiasTee Power injector.

MFJ-993BRT Tuner $299.95

300 Watt *remote* automatic antenna tuner matches wide-range 6-1600 Ohms impedances 1.8 to 30 MHz. Handles 300W SSB/CW. Tough, durable, weather-sealed, includes power injector.

MFJ-925 AutoTuner $179.95

Super-compact *MightyMite*™ *IntelliTuner*™ Matches 6-1600 Ohms, 1.8-30 MHz. 200 Watts SSB/CW. 10,000 antenna memories, *Instant Recall*™, *IntelliTune*™, *AdaptiveSearch*™.

MFJ-986 Tuner $369.95

Kilowatt *Differential-T* roller inductor antenna tuner, simple 2-knob tuning, lighted meter, 6-position antenna switch, balun for balanced lines. 1.8-30

MFJ-9982 Tuner $699.95

Antenna tuner handles *2500W continuous carrier* 1.8-30 MHz. Silver-plated, edge-wound roller inductor, 1000/500pF air capacitors, antenna switch, dummy load, balun.

MFJ-931 Ground $109.95

Create an artificial ground! Place your rig near earth ground potential even when you are on the second floor or higher with no earth ground possible! Get rid of RFI!

MFJ-910 Matcher $29.95

Mobile unit matches HF mobile antennas 10-80 Meters. Select five values of capacitance 120-470 pF to add at antenna feedpoint to ground to form an L-network with antenna. Get more power out! Handles 300 Watts.

MFJ-914 TuneExtender $79.95

Extends your transceiver's built-in automatic antenna tuner's impedance matching range. Transforms antenna impedance up/down by as much as 10 times! 160-10 Meters. Handles 300W. Bypass position.

MFJ-941EK Tuner $129.95

Build your own! MFJ's popular MFJ-941E *antenna tuner in kit form*. All knobs, hardware, components and switches are here. Spend a fun weekend putting it together!

MFJ-902B Tuner $109.95

Tiny Travel Tuner has real guts! Handles full 150 Watts. Covers 80-6 Meters. Has tuner bypass switch. Tunes nearly any antenna. Tiny 4½Wx2¼Hx2¾D inches.

Ultrasonic receiver with parabolic reflector pinpoints power line noise

MFJ-5008 **$179.95**

Find power line noise fast with this 18-inch diameter parabolic dish. Narrow beamwidth pin-points noise generated by corona discharge and arcing components to less than 12 inches at 50 feet. 3.5 mm jack lets you use headphones and for recording proof for the power company. Handle mounted to reduce fatigue. Listen to nature, bats, birds, insects.

MFJ-802B FieldStrength $49.95

Sensitive field strength meter. Ground independent telescoping 40-inch balanced dipole reduces influence of environment to give accurate relative field strength readings. 3" meter, sensitivity control, remote jack.

MFJ-815D Meter $89.95

Peak-reading HF SWR/Wattmeter covers 1.8-60 MHz, has large 3" Cross-Needle meter with LED backlight. True peak reading active circuit, 3000/300 Watt forward, 600/60 Watts reflected power. SO-239s.

MFJ-826B DigMeter $179.95

High-accuracy auto-ranging digital SWR/Wattmeter/frequency counter measures up to 1500 Watts. True peak or average forward and reflected power, SWR, frequency simultaneously displayed on lighted LCD. 1.8-54 Mhz.

MFJ-822 Wattmeter $59.95

Compact Cross-Needle SWR Wattmeter reads forward/reflected power and SWR simultaneously on large 3" meter. Two selectable power ranges, built-in meter light, 1.8-200 MHz. 30 or 300 Watt power range. **MFJ-842, $59.95.** 140-525 MHz.

MFJ-891 Meter $109.95

GIANT 3½" Meter covers 1.6-60 MHz, handles 2 kW in 3 ranges: 20/200/2000 Watts. Precision *True Active*™ PEP circuit for SSB. **MFJ-894, $129.95.** 1.6-60, 125-525 MHz.

MFJ-1700C AntSW $119.95

Six position transceiver and antenna switches cover 1.8-30 MHz and handle 2 kilowatts PEP SSB. 50-75 Ohm loads, SO-239 connectors. 4¾Wx6½Hx3D".

MFJ-4712 AntSwtch $79.95

2-position remote antenna switch covers 1.8 to 150 MHz and handles full legal limit 1500 Watts. Switch box weather protected, SO-239 connectors, BiasTee included.

MFJ-1164B AC Filter $79.95

Filters and reduces AC power line RFI, hash, noise, transients, surges generated by computers, motors, etc. by 30 dB and up to 60-80 dB with earth ground. Four 15A, 120VAC outlets.

MFJ-945E Tuner $139.95

Compact *mobile* antenna tuner covers HF (1.8-30 MHz) and 6-Meters. Handles 300W, antenna bypass switch. Lighted cross meter. Mobile mounting bracket, **MFJ-20, $6.95.**

MFJ-971 Tuner $129.95

Portable antenna tuner for QRP to 300Watts from 1.8 to 30 MHz. 300/30 or 300/6 Watt power ranges. For 6 Watt range swap internal jumper. 4:1 balun. Matches MFJ-90 rigs.

MFJ-704 LowPassFilter $59.95

Reduce transmitter harmonics, Avoid **TVI**. Keep neighbors happy! 1500 Watts, 1.8-30 MHz.

MFJ-700P9 Ferrite Chk $32.95

Eliminate RFI and TVI with *snap-on* ferrite chokes. Suppress harmful RF. 9 different sizes.

MFJ-888 FreqCounter $199.95

10-Hz to 3 GHz counter features fast-reading 300 MHz range w/ 0.1 Hz resolution, 4 gate speeds.

MFJ-1118 PowerStrip $84.95

Power two HF and/or VHF rigs and six or more accessories from rig's main 12VDC supply.

MFJ-1126 PowerStrip $84.95

Fused Power Strip. 8 outlets: a 1A, 3-5A, 2-10A, 1-25A and 1-40A. 6-pair *Anderson PowerPole*® 35Amp contact. RF tight aluminum cabinet.

MFJ-4225MV P.S. $99.95

Switching power supply. 25A surge, 22A continuous. 9-15 VDC out, 85-260 AC in, Cig lighter socket.

MFJ-4115 15A P.S. $59.95

Super-compact 1.5 lb. 3¾Wx2¼Hx7¾D" switching power supply delivers 17A surge, 15A continuous. 13.8 VDC.

MFJ-383 AmpSpeaker $29.95

Large 2½" speaker, 6 Watts output. Requires 12 VDC at 2A for max volume. 8' cord, 3.5 mm mono jack plug on 13' cord.

MFJ-8100K SW Rcvr $79.95

Relive wonder years of radio with this *regenerative* SWL receiver. 75-13 Meters in five bands. **Kit** $79.95/**Wired**, $109.95.

MFJ-1020C Antenna $99.95

Indoor Tuned Active SWL antenna covers 0.3-40 MHz. Improves selectivity, reduces noise VLF, AM, BC, SWL.

MFJ-8708 ATV Xmtr $159.95

Transmit high quality ATV signal on 433.97 MHz, cable channel 58, 59, 60. Solid 50-100 mW.

MFJ-279 Interface $139.95

Soundcard interface goes between rig and computer to decode all digital data. 8-pin round or modular transceivers.

www.mfjenterprises.com

MFJ

Dealer/Catalog/Manuals
Visit: http://www.mfjenterprises.com or call toll-free 800-647-1800

• 1 Year *No Matter What*™ warranty • 30 day money back guarantee (*less s/h*) on orders direct from MFJ

MFJ ENTERPRISES, INC.
300 Industrial Pk Rd, Starkville, MS 39759
PH: (662) 323-5869 **Tech:** (662) 323-0549
FAX: (662) 323-6551 8-4:30 CST, Mon.-Fri. *Add Shipping*

VISA MasterCard DISCOVER AMERICAN EXPRESS PayPal

MFJ-207 Analyzer, $109.95

HF SWR Analyzer lets you read SWR from 160 Meters to 10 Meters. Has jack for external frequency counter. Use 9 VDC or 110 VAC with optional MFJ-1312D, $15.95. 2½Wx7½Hx2¼D inches.

MFJ-870 Wattmeter, $79.95

GrandMaster MFJ SWR/Wattmeters. **MFJ-870, $79.95.** 1.6-60 MHz. 30/300/3000 Watt power ranges. **MFJ-874, $109.95.** 1.8-525 MHz. 5/20/200 Watt power ranges.

MFJ-818 Wattmeter, $79.95

Flat Mobile MFJ SWR/Wattmeter has large 3" Cross-needle meter. Use 12 VDC or plug into cigarette lighter plug with **MFJ-5510, $9.95** to light meter. 1.8-30 MHz. 5Wx3Hx2D".

MFJ-1703 SafetySwitch $29.95

Keeps your expensive transceivers safe from transmitting into nothing! Covers 1.8-30 MHz, connects two rigs and two antennas. 300 Watts PEP SSB, 150 Watts CW. Switches 50-75 Ohm unbalanced.

Antenna Window Feedthrough Panels

Three SO-239 *Teflon*® **coax connectors let you feed HF/VHF/UHF antennas. High voltage ceramic feed-thru insulators bring in 450/300 Ohm balanced lines. 48" cuts to your size to fit most windows. Ceramic feedthru insulator for long wire or random wire, stainless steel ground post brings in your ground. More models, see: *www.mfjenterprises.com***

MFJ-1708 T/R Switch $79.95

RF sense T/R switch switches your antenna from receive to transmit using a relay. Shorts antenna input to ground to protect receiver, provides auxiliary contact closure.

MFJ-250 DummyLoad $69.95

VersaLoad™ dummy load handles 1kW CW or 2kW PEP for 10 minutes. Run continuous duty 400 Watts PEP. Under 1.2:1 to 30 MHz. Includes transformer oil (no PCB). SO-239

MFJ-9296 QRPocket $229.95

QRPocket™ transceiver has a no-compromise receiver, solid QRP+ 5Watts transmit power on every band, QSK T/R switching, DDS Frequency control, Precise 100 Hz readout. All modules included: 80/40/30/20/17/15M.

MFJ-916B Duplexer $24.95

Use 2 rigs with one dual band antenna or 2 separate antennas on one dual band rig. Low loss SO-239s, 50 Ohm ports, 200 W PEP. Other duplexers, triplexers available, see *www.mfjenterprises.com*

MFJ-297 Desk Mic $69.95

Speech frequency tailored desktop microphone cuts through noise and QRM. Switch for SSB punch or full range broadcast quality. Flex boom neck, silibant sound shield.

MFJ-4125P 25A PS $94.95

25A, 22A continuous switching power supply has 2-pair *Anderson PowerPole*™ connections as well as 5-way binding posts. Just 3.5 lbs. 5½Wx2½Hx5¾D inches.

MFJ-1106 DC Power $34.95

6-way desk-top DC power distribution unit has seven *Anderson PowerPole*™ connections all connected in parallel. Includes mating connectors for your cables. Total current is 30A.

MFJ-1124 PowerStrip $64.95

DC Multi-outlet Power Strip features six total outlets including four *Anderson PowerPoles*® (35A contacts) and two pairs of 35A high current binding posts.

MFJ-393 Boom-Mic $39.95

Professional Boom-Mic headphones for contesting, DXing and traffic nets. Comort designed leatherette padding lets you operate for hours at the rig. Superb 3/4" ear padding/headband.

MFJ-890 Monitor $119.95

Get Worldwide DX band conditions on your beacon monitor. 14/18/21/24/28 MHz bandswitch, red LEDs light up in the country that the International beacon network are transmitting in.

MFJ-1979 TeleWhip $59.95

17-foot stainless steel telescopic whip is manufactured with a solid 7/8" diameter by 23/8" long chrome-plated brass base. Collapses to 27 inches. Operate 20M without loading coil and 30/40/60/80/160M with a loading coil. 5/8" diameter bottom section.

MFJ-407D Keyer $79.95

MFJ Curtis-Keyer has all keyer modes, dot-dash memories, jam-proof spacing, weight, sidetone, built-in speaker. Speed, weight and tone controls and tune, semi-auto and on/off switches are on the front panel.

MFJ-1932 Radial Kit $34.95

Provides necessary return path for ground currents to reduce ground losses. 2-sets of 4 radial wire assemblies giving a total of 14 radial wires. Each end wire has 1/4" ring lug.

MFJ-1903 Ant Tilt Base $79.95

Universal Antenna Tilt base fits most vertical antennas with or without a base bracket. Mount one side of tilt to mast and other to the base. Raise your antenna up/down with ease. Hardware included.

MFJ-711B TVI Filter $29.95

Suppress annoying TVI caused by 2-way, broadcast, commercial, amateur and CB radios below 30 MHz. Use between cable/antenna and TV/VCR. Type F connectors.

MFJ-561K Tiny paddle $24.95

Tiny Iambic paddle is just 1¾Wx ¾Hx1¾D inches and weighs just 2½ ounces. Precision paddle formed from phosphorous bronze, rugged metal base, non-skid rubber feet.

MFJ-1750 2M Antenna $34.95

5/8 Wave ground plane 2-Meter base antenna handles 300 Watts. Gives maximum possible calculated gain of any single element antenna.

MFJ-1868 Discone $69.95

Ultra wide-band antenna receives 25-1300 MHz, transmits 50-1300 MHz. Handles 200W. Includes SO-239, 50' coax, stainless steel elements and mounting hardware.

MFJ-850B Volt Meter $24.95

Reads voltage 95-135, with a 2% accuracy. Built-in AC socket, so you don't lose the outlet. Perfect for the ham shack and motor homes. Color coded scale for quick glances. 2¼Wx2¼Hx1½ in.

MFJ-553 Telegraph $29.95

Deluxe telegraph key is mounted on a non-skid, beautifully stained wood base. Steel under-plated bottom makes it stay put on your table. Prewired 3' cable with 3.5 mm plug is ready to hook to your rig.

MFJ-335BS 5" mag $15.95

Super-strong 5" magnets with 17' coax. Choose SO-239 (S), NMO (M) or 3/8-24 thread (T).

MFJ-336 Tri-Magnet $34.95

Three 5" Mags w/17' coax. S-SO-239, M-NMO, T-3/8-24.

MFJ-345T LipMount $39.95

HF trunklip mobile mount has 17' coax, adjustable 360° and up/down. 3/8-24 threaded connector.

MFJ-280 Speaker $19.95

Superb audio from this tiny mobile speaker. Matches 8/4 Ohm impedances. 3W, 30" cord.

MFJ-1412B Antenna $29.95

VHF/UHF *RuffRider*™ High Gain Antennahandles 200 Watts, just 40" long. Great gain on 2-Meters and 440 MHz. Fold-over lets you take it down in garage.

MFJ-1717 HT Antenna $18.95

World's best selling HT antenna. 15¾" halfwave on 440 MHz, efficient full size 1/4 wave on 2M. Rugged! BNC. SMA. SMA reverse for Pofung/Wouxun HTs.

MFJ-2820 License Mt $39.95

Stainless steel License plate antenna mount for HF/VHF/UHF. Antenna is offset mounted so that it does not block your license plate.

MFJ-2822 Hitch Mount $69.95

Trailer-hitch Mobile Antenna Mount slides into trailer hitch slot and a bolt locks it in place. Hold HF/VHF/UHF ants.

MFJ-139RC 24/12 Clock $99.95

Read TrueUTC! GMT push button, map location. JUMBO 4" digits.16Wx11H.

MFJ-188BRC Watch $39.95

Global radio-controlled wristwatch has 24/12 hour face. Highly sensitive receiver receives USA, UK Germany, Japan, 60 KHz.

MFJ-105D Quartz Clock $24.95

Handsome black face wall clock has true 24-hour Quartz movement. Large white numerals, gold colored hands.

MFJ-115 World Clock $24.95

Premier world map clock has 24-hour Quartz accuracy.Face indicates different country timezones.

www.mfjenterprises.com

MFJ ANALYZERS

MFJ-259C . . . World's Most Popular Antenna Analyzer!

New!

MFJ-259C **$299.95**

Super easy-to-use!

Dual analog meters, LCD

New and improved, now covers 530 KHz-230 MHz!

World famous MFJ-259C gives you a complete picture of your antenna's SWR and Complex Impedance.

MFJ-259C is a complete ham radio test station including -- frequency counter, RF signal generator, *SWR Analyzer™*, RF Resistance/Reactance Analyzer, Coax Analyzer, Capacitance/Inductance Meter and more!

You can read Complex Impedance as series resistance and reactance (R+jX) or as magnitude (Z) and phase (degrees).

Determine velocity factor, coax cable loss in dB, length of coax and distance to short/open.

You can read SWR, return loss and reflection coefficient at any frequency simultaneously.

Read inductance (uH) and capacitance (pF) at RF frequencies.

Large easy-to-read two line LCD screen and side-by-side meters clearly display your information.

Built-in frequency counter, Ni-MH/Ni-CD charger circuit, battery saver, low battery warning, smooth reduction drive tuning.

Super easy to use! Just set the bandswitch and tune the dial -- just like your transceiver. SWR and Complex Impedance are displayed instantly!

Fully portable, take it anywhere -- remote sites, up towers, on DX-peditions. Use 10 AA or Ni-Cad or Ni-MH batteries (not included) or 110 VAC with MFJ-1312D, $15.95. Rugged metal cabinet only 4x2x6¾ inches.

MFJ *No Matter What™* Warranty

Every MFJ analyzer is protected by MFJ's famous one year No Matter What™ limited warranty. We will repair or replace your MFJ analyzer (at our option) for a full year.

MFJ-249C, $279.95. If digital display is all you need MFJ-249C does everything MFJ-259C does without analog meters.

More hams use MFJ analyzers than all others in the world!

MFJ-269C 530 KHz - 230 MHz *plus* 415-470 MHz, 12-bit A/D

MFJ-269C **$399.95**

New!

MFJ-269C is a *super* MFJ-259C that adds 415-470 MHz and 12-bit A/D converter that gives you much better accuracy. *Complex Impedance Analyzer* reads series/*parallel* equivalents and magnitude/phase. *CoaxCalculator™* gives line length from electrical degrees and vice-versa for any frequency, Velocity Factor, coax loss in dB. Use any characteristic impedance 10-600 Ohms. Has LCD log SWR bargraph, N-connector.

MFJ-266C 1.5-65, 105-230 300-490 MHz -- *all* Ham Bands

MFJ-266C **$359.95**

New! 220 MHz band!

MFJ-266C *new* compact *wide-range* analyzer covers HF (1.5-65 MHz), VHF (105-230 MHz, including 220 MHz band) and UHF (300-490 MHz). Antenna Analyzer mode reads frequency, SWR, complex impedance *simultaneously*. 500 MHz freq. counter mode has 100 Hz resolution, measures relative field strength/frequency for tracking interference. Signal Generator mode, solid-state switching, and electronic tuning. Backlight, N-connector.

MFJ-225 1.5-180 MHz *ous* Two-Port Graphic Analyzer

MFJ-225 **$399.95**

Out in the field, MFJ-225 is a compact completely *self-contained handheld graphing analyzer*. On the bench it becomes a full-fledged two-port (S21) desktop machine when teamed up with your PC. Using powerful IG-miniVNA freeware, you'll run detailed data analysis and print out stunning color-graphic plots to document your work! Built-in back-lighted *3-inch LCD graphic* display. Make fine adjustments using full-screen easy-to-view SWR bargraph, capture vivid swept displays for SWR, impedance, return loss, phase angle, more. DDS generator.

MFJ-269C*PRO™* Analyzer

MFJ-269CPro, $429.95.

Like MFJ-269C, but UHF range covers *430 to 520 MHz* to include commercial and industrial frequencies. Rugged protective shell protects knobs, switches, meters, digital display for commercial, industrial and lab work.

HF/VHF/UHF SWR Analyzer™

CLOSEOUT!!!

MFJ-266B, $299.95.

Has all the features of MFJ-266C but MFJ-266B covers 1.5-65 MHz, 85-185 MHz and 300-490 MHz. Does not cover 220 MHz band.

HF/6M SWR Analyzer, 1-60 MHz

MFJ-213, $199.95.

Reads SWR, complex impedance, impedance magnitude. Measures capacitance, inductance, field strength, frequency, generate test signals. Fine tune stubs, analyze coax, test baluns, RF transformers, plus other RF tasks.

MFJ SWR Analyzer Accessories

A. **MFJ-29D/MFJ-39D, $24.95.** Carrying Pouch for MFJ-259C/269C.
B. **MFJ-92AA10, $29.95.** 10-Pack 2500 mAh Ni-MH Supercells.
C. **MFJ-66, $24.95.** Dip coils, set of two covers 1.8-230 MHz.
D. **MFJ-731, $99.95.** Tunable Analyzer Filter, 1.8-30 MHz, for strong RF fields.
E. **MFJ-917, $29.95.** 1:1 Current balun for SWR Analyzers to test balanced line antennas, other loads.
F. **MFJ-5510, $9.95.** 12VDC cigarette lighter adapter.
G. **MFJ-7737, $5.95.** PL-259 to BNC Female.
H. **MFJ-7727, $5.95.** PL-259 to SMA Female.
I. **MFJ-633, $29.95.** Ultra-fast intelligent charger.

Dealer/Catalog/Manuals

Visit: http://www.mfjenterprises.com or call toll-free 800-647-1800

• 1 Year *No Matter What™* warranty • 30 day money back guarantee (less s/h) on orders direct from MFJ

MFJ ENTERPRISES, INC.
300 Industrial Pk Rd, Starkville, MS 39759 **PH:** (662) 323-5869
Tech Help: (662) 323-0549
FAX:(662)323-6551 8-4:30 CST, Mon.-Fri. ***Add shipping.***

MFJ *IntelliTuner*™ Automatic Tuners

More hams use MFJ tuners than all other tuners in the world!

World's most advanced Automatic Antenna Tuners feature world renowned MFJ AdaptiveSearch™ and AutomaticRecall™ algorithms -- world's fastest ultra-wide range tuning. Nine World Class models! Choose your features: Digital/Analog/Audio SWR-Wattmeter, Antenna Switch, Balun, Radio Interface, Digital frequency readout, Remoteable, Coax/Balanced Lines/Wire Tuning, Field Upgradeable . . .

MFJ *IntelliTuner*™ Automatic Tuners

The MFJ-993B *IntelliTuner*™ lets you tune any antenna *automatically* -- *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.**

You get a highly efficient L-network, 6-1600 ohm matching at 300 Watts SSB/CW or *extra-wide* **6-3200 Ohm matching at 150 Watts SSB/CW, 1.8-30 MHz coverage, Cross-Needle** *and* **digital meters, audio SWR meter,** *backlit* **LCD, remote control port, radio interface, heavy-duty 16 amp/1000V relays.**

MFJ-993B **$269.95**

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***

600 Watt MFJ Automatic Tuner

Like MFJ-993B but handles 600 Watts SSB /CW, matches 12-800 Ohms. 10,000 memories. Does not have LCD display, antenna switch, 4:1 current balun, audio SWR meter/feedback. 10Wx2¾Hx9D in.

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 **$229.95**

200 Watt ...Compact

Digital Meter, Ant Switch, Wide Range

World's fastest compact auto tuner uses MFJ *Adaptive Search*™ **and** *InstantRecall*™ **algorithms. 132,072 tuning solutions instantly match virtually any antenna with near perfect SWR.**

MFJ-929 **$229.95**

200 Watt ...Econo

Small, Ant Switch, 20K VA Memories

MFJ-928 **$199.95**

High-speed, wide matching range and compactness at low cost! Leave in-line and forget it -- your antenna is *always* **automatically tuned! 2-position antenna switch.**

200 Watt *MightyMite*™

Matches IC-706, FT-857D, TS-50S

MFJ-925 **$179.95**

No *extra space needed!* **Just set your IC-706/7000, FT-857D, TS-50S on top of this matching low-profile automatic tuner -- it's all you need for a completely automated station using** *any* **antenna! Just tune and talk!**

G5RV Antenna

MFJ-1778 **$44.95**

Covers all bands, 160-10 Meters with antenna tuner. 102 ft. long. Can use as inverted vee or sloper. Use on 160 Meters as Marconi.1500 Watts. Super-strong fiberglass center/feedpoint insulators. *Glazed ceramic* **end insulators. All hand-soldered connections. Add coax, some rope and you're** *on the air!*

MFJ-1778M, $39.95. **G5RV Junior. Half-size, 52 ft. 40-10M with tuner, 1500 Watts.**

200W...Weather-sealed

for Remote/Outdoor/Marine

MFJ-926B **$279.95**

Fully *weather-sealed for remote Outdoor/Marine use!* **Tough, durable, built-to-last the elements for years.**

200 Watt...Remote

Coax/Wire Ant, No pwr cable needed

MFJ-927 **$259.95**

Weather protected fully automatic *remote* **auto tuner for wire** ***and*** *coax* **antennas -- an MFJ exclusive. Powers through coax -- No separate power cable needed.**

Free MFJ Catalog

Visit: http://www.mfjenterprises.com or call toll-free 800-647-1800

• 1 Year *No Matter What*™ warranty • 30 day money back guarantee (less s/h) on orders direct from MFJ

MFJ ENTERPRISES, INC.
300 Industrial Pk Rd, Starkville, MS 39759 **PH:** (662) 323-5869
Tech Help: (662) 323-0549
FAX:(662)323-6551 8-4:30 CST, Mon.-Fri. ***Add shipping.***

http://www.mfjenterprises.com for instruction manuals, catalog, info

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 October 3, 2014 through November 3, 2014.
Get on the web and vote today at **www.arrl.org/quickstats**!

As we prepare to celebrate 2015, what sort of year will this be for Amateur Radio?

An exciting year. I'm looking forward to it! **50%**
A neutral year. I don't see much change in the year to come. **42%**
A year of continued decline. I think our best days are behind us. **8%**

Increasing numbers of hams are operating distant stations by Internet remote control. What do you think of this trend?

I welcome it. It is a great solution for antenna-restricted hams. **60%**
I have no opinion. **15%**
I'm against it. I think it is harmful to the hobby. **25%**

Compared to 20 years ago, would you say the quality of on-air behavior has improved, deteriorated, or stayed about the same?

Improved **8%**
Stayed about the same **48%**
Deteriorated **44%**

Compared to 5 years ago, would you say you are more active on the air, less active, or unchanged?

More active **48%**
Less active **17%**
Unchanged **26%**
I didn't have my license five years ago **9%**

MFJ TUNERS

New, Improved MFJ-989D 1500 Watt *legal limit* Antenna Tuner

World's most popular 1500 Watt Legal Limit Tuner just got better -- much better -- gives you more for your money!

New, improved MFJ-989D *legal limit* antenna tuner gives you better efficiency, lower losses and a new *true* peak reading meter. It easily handles *full* 1500 Watts SSB/CW, 1.8 to 30 MHz, including MARS/WARC bands.

New dual 500 pF *air variable capacitors* give you twice the capacitance for more efficient operation on 160 and 80 Meters.

New, improved *AirCore™ Roller Inductor* gives you lower losses, higher Q and handles more power more efficiently.

New *TrueActive™* peak reading Cross-Needle *SWR/Wattmeter* lets you read *true* peak power on all modes.

MFJ-989D **$409.95**

New high voltage *current balun* lets you tune balanced lines at high power with no worries.

New *crank knob* lets you reset your roller inductor quickly, smoothly and accurately.

New larger 2-inch diameter *capacitor knobs* with easy-to-see dials make tuning much easier.

New cabinet maintains components' high-Q. Generous air vents keep components cool. 12⅞Wx6Hx11⅝D inches.

Includes six position ceramic antenna switch, 50 Ohm dummy load, indestructible multi-color Lexan front panel with detailed logging scales and legends.

The MFJ-989D uses the superb time-tested T-Network. It has the widest matching range and is the easiest to use of all matching networks. Now with MFJ's new 500 pF air variable capacitors and new low loss roller inductor, it easily handles higher power much more efficiently.

***No Matter What™* Warranty**

Every MFJ tuner is protected by MFJ's famous one year *No Matter What™* limited warranty. We will repair or replace your MFJ tuner (at our option) for a full year.

More hams use MFJ tuners than all other tuners in the world!

MFJ-986 Two knob *Differential-T™*

Two knob tuning (differential capacitor and *AirCore™* roller inductor) makes tuning foolproof and easier than ever. Gives minimum SWR at only one setting. Handles 3 KW PEP SSB amplifier input power (1.5 KW output). Gear-driven turns counter, lighted peak/average Cross-Needle SWR/Wattmeter, antenna switch, balun. 1.8 to 30 MHz. 10¾Wx4½Hx15 in.

MFJ-986 **$369.95**

MFJ-962D *compact* kW Tuner

A few more dollars steps you up to a KW tuner for an amp later. Handles 1.5 KW PEP SSB amplifier input power (800W output). Ideal for Ameritron's AL-811H! *AirCore™* roller inductor, gear-driven turns counter, pk/avg lighted Cross-Needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8-30MHz. 10¾x4½x10⅞ in.

MFJ-962D **$319.95**

MFJ-969 300W *Roller Inductor* Tuner

Superb *AirCore™* Roller Inductor tuning. Covers *6 Meters* thru 160 Meters! 300 Watts PEP SSB. *Active* true peak reading lighted Cross-Needle SWR Wattmeter, *QRM-Free PreTune™*, antenna switch, dummy load, 4:1 balun, Lexan front panel. 3½Hx10½Wx9½D inches.

MFJ-969 **$229.95**

MFJ-949E *deluxe* 300 Watt Tuner

More *hams use MFJ-949s than any other antenna tuner in the world!* Handles 300 Watts. Full 1.8 to 30 MHz coverage, custom inductor switch, 1000 Volt tuning capacitors, *full size* peak/average lighted Cross-Needle SWR/Wattmeter, 8 position antenna switch, dummy load, *QRM-Free PreTune™*, scratch proof Lexan front panel. 3½Hx10⅝Wx7D inches. **MFJ-948, $159.95.** Economy version of MFJ-949E, less dummy load, Lexan front panel.

MFJ-949E **$179.95**

MFJ-941E *super value* Tuner

The *most for your money!* Handles 300 Watts PEP, covers 1.8-30 MHz, *lighted* Cross-Needle SWR/Wattmeter, 8 position antenna switch, 4:1 balun, 1000 volt capacitors, Lexan front panel. Sleek 10½Wx2½Hx7D in.

MFJ-941E **$139.95**

MFJ-945E HF/6M *mobile* Tuner

Extends your mobile antenna bandwidth so you don't have to stop, go outside and adjust your antenna. Tiny 8x2x6 in. *Lighted* Cross-Needle SWR/Wattmeter. Lamp and bypass switches. Covers 1.8-30 MHz *and* 6 Meters. 300 Watts PEP. **MFJ-20, $6.95,** mobile mount.

MFJ-945E **$129.95**

MFJ-971 *portable/QRP* Tuner

Tunes coax, balanced lines, random wire 1.8-30 MHz. Cross-Needle Meter. SWR, 30/300 or 6 Watt QRP ranges. Matches popular MFJ transceivers. Tiny 6x6½x2½ in.

MFJ-971 **$129.95**

MFJ-901B *smallest* Versa Tuner

MFJ's smallest (5x2x6 in.) and most affordable wide range 200 Watt PEP Versa tuner. Covers 1.8 to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-901B **$99.95**

MFJ-902 *Tiny Travel* Tuner

Tiny 4½x2¼x3 inches, full 150 Watts, 80-6 Meters, has tuner bypass switch, for coax/random wire.

MFJ-902B **$99.95**

MFJ-904H, $149.95. Same but adds Cross-needle SWR/Wattmeter and 4:1 balun for balanced lines. 7¼x2¼x2⅝ inches.

MFJ-16010 *random wire* Tuner

Operate all bands anywhere with MFJ's reversible L-network. Turns random wire into powerful transmitting antenna. 1.8-30 MHz. 200 Watts PEP. Tiny 2x3x4 in.

MFJ-16010 **$69.95**

MFJ-906/903 *6 Meter* Tuners

MFJ-906 has lighted Cross-Needle SWR/Wattmeter, bypass switch. Handles 100 W FM, 200W SSB. **MFJ-903, $69.95,** Like MFJ-906, less SWR/Wattmeter, bypass switch.

MFJ-906 **$99.95**

MFJ-921/924 *VHF/UHF* Tuners

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8x2½x3 in.

MFJ-921/924 **$89.95**

MFJ-931 *artificial* RF Ground

Eliminates RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding. Creates artificial RF ground or electrically places far away RF ground directly at rig. **MFJ-934, $209.95,** Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

MFJ-931 **$109.95**

Dealer/Catalog/Manuals

Visit: http://www.mfjenterprises.com or call toll-free 800-647-1800

• 1 Year *No Matter What™* warranty • 30 day money back guarantee (less s/h) on orders direct from MFJ

MFJ ENTERPRISES, INC.
300 Industrial Pk Rd, Starkville, MS 39759 **PH:** (662) 323-5869
Tech Help: (662) 323-0549
FAX:(662)323-6551 8-4:30 CST, Mon.-Fri. ***Add shipping.***

MFJ Power Supplies

World's best and largest selection of clean, no RF hash, no RFI power supplies designed specifically for ultra-reliable ham radio communications

No Matter What™ Warranty
One Year Warranty • 30 Day Money-back guarantee (less s/h) MFJ direct

Dealer/Catalog/Manuals:
www.mfjenterprises.com or toll-free 800-647-1800
MFJ ENTERPRISES, INC.
300 Industrial Pk Rd, Starkville, MS 39759
PH: (662) 323-5869 Tech: (662) 323-0549
FAX: (662)323-6551 8-4:30 CST, Mon.-Fri. Add shipping.

VISA DISCOVER PayPal

$89.95 30 Amp, 4-16 Volts Adjustable, Volt/Amp Meter, 5Wx2½Hx6D"

Ham Radio's Best Seller!

New!

MFJ-4230MV is Ham radio's best selling and most compact switching power supply -- just 5Wx2½Hx6D" and 3 lbs. Takes up little room on your operating position and perfect for home station, field day, DXpeditions, camping, hiking, or for your next business trip or vacation.

MFJ-4230MV gives 25 Amps continuously or 30 Amps surge at 13.8 VDC. Voltage is front-panel adjustable from 4 to 16 VDC.

Selectable input voltage of 120 or 240 VAC at 47-63 Hz lets you carry it with you and use it worldwide.

Front-panel rocker switch lets you choose Amp or Volt meter for continuous monitoring. Cool operation with excellent 75% efficiency. Extra low ripple and noise is less than 100 mV.

It's quiet! Continuous air-flow gently cools the power supply and a heat sensor increases the fan speed if the temperature rises above 70 degrees celsius.

Over-voltage and over-current protection fully protects your transceiver and has ALARM LED. DC output is five way binding posts on the back so you can power your HF, VHF, UHF transceiver and accessories with ease.

Add a pair of *PowerPoles*®

$99.95
MFJ-4230MVP
Adds a pair of *Anderson PowerPoles*® on back of unit.

75-Amps, $259.95

MFJ-4275MV high-current switching power supply gives 75A max/70A continuous. Great for ALS-500M amplifier. Adjustable output 4-16 VDC. 110/220 VAC. Binding posts, quick connects, *PowerPoles*®, cigarette lighter socket on front. Battery charger gives charging current of 20A max, 5A continuous. 9¼Wx5½Hx9½D". Only 10.5 lbs.

45-Amps, $149.95

MFJ-4245MV Switching power supply gives 45A surge/40A continuous. 9-15 VDC out. 85-260 VAC in. Low ripple, highly regulated. 5-way posts, cig lighter, quick connects. 5 lbs., 7½Wx4¾Hx9D".

35-Amps, $134.95

MFJ-4235MV switching power supply gives 35A surge and 30A continuous. 4-16 VDC with 1% voltage regulation. < 9 mV peak-to-peak ripple. AC input 90-125 or 200-240V. 7Wx4¼Hx8¾D", 4 lbs.

35-Amps, $149.95

MFJ-4035MV *19.2 lb. transformer* delivers 35A max, 30A continuous. 1-14 VDC out, 110 VAC in. Highly regulated, 1% load regulation. 1 mV ripple. 5-way bind posts, quick connects. 9½Wx6Hx9¾".

28-Amps, $84.95

MFJ-4128 switching power supply delivers 28A surge, 25A continuously at 13.8 VDC. Selectable AC input voltage 85-135 and 170-260 VAC. 5-way binding posts, cigarette lighter socket, fan "on" LED, 7Wx2¼Hx7½D", 4 lbs.

25-Amps, $99.95

MFJ-4225MV Switching power supply gives 25A surge, 22A continuous. Adjustable 9-15 VDC output, 85-260 AC input. Large 3" dual Amp/Volt meters, Binding posts, Cigarette lighter socket. 3.7 lbs. 5¼Wx4½Hx6D inches.

25-Amps, $84.95

MFJ-4125 gives 25A surge, 22A continuous. 13.8 VDC switching power supply has 5-way binding posts on front panel and quick connects on back. 3.5 lbs. Super compact 5½Wx2½Hx5¾D inches fits anywhere.

25-Amps, $94.95

MFJ-4125P gives 25A surge, 22A continuous. 13.8 VDC switching power supply front has 2-pair of *Anderson PowerPoles*™ and 5-way binding posts on front. Quick connects on back. 3.5 lbs. Super compact 5½Wx2½Hx5¾D".

18-Amps, $99.95

MFJ-4218MV *ham radio's* ***only*** *adjustable 0-24 VDC output switching power supply!* 18A at 13.8 VDC, 9A at 24 VDC. Backlighted Volt/Amp meters, 5-way binding posts outputs, LED load fault indicator. 6Wx2¼Hx6¾D", 2.2 lbs. 110/220 VAC input.

15-Amps, $69.95

MFJ-4215MV switching power supply gives 15A surge and 13A continuously. Variable 4-16 VDC with 1% voltage regulation. Less than 9 mV peak-to-peak ripple. Select AC input 90-125 or 200-240 VAC. Backlighted Volt/Amp Meters. 5-way binding posts for output. 5Wx3¾Hx7D", 2.9 pounds.

15-Amps, $59.95

Super-compact 3¾Wx2¼Hx 7¾D", 1.5 lb. switcher. 17A surge, 15A cont. 13.8 VDC. 110/220 VAC. Fault LED, 5-way posts.

MFJ High Current DC Multi-Outlet Strips

Power multiple transceivers/accessories from a single DC power supply

MFJ-1118, $84.95. Power two HF and/or VHF rigs and six accessories from rig's 12VDC supply. 35A high-current and 15A accessory binding posts, Voltmeter, on/off switch. Master fuse, RF bypass.

MFJ-1116, $59.95. Like MFJ-1118 but 15A total, 8 pairs 5-way posts. "On" LED, 0-25 VDC voltmeter.

MFJ-1112, $44.95. Like MFJ-1116 but 6 pairs 5-way binding posts, no meter or switch. 12½Wx2¾Hx2½D".

MFJ-1117, $64.95. High-current. Powers four HF/VHF radios *simultaneously* -- two at 35A each and two at 35A combined. 8Wx2Hx3D".

MFJ-1129, $114.95 10 outlets. Installed fuses: two 1A, three 5A, three 10A, two 25A, one 40A. Outlets 1, 2, 4-8 are *PowerPoles*®. Outlet 3 is a 35A high current binding post, outlet 9, 10 are 15A binding posts. On/off switch, 0-25 VDC voltmeter. 12½Wx1¼H".

MFJ-1128, $104.95 12 fused *Power Poles*®: three 1A, four 5A, four 10A, one 25A, one 40A. Switch. Meter.

MFJ-1126, $84.95. 8 fused *PowerPoles*®: a 1A, three 5A, two 10A, one 25A, one 40A. Switch. Voltmeter. 9Wx1¼Hx2¾D".

MFJ-1124, $64.95. Four pairs 35A *PowerPoles*®, two pairs 35A high current binding posts.

www.mfjenterprises.com

ICOM

2m + 70cm
VHF/UHF FM Mobile Transceiver
IC-2730A

NEW!

Optimize your mobile experience

- 50/15/5 Watt Output*
- RX: 118–136.975MHz AM/AM-N, 137-174MHz and 375-550MHz FM/FM-N
- 1052 Memory Channels
- V/V, U/U simultaneous receive capability
- Large backlit display
- Independent band controls
- Weather channel with weather alert (US only)
- Time-honored analog functionality
- CI-V remote control capability (OPC-478UC required)
- Free CS-2730 PC programming software
- Free RS-MS1A Android™ app (Opt. UT-133 required)
- Bluetooth® Capabilities (Opt. UT-133 required for operation VS-3 headset available)

Information & Downloads

AMATEUR TOOL KIT | COMIC BOOKS | VIDEOS | WWW.ICOMAMERICA.COM

Electronic advertisements feature active links.

*Frequency coverage may vary. Refer to owner's manual for exact specifications.

†www.icomamerica.com/amateur/DSTAR for details about free software

GET OUT. GET MOBILE.

ID-5100A 2m + 70cm Digital Transceiver

D-STAR ready Bluetooth

Touch screen operation!

- 50/15/5 Watt Output*
- RX: 118 –174, 375–550MHz*
- 1000 Alphanumeric Memory Channels
- Dplus Reflector Linking
- Integrated GPS Receiver
- Bluetooth® Capabilities (Opt. UT-133 headset required)
- Free RS-MS1A Android™ Application
  (Performance may vary, depending on Android™ device.)

ID-7100 HF/VHF/UHF Transceiver D-STAR ready

Intuitive touchscreen interface!

- 100/100/50/35 Watt Output*
- RX: 0.03-199.999, 400-470MHz*
- 1205 Alphanumeric Memory Channels
- 32-bit IF-DSP
- Built-in Digital IF Filtering
- Twin Passband Tuning with Selectable Width and Shape
- USB (Audio & Radio Control)

ID-2300H 2m

Compact, lightweight & submersible!

- 65/25/10/5 Watt Output
- RX: 136–174MHz*
- 207 Alphanumeric Memory Channels
- 4.5W Audio Output
- Built-in CTCSS/DTCS Encode/Decode
- MIL-STD 810 G Specifications

ID-880H 2m + 70cm D-STAR ready

Entry-class digital mobile.

- 50/15/5 Watt VHF/UHF
- FM, AM (Receive only), DV
- RX: 118–999.99MHz*
- 1052 Alphanumeric Memory Channels
- Free Programming Software!†

YouTube

ICOM

TIMEWAVE TECHNOLOGY INC.

Available at:
- Universal Radio
- AES
- HRO
- Radio City
- R&L Electronics

The *Navigator* Sound Card Modem

See QST Short Takes Review - May 2014-P. 62

- **Single USB connection to computer**
- **USB Sound Card built-in**
- **USB Powered**
- **Universal Rig Control built-in - logic level +/-, CI-V, CAT, & RS-232!**
- **Software Configuration - *No jumpers!***
- **FSK Controller for Precise RTTY**
- **K1EL Paddle & Keyboard Precise CW**
- **Separate COM ports for PTT, FSK, CW, CI-V/CAT & RS-232 - *no port splitters!***

- ***Quiet - hear what others miss!***
- ***Convenient - No annoying jumpers!***
- ***Precise - FSK & CW controllers on board***
- ***Complete - Six COM ports***

The *Navigator* is a complete USB sound card modem featuring a proven USB audio sound card chip, six FTDI USB serial COM ports, a K1EL WinKeyer, True FSK and rig control connections for every radio. It has a built-in USB sound card with isolated audio I/O to your radio to prevent ground loops. A second audio input lets you use both receivers in a dual receiver radio. The logic level and RS-232 rig control ports support your Icom CI-V, Yaesu CAT, Kenwood and other radios. Front panel controls set both RX audio levels, TX audio ouput level, audio monitor level and the CW speed. There are no annoying internal configuration jumpers - just conveniently set the software-controlled configuration settings from your PC.

Need Software? Check the Ham Radio Deluxe & Radio Operating Center bundle!
Optimized for the Navigator, PK-232SC+ and other Timewave/AEA TNCs www.ham-radio-deluxe.com

PK-232SC+ with New Dual Port Option!

PK-232SC+ Multimode Data Controller*

Sound Card, Rig Control, USB, Pactor, RTTY, CW Packet, Dual Port Option & more!

100,000 sold - All-time top selling data controller!

- **Dual Port - two radios at same time!**
- **Single USB connection to computer**
- **USB Sound Card built-in**
- **3-Way Rig Control built-in - logic level, RS-232 & USB!**
- **Computer isolated from radio**
- **Real FSK and high-speed keyboard CW**

For the first time in 23 years, we tweaked the PK-232's main PC board! Now with a dual port option, the incredible PK-232SC+ again expands its role in your radio station. The new PK-232SC+ can operate legacy modes on one port and sound card modes on the other - simultaneously! The SC+ connects to your computer with a single USB cable - no audio cables, no RS-232 cables! It has a built-in USB sound card with isolated audio I/O to your radio to prevent ground loops. The logic level and RS-232 rig control is optically isolated for your Icom CI-V, Yaesu CAT, Kenwood and other radios. A new optically isolated DTR PTT option works with legacy sound card software and radios. We even added a pair of USB ports for that new radio with USB rig control and other accessories.

**Upgrade any PK-232 to the PK-232SC with New Lower SC & DSP Upgrade Combo Pricing!*

Customize your PK-232 installation with our complete line of upgrades, accessories and cables.

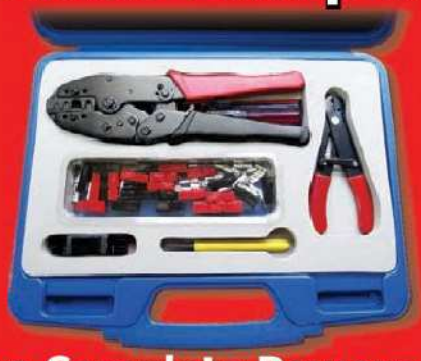
- **HamLinkUSB™ Rig Control+**
  CI-IV, CAT, RTS (PTT, FSK or CW) for sound card software
  Perfect for HRD owners with simple sound card adapters
- **HamLinkUSB™ USB-to-RS-232 Adapter**
  Proven FTDI Chip. 9 and 25 pins for all radios and TNCs!

Timewave Technology Inc.
23 Empire Drive
St. Paul, MN 55103 USA
651-489-5080
Fax 651-489-5066
www.timewave.com
sales@timewave.com

Quicksilver Radio

2015 Must Haves

Andy-Crimp Pro™ Deluxe Crimp Kit



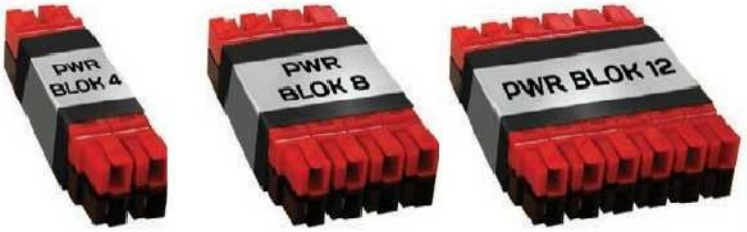
The Complete Powerpole Prep, Strip & Crimp Kit.
2015 Special $99.73

Ultimate Crimp Kit™

The Ultimate Powerpole & Coax Prep, Strip & Crimp Kit.
Only $129.73

PWR-Blok™ Powerpole Splitters

Great in the shack, in the vehicle, or in the go-kit. Rated (conservatively) at 45A.



Andy-Crimp Pro™

15-30-45-50-75 Amp Powerpoles And Many Other Connectors

2015 Special $49.73

We carry a large variety of pre-made Powerpole cables for all your needs.

We Have More Powerpole Stuff Than Anybody!

We carry only genuine Anderson Powerpoles. No cheap copies here.

Sign up on our website for your **FREE** newsletter.
Ham Radio news, articles and special discounts.

www.qsradio.com

Happy New Year!

Quicksilver Radio

See our Large Line of Test Equipment.

SWR Meters

Volt and Ammeter

Digital Temperature Sensors

Professional Grade Component Analyzer

Large Selection of Premium USA Made Coax.

High Quality Crimp-On Connectors and Adaptors!

Ultra Compact Transceiver Dual Band 2M & 70CM

Just Arrived! In time for the New Year. Perfect for Mobile, Portable go-kit, or home use.

2015 Special $149.73

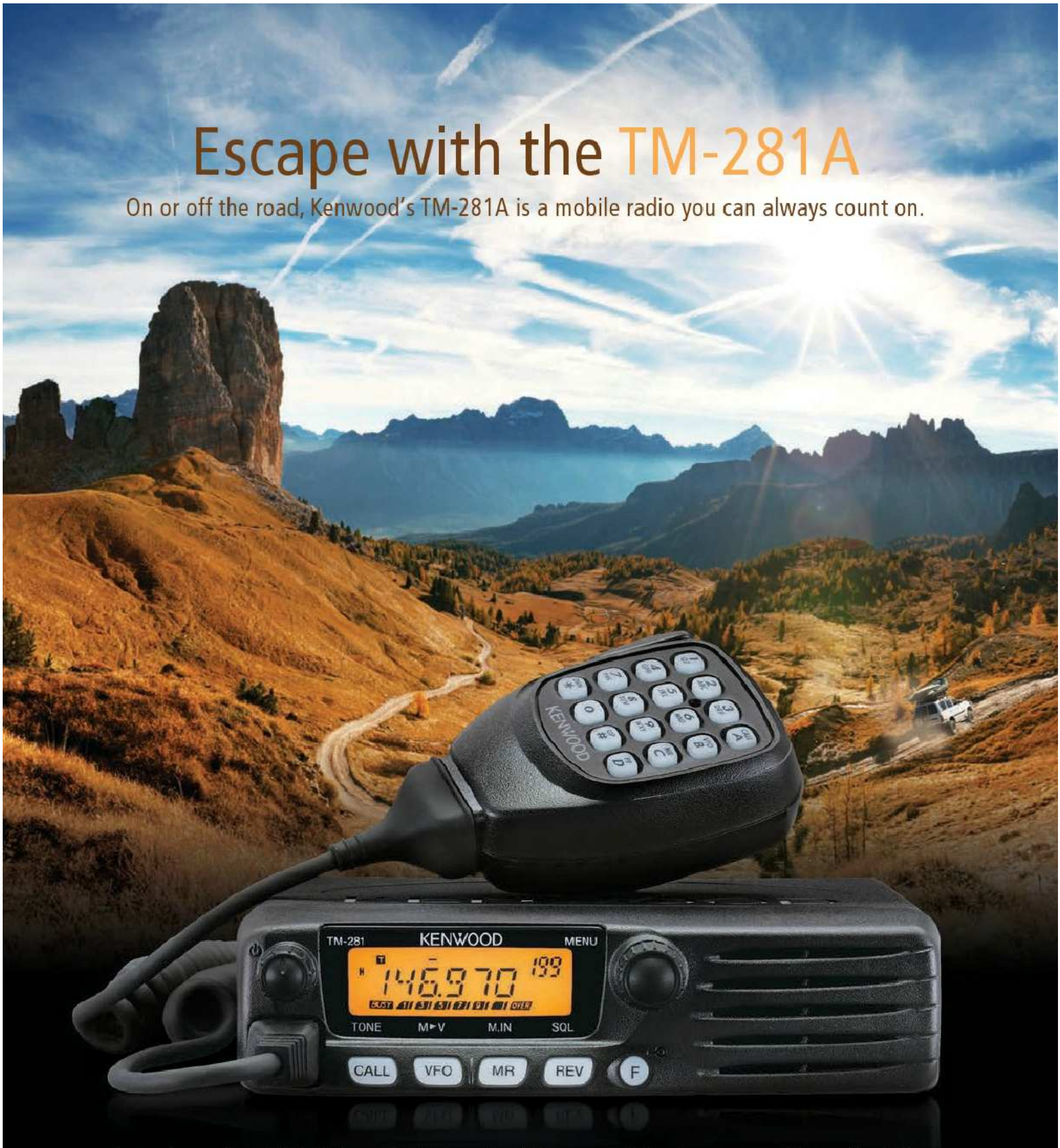
Antenna Rope, Wire and Accessories

Get All Your Ham Shack Essentials at Quicksilver Radio Products. Safe and Secure Ordering at:

www.qsradio.com

Escape with the TM-281A

On or off the road, Kenwood's TM-281A is a mobile radio you can always count on.



As tough as nails, this MIL-STD-compliant transceiver delivers powerful performance, excellent audio clarity, and a host of advanced features. It offers superb operating ease day or night thanks to the large backlit LCD and illuminated keys. So the next time you take off, take the TM-281A.

KENWOOD

Customer Support: (310) 639-4200
Fax: (310) 537-8235

www.kenwoodusa.com

ISO9001 Registered

ADS#48612

Scan with your phone to download TM-281A brochure.

The Radio Club of Junior High School 22

Bringing Communication to Education Since 1980

DONATE YOUR RADIO

Radios You Can Write Off - Kids You Can't

- Turn your excess Ham Radios and related items into a tax break for you and a learning tool for kids.
- Donate radios or related gear to an IRS approved 501(c)(3) charity. Get the tax credit and help a worthy cause.
- Equipment picked up anywhere or shipping arranged.

RC OF JHS 22 NYC
PO Box 1052
New York NY 10002

Call Now 516-674-4072
email: crew@wb2jkj.org www.wb2jkj.org

WB2JKJ

Yuma Hamfest

& 2015 ARRL Arizona Section Convention

Feb. 20 & 21, 2015

Yuma County Fairgrounds
2520 East 32nd Street, Yuma, Arizona

www.yumahamfest.org

Vendors & Exhibitors	Tailgating (Swap Meet)
Consignment Sales	Full Seminar Schedule
License Testing	DXCC Card Checking
Hourly Door Prizes	Fabulous Grand Prizes
On-site RV Camping	Near-Space Balloon Launch
Famous Buzzard BBQ	Admission Prize
Free Parking	Hospitality Area
$5.00 Admission	Antenna Clinic & T-Hunt

All Weather Materials

Now available at ARRL!

NEW! ARES All Weather Notebook
Pocket notebook conveniently sized to take with you–anywhere, anytime, in any weather! Great for public service volunteers, it features the ARES logo on a Polydura cover. 100 waterproof writing pages (50 sheets). Size: 3" x 5".
ARRL Order No. 5580
Only $6.95

NEW! ARRL All Weather Pen
All weather click pen writes on wet paper, upside down and in temperatures from -30F to 250F. Flat black metal barrel, ink black. Size: 5 1/4" long.
ARRL Order No. 6108
Only $13.95

NEW! Amateur Radio All Weather Minilog
Waterproof logbook made of synthetic paper. Takes extreme variations in temperature and humidity in stride. Ideal for harsh field conditions, maritime use, mobile use, as well as regular ham shack use. Portable, packable, tough and it floats! 50 pages. Size: 3" x 5".
ARRL Order No. 1374
Only $8.95

*plus shipping and handling

ARRL The national association for AMATEUR RADIO®

SHOP DIRECT or call for a dealer near you.
ONLINE WWW.ARRL.ORG/SHOP
ORDER TOLL-FREE 888/277-5289 (US)

QST 7/2014

Ham Ads

Please contact the **Advertising Department** at **860-594-0231** or **hamads@arrl.org** for further information or to submit your ad.

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.

4. Closing date for Ham-Ads is the 15th of the second month preceding publication date. No cancellations or changes will be accepted after this closing date. Example: Ads received November 16th through December 15th will appear in February *QST*. If the 15th falls on a weekend or holiday, the Ham-Ad deadline is the previous working day. Please contact the Advertising Department at 860-594-0209 or hamads@arrl.org for further information or to submit your ad.

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 Updated Monthly!

www.arrl.org/ham-ad-listing

Club/Hamfests/Nets

FRIEND OF BILL W?? 12:30 pm Eastern: HAAM Net Sat 14.290, Sun 14.340 and Mon-Fri 14.316 http://www.qsl.net/haam/

Lake Amateur Radio Association 2014 Annual tailgate November 1 Contact Frank Anders, KK4MBX email twfrank111@aol.com

MARCO Medical Amateur Radio Council. Professionals enjoying ham radio. Free newsletter & info. secretary@marco-members.info 423-665-2621

RAINBOW AMATEUR RADIO ASSOCIATION Serving the international gay/lesbian/GLBT community since 1995. ARRL affiliated. Privacy respected. Active HF/VoIP nets, newsletter, chat room, message forums, cruises, Dxpeditions. Web Site: WWW.RARA.ORG. Information: 954-502-6969 PO Box 18541, Rochester NY 14618-0541.

WWW.THESIGNMAN.COM Club BADGES, call sign HATS, coffee MUGS, Vinyl letters & mag signs 877-SIGNMAN (744-6626)

MARCO Medical Amateur Radio Council. Professionals enjoying ham radio. Free newsletter & info. secretary@marco-members.info 423-665-2621

Property/Vacation/Rentals

Aruba Radio Rental www.p49v.com

COLORADO CHALET with ham gear for weekly rental, www.lostcreekcabin.com. WØLSD, Buena Vista, CO.

FLORIDA 1/2AC NO CC&Rs! Build your antenna farm where it's warm. Large, double-lot in Silver Springs Shores Subdivision, Ocala, FL $25K 60HzEE@gmail.com 205-329-4445

HAWAII DX VACATION RENTAL STEPP-IR Antennas KH6RC. 808-929-7101 www.leilanibedandbreakfast.com

Lee Shaklee W6BH (Shaklee products) passed away in 2013. His 20 acre RADIO RANCH mountain top remote operation located in southern California is for sale. Contact Ted Halter at 951 316 6777 for further information.

Paradise Antenna Farm. 40 acres. **Southern Arizona**, $294K. Large tall towers, many antennas, living area and ham shack. Remote control station via internet. Call for details 520-398-2722 **w7uo@hotmail.com**

COLORADO CHALET with ham gear for weekly rental, www.lostcreekcabin.com. WØLSD, Buena Vista, CO.

VY2TT www.peidxlodge.com

Antique/Vintage/Classic

AM relic - 1930-40s AM transmitter, 6 chassis with Thordarson transformers and choke coils, Partial listing of tubes - Taylor T40, RCA 76, Arcturus 6A3. WA4DLR@Verizon.net

ANTIQUE WIRELESS ASSOCIATION. The organization for all enthusiasts of antique and historical radio! Publishes THE AWA JOURNAL, covering vintage ham gear, keys, telegraphy, contests, broadcast receivers, vacuum tubes, historical, technical articles, restoration, and much more. AWA produces the famous annual Rochester, NY meet. Maintains world-famous historical radio-electronics communications museum. Membership only $25/year USA, $30 elsewhere. Antique Wireless Association, PO Box 421, Dept. 1, Bloomfield, NY 14469. Check our Website: http://www.antiquewireless.org

CLASSIC REPAIR - Specializing in Collins, Drake and other fine tube radios. Steve, 661-557-0014. n6hk@hotmail.com

CODE PRACTICE OSCILLATOR MUSEUM: http://www.n4mw.com

DISPLAY STANDS www.TubeDisplays.com

FOR SALE much sought after Hallicrafters SX115 receiver $750.00. Kenwood TS820S needs work $450.00 802-388-6634

Insanely great six decades as ham www.kk4ww.com

"SOFT START YOUR RADIO from SIGTOMICS.com or (607) 785-7085 WA2LTD"

Visit THE SOUTHERN APPALACHIAN RADIO MUSEUM! - www.saradiomuseum.org 828-299-1276. Asheville, NC.

Vintage Repair www.mcveyelectronics.com/ham-radio

W4QCF MANUALS - 828-298-1847 http://www.w4qcfmanuals.com

QSLCards/Call Sign Novelties

CALLSIGN PLAQUES www.HamPlaques.com

DISPLAY YOUR AMATEUR LICENSE on the wall in your shack with this beautiful holder. Visit: www.fan--nanenterprises.com

ENGRAVING: Callsign/name badges by WØLQV. Send for price list. 8319 Marty St., Overland Park, Kansas 66212-1963. E-mail: w0lqv@arrl.net

Engraving, **QSL's,** Memo's, Stamps, Labels, Plaques since 1962. Full Service Printing. Samples. WA2WAO@CornerPress.com [425] 286-5952

CALL SIGN ID CARD with "Amateur Radio Active" logo. Deputypatch.com

Get **Top Quality Full Color UV-Coated QSL Cards** direct from the printer. Chester QSL Cards is now Star Cards, Inc. Call (800) 748-7089 for info or visit www.star-cards.net

HANDCRAFTED OAK CALL SIGNS www.oakcallsigns.com 314-605-4971, KCØSDV

QSLKIT – CardBoxes – Dividers – MORE www.HamStuff.com by W7NN

WWW.THESIGNMAN.COM 877-SIGNMAN (744-6626)

General

#1 AMATEUR CALLSIGN DVD! HamCall contains over 2,223,000 world-wide callsigns. 7,600,000 archive callsigns. Supported by most logging programs. Six FREE monthly Internet updates and HamCall.net Gold online access included. Check/ Visa/MC/Discover. $50 + $5 S/H Buckmaster, 6196 Jefferson Hwy., Mineral VA 23117 800-282-5628, http://hamcall.net

73s: Join our hamradio social network! http://www.73s.com

ANTENNA COMPARISON REPORT: TRIBANDERS K7LXC & NØAX test Hy-Gain, KLM, CC, Bencher, Force 12, Mosley and others. $17 + $4 s/h. More info at www.championradio.com 206-890-4188

ANTENNA COMPARISON REPORT: VERTICALS. K7LXC & NØAX test CC, Butternut, MFJ, Force 12, Diamond, Hustler, GAP and other. $17 + $4 s/h. More info at www.championradio.com 206-890-4188

Antennas plus accessories equals FUN! http://HamRadioFun.com

AM relic - 1930-40s AM transmitter, 6 chassis with Thordarson transformers and choke coils, Partial listing of tubes - Taylor T40, RCA 76, Arcturus 6A3. WA4DLR@Verizon.net

BIGGEST on-line ham classifieds: http://swap.QTH.com

Bugbook Historical Microcomputer Museum www.microcomputermuseum.com

Cable Assemblies - APRS Link, Programming, PC Connect, Voice Com Control, Mobile Power - http://stores.ebay.com/Jabber-Electronics WE6G 480-905-8484

CQ DX. Well established WAS and DX Awards Net needs DX checkins. Please contact buddys70@gmail.com for more details if interested.

A perfect Christmas gift for any ham or wannabee ham is **"World's Best Hobby"** – a new book by Dave Bell, W6AQ. This memoir covers Dave's life making films with such Ham notables as King Hussein of Jordan, JY1, Senator Barry Goldwater, K7UGA, Arthur Godfrey, K4LIB, and Walter Cronkite, KB2GSD. It also covers Dave's professional life as a veteran television producer, and goes with him on many of his DXpeditions. It's a fun read and is available from ARRL, The DX Store, DX Engineering, and of course, Amazon.

Help bring Ham Radio into classrooms: **HamRadioKids.com**

Custom Ham Maps by N1XFS!!! Customized azimuthal equidistant projection maps with beam headings and distances based on your QTH. Adds that special "wow" factor to your shack. Makes a great gift! Go to: **CustomHamMaps.com**

DIY ANTENNA MAST-better than telescopic. www.bend-gard.com

ELECTRIC RADIO MAGAZINE: America's popular monthly publication devoted entirely to vintage amateur radio, military equipment, restorations, and radio history. Samples $1. Electric Radio, P O Box 242, Bailey CO 80421, www.ERmag.com

EMT ANTENNA MASTS (YES, EMT)- www.bend-gard.com

"EVERYTHING FOR THE MORSE ENTHUSIAST." Morse Express. Keys, keyers, kits, books. 303-752-3382. http://www.MorseX.com

FAR CIRCUITS CD is available for $5.00 with orders or $8.50 including First Class shipping. CD contains over 350 articles and additional project information.

For Sale: Ross Distributing 208-852-0830

"FOR SALE: CUSHCRAFT R6000 VERTICAL ANTENNA FOR 6,10, 12, 15, 17, 20 METERS. NOT USED OB, $200. JOE WHISNANT, W4RIQ, 1233 NEW CASTLE WAY, MARYVILLE, TN 37803. 865-977-9024."

Glen Martin Hazer Tower Transit Systems. Same day shipping. www.antennapartsoutlet.com

Ham Radio and Shortwave repair -any make HF/VHF/UHF- Bob, KF8IY 440-984-0084 (home) 440-653-1179 (cell) E: bobd@vasucom.com

CQ DX. Well established WAS and DX Awards Net needs DX checkins. Please contact buddys70@gmail.com for more details if interested.

For Sale: Swan Mark II 2 K linear amplifier. Reconditioned. Original owner. $500. (317) 926-2358

HEATHKIT AMATEUR RADIO REPAIR by RTO Electronics, 601 E. 1st Street Calexico, CA 92231 269-468-7780. E-mail: hamtech@rtoham.com. www.rtoham.com

Help bring Ham Radio into classrooms: **HamRadioKids.com**

HOME of the world famous Yo-Yo Dipoles! http://HamRadioFun.com

ISOTRON ANTENNAS FOR 160 - 6 METERS! Efficient, rugged and resonant. Please visit www.isotronantennas.com . wd0eja@isotronantennas.com 719/687-0650.

INRUSH CURRENT LIMITER for your radio or linear. SIGTOMICS.com or (607) 785-7085 WA2LTD

EMT ANTENNA MASTS (YES, EMT)- www.bend-gard.com

KENWOOD AMATEUR RADIO REPAIR by K3TEN 609-846-5190 Email roy@k3ten.com Web http://www.k3ten.com TS-830, TS-820 And All Kenwood Hybrids, plus the TS-930's, TS-940's, TS950's, TS-2000s, TS-430s, TS-440s, TS-450s, TS-690s, TS-850s. TL-922 Amplifier Upgrades and Repairs.

Kenwood TS-520 restoration and repair call Jimmy @ 856-447-3391 or email j1777@comcast.net

Kenwood TS-590 base station, includes Astron RS-35M power supply, MC-60 mic, HS-5 headset, Signal Link, Par End-fed 20-40m antenna with two fiberglass 30-ft telescoping poles, coax, lightening arrestor. Used less than 15 hours, son needs money. $2800 firm + postage. Lloyd AE7VM 541-882-1088 PST or magnetservices@earthlink.net

Kenwood, Hybrid repairs and restoration 520, 520S, 520SE For more info please call **856-447-3391**

CALL SIGN ID CARD with "Amateur Radio Active" logo. Deputypatch.com

LEARN CODE by Hypnosis, www.success-is-easy.com 561-302-7731

LICENSE FRAMES - www.Gifts4Hams.com

MFJ 2990 - $175.00; MFJ 259B SWR Analyzer - $150.00; (631) 979-8198

MARCO Medical Amateur Radio Council. Professionals enjoying ham radio. Free newsletter & info. secretary@marco-members.info 423-665-2621

SELL Drake FS-4 Synthesizer $500 BO AS IS K0IC 712-379-3614

MicroLog-By-WA0H .. Easy to use logging program .. Free download .. www.wa0h.com

Microsoft Abandons XP - XpExtend provides critical security updates for Windows XP systems. Stop exploits before malware eats your machine! Visit http://xpextend.com

PRINTED CIRCUIT BOARDS for projects shown in QST, QEX, HR, ARRL HB, 73 and more. Custom boards available. FAR Circuits, 18N640 Field Ct, Dundee, IL 60118; fax/phone 847-836-9148; www.farcircuits.net; mail@farcircuits.net

QRP KITS: Easy to build. Fun to use. www.breadboardradio.com

EMT ANTENNA MASTS (YES, EMT)- www.bend-gard.com

QST magazine copies in QST binders Details: www.synergiaglobal.com/qst

Rohn Tower, telescoping poles, tripods and antenna parts delivered to your door. **www.antennapartsoutlet.com**

ROPE All kinds, types, including: antenna rope, hauling, gin pole. **FREE** Consultation. www.DavisRopeandCable.com <http://www.DavisRopeandCable.com **Veteran Owned, K1PEK 978-369-1738**

SMC ELECTRONICS - Surplus and refurbished electronic equipment including repair/replacement/ experimenter parts and accessories. Over 20,000 items in stock, including over 12,000 Service Manuals. www.smcelectronics.com

TOWER ACCESSORIES Gin Pole Kits - stand off brackets - antenna mounts - vehicle radio mounts for 30 years. IIX Equipment Ltd. 708-337-8172 www.w9iix.com

WANTED: Good 8236 Pentode Electron Tubes for my transmitter. What price do you need and how many can I get? Dave at 2817815955 or fullerphone7150@yahoo.com

WANTED A Ten-Tec scout e: ve1bc@rac.ca

WE BUY/SELL RADIOS. **#1 IN ESTATES** – www.recycledradio.com (603) 942-7173

www.SecondHandRadio.com Electronic or Electrical - find it here, sell it here.

WWW.THESIGNMAN.COM Hats, license plates & frames, decals & gifts

"YOU CAN check spots, log contacts: www.dxtreme.com"

AMSAT – Join now! Call 301-589-6062

QST Index of

Contact Information:

Toll Free: 800-243-7768
Direct Line: 860-594-0207
Fax: 860-594-4285
E-mail: ads@arrl.org
Web: www.arrl.org/ads

Additional advertising information is available on the web at:
www.arrl.org/ads

Advertisers

QST Advertising Deadlines:

Issue	Reservation Date	Materials Due Date
February 2015	Friday, December 12, 2014	Monday, December 15, 2014
March 2015	Monday, January 19, 2015	Thursday, January 22, 2015

For links to the Web sites of all ARRL advertisers, visit www.arrl.org/ads/adlinks.html

Let's Make This a Year to Remember...

Many members tell us they owe so much to Amateur Radio —and they wish they could do more to support the ARRL.

These days, we understand that tight budgets affect charitable giving—but there is an easy way you can support the ARRL and ensure a strong future for Amateur Radio. **Simply include the ARRL as a beneficiary in your Will, Life Insurance, Retirement Plan or Life Income Plan, and you can be a part of ARRL's legacy!**

Making a provision in your estate plans toward the **ARRL Endowment Fund** is an easy way to support Amateur Radio. Through a planned gift, you are helping to sustain all that ARRL does for an avocation that means so much to you. The ARRL Endowment Fund ensures that ARRL will continue to face the future in a strong financial position, and will continue to educate future generations, protect frequencies, preserve history, and provide the invaluable services and technical advice hams depend on.

For more information on making a planned gift to the ARRL Endowment Fund, or the ***ARRL Legacy Circle***, please visit **arrl.org/estate-giving** or contact:

Lauren Clarke, KB1YDD
Development Manager
ARRL
225 Main Street, Newington, CT 06111-1494
860-594-0348
lclarke@arrl.org

If you have already included a commitment to ARRL in your estate plans, ***thank you!*** When you notify the ARRL Development Office of your gift, you will be welcomed into the ***Legacy Circle*** and provide us the opportunity to thank you for your thoughtful generosity.

powerwerx.com

Bringing you the best in DC power products!

NEW!

Panel Mount Dual USB Socket
3 Amp Device Charger

NEW!

Panel Mount Digital Volt Meter
5-25VDC Input Range

NEW!

Crimpable Inline ATC/ATO
Blade Fuse Holder

NEW!

TestBuddy, the Powerpole
LED Polarity Tester

Anderson Powerpoles & Accessories

All Amps, Gauges & Colors in Stock!

Two-Way Dual Band Radios

NEW!

KG-UV8D
Amateur Radio

KG-UV3D
Amateur Radio

KG-UV6X
Commercial

12V Power Supplies

Variable Supply
with Digital Meters

Switching Supply
with Powerpoles

Rack Mount Supplies in
Single, Dual or Redundant Configurations

Power Splitters & Adapters

Wire & Cable

Batteries & Chargers

AGM Batteries up
to 110 amp hours

Automatic Power
Off Timer, Low Voltage
Disconnect & More!

40A Battery
Charger

Noco Genius
Charger

Fuse Holders & Fuses

Tools & Meters

Watt Meter 130A
Now with Blue Backlight

powerwerx.com

Order online at powerwerx.com
Order toll free 888-321-0073

Follow us on Facebook
facebook.com/powerwerx

Follow us on Twitter
twitter.com/powerwerx

Universal

B-18 SERIES
Light duty aluminum self supporting towers. Five models ranging from 30 to 50 feet, and supporting up to 12 square feet of antenna wind load.

B-26 SERIES
Medium duty aluminum self supporting towers. Thirteen models ranging from 30 to 90 feet and supporting up to 34.5 square feet of antenna wind load.

B-30 SERIES
Heavy duty aluminum self supporting towers. Nineteen models ranging from 40 to 100 feet, supporting up to 34.5 square feet of wind load.

CALL FOR MORE INFO!

ROHN

25G $119
25AG2/25AG4 ..... $189/239
AS25G/AS455G $65/119
BPC25G/BPH25G $69/279
BAS25G/BPL25G $299/199
EP2534-3/5 ..... $49/65
GA25GD/GA45GD .. $159/189
GAC3455 ..... $139
GAR30/GAS604 ..... $45/69
HB25AG/HB25BG .. $119/129
SB25G/SB25G5 ..... $79/109
SBH25G $249
TB3/TB4 ..... $159/179
TRT36/TRT60 ..... $59/69
TRTAG2/9H50 ..... $219159
WP25G/WP45G $149/159

IIX EQUIPMENT
BP1X Snatch Block $149
GP21X Clamps/Kit .. $279/319
GP31T Clamps/Kit .. $329/409
GP-81 Clamp/Kit $239/299
GP-UPS Gin Pole $209
GPP Gin Pole Pulley $109
S01X Stand-Off $199
S04 Stand-Off $169
S05-6" Stand-Off $99
S05-26" Stand-Off $139

YOUR NUMBER FOR SAVINGS (800) 272-3467

www.texastowers.com

- Great Gear
- Great Deals
- Great Service

TEXAS TOWERS
Savings As Big As Texas!

TEXTENNA
TexHex 5-Band $589
Provides broadband (typical VSWR <1.5:1) coverage of 10/12/15/17/20m. Optional 6m kit. Improved heavy-duty mounting plate fits masts up to 2" OD. Pre-tuned elements, easy to install. In stock!

TIMES LMR COAX
Lower loss than traditional coaxes without the water displacement problems common to 9913 and 9086 types.

LMR-200 ..... $.65/FT.
LMR-200 Ultraflex .... $.85/FT.
LMR-240 ..... $.69/FT.
LMR-240 Ultraflex .... $.89/FT.
LMR-400 ..... $.89/FT.
LMR-400DB ..... $1.09/FT.
LMR-400 Ultraflex .. $1.39/FT.
LMR-600 ..... $1.59/FT.
LMR-600 Ultraflex .. $2.49/FT.
MORE LMR CABLES IN STOCK

DAVIS RF

COAX - MADE IN USA
All have high-quality non-contaminating outer jackets.

RG-58C/U ..... $.29/FT.
RG-8X Mini ..... $.29/FT.
RG-213/U ..... $.79/FT.
BuryFlex ..... $.89/FT.
Belden 9913F7 ..... $1.29/FT.

COMET ANTENNAS
CAA-500 Analyzer $439
CHA-250B $389
GP-3/GP-6 ..... $99/149
GP-9/GP-9N $189/189
GP-15/GP-98 ..... $169/189

DIAMOND ANTENNAS
X-30A/X-50A $69/99
X-200A/X-300A $129/139
X-510HDMA/HDNA $199
X-3200A/X-6000A $179

MFJ
MFJ-259C Analyzer $249
MFJ-269C Analyzer $359

GLENMARTIN

H2 Hazer $609
H3 Hazer $459
H4 Hazer $589
RT-424 Roof Tower $319
RT-832 Roof Tower $469
RT-936 Roof Tower $779
RT-1832 Roof Tower $1029
RT-2632 Roof Tower $1709

texcom RF PRODUCTS

Crimp Kit $99
Tool kit to prepare and crimp RF connectors for .100", .200", .240" and .405" diameter coax cables, including LMR-100, LMR-200, LMR-240, LMR-400, RG-8/8X/58/213, BuryFlex, 9913, 9086, 9096 and other similarly sized cables. With rugged plastic storage case.

Crimp Kit Plus $109
Same as the Crimp Kit, but also includes dies for Anderson PowerPole™ connectors.

WE HAVE A HUGE STOCK OF CRIMP CONNECTORS FOR MANY COMMON COAX CABLES. PLEASE CHECK OUR WEB SITE OR CALL.

ROTATORS
Hygain, CD-45II $429
Hygain, Ham-IV $599
Hygain, Ham-V $939
Hygain, T2X $699
Hygain, T2X Digital $1,159

ROTOR CABLE - US MADE
R62, 6-#18 ..... $.59/FT.
R81, 2-#18/6-#22 ..... $.49/FT.
R82, 2-#16/6-#18 ..... $.79/FT.
R83, 2-#14/6-#18 ..... $.89/FT.

STEEL MASTS
High-carbon steel masts. Typical yield strength of 83,000 PSI.

	.12"	.18"	.25"
5 FT.	$69	$79	$99
8 FT.	$109	$129	$159
10 FT.	$129	$149	$189
12 FT.	$159	$179	—
13 FT.	—	$199	$239
15 FT.	—	$229	—
18 FT.	—	—	$329
21 FT.	$269	$319	—
22 FT.	$279	—	—
23 FT.	—	$339	$429

ALUMINUM TUBING
Our 6063-T832 aluminum tubing is all American made to our exacting standards for the highest quality and precision.

O.D.	WALL	COST/FT.
6063-T832 DRAWN ALUMINUM TUBING		
.375"	.058"	$.65
.500"	.058"	$.70
.625"	.058"	$.80
.750"	.058"	$.90
.875"	.058"	$.95
1.000"	.058"	$1.00
1.125"	.058"	$1.10
1.250"	.058"	$1.30
1.375"	.058"	$1.40
1.500"	.058"	$1.50
1.625"	.058"	$1.65
1.750"	.058"	$1.80
1.875"	.058"	$1.95
2.000"	.058"	$2.10
2.125"	.058"	$2.25
6061-T6 EXT. AL. SQUARE TUBING		
.750"	.062"	$.95
1.000"	.062"	$1.25

TEXAS TOWERS

1108 Summit Avenue, #4 • Plano, TX 75074
Hours: M-F 9 AM–5 PM Central Time
Email: sales@texastowers.com

TOLL FREE **(800) 272-3467**

Proudly Serving Ham Operators Since 1978!
MASTERCARD VISA • DISCOVER
Visit Our Website for More Great Deals:
http://www.texastowers.com

RT Series Tuners

THE ACE UP YOUR SLEEVE

LDG ELECTRONICS

Our new house had everything: a nice big yard with some trees in the back, a bedroom for each kid, a two-car garage, and a den for the ham shack. I hated it; there's a Home Owner's Association. I submitted plans for a tower to the HOA, and they actually laughed at me. I invoked PRB-1; they countered with PR-We Don't Care. The word "litigation" hovered like a toxic cloud over the table.

I gave up, partly because I don't have money to waste on lawyers, but partly because I had an ace up my sleeve. A ground-mounted vertical back in the trees, a can of brown spray paint, a few ground rods, and I'd be in business. Yes, I've heard the one about how a vertical is an antenna that radiates equally poorly in all directions, but it was that or nothing. I knew without a radial field I'd need a tuner, and the one built into my transceiver wasn't going to cut it.

Any of LDG's automatic tuners would do the trick, but in a coax run that long SWR losses would be pretty high. LDG now has weatherproof tuners that mount right at the antenna, eliminating coax SWR losses. LDG's RT tuners are completely automatic, and are powered over the coax feedline; no separate power line is required. The RT-100 handles up to 100 watts, and the RT-600 up to 600 watts. The included remote control inserts 12 volts dc onto the coax, and lets you select the operating mode. It all works great; I just transmit and the RT-100 automatically tunes as needed. The rig just hums along into a perfectly matched all-band antenna, and it's the next best thing to invisible.

LDG's RT tuners will work with any coax fed antenna, or long wires and antennas fed with ladder line through a balun. Visit us on the web at www.ldgelectronics.com for more information, and for links to the fine dealers who sell LDG products.

NEW! RT/RC Series Tuners & Control Units

A Technological Breakthrough In Remote Tuning!

Coax in / coax out tuner designed to be placed near the feedpoint of the antenna. Place the RT Series Tuner near the feedpoint and virtually eliminate all feed line loss due to SWR. DC powered over the coax, so use the RC Series Control Unit to power and control the tuner from your shack. The RC Series Conrol Unit will provide DC power over the coax as well as control for Auto mode, Lock, and Tune.

100 Watt
RT/RC-100 Suggested Price $249.99

600 Watt
RT/RC-600 Suggested Price $449.99


RT-100


RT-600

www.ldgelectronics.com **410-586-2177**

Your Favorite Dealer has these tuners in stock NOW! Don't Miss Out - Call or visit them TODAY!

The Legend Continues

The TS-590SG

Back in 1973, Kenwood introduced the first affordable HF radio to the world, the legendary TS-520... 27 years later, the TS-570D and the TS-570S with 6 meters were by far the most popular HF and HF+6 transceivers on the market.

Be witness to the evolution of KENWOOD's pride and joy - the TS-590S HF transceiver - pushing performance and technology to its utmost limit, with the receiver configured to capitalize on roofing filter performance and IF AGC controlled through advanced DSP technology. Enter the TS-590SG. A new generation of high performance transceiver, with the type of high level response to meet DX'ers needs.

Don't be fooled by big boxes, high price tags, complex operation and broken promises. As Kenwood continues to build outstanding products with unparalleled performance and great value, it's no surprise Kenwood is rated as one of the leading choices for HF radios.

It's not too late to own an HF legend because we still build them today.

KENWOOD

Customer Support: (310) 639-4200
Fax: (310) 537-8235

www.kenwood.com/usa

ISO9001 Registered

ADS#43214