Official Journal of
ARRL
The national association
for AMATEUR RADIO

QST

devoted entirely to
AMATEUR RADIO

February 2004

QST reviews

Elecraft KPA100
100 W upgrade
for the K2

AOR ARD9800
digital voice
modem

Mobile antenna base
with internal
capacitive matching

**Power and
antenna gain
on 60 meters**

RV Mobile to Alaska

$4.99 U.S. $6.99 Can.
02
19260
0 843655 9

Tune in the world with Icom!

New IC-R5

Winning performance! Compact, and packed with features!

150 kHz – 1.3 GHz* • AM, FM, WFM • 1250 Alphanumeric Memories • CTCSS/DTCS Decode • Weather Alert • Dynamic Memory Scan (DMS) • Preprogrammed TV & Shortwave • Weather Resistant • 2 AA Ni-Cds • PC Programmable

IC-R3

See & Hear all the action!

• 500 kHz – 2.45 GHz* • AM, FM, WFM, AM-TV, FM-TV • 450 Alphanumeric Memories • CTCSS with Tone Scan • 4 Level Attenuator • Telescoping Antenna with BNC Connector • 2" Color TFT Display with Video/Audio Output • Lithium Ion Power • PC Programmable

IC-R10

Advanced performance!

500 kHz – 1.3 GHz* • AM, FM, WFM, USB, LSB, CW • 1000 Alphanumeric Memories • Attenuator • Backlit Display & Key Pad • VSC (Voice Scan Control) • 7 Different Scan Modes • Beginner Mode • Band Scope • Includes AA Ni-Cds & Charger • PC Programmable

New Software IC-PCR1000 BON

Turn your PC into a wide band receiver! Compatible with most PC's and laptops, the 'PCR1000 connects externally- in minutes! Now with Bonito™ software! Updated ICOM software compatible with later versions of Windows™ OS is also now available!

• 100 kHz – 1.3 GHz* • AM, FM, WFM, USB, LSB, CW • Unlimited Memory Channels • Real Time Band Scope • IF Shift • Noise Blanker • Digital AFC • Voice Scan Control • Attenuator • Tunable Bandpass Filters • AGC Function • S Meter Squelch • CTCSS Tone Squelch • Computer Controlled DSP w/optional UT-106

download frequencies right from the web

www.icomreceivers.com

IC-R75

Pull out the weak signals!

• 30 kHz - 60.0 MHz* • AM, FM, S-AM, USB, LSB, CW, RTTY • 101 Alphanumeric Memory Channels • Twin Passband Tuning (PBT) • Commercial Grade • Synchronous AM Detection (S-AM) • Optional DSP with Noise Reduction Auto Notch Filter • Triple Conversion • Up to Two Optional Filters • Front Mounted Speaker • Large Display • Well Spaced Keys and Dials • PC Remote Control with ICOM Software for Windows® (RSR75)

IC-R8500

The experts choice!

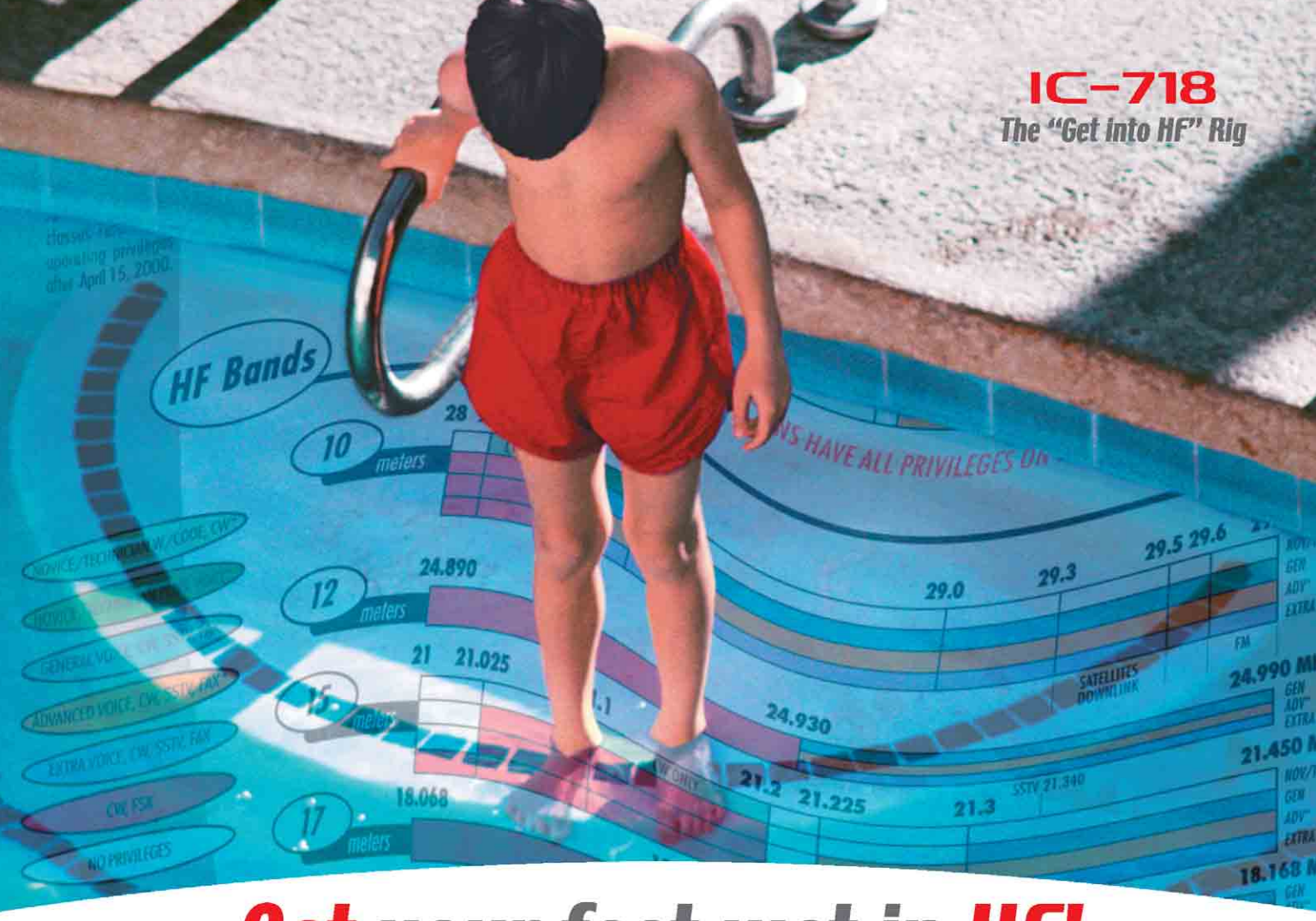
• 100 kHz - 2.0 GHz* • AM, FM, WFM, USB, LSB, CW • 1000 Aphanumeric Memories • Commercial Grade • IF Shift • Noise Blanker • Audio Peak Filter (APF) • Selectable AGC Time Constant • Digital Direct Synthesis (DDS) • RS-232C Port for PC Remote Control with ICOM Software for Windows® (RSR8500)

Find out more!

www.icomamerica.com

ICOM®

*Cellular frequencies blocked.



Get your feet wet in HF!

Want to get your feet wet in HF, without getting soaked? The '718 is the rig for you! Straight forward operation, user friendly features, and low, low price make this one rig you can grow with. Jump in at your authorized Icom dealer.

HERE'S WHAT QST HAS TO SAY:

"The Icom IC-718 offers a nice collection of the more desirable features that are typically absent from transceivers in its price class."

"I found that the IC-718 was very easy to operate with a minimum of "manual" intervention."

"Operating RTTY or PSK31 with the IC-718 was a breeze."

"The IC-718 provides 100W on SSB, RTTY, and CW and 40W on AM. The RF power output is continuously variable between approximately 5 and 100W (from 2 to 40W on AM)."

QST, Product Review, July 2000

160-10M Coverage* • 100W Output Power (40W on AM) • RX Coverage 0.03 - 30MHz • 101 Memories • Multiple Scanning Functions • Front Mounted Speaker • IF Shift • Mic Compressor • RF Gain Control • Noise Blanker • RF Attenuator & PreAmp • Auto Notch Filter • Ample CW features including Electronic Keyer • VOX • Digital S/RF Meter • Flexible Filter Selection • Optional DSP • Optional Voice Synthesizer • And much more!

Free DSP!

Get a Free UT-106 DSP module when you purchase a new IC-718. DSP enhances receive performance with the addition of Noise Reduction and an Auto Notch Filter. This is a limited time offer, so see your participating authorized Icom dealer today!

Ready for HF?

www.icomamerica.com

ICOM®

*Except 60M band.

hy-gain Rotators

. . . the first choice of hams around the world!

Hy-Gain rotators are the first choice of hams around the world!

Hy-Gain's world famous Bell Shaped Rotator™ design is the standard that other rotators are measured against.

Its bell construction gives you total weather protection for super reliable operation. Its super heavy duty steel gear drive gives you years of superior and trouble-free performance. Many Hy-Gain rotators still provide excellent service after over 25 years of outstanding performance.

The last thing you want to fall apart is your rotator that's mounted on the top of your tower. You won't make any compromises when you buy and install high quality Hy-Gain rotators.

And we're the only manufacturer to offer a full line of rotators that are completely MADE IN THE USA.

HAM-IV, $559.95. *The heavy duty Ham-IV is the most popular rotator in the world!* It is designed for medium size antenna arrays up to 15 square feet wind load area when mounted in-tower, or 7.5 square feet when mast mounted with an optional lower mast bracket. New alloy ring gear gives extra strength up to 100,000 PSI for maximum reliability. New low temperature grease permits normal operation down to -30 degrees Fahrenheit. New wire-wound potentiometer gives reliable and precision directional indication, new ferrite beads reduce RF susceptibility, new Cinch plug connector plus 8-pin plug at control box (no screwdriver needed). Dual 98 ball bearing race for load bearing strength. Strong electric locking steel wedge brake prevents wind induced antenna movement. Easy-to-use Control Box has illuminated directional meter with North or South center of rotation scale, separate snap-action brake and rotation switches. Uses low voltage control for safe operation. Accepts masts up to $2^{1}/_{16}$ inches diameter. Rotator size is $13^{1}/_{2}$Hx8D inches.

T-2X, $649.95. *Extra heavy duty Tailtwister antenna rotator!* For large antennas up to 20 square feet wind load when mounted in-tower, or 10 square feet when mast mounted with optional support bracket. Triple 138 ball bearing race, strong electric locking steel wedge brake. Control Box has an illuminated directional indicator with North or South center of rotation scale, separate snap-action brake and rotation control switches. Accepts masts up to $2^{1}/_{16}$ inches diameter. Rotator size is $14^{1}/_{16}$Hx$9^{1}/_{16}$D in.

CD-45II, $389.95. *Medium duty antenna rotator.* Handles antenna arrays up to 8.5 square feet windload area when mounted in-tower, or 5 square feet when mast mounted with supplied lower support. Dual 48 ball bearing race, disc brake system. Control Box has an illuminated directional indicator with North or South center of rotation scale, separate snap-action brake and rotation control switches with disc brake release. Accepts mast sizes up to $2^{1}/_{8}$ diameter. Includes light duty lower mast support, Rotator size is $17^{3}/_{8}$Hx8 D inches.

AR-40, $289.95. *Lightweight antenna rotator.* Handles smaller ham antennas and large TV/FM antennas up to 3.0 square feet windload area when mounted in-tower, or 1.5 square feet when mast mounted using the supplied lower support bracket. Dual 12 ball bearing race, disc brake system. Silent, automatic control box -- just dial and touch for desired direction. Accepts mast sizes up to $2^{1}/_{8}$ diameter. Includes light duty mast support. Rotator size is $17^{3}/_{8}$Hx8D inches.

Call your dealer for your best price!

Rotator Specifications	T2X	HAM-IV	CD-45II	AR-40
Wind Load capacity (inside tower)	20 sq. ft.	15 sq. ft.	8.5 sq. ft.	3.0 sq. ft.
Wind Load (with mast adapter)	10 sq. ft.	7.5 sq. ft.	5.0 sq. ft.	1.5 sq. ft.
Turning Power (in pounds)	1000	800	600	350
Brake Power (in pounds)	9000	5000	800	450
Brake Construction	Electric wedge	Electric wedge	Disc brake	Disc brake
Bearing Assembly/How many	Tripl race/138	Dual Race/96	Dual race/48	Dual race/12
Mounting Hardware	Clamp plate	Clamp plate	Clamp plate	Clamp plate
Control Cable Conductors	8	8	8	5
Shipping Weight (pounds)	28	24	22	14
Effective Moment (in tower)	3400 ft/lbs.	2800 ft/lbs.	1200 ft/lbs.	300 ft/lbs.

HAM IV

$559.95
Suggested Retail

T-2X

$649.95
Suggested Retail

CD-45II

$389.95
Suggested Retail

AR-40

$289.95
Suggested Retail

Free Hy-Gain Catalog
Nearest Dealer/Free Catalog . . . 800-973-6572

hy-gain

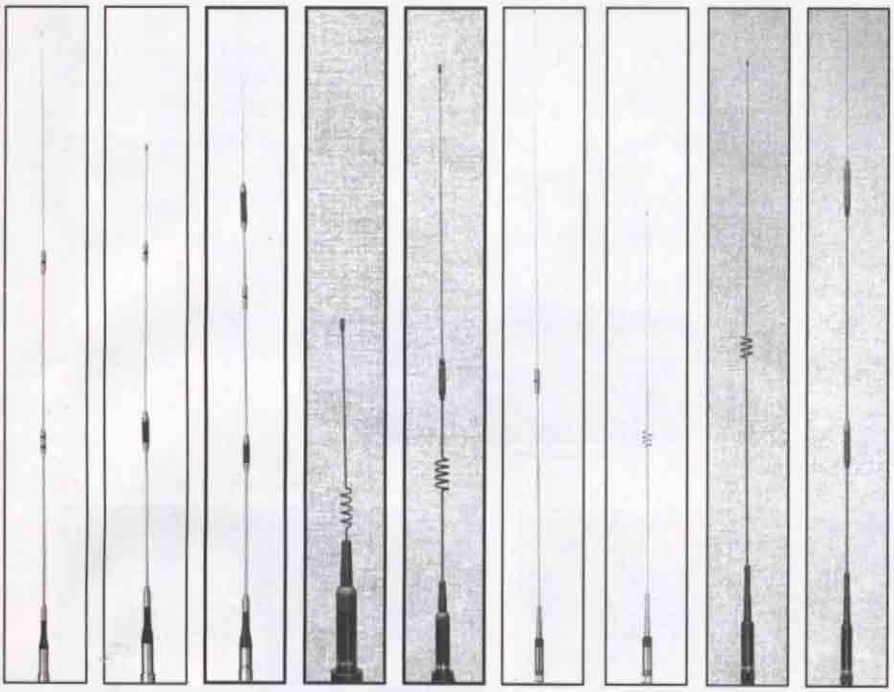
Antennas, Rotators & Towers
308 Industrial Park Road, Starkville, MS 39759 USA
Toll-free Customer Sales Hotline: 800-973-6572
• **TECH:** 662-323-9538 • **FAX:** 662-323-6551
http://www.hy-gain.com

DIAMOND ANTENNA

DIAMOND'S STATE-OF-THE-ART

VHF/UHF And HF/VHF Mobile Antennas– Maximum Performance Without Compromise

You've seen the rest...now own the BEST!



SG2000HD · SG7500A SG7500NMO · SG7900A · NR72BNMO · NR73BNMO · NR2C · NR770HA NR770HB · NR770HNMO NR770HBNMO · CR627B CR627BNMO

HV7A Mobile Antenna System

For New HF/VHF transceivers (Such as: IC706 series and FT100) NEW!

Optional Loading Coils

HVC7	40m
HVC14	20m
HVC18	17m
HVC21	15m

Recommended Antenna Mounts: K400C or K600M

MX62M Duplexer

Specifications:
HF/6m & 2m/70cm bands
1.6-56 MHz LPF
76–470 MHz HPF
(76–120 receive only)

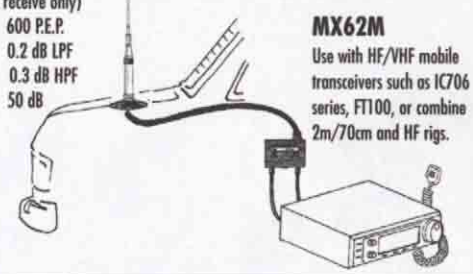
Watts:	600 P.E.P.
Loss:	0.2 dB LPF
	0.3 dB HPF
Isol.:	50 dB

The NEW HV7A has 5 band capability: 70cm, 2m, 6m, and 2 HF bands through use of loading coils. Foldover feature allows for easy access into low overhead buildings. Ideal for users of IC706 series and FT100 radios.

Bands Supplied:	10m/6m/2m/70cm
Opt. Loading Coils:	40m/20m/17m/15m
Power, P.E.P.:	HF 120w/VHF 200w
Mount Connection:	UHF
Length:	54"
SWR:	1.5:1 nominal

MX62M

Use with HF/VHF mobile transceivers such as IC706 series, FT100, or combine 2m/70cm and HF rigs.



SPECIAL FEATURES:

- Factory pre-tuned/no adjustment
- Highest Performance antennas
- NMO and UHF (PO) base styles
- 24 Kt gold plated connector pin
- No grounding required unless noted
- Fold-over feature on most models

FOLD-OVER

Patented One-Touch Fold-over Feature
(Not available on NR72BNMO, NR73BNMO, & NR770SA.)

MODEL	BAND (MHz)	WATTS	CONN.	HT. IN.	ELEMENT PHASING
NR72BNMO*6	2m/70cm	100	NMO	13.8	1/4λ, 1/2λ
NR73BNMO	2m/70cm	100	NMO	33.5	1/2λ, 1-5/8λ
NR770HA7	2m/70cm	200	UHF	40.2	1/2λ, 2-5/8λ
NR770HNMO8	2m/70cm	200	NMO	38.2	1/2λ, 2-5/8λ
NR770RA	2m/70cm	200	UHF	38.6	1/2λ, 2-5/8λ
SG7000A*6	2m/70cm	100	UHF	18.5	1/4λ, 6/8λ
SG7500A	2m/70cm	150	UHF	40.6	1/2λ, 2-5/8λ
SG7500NMO	2m/70cm	150	NMO	41.0	1/2λ, 2-5/8λ
SG7900A*	2m/70cm	150	UHF	62.2	7/8λ, 3-5/8λ

* Not recommended for Magnet Mount
6 Grounding required.
7 NR770HB same specifications but in black finish.
8 NR770HBNMO same specifications but in black finish.
9 52-54MHz only

MODEL	BAND (MHz)	WATTS	CONN.	HT. IN.	ELEMENT PHASING
NR2C	2m	150	UHF	55.5	1/2λ+1/4λ
SG2000HD*	2m	250	UHF	62.6	1/2λ+3/8λ
SG6000NMO*6,9	6m	150	NMO	39	1/4λ
CR224A*6	2m/1-1/4m	150	UHF	68.5	7/8λ, 2-5/8λ
CR320A*6	2m/1-1/4m 70cm	200 100/200	UHF	37.4	1/4λ, 1/2λ 2-5/8λ
CR627B*6,9	6m/2m/	120	UHF	60	1/4λ, 1/2+1/4λ/
CR627BNMO*6,9	70cm	120	NMO	60	2-5/8λ

1/4λ rated in dBi.

www.rfparts.com/diamond

Diamond Antenna Division of RF Parts Co. Tel: (760) 744-0900 • FAX: (760) 744-1943 • E-mail: rfp@rfparts.com

QST

February 2004 ♦ Volume 88 Number 2

CONTENTS

Technical

28 Homebrewing—Surface Mount Style — *Ed Kessler, AA3SJ*
They're everywhere, and they're tiny. But SMDs need not be a daunting challenge to work with.

31 The Well Adjusted Ham — *Tom Morton, W5TOM*
Ensure that you are where you think you are by calibrating your VFO.

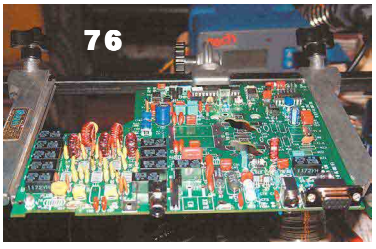
33 A Historic Receiver from a Radio Pioneer—Fred Schnell — *Dan Clark, W9VV*
Delving into a regenerative receiver from the 1920s once owned by a history-making member of the ARRL staff.

36 Power and Antenna Gain on 60 Meters — *L.B. Cebik, W4RNL*
How to determine allowable power levels on our new band—if you're not using a dipole.

43 A Mobile Antenna Base with Internal Capacitive Matching — *Phil Salas, AD5X*
A no-holes solution to installing an effective mobile antenna.

47 Digital Slow-Scan Television — *Ralph Taggart, WB8DQT*
Use your computer and some new software to explore this new image mode.

76 Product Review — *Joel R. Hallas, W1ZR*
Elecraft KPA100 100-W upgrade for the K2 transceiver; AOR ARD9800 digital HF voice modem



News and Features

9 "It Seems to Us. . ." BPL Update

12 ARRL in Action — *Dave Hassler, K7CCC*
SC section links up with statewide Web site; NYC/LI "tower team" scores another victory; WWA section manager testifies on BPL before state senate committee; more.

52 Public Service, VU-Style, or Goddess Durga and the Radio Ham
Kolkata, formerly Calcutta, is home to the annual *Durga Puja* festival—the perfect opportunity for the Calcutta VHF ARS to provide public service. — *Nilanjan Majumdar, VU2HFR*

55 Three Flags Mobiling, from ALCAN to the Yucatán—*Part 1*
A trip to the Yukon and Alaska by way of the desolate ALCAN Highway without ham radio? No way! — *David A. Rosenthal, N6TST*

58 These Field Volunteers are *Far* Afield! — *Dave Hassler, K7CCC*
Beyond—in some cases far beyond—the continental US, a dedicated corps of ARRL volunteers face unique challenges while preparing for and dealing with emergencies.

61 Announcing the 13th Annual McGan Award — *Jennifer Hagy, N1TDY*
The deadline to nominate a ham who has excelled at promoting Amateur Radio in the media is May 21.

62 How to Avoid Contest Score Shrinkage — *H. Ward Silver, NØAX*
"What the heck happened to my score?" Some tips to help avoid unwelcome surprises.

84 Happenings — *Rick Lindquist, N1RL*
FEMA: BPL will "severely impair" essential HF operations; Spectrum Protection Act gains new cosponsors; FCC news; Media Hits; more.

QST (ISSN:0033-4812) is published monthly as its official journal by the American Radio Relay League, 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

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.

See page 15 for detailed contact information.

Telephone: 860-594-0200
Fax: 860-594-0259

QST Workbench

64 The Doctor is IN
Installing ladder line; dealing with conductive interference and noise in a mobile installation; more.

66 Short Takes — *Steve Ford, WB8IMY*
PSKMeter kit

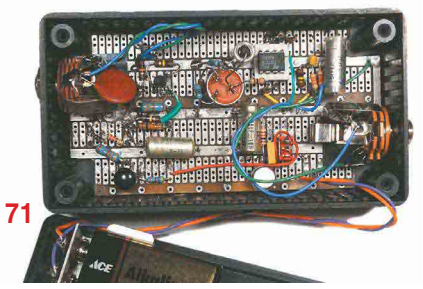
67 Do you do Zulu? — *J. D. Harper, K6KSR*
Use the right time every time—UTC.

69 Hands-on Radio — *H. Ward Silver, NØAX*
Experiment #13—Attenuators

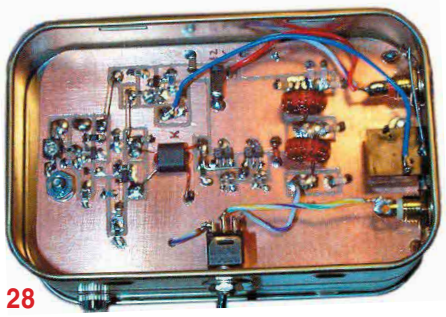
71 An Automatic Audio Volume Leveler — *Larry Coyle, K1QW*
A easily adjustable "black box" that keeps audio output level.

74 Hints & Kinks — *Robert Schetgen, KU7G*
Pyrite crystal radio; adding 60 meters to a Butternut vertical; QRP on the cheap; more.

33



71



28

105

Our Cover
Heading first north in a rental RV, then south in a rental car, David Rosenthal, N6TST, found he could enjoy all ham radio had to offer by making a few temporary vehicle mods. Part 1 of his travel adventure (the northern route to the Yukon and Alaska) starts on page 55. Photos courtesy of David Rosenthal, N6TST.

Operating

105 2003 IARU World Championship Results — *Carl Luetzelschwab, K9LA*

Departments

Coming Conventions 101
Contest Corral 103
Correspondence 24
Feedback 54
Ham Ads 138
Hamfest Calendar 101
How's DX? 91
Index of Advertisers 158
New Products 42, 54, 68
Old Radio 96
Op-Ed 98
Public Service 88
Silent Keys 99
Special Events 104
Strays 30, 99, 102
Technical Correspondence 82
Up Front in *QST* 20
VHF/UHF Century Club Awards 95
W1AW Schedule 100
We're at Your Service 15
The World Above 50 MHz 93
75, 50 and 25 Years Ago 100

US & Possessions: Membership in the ARRL, including a one year subscription to *QST*, is available to individuals at $39. Age 65 and over, with proof of age, $34. 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.* Age 65 and over, $850.* Membership and *QST* cannot be separated. Libraries and institutions, $39 per year. Single copies $5.

International
To compensate for additional postage for mailing outside the US, the following rates apply:
Canada: Membership in the ARRL, including a one 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.

*Payment arrangements available. Please write for details.

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.

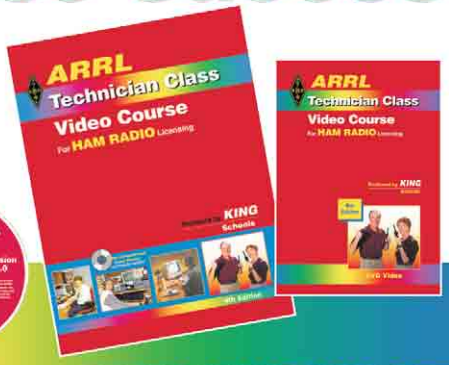
QST is available to blind and physically handicapped individuals on audio cassette from the Library of Congress, National Library Service for the Blind and Physically Handicapped. Call 1-800-424-8567.

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

Available for Tech and General licensing

The Fastest Way to License Success!

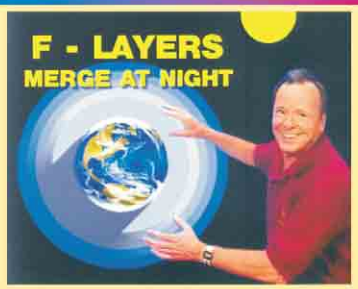
ARRL Video Courses



High Quality Instruction! Your ARRL video course was produced in conjunction with King Schools—a world leader in the production of exam preparation video courses. You will enjoy the enthusiastic instruction and talent of John, KD6SCY & Martha King, KD6SCZ, as they lead you to passing your license exams.

Why do things the hard way? Sit back, relax and learn everything you need to know. Each ARRL video course gives you everything you need to ace your written license exam.

HERE'S WHAT YOU GET!



Order with total confidence — No Risk! Your ARRL Video Course comes with a full 30-day, no hassles-no risk-guarantee. If this program is not what you expected, for any reason, simply return it to us for a prompt, full (& friendly) refund. Include a dated proof of purchase with your return.

Your Complete License Course

Look at all you get with your ARRL Video Course:

- **Full-color Videos**—hours of fast, fun instruction
- **Technician Course** now available on **DVD!**
- **Coursebook** with detailed notes
- **Every exam question**, with thorough step-by-step explanations
- **3 Practice Exams** (test yourself before exam day)
- **ARRL's Computerized Exam Review** CD-ROM
- **Personalized Graduation Certificate**

Included with EVERY course!

Practice Exam Software

Every video course includes the ARRL Computerized Exam Review CD-ROM*. Use it with your video course to emphasize important points, and to provide practice using questions from the actual examination question pool! View detailed explanations for questions that cause you difficulty. The computer will record your answers, and issue a Report Card. We'll make sure you're ready on exam day!

*Requires Microsoft *Windows*, Pentium 133 (minimum) or compatible computer, and 50 MB available hard drive space.

JUST $149! (plus S&H)

Ship me my Complete Course!

Order by phone, toll free 1-888-277-5289 or on the web www.arrl.org/shop/video

1 Shipping Address:

Name _____ Call _____ (Optional)

Street Address _____

City _____ State/Prov. _____

ZIP/Postal Code _____ Country _____

Telephone _____ Email _____

2

❑ **Technician Class Video Course.** Earn your FIRST HAM RADIO LICENSE!
Includes 2 DVDs or 4 videotapes, coursebook, and software. 4th edition.

❑ **DVD Course**, ARRL Order No. 9116 ..... **$149** plus shipping & handling, and sales tax.*

❑ **VHS Course**, ARRL Order No. 8837 ..... **$149** plus shipping & handling, and sales tax.*

❑ **General Class Video Course.** Upgrade with confidence!
Includes 3 videotapes, coursebook, and software. 3rd edition.
ARRL Order No. 8349 ..... **$149** plus shipping & handling, and sales tax.*

Shipping within US (select one):

❑ $10 UPS ground ❑ $15 UPS 2-day ❑ $26 UPS Overnight

*Sales Tax required for shipments to CA, CT, VA, and Canada.

3 ❑ **Amount enclosed, payable to ARRL in US funds** $ _____.

❑ Charge to ❑ VISA ❑ MasterCard ❑ Amex ❑ Discover

_____ (Card Number) _____ (Expiration Date)

_____ (Name on Card)

ARRL • 225 Main Street, Newington, CT 06111-1494 tel: 860-594-0355 fax: 860-594-0303

QST 2/2004

WORLD'S SMALLEST DUAL-BAND HT WITH WIDE-BAND RX

The world's smallest Dual-Band HT with up to 1.5 Watts* of output power is your high-tech gateway to the world, via VHF, UHF, Shortwave Broadcast, Marine and Aircraft bands, or WIRES™ Internet linking!

*1.5 W/144 MHz, 1 W/430 MHz

SMALLEST HT WITH HIGH OUTPUT POWER

Measuring just 1.9" x 3.2" x 0.9" and weighing less than 3/10ths of a pound, the VX-2R is supplied with a 1 Amp-hour (3.7 V) FNB-82LI Lithium-Ion Battery Pack, providing up to 1.5 Watts of output power on the 144 MHz band, and 1 Watt on 430 MHz. If you supply 6 Volts of DC power from the optional E-DC-21 DC Adapter, the VX-2R puts out 3 Watts on VHF, and 2 Watts on UHF!

WIDE BAND RECEIVE

The wide frequency coverage of the VX-2R includes the AM Broadcast band, continuous HF shortwave coverage, VHF/UHF coverage up to 729 MHz, plus 800-960 MHz (cellular blocked). So you won't miss any of the action, whether you're on the Ham bands or monitoring overseas news, FM broadcasts, TV audio, Marine or Air Band users, or Public Safety communications. Special memory banks allow quick recall of Marine, Shortwave, and NOAA Weather broadcasts (with "severe weather" alert).

HIGH PERFORMANCE

- WIRES™ Internet Linking Key and 9-Memory DTMF Autodialer
- Over a Thousand Memory Channels (20 Memory Groups available)
- CTCSS/DCS Encode/Decode
- Automatic Repeater Shift
- Host of Convenient Scanning Features

New style High Capacity Compact Lithium-Ion Battery FNB-82LI (3.7 VDC 1 Ah)

Rugged Diecast Chassis

Supplied accessories:
FNB-82LI, Charger NC-85, Antenna, Belt Clip

Actual Size

*Simulated LCD.

VX-2R

Ultra-Compact 144/430 MHz Dual-Band FM Transceiver

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

Vertex Standard
US Headquarters
10900 Walker Street
Cypress, CA 90630 (714)827-7600

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

AOR ARD9800 Fast Modem – Digital Voice and Image Interface

Convert Your Analog Transceiver to Digital Voice & Image

In One Easy Step!

No transceiver modifications are necessary.

Use any conventional voice transceiver for digital voice communications and images* while you maintain analog capabilities.

The ARD9800 is a breakthrough in communications technology. By simply connecting the ARD9800 to a pair of transceivers, clear, reliable digital communications are a reality.

- **Digital voice communications using existing analog 2way radios.**
The ARD9800 uses the same audio frequencies (300 Hz ~ 2500 Hz) as microphone audio to modulate the voice signal. This allows you to use an analog radio as a digital voice radio.

- **Works on Single Side Band (SSB) mode.**
The Automatic frequency clarifier function adjusts frequency drift automatically in the SSB mode. (Approximately up to +/- 125 Hz). Utilizes the OFDM (Multi Carrier Modulation) circuit that is effective against Multi-path or Selective Fading, a powerful tool against adverse band conditions.

- **Automatic digital receive**
Automatic voice signal detector recognizes the received signal as analog or digital, automatically switching to the appropriate mode.

- **Digital Slow Scan TV***
Built-in video capture function (NTSC). Compresses the signal into AOR's original adaptive JPEG. Send and receive images (similar to analog slow scan TV, but better) in the digital mode. Built-in video output connector (NTSC) allows viewing the picture on an external monitor.

- **Built-in high grade Vocoder (AMBE)**
Utilizing high-grade digital voice compression delivers quality digital voice communications.

- **Built-in FEC error correction**
A powerful error correction circuit delivers stable and reliable communications also allowing "round table" conversations.

- **Small and compact unit. Easy to operate.**
Simply connect the ARD9800 between the microphone jack and microphone. No complicated modifications necessary.

- **Utilizes a uniquely designed high performance DSP engine**

- **Uses the established G4GUO open protocol**

Digital Amateur Radio could be the biggest development on the ham bands since SSB! Be sure to see the FAQ at www.aorusa.com!

AOR™
Authority On Radio

AOR U.S.A., Inc.
20655 S. Western Ave., Suite 112, Torrance, CA 90501, USA
Tel: 310-787-8615 Fax: 310-787-8619
info@aorusa.com http://www.aorusa.com

**image feature requires optional memory module.*
Specifications subject to change without notice or obligation.

"IT SEEMS TO US..."

BPL Update

Broadband over Power Lines (BPL) has been a recurring topic on this page. In the October 2002 issue we first raised the specter of "radio smog" that would result from the introduction of RF onto unbalanced, unshielded conductors. In June 2003 we lamented FCC Chairman Powell's opting to be a cheerleader for questionable technology instead of an impartial regulator looking out for the public interest. In October we used BPL proponents' own words to show that they seem to populate a parallel universe in which the laws of physics do not apply. The following month we questioned whose interests were served by BPL, since the claimed benefits did not stand up to even cursory scrutiny.

Quite a lot has happened since then, both good and bad.

One of the most positive developments is reported in "Happenings" this month (page 84). After giving the matter careful study, the Federal Emergency Management Agency (FEMA), which is now part of the Department of Homeland Security, concluded that BPL could not be implemented in the HF radio spectrum without significant detriment to national security and emergency preparedness requirements. FEMA has advised the FCC accordingly, in comments filed in response to the Notice of Inquiry in ET Docket 03-104.

The National Telecommunications and Information Administration (NTIA), which already has expressed concerns about potential BPL interference to the FCC, has taken measurements at BPL test sites and is expected to issue a report sometime early in 2004. While the FCC is rumored to be working on a Notice of Proposed Rulemaking on BPL, surely it's better for that to await publication of the NTIA's results.

Another encouraging turn was the clarification by FCC Commissioner Abernathy's Senior Legal Adviser, reported in January "Happenings," of earlier remarks the Commissioner had made that appeared to be an uncritical endorsement of BPL. In fact, we and others were assured, "Ensuring that BPL and all new technologies avoid causing harmful interference to licensed RF users is a **bedrock position** [emphasis added] for Commissioner Abernathy." She did not intend to suggest, we were told, that BPL "necessarily will emerge as a viable platform or that it does not present interference issues."

On November 7 the National Association of Broadcasters hosted an ARRL-sponsored meeting of 25 representatives of organizations that are concerned about BPL. During the meeting, representatives from the shortwave broadcasting, public safety, aeronautical and scientific communities joined amateur, amateur-satellite, and industry representatives to discuss the threat of BPL and possible avenues to combat its interference potential to licensed HF and low-VHF spectrum users. Military and consumer electronics representatives participated as observers.

Even the power industry has been expressing doubts about the viability of BPL. In a November 12 article in *EPRI Journal online*, the Electric Power Research Institute reports the publication of a study that analyzes "five very sobering influences on BPL": money, performance, utility motivation, competition, and the timing of its introduction into the market alongside other more mature technologies. "The elusive 'silver bullet' (commercially proven, long-distance high-speed PLC [power line communications]) remains, at this point, a target and not an accomplishment," the article concludes. In a separate development, Progress Energy, a power utility in North Carolina, has shown its willingness to work with amateurs to assess interference issues.

Also surfacing since the November editorial was put to bed was news from Corridor Systems of Santa Rosa, California, that it had successfully demonstrated 216 Mbps capacity by using a 1/4 mile segment of power line as a microwave transmission line. Members who recall the description of "G-line" single-wire UHF transmission line in 1960s ARRL publications will recognize the concept; Corridor's "E-line" is said to be a variation on the theme. In any case, as long as Corridor avoids using HF to link from the medium-voltage power line to individual customers, their system deserves to be distinguished from the spectrum polluters whose systems operate below 80 MHz.

On the other hand, distressing evidence that BPL is a growing problem worldwide news arrived from Zaragoza, Spain, where PLC (the European term for BPL) has been documented to be causing extremely serious interference. In-depth information in Spanish, including an 18 page technical report prepared by the Zaragoza branch of Unión de Radioaficionados Españoles, is available at **www.ure.es/plc/**. This and other reports put the lie to the oft-repeated but utterly false claim by BPL proponents that their technology "has not caused harmful interference." Why they persist in denying plain facts—and why they think they can get away with it—is one of the mysteries of the whole BPL scenario.

Apparently, we are about to see a similar situation arise in Manassas, Virginia, where a very small-scale pilot program is about to be extended to four subdivisions of 2100 residences. Fortunately, in this country the regulations are clear: BPL is not allowed to cause harmful interference to over-the-air radiocommunication services, including the amateur service. To quote from §15.5 of the FCC Rules, "The operator of a radio frequency device shall be required to cease operating the device upon notification by a Commission representative that the device is causing harmful interference. Operation shall not resume until the condition causing the harmful interference has been corrected." Manassas is just down the road from the FCC's Washington headquarters. We'll make sure that Commission enforcement personnel know what's going on in Manassas if we have to drive them there ourselves.

—*David Sumner, K1ZZ*

hy-gain HF BEAMS...

...are stronger, lighter, have less wind surface and last years longer.

Why? Hy-Gain uses durable *tooled* components -- massive boom-to-mast bracket, heavy gauge element-to-boom clamps, thick-wall swaged tubing -- virtually no failures!

TH-11DX, $1159.95. 11-element, 4.0 kW PEP, 10,12,15,17,20M

The choice of top DXers.

With 11-elements, excellent gain and 5-bands, the super rugged TH-11DX is *the "Big Daddy" of all HF beams!*

Handles 2000 Watts continuous, 4000 Watts PEP.

Every part is selected for durability and ruggedness for years of trouble-free service.

Features a low loss log-periodic driven array on all bands with monoband reflectors, BN-4000 high power balun, corrosion resistant wire boom support, hot dipped galvanized and stainless steel parts.

Stainless steel hardware and clamps are used on all electrical connections.

TH-7DX, $869.95. 7-element, 1.5 kW PEP, 10,15,20 Meters

7-Elements gives you the *highest average gain* of any Hy-Gain tri-bander!

Dual driven for broadband operation without compromising gain. SWR less than 2:1 on *all* bands.

Uniquely combining monoband and trapped parasitic elements give you an excellent F/B ratio.

Includes *Hy-Gain's* diecast aluminum, rugged boom-to-mast clamp, heavy gauge element-to-boom brackets, BN-86 balun. For high power, upgrade to BN-4000.

TH-5MK2, $759.95. 5-element, 1.5 kW PEP, 10,15,20 Meters

The broadband *five element* TH5-MK2 gives you outstanding gain.

Separate air dielectric *Hy-Q* traps let you adjust for maximum F/B ratio on each band.

Also standard is *Hy-Gain's* exclusive *BetaMATCH*™, stainless steel hardware and compression clamps and BN-86 balun.

TH-3MK4, $469.95. 3-element, 1.5 kW PEP, 10,15,20 Meters

The super popular TH-3MK4 gives you the *most gain for your money* in a full-power, full-size durable Hy-Gain tri-bander!

You get an impressive average gain and a whopping average front-to-back ratio. Handles a full 1500 Watts PEP. 95 MPH wind survival.

Fits on average size lot with room to spare -- turning radius is just 15.3 feet. Four piece boom is ideal for DXpeditions. Rotates with CD-45II or HAM-IV rotator.

Features *Hy-Gain BetaMatch*™ for DC ground, full power *Hy-Q*™ traps, rugged boom-to-mast bracket and mounts on standard 2"O.D. mast. Stainless steel hardware. BN-86 balun recommended.

TH-2MK3, $369.95. 2-element, 1.5 kW PEP, 10,15,20 Meters

The 2-element TH-2MK3 is Hy-Gain's *most economical* full power (1.5kW PEP) full size tri-bander.

For just $339.95 you can greatly increase your effective radiated power and hear far better!

Ruggedly constructed, top-performing, compact 6 foot boom, tight 14.3 foot turning radius. Installs almost anywhere. Rotate with CD-45II or HAM-IV. BN-86 balun recommened.

EXP-14, $599.95. 4-element, 1.5 kW PEP, 10,15,20 Meters

Revolutionary 4-element compact tri-bander *lets you add 40 or 30 Meters!* Has 14 foot boom and tight 17.25 feet turning radius. Fits on roof tri-pod, mast or medium duty tower.

Hy-Gain's *patented* broadbanding *Para Sleeve* gives you less than 2:1 VSWR. 1.5kW PEP.

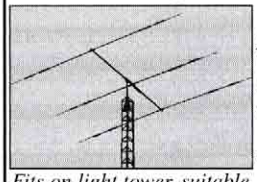
BetaMATCH™ provides DC ground to eliminate static. Includes BN-86 balun. Easily assembled.

Truly *competitive against giant tri-banders at half the cost!*

QK-710, $179.95. 30/40 Meter option kit for EXP-14.

Compact 3-element 10, 15, 20 Meter Tri-Bander

For limited space . . . Installs anywhere . . . 14.75 ft turning radius . . . weighs 21 lbs . . . Rotate with CD-45II, HAM-IV



Fits on light tower, suitable guyed TV pole, roof tri-pod

TH-3JRS, $359.95. Hy-Gain's *most popular* 3-element 10, 15, 20 Meter tri-bander fits on most lots! Same top performance as the full power TH3MK4 in a compact 600 watt PEP design.

Excellent gain and F/B ratio let *you* compete with the "big guns".

Tooled manufacturing gives you *Hy-Gain* durability with 80 MPH wind survival.

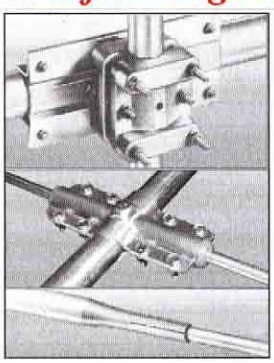
Model No.	No. of elements	avg Gain dBd	avg F/B dB	MaxPwr watts PEP	Bands Covered	Wind sq.ft. area	Wind (mph) Survival	Boom (feet)	Longest Elem. (ft)	Turning radius(ft)	Weight (lbs.)	Mast dia O.D.(in.)	Recom. Rotator	Retail Price
TH-11DX	11	*For Gain and F/B ratio--See...*		4000	10,12,15,17,20	12.5	100	24	37	22	88	1.9-2.5	T2X	$1159.95
TH-7DX	**7**			**1500**	**10, 15, 20**	**9.4**	**100**	**24**	**31**	**20**	**75**	**1.5-2.5**	**HAM-IV**	**$869.95**
TH-5MK2	5	• www.hy-gain.com		1500	10, 15, 20	7.4	100	19	31.5	18.42	57	1.5-2.5	HAM-IV	$759.95
TH-3MK4	**3**	• Hy-Gain catalog		**1500**	**10, 15, 20**	**4.6**	**95**	**14**	**27.42**	**15.33**	**35**	**1.9-2.5**	**CD-45II**	**$469.95**
TH-3JRS	3	• Call toll-free		600	10, 15, 20	3.35	80	12	27.25	14.75	21	1.25-2.0	CD-45II	$359.95
TH-2MK3	**2**	800-973-6572		**1500**	**10, 15, 20**	**3.25**	**80**	**6**	**27.3**	**14.25**	**20**	**1.9-2.5**	**CD-45II**	**$369.95**
EXP-14	4			1500	10,15,20 (opt. 30/40)	7.5	100	14	31.5	17.25	45	1.9-2.5	HAM IV	$599.95

Tooled Manufacturing . . . Highest Quality Materials

1. Hy-Gain's famous super strong *tooled* die cast *Boom-to-Mast Clamp*

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

3. Thick-wall *swaged* aluminum tubing



Tooled *manufacturing* is the difference between Hy-Gain antennas and the others -- they just don't have it (it's expensive!).

Die-cast aluminum boom-to-mast bracket and element-to-boom compression clamps are made with specially *tooled* machinery.

Hy-Gain antennas feature *tooled* swaged tubing that is easily and securedly clamped in place. All tubing is deburred and cleaned for smooth and easy assembly.

Durable precision injection molded parts.

Hy-Gain *antennas are stronger, lighter, have less wind surface area, better wind survival, need no adjustments, look professional and last years longer.*

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

Extremely Xcellent

MaXimize your enjoyment of the hobby with these great Xtras from Alinco!

DM-330 MVT
Communications Grade Switching Power Supply

This "breakthrough" switching power supply packs a lot of features into a compact, lightweight design that features 5 ~ 15 VDC variable output and delivers up to 30 amps continuous, 32 amps peak. Unlike some other "switchers" it's electrically quiet. But if you should find noise, the patented Noise Offset Circuit™ lets you move any noise you might find to another frequency. Other features include a large illuminated Volt/Amp meter, rear panel binding posts (32 A), front panel cigar outlet (10 A), two sets of snap-in terminals (5 A each), front panel voltage adjust, customer-defined output "memory", ripple less than 15mV p-p and triple circuit protection for short circuit, over temperature, and current limiting.

EDX-2 Automatic Wire Antenna Tuner

Tunes 160 ~ 10 meters (amateur bands) in seconds and mates with DX-70 or DX-77 HF transceivers. Can be mounted outdoors and used for base/mobile.

Add to the Xtreme enjoyment of your Alinco radio with these Xcessories!

ERW-4
Programming Cable for use with the software

EME-12
Headset with VOX

EDC-36
Cigar Plug Cable with filter

EMS-47
Mic for Handhelds

EMS-14
Desk Mic

ESC-36
Soft Case for DJ-196 series

EDH-29
Drycell for DJ-V5TH

EDC-91
Rapid Charger for DJ-V5TH

EJ-47U
Digital Board for DR-620

EJ-50U
TNC Board for DR-620

For these and many more Xciting Xtras from Alinco, call or stop by your local Alinco dealer or visit Alinco on the web!

www.ALINCO.com

ARRL in ACTION

***YOUR* membership at work**

By Dave Hassler, K7CCC, dhassler@arrl.org

South Carolina Section Links Up with Statewide Web Site

South Carolina Public Information Coordinator Dan Donovan, KF4VIS, has linked the ARRL South Carolina Section Web site to the South Carolina Information Highway site. "I found that it contained everything you wanted to know about people, groups and events in South Carolina," Donovan said. "Many students use the site when researching things in school." The South Carolina Section Web site was updated and expanded recently by Section Manager Jim Boehner, N2ZZ. Donovan contacted **www.sciway.net** and let them know about the South Carolina Section site. "[Their administrator] was impressed with the information about ham radio and our links, and she let me know that she included it in the index and was featuring it in her 'SC Web Site of the Day.'"

The South Carolina Section's Web site was recently honored as "Web Site of the Day" on the South Carolina Information Highway site, which is seen by thousands of South Carolinians daily.

Donovan told **sciway.net** about Amateur Radio's involvement in volunteer emergency communications and its statewide radio coverage, with over 50 2-meter repeaters and statewide HF nets. The South Carolina Section Web site (at **www.qsl.net/arrl-sc**) has section and Amateur Radio information, plus links to the state department of transportation, hurricane evacuation maps, the state emergency management division Web site and ham club sites.

ARRL NYC/LI "Tower Team" Succeeds at Variance Hearing

Who ya gonna call? Well, if it's a tower project in the New York/Long Island Section that's in a variance hearing, you call the "Tower Team," said ARRL NYC/LI Section Manager and State Government Liason George Tranos, N2GA.

On November 13, 2003, five hams from the NYC/LI Section testified at the variance hearing of Sal "Ted" Console, K2QMF, in the town of Riverhead, Long Island. Console moved to Riverhead from Queens last May and submitted plans for a 70 foot crank-up tower. Norm Wesler, K2YEW, a professional engineer and NLI Assistant Section Manager, testified on the need for the antenna height. Richard Knadle, K2RIW, a noted RF engineer specializing in microwave emissions, testified about RF emissions and safety. NYC/LI Technical Specialist Howard Liebman, W2QUV, testified about television and telephone interference. Tranos and Hudson Division Director Frank Fallon, N2FF, were on hand to testify about the value of Amateur Radio and the ARRL.

"The town board, in an unusual decision, decided to issue a variance that night and included Console's tower under the town's existing 50-foot Amateur Radio exemption. The town issued the variance with the proviso that the tower can only be cranked up above 50 feet for 1500 hours a year," Tranos said. "This is the latest in a long line of victories for this 'tower team.' They previously have testified at more than 10 successful variance hearings in Nassau and Suffolk counties on Long Island and elsewhere."

ARRL Staff, Volunteers Provide Information on BPL

♦ ARRL Media Relations Manager Jennifer Hagy, N1TDY, and ARRL Lab Manager Ed Hare, W1RFI, worked with a reporter from The Tampa (FL) *Tribune* for an upcoming story on the negative effects of broadband Internet delivery over power lines (BPL) on ham radio. In Oregon, Public Information Coordinator Everett Curry, W6ABM, helped Mark Perrin, N7MQ, with materials that resulted in getting his response to a recent BPL story printed in *The Register-Guard* (Eugene, OR) newspaper.

League Asks FCC for Migratory Bird Exemption

The ARRL asked the FCC to specifically exempt Amateur Radio antennas and support structures less than 400 feet tall from routine environmental processing relative to their impact on migratory birds. In reply comments filed December 1, 2003, the League said there is no scientific evidence that antenna structures below that height contribute significantly to migratory bird mortality. The League told the FCC that the migratory bird issue often arises at municipal land use hearings and in the drafting of ordinances regulating antenna structures.

Hobart Builds Ham Awareness at Citizen Corps Gathering

ARRL Chief Development Officer Mary Hobart, K1MMH, attended a national Citizen Corps Strategic Conference December 2-3, 2003 at the National Emergency Training Center in Emmitsburg, Maryland. The conference was held to assist in determining the strategic goals and direction of the USA Citizen Corps, of which ARRL is an affiliate. The League signed a *Statement of Affiliation* with USA Citizen Corps—funded through the Department of Homeland Security—at the 2003 ARRL National Convention in Dallas, Texas.

"Some attendees are aware of the role Amateur Radio plays in emergencies, agencies such as the Department of Justice, Volunteers in Police Service and the American Red Cross," Hobart said. "Other groups had no idea or had misperceptions regarding ham radio. It turned out to be a great opportunity to build awareness of Amateur Radio's capabilities in emergencies and provided a long term opportunity to raise the visibility of Amateur Radio as part of Citizen Corps."

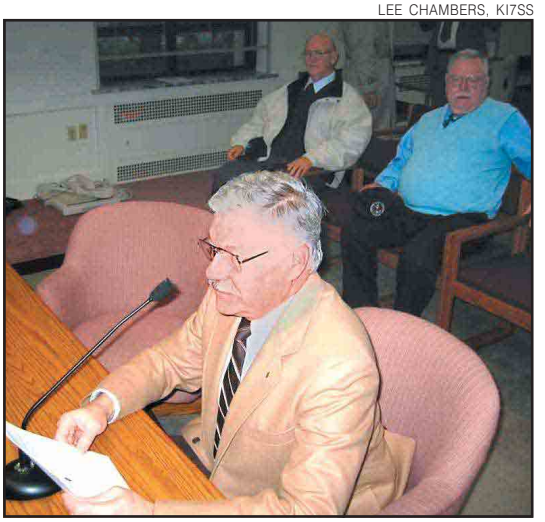
RICK LINDQUIST, N1RL

ARRL Chief Development Officer Mary Hobart, K1MMH.

ARRL Western Washington SM Testifies before State Senate Committee

A single phone call started the ball rolling, and that ball ended up scoring on a nice play for Amateur Radio. ARRL Western Washington Section Manager Ed Bruette, N7NVP, testified December 9, 2003 before the Washington State Senate Technology and Communications Committee during an informational inquiry on broadband Internet delivery over power lines (BPL). He was invited by the committee to testify after a senior staffer received an inquiry from Gloria Sharp, WA7GYD, of Ellensburg, asking if Amateur Radio was going to be represented at the hearing. Bruette was given the opportunity to make a 15 minute presentation.

LEE CHAMBERS, KI7SS



Western Washington Section Manager Ed Bruette, N7NVP, makes a BPL presentation to the Washington State Senate Technology and Communications committee, as Dan Crane, KB7DFL, and Bob Goodnow, N7JHJ, listen.

After two industry representatives spoke, Bruette was up. "My presentation outlined the Part 15 device limitations, the interference issues both to and from Amateur Radio, BPL trials in Europe and Japan, and the other users of the HF and VHF spectrum who will be impacted by interference from BPL," he said. "I included the first 37 seconds of the BPL video made by ARRL Lab Manager Ed Hare, W1RFI, along with an NTIA spectrum allocation chart that I modified to show the potential loss of spectrum. The...feedback I got from the committee was positive, as was the feedback from the four hams in the audience."

Bruette said he was surprised to hear an industry representative say that power lines are antennas; equally—and pleasantly—surprising was an admission by the Chelan County Public Utility District that they have gotten letters from local hams.

Persistence Pays for Louisiana Club Coordinator

New ARRL Louisiana Affiliated Club Coordinator Ray Husher, W5EW, jumped into his new Field Organization appointment last summer with gusto, helping to boost active club affiliation in the Pelican State by 50%. In July 2003, the Louisiana section had 22 active, 31 inactive and 7 special service clubs; in 6 months the numbers grew to 33 active, 20 inactive and 10 special service clubs. The change was the result of research and persistence.

In addition to setting a goal of either he or Section Manager Mickey Cox, K5MC, visiting every club in the state at least once a year, Husher secured the ARRL club list and printed a list of the active and inactive clubs in his section. "I then began contacting the inactive clubs and assisting them in updating their records, with a lot of help from Linda Mullally, KB1HSV, and Marjorie Bourgoin, KB1DCO, at ARRL Headquarters," he said. "I used a lot of e-mail and a lot of phone time. I planned calls to be around 9 PM or a few minutes after, as most people are at home by that time."

When Husher visits a club, he said he always asks for information on surrounding clubs that may be inactive. "Likewise, when I go to a hamfest, I take a moment to speak and seek assistance from those present. In short, I do not hesitate to ask any person for help in finding persons associated with old clubs," he said. "I don't hesitate to ask for applications, either, be it for a regular affiliation or Special Service Club or for an individual new ARRL member."

Amateur Radio Today CD Finds New Outlets

♦ ARRL's *Amateur Radio Today* video presentation—featuring former CBS News anchor Walter Cronkite, KB2GSD—took a new road to reach the public in November 2003 with the mailing of the CD-ROM to the League's advertisers and publications dealers. ARRL Marketing Manager Bob Inderbitzen, NQ1R, said the recipients of the video were encouraged to share the CD-ROM with associates and customers, with some taking the video along to support speaking engagements at schools and local community groups.

The *Amateur Radio Today* video was produced for nonhams and those volunteers seeking a handy presentation to use at civic club meetings. Highlights of the video include Amateur Radio's response to the events of September 11, 2001, ham radio's efforts during the wildfires in the Western US during 2002 and space-based Amateur Radio educational initiatives.

ARRL Section Volunteers Report Recruitment Success

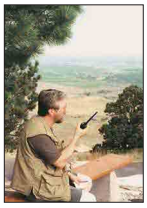
At the Fox Cities Amateur Radio Club hamfest in Appleton, Wisconsin this past fall, Wisconsin Section Manager Don Michalski, W9IXG, set up a display and with the help of John Ensley, N9RJZ, the effort resulted in 18 new or renewed ARRL memberships. Out in San Francisco, Section Manager Bill Hillendahl, KH6GJV, handled a stack of League membership signups during the Willits Amateur Radio Society's October meeting.

ARRL Outgoing QSL Service Shipped 1.27 Million Cards in '03

The activity wasn't as hot this past year as it was in 2001 and 2002, yet the ARRL Outgoing QSL Service still sent out over 1.2 million domestic QSL cards to incoming bureaus around the world. As of December 16, 2003, ARRL QSL Service Manager Martin Cook, N1FOC, said his office had shipped out 1,273,775 member cards. That's down some from the 2002 total of 1,963,165 cards, which Cook attributed to waning propagation as the current solar cycle winds down. "Band conditions this summer were terrible on HF, and it seems that we're losing a little QSLing to Logbook of The World," he commented.

Guide to ARRL Member Services

ARRL, 225 Main Street, Newington, CT 06111-1494



www.arrl.org/services.html/ **860-594-0200**

Technical and Regulatory Information Services

A wealth of problem-solving information is available to you on the ARRLWeb at **www.arrl.org/tis/**. Can't find the answer there? Call the Technical Information Service at 860-594-0214 from 9 AM to 4 PM Eastern Time, or e-mail **tis@arrl.org**.

Do you have a question about FCC Rules or local antenna restrictions? See the Regulatory Information Branch on the Web, call 860-594-0236 or e-mail **reginfo@arrl.org**.

ARRLWeb www.arrl.org

Log on for news, information and ARRL services. Members have access to special ARRL Web site features. Place free classified ads. Download and view *QST* product reviews and search the on-line periodicals index.

ARRL E-mail Forwarding

Life in cyberspace is easier when you have your own **arrl.net** e-mail address. When you switch Internet Service Providers, all you have to do is let us know and we'll change your e-mail forwarding automatically. You're spared the hassle of having to tell everyone that you've changed addresses! Sign up on the Web at **www.arrl.org/members-only/emailfwd.html**.

ARRL News

The ARRL News service is the most credible source of news for the amateur community. Breaking stories are available on the ARRLWeb. You can also listen to ARRL Audio News on the Web, or by telephone at 860-594-0384. Have a news tip? E-mail **n1rl@arrl.org**.

QSL Service

The most economical way to send and receive QSL cards throughout the world is through the ARRL QSL Service.

Educational Materials

A complete line of educational materials are available to schools, clubs and individuals.

Books, Software and Operating Resources

You can rely on ARRL for the very best publications and products: license manuals, circuit design and project resources, antenna construction ideas, and more. Shop online or locate a dealer near you at **www.arrl.org/shop**. What's the secret for making great publications even better?**—We listen to you!** E-mail your publications feedback, suggestions and product ideas to **pubsfdbk@arrl.org**.

Insurance

The ARRL "All Risk" Ham Radio Equipment Insurance Plan provides protection from loss or damage to your amateur station and mobile equipment by theft, accident, fire, flood, tornado, and other natural disasters. Antennas rotators and towers can be insured too. Call 860-594-0211.

DXCC/VUCC

The DX Century Club and VHF/UHF Century Club award programs are among the most popular Amateur Radio awards in the world.

Volunteer Examiner Coordinator (VEC)

Are you looking for a place to take your license exam? Do you have questions about the examination process? The ARRL VEC network is the largest in the nation.

Trust in Advertising

ARRL's advertising acceptance process is a unique and respected service provided to both members and advertisers. The ARRL Lab regularly evaluates products for acceptable construction quality, safety, compliance with FCC requirements and performance claims. Members rely on *QST* and other ARRL publications to locate reputable suppliers of Amateur Radio equipment and services.

ARRL Foundation

This is your source for scholarships and other financial grant programs to support Amateur Radio. See **www.arrl.org/arrlf/** on the Web or call 860-594-0230.

Write for *QST*

We're always looking for articles of interest to amateurs. See our Author's Guide at **www.arrl.org/qst/aguide/**. If you have questions, or wish to submit an article for consideration, send an e-mail to **qst@arrl.org** or simply mail your article to *QST* c/o ARRL Hq.

Interested in Becoming a Ham?

Phone toll free 1-800-326-3942, or e-mail **newham@arrl.org**. We'll provide helpful advice on obtaining an Amateur Radio license. See **www.arrl.org/hamradio.html**.

We're at *your* Service

ARRL Headquarters is open from 8 AM to 5 PM Eastern Time, Monday through Friday, except holidays. Call **toll free** to join the ARRL or order ARRL products: **1-888-277-5289** (US), Monday-Friday only, 8 AM to 8 PM Eastern Time. From outside the US, call 860-594-0355. The fax number is 860-594-0303 (24 hours a day, 7 days a week).

If you're in Connecticut, stop by ARRL Headquarters for a visit and tour. Located at 225 Main St, Newington, CT 06111, HQ offers tours at 9, 10 and 11 AM, and 1, 2 and 3 PM Monday through Friday, except holidays. Bring your license and operate W1AW anytime between 10 AM and noon, and 1 to 3:45 PM.

If you have a question, try one of these ARRL Headquarters departments . . .

	Contact	*Telephone*	*Electronic Mail*
Joining ARRL	Membership Desk	860-594-0338	**membership@arrl.org**
***QST* Delivery**	Circulation Desk	860-594-0338	**circulation@arrl.org**
Permission Requests	Maty Weinberg	860-594-0229	**permission@arrl.org**
Publication Orders	Sales Desk	860-594-0355	**pubsales@arrl.org**
Amateur Radio News	Rick Lindquist	860-594-0222	**n1rl@arrl.org**
Regulatory Info	John Hennessee	860-594-0236	**reginfo@arrl.org**
Exams	VEC	860-594-0300	**vec@arrl.org**
Educational Materials	Educational Services	860-594-0267	**ead@arrl.org**
CCE/EmComm Courses	Dan Miller	860-594-0340	**dmiller@arrl.org**
Contests	Dan Henderson	860-594-0232	**contests@arrl.org**
Technical Questions	ARRL Lab	860-594-0214	**tis@arrl.org**
DXCC	Bill Moore	860-594-0234	**dxcc@arrl.org**
Awards/VUCC	Eileen Sapko	860-594-0288	**awards@arrl.org**
Development Office	Mary Hobart	860-594-0397	**mhobart@arrl.org**
Advertising	Advertising Desk	860-594-0207	**ads@arrl.org**
Media Relations	Jennifer Hagy	860-594-0328	**newsmedia@arrl.org**
QSL Service	Martin Cook	860-594-0274	**buro@arrl.org**
Scholarships	Mary Lau	860-594-0230	**foundation@arrl.org**
Emergency Comm	Steve Ewald	860-594-0265	**emergency@arrl.org**
Clubs	Field Services	860-594-0267	**clubs@arrl.org**
Hamfests	Gail Iannone	860-594-0262	**hamfests@arrl.org**
Write for QST	Joel Kleinman	860-594-0273	**qst@arrl.org**

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 mail to Martin Cook, QSL Service Manager, use **n1foc@arrl.org** or **mcook@arrl.org**. If all else fails, send a message to **hq@arrl.org** and it will get routed to the right person or department.

ARRL Division Directors

As an ARRL member, you elect the directors and vice directors 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.

Atlantic Division

BERNIE FULLER, N3EFN*
17668 Price Rd, Saegertown, PA 16433
(814-763-1529); **n3efn@arrl.org**

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

Central Division

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

Vice Director: Howard S. Huntington, K9KM
25350 N Marilyn Ln, Hawthorn Woods, IL 60047
(847-438-3452); **k9km@arrl.org**

Dakota Division

JAY BELLOWS, KØQB
997 Portland Ave, St Paul, MN 55104
(651-238-4444); **k0qb@arrl.org**

Vice Director: Twila Greenheck, NØJPH
3333 Owasso Heights Rd, Shoreview, MN 55126
(651-483-1214); **n0jph@arrl.org**

Delta Division

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

Vice Director: Henry R. Leggette, WD4Q
7335 Ginger Snap Cove, Memphis, TN
38125-4732 (901-757-0444); **wd4q@arrl.org**

Great Lakes Division

JIM WEAVER, K8JE
5065 Bethany Rd, Mason, OH 45040-9660
(513-459-0142); **k8je@arrl.org**

Vice Director: Richard Mondro, W8FQT
800 Dover St, Dearborn Heights, MI 48127
(313-730-2111); **w8fqt@arrl.org**

Hudson Division

FRANK FALLON, N2FF
30 E Williston Ave, East Williston, NY 11596
(516-746-7652); **n2ff@arrl.org**

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

Midwest Division

WADE WALSTROM, WØEJ
7431 Macon Dr, Cedar Rapids, IA 52411
(319-393-8982); **w0ej@arrl.org**

Vice Director: Bruce Frahm, KØBJ
PO Box DX, Colby, KS 67701
(785-462-7388); **k0bj@arrl.org**

New England Division

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

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

Northwestern Division

GREG MILNES, W7OZ
740 SE 24th Ave, Hillsboro, OR 97123-7286
(503-648-6990); **w7oz@arrl.org**

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

Pacific Division

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

Vice Director: Andy Oppel, N6AJO,
1308 Burbank St, Alameda, CA 94501-3946
(510-864-2299); **n6ajo@arrl.org**

Roanoke Division

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

Vice Director: Rev Leslie Shattuck, K4NK
218 Marion Ave, Anderson, SC 29624
(864-296-0916); **k4nk@arrl.org**

Rocky Mountain Division

WALT STINSON, WØCP
5295 E Evans Ave, Denver, CO 80222-5221
(303-770-3926); **w0cp@arrl.org**

Vice Director: Warren G. "Rev" Morton, WS7W
1341 Trojan Dr, Casper, WY 82609
(307-235-2799); **ws7w@arrl.org**

Southeastern Division

FRANK M. BUTLER JR, W4RH
323 Elliott Rd SE, Ft Walton Beach, FL 32548
(850-244-5425); **w4rh@arrl.org**

Vice Director: Sandy Donahue, W4RU
222 Briarhill Ln, Atlanta, GA 30324
(404-315-1443); **w4ru@arrl.org**

Southwestern Division

ART GODDARD, W6XD
2901 Palau Pl, Costa Mesa, CA 92626
(714-556-4396); **w6xd@arrl.org**

Vice Director: Tuck Miller, NZ6T
3122 E 2nd St, National City, CA 91950
(619-434-4211); **nz6t@arrl.org**

West Gulf Division

COY C. DAY, N5OK
RR 1, Box 254, Union City, OK 73090-9726
(405-483-5632); **n5ok@arrl.org**

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

*Executive Committee member

ARRL Section Managers

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: Randall K. Carlson, WB0JJX, 121 Scarborough Park Dr, No. 10, Wilmington, DE 19804 (302-655-6179); **wb0jjx@arrl.org**
Eastern Pennsylvania: Eric Olena, WB3FPL, 284 Blimline Rd, Mohnton, PA 19540 (610-775-0526); **wb3fpl@arrl.org**
Maryland-DC: Tom Abernethy, W3TOM, PO Box 73, Accokeek, MD 20607 (301-292-6263); **w3tom@arrl.org**
Northern New York: Thomas Dick, KF2GC, 4 Jenkins St, Saranac Lake, NY 12983 (518-891-0508); **kf2gc@arrl.org**
Southern New Jersey: Jean Priestley, KA2YKN, 7158 Chandler Ave, Pennsauken, NJ 08110 (856-662-3587); **ka2ykn@arrl.org**
Western New York: Scott Bauer, W2LC, 1964 Connors Rd, Baldwinsville, NY 13027 (315-638-7551); **w2lc@arrl.org**
Western Pennsylvania: Rich Beaver, N3SRJ, 4A Cardinal Dr, Jeannette, PA 15644 (724-523-5656); **n3srj@arrl.org**

Central Division (IL, IN, WI)

Illinois: Sharon Harlan, N9SH, 5931 Alma Dr, Rockford, IL 61108 (815-398-2683); **n9sh@arrl.org**
Indiana: James S. Sellers, K9ZBM, 54676 County Road 8, Middlebury, IN 46540-8710 (574-825-5425); **k9zbm@arrl.org**
Wisconsin: Donald Michalski, W9IXG, 4214 Mohawk Dr, Madison, WI 53711 (608-274-1886); **w9ixg@arrl.org**

Dakota Division (MN, ND, SD)

Minnesota: Randy "Max" Wendel, KM0D, 8539 Bryant Ave S, Bloomington, MN 55420-2147 (952-888-5953); **km0d@arrl.org**
North Dakota: Kent Olson, KA0LDG, 7702 Forest River Rd, Fargo, ND 58104-8004 (701-298-0956); **ka0ldg@arrl.org**
South Dakota: Richard L. Beebe, N0PV, 913 S Gordon Dr, Sioux Falls, SD 57110-3151 (605-332-1434); **n0pv@arrl.org**

Delta Division (AR, LA, MS, TN)

Arkansas: Dennis Schaefer, W5RZ, 181 Schaefer Dr, Dover, AR 72837-7923 (479-967-4372); **w5rz@arrl.org**
Louisiana: Mickey Cox, K5MC, 754 Cheniere-Drew Rd, West Monroe, LA 71291 (318-397-1980); **k5mc@arrl.org**
Mississippi: Malcolm Keown, W5XX, 14 Lake Circle Dr, Vicksburg, MS 39180 (601-636-0827); **w5xx@arrl.org**
Tennessee: Larry W. Marshall, WB4NCW, 11 Hovis Bend Rd, Fayetteville, TN 37334 (931-433-5088); **wb4ncw@arrl.org**

Great Lakes Division (KY, MI, OH)

Kentucky: John D. Meyers, NB4K, 218 Cory Ln, Butler, KY 41006-9740 (859-472-6690); **nb4k@arrl.org**
Michigan: Dale Williams, WA8EFK, 291 Outer Drive, Dundee, MI 48131 (734-529-3232); **wa8efk@arrl.org**
Ohio: Joe Phillips, K8QOE, 2800 Jupiter Dr, Fairfield, OH 45014-5022 (513-874-0006); **k8qoe@arrl.org**

Hudson Division (ENY, NLI, NNJ)

Eastern New York: Pete Cecere, N2YJZ, 378 Ohayo Mtn Rd, Woodstock, NY 12498 (845-679-9846); **n2yjz@arrl.org**
NYC-Long Island: George Tranos, N2GA, PO Box 296, Bellport, NY 11713 (631-286-7562); **n2ga@arrl.org**
Northern New Jersey: William Hudzik, W2UDT, 111 Preston Dr, Gillette, NJ 07933 (908-580-0493); **w2udt@arrl.org**

Midwest Division (IA, KS, MO, NE)

Iowa: Jim Lasley, N0JL, PO Box 5, Chillicothe, IA 52548 (641-935-4337); **n0jl@arrl.org**
Kansas: Ronald D. Cowan, KB0DTI, PO Box 36, LaCygne, KS 66040 (913-757-4455); **kb0dti@arrl.org**
Missouri: Dale C. Bagley, K0KY, PO Box 13, Macon, MO 63552-1822 (660-385-3629); **k0ky@arrl.org**
Nebraska: Bill McCollum, KE0XQ, 1314 Deer Park Blvd, Omaha, NE 68108 (402-734-3316); **ke0xq@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: Phil Temples, K9HI, Apt 803, 125 Coolidge Ave, Watertown, MA 02472-2875 (617-331-0183); **k9hi@arrl.org**
Maine: William Woodhead, N1KAT, 68 Madison St, Auburn, ME 04210 (207-782-4862); **n1kat@arrl.org**
New Hampshire: Al Shuman, N1FIK, PO Box 119, Goffstown, NH 03045-0119 (603-487-3333); **n1fik@nhradio.org**
Rhode Island: Bob Beaudet, W1YRC, 30 Rocky Crest Rd, Cumberland, RI 02864 (401-333-2129); **w1yrc@arrl.org**
Vermont: Paul N. Gayet, AA1SU, 124 Macrae Rd, Colchester, VT 05446 (802-860-1134); **aa1su@arrl.org**
Western Massachusetts: William Voedisch, W1UD, 240 Main St, Leominster, MA 01453 (978-537-2502); **w1ud@arrl.org**

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

Alaska: David Stevens, KL7EB, PO Box 113242, Anchorage, AK 99511 (907-345-6506); **kl7eb@arrl.org**
Eastern Washington: Mark Tharp, KB7HDX, PO Box 2222, Yakima, WA 98907-2222 (509-965-3379); **kb7hdx@arrl.org**
Idaho: Doug Rich, W7DVR, 2025 Regal Dr, Boise, ID 83704-7153 (208-376-7651); **w7dvr@arrl.org**
Montana: Doug Dunn, K7YD, 216 Fiddle Creek Rd, Livingston, MT 59047-4116 (406-686-9100); **k7yd@arrl.org**
Oregon: Randy Stimson, KZ7T, PO Box 1302, Beaverton, OR 97075-1302 (503-641-3776); **kz7t@arrl.org**
Western Washington: Edward W. Bruette, N7NVP, 305 NW Paulson Rd, Poulsbo, WA 98370-8112 (360-698-0917); **n7nvp@arrl.org**

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

East Bay: Ti-Michelle Connelly, NJ6T, 14490 Hemlock St, San Leandro, CA 94579 (510-483-6079); **nj6t@arrl.org**
Nevada: Dick Flanagan, K7VC, 2851 Esaw St, Minden, NV 89423 (775-267-4900); **k7vc@arrl.org**
Pacific: Bob Schneider, AH6J, PO Box 131, Keaau, HI 96749 (808-966-8146); **ah6j@arrl.org**
Sacramento Valley: Jettie Hill, W6RFF, 306 Saint Charles Ct, Roseville, CA 95661-5008 (916-783-0383); **w6rff@arrl.org**
San Francisco: Bill Hillendahl, KH6GJV, PO Box 4151, Santa Rosa, CA 95402-4151 (707-544-4944); **kh6gjv@arrl.org**
San Joaquin Valley: Charles P. McConnell, W6DPD, 1658 W Mesa Ave, Fresno, CA 93711-1944 (559-431-2038); **w6dpd@arrl.org**
Santa Clara Valley: Glenn Thomas, WB6W, 502 Walnut Dr, Milpitas, CA 95035-4133 (408-263-9450); **wb6w@arrl.org**

Roanoke Division (NC, SC, VA, WVA)

North Carolina: John Covington, W4CC, PO Box 1604, Belmont, NC 28012 (704-577-9405); **w4cc@arrl.org**
South Carolina: James F. Boehner, N2ZZ, 525 Barnwell Ave NW, Aiken, SC 29801-3939 (803-641-9140); **n2zz@arrl.org**
Virginia: Carl Clements, W4CAC, 4405 Wake Forest Rd, Portsmouth, VA 23703 (757-484-0569); **w4cac@arrl.org**
West Virginia: Hal L. Turley, KC8FS, 6 Ives Dr, Huntington, WV 25705 (304-736-2790); **kc8fs@arrl.org**

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

Colorado: Jeff Ryan, K0RM, 6721 Northface Ln, Colorado Springs, CO 80919-1508 (719-260-6826); **k0rm@arrl.org**
New Mexico: Bill Weatherford, KM5FT, 540 Mesilla NE, Albuquerque, NM 87108 (505-254-2299); **km5ft@arrl.org**
Utah: Mel Parkes, AC7CP, 2166 E 2100 North, Layton, UT 84040 (801-547-1753); **ac7cp@arrl.org**
Wyoming: Jay Ostrem, W7CW, PO Box 1993, Gillette, WY 82717-1993 (307-682-7839); **w7cw@arrl.org**

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

Alabama: Greg Sarratt, W4OZK, 912 Pine Grove Rd, Harvest, AL 35749 (256-337-3636); **w4ozk@arrl.org**
Georgia: Susan Swiderski, AF4FO, 772 Camelot Way, Norcross, GA 30071 (770-449-0369); **af4fo@arrl.org**
Northern Florida: Rudy Hubbard, WA4PUP, PO Box 843, Milton, FL 32572-0843 (850-626-0620); **wa4pup@arrl.org**
Puerto Rico: Victor Madera, KP4PQ, PO Box 191917, San Juan, PR 00919-1917 (787-789-4998); **kp4pq@arrl.org**
Southern Florida: Sharon T. "Sherri" Brower, W4STB, 736 34th Ter, Vero Beach, FL 32968-1226 (772-562-3240); **w4stb@arrl.org**
Virgin Islands: John Ellis, NP2B, PO Box 24492, Christiansted, St Croix, VI 00824 (340-773-9643); **np2b@arrl.org**
West Central Florida: Dave Armbrust, AE4MR, 3024 Salem Ave, Sarasota, FL 34232 (941-685-2081); **ae4mr@arrl.org**

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

Arizona: Clifford Hauser, KD6XH, 8741 N Hollybrook Ave, Tucson, AZ 85742 (520-744-9095); **kd6xh@arrl.org**
Los Angeles: Phineas J. Icenbice Jr, W6BF, 19323 Halsted St, Northridge, CA 91324 (818-349-3186); **w6bf@arrl.org**
Orange: Carl Gardenias, WU6D, 1873 Dundee Ave, Highland, CA 92346-2452 (909-862-0720); **wu6d@arrl.org**
San Diego: Kent Tiburski, K6FQ, 1405 Greenbay St, San Diego, CA 92154 (619-575-1964); **k6fq@arrl.org**
Santa Barbara: Robert Griffin, K6YR, 1436 Johnson Ave, San Luis Obispo, CA 93401-3734 (805-543-3346); **k6yr@arrl.org**

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

North Texas: Roy Rabey, AD5KZ, 600 Morning Glory Ln, Bedford, TX 76021-2207 (214-507-4450); **ad5kz@arrl.org**
Oklahoma: John Thomason, WB5SYT, 1517 Oak Dr, Edmond, OK 73034-7408 (405-844-1800); **wb5syt@arrl.org**
South Texas: E. Ray Taylor, N5NAV, 688 Comal Ave, New Braunfels, TX 78130 (830-625-1683); **n5nav@arrl.org**
West Texas: John C. Dyer, AE5B, 9124 CR 301, Cisco, TX 76437-9525 (254-442-4936); **ae5b@arrl.org**

AMERITRON . . . 800 Watts . . . $799!

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

AL-811H
$799
Suggested Retail
4-Tubes, 800 Watts

AL-811
$649
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, $649. Like AL-811H, but has three 811A tubes and 600 Watts output.

AMERITRON *no tune* Solid State Amplifiers

ALS-500M 500 Watt Mobile Amp

AL-500M
$799
Suggested Retail

500 Watts PEP/400W CW output, 1.5-22 MHz, instant bandswitching, no tuning, no warm-up. SWR, load fault, thermal overload protected. On/Off/Bypass switch. Remote on/off control. DC current meter. Extremely quiet, fan off until needed. Uses 13.8 VDC. Compact 9Wx3½Hx15D in., 7 lbs.

ALS-600 Station 600 Watt FET Amp

AL-600
$1299
Suggested Retail

***No tuning**, no fuss, no worries -- just turn on and operate.* 600 Watts PEP/500W CW, 1.5-22 MHz, instant bandswitching, SWR protected, extremely quiet, lighted Cross-Needle SWR/ Wattmeter, front panel ALC control. 120 or 220 VAC. Inrush protected. 9½Wx6Hx12D in.

AL-80B . . . *Desktop Kilowatt* 3-500G Amp

AL-80B
$1349
Suggested Retail

AL-80B kilowatt output *desktop* linear amplifier doubles your average SSB power output with high level RF processing using our exclusive *Dynamic ALC*™!

You get cooler operation because the AL-80B's exclusive *Instantaneous RF Bias*™ completely turns off the 3-500G tube between words and dots and dashes. Saves hundreds of watts wasted as heat for cooler operation and longer component life.

You get a full kilowatt PEP output from a whisper quiet desktop linear. Compact 15½Wx8½Hx14D inches. Plugs into your nearest 120 VAC outlet. Covers 160 to 15 Meters, including WARC and MARS (user modified for 10/12 Meters w/license).

You get 850 Watts output on CW, 500 Watts output on RTTY, an extra heavy duty power supply, genuine 3-500G tube, nearly 70% efficiency, tuned input, Pi/Pi-L output, inrush current protection, multi-voltage transformer, dual Cross-Needle meters, QSK compatability, two-year warranty, plus much, much more! Made in U.S.A.

Near Legal Limit ™ Amplifier

AL-572
$1445
Suggested Retail

New class of *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.

HF Amps with Eimac *3CX800A7*

AL-800
$1825
Suggested Retail
1 tube, 1250 W

AL-800H
$2695
Suggested Retail
2 tubes, 1.5 kW *Plus*

These HF linears with *Eimac*® 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. grain oriented silicone steel core transformer, high capacitance computer grade filter capacitors. Multi-voltage operation, dual lighted cross-needle meters.

AMERITRON *full legal limit* amplifiers

AMERITRON legal limit amps use a super heavy duty Peter Dahl Hypersil® power transformer capable of 2.5 kW!

Most powerful / *3CX1500/8877*

AL-1500
$3045
Suggested Retail

Ameritron's *most powerful* amplifier uses the herculean *Eimac*® 3CX1500/8877 ceramic tube. It's so powerful that 65 watts drive gives you full legal output -- and it's just loafing because the power supply is capable of 2500 Watts PEP.

Toughest / *3CX1200A7*

AL-1200
$2645
Suggested Retail

Get ham radio's *toughest* tube with the Ameritron AL-1200 -- the *Eimac*® 3CX1200A7. 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
$2545
Suggested Retail

This linear gives you full legal output using a *pair* of *Amperex*® 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: 800-713-3550

Ameritron brings you the finest high power accessories!

ARB-704 amp-to-rig interface. . . $49.95

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

RCS-4 Remote Coax Switch . . . $139

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. . . $149

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. . . $159

Replace **8** coax with 1! SWR<1.3 to 60 MHz. **RCS-10L, $199.95** with lightning arrestors.

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
http://www.ameritron.com

R&L Electronics

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

MFJ

Call, write, or email for a FREE catalog
Send $2 for Express service

Popular MFJ Tuners

MFJ901B	*200 watt tuner*	**67.95**
MFJ945E	*300w tnr w/mtr*	**89.95**
MFJ948	*300w tnr w/mtr,sw*	**109.95**
MFJ949E	*300w tnr w/mtr,sw*	**129.95**
MFJ969	*6-160m tnr 300w*	**168.95**
MFJ986	*3kW DEF-ROL tnr*	**269.95**

We carry most all Ameritron, Hygain, MFJ, Mirage, and Vectronics products. Please don't hesitate to call!

MFJ-989C

Legal Limit Antenna Tuner w/Dummy Load

MFJ uses super heavy duty components -- roller inductor, variable capacitors, antenna switch and balun -- to build the world's most popular high power antenna tuner. The rugged world famous MFJ-989C handles 3 KW PEP SSB amplifier input power (1500 watts PEP SSB output power). Covers 1.8 to 30 MHz, including MARS and WARC bands.

$269.95

Special price good through 2/15/04 or until stock is depleted, Limit 2

MFJ259B
1.8-170Mhz SWR Analyzer (Pictured)
219.95

MFJ269
1.8-170, 415-470Mhz SWR Analyzer
295.95

YAESU

Choice of the World's top DX'ers℠

FT857.....Call

DSP2	*DSP Unit*	**64.95**
TCXO9	*TCXO Unit*	**89.95**
YF122C	*Collins 500hz CW filter*	**154.95**
YF122CN	*Collins 300hz CW filter*	**154.95**
YF122S	*Collins 2.3khz SSB filter*	**156.95**
YSK857	*Separation Kit*	**51.95**

VXA700

Air Band Operation, VOR Navigation and Amateur Radio Communications, All In One!

Yes, this radio will transmit AM in the air band and FM in the 2m band! 5 watts of TX power, FM radio broadcast band receive (88-108Mhz), 190 memory channels, Submersible, Back-lit keypad and display w/dimmer, One touch emergency frequency (121.5 Mhz band), RX battery saver, CTCSS and DCS operation (amateur band only), NOAA weather channel receive, NOAA weather alert

VX7R/B .....Call

SMABNC	*BNC to SMA Adapter*	**3.50**
CD15A	*Desktop Rapid Charger*	**29.95**
CMP460A	*Waterproof Speaker/Mic*	**48.95**
CSC88	*Soft Case*	**14.95**
CT91	*Microphone Adapter*	**9.95**
EDC5B	*DC Cable w/Cigarette Plug*	**23.95**
EDC6	*DC Cable*	**7.95**
FBA23	*AA Cell Battery Case*	**27.95**
FNB80LI	*Lithium Ion Battery*	**59.95**
MH57A4B	*Speaker Mic*	**27.95**
SU1	*Barometric*	**33.95**
VC27	*Earpiece Microphone*	**27.95**

FT8900R.....Call

MEK2	*Mic Extension Kit*	**38.95**
MLS100	*High Power External Speaker*	**43.95**
MMB60	*Quick Release Mobile Mount*	**27.95**
YSK8900	*Separation Kit*	**62.95**

Yaesu Closeout Items

CSC62	*Soft Case for 11/41 w/FNB31*	**4.95**
CT30	*Mic "Y" Connector for 10/40/50*	**7.95**
FBA17	*AA Holder 23/411/470*	**17.95**
FNB31	*4.8v 600mah battery for 11/41/51*	**25.95**
FNB38	*9.6v 600mah battery for 11/41/51*	**29.95**
MH36A6J	*Replacement Mic FT3000M*	**39.95**
RH1	*Rubber Protector for 10/50*	**4.95**
XF117CN	*300hz CW filter for FT100*	**69.95**

Prices are subject to change without notice.
Not responsible for typographical errors.

Get out of the Traffic-Jam!

TS-480HX 200W (100W 50-54MHz) **TS-480SAT** 100W with built-in tuner

▮ All Amateur bands 1.8 to 54mHz ▮ Continuous RX from 500kHz to 54mHz ▮ Quad-mixer provides RX dynamic range equal to that of the TS-950 class ▮ Separate control panel with speaker ▮ PSK-31 friendly ▮ Optional software enables PC control as well as VoIP (voice over internet protocol) with Kenwood Network Command System for remote control via a LAN or Internet ▮ Forms a system with the TM-D700AG version 2.0 (option) allows cross-band /cross mode repeater operation, from VHF/UHF to HF. As well as DX Packet Cluster Tune ▮ AF Digital Signal Processing offers many powerful features: Digital noise limiter (DNL) / Beat cancel / Noise reduction / TX\RX equalizer / AF filters / TX passband filter / Speech processor & CW auto tune.

TS-480HX/SAT

KENWOOD
COMMUNICATIONS

KENWOOD U.S.A. CORPORATION
Communications Division
Division Headquarters
3975 Johns Creek Court, Suwanee, GA 30024-1265
Customer Support/Distribution
P.O. Box 22745, 2201 East Dominguez St., Long Beach, CA 90801-5745
Customer Support: (310) 639-4200 Fax: (310) 537-8235
KENWOOD ELECTRONICS CANADA INC.
Canadian Headquarters and Distribution
6070 Kestral Road, Mississauga, Ontario, Canada L5T 1S8

INTERNET
Kenwood News & Products
http://www.kenwood.net
#101903

JQA-1205 091-A
ISO9001 Registered
Communications Equipment Division
Kenwood Corporation
ISO9001 certification

K3UG Celebrates his 50th at W1AW

By David Collingham, K3LP

As a good friend, Barry Thaysen, K3UG, was about to celebrate his 50th birthday, several ham friends decided to treat him to a trip he had dreamt about for many years—ARRL HQ and W1AW. Barry's dad, Hans, W6HWZ, was his Elmer. From the conversations Barry shares about his father, who became a Silent Key in 1973, you can still see the twinkle in his eye and the devotion and respect his father installed in him regarding Amateur Radio. Each one of us should have someone we are indebted to in this way.

Barry earned his Novice license in 1963 at age 11. Like any new ham back then, back issues of *QST* and *The ARRL Handbook* were his primary reference sources. It was natural that he would envision himself operating from W1AW someday.

On the day Barry and I flew to Connecticut, I was just as excited as he was to be on this trip. We both had had the vision of visiting W1AW since our teens. Finally, we were going to ARRL!

We arrived at HQ around 8:30 AM and were greeted with friendly faces at the front desk. The ARRL HQ building is a large modern building behind the old, famous W1AW building we grew up seeing as kids. We quickly joined a tour (tours are given at 9, 10 and 11 AM, and at 1, 2 and 3 PM weekdays except holidays). It was fun visiting the Lab, publications, DXCC and the Outgoing QSL Service. Barry had brought his QSL cards and paperwork, and applied for DXCC while we were there. The DXCC group were very efficient in handling his first 100 DX QSLs, and completed the process before we left. Now that's service!

DAVID COLLINGHAM, K3LP

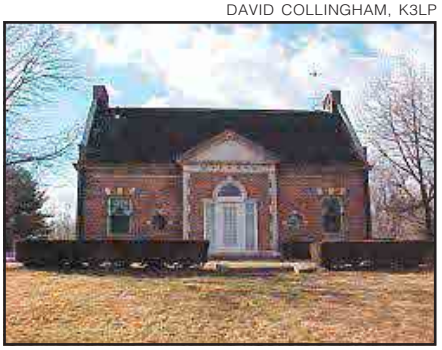
Barry, K3UG, and David, K3LP, friends who traveled to Connecticut together to celebrate Barry's 50th birthday, at the Maxim Memorial Station, W1AW.

Finally, W1AW is on the air with K3UG and K3LP on different bands. Joe, NJ1Q, the W1AW station manager, was very helpful in getting us set up and on the air. FCC-licensed amateurs may operate the W1AW station from 10 AM through 11:45 AM and then from 1 PM through 3:45 PM weekdays. Be sure to bring your current FCC license or a photocopy. For more information, see **www.arrl.org/visithq.html**.

After operating in the morning, we went to lunch and then returned to the operating positions until 3:45 PM, when bulletin and CW transmissions are scheduled. The day ended with a nice dinner and a trip home the following day.

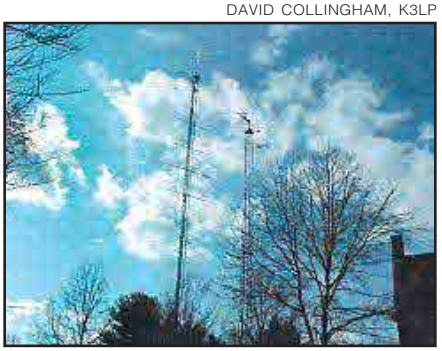
We both look forward to another trip to operate W1AW!

DAVID COLLINGHAM, K3LP



The historic W1AW building, which dates to 1938.

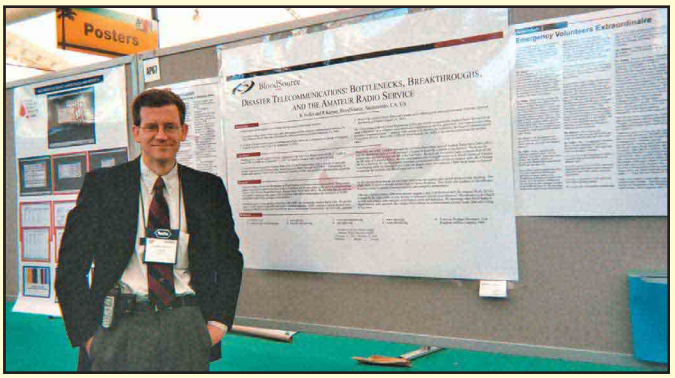
DAVID COLLINGHAM, K3LP



Part of the W1AW antenna farm.

Poster presentation promotes Amateur Radio: In October, two members of the staff of BloodSource, in Sacramento, California, presented a poster with an Amateur Radio theme at the annual meeting of the American Association of Blood Banks in San Diego. Entitled "Disaster Telecommunications: Bottlenecks, Breakthroughs and the Amateur Radio Service," the poster's target audience was scientists, technicians and administrators in blood banking and transfusion medicine. One of the presenters, Kenneth E. Nollet, MD, KØEN, writes: "Amateur Radio communications is an important part of our emergency preparedness efforts within the California Blood Bank Society. AABB is developing a national plan with input from CBBS and, of course, ARRL."

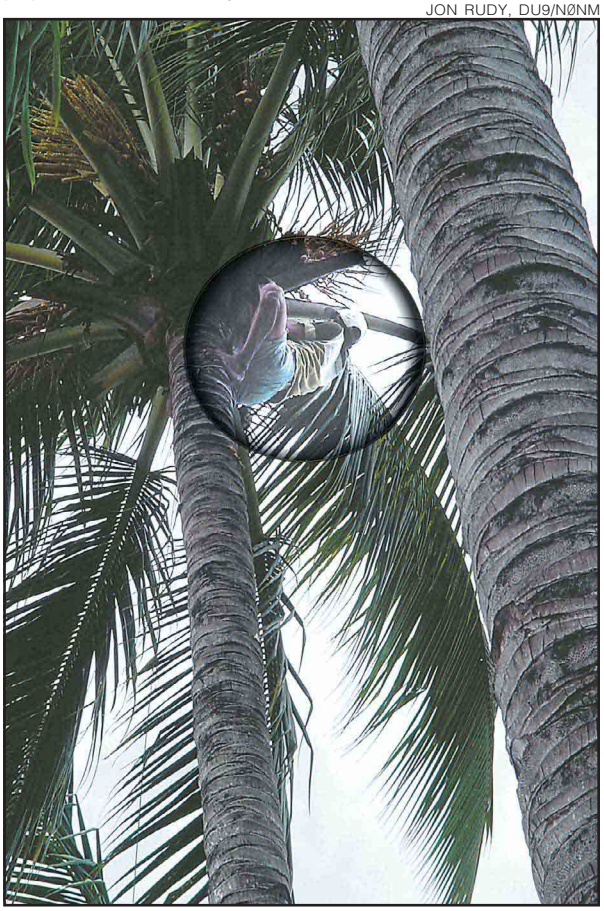
KENNETH E. NOLLET, MD, KØEN



This poster, presented at the annual meeting of the American Association of Blood Banks, helped underscore the value of Amateur Radio in the aftermath of a disaster.

Tower work in the Philippines: The 160 meter antenna support at DU9/NØNM needs regular maintenance. The 60 foot coconut trees regularly shed all matter of debris, from 40 pound palm fronds, baby and ripe coconuts and other dangerous objects that could injure living things that happen to be standing below them. Fortunately Mindanao, Philippines, is covered with coconut trees, so the skills required for this type of tree maintenance abound in the local populace.—*Jon Rudy, DU9/NØNM*

JON RUDY, DU9/NØNM

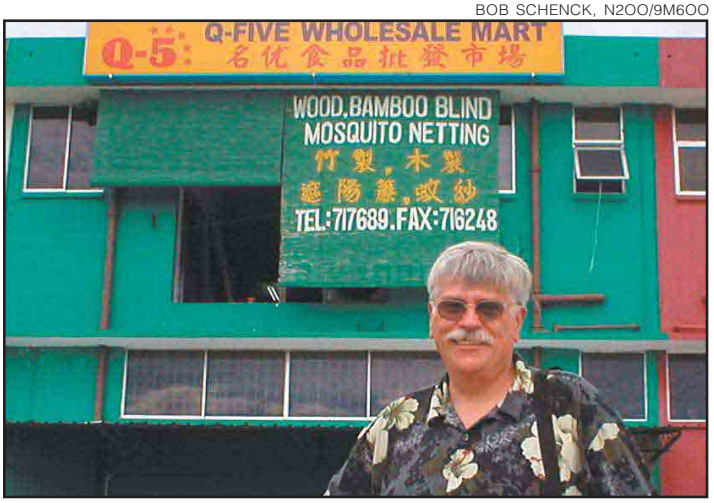


The coconut tree that supports the 160 meter inverted L vertical at DU9/NØNM undergoes maintenance to prevent injury to those below—from falling coconuts. Jon reports that his tree trimmer held on with one hand while cutting with the other and dangling both feet—while 60 feet up!

ART TRAMPLER, W2QR

New Beetle; new license plate. **For another take on a ham's New Beetle, see the article that begins on page 43 of this issue.**

BOB SCHENCK, N2OO/9M6OO

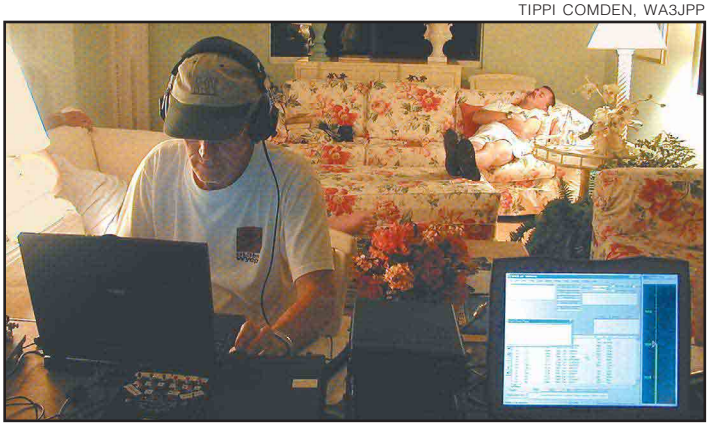


***Q5 in Sabah*: Bob Schenck, N2OO/9M6OO, of Tuckerton, New Jersey, writes: "Sounds like a great place to buy a new rig or perhaps a new antenna. Well, at least you could buy bamboo here for your new quad—and mosquito netting for next year's Field Day!" Bob came across this enticing store sign while visiting Borneo (Sabah, East Malaysia) in November while on a DXpedition visit to the Hillview Gardens ARC.**

MIKE MAXSON, N1NG

Two awards for a young Washington ham: **At the Spokane Hamfest in September, Northwestern Division Director Greg Milnes, W7OZ, presented two awards (count 'em!) to Ben Schupack, NW7DX (left), of Sammamish, Washington: the Hiram Percy Maxim Award and the ARRL Foundation William R. Goldfarb Scholarship. The latter, awarded for the first time in 2003, consists of a full, four-year undergraduate scholarship.**

TIPPI COMDEN, WA3JPP



USVI DXpedition: **In early October, a group from the Wireless Association of the South Hills (Washington, Pennsylvania) mounted a DXpedition to St John, US Virgin Islands, where they worked both the California QSO Party and the Pennsylvania QSO party—and did their share of DXing in between. The photo tells it all, from the sacked out ham in the background (W3SRL) to the grizzled op (K3VX) in the foreground.—*Tippi Comden, WA3JPP***

Antenna Tuners for Your Applications

LDG Autotuners will match your antenna with an SWR up to 10:1 down to 1.5:1 or less!

- Gone are the days of endlessly spinning knobs on a manual tuner
- Switched L network gives you the most efficient power transfer to your antenna
- All tuners are microprocessor controlled and operate on +12VDC
- Interfaces available for many popular radios but are not required for operation

AT-1000 Hi Power Autotuner

- Up to 1000 watts SSB, 750 watts CW, 500 watts Digital
- Coverage to 54 MHz
- Analog Power/SWR meter

$599

RC-1000 Remote Control

- Remote Control Head for the AT-1000
- Controls Power Bypass, Tune, and Fine Tuning
- Includes ten foot interface cable

$99

AT-897 Autotuner

- Bolts on Yaesu FT-897
- Coverage to 54 MHz
- Powered from CAT Port
- Latching relays, no fan

$199

RT-11 Remote Autotuner

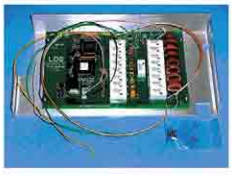
- 0.1 to 125 watts peak
- Coverage to 54 MHz
- Water resistant case
- Optional Remote Head — **RT-11 RH**
- Perfect for remote installation

$209

PT-11P Pegasus Autotuner

- Installs inside the Tec-Tec Pegasus
- 240 Memories (via supporting external software control)
- User installed in about 1.5 hours
- Only 8 solder connections required

$199



Z-100 Low Cost Autotuner

- 0.1 to 125 watts
- Coverage to 54 MHz
- Latching relays
- LED status and SWR indicators
- 200 fast memories

$149

AT-11MP/Z-11 Memory Upgrade

- Adds 200 fast memories
- Reduces tuning time by 90%
- Improved meter on AT-11MP
- Easy to install

For as low as $20

RBA-1:1 External 1:1 Balun

- Power range to 200 watts
- 1.8 to 30 MHz
- BNC/binding post connectors
- Weather resistant
- Just 5 x 2.5 x 1.25 inches

$30

RBA-1 External 4:1 Balun

- Power range to 200 watts
- 1.8 to 30 MHz
- BNC/binding post connectors
- Weather resistant
- Just 5 x 2.5 x 1.25 inches

$30

"One Touch Tune" Autotuner Controllers

- Intelligent radio to LDG tuner interface
- Simply press the tune button on an LDG autotuner, and the OTT handles the rest!
- K-OTT works with TS-2000, TS-450S, TS-50S, TS-690S, TS-850S, TS-570, TS-870S
- Y-OTT works with FT-100D, FT-817, FT-857 and FT-897

$59

Repeater "Voter"

- Use up to 8 remote receivers to "fill in" the coverage area of a repeater
- Audio-noise-based S/N converter automatically selects the best signal

RVS-8 **$319**

LDG ELECTRONICS

LDG Electronics, Inc.
1445 Parran Road, St.
Leonard, MD 20685
Toll Free Sales: 877-890-3003
Support: 410-586-2177
Fax: 410-586-8475

Visit Our Website:

www.ldgelectronics.com
or your favorite dealer

you get MORE than just a RADIO

With Ten-Tec, you get more than just a radio. Our 100 employees include a team of 28 active hams who understand how you operate, can provide advice on what equipment you need, and most importantly how to use it. We design, manufacture and service all of our equipment from one location. Everything we build is backed by a 30 day trial period—no restocking fee is charged, only shipping, if you're not satisfied. Service is always available on our rigs going back to the 1960s. Our reputation is unmatched because we earned it the hard way, one ham at a time, year after year. When you need questions answered, we are as close as a phone call or email message. Want to speak with us? Call (865) 453-7172 and ask to be connected to the appropriate extension. Jack, ext. 108. Gary, ext. 107. Scott, ext. 103. Paul, ext. 122. Larry, ext.129. From the company president on down, we are here to assist you in any way possible!

Clockwise from left: Jack Burchfield (seated), K4JU, President; Gary Barbour, AC4DL, VP/Engineering Director; Scott Robbins, W4PA, Sales & Marketing Manager; Larry Worth, WA4BSM, Production Manager; Paul Clinton, WD4EBR, Service Manager

$1269

Come see why JUPITER is Ten-Tec's best-selling transceiver. Priced at only $1269, the JUPITER will provide years of HF operating pleasure. The best part about JUPITER is that it's a powerful transceiver that is VERY EASY to operate!

- Easy to operate – all functions clearly labeled even in the menu
- Only 1 operation menu
- Great SSB Audio
- 90 dB of receiver dynamic range
- All filtering built-in, no accessory to buy.
- Instant upgrades over the Internet – always have the latest version of the radio
- 30 day risk-free trial, 1 year warranty
- Extended financing available!

For complete information on the JUPITER, call our sales department at (800) 833-7373 or visit our website at www.tentec.com.

TEN-TEC

1185 Dolly Parton Parkway • Sevierville, TN 37862 • USA
Sales Dept: 800-833-7373 • Sales Dept: sales@tentec.com • Service Dept: service@tentec.com
Monday - Friday 8:00 - 5:30 EST • We accept VISA, Mastercard, Discover, and American Express
Office: (865) 453-7172 • FAX: (865) 428-4483 • Repair Dept.: (865) 428-0364 (8 - 5 EST)
Shipping is additional. TN residents add 9.5% TN sales tax.

CORRESPONDENCE

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

TAKE A BOW

♦ Now wasn't that a revelation to find an article in *QST* not penned by someone with more degrees than a thermometer! I refer of course to KØIPG's article ["An Easy to Build, Dual Band Collinear Antenna," Sep 2003, pp 28-29]. And what's more, he is only a 17 year old high school student. I liked the idea of his collinear so much that I built one. It works great, too. So, Dan, take a bow.—*Ray J. Howes, G4OWY, Dorset, United Kingdom*

MORE THAN JUST EQUIPMENT

♦ It is no state secret that hamfests are not very healthy these days. Sponsoring clubs are combining forces to survive, and even at the largest of them all, the (Dayton) Hamvention, attendance has dropped over the past several years. Without question, equipment sales and purchases are the main attraction, and that is what most of us go there for. But for a number of amateurs, it is more than just equipment that pulls them to these events.

I had forgotten about that aspect of hamfests until a relatively new ham friend I met a few years ago gave me reason to think about it. After each hamfest I would listen to the conversations of those returning: *"the weather was bad"; "terrible, no vendors", "a lot of vendors but no buyers"; "okay, I guess"; "I'll never go back to that one again"; "pretty good 'fest"* and so on.

In contrast, my friend always returns from every hamfest he attends saying: *"the hamfest was great and I had a wonderful time!"* Never a negative or disparaging remark, time and time again. His primary reason for going was to meet people, and enjoy the fellowship of the ham community. For him, it is a means of meeting old acquaintances or someone he has talked to on the air but had never met face to face. It is an opportunity to sit down with an old friend he has not seen in years, have a cup of coffee, a mug of beer or a meal and do something that we have done so well over the airwaves—talk.

Talking by radio cannot compete against face to face human contact, coupled with a handshake, slap on the back and even a hug. Yup, "real hams do hug"—get used to it. It is also a means of financially supporting the club(s) that sponsored the hamfest, thanking them for their volunteer work. Equipment is certainly an important aspect, but he found that it could never compare with personal relationships. The combination of equipment and socializing, of course, was unbeatable.

Maybe we have underestimated that aspect of hamfests and should try a little harder to entertain it. If we can all make that effort, perhaps like my friend, we will return saying *"I had one heck of a good time."—Murray Green, K3BEQ, Cheverly, Maryland*

10 METER AMPS AND eBAY

♦ I read the letter in the January 2004 issue called "Horrendous." The problem not only lies with unlicensed operation in the lower part (CW) portion of the 10 meter band, but also the CBers here in the midwest who are running power in the hundreds of watts. Recently, while looking over the ads on eBay, in the Amateur Radio section no less, I found several ads for illegal "10 meter amps." It is a shame that a ham with a valid license cannot have access to a legal 10 meter amp, but it is very easy for an unlicensed person to acquire one from an eBay listing. Reporting the sellers to eBay does no good since by the time the seller is investigated the auction is over.

Maybe the FCC should investigate these listings with as much vigor as they do the users.—*Chuck Freeman, WØCBF, Shawnee, Kansas*

OVERCOMING DYSLEXIA

♦ The July 25, 2003 issue of *Time* magazine featured an article entitled "The New Science of Dyslexia." It caught my attention because the subject has been of interest and concern to me. The article cited Dr Sally Shaywitz's new book entitled *Overcoming Dyslexia*, which I then read and found worthy of recommending to those with young children and grandchildren. The book also alerted me to a fact about dyslexia that impacts Amateur Radio—especially those trying to pass their FCC license examinations.

Dyslexia is a chronic neurological malfunction that exhibits a marked impairment of an ability to recognize and comprehend written words. As explained by Dr Shaywitz, brains of dyslexic individuals produce neurological responses that can be clinically distinguished from those of normal readers through functional Magnetic Resonance Imaging (fMRI) scans.

While dyslexia cannot be cured, it can be treated. Dr Shaywitz provides names and Internet links to training programs that are "evidence-based" or proven to improve a dyslexic reader's reading skills and comprehension. She also provides a list of schools that use these programs.

The book describes methodologies that will accommodate needs of dyslexic readers. One of these, which surprised me, is the use of a computer for note taking and writing. That made me wonder whether dyslexia would affect (positive or negative) a person's ability to send and receive Morse code.

I have been a Volunteer Examiner (VE) for many years and have sometimes been surprised by who flunked FCC license examinations that I have proctored. Now, I am not describing those who missed by a few points, but those who I believed were very bright and who flunked by 20 points. *Overcoming Dyslexia* provides an answer that goes to the very heart of our license examinations.

Dr Shaywitz has found that dyslexic readers do poorly on multiple-choice examinations because of sparse content and time constraints. While Amateur Radio examinations are not time-limited, they do consist of multiple-choice questions with sparse content. Thus, a dyslexic reader coming across a word that she does not know by sight or cannot convert to sounds will not have sufficient ancillary text to "decode" the meaning of the unfamiliar word. Thus, the dyslexic can only guess at an answer.

I recommend that those of us who are VEs should offer dyslexic applicants testing accommodations such as a VE reader (as we would do for a blind applicant) or a quiet room with earplugs. Since dyslexic readers may not know they have a disability or may be fearful of admitting it, I recommend that we should be watchful for applicants who flunk by a large number of points and who appear to be knowledgeable. These applicants should

be retested without charge and with accommodations.—*Shel Epstein, K9APE, Wilmette, Illinois*

THE RILEY WAY

♦ Re December 2003 *QST*, pp 64-65 ["Amateur Radio Enforcement 'The Riley Way' Marks Five Years"]: Phone Sweepstakes is over for another year. Reading this article reminded me of how very different SS on 75 meters was this year compared to just 5 years ago. Then the "rusted dial" inhabitants of "their" frequencies and the contesting "invaders" were locked in vicious turf wars with foul language, unmodulated carriers, noisemakers and frequency faceoffs to see who would give up and move on.

Now, contesters usually ask if a frequency is in use (and wait more than 10 ms before hitting the voice keyer) and rag chewers generally accept the unusually crowded bands with a degree of tolerance. I would really like to think that hams have spontaneously become more courteous and understanding. I seriously doubt that it would have happened without "The Enforcer." Thanks, Riley! —*Jim Jordan, K4QPL, Raleigh, North Carolina*

WHO STOLE CHRISTMAS?

♦ When will I be receiving my December, Christmas Edition of *QST*? What I received could just as well have been the August edition. The cover photo of the ARRL HQ building could just as well have been on the February issue. The only reference to the holiday was a "Season's Greetings" that got covered by my mailing label. Even the advertisers failed to acknowledge the holiday. Don't hams get radio gear for Christmas any more? Mr Editor, take a look at December issues a few years ago and compare them to this year's. I want to see Christmas trees, holly, wreaths, Santa Claus, Ho Ho Ho, etc. Who's the Grinch that stole my Christmas?—*Bob Ray, K5VVA, Columbus, Mississippi*

MEMORABLE QSOs

♦ With great interest, I read the article "A Voice from the Ether—B. H. "Tex" Burdick, W5BQU" [Dec 2003, pp 48-49] because I agree with the author's statement about how memorable QSOs are with such landmarks and icons of our great hobby.

On August 4, 2003 I had such a memorable QSO with Ollie Blackburn, WØMB, from St Louis, Missouri, on 40 meter CW. When Ollie told me he was 101 years old, I thought my copying skills had suffered another relapse—especially since I had just had a QSO with 10 year old David Huhtala, KC8WGA, a few days prior. (Both of these hams sent great CW—real professionals.) Ollie went on to say he had worked for 50 years for the Wabash Railway as a telegrapher and station agent, so then I knew he really was 101 years of age. This really made my day—what a great QSO!

Ollie celebrated his 102nd birthday September 1, 2003. Who knows—Ollie may be the 2nd place winner for the distinction of "Oldest ham in the US."

I just feel honored to have met one of these two very fine gentlemen and look forward to every new QSO—you just never know who it may be. What a great hobby!—*Wes Molenaar, KB9TXS, St John, Indiana*

THAT'S DENSE!

♦ I enjoyed the excellent article about the Baker Island DXpedition by YU1DX in the January 2004 issue of *QST* ["Baker Island, K1B," pp 38-42]. However, I must take exception to his statement that Funafuti Island, with population of 4000 is "...the most densely populated island in the Pacific."

From 1983 to 1989, I operated as KX6DS from what is now Kwajalein, Republic of the Marshall Islands. I also operated twice, for one week each, as KC6TO from what is now Pohnpei, Federated States of Micronesia. I made a total of 83,000 QSOs in those five and a half years. Next to Kwajalein in the atoll was Ebeye Island. It is on this island that the Marshallese people live. They were restricted to living on about three of the islands in the atoll, the other two being Third Island and Ennilbagen. The population of Eyebye at the time I was there was 12,000. The average age was 12 years. The land area of Ebeye Island is 78 acres. This is not a misprint. Since that time, I have heard that the population has grown to 15,000, but I cannot be sure of this number. The island was so crowded that there were not enough beds for sleeping. The people had to sleep in shifts.

Having said all of this, I must point out that since I was there, a causeway has been built, linking Ebeye to some number of adjacent islands (not Kwajalein, since it a US Army facility and access by native people is restricted). There may now be native people living on more than three islands in the Kwajalein Atoll (the world's largest atoll).

I might add that I still have the logbooks (all 20 of them) for all of my operations and do QSL for any valid QSL requests. SASE required.—*Dave Sublette, K4TO, Winchester, Kentucky* QST

ARRL PUBLICATIONS

SHOP DIRECT or call for a dealer near you.

ONLINE WWW.ARRL.ORG ORDER TOLL-FREE 888/277-5289 (US)

License Study Materials

Technician Class

Exam: • 35-question Technician test (Element 2)
• No Morse Code Exam

Now You're Talking! 5th edition. Amateur Radio's most popular FIRST license manual.
Order No. 8810 ..... **$19.95**

ARRL's Tech Q&A. 3rd edition. Review from the entire Technician question pool. Brief explanations follow each question. Quick & Easy!
Order No. 8829 ..... **$12.95**

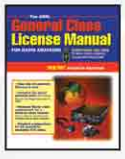
Now on DVD too!

ARRL Technician Class Video Course. 4th edition. Ace your first license exam — the fast, easy, fun way! Complete course includes 2 DVDs or 4 videotapes, coursebook, and practice exam software (CD-ROM, requires Microsoft *Windows*).

DVD Course, Order No. 9116 ..... **$149** plus $8 s&h
VHS Course, Order No. 8837 ..... **$149** plus $8 s&h

Ham University—Technician Edition. Get ready for your first license with this test-yourself quiz system.
CD-ROM for Win95-XP. Order No. 8956 ..... **$24.95**

General Class (upgrade from Technician)



Exams: • 35-question General test (Element 3)
• 5 WPM Morse code test (Element 1)

ARRL General Class License Manual—4th edition
Order No. 8004 ..... **$15**

ARRL's General Q & A. Make upgrading to General class Quick & Easy! Review from the entire question pool. Brief explanations follow each question. Order No. 8586 ..... **$12.95**

ARRL General Class Video Course.
Passing your General written exam has never been easier! Complete course includes 3 videotapes, coursebook, and practice exam software (CD-ROM, requires Microsoft *Windows*).
Order No. 8349 ..... **$149** plus $8 s&h

Your Introduction to Morse Code. Pass the 5 WPM code test. Set includes two cassette tapes or two audio CDs with nearly 2-1/2 hours of practice.
cassettes #8322 ..... **$14.95**
audio CDs #8314 ..... **$14.95**

Ham University—Complete Edition. Learn Morse code with this feature packed easy-to-use software. Includes a written exam quiz generator with all three question pools. CD-ROM for Win95-XP.
Order No. 8735 ..... **$39.95**

Extra Class (upgrade from General)

Exam: • 50-question Extra test (Element 4)

ARRL Extra Class License Manual—8th edition
Order No. 8659 ..... **$24.95**

ARRL's Extra Q & A.
Order No. 8888 ..... **$17.95**

Operating and Reference

ARRL Repeater Directory®—2003/2004 edition. The authoritative source of VHF/UHF repeater listings. Order No. 8918 ..... **$9.95**

TravelPlus for Repeaters™—2003-2004 edition.
Map your travel route, locate repeaters, and tune in! More data! Supports GPS. CD-ROM, version 7.0. Order No. 8985 ..... **$39.95**

MAPS

The Radio Amateur's World Atlas. Full-color maps showing country boundaries, CQ zones, and more. Order No. 5226 ..... **$9.95**

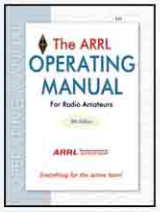
ARRL Map of North America. 27 x 39 inches.
Order No. 8977 ..... **$15**

ARRL Map of the World (Azimuthal). 27 x 39 inches.
Order No. 7717 ..... **$15**

ARRL Map of the World (Robinson). 26 x 34.5 inches.
Order No. 8804 ..... **$15**

NEW!

The ARRL Operating Manual. The most complete book about Amateur Radio operating. Information on hundreds of activities and modes. Everything for the active ham! 8th edition.
Available February. Order No. 9132 ..... **$25**



The ARRL DXCC List (May 2003 ed.)
Order No. 8942 ..... **$4**

The ARRL FCC Rule Book—13th Edition. Order No. 9000 .... **$12.95**

ARES Field Resources Manual. Order No. 5439 ..... **$9.95**

The ARRL Emergency Coordinator's Manual. Order No. FSD9 .. **$5**

Best of the New Ham Companion. Order No. 6001 ..... **$12**

Stealth Amateur Radio. Order No. 7571 ..... **$14.95**

DXing on the Edge—The Thrill of 160 Meters. Operating tips and fascinating history. Book with audio CD! Order No. 6354 ..... **$29.95**

The ARRL RFI Book. Real Answers and Real Cures to your radio frequency interference problems. Order No. 6834 ..... **$20**

RF Exposure and You. Meet the FCC RF exposure regulations. It's not complicated! Order No. 6621 ..... **$19.95**

QRP Power shows just how much fun it is to operate with 5 W or less.
Order No. 5617 ..... **$12**

Hints & Kinks. 16th Edition. Order No. 8926 ..... **$15.95**

Ham Radio FAQ. Order No. 8268 ..... **$14.95**

YASME—The Danny Weil and Colvin Radio Expeditions.
Order No. 8934 ..... **$24.95**

Your Mobile Companion. Order No. 5129 ..... **$12**

CD-ROM Collections

QST on CD-ROM!

QST View CD-ROM includes back issues of *QST* in convenient, space-saving CD-ROM format. ..... **$39.95** per set.

$39.95 per set!

Years			
1995-99*	Order No. 8497	1965-69	Order No. 6451
1990-94	Order No. 5749	1960-64	Order No. 6443
1985-89	Order No. 5757	1950-59	Order No. 6435
1980-84	Order No. 5765	1940-49	Order No. 6648
1975-79	Order No. 5773	1930-39	Order No. 6710
1970-74	Order No. 5781	1915-29	Order No. 7008

*1995-99 set includes latest viewer (supports all sets).

QST View Collection. SAVE $80.40 when you order all 12 CD-ROM sets! Order No. QSTV ~~$479.40~~ ..... **Only $399**

ARRL Periodicals CD-ROM is a compilation of all *QST*, *QEX* and *NCJ* issues on one CD. ..... **$19.95 per set.**

2003 Edition, Order No. 9124
2002 Edition, Order No. 8802
2001 Edition, Order No. 8632
2000 Edition, Order No. 8209
1999 Edition, Order No. 7881
1998 Edition, Order No. 7377
1997 Edition, Order No. 6729
1996 Edition, Order No. 6109
1995 Edition, Order No. 5579

QEX Collection CD-ROM. For Communications Experimenters! Includes all issues from ARRL's technical journal, *QEX*, from its beginning in 1981 through 1998. Order No. 7660 ..... **$39.95**

NCJ Collection CD-ROM. Contesters! Enjoy all the back issues of ARRL's popular contesting journal, *NCJ* from 1973 through 1998. Order No. 7733 ..... **$39.95**

Communications Quarterly CD-ROM. Access advanced technical topics in articles which cover transmitter, receiver and transceiver projects, theory, antennas, troubleshooting and more. Includes all issues published from 1990-1999. Order No. 8780 ..... **$39.95**

Ham Radio CD-ROM. Quick access to back issues of ham radio magazine, published from March 1968 to June 1990. ..... **$59.95 per set.**

Years 1968-1976 Order No. 8381 — **SAVE $30 when you order**
1977-1983 Order No. 8403 — **all 3 sets (1968-1990)**
1984-1990 Order No. 8411 — **Order No. HRCD $149.85**

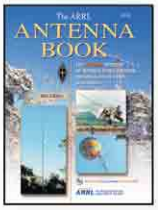
HamCall™ CD-ROM. Thousands of worldwide call sign listings. Requires Microsoft *Windows* or MS-DOS. Updated regularly. Order No. 8991 ..... **$49.95**

Radio Amateur Callbook CD-ROM. Thousands of worldwide call sign listings. Requires Microsoft *Windows* or MS-DOS. Updated bi-annually. Order No. 9194 ..... **$49.95**

Winter Edition

Antennas and Transmission Lines

The ARRL Antenna Book—20th Edition



Current antenna theory and a wealth of practical, how-to construction projects. Fully-searchable CD-ROM included (for *Windows* and Macintosh). Softcover, Order No. 9043 ..... **$39.95**

NEW!

International Antenna Collection. Fixed and mobile antenna designs from 136 kHz to 1.3 GHz. Order No. 9156 ..... **$19.95**

Antenna Zoning for the Radio Amateur. Order No. 8217 ..... **$49.95**

ON4UN's Low-Band DXing. Antennas, Equipment and Techniques for *DXcitement* on 160, 80 and 40 Meters. Order No. 7040 ..... **$28**

ARRL's Yagi Antenna Classics. Yagis, Quads, Loops and other Beam Antennas. Order No. 8187 ..... **$17.95**

Simple and Fun Antennas for Hams. Order No. 8624 ..... **$22.95**

ARRL's Wire Antenna Classics. Order No. 7075 ..... **$14**

More Wire Antenna Classics—Volume 2. More dipoles, more loops, more collinears, and more wire beams and verticals! Order No. 7709 ..... **$14**

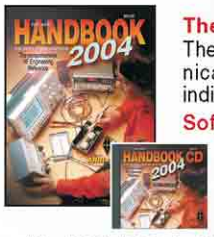
Vertical Antenna Classics. Order No. 5218 ..... **$12**

ARRL's VHF/UHF Antenna Classics. Build your own portable, mobile and fixed antenna designs. Order No. 9078 ..... **$14.95**

ARRL Antenna Compendium series—Practical antenna designs, and other articles covering a wide range of antenna-related topics.

Volume 7. Order No. 8608 **$24.95** — **Volume 3**. Order No. 4017 **$14**
Volume 6. Order No. 7431 **$22.95** — **Volume 2**. Order No. 2545 **$14**
Volume 5. Order No. 5625 **$20** — **Volume 1**. Order No. 0194 **$10**

Practical Circuits and Design



The ARRL Handbook—2004

The Standard in applied electronics and communications! Filled with projects, antennas, and indispensable references. Always revised!

Softcover, Order No. 1964 ..... **$34.95**

Hardcover, Order No. 1972 ..... **$49.95**

ARRL Handbook CD 8.0

View, search and print from the entire 2004 edition! CD-ROM for *Windows* and Macintosh. Order No. 1980 ..... **$39.95**

Digital Signal Processing Technology—Essentials of the Communications Revolution. Order No. 8195 ..... **$44.95**

Understanding Basic Electronics. Order No. 3983 ..... **$20**

Experimental Methods in RF Design. Design, build and measure equipment at both the circuit and the system level. Explore wide dynamic range, low distortion radio equipment, the use of direct conversion and phasing methods, and digital signal processing. CD-ROM included. Order No. 8799 ..... **$49.95**

NEW!

L/C/F and Single-Layer Coil Winding Calculator. A slide rule for the experimenter working with filters, oscillators, impedance matching circuits or antenna coils and traps.Order No. 9123 ..... **$12.95**

Introduction to Radio Frequency Design. The fundamental methods of radio frequency design using mathematics as needed to develop intuition for RF circuits and systems. CD-ROM Included. Order No. 4920 ..... **$39.95**

W1FB's QRP Notebook is packed with construction projects for QRP transmitters, receivers and accessories. Order No. 3657 ..... **$10**

Digital and Image Communications

ARRL's HF Digital Handbook. 2nd Edition. Operate PSK31 and MFSK16—and many of the other popular digital modes. Order No. 8233 ..... **$17.95**

The ARRL Image Communications Handbook. See and talk with other hams! CD-ROM included with software utilities. Order No. 8616 ..... **$25.95**

Space and VHF/UHF/Microwave Communications

The Radio Amateur's Satellite Handbook. The most complete book for every satellite operator and beginner! Revised First Edition. Order No. 6583 ..... **$24.95**

Tune in the Universe! Amateur Radio and the Search for Extraterrestrial Intelligence (SETI). Interactive book on CD-ROM. Order No. 8543 ..... **$24.95**

The ARRL Satellite Anthology — 5th Edition. Includes specific satellite operating details. Order No. 7369 ..... **$15**

Weather Satellite Handbook. Order No. 4483 ..... **$20**

The ARRL UHF/Microwave Experimenter's Manual includes information on design and fabrication techniques, propagation, antennas and much more. Order No. 3126 ..... **$20**

The ARRL UHF/Microwave Projects CD. Construction articles for transverters, preamplifiers, power amplifiers, high performance antennas, and test and measurement equipment. CD-ROM includes Volumes 1 and 2 of *The ARRL UHF/Microwave Projects Manuals*. Order No. 8853 ..... **$24.95**

International Microwave Handbook. Reference information and designs for the microwave experimenter. Order No. 8739 ..... **$39.95**

If you'd like a complete publications listing or would like to place an order, please contact us:

1. To order or obtain the address of an ARRL Dealer near you, call toll-free (US): 1-888-277-5289 (non-US call 860-594-0355) 8 AM-8 PM Eastern time, Monday-Friday.
2. Fax 1-860-594-0303 24 hours a day, 7 days a week.
3. By mail to: ARRL, 225 Main St, Newington CT 06111-1494
4. Visit our World Wide Web site: http://www.arrl.org/shop

Shipping and Handling Information

In the US, add the following amounts to your order to cover shipping and handling (S/H). Add an additional $5.00 to the US rate for shipment outside the US. US orders will be handled via UPS or comparable ground service. International Air and other specialty forwarding methods are available. Please call or write for information. Sales Tax is required for shipments to CT 6% (including S/H),VA 4.5% (excluding S/H), CA (add applicable tax, excluding S/H). Canadian Provinces NS, NB and NF add 15% HST, all other Provinces add 7% GST (excluding shipping/handling). Fees effective February 1, 2004.

Amount of Order	Add	Amount of Order	Add
$10.00 or less	$6.00	40.01 - 50.00	10.00
10.01 - 20.00	7.00	50.01 - 75.00	11.00
20.01 - 30.00	8.00	Over $75.00	12.00
30.01 - 40.00	9.00	CD-ROM only	6.00

We accept the following major credit cards: American Express, MasterCard, Visa and Discover. Prices and product availability are subject to change without notice.

By Ed Kessler, AA3SJ

Homebrewing—Surface Mount Style

There's no denying that components are getting smaller; some are obtainable only in surface mount devices (SMDs). AA3SJ tells how to use a common Dremel tool to make the PC boards to accept them.

Building one's own rigs and accessories is a rewarding part of ham radio, but current surface mount technology (SMT) can be daunting and prohibitive, even for the enthusiast. Yet, with a bit of patience and experience, a builder can utilize surface mount devices confidently. Surface mounted devices are designed for use with printed circuit boards. Generally, they are useful only when a builder is willing to fabricate a board to accept them. In this regard, several available kits using surface mount devices provide a helpful arena for practice.[1] These are of little help, however, for the experimenter wanting to try new circuits with a "one of a kind" board.

While the components are smaller, good construction practices should apply to any technique used. Whether the builder tackles a project using "ugly construction," gluing pads onto a board (commonly known as "Manhattan" construction) or etching one's own circuit board, time is well spent studying the circuit and working out an effective layout.

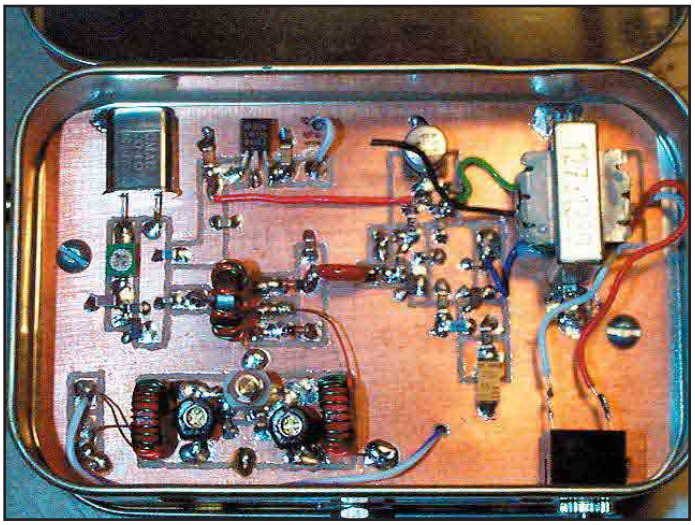


Figure 1— A direct conversion receiver built using the techniques described by the author.

Using A Dremel Tool to Make SMD Boards

One technique for building a project comprised of SMDs is to use a Dremel brand rotary tool to cut pads into printed circuit board material. This technique evolved naturally from the methods mentioned above. The process involves considerably more time devoted to board layout and preparation than the actual installation of the components themselves. What follows are some suggestions for the builder who would like to experiment with surface mounted components using this technique. The aim is to shorten the learning curve.[2]

Dremel bits come in a variety of shapes and sizes. My first attempts at grinding pads involved $^{3}/_{32}$ and $^{1}/_{8}$ inch round carbide burrs. They were used successfully in making a few pads; however, the carbide burrs have several drawbacks. They do not cut well using the tip of the bit where the cutting edges are fine and more closely spaced. If one lays the bit on its side, however, they cut more effectively. There is also the tendency to apply more pressure while cutting, and when the "teeth" of the bit finally engage the copper material, the result can be more of a gouge than a finely engraved line.

Dremel also markets diamond impregnated burrs[3] which cut more consistently across the entire bit and require less pressure on the cutting tool. A 1.8 mm round diamond burr works well for cutting long broad lines and the 1 mm version produces a fine line that can be bridged by even a well-placed 0603 sized component (1.6 mm × 0.8 mm).[4] For example, a capacitor or resistor can be connected from a pad to the ground plane this way. Even so, the diamond bits still cut better when laid on their sides.

Regardless of which bit one uses, there is a helpful maxim—let the Dremel do the work. A light touch with more time and more patience does a better job of cutting the lines on the substrate. I discovered that, if I try to force the cutting process, the tip will bind in the copper, producing an uneven line in both thickness and depth. It is even possible to cut completely through the board, if one pushes too hard, although with care that seldom happens.

The copper used on PC boards also varies in thickness and thus in ease of re-

[1]Notes appear on page 30.

moval. While the thinner and/or softer copper substrate lends itself to easier cutting with any of the Dremel bits mentioned above, the diamond bits are far less frustrating when working with harder material.

Practical Suggestions For Using the Dremel Technique

Here is a description of the process. Begin with the schematic, a ruler and an extra fine tip Sharpie pen and draw the pads on the copper clad board. An ink eraser removes unwanted lines. Keep a selection of components nearby to use as templates for pad layout, especially an SOT-23 transistor or diode, an SOT-89 transistor and the common integrated circuits. (Putting together a small bag of components labeled "Layout" that are used only for constructing a board is helpful.) Another construction practice is to use double-sided board material and keep the bottom side for the primary or additional ground plane connections. A small hole can be drilled from a pad through the board and a wire jumper soldered on both sides. This is not always necessary if the layout lends itself to a sufficient "top surface" ground plane. With smaller projects the builder can lay out the circuit directly onto the copper board, but for more extensive circuits it may be helpful to use a slightly different technique.[5]

Larger projects require a different technique. Use a piece of graph paper that has a grid that accommodates the necessary pad size (0.25 inch grids work well) and draw the pads with a pencil and the necessary eraser. When you're satisfied that the pad placement will work, transfer the grid onto a piece of PC board using a square and a pencil. The next step is to transfer the pad placement onto the board itself, using a fine-tipped Sharpie. I have built receivers and transmitters this way. Small boards, with one or two stages on each and interconnected after construction, work well for larger systems. An 80 meter CW transceiver with a superhet receiver and a 3 pole crystal filter was built using this method.

When using the Dremel "freehand," lay out the circuit one section at a time and be very careful to check the corners of pads. These can be likely culprits for shorts to the ground plane. After each section has been cut, use a hard ink eraser or Scotch Brite to buff the board. Be sure to blow or brush off the copper grit. On several projects it was noticed that fresh solder flux tended to attract the copper grit. Additional pads can be inserted later, if you desire to modify the circuit, provided there is sufficient space remaining on the board itself. While no shorts have been experienced because of this, extra care may be advised when adding pads after some components have been installed. Always check each isolated pad for continuity to ground and to other adjacent pads with an ohmmeter. Use magnifier headsets to inspect the pads and to inspect the installed components.

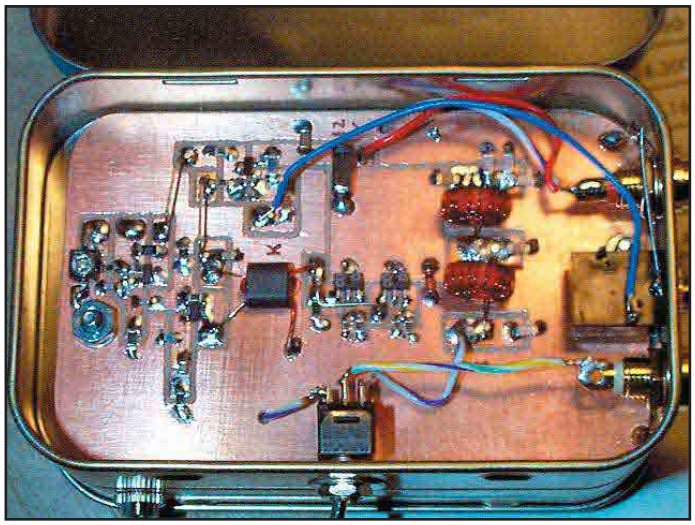


Figure 2—A matching low power transmitter built with SMT parts.

Place the copper board on a surface higher than the workbench itself. As mentioned earlier, the Dremel burrs cut most efficiently on their sides, not on the tip. A 3/4 inch piece of pine board can be used as a secondary work surface, while you rest your Dremel hand on the lower surface of the workbench.

Fine solder, such as 0.020 Kester NoClean does a nice job. However, since there is little flux in 0.020 solder, it sometimes is helpful to tin the pad first, using desoldering braid (wick) to remove the excess solder. Components can be held on the board with fine-tipped tweezers while soldering. Sometimes the tweezer tips tend to pick up solder flux, making them sticky. Trying to manipulate an SMT part with sticky tweezers is interesting, to say the least! It's helpful to frequently clean the tweezers with isopropyl alcohol to remove the flux. If one is using metal tweezers, degaussing is periodically necessary to eliminate magnetic effects. Controlling a tiny SMT part with a magnetized tool can be equally frustrating. Alternately, one could use a ceramic or plastic pair of tweezers.

A neat job can be accomplished by placing connecting wires and jumpers on the bottom of the board. This helps keep wires out of the way and makes layout simpler. Drill a very small hole through the appropriate pads from the top of the board through to the bottom. Be sure to use the Dremel to clear the copper around the hole on the bottom of the board to prevent shorting the line to ground. In a 40 meter superhet receiver, the crystals for the filter (5 pole) were placed on the bottom of a single-sided board, mounting only the SMT capacitors on the top. Although this worked, I did run out of room and had to put one crystal on top.

Keeping common components sorted with small Ziploc bags speeds up the construction process. At first, all the surface mount resistors were kept in their respective tapes in one large box. After spending 15 minutes looking for one needed resistor value, I decided that it would save time if the common values were sorted, and each placed in its own separate bag. Alternately, parts can be stored in small "coin" envelopes that come in various sizes.

Working with small SMD components and using the Dremel to make fine cuts on a board does seem to tax one's energy level more severely. When a builder has trouble concentrating or feels tired or bleary-eyed, it's time to take a hike, get on the air or go to bed.

Don't be afraid to use leaded components when they will fit better into your layout or when you simply do not have a needed value in SMD form. Unless you're a purist, it doesn't detract from the project. My first projects used about 50% SMDs and the last used all SMDs, with the exception of a 9 V voltage regulator that I didn't have in SMT form, a couple of toroidal inductors and a few 7-125 pF trimmer caps.

How Small Can You Go?

SOIC (small outline integrated circuit) components, with their 0.05 inch lead spacing, present a challenge to the Dremel process, but with care they can

be used successfully. It's easier, however, to bend the leads of an IC in a DIP (dual in-line) package to imitate a surface mounted part because of its 0.1 inch pin spacing. The DIP package is not much larger or taller and the corresponding pads are sized nicely for SMT resistors and capacitors. Another technique is to use an SOIC part but place it on a small board of its own and use wires to connect it to the main board.

To be certain, the smallest SMDs are impractical for the home builder. There are limits to how small a device we can handle and install using this Dremel technique. MSOP (miniature small outline package) parts with 0.025 inch lead spacing are best left to etched boards. But don't be afraid to think small! When my first VFO using SMDs was attempted, I was amazed at how much board space had been "wasted." A board half as small could have been used with room to spare.

Even with that said, don't attempt anything too small at first. Your boards will begin to shrink in size as you gain confidence and experience. It is often beneficial to begin the layout process at the center of the board and then cut it to final form after the pads have been cut. When placing a 0603-sized capacitor, don't sneeze!

Adding an X-Y Table

One colleague (W7ZOI) has modified this procedure for his SMT breadboards. His shop includes a Dremel drill-press stand. The Dremel tool is vertical for normal use with this stand and pushing on the level causes the tool to move downward to drill a hole. He's built a fixture from wood scraps that holds the Dremel tool, in the stand, in a horizontal position. A cut can then be made in a copper surface when the Dremel is loaded with a rotary cutting tool.

This setup is enhanced with a simple X-Y table made from wood and aluminum scraps. A small piece of circuit board material is clamped to the table. The rotating cutting wheel is then lowered until the copper is being cut. It is held in this position while the table is moved, allowing a long cut to be made. The process is then repeated after the "target" has been adjusted, allowing another cut to be made close to and parallel with the first. These methods are described on the Web.[6]

The Benefits

Several benefits emerge justifying the use of surface mount components and the techniques described above. The industry standard is now focused on leadless components. They are thus readily available and generally cost less than their leaded counterparts. A more compact design is realized because of the smaller size and lighter weight of the finished circuit. A 40 meter superhet transceiver I built weighs about 6 ounces and is about the size of a small paperback book (including the SMT keyer!). The MicroR1[7] and its companion transmitter, shown in Figures 1 and 2, weigh just 5 ounces and an 80 meter transceiver, although larger in size, weighs less than a pound. Since I like to backpack with my rigs, this is ideal.

All of these projects were built at home using simple shop tools and nonhazardous etchants. All the circuits were built over a healthy ground plane that provided optimum performance. Modifying an existing rig or adding a keyer or additional filtering is easier using this technique because the boards are much smaller. They also can be more easily placed inside an already full enclosure. This Dremel method adapts well to most of the common sizes of SMT components. I find that I rarely think about whether the resistor or capacitor I use will be 0603, 0805 or 1206 in size. Generally, any of the larger sizes will fit just fine and that is quite helpful when shopping for SMT components in the surplus market. And finally, it's just good old ham radio fun.

Notes

[1]Embedded Research (**www.embres.com**) currently markets a surface mount keyer kit.

[2]See **www.dremel.com** for a description of their product line.

[3]I bought the diamond impregnated bits at a local hardware store, but I have also used "generic" versions that I bought from a vendor at a hamfest.

[4]The 4 digit code of an SMD component refers to its approximate size in hundreds of an inch. Length is first, followed by width. A 0603 component is thus about 0.06 inches long by 0.03 inches wide.—*Ed.*

[5]Figures 1 and 2 show projects that were drawn freehand, directly on the board material.

[6]Hayward's Web site information can be accessed at: **users.easystreet.com/w7zoi/smtbb.html.**

[7]Hayward, Campbell, Larkin, "Experimental Methods of RF Design," page 8.4. Available from the ARRL Bookstore. Order no. 8799. Telephone toll-free in the US 888-277-5289 or 860-594-0355, fax 860-594-0303; **www.arrl.org/shop/**; **pubsales@arrl.org**.

All photos by the author.

Ed Kessler, AA3SJ, was first licensed as a Novice in the 1970s at age 14, but was deterred by other pursuits until the fall of 1998 when he re-entered the Amateur ranks and earned his General class ticket. An Extra class license followed a year later. Having always enjoyed homebrew construction and design, he became an ardent low power (QRP) advocate under the guidance of several mentors, including W3TS, AA3PX and W7ZOI. Ed is a clergyman by profession and is part-time adjunct professor of biblical studies at Messiah College in Grantham, Pennsylvania. He can be contacted at 950 Woodside Station Rd, Millersburg, PA 17061; **edkess@pa.net**. *Ed maintains a Web page at* **www.qsl.net/aa3sj**.

STRAYS

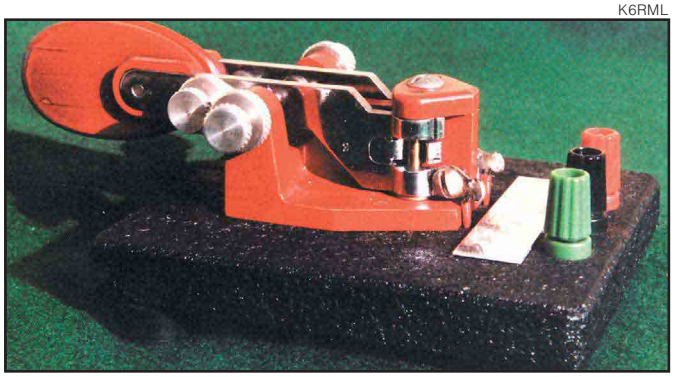
ONLINE ELMERS

◊ The purpose of the HAM-ELMER computer group is to help prospective hams obtain their license, guide newly licensed operators, and to answer technical and procedural questions. The format for the list is pretty much a question and answer, where more experienced hams provide the answers. For more information, see **groups.yahoo.com/group/HAM-ELMER/**.—*Bob Raymond, W7RJR*

I would like to get in touch with...

◊ nuclear power plant operator, engineers, technicians, workers, vendors and government agents interested in taking part in a special event operation February 28. I am proposing that all nuclear stations in the country be able to contact each other (and the NRC) on HF and IRLP. Please contact Larry Wheeler, KG4RGN at **kg4rgn@yahoo.com**.

K6RML



One of a kind: **Bob Niemeyer, K6RML, of Carmel, California, a bug and key collector, found this gem by scanning Radios Online on the ARRLWeb (www.arrl.org/RadiosOnline/). Dating from 1980, it's a handmade prototype of Ham Key's HK-1. He reports that he purchased it directly from the maker.**

By Tom M. Morton, W5TOM

The Well Adjusted Ham

There's a better way to calibrate your SSB transceiver.

The advent of transceivers with 1 Hz readouts and "broadcast-quality" audio has made us all very conscious of frequency. When a station is transmitting an SSB signal with low frequency content in the 50 to 100 Hz range, a VFO change of 10 Hz makes a noticeable difference. Trying to be exactly on frequency has sent many hams to their instruction books to find out how to zero in on those zeros at the end of their readouts.

Calibrating Your VFO

The "Zero Beat" method for calibrating a SSB transceiver is common knowledge—just tune in WWV and zero beat the carrier. This is inadequate because the response of most receivers and of your ears rolls off at very low frequencies below 50 Hz, as illustrated in Figure 1. Here you can see that the level of the beat signal between the local oscillator and carrier drops off dramatically as you approach zero frequency. Zero frequency can't be heard at all. At best, this procedure will get you within ±20 Hz.

The "Sideband Toggle" method is more precise, using the 500 Hz and 600 Hz tones that modulate the WWV carrier, alternating with each minute. WWV's signal is double-sideband AM, so both the upper and lower sidebands will have the same frequency offset from the carrier. With WWV tuned in, you quickly toggle back and forth from USB to LSB and try to get the tone to sound the same on both. The change in tone is twice the frequency error, which improves your ability to discriminate. This is a good method, but requires you to remember exactly what the tone sounded like between toggles. This may not be so easy and depends on the speed at which you can change sidebands. Some radios don't allow you to do this at all.

There is a variation called the "Dual VFO" method. Tune one VFO 300 Hz or 400 Hz above the carrier and the other VFO the same below. In other words, VFO A will be at 10,000,300 Hz and VFO B at 9,999,700 Hz. The offset results in a beat tone with the carrier and the modulation audio tones are ignored. Toggle from one VFO to the other and tune to match the tones as in the "Sideband Toggle" method. The lower the offset that you use, the more accurate you can be. But a higher frequency is easier to discriminate by ear. This method is only usable with radios that use the same oscillator for both VFOs. If the VFOs use separate oscillators there is no common relationship to the standard or oscillator to be calibrated. If you are persistent, these procedures will get you to within ±8 to ±10 Hz.

The W5TOM Methods

These next two methods I call the "W5TOM Methods." They were invented because I mailed my TS-50's calibration jumper to KV2AA by mistake. While trying to calibrate my TS-50, there was a battery-operated shortwave receiver on the bench. The idea came to me in a flash—I could match the WWV modulation tones on the TS-50 and AM receivers! I tuned in WWV on the TS-50 using upper sideband (the only choice) and on the shortwave receiver using AM (also the only choice). I now heard the modulated 600/500 Hz tones on both receivers. The tone on the AM receiver had to be accurate since it wasn't using a local oscillator, but the same tone changed pitch on the TS-50 as I tuned the VFO. When I adjusted the volume and put the speakers next to each other, I noticed that the two tones beat together very clearly.

The most accurate methods are saved for last. They require a computer with an audio generator and analyzer programs and the ability to send audio to your computer through the sound card. The first is a variation of the "W5TOM Method" except that it uses a computer-based audio oscillator program to generate the 500/600 Hz reference tone.[1] A good generator program is *NCH Toner*, available free of charge from **www.nch.com.au/tonegen/index.html**. The generated tone's volume is more stable than one received off the air, and both tones can be combined in a pair of earphones using your sound card's audio mixer. (Connect

[1]Notes appear on page 32.

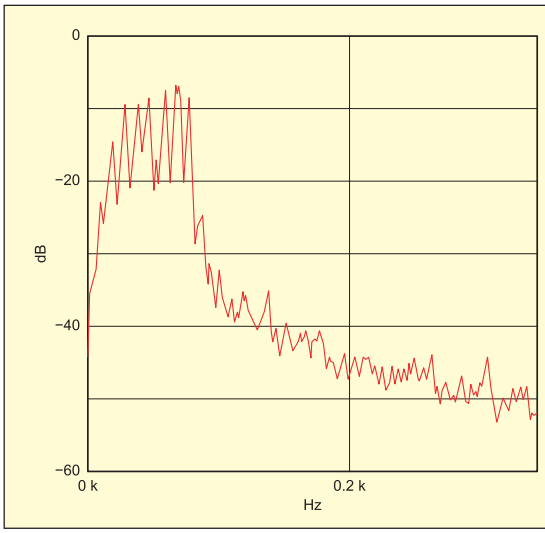


Figure 1—This display was generated while tuning to zero beat from one side. It shows the sharp drop in audio level as zero frequency is approached.

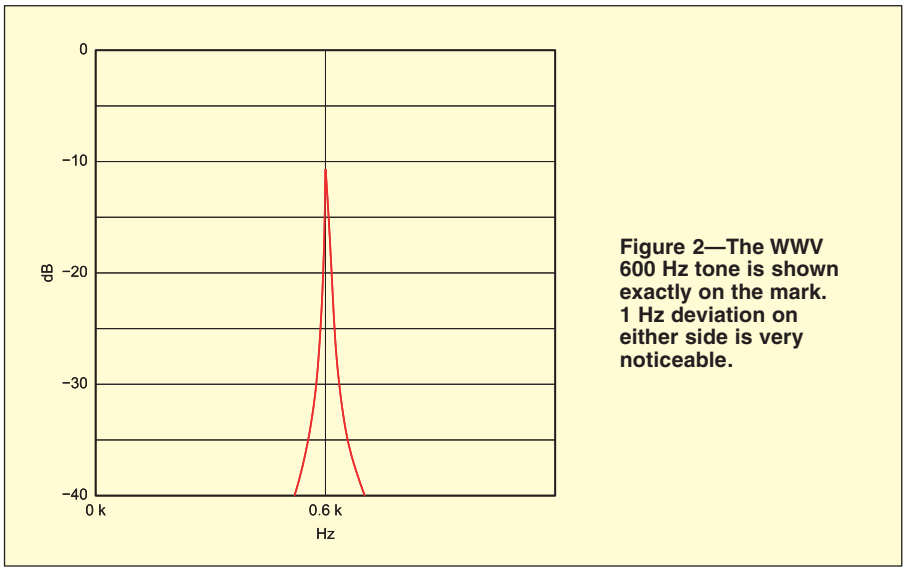


Figure 2—The WWV 600 Hz tone is shown exactly on the mark. 1 Hz deviation on either side is very noticeable.

the receiver output to the sound card LINE IN jack.) After the volume levels have been adjusted, simply beat the two tones together. Since the tones are the same level and are heard in the middle of your head, the beat is very precise and clear. I was able to hit zero beat dead on many times in a row with the VFO readout covered by a cloth.

With these methods, the human ear and brain is the discriminating test instrument, for better or worse. Simultaneously hearing the two tones at the same volume makes that instrument work much better. With the "W5TOM Methods" you can achieve ±1 Hz accuracy with ease.

The last method, I call the "*Hamalyzer* Method." This requires a computer running *Hamalyzer*, a software audio spectrum analyzer connected to your radio's audio through the sound card. It is available from **www.hamalyzer.com** for a nominal fee. Set the Hamalyzer parameters as follows: TRACE=FREE, FAST FOURIER TRANSFORM (FFT) SIZE= 16384, SAMPLE RATE=11025 and X RANGE adjusted to present 0.6 kHz in the middle of the display. This will result in a resolution of 1 Hz, a continuously updating display, and a line at the middle of the display indicating 600 Hz.

Tune in WWV on either sideband and listen during the minutes that transmit a 600 Hz tone. You simply adjust your VFO to put the peak of the audio component exactly on the 600 Hz line as in Figure 2. Although it appears that you are exactly on the money, the FFT algorithm outputs data in only integer frequency values. This limits your accuracy to ±0.5 Hz.

Calibration Versus Adjustment

There is a significant difference between the terms *calibrate* and *adjust*. If you calibrate your VFO by one of the previous methods, you determine the display's error. Let's say you are 23 Hz low. That means to be right on, you must set your VFO 23 Hz high to be exactly on frequency. Just knowing this error means your radio is now *calibrated*. Those pesky non-zero numbers are still present, however, in the least significant digits of your frequency display. To set them to zero you must *adjust* the readout and this may be easy or difficult, depending on your radio. It will require time spent with the instruction manual.

To be useful, a calibration must be referenced to a *traceable* standard. In these cases, that is the WWV transmission, whose carrier frequency is accurate to one part in a billion (0.01 Hz at 10 MHz), and certainly sufficient for any ham application. In the case of the "Zero Beat" and "Toggle" methods, the accuracy (or uncertainty) is limited to approximately 1 Hz (poorer if your receiver's output at low frequencies is low). In the case of the W5TOM methods using the AM receiver and the computer-generated tone, accuracy is limited by the human ear's ability to detect differences in frequency, approximately 0.3%, or 1.8 Hz at 600 Hz. Using the *Hamalyzer* method, accuracy is limited by the accuracy of the clock oscillators in your computer or sound card, typically ±30-100 parts per million. Even at 100 ppm error, the accuracy of a 600 Hz tone or trace from the analyzer is ±0.06 Hz, certainly adequate for most ham applications.[2]

The precision of these methods was determined by repeatedly calibrating to WWV with the frequency display covered to avoid influencing the measurement. After each measurement the display was uncovered and the frequency was recorded. The radio used in these tests was the Ten-Tec Pegasus (with integrated Ten-Tec R320 receiver) and the computer was a Compaq Presario 1800 laptop running *N4PY* radio software (available from **n4py@earthlink.net**), *Hamalyzer* and *NCH Toner*. The WWV Web site **boulder.nist.gov/timefreq/stations/iform.html** provides the signal and time schedule for their transmissions.

Satisfyingly Correct

Five years ago, I had a Kachina 505 computer-controlled transceiver that would self-calibrate to within ±1 Hz. Being an AM broadcast fan, I decided to check some local Houston broadcast stations for frequency accuracy. Most were within a couple of Hz of their assigned frequency. [FCC rules require ± 20 Hz. —*Ed.*] KPRC, however, was 32 Hz high. Just for fun, I called the station and got the engineer on the phone. When I told him that the station was 32 Hz high, he was incredulous and wanted to know how I knew. I told him what I was doing and he politely said he would look into it. From his tone of voice, he obviously thought I was a nut. A few hours later, I checked KPRC again and they were dead on frequency. Being well adjusted not only can eliminate the "frequency dance," but it also can be fun.

Acknowledgments

I would like to thank Sam, KT4QW, for beta testing these methods and for his help in developing the article and, of course, thanks to Joe, KV2AA, for needing my TS-50 calibration jumper. That started this whole adventure!

Notes

[1]The use of an external calibrated audio source is similar to one of N0AX's methods of frequency measurement in his article, "The ARRL Frequency Measuring Tests" in October 2002 *QST*.

[2][The subject of measurement uncertainty when using WWV signals is discussed in detail in NIST Special Publication 432, "NIST Time and Frequency Services," by Michael Lombardi. It is available at **boulder.nist.gov/timefreq/general/pdf/1383.pdf**. Table 3.13 lists uncertainties for different types of measurements and can be found on page 55 of that publication.—*Ed.*]

Tom Morton, W5TOM, received his first license in 1977 and the Amateur Extra ticket in 1997. A freelance photographer and a writer, Tom has also owned a hobby shop specializing in radio control equipment. Tom was with the US Signal Corps from 1959 to 1962. He has a degree in Mechanical Engineering from Vanderbilt University. Tom can be reached at **w5tom@houston.rr.com**.

By Dan Clark, W9VV

A Historic Receiver from a Radio Pioneer—Fred Schnell

"I heard 1AW and 1AY last night!" Here's a receiver that might have copied both Maxim and Tuska in 1928.

Some time ago, a friend of mine, Jack Montgomery, K9DQU, mentioned he had two receivers built by Fred Schnell in the early years of Amateur Radio. These had been obtained from Fred Schnell's son, Dick, K9HPD. Having a strong interest in antique radios, I obtained both of these from Jack and decided to restore them to operating condition. The most interesting one was a regenerative set designed for both Amateur Radio communication and general coverage short wave.

Figure 1—A front view of the Fred Schnell regenerative receiver. The meter measures filament voltage—a useful feature for battery-operated sets.

Who Was Fred Schnell?

Fred Schnell was a real pioneer, not only in Amateur Radio, but in shortwave communication as well. He was active in radio communication during World War I, when he copied a message from Rome to President Wilson, the first two-way message between Italy and the US. He also copied the peace acceptance message from Germany and later transmitted the first message to Germany after the war. He was chief operator on the USS *George Washington* when Wilson attended the Peace Conference in France in 1919.

In 1920, Schnell became Traffic Manager for the League and remained there for some 15 years. In 1925, as a US Navy Lieutenant, he demonstrated the value of shortwave radio to the Navy during a cruise to Australia. Up to that time, all military communication was conducted on long waves, as high frequencies (below 200 meters) were not considered to be of any practical use.

His best remembered achievement occurred in 1923, when he made the very first two-way transatlantic amateur radio contact. Up to that time, Americans had heard few Europeans and, although many US signals had been heard in Europe, no contacts had resulted. Operating his station, 1MO, and using about 400 W of power on 100 meters (3 MHz), Fred kept a schedule with Leon Deloy, 8AB, in Nice, France, which finally resulted in a two-hour-long contact. The receiver described here is not the one used in that historic QSO. That receiver, as described by Schnell, was built as a "haywire" arrangement and probably no longer exists.

In later years, Schnell worked for the General Household Utilities Co (the maker of Grunow radios) and was involved in consulting engineering. From the mid-1930s through the '40s he was the Communications Officer for the Chicago Police Department. At the time, police communications base stations used 1.7 MHz AM for talking to patrol cars. Schnell developed a vehicle loop antenna that improved reception in areas with high electrical noise. He later worked for Motorola, retiring in 1956. Schnell held the call W9UZ while living in the Chicago area and later on, in Florida, he was W4CF. After a long and productive career in radio communication, Fred Schnell became a Silent Key in 1975.

The Receiver

The receiver I have was probably built in the late 1920s, judging from the construction, the circuit and the components used. Schnell wrote an article on this receiver that originally appeared in *Short-Wave Craft* magazine.[1] A front view of the receiver is shown in Figure 1.

Circuit Description

The original circuit diagram of the receiver is shown in Figure 2. It is a battery operated regenerative receiver, as were most amateur shortwave receivers of the 1920s and early '30s. This one is unusual in that it uses push-pull circuits for the tuned RF stage, as well as a regenerative detector stage. Push-pull circuits are widely used for transmitters and audio power amplifiers, even today. The claimed advantage for their use in receiver circuits was that the effect of tube input capacitance was reduced, permitting operation at higher frequencies. I saw one magazine article from 1929 that carried the push-pull theme all the way through from the RF stage to the audio stages. This receiver doesn't go that far; it uses two conventional single-ended audio stages.

The RF amplifier stage uses a pair of UX222 (type 22) tubes, which were the first tetrode tubes made in the US. This tube had a 3.3 V filament that drew 0.132 A, and it was primarily intended for battery operation. These tubes provided considerably more gain than the triodes of the time, without the necessity of neutral-

[1]Schnell, Fred "My Favorite Short Wave Receiver," *How To Build and Operate Short Wave Receivers*, Short-Wave Craft, 1934. Reprinted by Lindsay Publications, 1989

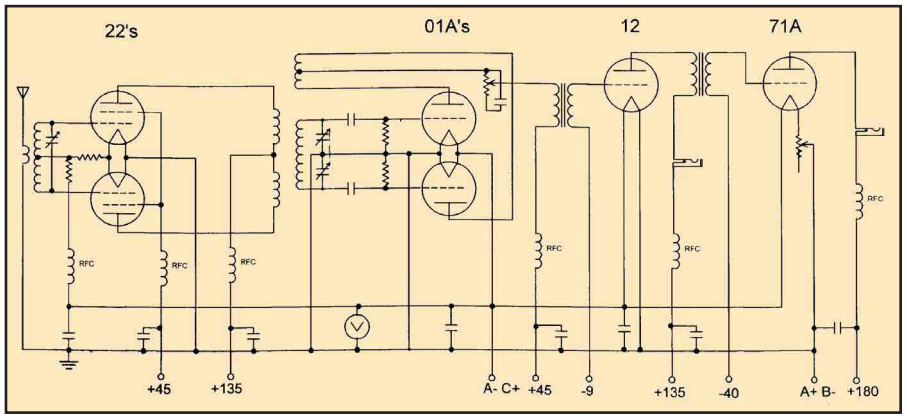


Figure 2—The schematic of the Schnell receiver. Note the push-pull arrangement of both the RF stage and the detector.

Figure 3—The complete set of plug-in coils for the receiver.

Figure 4—A close-up of a detector coil.

izing the grid to plate capacitance. Since all other tube types in this receiver use a nominal 5 V supply, there is a dropping resistor in the filament circuit. A tap on this resistor furnishes negative bias to the RF amplifier tubes through the center tap of the antenna coil.

Plug-in coils are used in both the RF amplifier stage and the following detector stage to change the frequency band. The receiver tunes from 92 meters to 18.7 meters (3.26 to 16 MHz). The antenna coils are wound on a commercially available form with a special matching socket. The detector stage uses homebuilt coils that have three windings, two of them with center taps. It is rather complex and must have required considerable experimentation to get the correct coupling. Four detector coils and two antenna coils are used to cover the frequency range. A view of the coils is shown in Figure 3 and a close-up of a detector coil can be seen in Figure 4.

The push-pull detector stage uses a wire wound rheostat in the plate supply to control regeneration. This was a common way to do this at that time, although some other designs varied the filament voltage to control regeneration. Audio appears on this line and the capacitor across the rheostat shunts audio around the regeneration control to the first audio transformer.

The two audio stages are straightforward transformer coupled circuits. There are two phone jacks on the front panel; one connects the headphones to the plate circuit of the first audio stage and the other connects to the second audio stage. A high impedance loudspeaker could also be plugged into the second jack instead of headphones. It was common practice at the time to run the dc plate current directly through the headphones or a high impedance loudspeaker. The two audio stages have separate batteries furnishing negative grid bias. Note that RF chokes and bypass capacitors are on all plate lines as well as the filament wiring, in order to prevent interaction between the stages.

Layout

Figure 5 is a top view of the receiver's interior. Notice the complete shielding, consisting of $^1/_8$ inch aluminum sheet between the stages. Originally, the receiver had a top shield, as well. Most of the components and circuitry are mounted on a varnished wood base. Wiring is heavy enameled bus bar with solder lugs on each end. Where tie points connecting several wires are required, a wood screw holds the end lugs together and fastens them to the wood base.

At the left side of the chassis is the push-pull RF amplifier stage with its plug in coil and variable tuning capacitor. There is a planetary vernier drive on this capacitor as well as on all the other receiver controls, with the exception of the filament rheostat. There are three plug-in coils in the RF stage to cover the tuning range of the receiver. Since the tuned circuit must be balanced with respect to ground, the three-plate tuning capacitor is mounted on insulators. The tuning shaft of this variable capacitor has an insulated coupling to prevent hand capacitance effects. The small cylindrical parts seen in Figure 5 are bypass capacitors and the larger, dark-colored round items are RF chokes encased in bakelite.

The center compartment of the receiver houses the push-pull detector stage, which uses two type 01A tubes. The sockets are mounted on sponge rubber and flexible braided wire is used for connections to the sockets. This was necessary to protect against vibration, as the tubes are highly microphonic. It's difficult to see them all, but there are eight connections to the detector coil (see Figure 4). These are managed by homemade plugs and sockets made from banana plugs and jacks. They are spaced so that the coils can only be inserted one way into their sockets.

On the front panel are the main tuning and the fine-tuning variable capacitors. Both have insulated couplings on their shafts to their respective vernier drives. The main tuning capacitor is a split-stator type in order to preserve the balance of the tuned circuit. The fine-tuning capacitor is unusual—it has only a single rotor plate and no stator, as shown in Figure 6. Apparently it works by varying the capacitance between the rotor and both support rods that originally held the stator plates. The

wirewound rheostat that controls regeneration can be seen mounted to an insulated plate supported from the front panel by two standoff insulators. An insulated coupling and a vernier drive is used on this control, as well. The rectangular item near the regeneration control is the control's audio bypass capacitor. The square items are mica-type coupling capacitors, and the items that look like cartridge fuses are the grid leak resistors. These are mounted in sockets like fuses.

The audio stages are in the right hand compartment and contain two audio transformers, two audio tubes and decoupling RF chokes and capacitors. The decoupling is necessary because, when the detector of this receiver oscillates (under normal CW reception), it radiates considerable RF. If this RF gets into the audio stages, it will cause a feedback howl under certain conditions. The filament rheostat is the large wirewound control on the front panel.

The rear panel of the receiver contains all the power connections and the antenna and ground connections. These use separate binding posts. Most likely, four 45 V batteries were connected in series, and taps on the various batteries went to the binding posts supplying the amplifier and detector stages.

Controls

On the left of the receiver front panel (Figure 1) is the tuning control for the RF stage. Immediately to the right of that is the fine tuning control, which makes use of the one plate capacitor. To the right of the fine tuning control is the main tuning control. The smaller knob without a scale is the regeneration control. The two phone jacks permit connection to the first or second audio stage. The audio output level (with headphones) from the first audio stage was found to be more than adequate. The second stage was most probably used to drive a loudspeaker.

The small knob below the meter is the filament rheostat. Most of the tubes in the receiver were designed for 5 V dc of filament voltage. In the 1920s, 6 V storage batteries were commonly used for a filament supply. Presumably, the 5 V tubes allowed for operation with a weak battery. Operating them with full 6 V from a battery might shorten tube life, so most receivers used a filament rheostat to keep the filament voltage to 5 V or less. The better receivers of the day often provided a voltmeter on the filament line to allow the user to monitor filament voltage. This receiver does have a filament voltage meter at the upper right of the panel. Receivers without voltmeters were simply adjusted for a minimum value of filament voltage that would provide acceptable audio output. The rheostat also served as a volume control and, on regenerative receivers, as a regeneration control. It turned out that, on this receiver, it served both functions.

The small switch at the lower right of the panel is the filament switch. It does not switch the high voltage supply, since the circuitry does not draw any current from the high voltage batteries with filaments off.

Restoration

The receiver did not require much restoration other than a thorough cleaning. The calibrated knobs were missing white paint in the engraved numbers, so the remaining paint was removed with a needle and replaced with white wax.

Some tubes were missing. The detector, however, used a type 01A, which was easily found. The audio tubes are also common types. The type 22 tubes used in the RF stage were more difficult to find, but since they are not in demand by radio restorers, they were available at a reasonable price.

Several high resistance connections, including the tube pins and tube sockets, had to be located and corrected. The wirewound variable resistors also required cleaning, but after I did all of this, the receiver gradually came to life.

In initial testing of the receiver, an annoying ac hum was found in the audio, even with the filaments operating from a battery supply. It wasn't coming from the high voltage power supply either, since it wasn't 120 Hz ac ripple. The mystery was cleared up when it was found that simply bringing one's hand within a few inches of the detector tubes increased the hum level. That induced hum was being amplified by the unshielded tubes and the long (5 inch) grid leads. When a piece of sheet metal was placed over the receiver to act as a top cover, the hum was reduced to the vanishing point.

Operation

An older edition of *The ARRL Handbook* contains a passing statement that the operation of regenerative receivers requires some operator skill. I'd agree with that! This one is cranky, cantankerous and full of quirks. But it works amazingly well, if you spend some time optimizing the controls.

The RF amplifier tuning is no problem; it isn't critical at all. The main tuning, however, is extremely sensitive and requires a very light touch to locate a station. When a station is found, the regeneration is increased, which then increases the selectivity. You find that you must then readjust the tuning, which becomes even more critical. The regeneration control is very abrupt since it is a wirewound variable resistor—just one wire change in its setting can bring the receiver into or out of regeneration. The

[Continued on page 46.]

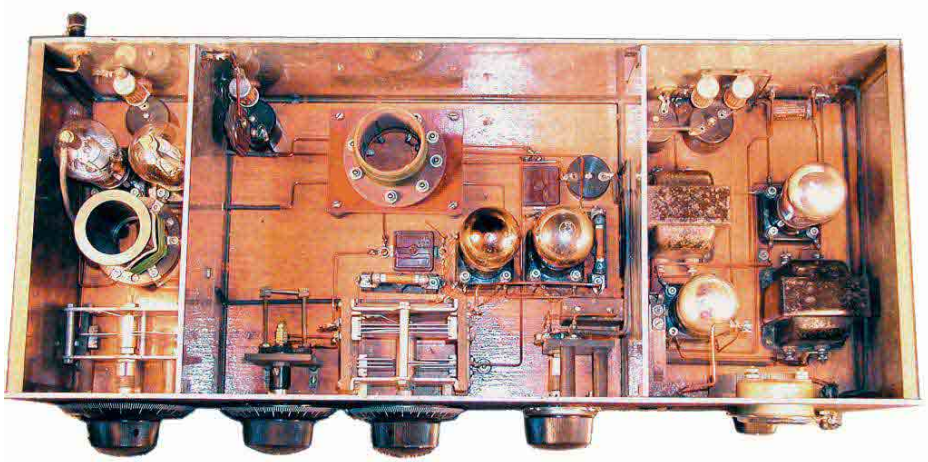


Figure 5—The chassis of the regenerative set. Note the careful shielding between stages and the varnished "breadboard" type chassis—a popular construction method of the 1920s.

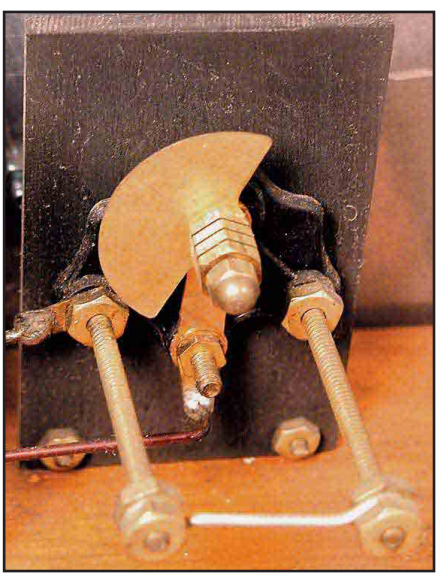


Figure 6—A close-up of the homebrew one plate fine-tuning capacitor.

By L. B. Cebik, W4RNL

Power and Antenna Gain on 60 Meters

Our new 60 meter allocation restricts you to 50 W PEP into a dipole, but what if you're not using a dipole? How much power can you use?

Rules for the new 60 meter band require that the operator use no more than 50 W PEP into a half-wave dipole, or an equivalent ERP (effective radiated power) when using an antenna other than a dipole.[1] Two questions have emerged from the community of new 60 meter operators. How do I calculate the maximum transmitter power output for my particular antenna? What is the gain of my antenna relative to a dipole?

The power calculation question is the simpler of the two. After I show a step-by-step procedure for calculating allowable 60 meter power, I'll explore a small compendium of antennas to find usable values of relative gain.

Calculating Allowable Power

Antenna gain values appear in decibels (dB) relative to some standard. To make the power calculation, we need to know the gain of a dipole and of the antenna in question relative to the same standard. If we use an isotropic standard (dBi), as does virtually all antenna-modeling software, then the free-space gain of a lossless dipole is about 2.15 dBi, or slightly less if we specify a material such as copper wire. For any other antenna, we need only find the gain difference (positive or negative) between the antenna and the dipole. Let's call that value "delta gain," abbreviated ΔGn_{dB}.

Since the allowable power with a dipole is 50 W PEP (peak envelope power), the allowable TPO (transmitter power output) with the other antenna is:

$$P_{al} = \frac{50}{\log^{-1}\left(\frac{\Delta Gn_{dB}}{10}\right)}$$

where

P_{al} is the allowable TPO in W, and

ΔGn_{dB} is the gain difference in dB between a dipole and the antenna in question

To perform the calculation on a calculator (which must have an anti-log or $\log^{-1}$ function), follow these steps:

1. Divide the gain difference by 10.
2. Take the anti-log (or inverse log) (base 10) of the result of step 1.
3. Divide the result of step 2 by 50.
4. Take the inverse of the step 3 result using the 1/x function key.

If you carry out the steps with an antenna that has 3 dB more gain than a dipole or 3 dBd, you will end up with 25.06 W of allowable TPO. If your antenna has –3 dBd gain relative to a dipole, your allowable TPO is 99.76 W. (Gain relative to a dipole is abbreviated as dBd. If an antenna has a gain of 0 dBd, it will give the same effective radiated power as a dipole for any power level.)

Before we leave the calculation, let's consider those decimal places in the sample results. The very best power meters available to amateurs may be accurate to ±5%, but ±10% is more usual. 10% of the 50 W power limit is 5 W, which is nearly equivalent to a half dB antenna gain difference relative to a dipole. Rounding all antenna-gain differences to the nearest half dB and all power adjustments to the nearest 5 W will match the accuracy limits of your equipment.

Now all that we need to know is the gain of the antenna that we plan to use and its difference in gain from that of a dipole. Let's make a catalog of some common antenna types.

Resonant 60 Meter Antennas

To fairly compare one antenna with

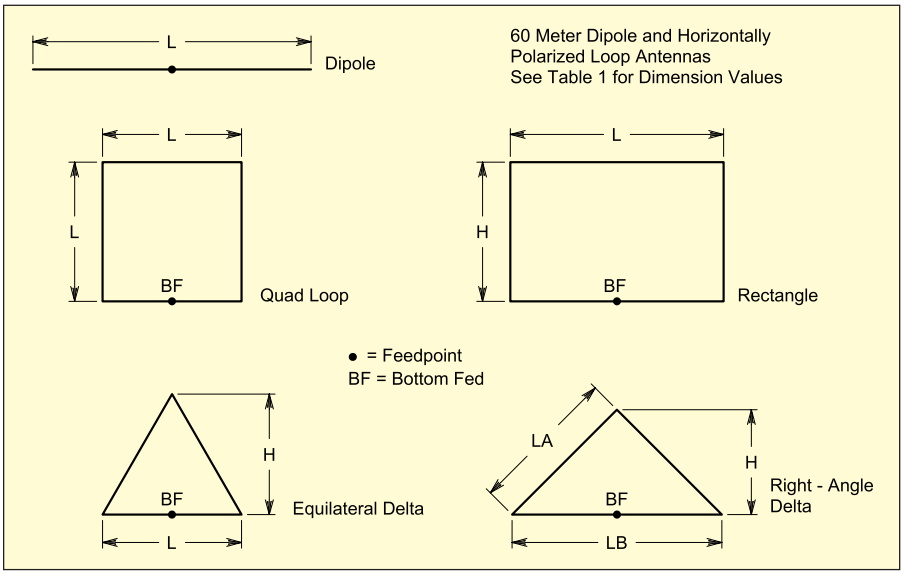


Figure 1—An outline of horizontally polarized wire antennas suitable for 60 meter use.

[1]Notes appear on page 42.

Table 1

Horizontally Polarized Antennas Included in the Resonant 60 Meter Group

All antennas use 14 gauge copper wire.
Dimensions are referenced to the outline figures.
Gain differentials are with respect to a free space dipole.
Free space dipole gain = 2.04 dBi.

Antenna	*Model file name*	*Dimensions Feet/Meters*	*Resonant Free-Space Impedance (Ω)*	*Delta Gain Gain (dBi)/(dB)*	*Allowable Power (W)*
1/2 wavelength dipole	dpl60-fs	L = 89.2 / L=27.19	73.7	2.04 / ——	50.0
1 wavelength vertical quad loop, bottom-fed	q60-fs-bf	L=47.9 / L=14.6	127.0	3.14 / 1.10	38.8
1 wavelength equilateral delta loop, bottom-fed	eqd60-fs-bf	L=64.32 / L=55.7 H=55.7 / H=16.98	117.4	2.80 / 0.76	42.0
1 wavelength right-angle delta loop, bottom-fed	rad60-fs-bf	LB=79.0 / LB=24.08 LA=55.86 / LA=17.03 H=39.5 / H=12.04	196.4	2.42 / 0.38	45.8
1 wavelength rectangle, bottom-fed	rect60-fs-bf H=20.0 / H=6.1	L=72.5 / L=22.1	259.3	2.25 / 0.21	47.6
2 element Moxon rectangle	mox60-fs	A=66.99 / A=20.42 B=10.36 / B=3.16 C=1.48 / C=0.45 D=12.32 / D=3.75 E=24.16 / E=7.36	56.2	5.72 / 3.68	21.4
2 element driver-reflector Yagi	2lyag60-fs	LR=91.7 / LR=27.95 LDR=87.64 / LDR=26.71 SP=26.6 / SP=8.11	42.0	6.07 / 4.03	19.8
3 element Yagi	3lyag60-fs	LR=91.2 / LR=27.8 LDR=89.0 / LDR=27.13 SP1=28.6 / SP1=8.72 LDI=86.0 / LDI=26.21 SP2=32.4 / SP2=9.87	27.1	7.63 / 5.59	13.8

another, we must give them a common environment. For most horizontally polarized antennas, the easiest common environment for comparison is free space. In the absence of specific regulatory guidance, we shall use free space as the basis for all of the horizontal antenna comparisons to follow. The sidebar shows why free space is an adequate basis for general guidance, although wherever you can model both the dipole and your own antenna at the actual height, you should use that method. Be aware that free space may not be an adequate guide to real antenna comparisons when antennas are at low heights, that is, below about 30 feet (9.1 m or 0.16 wavelength). A wavelength at the center of 60 meters (about 5.368 MHz) is 183 feet or 55.8 meters. Most common backyard antennas will likely be between 0.15 to 0.25 wavelength above ground.

I have modeled a sample of common resonant 60 meter antennas. Figure 1 outlines most of the horizontally oriented loops, while Figure 2 shows the outlines of the sample wire beams. All of the models used 5.368 MHz as the design frequency. Since the band is only 73 kHz wide, performance does not vary from one end of the band to the other, other than the SWR for some of the narrow band antennas. The 2 and 3 element wire Yagis are typical narrow band antennas. All antennas in the comparisons use 14 gauge (0.0641 inch diameter) copper wire. However, wire sizes from 18 gauge through 10 gauge do not change the gain values enough to call for attention.

Table 1 lists a variety of information for each type of antenna. The file names refer to available models of the antennas.[2] Dimensions in feet and meters correlate to designations in the two outline graphics. The resonant impedance is the feed-point resistance as modeled. This value may change for antennas mounted at low heights. The 14 gauge copper wire dipole has a free-space modeled gain of 2.04 dBi, the reference value for all of the other antennas in the group. The gain difference used in the power calculation follows, along with the calculated allowable power value.

The vertically oriented loops show a feed-point at the bottom center of the loop, regardless of shape. This position yields a horizontally polarized signal broadside to the loop. In free space, it does not matter whether the delta or triangular loops place the apex at the top or the bottom or whether the feed-point is centered on the base line or the apex. These antennas are 1 wavelength loops at 60 meters, but usable as multiband loops for all HF frequencies above 5 MHz.

The beams represent three different gain levels and are about the largest common arrays likely to be used on 60 meters. For more detailed information about each antenna type, consult a good antenna reference, such as *The ARRL Antenna Book*.

Horizontally Polarized Multiband Wire Antennas

We may apply the same set of free-space comparisons between a dipole and virtually any horizontally polarized antenna in order to determine the allowable power for our 60 meter operations. Figure 3 shows some of the common arrays we might use, minus the collection of doublets ranging from 67 feet to 135 feet. The data in Table 2 mirrors the information pro-

Is the Free-Space Dipole Standard a Fair Comparator?

The fairness or technical appropriateness of using free-space antenna models to determine the allowable power on 60 meters is divisible into two questions, one each for horizontal and vertical antennas.

Horizontally Polarized Antennas

The alternative to using the free-space comparisons set forth as initial guidelines involves comparing a dipole and some other proposed antenna at the same height over real ground. To do a preliminary test of the consequences of using this method, I modeled a 14 gauge copper wire dipole at 20 foot intervals from 20 through 200 feet, passing the 1 wavelength height of 183.23 feet. I then selected the 2 element Yagi for the same test, because it exhibits a large degree of difference between its TO angle and that of the dipole at lower heights. The results of the modeling exercise appear in Table A-1. The table has an additional column based upon an alternative premise. Since the TO angles vary so widely at low antenna heights, why not take the gain values at a reasonable but arbitrary elevation angle? 20° seemed to match likely propagation angles. So the last two columns record the modeled and calculated results for that test.

The supplementary data in the table show averages of gain difference between the dipole and the Yagi both with the abnormal 20 feet results and without them. The oddity of the 20 feet results are a function of the interactions with the ground, so the Fresnel zone reflections don't behave as they would with the antenna higher. Regardless of which method one uses to average the results, the allowable power falls within 5 W of the calculated value based on a free-space comparison of gain levels. As noted earlier, 5 W falls within the limits of accuracy of most power meters accessible to radio amateurs. Since a 5 W variation represents only about 0.5 dB of antenna gain, the free-space comparison remains a valid method of setting power in order to remain within the 50 W ERP requirement for 60 meters.

Vertically Polarized Antennas

The comparator for vertical monopoles in the main text is a ½ wavelength dipole of 14 gauge copper wire with its base 5 feet above average ground. This antenna yielded a gain of 0.00 dBi at 17° elevation angle, a convenient value for other comparisons. We need only to raise the question of whether one may fairly use a free-space comparison for vertically polarized antennas and arrays that require no radial system. Such antennas include all of the side-fed loops and the open-ended half square and bobtail curtain.

The most extreme case among this group of antennas is the half square. The free-space analysis of the half square yields a gain difference of 2.56 dB, with a resulting allowable power of 27.7 W. If we place the half-square about 5 feet above average ground, we obtain a maximum gain of 3.41 dBi at 20° elevation. The calculated allowable power level is 22.8 W. The difference between the two analyses is within (but just barely) the 5 W limit of recommended allowable rounding. Since gain variations for these antennas will track within close limits as we change soil quality and make minor changes in the height of either the dipole standard or the proposed vertically polarized antenna, further refinement of values is not warranted within the context of this exercise. Wherever you, as an individual operator, can develop more exact data about your own antenna, however, you should use it in place of the very general guidance provided by these notes.

Table A-1
Comparison of Gain and Calculated Allowable 60 Meter Power
Based on horizontal dipoles and 2-element Yagis above average ground

Dipole Height (feet)	*Max Gain (dBi)*	*TO Angle (degrees)*	*Gain@20° (dBi)*
20	5.04	88	–2.40
40	6.15	76	0.90
60	6.04	43	3.19
80	6.93	32	5.59
100	7.92	25	7.49
120	7.88	21	7.85
140	7.30	18	7.21
160	7.21	16	6.60
180	7.68	14	6.02
200	8.04	13	4.65

2-Element Yagi

Height (feet)	*Max Gain (dBi)*	*Delta Gain dipole (dB)*	*TO Angle Gain@20° (degrees)/(dBi)*	*Delta Gain dipole@20° (dB)*
20	5.09	0.05	56 / 0.38	2.78
40	8.44	2.29	45 / 5.12	4.22
60	9.64	3.60	36 / 7.60	4.41
80	10.59	3.66	30 / 9.59	3.99
100	11.25	3.33	24 / 10.94	3.45
120	11.33	3.45	21 / 11.32	3.47
140	11.29	3.99	18 / 11.16	3.95
160	11.39	4.18	16 / 10.69	4.09
180	11.62	3.94	14 / 9.84	3.82
200	11.72	3.68	13 / 8.21	3.56

Average Gain difference		
Using 20 foot values	3.22 dB	3.77 dB
Allowable power	23.8 W	21.0 W
Average Gain difference		
Without 20 foot values	3.57 dB	3.88 dB
Allowable power	22.0 W	20.4 W

Free-space comparison gain difference: 4.03 dB
Allowable power: 19.8 W

Table 2
Horizontally Polarized Antennas Included in the Multiband Group

All antennas use 14 gauge copper wire.
Dimensions are referenced to the outline figures.
Gain differential is with respect to a free space dipole.
Free space dipole gain = 2.04 dBi.

Antenna	*Model file name*	*Dimensions Feet/Meters*	*Impedance (Ω)*	*Free-Space Gain (dBi)*	*Delta Gain (dB)*	*Allowable Power (W)*
135 foot doublet	dblt135-60-fs	L=135.0 / L=41.15	400+*j*1128	2.67	0.63	43.2
102 foot doublet	dblt102-60-fs	L=102.0 / L=31.09	113+*j*250	2.18	0.14	48.4
67 foot doublet	dblt67-60-fs	L=67.0 / L=20.42	34.8–*j*439	1.83	-0.21	52.5
Extended double Zepp	edz60-fs	L=229.0 / L=69.8	176–*j*986	4.96	2.92	25.5
8JK	8jk60-fs	L=183.2 / L=55.84 W=45.8 / W=13.96	20.3–*j*250	6.92	4.88	16.3
Lazy-H	lh60-fs	L=183.2 / L=55.84 H=91.6 / H=27.92	24.5+*j*1.8	8.00	5.96	12.7
80 m, 2 wavelength loop square, corner-fed	hohpl80-60-fs-cf	L=140.0 / L=42.67 C=560.0 / C=170.69	252–*j*27	4.97	2.93	25.5
80 m, 2 wavelength loop square, side-fed	hohpl80-60-fs-sf	L=140.0 / L=42.67 C=560.0 / C=170.69	248–*j*39	3.04	1.00	39.7
80 m, 2 wavelength loop triangle, corner-fed	hohpl80-tri-60-fs-cf	L=186.0 / L=56.69 C=560.0 / C=170.69	112+*j*19	3.05	1.01	39.6
80 m, 2 wavelength loop triangle, side-fed	hohpl80-tri-60-fs-sf	L=186.0 / L=56.69 C=560.0 / C=170.69	130+*j*6	2.91	0.87	40.9
60 m, 2 wavelength loop square, corner-fed	hohpl60-fs-cf	L=90.0 / L=27.43 C=360.0 / C=109.73	79–*j*334	1.18	-0.86	60.9
60 m, 2 wavelength loop square, side-fed	hohpl60-fs-sf	L=90.0 / L=27.43 C=360.0 / C=109.73	241–216	2.99	0.95	40.2
60 m, 2 wavelength loop triangle, corner-fed	hohpl60-tri-fs-cf	L=120.0 / L=36.58 C=360.0 / C=109.73	256–*j*222	2.30	0.26	47.1
60 m, 2 wavelength loop triangle, side-fed	hohpl60-tri-fs-sf	L=120.0 / L=36.58 C=360.0 / C=109.73	195–*j*315	2.59	0.55	44.1

vided in Table 1. However, the feed-point impedances as modeled in *NEC-4* are not resonant. Once again, for antennas at low heights, the impedances may vary considerably from the listed values.

The table begins with the most common doublets in amateur service. ("Dipole" indicates a 1/2 wavelength antenna, while "Doublet" refers generally to any single-wire antenna fed at its center.) An antenna of 135 feet corresponds to an 80 meter dipole, while 67 feet is the length of a 40 meter dipole. Any doublet shorter than a 40 meter dipole is likely to show a low resistance and a level of capacitive reactance at the feed point that will challenge an antenna tuner's matching ability and efficiency. The 102 foot doublet is the length of the antenna often called the G5RV. The extended double Zepp is any wire about 1.25 wavelengths long at the operating frequency. All of these antennas presume the use of parallel transmission line and an antenna tuner.

The 8JK antenna is a common wire phased array using two elements. The version shown in Figure 3 uses 1 wavelength elements with 1/4 wavelength spacing between elements and 600 Ω transmission lines to the junction that forms the feedpoint. If one has sufficiently tall vertical supports, the lazy-H provides excellent performance. The basic version uses two 1 wavelength elements vertically spaced 1/2 wavelength apart. Note that we feed the elements in phase, in contrast to the 8JK feed system. The modeled phasing lines are 600 Ω.

All of the multi-band antennas we have listed so far are bi-directional, with equal major lobes broadside to the elements. The horizontally oriented loops have more irregular patterns, depending upon the exact shape and the position of the feedpoint at a corner or centered on one side. The listing shows values for 80 meter loops pressed into 60 meter service as well as for loops cut specifically for 60 meters. The table shows both square and triangular horizontal loops, with some differences in pattern shape and consequential differences in maximum gain. The dimensions show two values: the length of one side (L) and the total circumference (C). If a loop is closer to 1 wavelength than to the 2 wavelength circumference shown, it will tend to radiate broadside to the loop, that is, straight up. Hence, the 2 wavelength minimum circumference is a recommended minimum size for edge-wise radiation. However, the 1 wavelength loop is useful for NVIS communications.

The listing of multiband horizontal antennas is necessarily incomplete. Nevertheless, you may safely interpolate gain

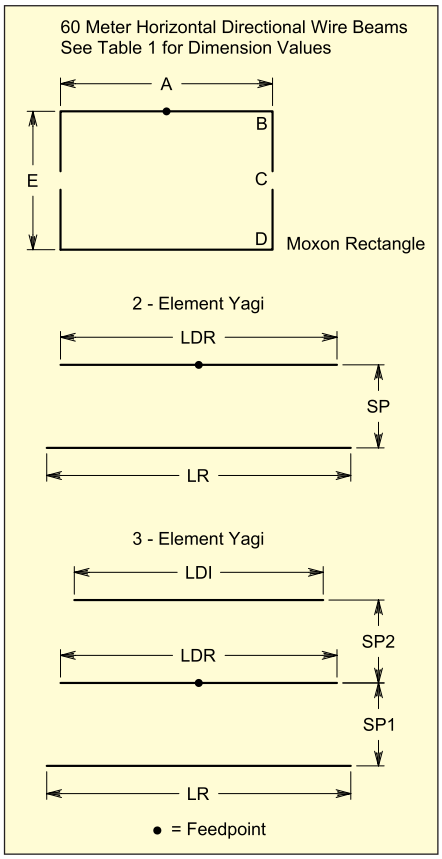


Figure 2—An outline of some horizontal directional wire beam antennas.

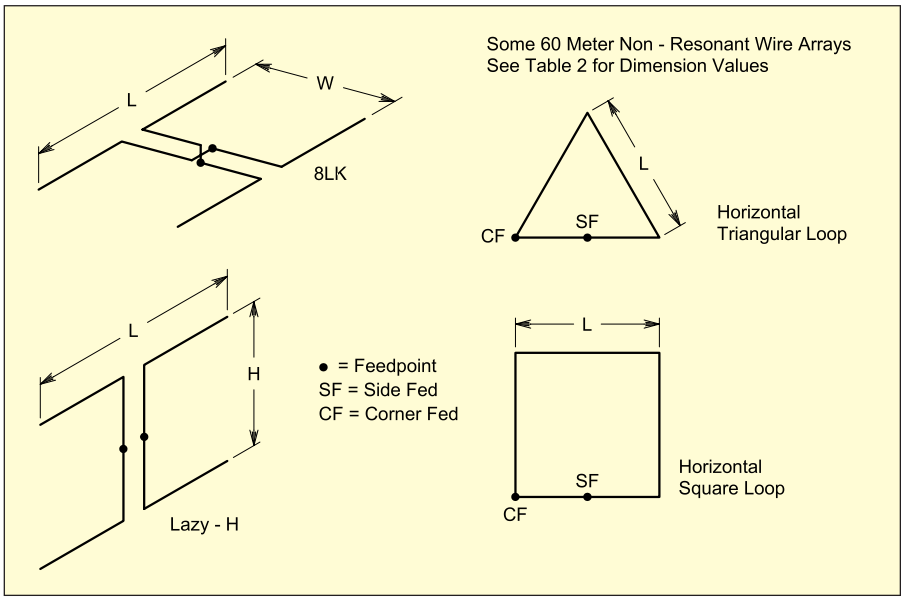


Figure 3—An outline of some 60 meter non-resonant wire antennas.

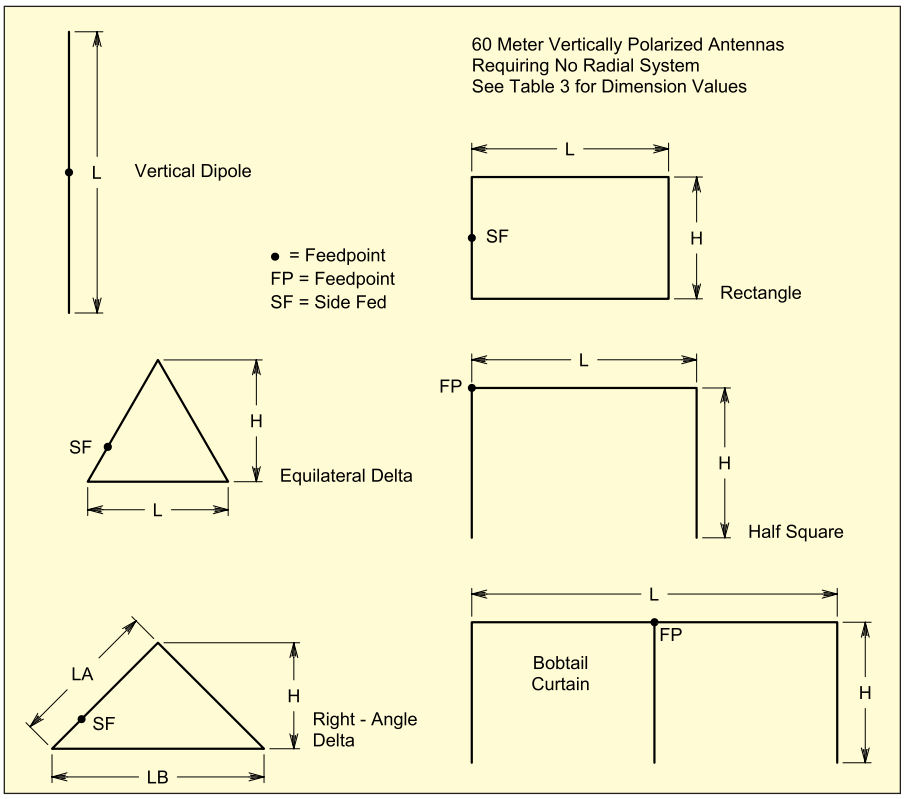


Figure 4—Vertically polarized vertical antennas without radials.

values for minor variations on the antennas listed or for doublets between the limits of those that appear in the table.

Vertically Polarized Above-Ground Antennas

When we turn to vertically polarized antennas that are wholly above ground and require no ground radial system, we need a new gain reference standard. For that standard I have adopted the vertical wire (14 gauge copper) dipole with its base 5 feet above average ground (conductivity 0.005 s/m, permittivity 13). This antenna shows a *NEC-4* gain of 0.00 dBi, a convenient value that simplifies comparisons with other antennas. The comparative gain values remain relatively constant as we change soil quality. Hence, the calculated allowable power will remain valid within the ±5 W rounding limit. The sidebar also provides a comparison between the use of the vertical dipole above real ground and the use of a free-space model with one of the above-ground vertical antennas to further validate the new standard.

Figure 4 outlines the collection of vertically oriented, vertically polarized antennas. All of the antennas are bidirectional, with lobes broadside to the horizontal wire(s). The group includes a number of 1 wavelength loops with their feed points positioned to achieve vertical polarization. For the deltas or triangles, this position is about 1/4 wavelength away from the apex. Table 3 lists the deltas with the apex both up and down to demonstrate the minor differences that result from the change of orientation. The lowest wire in each model is 5 feet above average ground.

The listing also includes two popular open-ended arrays, the half-square and the bobtail curtain. These arrays tend to show higher gain at low heights than the loops. These two arrays and the side-fed rectangle are subject to variations in published horizontal and vertical dimensions, however, and these changes may affect an array's broadside gain. Like the loops, the lowest point for the vertical wires is

Table 3

Vertically Polarized Above Ground Antennas Included in the Resonant 60 Meter Group

Dimensions are referenced to the outline figures.
Gain differential is relative to a vertical dipole.
All antennas use 14 gauge copper wire with the lowest wire point 5 feet above average ground.

Antenna	*Model file name*	*Dimensions Feet/Meters*	*Impedance (Ω)*	*Resonant TO Angle/Delta Gain (degrees)/(dB)*	*Allowable Power (W)*
1/2 wavelength vertical dipole	vdpl60-5	L=89.3 / L=27.22	92.0	17 / 0.00	50.0
1 wavelength vertical quad loop, side-fed	q60-5-sf	L=47.0 / L=14.33	217.7	22 / 0.92	40.5
1 wavelength equilateral delta loop, side-fed, apex up	eqd60-5-sf	L=63.2 / L=19.26 H=54.73 / H=16.68	196.8	23 / 0.78	41.8
1 wavelength equilateral delta loop, side-fed, apex down	eqd60-5-ad-sf	L=64.2 / L=19.57 H=54.73 / H=16.68	175.5	19 / 0.68	42.8
1 wavelength right-angle delta loop, side-fed, apex up	rad60-5-sf	LB=79.26 / LB=24.16 LA=55.99 / LA=17.07 H=39.6 / H=12.07	99.4	25 / 1.03	39.4
1 wavelength right-angle delta loop, side-fed, apex down	rad60-5-ad-sf	LB=80.0 / LB=24.38 LA=56.56 / LA=17.24 H=40.0 / H=12.19	90.4	22 / 1.00	39.7
1 wavelength rectangle, side-fed	rect60-5-sf	L=72.4 / L=22.07 H=20.75 / H=6.32	55.1	26 / 1.42	36.1
Half-square	hs60-5	L=83.0 / H=25.3 H=51.55 / H=15.71	78.1	20 / 3.41	22.8
Bobtail curtain	bc60-5	L=166.2 / L=50.66 H=50.05 / H=15.26	84.5	20 / 4.91	16.1

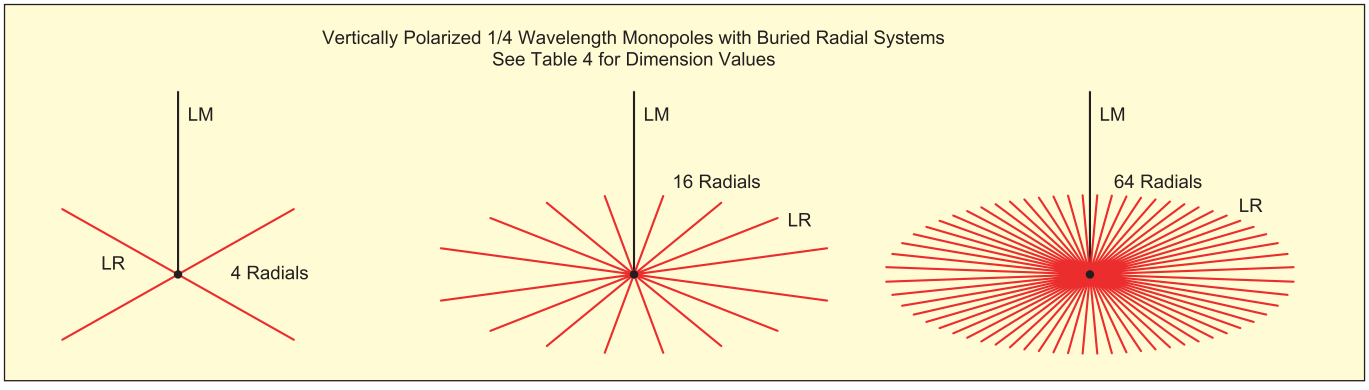


Figure 5—Some vertical ground-mounted antennas.

5 feet above ground. Although this height is convenient for our power calculations, actual antennas should be high enough to place all wires out of the reach of any person. Even at low power, the antennas have points with very high voltages.

Vertical Monopoles with Buried Radial Systems

Although we shall retain our slightly elevated vertical dipole as a standard for the gain comparisons needed for calculating allowable power, we shall alter our procedure for evaluating 1/4 wavelength vertical monopoles with radial systems. We shall survey three sizes of radial fields: 4, 16 and 64 radials. Figure 5 outlines the range of model sizes, all of which continue the use of 14 gauge wire throughout. The collection of available models will include versions with buried radials for *NEC-4* users and the roughly equivalent models with above ground radials for *NEC-2* users. We shall also sample different soil qualities, ranging from very poor (conductivity 0.001 S/m, permittivity 5) through very good (conductivity 0.0303 S/m, permittivity 20).

The results of the survey appear in Table 4. After a listing of the soil qualities used in the sampling, the table shows values for the vertical dipole for each soil condition. In the data for the vertical monopoles using three different radial fields, the gain difference entry is based on the dipole gain for the operative soil quality. For this set of antennas, every radial is exactly 1/4 wavelength long. The height of the monopole is varied with the size of the radial field so that the monopole is resonant over the soil quality labeled as "good."

Table 4

Antennas Included in the 60 Meter Vertical Monopole Group

Dimensions are referenced to the outline figures.
Gain differential is referenced to a vertical dipole.
All antennas use 14 gauge copper wire.
All radials are 0.001 wavelength below ground surface (2.2 inches) and are 1/4 wavelength long (45.81 feet).

Soil Qualities

Label	*Abbr*	*Conductivity (S/m)*	*Permittivity*
Very Good	VG	0.0303	20
Good	G	0.005	13
Poor	P	0.002	13
Very Poor	VP	0.001	5

Antenna	*Model File name*	*Soil Quality*	*Monopole Length (LM) Feet/Meters*	*Gain (dBi)*	*TO Angle*	*Impedance (Ω)*	*Delta Gain (dB)*	*Allowable Power (W)*
Reference dipole								
1/2 wavelength vertical dipole	vdpl60-5	VG	L=89.3 / L=27.22	2.40	14	94.7+*j*1.3	——	50.0
		G		0.00	17	92.0–*j*0.8	——	50.0
		P		–0.21	18	90.4–*j*0.4	——	50.0
		VP		–0.75	20	87.1–*j*2.1	——	50.0
4 radial system								
1/4 wavelength vertical monopole	vmp60-4b	VG	LM=43.58 / LM=13.28	0.80	20	46.1–*j*3.7	–1.60	72.3
		G		–2.47	26	64.0–*j*0.3	–2.47	88.3
		P		–3.19	27	70.2–*j*6.4	–3.40	109.4
		VP		–5.34	29	101+*j*16	–4.59	143.9
16 radial system								
1/4 wavelength vertical monopole	vmp60-16b	VG	LM=44.1 / LM=13.44	1.94	20	37.6–*j*1.2	–0.46	55.6
		G		–0.23	26	40.8+*j*0.2	–0.23	52.7
		P		–0.53	27	42.8+*j*0.4	–0.74	59.3
		VP		–1.37	29	38.5+*j*4.7	–0.62	57.7
64 radial system								
1/4 wavelength vertical monopole	vmp60-64b	VG	LM=44.4 / LM=13.53	2.47	20	33.8+*j*0.1	0.07	49.2
		G		0.73	26	32.4–*j*0.5	0.73	42.3
		P		0.71	27	31.2–*j*0.3	0.50	44.6
		VP		–0.44	29	28.9–*j*2.3	0.31	46.6

If you perform the same exercise using *NEC-2*, then the radials must be above ground, but very close to it (0.001 wavelength). The results will differ from *NEC-4* models. For example, for some radial fields, you may find that poor soil yields a slightly higher gain than good soil, similarly to the results for the vertical dipole standard.

Going Further on Your Own

The tables provided in these notes are for very general initial guidance in the process of determining your allowable 60 meter power for the antenna that you are using (or propose to use). They set up a usable dipole standard and compare modeled versions of each antenna against the standard. If your own antenna differs significantly from those surveyed or if you plan to install it less than 0.25 wavelength above ground, you should take additional steps to obtain more precise data.

One useful step is to model both the dipole standard and the antenna in question at the same height above ground. The task, of course, requires that you obtain (or obtain access to) antenna modeling software. Modeling software based on *NEC* is adequate to the required analyses. For horizontal antennas below about 0.2 wavelength, however, *MININEC* models are likely to yield inaccurate results due to limitations of its ground calculation system.

On the side of caution, beware of gain figures for your proposed antenna that come from advertising, older literature, or sources that simply use "dB" without reference to a standard. Such figures may or may not be accurate. Perhaps the surest way to have confidence in the gain values for your 60 meter antenna is—in the absence of a rated antenna range—is to model both it and a reference dipole.

Notes

[1]The FCC Report and Order creating the 60 meter allocation is available at **hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-03-105A1.doc**. The specifications for operation are in item 31. Additionally, see "60 Meters: Frequently Asked Questions" in the August 2003 issue of *QST*.

[2]The entire collection of models used in this exercise is available at **www.arrl.org/files/QST-binaries/Cebik0204.zip/60MModels/**. There are both .EZ (*EZNEC*) and .NEC (generic *NEC*) versions of all 43 models.

*L. B. Cebik, W4RNL, has been licensed since 1954. He has hosted a Web site (***www.cebik.com***) devoted to antennas and related topics since retiring from academic life at the University of Tennessee, Knoxville. LB has written many articles and more than 15 books, including the* ARRL Continuing Education Course on Antenna Modeling. *He has been both a technical and educational advisor for the ARRL and has been inducted into the QRP and QCWA Halls of Fame. LB can be contacted at 1434 High Mesa Dr, Knoxville, TN 37938 or at* **cebik@cebik.com**.

NEW PRODUCTS

MACDOPPLERPRO V2.0 FROM DOG PARK SOFTWARE

◊ Dog Park Software has announced that version 2.0 of *MacDopplerPRO,* satellite tracking software for Macintosh computers, has been released and can be downloaded from **www.dogparksoftware.com/MacDopplerPRO.html**. This is a free upgrade for registered users of *MacDopplerPRO* who registered after October 25, a $50 charge otherwise. This release has been rewritten for Carbon —OS 9 and OS X and now works with *MacLoggerDX*. Check the Web site for the complete list of new features. For more information, contact Dog Park Software Ltd, **dagro@dogparksoftware.com**, **www.dogparksoftware.com**.

By Phil Salas, AD5X

A Mobile Antenna Base with Internal Capacitive Matching

Do you have a mobile antenna for that new car but don't want to drill any holes? Here's a great solution that adds the convenience of antenna matching built right into the mount.

For years I've tinkered with electronic projects at home. Two things have started to impact the fun: a harder time focusing up close (since I turned 50) and the fact that parts are getting smaller. One way around this is to concentrate on physically larger projects—like antennas and related items.

I needed a simple antenna mount that could easily attach to my new Volkswagen Beetle without drilling holes. I wanted this antenna mount to support most mobile HF antennas, especially a Hamstick or Carolina Bug Catcher, since these are my current antennas. Additionally, I wanted the mount to include internal capacitive matching, which is normally required for short antennas.

The VW Beetle Mobile Mount

The Volkswagen New Beetle has a heavy steel "loop" under the right rear part of the car, and this loop is bolted into the car frame. This is a tie-down loop used for new vehicle transport and it is present on many newer vehicles. It's an excellent place to attach an antenna mount. I had a couple of scrap pieces of 1/4 inch thick aluminum rack channels and cut them to the dimensions shown in Figure 1. The completed mounting bracket is shown in Figure 2. This is a sturdy mount and a much larger antenna could be mounted on it with no problem.

Base Matching for Mobile Antenna

When any antenna is properly resonated, you will see a total resistance composed of the radiation resistance, coil losses and ground losses. For short antennas, the radiation resistance is very low—on the order of 2 to 3 Ω for a center loaded 40 meter antenna. Assuming you have reasonable coil and ground losses, you will see low impedance at resonance that needs to be matched to 50 Ω. This can be done with either a shunt inductor or a shunt capacitor mounted at the base of the antenna.

By lengthening the antenna a little bit, the antenna will have an inductive component, so that shunt capacitive tuning works. The effective series inductance and shunt capacitance make up an L network that transforms the low impedance to 50 Ω. Similarly, if the antenna is shortened a bit, it looks capacitive and so a shunt inductor completes the L match to 50 Ω. With a shunt inductor, you need to change coil taps and with a shunt capacitor, you need to change the capacitors as you change bands. I've always preferred using shunt capacitors and I use 300 V silver-mica capacitors, which are fine for a 100 W transmitter.

The *ARRL Antenna Book*[1] and *ARRL Handbook for Radio Communications*[2] show how to calculate the capacitance values needed based on VSWR measurements. It's easy to just put a variable capacitor across the input to the antenna and find the value that gives the best match. Then measure this capacitor value with an antenna analyzer and replace it with a fixed value.

For the Carolina Bug Catcher and

[1]Notes appear on page 46.

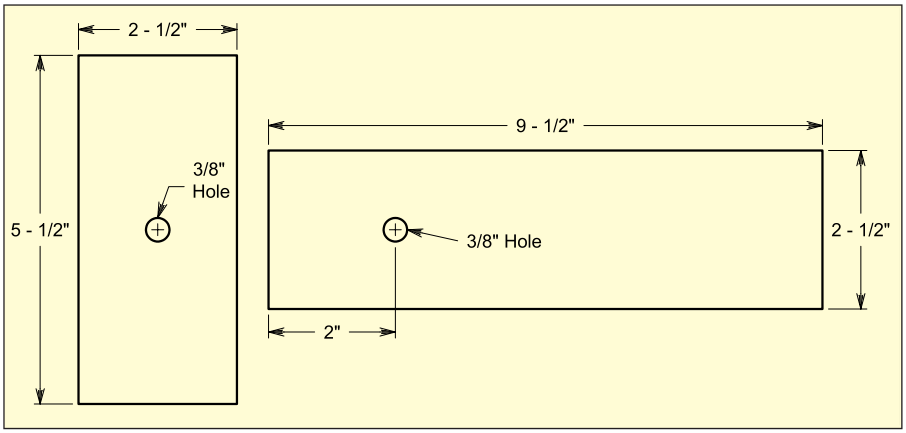


Figure 1—Detail of the Volkswagen antenna mounting bracket hardware.

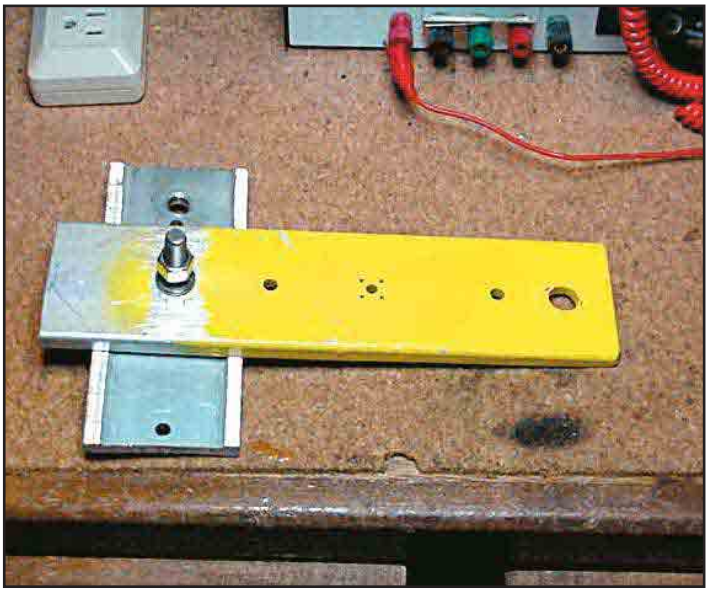


Figure 2—The completed bracket, ready for the mount.

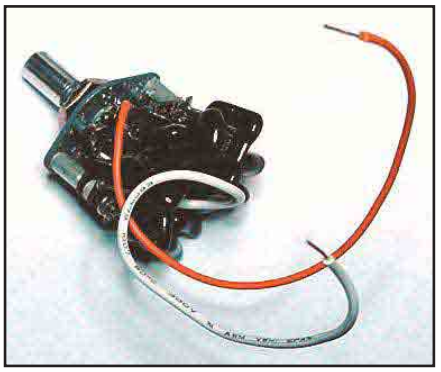


Figure 4—The 1 pole, 12 position rotary switch with the matching capacitors attached.

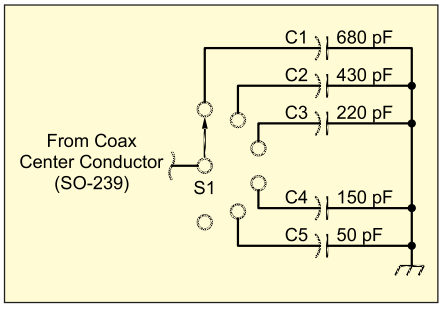


Figure 3—The schematic and parts list for the antenna matching base and rotary capacitor switch. Parts are available from a number of sources. The suppliers listed are Mouser Electronics, 1000 N Main St, Mansfield, TX 76063; tel 800-346-6873; www.mouser.com and RadioShack, www.radioshack.com.

C1—680 pF capacitor, 300 V (Mouser 5982-15-300V680).
C2—430 pF capacitor, 300 V (Mouser 5982-15-500V430).
C3—220 pF capacitor, 300 V (Mouser 5982-15-500V220).
C4—150 pF capacitor, 300 V (Mouser 5982-15-500V150).
C5—50 pF capacitor, 300 V (Mouser 5982-15-500V50).
S1—Switch, 1 pole, 12 position (Mouser 10YX112 or RadioShack 275-1385).
SO-239 UHF socket (Mouser 523-83-1R-RFX or RadioShack 278-201).

Plumbing Parts & Hardware

(1) 1/2×1/8 NPT brass adapter.
(1) 1 inch PVC "X" (4 port PVC junction).
(1) 1 1/4 inch PVC cap.
(1) 1×1/2 inch PVC threaded adapter.
(1) 1×1/2 inch PVC smooth adapter.
(1) 1 inch PVC plug.
(10) #6×3/8 inch stainless steel sheet metal screws.
(1) 3/8×16×2 1/2 inch stainless steel carriage bolt.
(1) 3/8 inch stainless steel lock washer.
(1) 3/8 inch stainless steel nut.
(1) #8×1 inch brass machine screw.
(1) #8 copper plated steel lock washer.
(1) #8 nut.
(1) #8 wing nut.

Table 1
Capacitance Values for Each Band

	40 M	*30 M*	*20 M*	*17 M*	*15 M*	*12/10 M*
Carolina Bug Catcher	680 pF	430 pF	220 pF	150 pF	50 pF	none
Hamstick	560 pF	390 pF	150 pF	150 pF	none	none

Hamstick antennas, the values of capacitance that properly match the antennas are shown in Table 1.

Antenna Mount with Capacitive Base Matcher

A 1 pole, 12 position, rotary switch is used for the capacitor selection. The schematic of the capacitor switch is shown in Figure 3, and a photo of this switch fully loaded with capacitors is shown in Figure 4. The necessary capacitors for the Carolina Bug Catcher are in the 40-10 meter positions. I also have in-between values of capacitors in the other 6 positions for other antennas.

The antenna mount with switched capacitors is built using a 1 inch PVC "X" (a 4 port PVC assembly). All PVC parts are standard 1 inch and 1 1/4 inch pieces along with a 1/8 NPT×1/2 inch brass adapter and stainless steel hardware as shown in the parts list of Figure 3. The 1/8 NPT (national pipe thread) threaded hole is slightly tapered and fits the 3/8×24 thread—the standard thread used for mobile antennas. Antennas terminated with the standard 3/8×24 thread will fit the 1/8 NPT threaded hole. Included is a brass screw ground point so radials can be added in a non-mobile situation or to enhance the ground if you are a "mobile-at-rest." The drawing of Figure 5 is self-explanatory and will aid the builder in assembly.

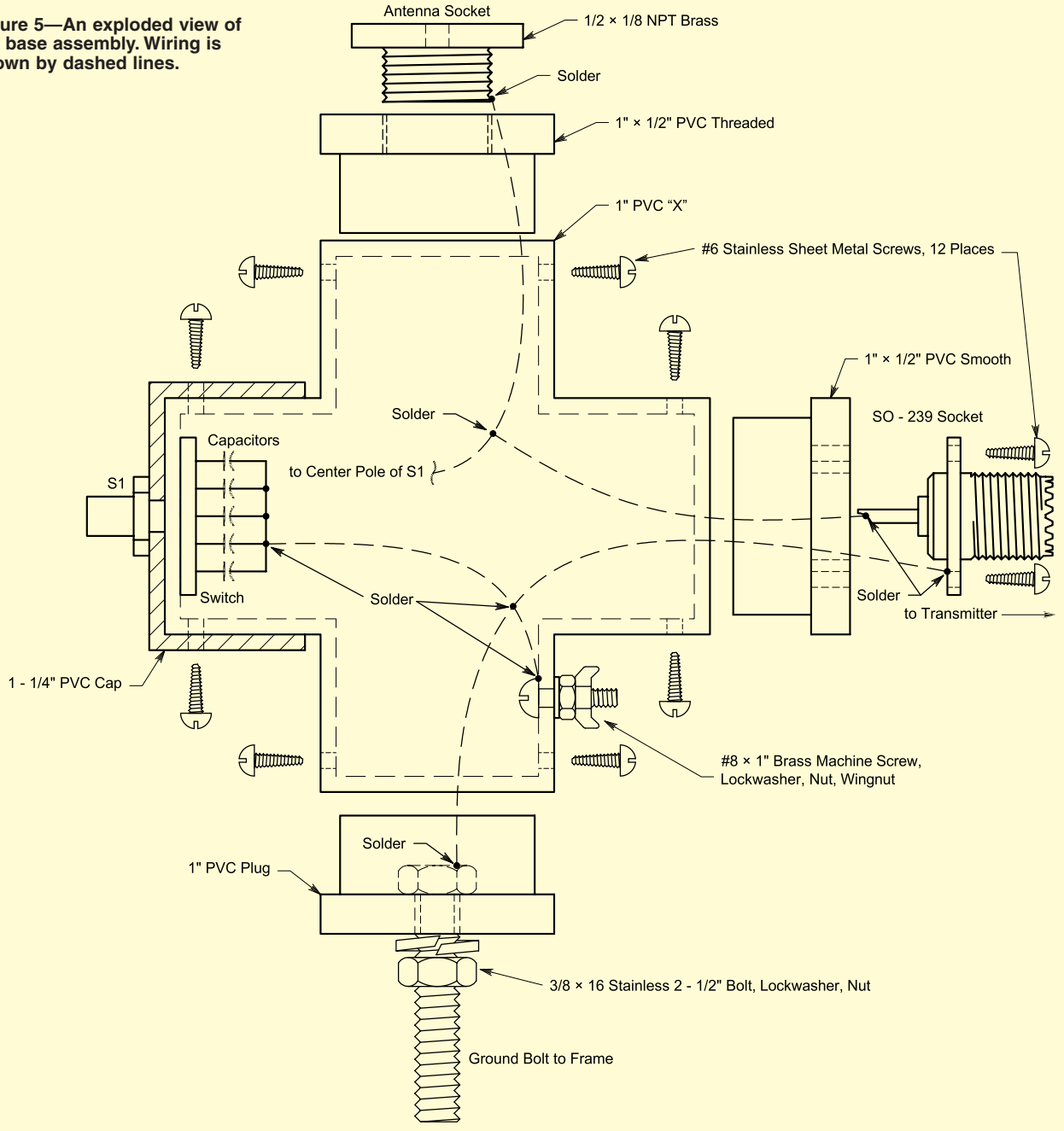
The only thing that takes a little work is filing, sanding or grinding off part of the surface of the 1 1/2 inch PVC cap. The PVC material is a little too thick for the switch bushing to extend through completely. With a little work, you can thin the material enough so the switch mounts correctly. With a large wood file it only takes a few minutes to accomplish.

I prefer to cut off about half of the internal collars of the PVC plugs (1×1/2 inch threaded, 1×1/2 inch smooth and 1 inch plug) to leave plenty of room inside the PVC "X" for components and wiring.

Soldering a short piece of 16 gauge bare wire to the inside flat edge of the brass adapter allows wiring to the 1/8 NPT brass adapter. This requires a heavy-duty soldering iron. This bare wire then becomes the tie point for interconnections. After soldering the wire to the brass adapter, screw the brass adapter into the 1×1/2 inch PVC threaded adapter. Drill and tap two 1/16 inch diameter holes in a 1×1/2 inch PVC smooth adapter such that you can attach an SO-239 connector as shown.

Connect a wire from the SO-239 center conductor to the wire soldered to the 1/2×1/8 NPT brass adapter for the antenna and to the switch for selecting the right capacitor. Then solder a wire to the SO-239 body and route it to the #8 ground screw, then to the 3/8×16 bolt. Solder the wire directly to the heads of the #8 brass

Figure 5—An exploded view of the base assembly. Wiring is shown by dashed lines.



screw and 3/8×16 bolt. Use a big soldering iron and, with a bit of filing and cleaning, you should be able to solder the wire to the stainless steel bolt. It is much easier if you use a galvanized bolt or one made from brass. Make sure all connections are electrically sound and watch out for "cold" joints—the mount will be subject to lots of vibration. You'll need sufficient heat on the larger bolts and fittings. Solder another wire from the common point of the capacitors on the switch to the brass screw head. You can use PVC glue but I prefer having the option of taking things apart if something needs to be fixed or changed. The completed PVC assembly is shown in Figure 6, and Figure 7 shows it mounted to the aluminum bracket.

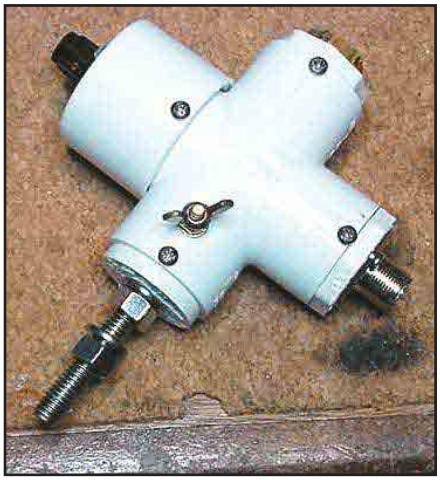


Figure 6—A view of the antenna matcher (not attached to mounting bracket).

Mounting it to the Car

Use a 1 1/2 inch long 3/8×24 stainless steel bolt, lock washer and nut to clamp the two pieces of aluminum. This configuration makes up the antenna-mounting bracket which secures to the steel loop. I lightly filed both sides of the steel loop to clear away paint and dirt and applied DeoxIt to the steel/aluminum interface to prevent corrosion (Noalox or Penetrox are also fine). It's probably a good idea to use quick-disconnects for

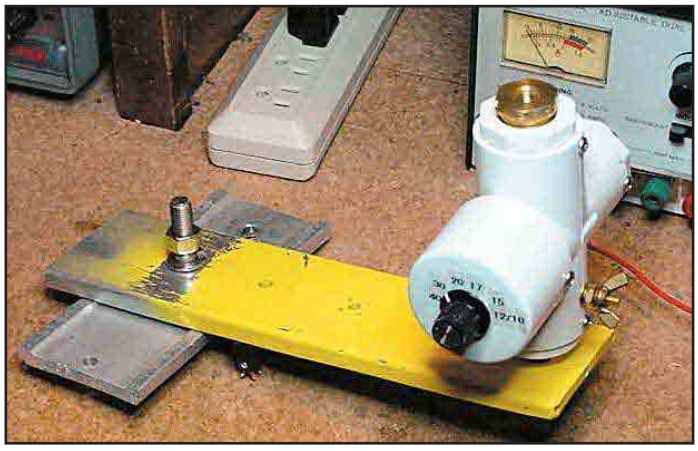


Figure 7—The antenna mounting bracket with antenna matcher attached. All that's missing is an antenna and a VW Beetle.

Figure 8—The completed assembly, consisting of mount, bracket , feed line and antenna, attached to the car and "ready to roll."

your antenna. This leaves the hole in the antenna mount plugged so it will not fill with water when you don't have an antenna installed. The base mounted to the car with feed line and antenna can be seen in Figure 8.

Conclusion

With all the small HF radios available today, operating HF mobile has never been easier. However, actually mounting an antenna on your car can be quite a challenge, especially if you have a small vehicle. The matching assembly is generic to any type of mount, so you can use this idea on other cars and antenna mounts. All the parts are readily available and inexpensive—give it a try.

Notes

[1]Available from your local dealer or the ARRL Bookstore. ARRL order no. 9043. Telephone toll-free in the US 888-277-5289, or 860-594-0355, fax 860-594-0303; **www.arrl.org/shop/**; **pubsales@arrl.org**.

[2]Available from your local dealer or the ARRL Bookstore. ARRL order no. 1964. Telephone toll-free in the US 888-277-5289, or 860-594-0355, fax 860-594-0303; **www.arrl.org/shop/**; **pubsales@arrl.org.**

All photos by the author.

Phil Salas, AD5X, is the Vice President of Engineering at Celion Networks in Richardson, Texas. He is an ARRL Life member, and has been licensed for 39 years. Phil holds a BSEE from Virginia Tech, and an MSEE from Southern Methodist University. He can be reached at **ad5x@arrl.net**.

The Historic Receiver

[Continued from page 35.]

vernier drives on all the controls help, but they really need a greater reduction ratio. The fine-tuning has a very limited range, and it's often found that a station cannot be completely tuned-in with it. It's then necessary to readjust the main tuning, which may or may not bring the desired station in range of the fine-tuning control.

Although the filament rheostat was some help in adjusting regeneration, it operated backward from the expected manner. In most regenerative receivers, increasing the detector filament voltage will increase regeneration—not with this receiver! *Increasing* the filament voltage took it out of regeneration and *reducing* the voltage placed it into regeneration. It was so smooth and gradual that this was found to be the best way to adjust regeneration. I believe the reason for this is that the filament rheostat adjusts the filaments of all tubes simultaneously, including the audio and RF stages. It was probably intended as a volume control. When the filament voltage of the RF stage is increased, it causes the RF amplifier tubes to conduct more heavily or, in other words, it reduces the plate resistance of these tubes. The lower plate resistance is coupled to the detector coil, reducing its Q, which reduces the regeneration. The detector loading offsets the increase in gain from the increased detector filament voltage. So, if the detector regeneration control is set at a point with the filament voltage within a certain range, good control of regeneration can be obtained. I doubt it was planned this way, but whatever works is fine with me!

After all of this was done, the receiver was found to be capable of remarkable performance. Connecting it to a calibrated signal generator, I found that a usable CW signal corresponded to an input of 0.5 µV on 20 meters. Many DX stations were heard with a 30 foot wire as an antenna. Of course, the stations could be long gone by the time the receiver was adjusted to optimum!

With strong AM stations, if the regeneration is set high so the detector is in oscillation, the detector locks to the station carrier frequency. The old timers call this *blocking*. This results in a crude form of synchronous detection, which helps with selective fading when receiving AM stations. If the receiver drifts a bit in frequency, however, the detector will fall out of lock with the received carrier, which results in a very loud heterodyne in the headphones. This feature was abandoned in order to preserve my hearing!

I was impressed with the careful design and the fine craftsmanship of the receiver. It probably was one of the best performing receivers of its time. And it probably cost a fair amount of money to build, since most of its components appeared new and not recycled from older receivers. After I used the receiver for a while, however, it was a relief to get back to my ICOM with its stability, smooth tuning, sharp selectivity, automatic gain control and digital frequency readout. As someone once said, the past is fun to visit...but you wouldn't want to live there.

My thanks to Jack Montgomery, K9DQU, now, sadly, a Silent Key, for supplying the receiver. Also thanks to Dick Schnell, K9HPD, for supplying some of the biographical information about his father.

All photos are by the author.

Dan Clark, W9VV, has been licensed since 1951 and has an Amateur Extra class ticket. Armed with a BSEE degree, Dan did mobile radio engineering for 39 years, retiring in 1995. He enjoys restoring vintage 1920s and '30s broadcast receivers and tinkering with antique clocks. Dan is presently active on CW and HF mobile SSB. You can contact him at 917 N Mitchell, Arlington Heights, IL 60004 or at **w9vv@hotmail.com**.

By Ralph E. Taggart, WB8DQT

Digital Slow-Scan Television

A new communications option, digital SSTV takes only a computer and the transceiver that's already in your shack.

Slow-scan television (SSTV) has been around for about 45 years now and there's been significant evolution and development of the mode. Early in its history all of the equipment was big and bulky and you had to build it yourself. There was essentially just a single SSTV mode—120 line, low-resolution, gray scale images. These were transmitted during an 8 second interval and fleetingly displayed using a long-persistence P7 phosphor of a surplus radar display CRT. A view of the imaging equipment of an early station can be seen in Figure 1.

Today, almost all SSTV operations are carried out using home computers equipped with sound cards. There are a large number of mode options including medium or high-resolution gray scale and color images. All of these options make SSTV one of the most versatile options for image communications on all bands from HF through microwaves. Medium resolution (320 by 240/256 × 24 bit) color modes are the most popular and typically require slightly less than two minutes for transmission or reception. Given reasonable HF conditions, the results can be excellent (Figure 2A).

With all the changes that have occurred in slow-scan, it is still an analog image transmission system—subject to the effect of marginal signal paths, interference, noise, fading or multipath (Figure 2B). Given the seemingly miraculous performance of digital communications modes such as PSK, many assume that digital image transmission should result in a significant performance improvement compared to conventional (analog) SSTV. In the last few years, just such a digital imaging system has been developed and it can now be encountered frequently on the HF bands. Digital Slow Scan Television (DSSTV) makes available a new set of imaging options in Amateur Radio, but the mode tends to complement rather than replace the capabilities of conventional SSTV. To understand both the strengths and limitations of this new imaging mode, we need to take a closer look at what DSSTV is and how it can be used.

DSSTV Basics

DSSTV is the result of the creative effort of Barry Sanderson, KB9VAK, and the enthusiastic work of a number of experimentally inclined amateurs who helped turn it into a practical image transmission system. An explanation of how the mode works is illustrated by a look at a simpler, non-imaging mode—phase shift keying. The most common form of PSK is BPSK (biphase shift keying) that modulates an audio subcarrier back and forth between two possible phase states. DSSTV uses the same basic principle with two critical differences:

- The signal format phase modulates a total of eight subcarriers (ranging from 590 to 2200 Hz at 230 Hz intervals).
- Instead of just two possible phase states, each subcarrier has nine possible modulation states.

The actual modulation format involves two levels of Reed-Solomon coding with enough redundancy to support robust error correction. A complete description of the coding strategy is beyond the scope of this article but is thoroughly documented in KB9VAK's presentation at the 2000 Dayton Hamvention (**www.svs.net/wyman/examples/HDSSTV/**). While most commonly used for image transmission, the signal format can handle any digital file. Throughput varies somewhat with file size, but averages approximately 92 bytes/second. This transmission rate is critical in defining the imaging capabilities of the system and we will return to it shortly.

What's In a Name?

The KB9VAK modulation/signal format is most properly known as *RDFT* (redundant digital file transfer). This transmission format can handle a wide range of data transmission, in addition to images. If the format is used to encode and transmit image files (the essence of DSSTV), the mode meets all current requirements for use on our HF bands. If it is used to transmit other data formats, however, the mode exceeds

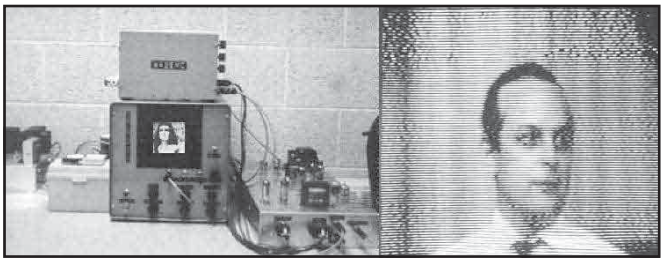


Figure 1—If you wanted to get on slow-scan in the pioneering days, you had to build a lot of specialized (and large) tube-type equipment. Shown on the left is equipment built by the author and in use at W8SH, the Michigan State University Amateur Radio Club in 1968. The pictures were all 128 line, gray scale images, which were "painted," line-by-line, on the face of surplus radar display tubes equipped with long-persistence P7 phosphors. This image from SMØBUO, received at W8SH in 1968, required 8 seconds for transmission and display.

Figure 2—When band conditions are good and interference levels are low, conventional slow-scan can deliver images of high quality (left), illustrated by this picture from WØLMD in Colorado, as received by the author in Michigan. In contrast, a marginal signal path, fading, multipath, noise or interference can all degrade the quality of the received signal (right), as evident in this image from GØMJS received by the author.

the current 300 baud limit imposed by the FCC for our frequencies below 28 MHz (see the accompanying sidebar, "Is the Transmission of Digital Image Files Permissible Under Part 97 Rules?").

Software

Transmission and reception of an image or any other file involves three distinct phases:

1. The original data file (typically an image) is processed and used to generate an audio WAV file. This will be the form of the transmitted file. The WAV file includes tuning and start data, a data header, the main body of the file, and a trailer. The time required to produce the WAV file depends on the original file size and the speed of the computer. For most practical image files the coding time can range from a second or two for a fast computer (2 GHz or faster) to a minute or more for a slow system (400 MHz).

2. The WAV file is routed through the transmitter. At the receiving station, the incoming WAV file is temporarily recorded to the computer hard drive. Data transfer occurs at approximately 92 bytes/second. The transmission and recording time is a simple function of the original file size.

3. The receiving computer then processes the recorded WAV file to reconstruct the original source file. This step is data intensive and the processing time depends on the size of the file, how much error correction has to be performed and the speed of the computer. This step can take 15 minutes or more on a relatively slow computer while a 2 GHz machine can complete the job in 15 seconds.

KB9VAK developed a series of *DOS* program modules to perform these and other functions associated with DSSTV transmission and reception. Initially these modules were used in sequence or linked via batch files to perform essential functions. More recently, two shell or "front-end" *Windows*-based programs have been developed that still use the *DOS* modules but which provide a *Windows* user interface and which more or less automate the processing sequence for DSSTV transmission and reception. Both programs are freeware and may be distributed to other Amateurs.

DIGISSTV by Erik Sundstrup, VK4AES, is designed for *Windows XP*, although some features will function under other versions of *Windows*. The program, along with KB9VAK's *DOS* routines, can be downloaded at **www. kiva.net/~djones/digisstv**.

Roland Zurmely, PY4ZBZ, wrote *DIGTRX*. This program is widely used because it is completely functional under any version of *Windows*. It can be downloaded from **www.kiva.net/~djones/digtrx.htm**. Since all of my computers are running *Windows 98*, the examples illustrated will be based on *DIGTRX*.

There is no complicated installation; you simply have to be sure that both the shell software and *DOS* executable files are located in the same directory. Hardware interfacing is identical to any other sound card based software including conventional SSTV. If you have a homebrew or commercial interface that you have been using on other modes, it will do just fine for DSSTV.

Configuration consists of selecting the serial (COM) port to control the TR function. If you are already operating other

Is the Transmission of Digital Image Files Permissible Under Part 97 Rules?

The idea of sending computer digital image files has prompted some discussion as to whether this is permitted in Part 97 of the FCC rules. Here's the picture.

Q Is HF transmission of digital images classified as *Data*, and thus subject to the provision in §97.307(f)(3) that "The symbol rate must not exceed 300 bauds…"
A No. It is classed as *Image* communications with permissible emissions defined in §97.3(c)(3). The *Data* symbol rate limitations in §97.307(f)(3) through (8) do not apply to this mode. §97.309 (RTTY and data emission codes) does not apply to image transmissions. However, these transmissions need to abide by §97.307(f)(2), that: "No non-phone emission shall exceed the bandwidth of a communications quality phone emission of the same emission type."

Q But, slow-scan television and facsimile that amateurs have been transmitting over many years use raster scanning. Digital graphic formats are different. Doesn't that make them *Data*?
A Actually some graphic file formats use raster scanning, albeit with some compression to eliminate redundancy. Not everything that is "digital" is automatically "*Data*." For example, digital voice is not *Data*, as elaborated in the sidebar to the article "Practical HF Digital Voice," by Charles Brain, G4GUO, and Andy Talbot, G4JNT, which appeared in the May/June 2000 issue of *QEX*. That sidebar was prompted by some of the same questions.

Q What are the emission designators for digital image transmission?
A 97.3(c)(3) defines them as follows: "Facsimile and television emissions having designators with A, C, D, F, G, H, J, or R as the first symbol; 1, 2 or 3 as the second symbol; C or F as the third symbol; and emissions having B as the first symbol; 7, 8 or 9 as the second symbol; W as the third symbol." Nevertheless, HF amateurs image transmission systems are most likely going to consist of an audio baseband signal modulating a single-sideband suppressed-carrier transmitter (the letter J as the first symbol), tone modulated (2 as second symbol) and C or F as the third symbol. If you assume a bandwidth of 2.8 kHz, the complete emission designation is 2K80J2C or 2K80J2F, depending on whether it is considered facsimile (C) or television (F).

Q How do I tell whether to classify it as facsimile or television?
A For the most part, it's not necessary to do that because Part 97 calls them both *Image*. For the purist, however, you have to start from the mindset of the day when the terms facsimile and television were coined. Both were raster scanned. Facsimile was considered a *telegraphy* system of sending a printed or handwritten page (a fixed graphic image) to be printed at the receiving end. Television was a picture (moving, transient or sometimes stationary) from a camera or similar device meant to be displayed on a cathode ray tube (CRT). Well, since the advent of personal computers, much of that has changed. It is possible to generate an image using a camera, a scanner or even a computer program. Similarly, the image at the receiving end can be displayed on a CRT, a liquid crystal display (LCD) screen or projector, printed on paper or even just stored in computer memory available for display at the option of the operator. So, the definitions of facsimile and television are getting a little blurred and the FCC's use of the word *Image* encompasses both without having to make a distinction.

Q What image formats are permissible as digital image transmissions?
A Certainly JPEG or GIF are the main ones that come to mind. However, there are numerous others and they continue to evolve.

Q Where in the band should this type of transmission be operated?
A The considerate operator would probably choose the same segments where conventional SSTV has been operating.

Q Does the transmission have to be purely image?
A *Image* and *Phone* emissions are permitted in the same segments of HF bands. There is no problem transmitting images and voice alternatively or simultaneously. Note that §97.307(f)(2) says "The total bandwidth of an independent sideband emission (having B as the first symbol), or a multiplexed image and phone emission, shall not exceed that of a communications quality A3E emission." —*Paul Rinaldo, W4RI, ARRL Technical Relations Manager*

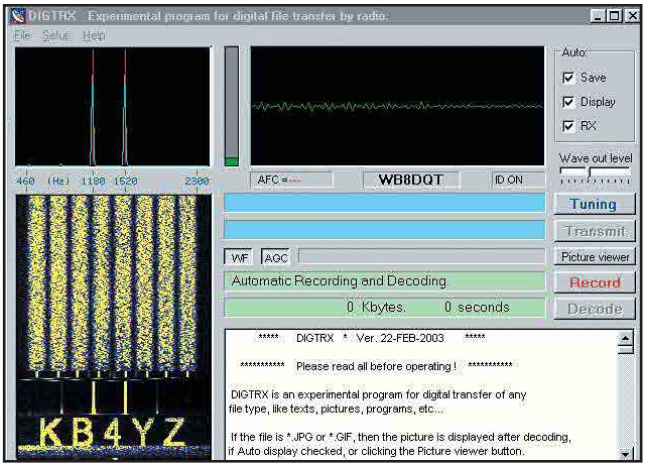


Figure 3—The *DIGSSTV* operating screen. Three different displays provide a detailed look at signals as they are received. The window at the upper right and center functions as a basic oscilloscope display. Two spectrographic displays share a common frequency calibration. The smaller window at the upper left shows a real-time spectrogram of the received signal while the elongated waterfall display below it permits you to watch the signal over time.

digital modes, use the same port values for DSSTV. You will also have to set the input level to the soundcard. With the software AGC disabled, adjust the soundcard input level so that subcarrier peaks on the upper-left spectrograph hit about 1/3 maximum amplitude with a clean signal. At that point you can re-enable the software AGC. The soundcard output level (or your interface LEVEL control) should be carefully adjusted so not to overdrive the audio input of your transceiver.

If you are already operating on PSK, use your current PSK power level. With a typical 100 W transceiver, your peak output power should probably not exceed 20-25 W. Under no circumstances should you switch in any audio processing. If you overdrive the audio, the resulting intermodulation (IMD) products will result in an excessively wide signal and it will be impossible for anyone to decode your transmissions. Fine adjustments to the audio drive level can be made using the WAVE OUT LEVEL slider on the upper right of the *DIGTRX* panel.

Operational Considerations

Finding Activity

On 20 meters there appears to be a reasonable amount of DSSTV activity on 14.233 and 14.240 MHz, especially on weekends. There is an excellent noontime net (US Eastern time) run by KB4YZ on or near 7.173 MHz—stations will often be exchanging pictures until late afternoon.

Getting on Frequency

You must be tuned to the other station with an accuracy of a few Hz if you are going to be able to reliably decode file transmissions. Make sure your RIT is off and ask the other station to send you "tuning tones." When you see the two-tone signal displayed in the spectroscope display on the upper left, as shown in Figure 3, tune the transceiver so the audio peaks align with the red calibration lines at 1180 and 1520 Hz and you are on frequency. If you are asked to send tuning tones, the TUNING button on the right side of the menu will cause the tuning tone sequence to be sent automatically.

Receiving a File

Although the various receiving functions can be initiated manually, it is much easier to let the software do the work. In the case of *DIGTRX*, you can automate the complete receiving sequence by clicking the RX (auto-start, stop, and decode), DISPLAY (automatically displays the image if it is a GIF or JPEG file), and SAVE (auto-saves the image in the AUTOSAVE subdirectory of your working directory) boxes in the AUTO area in the upper right side of the screen (Figure 3).

The spectral waterfall display in Figure 3 shows the basic sequence of events at the start of an image file transmission:

- If the transmitting station has enabled the call sign option, the subcarrier frequency will be swept to "paint" the station's call sign across the waterfall display. If the call sign option has not been enabled, the name of the software will be displayed.
- The software will send the two-tone tune signal. If you haven't already optimized your tuning, this is your last chance to do so.
- The receive software will start to record the incoming WAV file while displaying the eight phase-modulated subcarriers on the waterfall. They will also be displayed in the window above the waterfall. Unlike standard slow scan, there is no progressive display of the incoming image. DSSTV is not a real-time imaging mode and SSTV is probably not an ideal descriptive name. Unlike conventional SSTV, you cannot get an image after the file transmission has started. The transmission of this particular file (Figure 3) from KB4YZ was very clean. Amplitude of the eight subcarriers was essentially equal, indicating a flat pass-band for both the transmitter and receiver. Selective fading and multipath, which normally appear as patterns of darker patches migrating across the subcarrier waterfall display were absent, as was any interference. Total transmission time is proportional to the file size and will usually be announced by the transmitting station prior to transmission.
- When the file is complete, the software will automatically stop the WAV file recording and begin the process of decoding the file. The decoding time required is a function of the size of the original file, how much error correction had to be attempted, and the speed of your computer. A 400 MHz machine is slow for this application and decoding even modest images will take many minutes. In contrast, a 2 GHz system can finish the same job in 15-30 seconds. Unlike conventional SSTV, the decoding is an all-or-nothing process. You will either get a perfect copy of the image or you will get nothing at all.
- If the decoding was unsuccessful, a message will be posted describing the problem. Some of these messages are more helpful than others. If the decoding was successful, the statistics for the various image blocks will be posted. If the file was a GIF or JPG image file, the picture will be displayed. For other image formats, you will have to use other viewing software and retrieve the file from the AUTOSAVE subdirectory. While the all-or-nothing aspect of DSSTV may be depressing if you did not get a file for some reason, any other stations on frequency that got the image can, in effect, relay you a perfect copy.

Time and Resolution Constraints

In preparing image files for transmission via DSSTV, a great deal of attention has to be paid to both time and resolution.

Time

How much time can we spend transmitting an image on the amateur bands? The absolute answer is 10 minutes, given the station identification requirements imposed by the FCC. The real-world limit is considerably shorter. Extensive experience with analog SSTV has shown that on busy HF bands (20 meters and lower in frequency), something around two minutes is the practical limit. Higher frequency bands can be used for higher resolution images, where transmission times can exceed six or seven minutes, as long as the frequency isn't particularly busy. In practice, 120 seconds is a fair time limit for DSSTV images as well. While the higher frequency bands could be used for longer transmissions, increasing the transmission time simply raises the probability that something will occur that will generate a decoding error and cause the loss of the entire image. This is in contrast to transmitting

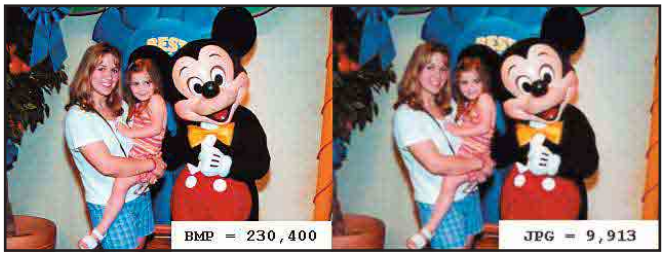


Figure 4—With the bandwidth and time constraints of Amateur image transmission on HF, significant compression of the image files is the only approach for the transmission of pictures of any size and complexity. The picture on the left is a 320×240 24 bit color image of the type that would typically be encountered when operating analog SSTV. This file, in uncompressed BMP format has a file size of 231,478 bytes. On the right, the same image has been subject to significant JPEG compression, dropping the file size down to 11,814 bytes for DSSTV transmission (see text). Although casual examination would suggest the two versions of the image are identical, Figure 5 shows that this is far from being the case.

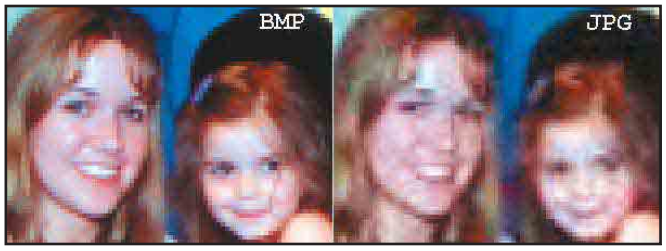


Figure 5—The central areas of these images have been magnified to the point where the pixel structure of the images is clearly evident. The sample of the BMP image on the left shows pixel structure but there are no obvious artifacts and the image tones are smooth and continuous. On the right, the severely compressed JPG image shows artifacts with respect to spatial and color sampling errors.

high-resolution images using analog SSTV where a momentary problem during transmission may result in errors with little practical impact on image quality.

Image File Size

If we set the maximum transmission time at around 120 seconds and we know that DSSTV data is transmitted at approximately 92 bytes/second, our maximum practical file size would be in the order of 120×92 or 10-11k. Smaller is better in terms of required transmission times and you could certainly stretch the 10k limit a bit, but 10k is a good reference point to look at our really big problem—image resolution. Image resolution involves both spatial resolution (the amount of detail in the image) and tonal resolution—the fidelity of the grayscale or color-coding of the individual pixels. The subject is discussed in detail in *The ARRL Image Communications Handbook*,[1] but we will simplify things by just looking at 320×240 medium-resolution images that dominate in the world of conventional SSTV. Such a picture has 320×240 or 76,800 pixels.

How large a file is required for the raw image data depends on the type of image we wish to send. Binary (black and white) images (typically line drawings), can encode 8 pixels per byte of file storage and thus produce the smallest image files. Gray scale images are typically encoded using one byte/pixel (256 gray scale values), so file size is essentially equal to the number of pixels in the image array. In contrast, 24 bit color images require 3 bytes of file storage for every image pixel and thus generate the largest image files for any particular image resolution. Thus, for the three primary image types— black and white, gray-scale and color—a 320×240 image can be characterized with respect to both file size and transmission time (see Table 1).

Table 1
Image Transmission Time

Image Type	*Raw File Size*	*Transmission Time sec(min)*
Binary	9,600 bytes	104(1.7)
Gray scale	76,800 bytes	835(13.9)
24 bit color	230,400 bytes	2504(41.7)

It is obvious that only the binary (line drawing) raw file falls under the arbitrary 10k, 2 minute "limit." In contrast, transmitting photographic images, either gray scale or color, is impractical given the extended time required to transmit the raw file data. The way around the file size/transmission time bottleneck is *image compression*. Approaches to image compression fall into two broad categories: lossless as opposed to lossy compression algorithms. Lossless compression formats (such as GIF) result in no penalty with respect to image resolution but the degree of compression that can be achieved is limited. The more complex or detailed the image, the lower the compression value that can be achieved.

Other approaches to compression such as JPEG can achieve much greater compression ratios but do so at the expense of some loss of image data. Unfortunately, to get the degree of compression we need (a factor of 20 or more in the case of the color image), we are going to have to accept some loss to squeeze the file size to approximately 10k.

JPEG compression techniques, widely used for Internet images, can really perform miracles when it comes to reducing image file size. Figure 4 (left) shows a 320×240×24 bit color image, typical of those transmitted via analog SSTV. Unfortunately, with a file size of over 230k this is not a file you can readily send via DSSTV. Using some pretty severe JPEG compression, the image file size was compressed to just over 11k and the image file can be sent in just 128 seconds (Figure 4, right). Unfortunately, the two versions of the image are not the same. Figure 5 shows the central area of the BMP (uncompressed) and the JPG (compressed) images from Figure 4. The differences are quite striking. While the uncompressed image is resolution limited (basically a medium-resolution image by analog SSTV standards), the color tones are continuous and smooth. In contrast, the JPEG image shows artifacts, spatial and tonal, resulting from the file compression. While DSSTV can transmit such an image file without error, the effective resolution of the image is quite modest compared to the original source picture.

Perfect transmission of an image that is notably corrupted by compression artifacts is a mixed blessing. Such compression artifacts are very common in DSSTV image samples on the Internet (see the directories of DSSTV images at **www.kiva.net/~djones/**) and illustrate the problem of applying excessive compression in an attempt to reduce transmission time. DSSTV is definitely not "high definition" SSTV, especially with reference to gray scale or color images. To make the most of the significant capabilities provided by DSSTV, image size, type, resolution and compression must be juggled to optimize the quality of the images that are sent. Figure 6 shows a sample of typical over-the-air images from 40 meters and illustrates the tradeoffs. Binary and line art images (Figure 6A) can be relatively large because such images already enjoy an effective 8:1 compression by virtue of the fact that the

[1]Available from your local dealer or the ARRL Bookstore. Order no. 8616. Telephone toll-free in the US 888-277-5289, or 860-594-0355, fax 860-594-0303; **www.arrl.org/shop/**; **pubsales@arrl.org**.

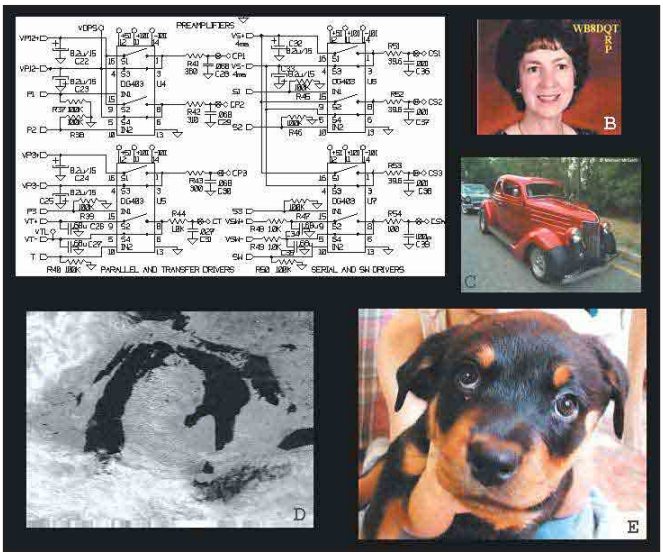


Figure 6—DSSTV images have no fixed format, unlike conventional slow-scan. Within the limits discussed in the text, there is a wide range of spatial and tonal resolution options. In general, the largest practical images are true black and white (binary) images such as the schematic (from KB4YZ) shown top left. Relatively small color images (under 200×200 resolution) can usually be compressed to the point where image transmission requires approximately one minute for transmission (B and C). B is an image file transmitted by the author at QRP power levels (approximately 2 W average output) and retransmitted by W9PKC. The image of the car (C) is the first DSSTV image I was able to receive and was transmitted by W9VMT. Because gray scale coding only requires 8 bits/pixel, compared with 24 bits/pixel for high quality color, gray-scale images of 320×240, such as the weather satellite image (D) can be compressed for transmission in about 1.5 minutes. This image was transmitted at QRP power levels by the author and retransmitted by K3DCC. Color images—320×240, 24 bit (E, transmitted by KB4YZ) present a challenge, as relatively high levels of compression are required to achieve practical HF transmission times (2 to 3 minutes).

pictures only have two color/tonal values—black or white. Drawings of the type shown here typically have large areas of white and lossless compression techniques, such as GIF, can often reduce file size to an acceptable value. If you wanted to send schematics and other printed material, DSSTV would be an excellent medium that can produce error-free file transfers.

Gray scale images (Figure 6D) enjoy an inherent 3:1 file size advantage compared with 24 bit color images and thus will require less compression to meet a specific file size limit. In general, you can transmit a larger or more detailed image if you can use gray scale as an alternative to 24 bit color. The same principle applies to color images if the image itself can be reduced with respect to color content. For example, if you can convert a 24 bit scan of a color cartoon to 8 bit color (256 color values), as in the case of gray scale images, you can use less compression to hit your target file size.

You will occasionally see large test patterns that have been transmitted in on-the-air-tests in as little as 30-40 seconds. This kind of promotion of DSSTV is highly misleading. The test patterns, by virtue of the image structure and number of actual colors, can be very highly compressed without introducing many image artifacts. Such test images have almost nothing in common with the photographic images (gray scale or color) that represent the mainstay of analog SSTV activity.

Detailed, full-color (24 bit) images present the greatest challenge. The most judicious approach is to do some reduction in image size and resolution in order to employ less compression. For this reason, you will encounter many images that are significantly smaller than our initial 320×240 example (Figure 6B and 6C) and thus don't require quite as much compression. While this may seem like rolling the technological clock back to earlier image formats with less resolution, the images can be quite effective because they can be reconstructed without error at the receiving end of the circuit. Figure 6E shows an excellent example of a 320×240 color image that was sent by KB4YZ in just a bit over two minutes.

The quality that Dave achieved with this image is a function of two factors: the limited color range of the picture and the use of advanced compression formats (such as JPEG 2000), which can achieve a specific degree of compression with fewer artifacts. If you need to transmit more complex images, you can always break a large image down into smaller subsets that can be transmitted individually. If the image subsets are received at all, they will be perfect, which means you can patch the pieces together to reconstruct the larger picture.

The Bottom Line

With the advent of *Windows* shell programs such as *DIGISSTV* and *DIGTRX*, DSSTV has reached a point where it can be part of the SSTV mainstream. DSSTV introduces a new toolbox of capabilities with respect to image communications, and every active SSTV operator should get some experience using the mode. It is unlikely that DSSTV, in its present form, will replace analog SSTV. Analog SSTV operates in real time and when conditions are good, images, while not error-free, can have a higher effective resolution than pictures that are practical using DSSTV. When conditions are poor, even a severely degraded image can be adequate to confirm a new state or country (see Figure 2B). While DSSTV operation is not yet as spontaneous as conventional SSTV, perfect image file transfers are possible, even under adverse conditions using low power.

DSSTV is an excellent mode for the operator who wants to try QRP on slow-scan, but it is demanding in terms of careful tuning, drive adjustment and hardware stability. You will also appreciate the virtues of a faster computer, especially while you are waiting to see if you did succeed in capturing that last image. Passing images around in the context of a net or other group is easy and, unlike analog SSTV relays, will not introduce additional image degradation.

DSSTV is certainly not a high-definition mode and it is quite unlike SSTV in that images are not displayed in real time. It is fun, highly effective and worth a look by both experienced and novice SSTV operators. Not all SSTV operations demand or even need perfection, but where it is desirable or useful, DSSTV will deliver. Whether it is analog SSTV or DSSTV, we have certainly come a very long way since slow-scan was introduced almost 45 years ago.

All photos by the author.

Ralph E. Taggart, WB8DQT, first licensed in the 1950s as WA2EMC, has been involved in amateur image communications since the early 1960s. He has authored several books and articles on the subject, among them The ARRL Image Communications Handbook. *He enjoys operating low power PSK31, CW, SSTV and ATV. Dr Taggart is currently a Professor in the Department of Plant Biology, the Department of Geological Sciences and Curator of Fossil Plants at Michigan State University. He and his wife Alison have three daughters and two granddaughters. You can contact him at 602 S Jefferson, Mason, MI 48854 or* **taggart@msu.edu**.

By Nilanjan Majumdar, VU2HFR

Public Service, VU-Style, or Goddess Durga and the Radio Ham

What do an ancient Indian goddess and Hiram Percy Maxim have in common? The answer lies in a warm October evening in the city of Kolkata...

Every nook and corner of the city formerly known as Calcutta is brightly lit with flashing, dancing lights. The noise of the blowing conch shells, the rhythmic beat of the Dhak (a kind of drum made of animal skin and wood), amplifiers blaring decibels of music, thousands of vehicles queuing up the streets and honking furiously and millions of people thronging the avenues brightly dressed in their recently purchased new seasonal attire—all this creates a crescendo of fun, frolic and laughter. The city is in a mad frenzy gripped by *Durga Puja* fever.

Kolkata and Sir J. C. Bose

The capital of India before independence, Kolkata is known as the gateway to eastern India. It is the capital of the state of West Bengal, which borders the nation Bangladesh, in eastern India, and is located on the banks of the river Ganges (also known as the Hooghly). Kolkata could also be considered the "Bethlehem of Radio." It is a pity that not many people let alone radio amateurs across the world are aware that in 1894, Sir Jagadish Chandra Bose converted a small enclosure adjoining a bathroom in the Presidency College, Calcutta, into a laboratory and in 1895 gave his first public demonstration of electromagnetic waves at the Town Hall in the presence of the Governor of Bengal. He successfully demonstrated the world's first wireless communication link using millimeter waves (microwaves) to trigger a gun and ring a bell remotely, inducing electric sparks in a cavity resonator system. All this took place two years before Marconi's demonstration.

The beauty of Kolkata lies in her diversity, and nowhere can you find so much diversity as you find in this sprawling metropolis. The official state language is Bengali or Bangla, and apart from the Bengalis who live here one finds people from all across India coexisting in complete harmony. Kolkata is a simmering cauldron of cultures—the Anglo Indians, the Armenians, the Zoroastrians (who came from Persia), the Jews and the Chinese, apart from Hindus, Muslims, Christians and Sikhs—turn this city into a miniature India. The one mega event that brings all 10 million people in the city together for four days in October every year is Durga Puja.

Durga Puja

According to Indian mythology, Goddess Durga lives in the Himalayas with her husband Lord Shiva. She is also known as Uma, the daughter of the Himalayas. The word *puja* means worship and Durga is worshipped as the "Mother of the Universe," the eternal strength and the "Supreme Energy" in the cosmos. An idol is made of the Goddess of straw and clay from the river Ganges and the beautiful Goddess is depicted with 10 arms wielding a variety of weapons mounted on a lion, destroying an evil demon. Durga signifies the infinite energy within us all triumphing over evil. The people of Bengal and the whole of Kolkata wait with bated breath every October for the arrival of the Goddess for four days. Centered around her is a huge festival, a carnival unlike any other anywhere in the world.

The city of Kolkata starts getting into festival gear from the month of September as the crowds swell on the street and there is a spree of last minute buying of designer clothes, shoes and bags. There are approximately 1200 community pujas in the city. These are held at various parks, street corners, lanes and bylanes, and they bring traffic in the city to a snail's pace during September and October. Massive temporary structures called *pandals* are erected at the puja sites made of bamboo and cloth. The festival provides artisans, craftsmen and sculptors the opportunity to showcase their skill and expertise. From 20 feet to over 100 feet high, pandals are made of a variety of materials starting from the traditional bamboo poles and cloth to razor blades, gramophone records, compact discs and edible items such as biscuits and sugarcane. They are amazing replicas of famous temples, mosques, churches,

Figure 1—Horey, VU2HFR, at the CVARS control station during Durga Puja 2003.

Figure 3—Surojit, VU2SKD (far right), along with Debkumar, VU3IAD, operating from a CVARS ham assistance booth at a pandal during Durga Puja 2003.

castles, forts, dilapidated ruins, aircraft and ships. The illumination is breathtaking with giant rolling displays on bamboo frames created by traditional craftsmen and electricians and guess what—no microprocessors but a complex array of wires and electromechanical switches with rolling drums to control them. An entire parallel economy and industry revolves around this festival. Competition between the organizers of the different pujas for the best pandal, the best lighting and illumination and the best image is fierce, and millions of people in India depend on this festival to provide them with income for the rest of the year.

CVARS

The Calcutta VHF Amateur Radio Society has been participating in public service events for the last few years. Since its inception in 1992, the society has grown steadily and currently has around 70 members in and around Kolkata. Before 1990, VHF activity in the city was nonexistent. The society distributed a crystal controlled, two channel 2 meter kit based on the FM subsystem IC MC3359 among its members, and it soon became very popular both in Kolkata and in many other parts of the country. VHF activity in the city grew rapidly, and 2 meters became a very popular band.

Since 1998, the society has been participating in a festival at Sagar Island in the Bay of Bengal every January, when millions throng to the island in the month of January. The society's HF operations from Sagar Island in January 2001 activated Sagar IOTA AS-153, and hams worldwide look forward to the IOTA station from January 10-16 every year. The society achieved great success in locating hundreds of people missing in the

Figure 2—Deepak, VU2DPM, was one of the many volunteers who operated from a CVARS ham assistance booth during Durga Puja 2003.

festival by setting up ham radio stations at the various crossover points on the mainland and the island.

On the basis of the success of these operations, the Missing Persons Squad (MPS) of the Kolkata Police approached the society for assistance during Durga Puja. The city of Kolkata has a population of around 10 million. The city dates back more than 300 years, and has few roads. With a great multitude coming from the villages and the outskirts to enjoy the atmosphere and ambience, join in the revelry, tour the city throughout the night watching the pandals, the images and the brilliant lights, the crowds swell to astronomical proportions. Traffic comes to a virtual standstill and the police have a nightmare trying to bring order out of total chaos. It is a daunting task.

Amateur Radio and Durga Puja 2003

Lack of commercial ham gear makes it very difficult for hams in India to pursue Amateur Radio. Most hams in Kolkata cannot afford the phenomenal costs of commercial radio equipment, and as a result Kolkata is considered the Mecca of homebrewing in India. The CVARS has for a long time tried to set up a commercial 2 meter repeater in Kolkata, without much success. It has approached many organizations for help but to date has only received verbal promises and mute responses. Hams here are trying to put up a homebrew two-antenna repeater system without duplexer, but it is still not ready yet. Creating an Amateur Radio network in the city without a repeater was proving to be difficult.

The Mobile Operations Team (MOT) of the society divided the city into three zones, North, South and Central. Nine major puja pandals were selected in the city (three in the North, four in the Central and two in the South zone), as per the list provided by Kolkata Police. Ham Radio Assistance Booths were set up at all these pandals. Two control stations were set up, one on top of a five story building in central Kolkata at the studio of a local cable television channel. The other main control station was set up at the 5th floor apartment of VU2KFR and VU2HFR in South Kolkata. (See Figure 1.) The elevations of the VHF groundplane antennas at these two control stations were 60 and 140 feet, respectively. The rest of the ham stations at the assistance booths used plumber's delight dipoles, whips and rubber ducks. (See Figures 2 and 3.) The age-old human relay system was employed and messages were routed through the control stations when direct contact was not possible between two stages.

The Durga Puja festival 2003 started October 2 and ended on the 5th. During

Durga Puja everything comes to a standstill in Kolkata. Offices, courts, schools, colleges, government departments, postal services, shops and all establishments remain closed and people let themselves drift in the inexhaustible sea of joy, happiness and merrymaking. Hams, too, have their families and it became increasingly difficult to find volunteers to operate the stations on all three evenings, as the police had requested. In the end, it became a game of Chinese checkers, as hams were juggled between various points to have all the stations active during all three evenings.

The stations were on the air from 1900 local time and remained open until 0400. The crowd started swelling from 2000 hours onward, and usually peaked around midnight. For three days it was an endless sea of humanity—just face upon face like waves of an unending ocean. People were holding hands, laughing, dancing, eating out at the countless temporary roadside eateries selling samosas, rolls, momos, burgers, sausages, noodles, pizzas, tea, coffee, soft drinks and you name it. The hams had a difficult time, as scores of missing person reports started pouring in. Local announcements were also made by the radio amateurs on the public address systems and relayed to the nearby pandals through the Amateur Radio links.

A number of cases of missing children between the ages of 5 and 12 were handled. The experience of the previous Sagar operations paid rich dividends, as hams were able to track most of the missing cases. Of a total of approximately 500 cases handled during the event, around 50% were tracked by ham operators and the rest it seemed went home or did not report back after being reunited. In the end, there wasn't a single untraced person waiting at the ham assistance booths, nor did we have to hand over any untraced child to the Kolkata police.

The festival ends with the immersion ceremony on the fourth and last day. On October 5, 2003, the day of the ceremony, huge processions from all the pandals wended their way through the city carrying images of Goddess Durga with bands playing music, people dancing and shooting off fireworks. The processions ended at the banks of the river Ganges and the images of Goddess Durga were immersed in the river. Figure 4 shows Goddess Durga at one of the many puja pandals.

This tradition has taken place throughout the ages. The Goddess embarks on what signifies as her return journey upstream to the icy glaciers of the Himalayas, her heavenly abode, leaving behind millions of her sons and daughters in tears as they start counting the days left for her arrival again next year. This day is known as *Vijaya Dashami* or the day when good triumphs over evil. People from all communities embrace each other, expressing their love and solidarity.

Figure 4—Goddess Durga in her true splendor at a Puja Pandal during Durga Puja 2003.

Durga Puja has a lot in common with the core spirit of Amateur Radio. It breaks all regional, political, social and economic boundaries and unites all through universal brotherhood, peace and harmony. So, returning back to where we started. "What do an ancient Indian Goddess and Hiram Percy Maxim have in common?" Amateur Radio, of course!

All photos by the author.

Nilanjan ("Horey") Majumdar has been a radio ham since 1989 at the age of 18 when he received his Grade I Amateur Radio Operator's License and his call sign VU2HFR. He is a medical laboratory technologist by profession. VU2HFR and his elder brother Kitchu, VU2KFR, share the same shack on the 5th floor of a 10 story building in South Kolkata. The author was also the Secretary of the Calcutta VHF Amateur Radio Society from 2000-2002. VU2HFR is active on HF/VHF/UHF, and mainly enjoys CW and the digital modes such as PSK31 and packet radio. You can access the author's EchoLink node VU2HFR-L (Node 148252) that is connected to an FT-100D transceiver on UHF. You can also contact VU2HFR at **vu2hfr@arrl.net**.

NEW PRODUCTS

DIGITAL COURSE ON CD

◊ Sierra Radio Enterprises has announced the debut of a new digital electronics course on CD-ROM. "The ABCs of Digital Electronics & Eight Key Digital Computer Building Blocks" consists of lessons and more than 400 Gbytes of reference documentation, software and practical exercises. Part 1 of the course starts from scratch and includes topics such as the use of binary bits, words and instructions, basic digital electronic parts and logic circuits, and eight key digital computer building blocks. Part 2 explores concepts in detail such as an anatomy of instructions, AND, OR, inverter and flip-flop circuits, computer memory and memory mapping, and software programming. $49.50. Contact: Sierra Radio Enterprises, 21 Coventry Way, Reno, NV 89506-1999; **www.sierraradio.com**.

FEEDBACK

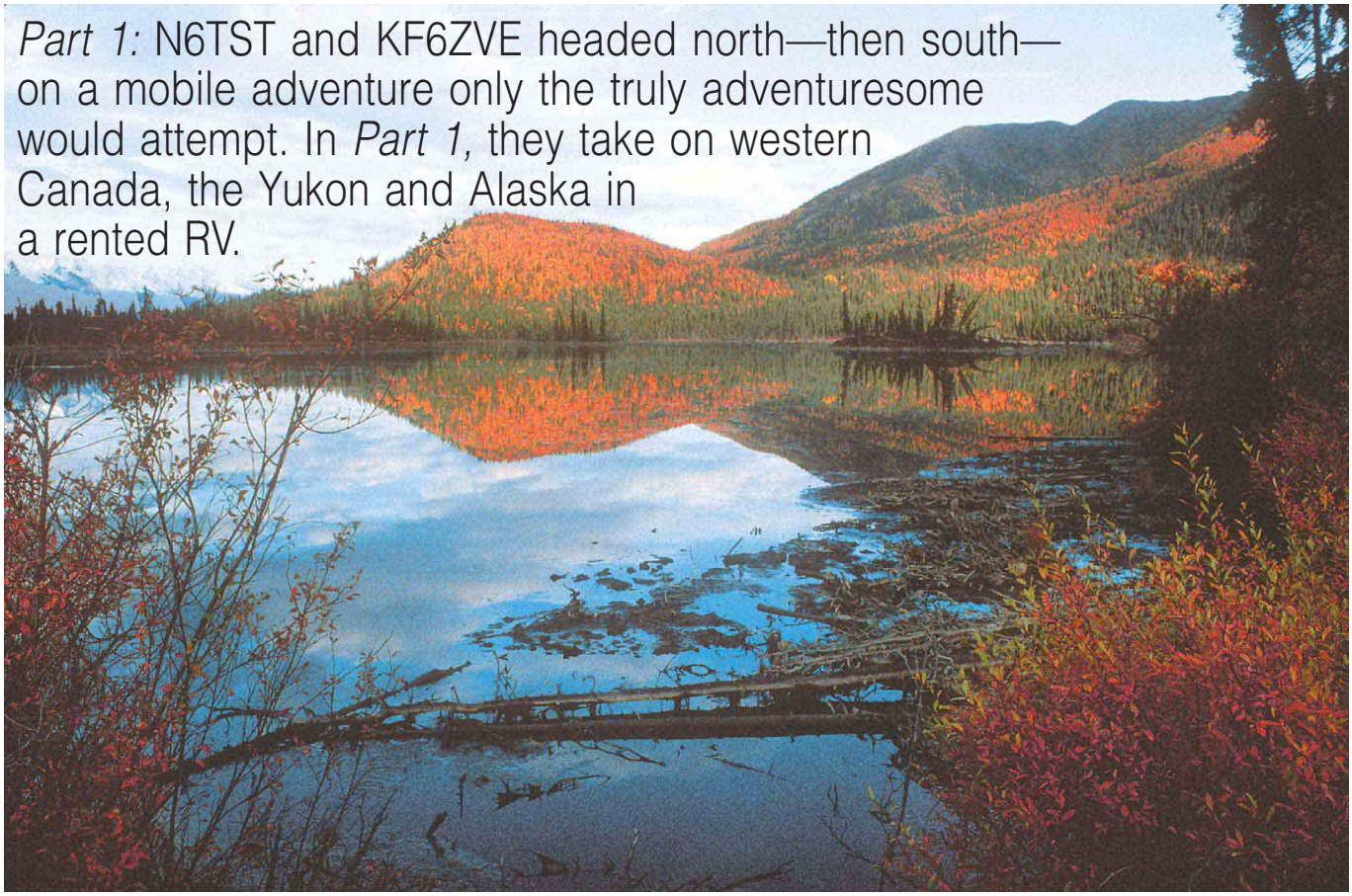
◊ Several readers commented on the Doctor's solution ["The Doctor is IN," Dec 2003, p 52] to feed a 3.2 Ω speaker from an 8 Ω source with a 250 or 500 Ω transformer. A better way to do this is to use a multi-tapped line to voice coil transformer as an autotransformer. Connect the 8 Ω secondary tap and the common across the audio output line and the 3.2 Ω tap and the common to the speaker. Let the primary "float" unconnected. A 70 V PA line to voice coil transformer works (RadioShack 32-1031).

◊ The J. E. Richards Middle School ["ARRL in Action," Jan 2004, p 12] is actually located in Lawrenceville, Georgia, a suburb of Atlanta.

By David A. Rosenthal, N6TST

Three Flags Mobiling, from ALCAN to Yucatán

Part 1: N6TST and KF6ZVE headed north—then south—on a mobile adventure only the truly adventuresome would attempt. In *Part 1,* they take on western Canada, the Yukon and Alaska in a rented RV.



Fall colors on a nearby mountain, made brilliant beyond belief by the sun's first rays, reflect in a tranquil lake to create a mirrored panorama that floods your rental RV's windows. You're parked somewhere along the Tok Cutoff in eastern Alaska and, outside, the late September temperature indicates 15°F. The gourmet coffee you started a few minutes ago is just finished so you sit down and switch on the HF to see what might be coming in over the Pole on 20 meters—or as you head into Yukon Territory, maybe pop over to 440 and link up with your home IRLP node to see what folks there are up to.

Impossible? Remember, this is a rented RV. It's not impossible at all if you had put together a suitcase-portable, full-powered HF, 144 and 440 MHz mobile system before you took off on this dream getaway. Can it be done? Absolutely—not only for an RV but for almost any rental vehicle.

Initial Challenges

I first got the idea for a go-mobile-anywhere station as the weeks ticked down for our long-anticipated RV adventure in Alaska and Canada. My travel-writer wife Donna, KF6ZVE, arranged a fall colors press trip where we'd drive a rented Class C motor home in a caravan from Anchorage, through Yukon Territory, Alberta and British Columbia to Seattle. We'd cover about 3200 miles in 13 days, most of which would cross vast emptiness.

Despite all this wide-open space, pre-trip homework indicated lots of repeaters and extensive linked systems, making 144/440 MHz operation not only practical, but interesting and challenging. HF prospects looked more than promising with literally thousands of miles of empty road, few power lines and ample time for ragchewing.

I wanted my system to be universal but knew I'd have little control over certain parameters such as power access and mounting locations. So I selected system components based on flexibility, robustness and the necessity for a no-damage/no-trace-remaining installation. I searched various RV manufacturers' Web sites to examine details of RVs typically

Figure 1—On rental RVs, the ladder is about the only place strong enough to hold an HF antenna. Simple mounts often prove to be the most effective. After installing it, make sure you stop after a few miles and recheck *all* your hardware for tightness.

Figure 2—For strong, easy, non-destructive temporary installations of lightweight VHF/UHF antennas on RV ladders or fragile railings, it's hard to beat today's "pipe clamp" mounts.

Figure 3—Checking RV manufacturer Web sites to get photos and dimensions of your rental coach makes installation a breeze, once you arrive. So does tossing your power screwdriver into the suitcase if there's room.

used as rental coaches as well as the specific one I knew we'd get. Soon, I had my design requirements narrowed down to where a fairly small equipment set could cover almost anything.

Transceiver and Antennas

I considered rigs and antennas together since they work as a team. Since my approach centered on simplicity while maximizing power efficiency, for HF I decided to skip the bulk and losses of a tuner and do my matching manually. Besides, there's no better way to reach back from the wilderness than with a truly resonant antenna.

Feature-intense competition among the ever-increasing population of HF/VHF/UHF rigs makes a perfect choice far more difficult nowadays. But for tunerless antenna matching on HF, one of the original compact classics, the ICOM IC-706MKIIG, still stands alone with its unique built-in ability to sample and display an antenna's SWR performance across a selectable "neighborhood" of bandwidth.

My broadly tunable modified Spider mobile antenna seemed to fill the bill since, with the '706, I could adjust it to be happy anywhere and, with all its resonators, I could work any band. I'd already built a take-down base shaft to allow it to fit inside a suitcase.

My VHF/UHF antenna turned out to be Comet's ground-independent '767, a clear winner in the cost, size and gain categories. Surprisingly rugged, it's an excellent choice for RV use, but the big plus is its light weight, since a heavier antenna and a long stretch of rough road can quickly pummel featherweight RV railings (about the only place for temporary mounting) into so much scrap aluminum.

Linked System Web Sites

For more information on linked systems in Alaska and Canada, see the following Web sites:

www.pgarc.org/
saralink.ca/index.html
www.kl7kc.com/~kl7kc/Repeat.html
www.hiway16.com/radio/index.htm
karc.ca

Mounts

About the only sufficiently strong HF antenna mounting spot on an RV today is its ladder. Some careful shopping revealed the best bet to be a four-bolt mirror-frame CB model I found for $7 at a truck stop. See Figure 1. For attaching my 144/440 MHz antenna to the rental RV's roof rail, Comet's RS560C "pipe clamp" anchored solidly at any angle and, traveling to and from the installation point, packed up snugly inside its own tiny pouch. See Figure 2.

Clean Power

Keeping weight and space to a minimum, I chose to operate exclusively from the battery, although we'd have power hookups at nearly every camping stop.

Fortunately, rental RVs often have separate batteries mounted in convenient spots (ours was in the coach's entry steps). Many even feature wing-nutted accessory lugs on the terminals. An excellent product for this application turned out to be an MFJ-1117 compact multiple dc outlet with 6 foot Monster Cable leads that connected to the RV battery. Between the MFJ-1117's cables and the rig's 6 foot power cable, my operating position could be located almost anywhere. I had no problems either driving or while parked.

Speaking of battery-only operation, an important specification to examine during compact rig shopping is its supply voltage tolerance, usually given as a percentage centered on 13.8 V dc. Fairly typical nowadays is $\pm$15%, which replaced the older specification of $\pm$10%, meaning improved regulation of the rig's internal operating voltage. This delivers two advantages: higher voltage noise transients are better attenuated, and the rig will continue producing full power when battery voltage droops. Beware of rigs specified for 13.8 V dc $\pm$10%, since their performance can drop off dramatically once you shut off the engine and the voltage falls to 12.0 V dc (or less). Do the math.

Figure 4—My finished RV antenna installation demonstrates my frighteningly simple overhead obstacle avoidance system: Pull your antenna over until it's low enough and mark your fore-aft guy rope with tape. As you approach a low-clearance point, pull in the guy until you see the tape. Works every time.

Figure 5—I stopped to shoot this sunset rainbow along an empty stretch of the ALCAN highway and then hopped back inside to enjoy the evening colors (they last about an hour at that latitude) while cranking up the laptop to work PSK31 into the lower 48 and the Pacific. In an hour and a half, we never saw another car.

Extra Goodies

Because I took the laptop, I made sure I brought along a compact audio interface for digital modes. I use a Rigblaster Nomic, one of a family of tiny computer port-powered take-alongs that enables you to unlock a world of adventure. A 2 ounce package puts digital modes like PSK31, MFSK16, SSTV, RTTY and many more literally at your fingertips. Software is available free on the Web or supplied with them.

Heil Sound's Traveler Headset with its long cord and PTT switch makes handy mobile installations yet handier and gets more from your transmitted audio. It's available for most compacts these days.

Another essential toss-in includes the ultimate tool: a roll of duct tape. Also indispensable is a pocket-sized digital voltmeter.

The Adventure

Days before departure, I made a visit to an RV dealer carrying the very coach we'd get. Crawling around underneath allowed me to find a bolt on the vehicle frame I could use to anchor my strip of $^3/_4$ inch copper ribbon to provide a solid RF ground for the antenna mounts on the ladder and railings. I was able to come up with coax-routing and access schemes (see Figure 3) as well as a solution to the potential clearance hazard presented by my 5 foot-plus HF antenna mounted atop an 11 foot high motor home.

Once we reached Anchorage, all the homework paid off handsomely. Between late-summer Alaskan rain showers, I had everything installed within 90 minutes. Figure 4 shows how I used my antenna spring and fore-aft guy rope anchored inside the driver's door to solve the clearance problem: As I approached obstacles (generally big steel bridges whose overhead clearances ran around 17 feet), I'd roll down the window and reel in the guy until reaching the piece of tape I put on the rope to mark the point where the antenna had lain over safely. Simple but 100% effective.

Tune-up for the HF antenna turned out to be a little tricky since, though I had a good RF ground, the RV's fiberglass body complicated things. But once I got it right, the old "if you can hear 'em, you can hit 'em" rule applied everywhere. Fifteen, 17 and even 12 meters were hot. In the RV park in Whitehorse, Yukon Territory, I had a casual MFSK16 three-way on 14.080 with ZK1DD in the Cook Islands and another station in North Carolina, as well as PSK31 contacts wherever we stopped a while and I cranked up the laptop. While others in the group grumbled over "No Service" readouts on dinky cell phones, we were telling folks in Chile about brilliant Canadian sunset rainbows and fall colors. See Figure 5.

Negotiating the endless expanse of forested lowlands and hills, it became interesting to stop on a nice promontory point to check our location relative to 2 meter or 440 repeaters that might still be 100 miles away and see whether we could hit them. Results varied but friendly VYs and VEs at the other end were always happy to give a signal report; they generally knew just where we were and told us about good spots if we wound up needing a reliable signal path.

Interestingly, groups of bears tended to favor these hilltop spots too. We often noticed a few several-hundred-pound residents lying in a nearby sunny spot and not too eager to give it up.

So Far, So Good

All considered, putting together a suitcase-portable mobile HF/VHF/UHF rental RV station turned out to be easier than I thought. Back home, I sat looking over my logs and the gear, totally satisfied with our results. But the next trip would take us to southern Mexico, where our spacious RV would be replaced with a tiny rental car. If I wanted to run HF mobile there, the time had come for additional engineering to further refine my traveling system and make it even more universal than it already was. The results turned out to be surprising—the experience showed me how some big problems could be solved with a few amazingly simple approaches. The "rest of the story" will be in Part 2.

All photos by the author.

David Rosenthal, N6TST, has been licensed since 1989 and holds an Amateur Extra Class certificate. He's an EE and a physicist actively working in RF engineering. He's written extensively in the areas of the Solar-Terrestrial environment, HF radio propagation and mobile radio system design. He maintains a real-time space weather Web site for HF communicators at **www.ridgenet.net/~n6tst**. *You can reach him at 840 W Springer Avenue, Ridgecrest, CA 93555;* **n6tst@ridgenet.net**.

By Dave Hassler, K7CCC

These Field Volunteers are *Far* Afield!

ARRL volunteers in Alaska, Puerto Rico and the Northern Mariana Islands manage to provide effective backup emergency communications despite the variety of challenges they face.

No matter where you do it, providing volunteer backup emergency communications takes work.

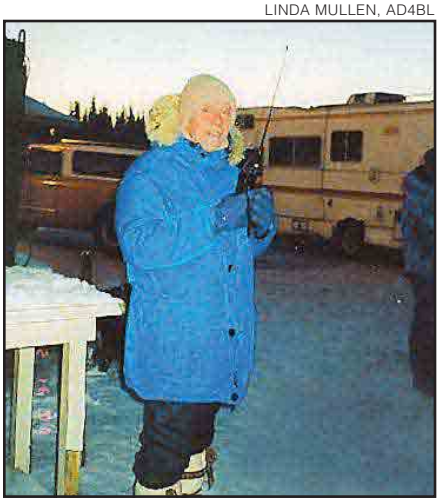
After a disaster, Amateur Radio responds the way no other volunteer group can. Hams provide numerous served agencies, both private and governmental, with essential communications when the usual means of moving messages have failed. That type of efficiency doesn't happen overnight. It takes a lot of dedication, planning and practice to ensure that the job will be done right. Now, imagine preparing for that job when you're hundreds, maybe thousands, of miles away from expected resources like fuel, food or medical aid. This article takes a look at representative ways ARRL volunteers in three remote locations tackle these problems.

Going the Distance

In Alaska, the Commonwealth of the Northern Mariana Islands (CNMI), Hawaii, the US Virgin Islands and Puerto Rico, distance is a major factor in operations. Outside of Alaska's population centers, vast distances separate amateurs in the 49th state from one another. In the mountainous CNMI, the vertical distances make typical VHF operation troublesome. And in Puerto Rico, the distance between English and Spanish can create a chasm that's sometimes difficult to cross.

The land area of Alaska is just over 570,000 square miles, or one-fifth the size of the rest of the United States. "Few roads exist and the great distances between settlements can only be spanned by small aircraft, boats, snow machines, dog sleds, or on foot," said Alaska Section Technical Specialist and former Emergency Coordinator Larry Ledlow, KL7/N1TX. "Fuel is expensive. Precious cargo space and foodstuffs command top dollar in the remote villages. Planning transportation for a communications response to a far-flung Alaskan region can be a full-time job.

LINDA MULLEN, AD4BL



William Mullen Jr, KE4ITP, stands by during a dog-sledding event outside of Fairbanks, Alaska. With temperatures near –35° F, handheld radios had to be kept under operators' coats between transmissions. The camper in the background served as the event base station—and shelter for chilly operators.

From the Northern Marianas, getting a message to the outside world can be tough when you're 4000 miles from the nearest state (Hawaii) and 6500 miles from the US mainland. Former CNMI DEC Tim Hayes, NHØH, said the best bets for extra-island contact from Saipan were to hams on nearby Guam on 40 meters or to the Philippines. Traffic is sometimes run through the Pacific Interisland Net's "Disaster Net" session on 20 meters. Contact directly with the US mainland is often limited. "Around 4 AM local time, 15 meters will open up for a few hours; 20 meters is usually open from 8 to 10 PM. That's not much to work with," Hayes stated. "Plus, it takes 400 W to consistently make contact. It's not always possible to get that kind of power out in a crisis."

With a distance of just over 1000 miles from the US mainland, Puerto Rico doesn't suffer so much from geographic isolation, said Puerto Rico Section Manager Victor Madera, KP4PQ. Communications on 15 and 20 meters get the job done regularly. The problem is one of language barrier, with many operators speaking Spanish as their first language. "Being that the language is a problem, here in Puerto Rico we are preparing training manuals in Spanish," Madera said.

Both geography and language have played a role in the development of Amateur Radio emergency communications in the Northern Marianas. Hayes said language differences initially made passing traffic difficult. "The natives of Saipan speak Chamorro and some English, the Philippine migrant workers speak Tagalog with English as a second language, and most of the Americans can only speak English. But we eventually learned that it didn't matter what language the traffic came in, just as long as it got into English before it left the island."

Adapting to the Environment

There's a lot more to Alaska than cold winter temperatures. Still, Alaska Section Emergency Coordinator Linda Mullen, AD4BL, said the weather can complicate things dramatically.

"Many remote radio stations can't be driven to," she said. "Batteries don't work very well in the cold, coax stiffens like steel and it's hard to operate in heavy gloves and with frozen fingers. It's almost impossible to put up an antenna in the dark at –40 degrees with the wind blowing."

"All this underscores the need for hams to be self-sufficient in every possible way. Flexibility and ingenuity become key traits in those who are successful," Ledlow said.

Twelve-volt dc battery chargers are essential, regardless of where a ham who is involved with emergency communications happens to live. Chargers for both automotive or marine batteries, as well as any handheld transceiver batteries or other NiCads in the station inventory, must be maintained, because in remote locations it's unlikely that replacements will be readily available during an emergency.

"Reliability is key," Hayes emphasized. "Ideally, you need a solar charging system for the batteries, and it makes especially good sense in the tropics. Gasoline or diesel electricity generators are not a good idea in remote areas. It's not like on the US mainland, where gasoline supplies are rarely, if ever, interrupted for any real length of time." Hams on Guam found that out in December of 2002 after Supertyphoon Pongsona devastated the US territory, located just south of the CNMI. Sources of gasoline and diesel fuel dried up quickly, and due to the remote location of Guam, it took weeks to get needed fuel to the island.

BONG MALASARTE, WHØX

Members of the Marianas DX Amateur Radio Club prepare and test Red Cross generators and other equipment in support of relief efforts on Guam in December 2002 after Supertyphoon Pongsona pounded the US territory.

Equipment that Gets the Job Done

On the mainland of the US, the most common form of Amateur Radio communication is via 2 meter FM repeaters. When a disaster hits a local area, the 2 meter machines are pressed into service to pass vital traffic. But in remote areas, 2 meter repeaters aren't necessarily the best medium of communication.

Considering the vast distances that both people and radio waves must traverse in Alaska, HF operation has proved a tremendous benefit to Alaskan hams. While several good repeater networks cover the major population areas, only a small portion of the state is accessible using VHF and UHF, Ledlow said. "Near Vertical Incidence Skywave propagation in the 80 and 40 meter bands works very well for whole regions, but long-haul antennas are required to move Amateur Radio traffic out of Alaska," Ledlow said, adding that formal traffic handling into remote areas has essentially died, as has packet.

In the Northern Marianas, geography hampers simple 2 meter operation. Saipan—where most CNMI citizens live—is a very mountainous island, and while it has a surface area of close to 180 square miles, no one repeater can reach all parts of the island. "One of our Philippine members got a hold of an older portable 2 meter repeater. It was designed around tubes and had eight crystals for four channels. It proved to be perfect for our application." Hayes said the next step was beefing up the antennas of many members' handheld 2 meter transceivers. The answer was deliciously simple and cheap: twinlead J-poles. "There was still a lot of relaying that had to be done to get the message through, but we could do it," Hayes stated.

Quickly, it became apparent to the CNMI operators that 2 meters may not be the best way to go. "It's also important to have 70 centimeter capability when you're in rugged, mountainous terrain. Surprisingly enough, we found that often 70 centimeters worked a lot better than 2 meters," Hayes said. He added that all ARES groups have to have a reliable link on HF to the outside world. When running on battery power, a 5 W rig will do in a pinch, but a 20 W radio is better. And good batteries—with charged backups—are a must, along with a good antenna system, Hayes stressed.

Madera said the situation in Puerto Rico has some similarities to what Alaskan and CNMI operators face. "Civil defense, police and other agencies use repeaters for their normal traffic. Usually, in a hurricane situation, they find themselves without communications because the repeaters are the first to fail during high winds," Madera said. The Puerto Rico Section field organization volunteers are promoting the use of HF nets in the 40 and 80 meter bands using NVIS antennas, he said. "After a hurricane we have a lot of welfare traffic with the States, which we handle using SSB on 20 and 15 meters."

Keeping the kit small and portable is essential in all situations, and that goes for both HF and VHF/UHF stations. Needed equipment should be broken into several packages suitable for handling by one person. "Anything that size can usually fit into the back of an airplane, in a boat or on a sled," Ledlow noted. "You never know what you might have to do to get the equipment where it needs to go."

ARRL resources are also made available, said ARRL Field and Public Service Team Supervisor Steve Ewald, WV1X. "When an Emergency Coordinator comes on board in a section, that EC is provided with a variety of resources: the *Emergency Coordinator Manual*, ARRL's Emergency Communications Courses and articles in the Public Service column of *QST*, so experiences can be shared and ideas exchanged."

Another is the ARRL emergency 2 meter repeater. "When Hurricane Marilyn hit the US Virgin Islands in 1995, almost all communications were wiped out," Ewald said. "Ham radio was going to be the best way to communicate, but most of the amateur infrastructure was damaged, too. ARRL saw a big need there and, through the ARRL Foundation, purchased a portable 2 meter repeater and got it to those folks as the recovery efforts were beginning. The repeater and other equipment has also been sent to Saba and Honduras after hurricanes wiped out local communications, and to North Dakota to aid in flood recovery."

In extreme circumstances, Section Managers can contact the ARRL Field and Education Services Office and make a request for the 146.810 machine. If the request is approved, ARRL HQ staff will handle the logistics.

Putting it all Together

The critical component in any emergency communications or other public service operation is the human element. It's not enough to have the best gear and solid relationships with served agencies. Ledlow said regular group training is necessary to make for a reliable and efficient emergency backup communications system. "It's not always easy to organize folks when they are hundreds of miles apart, but the effort

can pay off with seamless and unhesitant communications," he said.

On November 3, 2002, the Denali fault rumbled to life with a magnitude 7.9 earthquake. "Over 100 miles away, we in Fairbanks scrambled for the doorjambs and held on for nearly a minute," Ledlow recalled. "But just a few moments after the major shocks subsided, the Interior ARES net convened on the KL7KC network and requested emergency or priority traffic, with the Motley Group meeting on HF."

"Two hams were on site at the state seismology lab and quickly provided valuable information about the size and location of the quake.... The nets enabled us to stay in touch and to quickly gain a greater view of the situation," he said.

Amateur operations proved essential in connecting and comforting colleagues and neighbors across the vast land of Alaska, Ledlow added.

In the Northern Marianas, Hayes said the ARES group there has only recently been assembled, mostly due to the general lack of interest in emergency communications among the few hams on the islands.

One of the first things he set out to do was get as many of the Philippine CB operators on Saipan as possible licensed as hams. About a dozen went on to become Technician licensees. Hayes said that about the best thing he had going while trying to get an ARES group up and running was the support of the American Red Cross.

"They were very interested in having us help. This helped our status with Emergency Management, because they had directed the Red Cross to carry out many tasks in case of an emergency," Hayes said. "Having an official memorandum of understanding and a relationship between ham radio and the Red Cross that's decades strong helped a lot. We eventually became very involved and the Red Cross was happy to have us."

After the second drill that the Northern Mariana Islands ARES group ran in April 2003, the CNMI emergency management staff saw how effective Amateur Radio was, and allowed the hams more involvement, Hayes said. "During our second drill, we passed traffic out through the Pacific Interisland Net, which got routed into Hawaii. The next morning, when the ham in Hawaii called the North Mariana Islands Emergency Management Office to relay the message by telephone, they were both surprised and pleased."

Madera said that some Puerto Rican operators find it difficult to adjust to standard emergency communications practices and procedures, mostly due to language barriers. But since the Puerto Rico section has been promoting 40 meter drills, held each evening and Sunday mornings one hour after the usual club nets meet, hams interested in emergency communications are becoming steadily better at using standard methods and formats. Local district nets are also in operation using FM simplex on 2 meters.

BONG MALASARTE, WHØX

Marianas DX Amateur Radio Club members who assisted the American Red Cross NMI chapter during its Walkathon this year were joined for this photo by the governor of the Northern Marianas, Juan Babauta (in yellow visor), who was a Walkathon participant.

VICTOR MADERA, KP4PQ

ARRL volunteers in the Puerto Rico section have spent many hours teaching Technician license courses to members of the National Guard, police and other government officials, so they will have a better understanding of what Amateur Radio can do during a disaster.

Building Enthusiasm

One of the keys to a successful ARES organization is getting existing hams and others excited about emergency communications and teaching them what it can do for them and their communities in a crisis, Hayes said. "Then, it's important to [get interested people into Amateur Radio classes or elmer them individually] and guide them as they earn a Technician license."

The Puerto Rico Section also offers classes for the Technician license to members of the National Guard, police, Civil Defense, and other government officials and organizations, so they can get on board with what Amateur Radio can do during a disaster. "We have been successful with it," Madera reported. "We have noticed lately that some agencies are trying private nets on their own frequencies. The result? Failure, since they usually don't have enough trained personnel to handle the amount of traffic they face." He hopes that with building more of a public presence, Amateur Radio emergency communications volunteers can help to bridge those communications gaps that currently exist.

Regardless of whether you live in a remote area or right in the heart of town, there is always a place in an emergency communications group for a willing volunteer who wants to make a difference in the community. A list of all ARRL Section Managers, with their contact information, can be found on page 16 of each issue of *QST*. Your Section Manager will be happy to get you started. For hams with access to the World Wide Web, visit **www.arrl.org/sections/index.html** and click on your section.

Dave Hassler, K7CCC, is the News Editor of QST *and the ARRLWeb. He can be reached via e-mail at* **k7ccc@arrl.org**, *or by telephone at 860-594-0240.*

By Jennifer Hagy, N1TDY

Announcing the 13th Annual McGan Award

Throughout the year, ARRL Public Information Coordinators, Public Information Officers and other public relations volunteers work hard to keep Amateur Radio visible in their communities by publicizing special events, writing press releases, and maintaining good relations with local media among many other valuable activities. The job is an important one, and their efforts benefit us all. If you know a volunteer who has achieved public relations success on behalf of Amateur Radio, nominating him or her for the Philip J. McGan Memorial Silver Antenna Award is the perfect way to bestow much deserved recognition.

The award's namesake, journalist Philip J. McGan, WA2MBQ (SK), served as the first chairman of the ARRL's Public Relations Committee, which helped reinvigorate the League's commitment to public relations. Unfortunately, Phil never got to see how well his efforts paid off. In honor of Phil, his friends in the New Hampshire Amateur Radio Association joined with the ARRL Board of Directors to pay a lasting tribute to the important contributions he made on behalf of Amateur Radio.

The 2004 McGan Award will go to that ham who has demonstrated success in Amateur Radio public relations and best exemplifies the volunteer spirit of Phil McGan. The League's Public Relations Committee will pick the winner, subject to approval by the ARRL Board of Directors.

ARMY CURTIS, AE5P

North Texas Section Manager Roy Rabey, AD5KZ (left), presents the 2003 McGan Award to Tim Lewallen, KD5ING, during the Nacogdoches Amateur Radio Club's Christmas party.

Call for 2004 Nominations

1) The award is given only to an individual (not a group), who must be a full ARRL member in good standing at the time of nomination. The nominee must not be compensated for any public relations work involving Amateur Radio (including payment for articles) and may not be a current officer, director, vice director or paid staff member, or a member of the current selection committee.

2) The winner of the Philip J. McGan Memorial Silver Antenna Award will demonstrate volunteer public relations success on behalf of Amateur Radio at the local, state or national level, and will live up to the high standard of achievement exemplified by Philip J. McGan.

3) Anyone may make a nomination. Nominations must be on an official entry form, available from ARRL Headquarters. The nomination will include a written summary whenever possible.

4) Deadline: Nominations must be received at ARRL HQ in Newington by 5 PM May 21, 2004. Nominations arriving after the deadline or without an entry form cannot be considered.

5) Eligible nominations will be screened by a committee of Amateur Radio operators knowledgeable about public relations, which will forward its recommendation to the Volunteer Resources Committee of the ARRL Board of Directors. The Board will make a final determination at its July meeting and the winner will be notified shortly thereafter.

6) To obtain an entry form, call ARRL HQ at 860-594-0328 or e-mail **jhagy@arrl.org**. Ask for an official Philip J. McGan Memorial Silver Antenna Award entry form.

7) Return the completed entry form and supporting materials to Philip J. McGan Memorial Silver Antenna Award, c/o Jennifer Hagy, N1TDY, ARRL, 225 Main St, Newington, CT 06111. QST

Public Relations vs Public Service

In the past, there has been some confusion about the difference between "public relations" and "public service." Public Relations activities for which the McGan Award is given include efforts specifically directed at bringing Amateur Radio to the public's attention (and most often the media's) in a positive light. This may include traditional methods, like news releases; or non-traditional methods, such as hosting a radio show or being an active public speaker. Some candidates have been nominated for their public service activities, such as emergency communications, net leadership and other activities that, while helping maintain a positive impression of Amateur Radio among the public, don't fit the definition of "public relations." So, if you're considering nominating someone in your area for the 2004 award, please ask yourself if your candidate's work fits the *public relations* criteria.

By H. Ward Silver, NØAX

How to Avoid Contest Score Shrinkage

Ever been surprised when your score appeared in the final results of an ARRL contest? Perhaps it's time to review how contest logs are checked—and how to avoid those unwelcome surprises.

Part of the fun of a contest comes later—when scores have been posted and it's time to see if you beat your arch-rival, or if you simply did better than last year. Competitive operators vying for a top score want a level playing field in which everyone is subjected to the same standards of performance. It also matters to casual operators so they can improve their operating technique.

Starting at the beginning, what constitutes a valid contest QSO? Simply this: one in which *all* information on *both ends* is logged correctly. The term *busted* means that some of the information was not exchanged correctly. If any part of the information is wrong, at least one side of the QSO is busted. Most problems involve call signs. Here are some terms to become familiar with:

Unique (U)—a call sign that appears only in one log and cannot be positively identified as a busted call.

Busted (B)—a busted call is a miscopied version of a valid call as determined by cross-checking to other logs with similar calls.

Not-in-Log (N or NIL)—If your call does not appear in the other operator's log at the right time, your QSO is invalid.

Log Checking

In the Olde Days, when the fanciest logging program was a mechanical pencil, logs were checked manually by the contest manager. This was enough to evoke a high level of confidence in the results for the top scorers, but it left errors in lower-scoring logs unaddressed.

Today, with most logs being submitted as computer-readable files, software can be put to work verifying each QSO. Computerized checking also provides a valuable report to each contestant. The ARRL provides "LCR" (Log Checking Reports), and CQ's CQWW committee provides "UBN" or Unique/Busted/NIL reports showing exactly what the log checkers found.

What's Really an Error?

Obviously, not everything that fails to pass a computer check is a real error. The log checkers are aware of this and only assess scoring penalties for "high confidence" errors. The easiest types of errors to detect are busted exchanges in which the logged information doesn't match in both logs. Not-in-log QSOs are also pretty easy to peg as real errors.

Call sign errors can be difficult to identify with certainty. Here's an example from one of my log checking reports:

WB2UVV is a busted call. The correct call is WB2VVV.

The log checking software tried to match my QSO in WB2UVV's log, but couldn't find that log. It went looking for logs from other stations with similar calls. A match to a QSO with NØAX in WB2VVV's log was found and so it was determined that I had busted WB2VVV's call—my fault and my penalty. WB2VVV is not penalized.

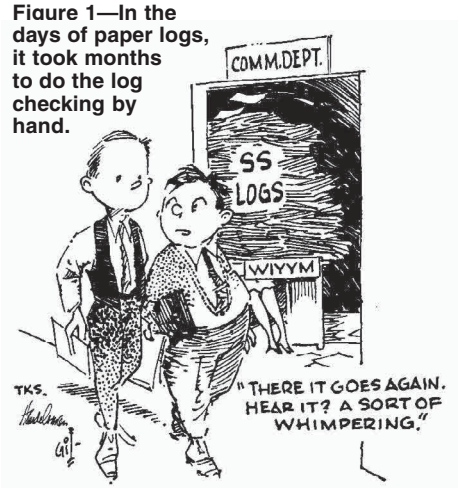


Figure 1—In the days of paper logs, it took months to do the log checking by hand.

Sometimes, the call simply can't be matched, as in this example from another log checking report from the ARRL Sweepstakes:

K5NU is a unique call. Received QSO# = 1.
Calls with same check/section: W5AK W5VX W5UX KG5U

The same lack of a call sign match was detected, but in this case no other log had a matching QSO at the same time. This is probably a "true unique."

This example is less likely to be a unique call:

VE3GX is a unique call. Received QSO# = 238.
Calls with same check/section: VE3XB

If VE3GX is really a unique, why was the QSO number 238? Although there was no clear match to any other log, this is probably a badly garbled call.

Unique calls don't result in a penalty for most contests because there are "real" uniques from casual operators. The price is that a lot of calls that really are busted get accepted along with the true uniques.

Why Penalize?

In the same Olde Days, it was not unknown for unscrupulous operators to "work the callbook" because the chances of detection were fairly low. Today, good log-checking keeps the playing field level.

There is a trade-off between being extremely accurate and high QSO rates. Without a penalty for inaccuracy, it's quite possible to just go fast and make up for the bad QSOs. Encouraging this type of operating is in no one's interest. Therefore a penalty is assessed—but *only* in the log in which the error occurred.

The ARRL removes the bad QSO plus one additional QSO. For the CQ World Wide, the bad QSO and three additional QSOs are removed. Both contest managers

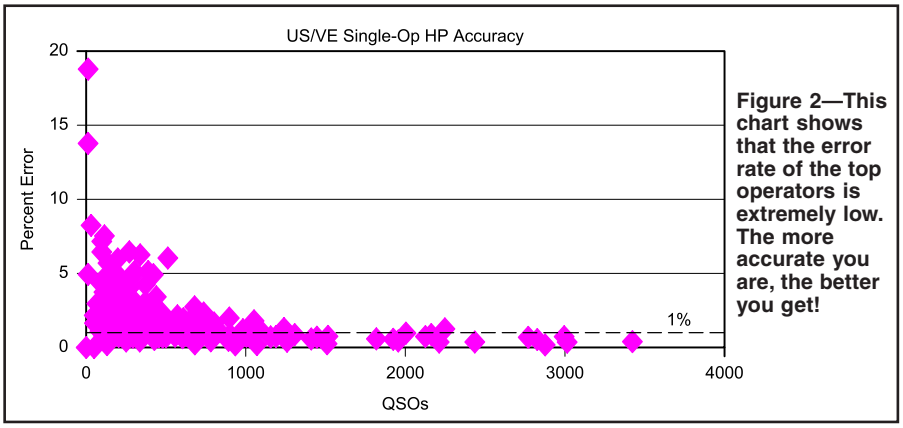


Figure 2—This chart shows that the error rate of the top operators is extremely low. The more accurate you are, the better you get!

Dancing with the Robot

When you turn in an ARRL contest log electronically in Cabrillo format,[1] it's first processed by a *robot*. "Why," you may be asking, "do I have to use Cabrillo format?" The proliferation of logging programs has made handling logs very complex. ARRL received logs in more than 80 different formats for the 2001 Sweepstakes! Importing each one of these logs is not a job I'd like. A standardized format such as Cabrillo is required to enable timely log checking and reporting.

Submitting a log by e-mail can be a little confusing if you haven't done it before. To be successful, attach your Cabrillo-formatted log to an e-mail message—no dupe or summary sheets. Don't alter the Cabrillo file in any way. When you e-mail your log to, say, **160meter@arrl.org**, the League's e-mail server passes your message with its attached file to the robot program. There is a separate robot for each contest (the addresses for each are found at **www.arrl.org/contests/e-mail.html**). The robot does four things:

1) Checks for a valid call sign in the SUBJECT: line of the e-mail. This allows us to quickly find your message if a question arises.

2) Opens the file and reads the header information to check that the information matches its contest. If you send a 10 meter contest log to the 160 meter robot, it will be rejected post haste.

3) Reads all of the data in the header and the log. It checks that the dates and times are all within the contest period and that it can read all of the QSO information.

4) Sends a message back to you with the results of steps one and two.

The robot *only* checks to see that your log data is readable and meets the contest rules. It does *not* check any of your QSOs against any other log.

If the robot determines your log data was okay, you'll get a message with a tracking number stating that your log was accepted and saved at ARRL HQ. Save that number—if there are any questions about your log later, you'll need it. The message looks like this:

Thank you for your participation in the contest and for submitting your log in Cabrillo format. Your tracking number is [1832.cwsprint].

If the robot found a problem that meant your log was missing valid information required to completely classify your entry, your file is discarded and you'll get a message that tries to explain the problem so you can fix and resubmit the log. Here's an example from the robot of a "fatal error":

UNABLE TO PROCESS LOG SUBMISSION: N0AX. Unfortunately our robot is unable to process your Cabrillo log file as submitted because it appears to be missing some critical information. Below you will find a list of the problems that were encountered in attempting to process your log, as well as a corresponding set of remedies that may fix these problems. Please review these problems, then update your log. You must then re-send it to **ssphone@arrl.org**.

ERROR #1: No callsign specified.

REMEDY #1: Please modify your Cabrillo log file to include a callsign. Here is an example of a valid callsign specification:

CALLSIGN: W1AW

I changed the information to match what was on the list provided by the robot, and my log was accepted. Just keep resubmitting until the robot accepts your log.

There are "non-fatal" errors at times that generally relate to problems detected on QSO lines. Again the robot details errors and asks you to correct them.

Only accepted logs are saved. If you decide to resubmit another copy of your log later, it will overwrite the first submission and you'll get a new tracking number. Then you can relax and say, "*Domo arigato, Mister Roboto!*"

[1]There's more about Cabrillo in D. Pruett, "Coping with Cabrillo," *QST*, Nov 2000, pp 45-47. The specs and other details can be found at **www.kkn.net/~trey/cabrillo/**.

feel that the penalties act as a deterrent to sloppy operating. Penalty QSOs affect only the QSO count, not multipliers.

The casual contester may be thinking, "Gee, if I'm not hyper-accurate, maybe I shouldn't send in a log at all. It would just hurt the serious operator!" Not to worry. As long as you record what you sent accurately, the only penalty you can cause is to your own score. By sending in a log for even a few QSOs, you contribute to the steady improvement in the quality of contest judging and reporting.

Improving Accuracy

Figure 2 shows the distribution of logging error rates from a recent contest. Those top operators make an incredible number of QSOs with high accuracy, don't they? The greatest opportunity for improving accuracy lies not with the top scorers, but with the rest of us.

Error rates can be startling at first. Don't be discouraged—everybody begins this way. Just knowing what causes errors is enough to set your course for a *Golden Log*—one with no errors. By paying close attention to what you copy, your error rate will fall quickly below 5%.

First, it's important to realize that no one is 100% accurate all the time. Noise, propagation and interference all take their toll. Operator fatigue sneaks up on everybody.

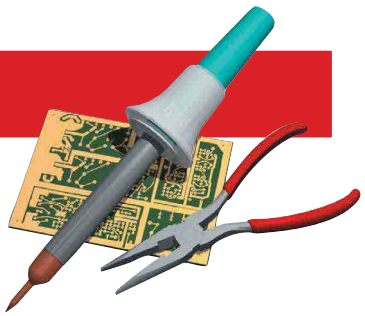
To get better takes practice. Get on the air and make contacts or just listen to the experts. Many of today's Big Guns recall that they spent hours just listening to their contesting heroes to learn their techniques—it works!

A common error is to assume or guess at information. Don't! Ask for repeats until you're sure. Avoid being fooled by logging software "suggesting" similar calls—turn off "Super Check Partial" call sign databases that encourage guessing. Don't let software fill in exchange information. If the first QSO with a station is bad, you'll lose all subsequent QSOs plus the penalty—ouch!

The most easily avoidable error is logging a call from a spotting network without verifying it—a growing problem. If you want to improve your logging accuracy, you have to do it by yourself. Don't let the convenience of spotting make you a sloppy op!

Summary

As the computer improves log checking, our accuracy is challenged more than ever. That's a good thing! Use the log checking information to improve your operating habits—it will serve you well any time you're on the air: ragchewing, contesting or in an emergency. If we work at it, we'll all be turning in Golden Logs someday!



The Doctor is IN

Q From Christopher, N3QXX, comes the following: I'm experiencing interference and wondered whether BPL could possibly sound like a digital carrier. I live in Baltimore and have power lines parallel to my home, and for about a month and a half now I have had horrible interference on HF. It is typically on 20 meters and sometimes, but rarely, on 40. The sound starts low, fades in and then hits S9 while completely wiping out stations on the air. The signal hangs for about five minutes or so, and just stops. I can then hear it on other parts of 20 meters. It seems to move around and is on multiple frequencies at any given time.

A The problem you describe is not BPL. Switch mode power supplies are notorious for creating discrete bands of noise on HF. The noise tends to drift, as it is non-synchronous, and that can be a clue. Switch mode supplies are in wide use as computer power supplies and many of these do not have adequate line filtering, so the noise tends to be conductive, to the power lines, and then radiated from them. The noise usually repeats every 30 to 50 kHz or so. Television receiver cathode ray tube (CRT) high voltage supplies, which operate at the CRT horizontal sweep rate (15,750 kHz) will also tend to repeat at that frequency spacing. Newer television receivers appear to have less shielding than earlier sets and are actually worse offenders in this regard. This could also be an arcing thermostat from a heating or cooling system. That could account for its cyclic nature. Try to determine a frequency interval; it could give a valuable clue as to its origin. Some wireless telephones use a frequency-hopping, spread spectrum technique, and while their RF frequencies are out of the HF radio spectrum, the gating switches could cause noise.

Unfortunately, conductive interference can become radiated interference if it reaches the power lines, and there's not much you can do about this short of antenna positioning. If the cause can't be discovered, there is one more approach you can try. There are a few "noise cancellers" available from several manufacturers. These are essentially noise receivers that detect and amplify the noise and inject it out of phase into the receiver, canceling or greatly diminishing the offending signal. They are most effective on a synchronous (stable in frequency and phase) noise source, but have to be evaluated in each case. Two such commercial devices are shown in Figure 1. Some transceiver noise blankers have adjustable gate times and these might also be effective. Once again, the repetitive nature of the noise could be a valuable clue as to its source. Good luck!

Figure 1—Two noise-canceling devices.

Q Danny, KD5UJ, writes: I have acquired a new Hammond HV transformer with a secondary rated at 2800 V at 5 kVA. The amplifier I want to build uses a 4CX250 tube which requires around 2000 V dc of plate potential. Will this transformer be suitable? If so, how do I reduce the secondary voltage? I've thought about attempting to build a power supply that could run both an HF and a VHF amplifier—one amplifier would require the 2000 to 2200 V dc and the other around 3200 V dc. Can you help me with this project?

A I assume the transformer rating you give is the ac rms output voltage. A 5 kVA transformer is one large device, capable of sourcing almost 2 A_{rms} of current at that secondary voltage—*be careful!* A transformer of that power rating will most certainly have a 230 V_{rms} ac primary winding. Your amplifier will require about 1400-1500 V_{rms} ac before the filter capacitors, with the full-wave rectified and filtered output bringing the dc voltage to about 2000 V dc. Accordingly, you can operate the 230 V_{rms} primary on 115 V_{rms} ac. That will give you the necessary 1400 V_{rms} ac output voltage prior to rectification and filtering. Be sure that the primary ac supply circuit can support the current requirement of the tube or tubes you are supplying. Another option, and one that is often used, is to power the primary through a Variac or Powerstat variable voltage auto-transformer. Auto-transformers for 230 V_{rms} ac are available on the surplus market, or you can use a 115 V_{rms} ac auto-transformer with an isolation transformer to convert the 115 V_{rms} to 230 V_{rms}. Just remember to allow adequate current ratings. That would let your transformer operate at any voltage within its maximum ratings, providing the current capability of the Variac or Powerstat is sufficiently high. It would also let you continuously vary the secondary voltage from near zero to the rated output voltage, 2800 V_{rms}… in effect, a variable voltage HV dc supply. Lastly, and once again, I stress, *be careful*—transformers of this power capability and voltage rating can be lethal and are not forgiving; there's usually no second chance, so remember—*switch to safety!*

Q From Dave, KCØLTD, comes this: I just put my radio in my semi (a 2000 model year Freightliner with a Cummins engine). Now I have noise that sounds like flowing water. I have a ground from the antenna to the frame, a ground from the radio to the frame and a separate ground from an amplifier to the frame. Does this sound like fuel pump or engine management computer noise and do you have any suggestions for reducing it?

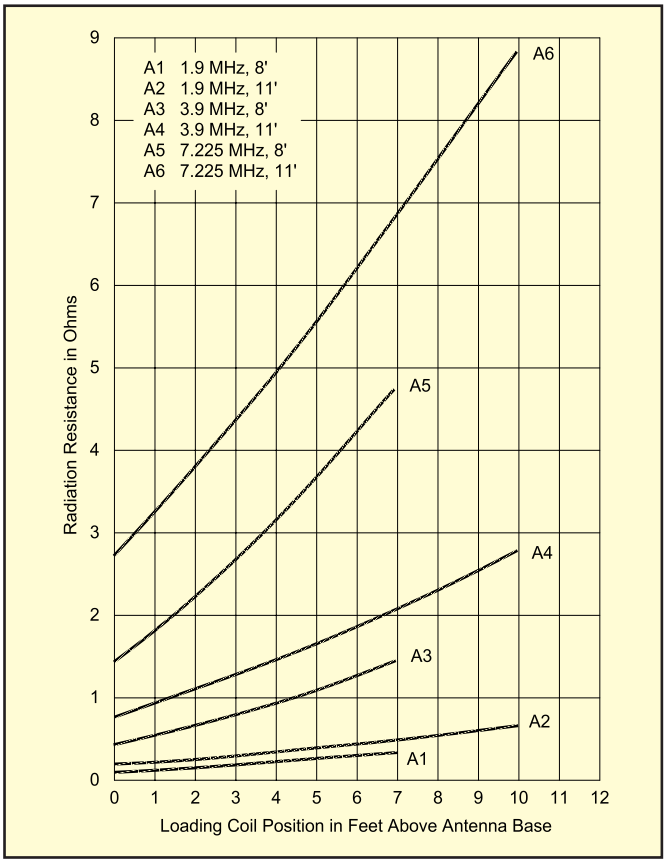


Figure 2—Radiation resistance of short mobile antennas.

Additionally, and along the same vein, Donald, AA2ZS, asks the following: I have RFI coming from my 1988 Ford Bronco. It appears to be the fuel pump. When it is disconnected, the noise goes away. I tried using a toroid suppression choke but it didn't work. Dropping the fuel tank and putting in a Ford EMI filter, which may or may not work, is expensive. The same noise is coming from a large cable going through the firewall. Any suggestions?

A Dave and Don, first, I would suggest using a separate shielded cable all the way to the battery for both the positive and negative dc connections. Heavy coaxial cable of RG-8/U-type is suitable for this. Just make sure the center conductor is adequate for the current required and take the cable length into consideration. Ground the shield on both the positive and negative cables. Put a fuse in both halves of this cable, too. In general, I suggest you seek help from your dealer in these situations. I'd also be concerned about all those ground cables. If they're excessively long they could be causing a problem rather than solving it. Long ground connections can actually pick up radiated engine noise. Dave, if the shielded battery cables don't cure your problem, I wonder whether you are hearing alternator whine. One way to tell is to disconnect the belt from the alternator temporarily to see if the noise quits. Check with your dealer to see if there are EMI/RFI filters to help, too.

Another common source of noise in vehicles are fuel injectors. Does the noise change at all with engine speed? If yes, and it sounds like ignition noise but you've eliminated ignition as a cause, you could have fuel injector noise. Again I suggest you consult with the dealer.

Don, if you've narrowed your problem down to the fuel pump, I would ask the dealer whether there are any service notes regarding fuel pump electrical noise. If Ford has a filter for correction, this may be an ongoing problem with the vehicle and the dealer may be able to guarantee corrective results. Bypassing and filtering should be done directly at the pump. If you don't do it there, you run the risk of the noise becoming radiated rather than conducted and that makes elimination more difficult.

The ARRL Web site has a page on automotive RFI that might be of interest to you both. Here's the link: **www.arrl.org/tis/info/rficar.html**. Good luck!

Q Mike, KB1HIF, writes: I am installing a mobile ICOM IC-706 with a Pro-Am 20 meter whip antenna and I am having difficulty tuning the antenna—it has a high SWR. I'm operating one band only, without an independent tuner. How should this antenna installation be approached? Is the length of the coax critical?

A A high SWR indicates a mismatch between the antenna and the coaxial transmission line. That effect is to increase the existing cable loss. A loaded and short mobile antenna will have a radiation resistance somewhere around 3 Ω on 40 meters. Figure 2 shows plots of radiation resistance versus coil position at several frequencies for short mobile antennas. Ground losses and loading coil Q will bring the base feed impedance to about 20 Ω, uncorrected.[1] I say "uncorrected" because this base impedance is normally lower than the output impedance of most transmitters (50 Ω). If you're using 50 Ω coaxial cable to feed the antenna (a common choice), that combination will give you an uncorrected SWR of 2.5:1. Without some form of antenna tuner, the IC-706 power foldback circuit will most certainly restrict the output power of the transceiver. Yes, the length of the coax will be critical, but only if the SWR is high.

My suggestion is to determine the actual feed point impedance of the antenna with an RF analyzer. Once you know the feed point impedance of the antenna, try to correct it with a matching network. If the antenna is inductive (too long), a shunt capacitor at the base will correct that reactance. If too short (capacitive), an inductor will be needed. The feed impedance is usually easier to correct with a capacitor. The capacitance value will depend upon frequency, antenna length, loading coil Q and ground loss. It could range from 50 pF to about 700 pF, with lower values of C at higher frequencies. Use a 600 V dc disc ceramic or mica capacitor. You might be tempted to use a quarter-wave coax transformer to match the antenna impedance to the feed line. That long coax can, however, make for a very lossy transformer and I would not advise doing this. Chapter 16 of *The ARRL Antenna Book*, 20th Edition, makes for worthwhile reading. My best advice would be to try to tune the antenna and bring the impedance closer to the feed-line impedance of 50 Ω.

Another answer, of course, is to use an antenna tuner. (It really doesn't *tune* the antenna, although it's called that. An "impedance transformer" would be a better name, but that applies to other devices, as well. So, I suppose, we're stuck with antenna tuner!) This will make the transceiver "see" a 50 Ω resistive load and will keep the transceiver power foldback circuitry from scaling back power (it does that to protect the output devices from high reflected power). Although a 1:1 SWR is preferable, a moderate SWR is normally not a problem at HF—mobile feedline lengths are normally short, thus limiting losses and the power levels are low enough to limit cable heating.

[1]See *The ARRL Antenna Book*, Chapter 16, Table 1, p 16-5.

Do you have a question or a problem? Ask the Doctor! Send your questions (no telephone calls, please) to: "The Doctor," ARRL, 225 Main St, Newington, CT 06111; doctor@arrl.org; www.arrl.org/tis/. Add your comments: "The Doctor is On-line" at www.arrl.org/members-only/qst/doctor/. QST

PSKMeter

How much would you pay for a perfect PSK31 or PSK63 signal, one that occupies as little bandwidth as possible and doesn't drive your fellow hams crazy with obnoxious splatter?

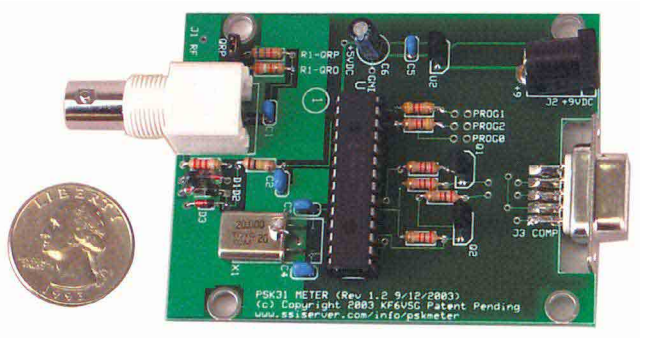
How about $39.35? That's the cost of the PSKMeter kit by Software Science. This clever gadget, developed by George Rothbart, KF6VSG, samples your transmitted RF and sends the results to your computer where the PSKMeter software *automatically* adjusts your sound card audio output until the splatter disappears. You never have to worry about whether your sound card levels have changed since the last time you were on the air. Just start transmitting and the PSKMeter takes care of the rest.

The PSKMeter sampling hardware is composed of a single PC board that's smaller than a pack of cigarettes (there is an enclosure available for an additional charge). At one end of the board there is a BNC RF connector; the other end sports a 9-pin serial jack and a coaxial power jack. You install the PSKMeter in your coaxial feedline through the use of a T adaptor (not supplied). The data is transferred to a COM port on your PC through a standard serial cable.

Installation and Operation

Once the kit is assembled, the fun begins. You start by downloading and installing the PSKMeter software for *Windows* from the Software Science Web site. The application is compact and runs in the background on most PCs without compromising performance.

I didn't have an available COM port, so I bought the serial-to-USB converter from Software Science. One thing the converter manual does not make clear is that you must *first* connect the converter cable to your USB port. When you do, *Windows* will detect that a USB device has been attached and will ask for the appropriate drivers. That's when you put the converter CD-ROM in the drive and continue. In my case, the drivers loaded quickly and soon I had a "virtual COM 3" on my USB.

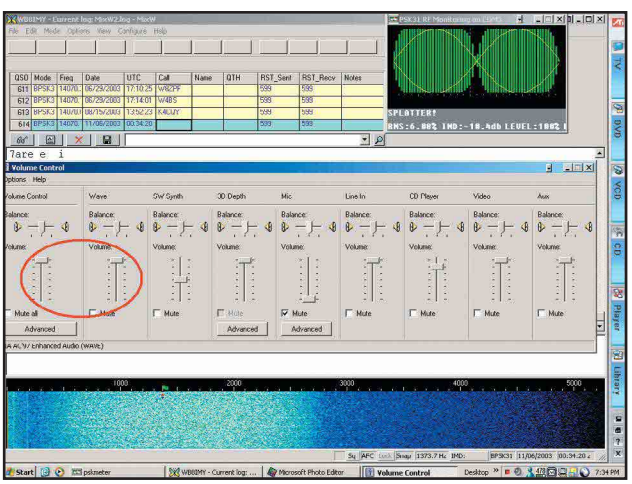


With the PSKMeter inserted in my feedline (it didn't affect the SWR) and the power cable attached, I was ready. The screen shots show the results. Using *MixW* software in the PSK31 mode, I deliberately moved the master VOLUME and WAVE sound card output controls to maximum and clicked TX (transmit). The PSKMeter told me that my signal was horrible, as you'd expect.

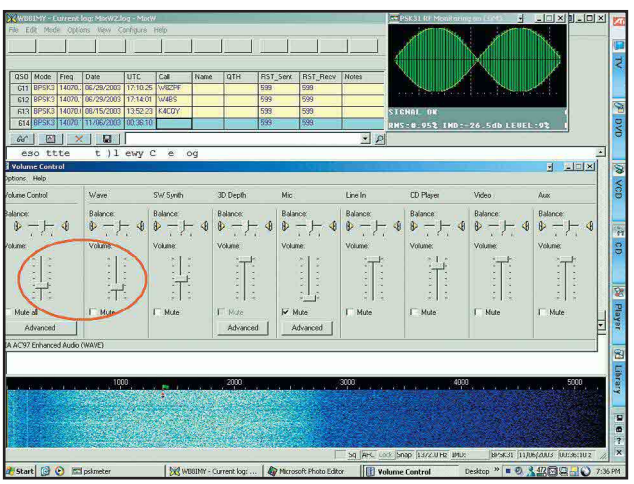
Next, I selected "Automatic Level Control" in the PSKMeter software and clicked TX again. It was fascinating to watch the PSKMeter perform its analysis and slowly reduce the audio output until my signal was clean. The process took about 8 seconds. In cleaning up my signal, the PSKMeter also dropped my RF output from 100 W to 50 W, but that's still more than enough power for PSK.

The PSKMeter may be the Holy Grail PSK operators have been seeking for several years. With a PSKMeter in the feedline, there is no excuse to transmit a dirty signal.

Manufacturer: Software Science, 7 Mt Lassen Dr, C250, San Rafael, CA 94903; **www.ssiserver.com/info/pskmeter/**. *Kit: $39.35. Enclosure: $6.95. BNC T connector: $4.99. Serial-to-USB converter: $29.95. Note: Kit instructions and software must be downloaded from the Software Science Web site.*



My hideous, overmodulated signal before the PSKMeter was allowed to adjust it. Note the "Splatter!" warning in the PSKMeter window (upper right) and the maxed-out VOLUME and WAVE controls (circled in red).



The PSKMeter takes over and my signal is as clean as the proverbial whistle. Note the new positions of the VOLUME and WAVE controls (circled in red).

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

By J.D. Harper, K6KSR

Do you do Zulu?

PDT, EST, CDT, UTC or GMT? Confused over which time reference to use for operating and logging? There's only one choice.

Okay, Old Man, I'll see you next Thursday on 40 at 1 PM my time."

"Roger that. That'd be 3 in the afternoon, my time, right?"

"Uh, I guess so. You guys on Daylight Saving Time back there?"

"Roger, CDT here—just remember that we're two hours ahead of you West Coast guys."

"Two hours? I thought you were three hours ahead of us, Old Man."

"If I was mobile and 50 miles east of here, I would be—I'd be in the Eastern time zone. Then I'd be on freq at 4 for your 1 o'clock sked. QSL?"

Sound familiar? I hope not…but unfortunately, it's not uncommon to hear this type of confusion on the air. The solution? Using *Coordinated Universal Time* (UTC), also known as *Zulu time*.

Take another listen...

"Okay, Old Man. I'll see you next Thursday on 40 at 2100 Zulu."

"Roger. 2100 Zulu. See you there. 73"

UTC is, Well, Universal

What makes the difference? No matter which time zone our two ham friends are in, it's the same UTC time for both. In fact, when it's 2100 Zulu at their QTHs it's 2100 Zulu around the globe—in the US, Paris, Tokyo and Kathmandu!

Hold on—how can it be 9 at night in Los Angeles, Dallas and Paris at the same time? Actually, it's 2100Z/9 PM at only a few places on the globe—those that sit on or near the *prime meridian*, located at 0° longitude—the home of Greenwich, England.

Greenwich Mean Time, or GMT, became a world time and date standard because it was used by Britain's Royal Navy and Merchant Fleet during the 19th century. Today, UTC is the recognized, universal time standard, the current term for what was once commonly referred to as GMT.

How do I Convert to UTC?

I was hoping you'd ask that question. Figuring out your UTC, or Zulu, time is easy. Use Table 1 to locate your current time zone (Eastern Daylight Time, Pacific Standard Time or whatever). Then simply cross reference your local time to UTC. Table 1 shows the number of hours you need to subtract or add to convert UTC to local time. Remember that UTC uses the 24 hour time notation system—0000Z (midnight) to 2359Z (1159) PM.

You'll also have to take notice of the date. When it's 2015 CDT (8:15 PM) Thursday in Dallas, it's 0115 Zulu (1:15 AM) *Friday* at Greenwich, England. (See Tables 1 and 2.)

Who says it's, say, 0115:32Z, anyway? The National Institute of Standards and Technology (NIST), that's who. Located in Boulder, Colorado, NIST (you can find a lot more information at **physics.nist.gov/GenInt/Time/time.html**) maintains the cesium beam clock system for the US. The NIST-F1 cesium atomic clock, said to be so accurate that it will neither gain nor lose one second in 20 million years, contributes to the international pool of the world's atomic clocks used to define Coordinated Universal Time.

Tuning in to the Time Signals

To synchronize your clocks with this highly accurate time standard, simply tune your receiver to WWV or WWVH. WWV broadcasts on 2.5, 5, 10, 15 and 20 MHz from Fort Collins, Colorado. The WWVH broadcasts can be heard on 2.5, 5, 10 and 15 MHz from Kauai, Hawaii. Timing signals are broadcast 24/7 from both stations. A tone with a timing click every second is interrupted by a voice announcement every 60 seconds, announcing the time in hours and minutes. More information on the NIST and the WWV stations can be found at **www.boulder.nist.gov/timefreq/general/broadcast.htm**. Looking for the real time in real time? See **nist.time.gov**.

Another time signal broadcast from NIST station, WWVB at Fort Collins, is used primarily to synchronize consumer electronics, and for high-level network time synchronization and frequency calibration. Time and frequency signals are

Table 1
Number of Hours to Subtract to Convert UTC to your Local Time

Local Time	*Subtract from UTC*
Atlantic Standard	4 hours
Atlantic Daylight	3 hours
Eastern Standard	5 hours
Eastern Daylight	4 hours
Central Standard	6 hours
Central Daylight	5 hours
Mountain Standard	7 hours
Mountain Daylight	6 hours
Pacific Standard	8 hours
Pacific Daylight	7 hours
Alaskan Standard	9 hours
Alaskan Daylight	8 hours
Hawaiian Standard	10 hours

Table 2
Conversion Chart from UTC to US Time Zones

UTC	*EDT/ AST*	*CDT/ EST*	*MDT/ CST*	*PDT/ MST*	*PST*
0000*	2000	1900	1800	1700	1600
0100	2100	2000	1900	1800	1700
0200	2200	2100	2000	1900	1800
0300	2300	2200	2100	2000	1900
0400	0000*	2300	2200	2100	2000
0500	0100	0000*	2300	2200	2100
0600	0200	0100	0000*	2300	2200
0700	0300	0200	0100	0000*	2300
0800	0400	0300	0200	0100	0000*
0900	0500	0400	0300	0200	0100
1000	0600	0500	0400	0300	0200
1100	0700	0600	0500	0400	0300
1200	0800	0700	0600	0500	0400
1300	0900	0800	0700	0600	0500
1400	1000	0900	0800	0700	0600
1500	1100	1000	0900	0800	0700
1600	1200	1100	1000	0900	0800
1700	1300	1200	1100	1000	0900
1800	1400	1300	1200	1100	1000
1900	1500	1400	1300	1200	1100
2000	1600	1500	1400	1300	1200
2100	1700	1600	1500	1400	1300
2200	1800	1700	1600	1500	1400
2300	1900	1800	1700	1600	1500
2400	2000	1900	1800	1700	1600

*0000 and 2400 are interchangeable. 2400 is associated with the date of the day ending, 0000 with the day just starting.

broadcast continuously on 60 kHz. There are no voice announcements on WWVB, but rather a complex time code format that is beyond the scope of this article. To learn more about WWVB, see their Web site at **www.boulder.nist.gov/timefreq/station/wwvb.htm**.

The Role of the US Naval Observatory

Another big-time player in the time game is the US Naval Observatory (USNO), located in Washington, DC. Charged by the Department of Defense with maintaining a DOD reference standard for precise time and time interval, the USNO performs an essential scientific role for the nation as a whole, and specifically the Navy and the Department of Defense. Included in its mission is the determination of the positions and motions of the Earth, Sun, Moon, planets, stars and other celestial objects. USNO provides a reliable and highly accurate time information source required by military operations, and modern navigation systems such as LORAN-C, satellite based NAVSTAR Global Positioning System (GPS), as well as the communications and intelligence fields. The USNO *Master Clock* is the time and frequency standard for all of these systems. If you'd like to explore the USNO further, see the Web site **tycho.usno.navy.mil**.

Zulu: It's for You!

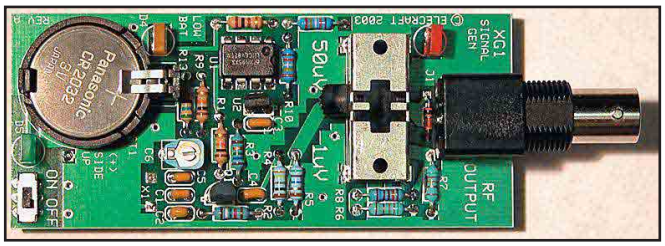
We need not be too concerned over the technicalities of the time standard. Simply get your Zulu working, synchronize your shack clock with WWV or WWVH, begin using 24 hour notation, and make your time-stamp *UTC*.

"This is K6KSR, Frisco, Texas, signing off at 1434 Zulu. 73, all!"

First licensed in 1955 as Novice station KN6KSR, John Harper cut his ham teeth on homebrew rigs and military conversion sets. A dedicated boatanchor fan and QRP enthusiast, he still builds much of his own gear. You can contact the author at 8260 Christie Dr, Frisco, TX 75034, **k6ksr@earthlink.net**.

NEW PRODUCTS

ELECRAFT XG1 RECEIVER TEST OSCILLATOR/S-METER CALIBRATOR



◊ Elecraft's new XG1 Receiver Test Oscillator can be an alternative to an expensive, lab-grade signal generator. The XG1 is a fixed-frequency (7.040 MHz) signal source with an accurate 1 µV and 50 µV output levels. The XG1 is said to achieve an absolute output accuracy of better than ±2 dB, and a unit-to-unit variation of typically ±1 dB. This ensures that measurements made with different XG1s can be directly compared.

The 1 µV level can be used to determine a receiver's MDS (minimum discernible signal) as well as its overall receive gain. Since 50 µV is widely used as the standard "S9" reference, this level can be used for S-meter calibration. Step-by-step procedures are included for receiver performance measurement and S-meter alignment. In addition to receiver testing, the XG1 can be used as a reference to calibrate other lab instruments. The XG1 also provides reduced output levels at harmonics of 7040 kHz, so it can be used for receiver alignment and qualitative tests on 20, 15 and 10 meters.

Additional features of the XG1 include an on-board 3 V battery (standard coin cell), low-battery LED (yellow), power-on LED (green) and reverse transmit warning LED (red). The unit is protected against brief accidental transmit, and has been tested at up to 10 W for 2 seconds.

The XG1 is 1.5 inches wide by 3.5 inches long. The output signal appears on a BNC. A BNC male-to-male (BNC-MM) adapter is offered to eliminate the need for coax cable and allow the direct connection of the XG1 to the back of a receiver or transceiver. Rubber feet are also included so the unit can be used on the workbench.

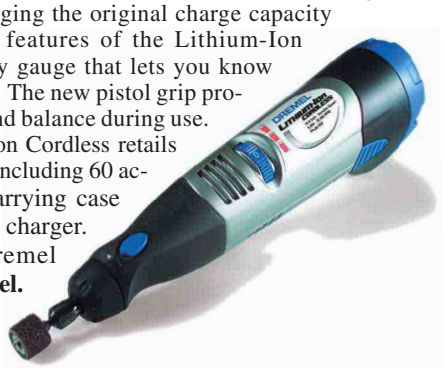
The XG1 is priced at $39. The BNC-MM adapter is $5. For further details on the XG1 and other Elecraft products, visit their Web site, **www.elecraft.com**.

LITHIUM-ION CORDLESS ROTARY TOOL

◊ Dremel has announced the introduction of a cordless model of its rotary tool, the Lithium-Ion Cordless. The tool operates at speeds ranging from 5,000 to 35,000 RPM, the same speed and power as its corded counterpart. It also works with the more than 150 Dremel accessories and attachments, providing a portable solution for jobs such as grouting, cutting, sanding, shaping, sharpening and grinding.

The lithium-ion power source uses the same battery technology as notebook computers and cell phones, holding a charge significantly longer than a standard nickel-cadmium (NiCd) battery. The result is that it retains 85 percent of its full charge for four months. In addition, lithium-ion batteries can be recharged at any time without damaging the original charge capacity or run time. Additional features of the Lithium-Ion Cordless include a battery gauge that lets you know when it's time to recharge. The new pistol grip provides improved comfort and balance during use.

The Dremel Lithium-Ion Cordless retails for approximately $69.99 including 60 accessories, a heavy-duty carrying case and a three-hour battery charger. For information on Dremel products see **www.dremel.com**; tel 800-437-3635.



Experiment #13—Attenuators

Thus far, we've concentrated on active circuits—those that use applied power to transform an input signal. There are other passive circuits out there that don't need a power supply, yet perform useful functions. Attenuators are an excellent example. This month we'll explore common types and you will have a couple of useful gadgets when we're through.

Terms to Learn

- *Minimum loss*—an attenuator designed to match two impedances while incurring the minimum amount of power loss.
- *Nepers (Np)*—a logarithmic ratio similar to the decibel, except that the Naperian or natural log (ln or $\log_e$, where e=2.71828...) is used. Np is often used to specify ratios of voltage or current.
- *Symmetrical*—an attenuator whose attenuation and impedance is the same in either direction.

Background

Attenuators are used in many different audio and radio applications. Your HF rig probably has an attenuator at the front end of its receiver and your signal generator might use one to switch output voltage ranges. Along with voltage reduction, attenuators are used for impedance matching and isolation. Most attenuators are made from fixed and variable resistors, but some RF attenuators are made from PIN diodes. Microwave attenuators may be made from material inserted into waveguide.

There are many types of attenuator circuits and Figure 1 shows the most common, the T, Pi, H, O and L. The T, Pi and L circuits are all *unbalanced*, meaning that all circuit voltages are referenced to the common ground. The H and O circuits are the *balanced* equivalents of the T and Pi, respectively. The balanced circuits do not have a common ground. The adjustable L attenuator is often found in audio systems, called an *L Pad*, with the potentiometers mechanically linked or *ganged*. Attenuators are often referred to as *pads* and attenuation as *padding*.

Attenuators are designed to have specific input and output impedances because the source and load impedances affect how much voltage appears across the attenuator's resistors. The source and load often need to be connected to a specific impedance to operate properly.

Designing Attenuators

The equations for attenuator resistor values are complex[1] so tables for values of attenuation and impedance are widely available, as in *The ARRL Handbook*, and reproduced as Table 1 for symmetric attenuators. Since most ham equipment uses 50 Ω inputs and outputs, we'll use that as our design impedance. Let's design a 50 Ω, 10 dB attenuator.

Although you may use either the T or Pi circuit, I used the Pi because it requires no center connection. If you choose the Pi, Table 1 gives values of 96.2 and 71.2 Ω for R1 and R2. (R1 = R3 for symmetric attenuators.) I substituted 100 Ω and 75 Ω resistors, which keeps the ratio (and thus the attenuation) close to 10 dB, while raising the impedance to 52 Ω.

- Build this circuit and test it by connecting it to a function generator on one side and a 51 Ω resistor on the other. (It's symmetrical, so it doesn't matter which side you choose as input and output.)
- Input a 1 kHz waveform and measure the output voltage. Calculate the attenuation using the following equation:

$$\text{Attenuation (dB)} = 20 \times \log (V_{out}/V_{in}) \qquad \text{[Eq 1]}$$

- Measure the input resistance with the 51 Ω output resistor connected. It should be within a percent or two of 52 Ω.

[1]Attenuator design equations can be found in *Reference Data for Radio Engineers*, Howard W. Sams & Company / ITT, Indianapolis, 1979 or at **www.microwaves101.com/encyclopedia/attenuators.cfm**.

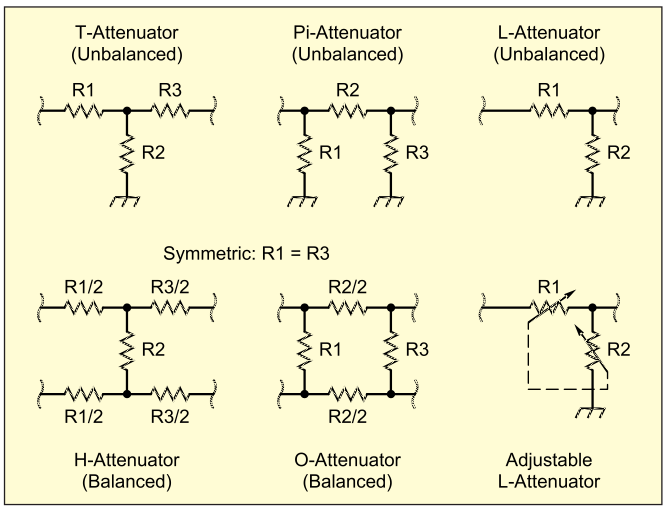


Figure 1—Several common attenuator circuits. To make the attenuators symmetric, make the values of R1 and R3 equal.

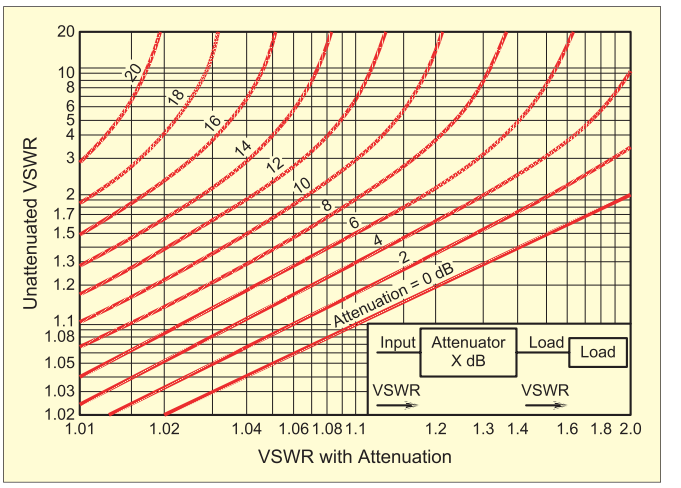


Figure 2—Attenuation can prevent a high SWR from upsetting a 50 Ω signal source. It can also mask an SWR problem at your antenna!

H. Ward Silver, NØAX ♦ 22916 107th Ave SW, Vashon, WA 98070 ♦ n0ax@arrl.org

Table 1
Resistance Values for Symmetric T and Pi Resistive Attenuators

Pi-Network Attenuators (50 Ω)			*T-Network Attenuators (50 Ω)*		
Atten (dB)	*R1, R3 (Ω)*	*R2 (Ω)*	*Atten (dB)*	*R1, R3 (Ω)*	*R2 (Ω)*
1	870.0	5.8	1	2.9	433.3
2	436.0	11.6	2	5.7	215.2
3	292.0	17.6	3	8.5	141.9
4	221.0	23.8	4	11.3	104.8
5	178.6	30.4	5	14.0	82.2
6	150.5	37.3	6	16.6	66.9
7	130.7	44.8	7	19.0	55.8
8	116.0	52.8	8	21.5	47.3
9	105.0	61.6	9	23.8	40.6
10	96.2	71.2	10	26.0	35.0
11	89.2	81.6	11	28.0	30.6
12	83.5	93.2	12	30.0	26.8
13	78.8	106.0	13	31.7	23.5
14	74.9	120.3	14	33.3	20.8
15	71.6	136.1	15	35.0	18.4
16	68.8	153.8	16	36.3	16.2
17	66.4	173.4	17	37.6	14.4
18	64.4	195.4	18	38.8	12.8
19	62.6	220.0	19	40.0	11.4
20	61.0	247.5	20	41.0	10.0
21	59.7	278.2	21	41.8	9.0
22	58.6	312.7	22	42.6	8.0
23	57.6	351.9	23	43.4	7.1
24	56.7	394.6	24	44.0	6.3
25	56.0	443.1	25	44.7	5.6
30	53.2	789.7	30	47.0	3.2
35	51.8	1405.4	35	48.2	1.8
40	51.0	2500.0	40	49.0	1.0
45	50.5	4446.0	45	49.4	0.56
50	50.3	7905.6	50	49.7	0.32
55	50.2	14,058.0	55	49.8	0.18
60	50.1	25,000.0	60	49.9	0.10

- Try some of the other attenuations in the table. A 6 dB Pi-attenuator can be made from 150 Ω and 39 Ω resistors. Use 39 Ω and 10 Ω resistors for a 20 dB T-attenuator.

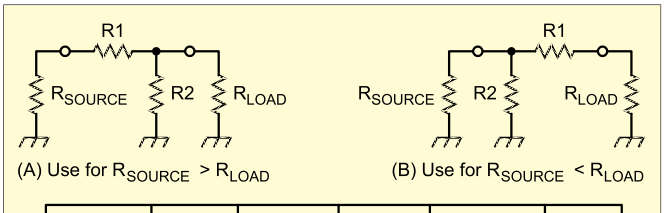
If you make the attenuator a permanent addition to your tool kit, you don't have to use a fancy enclosure. Find any metal enclosure that will seal tightly. (Some of the hallmarks of a good attenuator are insignificant leakage, constant impedance and accuracy.) Keep the leads short and straight so that the attenuator will work at high frequencies without looking like an inductor.

Using an Attenuator for Isolation

Attenuators can also provide isolation between two systems. This is useful at RF, where output amplifiers are usually designed to expect a load of 50 Ω. For example, signal generators expect a low VSWR to maintain their calibrated output level and purity. The input impedance of circuits such as filters, transmission lines and antennas is often not 50 Ω, however. An attenuator in front of the circuit being tested keeps the VSWR low at the generator's output.

Suppose you want to test a series-resonant trap to notch out a strong local broadcast station. The impedance of the filter will be just a few ohms, let's say 5 Ω at the notch frequency, and very high elsewhere. If you have the filter connected across a 50 Ω receiver input, the VSWR at the generator output will rise to 10:1 at the notch frequency. This will likely upset the generator calibration and degrade the accuracy of your filter attenuation measurements.

What happens if you put the 50 Ω, 10 dB attenuator between the generator and the filter? Because energy to and from the filter is reduced by 10 dB in each direction, the generator thinks the 10:1 SWR is much lower, 1.18:1. SWR is reduced because the attenuator reduces the reflected power from the mismatched load to a very small amount—0.7% of the generator's output power.[2] Figure 2 shows how much attenuation from a fixed attenuator or a feed line reduces VSWR.



R_{SOURCE}	R_{LOAD}	R1	R2	Atten (dB)	Circuit
50	75	43	87	5.7	A
50	300	274	55	13.4	B
50	600	574	52	16.5	B
75	50	43	87	5.7	A
75	300	260	87	11.4	B
75	600	561	80	14.8	B
300	50	274	55	13.4	A
300	75	260	87	11.4	A
300	600	424	424	7.7	B
600	50	574	42	16.5	A
600	75	561	80	14.8	A
600	300	424	424	7.7	A

Figure 3—Minimum-loss attenuators match system impedances while exacting the least amount of signal energy.

- Put the 50 Ω, 10 dB attenuator back together and measure the resistance at the input with the output connected to a 51 Ω resistor, a 5 Ω resistor (two 10 Ω in parallel), an open-circuit and a short-circuit.
- Compute the VSWR for each with the following formula:
  VSWR = $R_{meas}/50$ (if $R_{meas}>50$ Ω)
  VSWR = $50/R_{meas}$ (if $R_{meas}<50$ Ω)
  The 10 dB pad is pretty effective at reducing SWR, isn't it?

Using an Attenuator for Impedance Matching

You might be more interested in making an attenuator match the impedance of two systems than in creating a fixed amount of loss. This can be done effectively with just a few resistors in an L configuration, similar to that shown in Figure 1. It is desired to match the impedances while creating as little extra loss as possible. These are called *minimum loss* attenuators.

Figure 3 shows the L attenuator circuits used for this application and several sets of values that make useful impedance-matching attenuators. If you have other impedances to match, an on-line calculator is available at **home.sandiego.edu/~ekim/e194rfs01/minl_atten/minlosatten.html**.

Suggested Reading

Enter "audio attenuator" into an Internet search engine to find many different links. If you'd like to try a useful attenuator construction project, see the article at **www.arrl.org/tis/info/pdf/9506033.pdf**.

Shopping List

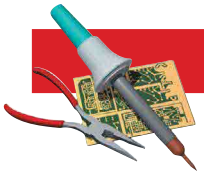
- 10 (2 each)—10, 39, 51, 75 and 100 Ω, 1/4 W resistors

Next Month

To transfer control and data signals between equipment with different grounds, engineers often use electro-optical components. Join in as we attempt to shed light on the workings of the optocoupler.

The Hands-On Radio Web site is **www.arrl.org/tis/info/html/hands-on-radio/**.

[2]The attenuator reduces the power reaching the load by 10 dB. The reflected power is 1.7 dB below the forward power (return loss), which the attenuator reduces by another 10 dB for a total round trip loss of 21.7 dB. This corresponds to a VSWR of 1.18:1. QST



By Larry Coyle, K1QW

An Automatic Audio Volume Leveler

Is your receiver AGC below par? Build this audio leveler and pamper your ears.

You know how it is when you're tuning around trying to dig out a weak signal—headphones on, volume control cranked up, automatic gain control (AGC) off—suddenly some "power house" appears on the band. Wham! Your eardrums ring for the next couple of minutes. Or, perhaps a blast of noise (QRN) from a distant thunderstorm makes you wince in pain.

Why not just turn the AGC on? If, like me, you have an older receiver with AGC that acts only at a signal level higher than you'd like (delayed AGC) or has a long recovery time, it's just plain annoying. It was so annoying that I tended to leave it off most of the time. I dealt with the loud beeps, squawks and static crashes for a while and then I began to search for some solution to the problem.

This article describes my eventual solution—a box that plugs in between my receiver's audio output jack and my headphones. It keeps the audio output nearly constant at some level, under *my* control, that I can vary with just the twist of a knob.

Design Approach

The first order of business was to come up with an overall design strategy. After a little thought, I decided a good approach would be to directly monitor the audio output level and continuously compare the amplitude to a dc voltage that I could adjust from a front-panel control. When the output exceeded the chosen level, I would rectify and filter the difference and feed it back as an error signal, to somehow control the audio level at the input to the circuit. This is a classic feedback-control system approach, where the output of a system is measured against some desired standard and the resulting error signal is used to correct the input. To look at it another way, I wanted an audio-derived AGC with adjustable delay.

Next, I needed a way to electronically control or limit the audio level. After combing through some of the literature, I considered, and rejected, several ideas:

- Diode limiters—the distortion was unbearable.
- Advanced linear ICs (variable gain amplifiers or analog multipliers)—expensive and hard to find.
- Microcontrollers or digital signal processors (DSPs)—overly complex.

I finally settled on an older approach—I used an FET as a voltage controlled resistor (VCR) and wired it up as one half of a voltage divider. That seemed intriguingly simple and the low cost of the parts was appealing, too. Figure 1 shows, in simplified block diagram form, how these ideas work together to form an automatic level controller.

Using an FET as a Voltage Controlled Resistor

An FET makes a fairly good variable resistor, because the drain-to-source channel has a well defined resistance value that can be changed simply by varying the voltage applied to the gate terminal. You need to be careful not to let the drain-source voltage get too large (a few hundred millivolts is about the limit) or nonlinearity will set in and cause distortion. The nice thing is, with such a limited voltage swing, this effect is actually bipolar. In other words, the channel continues to act as a well-behaved resistor even if V_{ds} reverses slightly. And there's no offset or crossover distortion to contend with. All this is very good for controlling ac signals, as we're doing here.

While browsing the Internet, I found some excellent information on this subject in an application note published by Vishay/Siliconix.[1] There's also a good write-up in one of my favorite electronics references[2] and both make for very interesting reading.

Circuit Details

Figure 2 shows a schematic diagram of the volume leveler. Notice that the incoming audio is attenuated by a 4:1 voltage divider (R3 and R5) before passing on to the rest of the circuit. The reason for doing this is that the FET VCR can handle

[1]Notes appear on page 73.

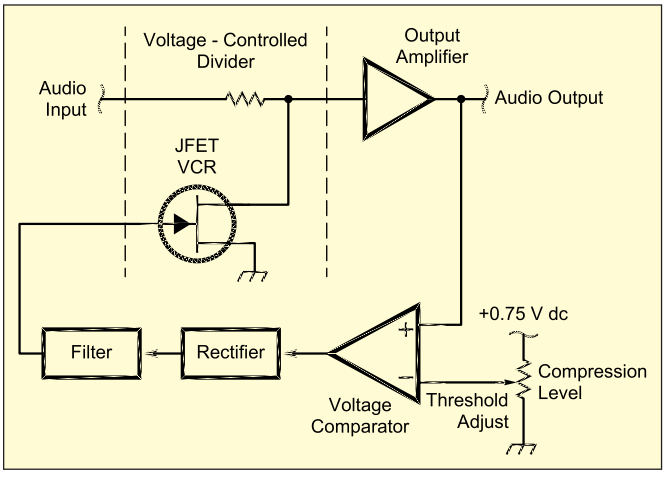


Figure 1—A simplified block diagram of the volume leveler circuit. The FET and the resistor at the input form a voltage-controlled divider that keeps the signal level just low enough to match the input threshold of the comparator.

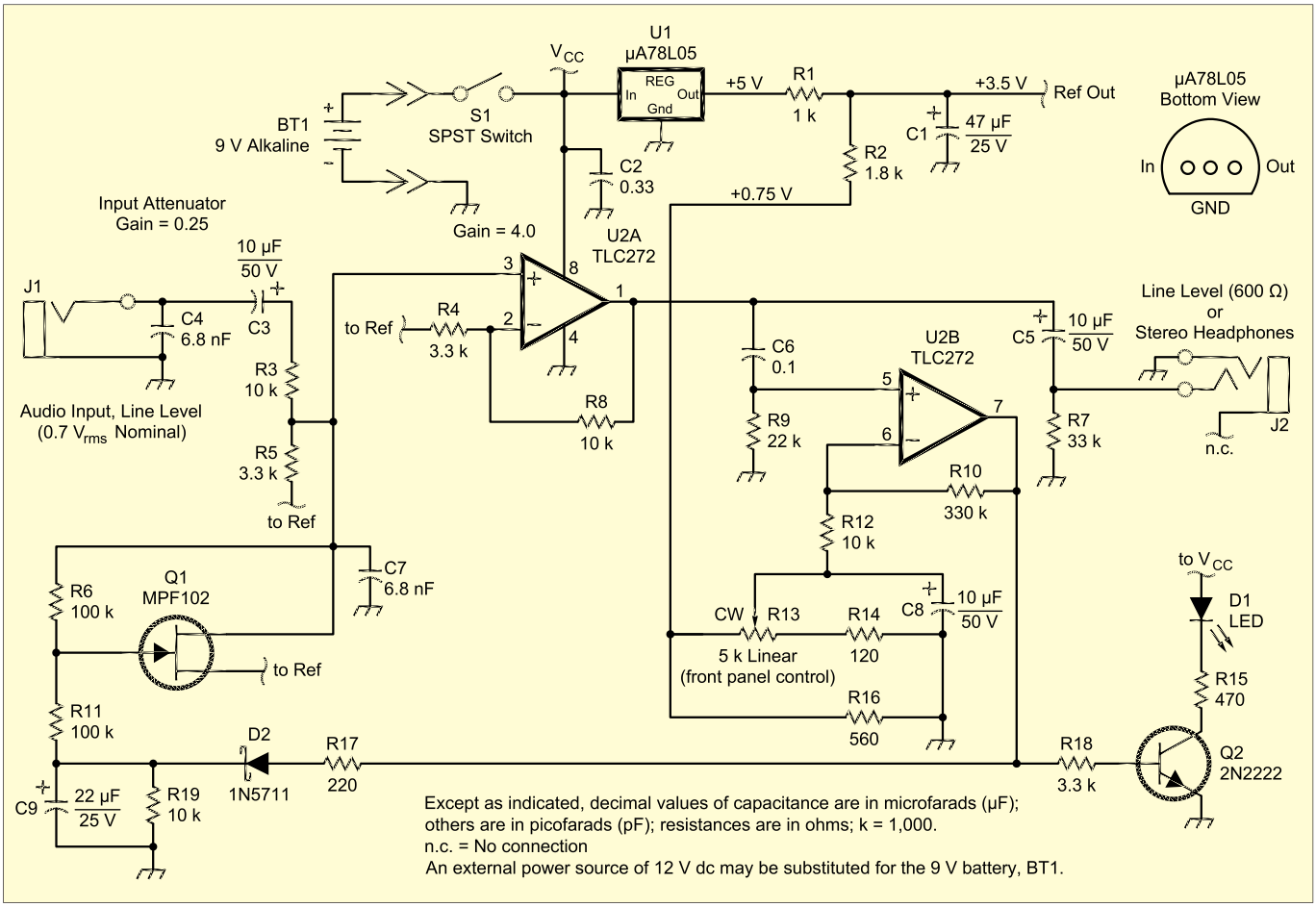


Figure 2—Schematic and parts list for the audio leveler. Noted parts are available from Digi-Key Corp, 701 Brooks Ave South, Thief River Falls, MN 56701; 800-344-4539; www.digikey.com. Others are commonly available.

BT1—9 V alkaline battery, with holder.
C1—47 μF, 25 V electrolytic capacitor.
C2—0.33 μF, 50 V ceramic capacitor.
C3, C5, C8—10 μF, 50 V electrolytic capacitor.
C4, C7—6.8 nF (6800 pF), 50 V ceramic capacitor.
C6—0.1 μF, 50 V ceramic capacitor.
C9—22 μF, 25 V electrolytic capacitor.
D1—LED, red.
D2—1N5711 Schottky diode (Digi-Key 497-2499-1-ND).
J1—1/4 inch mono phone jack.
J2—1/4 inch stereo phone jack.
Q1—MPF102 FET (Digi-Key MPF102-ND).
Q2—2N2222 transistor (Digi-Key 497-2598-5-ND).
R1—1 kΩ, 1/4 W, 5% resistor.
R2—1.8 kΩ, 1/4 W, 5% resistor.
R3, R8, R12, R19—10 kΩ, 1/4 W, 5% resistor.
R4, R5, R18—3.3 kΩ, 1/4 W, 5% resistor.
R6, R11—100 kΩ, 1/4 W, 5% resistor.
R7—33 kΩ, 1/4 W, 5% resistor.
R9—22 kΩ, 1/4 W, 5% resistor.
R10—330 kΩ, 1/4 W, 5% resistor.
R13—5 kΩ linear potentiometer, panel mount.
R14—120 Ω, 1/4 W, 5% resistor.
R15—470 Ω, 1/4 W, 5% resistor.
R16—560 Ω, 1/4 W, 5% resistor.
R17—220 Ω, 1/4 W, 5% resistor.
S1—SPST toggle switch, panel mount.
U1—μA78L05ACLP, 5 V voltage regulator (Digi-Key 296-1365-ND).
U2—TLC272IP, dual op-amp, Texas Instruments (Digi-Key 296-7355-5-ND).

only a limited voltage swing before it starts to distort. I experimented with a couple of FET types and found that the MPF102 was better than any of the others I had lying around. It could handle about ±250 mV with negligible distortion. Since I wanted to be able to input a signal of 1 V peak, a 4:1 reduction was necessary. The reduction is restored by the output stage, U2A, which has a gain of 4. In other words, when there is no compression of the audio, the gain from the input jack to the output jack is just unity.

The output signal is picked off by C6 and fed to amplifier U2B. That's where the output is compared to the dc voltage level set by R13, a control pot mounted on the front panel. When the audio output exceeds this level, U2B develops an output that is rectified by Schottky diode D2 and filtered by C9 and R19. The loop is closed by feeding back the dc control voltage to the gate of Q1, the VCR.

As long as the output signal is below the control voltage at the wiper of R13, the dc voltage at C9 is zero, Q1 is cut off, and the audio flows unimpeded from the input to the output. If the input signal rises above the setpoint, a voltage is developed across C9. The FET turns on and starts to play its VCR role, pulling down the audio signal at the junction of R3 and R5, until the output level again matches the set point.

As an aid to setting the front-panel control pot (in other words, the AGC delay level) I found it useful to have a visual indication of where signal compression was activating. Accordingly, I included LED D1, driven by Q2, to turn on when the error signal from U2B starts to build.

Filter components C9 and R19 determine the recovery time constant (the time to restore full sensitivity after a strong, highly compressed signal goes away). Using the component values given here, C9 discharges with a time constant equal to about 220 ms. That's short enough so that you don't miss the first few CW characters of a weak station replying to a strong

Figure 3—The front panel of the volume leveler. The "compressing" LED shows when leveling is taking place.

one, or the first few syllables of an SSB transmission.

Charging of C9 takes place rapidly through the low-value resistor R17, giving a fast attack/slow decay, operating characteristic.

Resistors R6 and R11 form a local feedback network around the FET to increase the linear range, as discussed in notes 1 and 2.

Construction

Photos of the finished project are shown in Figures 3 and 4. There is nothing critical about the layout, so I just used point-to-point wiring with all parts mounted on a piece of perf board cut to fit into a 2.5 × 4.5 × 1.5 inch plastic box. There was plenty of room inside the box for a 9 V alkaline battery that powers the whole thing. Powering the unit from an external 12 V dc supply will work well, too.

Notice that, on the schematic, the output stereo jack, J2, is wired to accept either mono or stereo headphones. This plan requires that the output jack be insulated from circuit ground. Should you build this into a grounded metal box, you must insulate the output jack; otherwise, only one side of your stereo phones will work. Or you could just use a mono headphone jack for the output.

How Well Does it Work?

I fed in a 1 kHz sine wave and made some measurements of output versus input at various settings of the front-panel control pot. You can see the results plotted in Figure 5 where the amplitude-limiting action is very noticeable. With larger inputs than I have plotted in this figure, I was able to measure more than 20 dB of amplitude compression.

Distortion is pretty good, too. I measured it at less than 2% over the full control range. Not music-listening quality perhaps, but perfectly adequate for communications work.

All in all, I'm quite happy with this little device. It does everything I expected, fits into a small package, and runs at a quiescent current of only 5 mA. Also, it makes use of an FET in an interesting way, which, with a little imagination, could be applied to other useful applications—a constant-level microphone preamp comes to mind. I'm sure there are others.

If you have a good quality receiver with a well-designed AGC system, you may not need this volume leveler. Many "well-designed" AGC systems, however, are lacking in attack or decay characteristics. They frequently are suited to one mode but are not ideal for another. (Some CW operators prefer to operate with the AGC off, advancing the audio and "riding gain" with the RF gain control. As this audio leveler's compressor isn't RF-derived, it could prove to be a valuable asset to that operation.) If you're not lucky enough to have a good AGC system, you may find, as I did, that this device makes long periods of tuning around the bands a lot less stressful. Besides, it put *me* back in control of the AGC, which is what started the whole thing in the first place!

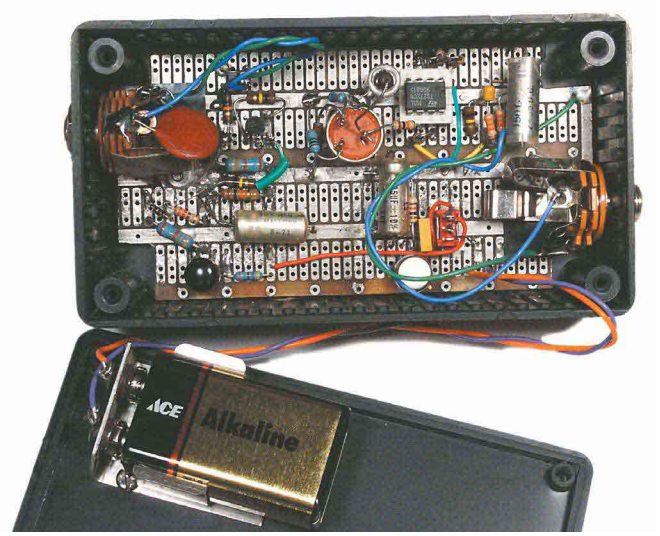


Figure 4—The interior of the audio leveler. It is built into a small instrument case and the layout is not critical. A 9 V battery is shown; it can also be powered from an external 12 V dc source.

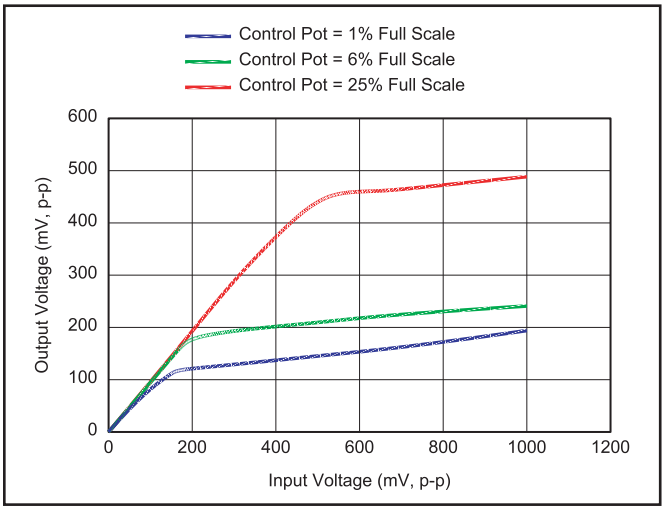


Figure 5—Compression plot showing the output level versus input level for three settings of the control pot. The leveler will achieve an ultimate compression ratio of more than 20 dB.

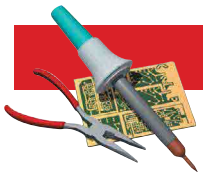
Notes

[1]Vishay/Siliconix Application Note AN105: "FETs as Voltage-Controlled Resistors," Mar 1997 (**www.vishay.com/docs/70598/70598.pdf**).

[2]P. Horowitz and W. Hill, *The Art of Electronics*, 2nd ed, Cambridge University Press, 1989, p 138.

All photos by the author.

Larry Coyle, K1QW, was first licensed in the 1950s, while in high school. He operated CW and phone then, using homebrew gear on 40 and 10 meters. Inactive for some 35 years while pursuing an MSEE degree and managing a career in electronics design, he recently reentered the amateur ranks and earned an Amateur Extra class license. Larry operates the HF CW bands again—whenever he can take time away from his EE consulting business. You can reach him at 100 Rolling Ln, Needham, MA 02492 or at **lmcoyle@comcast.net**.



HINTS & KINKS

A PYRITE CRYSTAL RADIO

◊ Years ago, a crystal set was an excellent way to introduce a youngster to the mystery and excitement of radio. Today, it is not as easy to get a crystal set to work as it was sixty years ago. Antenna restrictions, as well as the lack of big trees on today's small house lots, make it difficult for kids to string a suitable antenna. Modern low-impedance headphones are another problem.

Hams can bring back the crystal set magic by letting children (in my case, visiting grandchildren) use our antennas. My rooftop multiband vertical makes a very good broadcast-band antenna when both feed-line conductors are tied together. The antenna (feed-line and all) is used together with a ground connection.

A rock of iron pyrite[1] (fool's gold) makes a simple AM broadcast-band crystal radio (see Figure 1). Use an alligator clip to make one connection to the pyrite diode. A *cat-whisker* should be used for the other end. The cat-whisker can be a needle or a straight pin (they're easier to find when dropped) held by a miniature alligator clip (see Figure 2). The radio operator moves the cat-whisker to hunt for a "sweet spot" on the pyrite. I find that resting the needle very lightly on the pyrite gives the best result.

[1]Pyrite can be found in mine dumps near abandoned gold mines or it can be purchased inexpensively at rock and mineral shops. Galena was commonly used 60 years ago but is somewhat harder to find today. A parallel combination of four 1N34A diodes also works, but some of the magic is taken away.

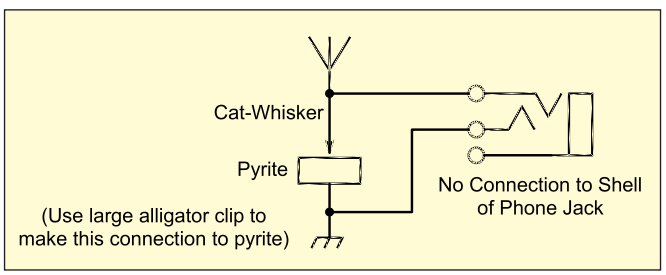


Figure 1—A schematic N7KSB's simple crystal radio.

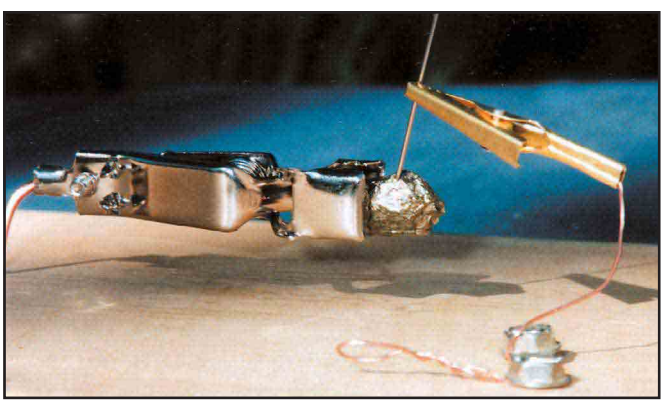


Figure 2—A photo of the world's simplest radio.

Connect headphones in *parallel* with the pyrite crystal diode via the wire loop in Figure 2 and another out of view at the screw holding the large alligator clip. Then connect the antenna and ground to either side of the pyrite diode (using the same loops). That's all there is to this radio! It picks up the strongest local signal with one or two weaker signals in the background. Except for tweaking the cat-whisker, there is no tuning. Best reception occurs during the day, before nighttime power reductions take place.

I use stereo headphones with the two earpieces connected in series. This is accomplished by connecting only to the "ring" and "tip" of the stereo phone plug. Leaving the "shell" unconnected results in a more sensitive 32 Ω headset. If more sensitivity is desired, add a small transformer (either one used for audio output matching or a small 12 V power supply) to transform the headphone impedance into the kilohm range.

More sophisticated crystal sets can be built, but until the Lone Ranger, Little Orphan Annie, and Captain Midnight return and kick the crude talk shows off the air, this simple radio will suffice.—*Lew Smith, N7KSB, 4176 N. Soldier Tr, Tucson, AZ 85749;* **evieandlewsmith@aol.com**

PUT YOUR BUTTERNUT VERTICAL ON 60 METERS

◊ If you've got a Butternut vertical, you can be on 60 meters in literally minutes. Just take a clip lead and short 11 of the 16 turns of the 80-meter coil. One end of the clip lead should be clipped to the screw at the bottom of the 80-meter coil, and the other end of the clip lead is connected up 11 turns. Use an antenna analyzer to find the exact point for lowest SWR at 5365 kHz. I was able to get less than 1.5:1 SWR at resonance and less than 2:1 at the band edges. Mark the turn with a permanent marker, so it is easy to find when you want to get on 60 meters. If you have some Solder-It aluminum solder, you can solder a tab to the aluminum 80-meter coil at the appropriate place (**www.solder-it.com**).

My Butternut is mounted about six inches from a cedar fence. To make things a little easier, I mounted a 12 V SPST relay in a plastic box to the fence near the 80-meter coil. The relay contacts are connected across the 80-meter coil as described above, letting me remotely switch in 60 meters from my shack. See you on 60 meters!—*Phil Salas, AD5X, 1517 Creekside Dr, Richardson, TX 75081-2913;* **ad5x@arrl.net**

POOR MAN'S QRP

◊ Many of my friends have built QRP transceivers from kits and have managed to decrease their signal strengths enormously. Sadly, I am not good at constructing, and I am also

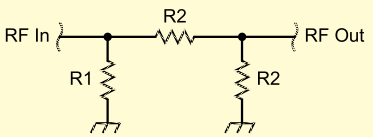


Figure 3—A simple π-network attenuator reduces a transmitter's 12-W output for QRP operation.

Bob Schetgen, KU7G ♦ Senior Assistant Technical Editor ♦ h&k@arrl.org

chronically short of cash. My ICOM transceiver only cranks down to 12 W output, which does not qualify as QRP, but I hit on a way to achieve QRP operation with no fuss or mess: build an attenuator.[2]

All you need is a box, two SO-239 sockets, three resistors and a switch to flip the attenuator in and out. Connect the resistors in a π network as shown in Figure 3: R2 should be 68 to 75 Ω, 4 W dissipation; R1 is 100 Ω (6 W) and R3 is 100 Ω (0.7 W). Resistors of lesser dissipation may work for SSB (or CW provided you don't hold the key down too long). *The resistors should be carbon*, not wire wound. If you only find wirewound resistors, all is not lost! Pick a value between 20 to 30 Ω for R2 and (omitting R1 and R3) install it between the attenuator sockets, set the rig to its lowest power at 7 MHz and measure the power output of the attenuator with a wattmeter. Change R1 until you get about 4 W out. On 14 MHz, you will have 2 W out and on 28 MHz, you'll have about 1 W—that's all good QRP! Install the switch to flip between QRO and QRP. This technique reflects power to the transceiver, but with the rig running 12 W, it's not a big deal.

On receive, the attenuator reduces the incoming signal too. There are two ways to handle this: either flip the switch to the "QRO" position when receiving, or use a separate receive antenna (some transceivers are equipped with a socket for this).

Once you have the Poor Man's QRP you, too, will be able to drop your signal into the noise. (Thanks to Frank, VE6CB, for calculating the resistor characteristics.)—*Bruce Fleming, KI7VR, 7401 NW 16th Ave, Vancouver, WA 98665;* **Fleming@pacifier.com**

[Bruce's friend, Frank, gave him an attenuator using standard-value resistors that drops his signal level by about 10 dB. Also, the resistor dissipations shown are adequate for light duty cycles only. Good engineering practice doubles the required dissipation, so R1 should be about 12 W, R2 8 W and R3 2 W. Personally, I would rather set the output at 5 W: R1 = 220 Ω 6 W; R2 = 27 Ω 10 W; R3 = 220 Ω 2 W. While checking the numbers on this hint, I developed a simple spreadsheet that yields the resistor values from the power input and desired power output. It also computes attenuation in decibels, given the resistor values. Finally, it gives the resistor dissipation with a safety factor of two for both scenarios.[3]—*Bob Schetgen, KU7G]*

AN OLD-FASHIONED RF AMMETER FOR LADDER LINE

◊ Those amateurs who use open wire feed lines to feed wire antennas may desire to observe the RF current in the feeders. An SWR measuring device in the coaxial cable between the transmitter and the antenna tuner will indicate a match of the entire antenna system to the rig, but it leaves a lot to be desired if you are interested in what is going on in the open wire feeders themselves. "Hot wire" or thermocouple RF ammeters are available but expensive, so I use an old-time method.[4]

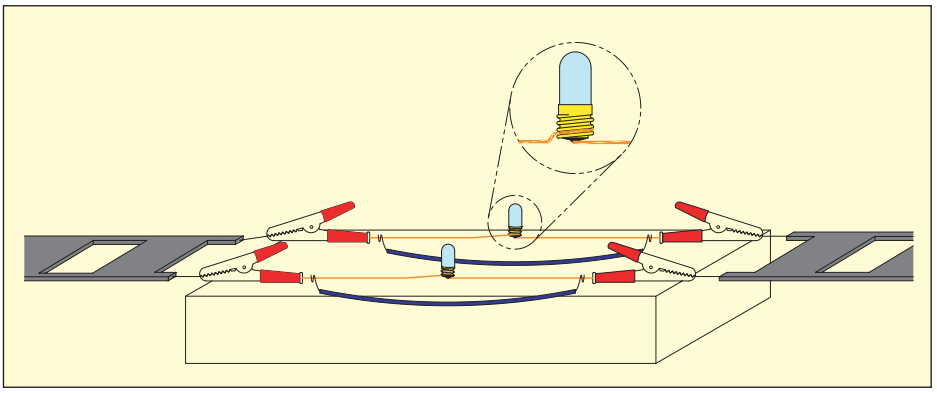


Figure 4—AL7N reminds of an old device for monitoring conditions in ladder line. A block of wood (or other insulator) serves as a base for two 2 V lamps, each parallel connected with a #24 AWG wire. Alligator clips connect the lamps to the station feed line. The glow of the lamps roughly indicates line balance and signal strength. The lamps, clips and shunts should be spaced to match the line spacing. See text for details.

This device uses a 2-V incandescent lamp (such as #43, #48 or #49), wired in series with each feeder at some point a little ways away from the antenna coupler or tuner. Each lamp is shunted with a piece of #24 AWG copper wire about six inches long. Lay out the device such that the symmetry and spacing of the feed line is maintained as closely as possible. I soldered two short pieces of wire to each side of the lamp so that the total length of the leads with the lamp in the center is six inches. Then the #24 AWG shunt wire is laid adjacent to each lamp with its leads, and the lamps with their shunts are mounted on a piece of insulated material (dry wood, unplated perf-board or equivalent) with suitable terminals at each end for connecting the feed line. If desired, a DPST knife switch with blade spacing similar to that of the feed line can be incorporated to bypass the device when desired. Do not use it if the transmitter power level at full power exceeds the capabilities of the lamps (they're too bright).

In use, the lamps will illuminate when some amount of RF power is applied to the antenna system. If the antenna system is well balanced, the lamps will illuminate to equal brilliance. If there is imbalance, one lamp will illuminate less than the other, displaying a qualitative measure of current imbalance.

You cannot quantitatively determine feeder current in RF amperes with this device, but you can easily see any imbalance and the success of efforts to correct it. Then you can tune your system for maximum current in the feeders, which should coincide with maximum power transfer to the antenna's radiating elements. In my station, a 50 W CW transmitter lights the shunted 2 V lamps to nearly full brilliance when the antenna system is matched to the rig.

I tune the system with reduced power, then if more output power is necessary, I close the cutout switch to prevent burning the lamps out at higher power levels.—*L. E. "Ed" Trump, AL7N, 2950 S Kobuk Ave, Fairbanks, AK 99709;* **al7n@arrl.net**

[2]For folks who can't set their transceiver's output so low, an earlier hint suggests ways to economically attenuate 100 W to QRP levels. Check out Jay Jeffrey, WV8R's hint "Operate QRP with an Easy-to-Build Attenuator," *QST*, Feb 1993, p 75.

[3]You can download this package from the ARRL Web **www.arrl.org/files/qst-binaries/**. Look for Pi-Atten.zip.

[4]A more sophisticated indicator was described by Zack Lau, W1VT, in "A Relative RF Ammeter for Open-Wire Lines," *QST*, Oct 1988, pp 15-17, 20.

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 **h&k@arrl.org**. Please include your name, call sign, complete mailing address, daytime telephone number and e-mail address on all correspondence. Whether praising or criticizing an item, please send the author(s) a copy of your comments.

Elecraft KPA100: A 100 W Upgrade for Your Elecraft K2 HF Transceiver

Reviewed by Larry Wolfgang, WR1B
ARRL Senior Assistant Technical Editor

How many Product Reviews have you read recently that started with a photo (Figure 1) of a box of parts? This review begins with a $3^1/_4 \times 12^1/_4 \times 9^1/_4$ inch box filled with carefully packaged components and a 64-page spiral-bound manual.

My review of the Elecraft K2 transceiver appeared in the March 2000 issue of *QST*.[1] That review describes the basic low power K2 radio, along with the KSB2 SSB adapter and KNB2 noise blanker accessories. Since then I had added the KBT2 internal gel-cell battery, the K160RX 160 meter module with extra receive antenna jack and the KAT2 internal 20 W automatic antenna tuner. Packed in an aluminum case, this makes a very nice portable station—although it sees plenty of operating time at my home station.

As with the construction of the K2, you will need a few basic tools to build the upgrade. (Note that this is strictly an "upgrade." In compliance with FCC amplifier rules this has been designed as a "part of the radio as manufactured" so it cannot serve as an amplifier without being an integral part of the K2.) A grounded, temperature-controlled soldering iron, small needle-nose pliers, flush-cutting pliers, screwdrivers and a multimeter make up the required complement of tools. (A digital multimeter with capacitance measurement capability is helpful, although not required.)

One of the tools I used most belongs to my wife Jean, WB3IOS—a large magnifying glass that she uses for needlepoint and crafts. In fact, this came in handy for the second step in building the kit. (The first step is to mark the errata and assembly updates in the manual.) Doing a complete parts inventory is a very important step, even if it is tempting to skip it and just start building. I discovered one diode and one capacitor missing from the envelopes packed inside the box. I made a call to Elecraft, and had replacement parts in a few days. The three hours or so spent checking off every component in the parts list was time well spent.

Maybe it's my age showing, but even though they're standard size parts, I could not read the labels on most of the capacitors, diodes, transistors nor even the color codes on most of the resistors without Jean's magnifying glass. With the cord over my neck and the base of the magnifier resting on my chest, I could hold each component under the glass and read the labels easily.

Taking inventory at the start helps identify the proper components when called for in the assembly stage. One step I will add the next time I build a kit like this is to place the sorted capacitors, resistors and other components in separate small plastic bags or bins. I have seen the suggestion of using an egg carton, and placing the components in the compartments. This would not work for me because I don't have a space to leave everything undisturbed throughout the building process. Small zipper-lock snack bags or even tiny zipper-lock bags work well because the bags can be packed back into the box and safely stored between building sessions. Because I did not initially take that step, I found my self sorting through the component bags several times looking for a specific component.

Bottom Line

Elecraft has increased the flexibility of their popular K2 transceiver by providing a 100 W option. QRP capability is not lost, and an easy reconfiguration restores QRP operation whenever needed.

Updating the K2

To Elecraft's credit, as product improvements are defined, they are both included in new units and made available as modestly priced upgrade kits to existing users. The fact that the units are built as kits and owners are used to being in them with soldering irons is what makes this possible. Elecraft refers to units with

Figure 1—The box of parts that will make the K2 into a K2/100.

[1]L. Wolfgang, WR1B "Elecraft K2 HF Transceiver Kit, Product Review, *QST*, Mar 2000, pp 69-74.

Joel R. Hallas, W1ZR ♦ Assistant Technical Editor ♦ w1zr@arrl.org

Table 1
Elecraft K2/100, serial number 00495

Manufacturer's Specifications	Measured in the ARRL Lab
Freq coverage: Receive and transmit, 3.5-4; 7-7.3; 10-10.2; 14-14.5; 18-18.2; 21-21.6; 24.8-25; 28-28.8 MHz.[1,2]	Receive, 2.9-4.1, 6.5-7.3, 10-10.5, 13.2-14.7, 17.1-22;23.2-30.4 MHz; transmit, as specified.
Modes of operation: USB, LSB, CW.	As specified.
Power requirement: 11-15 V dc, receive, 0.5 A; transmit, 20 A, at 13.8 V.	Receive, 0.50 A (max volume, no signal); transmit, 15 A (max), tested at 13.8 V.
Size (HWD): 3.4×7.9×9.9 inches; weight, 5 lbs.	
Receiver	**Receiver Dynamic Testing**
SSB/CW sensitivity: preamp off, –130 dBm; preamp on, –135 dBm.	Noise floor (mds), 400 Hz filter: *Preamp off* / *Preamp on* 3.5 MHz –134 dBm / –138 dBm 14 MHz –130 dBm / –136 dBm
Blocking dynamic range: preamp off, 133 dB; preamp on, 125 dB.	Blocking dynamic range (400-Hz IF filter): Spacing 20 kHz 5 kHz *Preamp off/on* *Preamp off/on* 3.5 MHz 135/125 dB 135/125 dB 14 MHz 134/126 dB 135/126 dB
Two-tone, third-order IMD dynamic range: preamp off, 96 dB; preamp on, 97 dB.	Two-tone, third-order IMD DR (400-Hz filter:) Spacing 20 kHz 5 kHz *Preamp off/on* *Preamp off/on* 3.5 MHz 98/94 dB 90*/88* dB 14 MHz 97/95 dB 91*/91* dB
Third-order input intercept point: Not specified.	Spacing 20 kHz 5 kHz *Preamp off/on* *Preamp off/on* 3.5 MHz +15/+4 dBm +15/+4 dBm 14 MHz +21/+8 dBm +21/+8 dBm
Second-order intercept point: preamp off/on, +70 dBm.	14 MHz, preamp off/on, +80 dBm/+79 dBm.
S-meter sensitivity: Not specified.	S9 14 MHz signal: preamp off/on, 86 µV/16 µV.
Receiver audio output: 2 W into 4 Ω, THD not specified.	2 W at 0.6% THD into 4 Ω.
IF/audio response: Not specified.	Range at –6 dB points, (bandwidth)[3]: CW-N: 467-736 Hz (266 Hz) CW-W: 370-1029 Hz (659 Hz) USB: 733-2638 Hz (1900 Hz) LSB: 408-2640 Hz (2232 Hz)
IF rejection: Not specified.	Preamp off, 89 dB.
Image rejection: Not specified.	Preamp off, 74 dB.
Transmitter	**Transmitter Dynamic Testing**
Power output: SSB, CW, 0.1-100 W.	Typically 1-100 W CW; 0.1-100 W SSB.
Spurious-signal and harmonic suppression: 40 dB.	41 dB. Meets FCC requirements.
SSB carrier suppression: 40 dB or greater.	50 dB.
Undesired sideband suppression: Not specified.	62 dB.
Third-order intermodulation distortion (IMD) products:	See Figure 6.
CW keyer speed range: 9-50 wpm.	9-41 wpm.
CW keying characteristics: Not specified.	See Figure 7.
Transmit-receive turnaround time (PTT release to 50% audio output): Not specified.	S9 signal, 24 ms. Suitable for ARQ modes.
Receive-transmit turnaround time ("tx delay"): Not specified.	SSB, 23 ms.
Composite transmitted noise: Not specified	See Figure 8.

All dynamic range measurements are taken at the ARRL Lab standard spacing of 20 kHz.
*Measurement was noise limited at the value indicated.
[1]Plus 1.8-2 MHz with 160M option.
[2]Receive range extends beyond the transmit range but performance may not meet specification.
[3]Filter passband ranges are adjustable (see text).

serial numbers below 3000 as "revision A," while newer units are "revision B." Unless your K2 is very recent or you are building the K2/100 as a new radio, you have the option of adding some or all of the updates while you are adding the amplifier. We elected to add all the available mod kits (these are described within the mods and parts list section of the price list tab on their Web page, **www.elecraft.com**) to our very early K2 (serial number 495). Note that the lab test data reflect not only the incorporation of the KPA100, but also the upgrade to revision B.

On to KPA100 Construction

Following the step-by-step instructions, components are added in a logical manner. In general, resistors are added first, then diodes and capacitors, moving from top left across the board in rows. Some resistors and capacitors are skipped for now, making it easier to add relays, inductors and transistors when the time comes. Figure 2 shows the partially assembled KPA100 board.

Identify the correct components carefully. There are several resistors and capacitors with the same values but different ratings or lead spacings. This is especially true with the capacitors, since you are also dealing with different construction types, such as disc ceramic, silver mica and monolithic ceramic chip capacitors.

Some of the component leads must be clipped very close to the circuit board. The manual warns that normal diagonal cutters will not be able to cut these leads close enough. This is why the flush-cutting pliers are so important. When the small relays are added, component leads that come through the board under those relays must not touch the relay body. If they do, they will prevent the relay from seating properly against the board. Even with flush-cutting pliers I had problems with a couple of component leads.

At this point you will connect the KPA100 to your K2 and make some preliminary voltage measurements. The K2 display will acknowledge the presence of the KPA100 board with a NO PA PS message. You are still using the original K2 power supply input barrel connector at this point, so there is no high current power supply connected to the KPA100. I was quite pleased to find all voltage measurements within the specified range at this point. I verified that the K2 menu acknowledged PA OFF and that I could turn it ON. I was ready to proceed to Part II of the assembly.

On Winding Toroids

Yes, there are 15 toroidal inductors and two bifilar toroidal transformers to wind

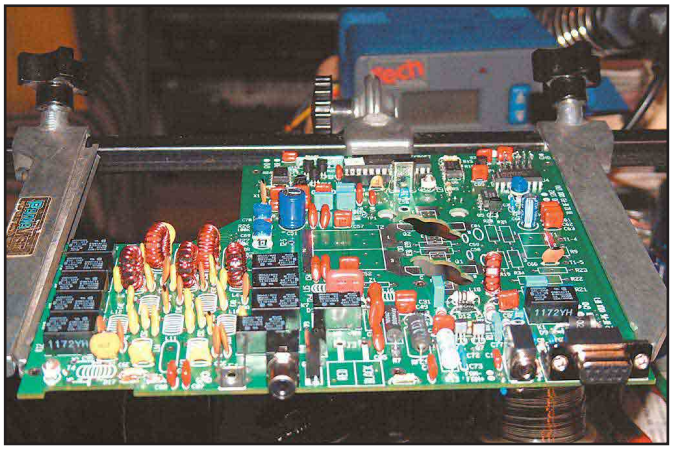


Figure 2—The 100 W KPA100 board, partially assembled.

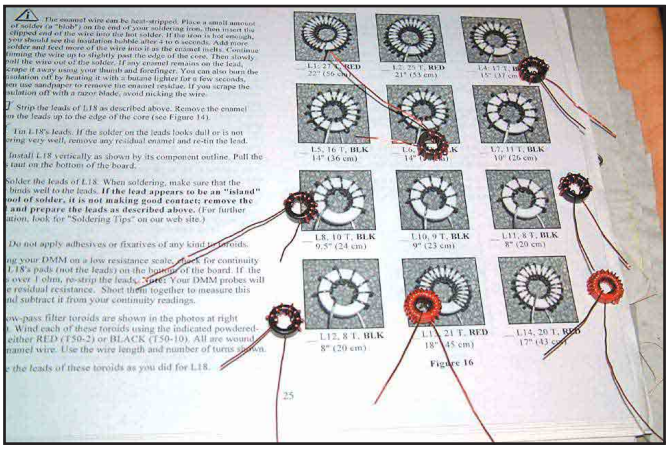


Figure 3—Some of the toroidal inductors wound as part of the kit.

(see Figure 3). This is one of those tasks that few people seem to enjoy. For those who absolutely hate it, there is help, however. Apparently, there is one fellow who enjoys this task so much that he is willing to sell you pre-wound toroids—with tinned leads—for your kit! Mychael Morohovich, AA3WF, winds toroids that have been approved to meet Elecraft standards. The order form is even included in the box. For $42 you can order all the toroids for the basic K2 and another $36.50 gets you the complete set for the KPA100. I wound my own toroids. I don't find the task that difficult, but I do not enjoy tinning the leads. The suggested method is to get a good ball of molten solder on your iron tip, and then hold the toroid leads in the solder until the enamel insulation burns off, leaving a perfectly tinned lead (Figure 4). Even with my big heavy iron, that never seems to quite work. I still have to use a piece of fine sandpaper to clean the lead completely. With care and a bit more time, the inductors are ready for the circuit board. If you don't clean all the enamel off the lead, you may not get a good solder connection to the circuit board.

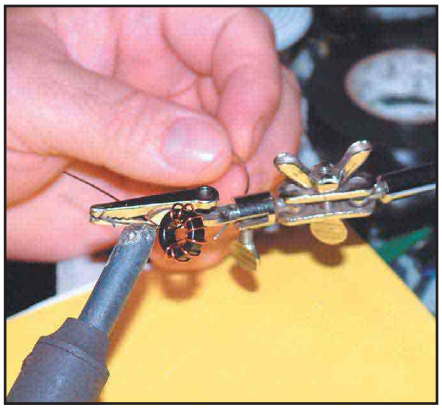


Figure 4—Tinning toroid leads.

Adding the Power Transistors and Heat Sink

You will have some "cleanup" work to do on the machined heat sink. You will have to remove the black anodized finish at points where it bolts to the circuit board. Perform this task carefully so you don't remove the finish from too wide an area, or from other parts of the heat sink. The black finish makes the heat sink a more effective heat radiator.

Prior to soldering the final transistors to the circuit board, the board is attached to the heat sink and the transistors are fastened to the heat sink with machine screws and washers. This ensures that the transistors are positioned correctly, and that the screws will align properly with their mating holes in the heat sink at final assembly. Those power transistors are a matched pair of 2SC2879 bipolar transistors.

The final assembly steps include adding the RF and auxiliary power leads and connectors. These jumpers go to mating connectors on the K2 RF board. The speaker is bolted to the heat sink and leads soldered to the circuit board. Another jumper brings the received audio signal from the K2 RF board.

Testing and Alignment

The tests and measurements steps were well defined and went fine—once I uncovered a short on the 12 V line due to not following directions on the proper orientation of Q3 and Q4! Back to setting the bias current, this time R6 easily adjusted the current to the desired value. Further tests indicated that the radio was receiving on all bands, putting out up to 100 W on all bands, and in general operating as expected (Figure 5). My first contact with the K2/100 was with Tim, KB7PGT, flying in a WW II vintage B-17 bomber, aeronautical mobile at 29,000 feet, somewhere off the New Jersey coast.

Table 1 shows the results of the ARRL Lab measurements of the radio performance with details shown in Figures 6 through 8.

Some New Features in Firmware

The latest firmware revision (2.03) adds support for the KAT100 external 150 W automatic antenna tuner. (If this works anything near as well as my low power KAT2 internal tuner, I want one!) This version also supports an optional LED that you can add to the front panel to indicate that SPLIT or RIT or XIT are active. Details are in an application note on the Elecraft Web site, **www.elecraft.com**.

Earlier firmware revisions added a number of new features not previously available on my K2. There is now an RTTY/Data mode with four independent crystal filter settings. The display shows an r when stepping through the modes. This is especially useful for selecting narrow filter settings for use on RTTY, PSK31 or other digital modes. The "fast play" CW memory feature is one I expect to use quite a bit, too. With this feature I can select a group of buttons for one-button play of keyer memories in CW mode. The new VFO dial calibration, in which CAL PLL only has to be run on one band makes this process go much faster. While not a procedure you have to do often, it is a great time saver when you do.

There are now a whole new set of "secondary" menu items, which allow adjustment of such new features as squelch level, tuning rate, dot/space keyer weighting, RS232 interface port settings, PA on/off control and transverter band setup parameters. If you add the KAF2 audio filter board or the KDSP2 DSP filter board you will also have a real time clock, which will show the time or date on the K2 display.

The KPA100 includes an RS232 port for computer control of the radio. The KIO2 RS232 interface provides this fea-

Figure 5—A complete Elecraft K2/100 ready for prime time.

ture in the QRP radio, so there is a savings here if you were thinking of performing this upgrade.

Elecraft's command set is similar to that used by Kenwood transceivers, which provides compatibility for those with older contest and logging software. Some extended commands that apply only the K2 are also supported and some software packages now include "K2" as a selection.

The interface operates at 4800 baud, 8 data bits, no parity and 2 stop bits. No hardware handshaking is required. The radio is designed to be compatible with a wide range of existing PC-based logging, DXing, contesting and other remote control programs. Elecraft also offers free download of their *K2REMOTE* and *K2 VOICE* control software. *K2REMOTE* provides flexible remote control of the K2/100 radio, but Elecraft encourages users to develop their own control programs and add even more features. They offer to put links on their Web site to anyone else who wants to make their own code available for other owners. The interface uses control-line keying. That means the computer program generates the dots and dashes, turning the control line on and off to key the radio. No additional interface is required to have a keyboard keyer!

K2 VOICE is a voice feedback program that makes the radio fully usable by hams who are unable to see or use the normal K2 controls and displays. This should prove very popular with many visually impaired hams.

So What's it Like to Operate a K2/100?

I must admit that I have had limited operating time with the amplified radio. After completing the construction the radio was in the ARRL Lab for nearly a week of performance testing. I had the radio for one weekend before having to complete this review. That weekend happened to be "ScoutShow 2003" for my local Connecticut Rivers Council, BSA. I helped set up a station at the show to operate WA1BSA and demonstrate Amateur Radio for many of the 11,000 Cubs and Scouts attending the show. Several other operators were helping run the station, and the K2/100 was the most popular radio there. The radio performed flawlessly, and we made many contacts on all HF bands. For a scheduled 40 meter contact with K1J at the New Hampshire Jamboree—a similar gathering of Scouts in New Hampshire—Tom Dean, KB1JIJ, an Extra Class ham and Boy Scout, slid into the operating seat. Tom ran that contact and passed the mic around to the other Scouts in the station tent at that time. They talked with Scouts at the NH campout about their various activities.

The K2 is definitely a fun radio to operate. I have seen some people refer to it as a radio "without all the bells and whistles." I disagree. The K2 is a solid performer, with one of the best receivers I have ever used. Loaded with all the options, and considering the new features added by the 2.03 firmware revision, I would have a difficult time thinking of any significant bells and whistles that I would find on other radios. Dual VFOs with split frequency operation? Got it. Direct keypad frequency entry? Got it. Memory channels? Ten of them. Scanning? Continuously scan any band segment, between the frequencies set in VFO A and VFO B. The tunable crystal filter settings by mode are very effective. There is no need to add extra filters in this radio—unless you want the audio filter or DSP filter option. Automatic antenna tuner? Available. Admittedly, the current crop of top of the line radios now offer features that the K2 doesn't, such as a spectrum analyzer/band scope, two receivers and general coverage receive. On the other hand they cost a *lot* more money!

There are many features aimed at CW operators. Very nice QSK, or you can set a TR delay to suit. Memory keyer with 10 memories and selectable Curtis Iambic A or Iambic B type keying. Select the normal or reverse paddle input to use your

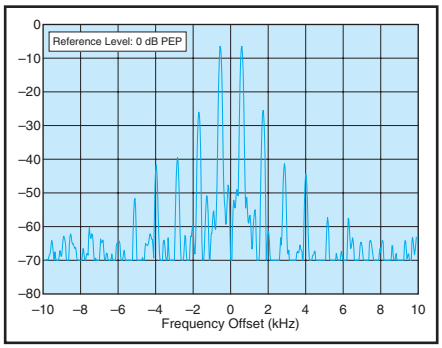


Figure 6—Worst-case spectral display ofthe Elecraft K2/100 transmitter during twotone intermodulation distortion (IMD) testing. The worst-case third-order product is approximately 26 dB below PEP output, and the worst-case fifthorder product is down approximately 40 dB. The transmitter was being operated at 100 W PEP output at 24.950 MHz.

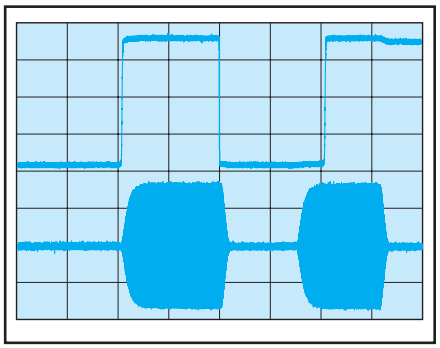


Figure 7—CW keying waveform for the Elecraft K2/100 showing the first two dits in full-break-in (QSK) mode using external keying. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 100 W output at 14.2 MHz.

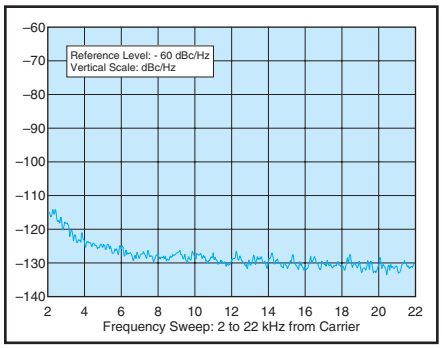


Figure 8—Worst-case spectral display of the Elecraft K2/100 transmitter output during composite-noise testing. Power output is 100 W at 14.25 MHz. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 2 to 22 kHz from the carrier.

"other" hand instead of changing the paddle wiring. Want to use a straight key? Select the hand key input. No key? Use the mic PTT button. The sidetone frequency is set from a menu option, and the transmit offset tracks your setting. The list seems to go on and on.

Another nice feature is that you don't have to give up your nice K2 QRP rig when going to the K2/100. With a few screws and connectors you can remove the 100 W cover and replace it with the original QRP cover. I had added the internal battery option and the internal automatic antenna tuner to mine, so after a quick change I can be off to the woods or scout camp with my original self contained QRP rig! You can also turn down the power of the PA below 11 W and the amplifier will be bypassed allowing low battery drain QRP operation even with the KPA100 in place (drawing about 100 mA more than if the QRP cover were in place). Lots of flexibility in a small box. When moving back to high-power operation, make sure you change the optimization from battery to performance to get the top notch receive performance noted in the lab report. This led us on a bit of a wild goose chase during lab testing!

Can I Build It?

Probably the most common question I have had from other hams when showing them my K2 has been "Do you think I could build one of them?" The answer is a qualified *definitely*! Make no mistake. The K2 or KPA100 are not ideal first kits. You should have some soldering experience, and be reasonably good at it. You should have some experience handling components, identifying them and fitting them on circuit boards and so on. We are talking about a significant investment here, and you don't want to end up with a useless box of parts. The goal is to create a working radio. That said, if you can follow directions, take your time and work carefully, you should be able to build this radio. Remember that Elecraft provides excellent support, by way of Wayne Burdick, N6KR, and Eric Swartz, WA6HHQ; Tech Support staffers Gary Surrency, AB7MY, and Scott King, AH6KL, as well as all the other builders on the Elecraft reflector. Help is available when you need it.

Manufacturer: Elecraft, PO Box 69, Aptos, CA 95001-0069; tel 831-662-8345; fax 831-662-0830; **www.elecraft.com**. Price: KPA100 (including computer interface option) $359; K2 $599; other accessories as listed on their Web site.

AOR ARD9800 Digital HF Voice Modem

By Joel R. Hallas, W1ZR
Assistant Technical Editor

The January[2] and February[3] 2002 issues of *QST* included articles by Doug Smith, KF6DX, first discussing the evolution of digital telephony for amateurs and then describing the direction it would likely head. One of his predictions was that the first application of this technology to HF would likely be via separate modem units, connecting to existing SSB transmitters. Well, AOR is the first company to provide a fully assembled, turnkey system for amateur use.

So What Is It?

The unit under review is the AOR ARD9800, a digital modem unit that converts analog voice into a digitally encoded signal transmitted via a set of 36 sub carriers (modem tones). Each carrier is phase shift keyed for transmission via a standard voice radio. The unit is specifically designed to match the bandwidth characteristics of most HF SSB radios, but can just as well be used over VHF FM or even AM radios. In addition to voice, the unit has the capability to send digital data and to capture video frames (from a VCR or video camera, for example), if an optional memory module is added.

Why Might You Want One?

Digitally encoded voice transmission has advantages when compared to analog voice systems, such as SSB. In a digital system, the signal to noise ratio (S/N) is set by the accuracy of the encoding process. Then, no matter what the channel S/N, as long as the receiver is able to decode the bits, the S/N is maintained even as the noise level increases. As the noise gets higher, this digital system will even be able to correct for some quantity of errors using its forward error correction algorithms. In comparison, with an analog transmission as the noise increases, the reception continuously degrades.

Another advantage of this particular coding, which may or may not be important, is that the actual audio bandwidth provided is around 3 kHz, significantly higher than the 2.3 kHz channel bandwidth. The resulting audio is thus what the telephone companies would call "toll quality" based on both bandwidth and S/N, rather than our usual "communications quality."

In addition to audio, and video, an eight pin DIN connector with included cable provides an RS-232 interface for data transmission at up to 2400 bit/s. Note that in the US, data transmission is limited to 300 baud below 28 MHz and 1200 baud below 50.1 MHz, even though the same type of signal results from the digitized voice transmission.

A front panel switch selects digital encoding or analog transmission, so the unit can be kept in the line when not used in digital mode. On the receive side, the modem automatically detects the synch signal and switches to digital if appropriate.

Bottom Line

AOR brings amateur HF SSB into the digital age with its ARD9800 digital voice modem.

Figure 9—ARD9800 under test at W1ZR.

[2]D. Smith, KF6DX, "Digital Voice: The Next New Mode?" *QST*, Jan 2002, pp 28-32.
[3]D. Smith, KF6DX, "Digital Voice: An Update and Forecast" *QST*, Feb 2002, pp 38-41.

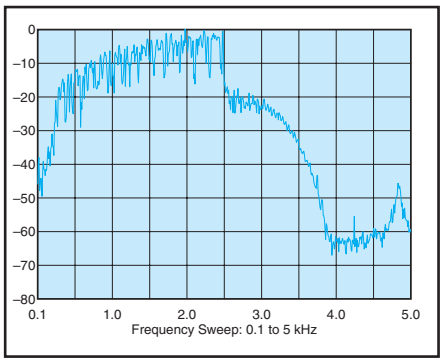


Figure 10—Output spectrum of the ARD9800 in digital mode. The individual subcarriers are evident.

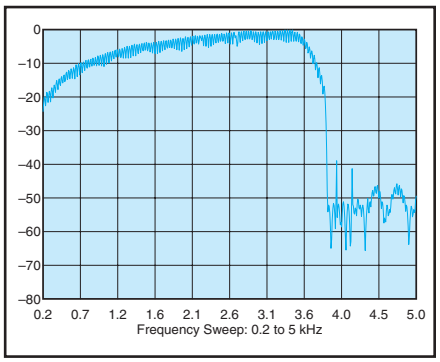


Figure 11—Transmitted frequency response of ARD9800 in digital mode. Note that the audio response is greater than the channel bandwidth.

Table 2
AOR ARD9800 Fast Radio Modem

Manufacturer's Specifications	*Measured in ARRL Lab*
Power requirements: 10.7-16 V dc, 0.2 A.[1]	0.37 A max,[2] tested at 13.8 V.
Size (height, width, depth): 1.3×4.0×6.2; weight, 5.3 pounds.	
Audio output: Not specified.	125 mW@1.5% THD (max volume).
Audio response: Not specified.	See Figure 11.

[1]Operation from batteries at 5.6-6.5 V dc is also possible.
[2]Receive in digital mode, maximum volume. 0.16 A in transmit and 0.18 A in idle (receive, no signal).

The ARD9800 uses the open G4GUO digital protocol, a digital format that incorporates elements of phase shifting (QPSK) to transmit the digital signal. The digital tones have been engineered to fit within the normal voice audio passband, making it possible to use unmodified, existing radios. The format uses forward error correction (FEC), making unlinked communications possible with two or more participants.

Hooking It Up

The modem has an eight pin microphone connector on the front, a push to talk hand mic is provided. We wondered which of the three eight pin mic connector "standards" (ICOM, Kenwood or Yaesu) they chose, and found that they apparently chose to avoid favoritism by defining a new standard! On the back is another eight pin connector for the cable run to the radio mic jack—and yes this one is wired differently from the front and from all the others! A connector is supplied for this and you get to make up the cable. AOR reports that they now have prewired cables to match popular radios.

The modem requires a 12 V dc power source (10.7 to 16 V) at 200 mA and a power cable is provided. It is also possible to change an internal jumper to set the unit to run from a 6 V supply. Note their warning that it will burn up if then connected to 12 V.

We had problems with RF feedback unless we ran separate shielded cables for the mic audio and push to talk between units. The two grounds need to be isolated, at least at the modem end. Figure 9 shows the unit ready for test at W1ZR.

How Does it Play?

These units are the first of a new breed of devices we've encountered and ARRL Lab Test Engineer Mike Tracy, KC1SX, was faced with defining a new set of tests to characterize their performance. His approach was to look at both the signal on the channel, see the resultant spectrum of the 36 tone system in Figure 10, and at the performance of a pair of modems back to back with noise injected into the channel. The resultant audio signal to noise ratio behaved about as expected with the audio S/N tending to stay relatively constant (at an unusually high 50 dB) as the channel noise increases. When the channel S/N reaches a threshold of about 17 dB, the apparent background noise remains low, but an occasional short loss of transmission is observed every 30 seconds or so. At this point it is not enough to be objectionable, but it gets more frequent as the channel S/N decreases. At about 14 dB SNR it starts to become annoying, and finally at about 10 dB S/N the errors are not recoverable and the system can no longer support communication.

To provide a real world HF calibration on performance, I enlisted the support of *QST* Technical Editor Stu Cohen, N1SC, and we made a test contact between our home stations, about 50 miles apart, on 75 meters in the evening. I also set up a tape recorder to record his signal so we could listen off line. The recording is available via a link from the ARRL Web site: **www.arrl.org/members-only/prodrev/pdf/pr0402.pdf**.

The performance is unlike anything I've heard in ham radio—it really sounds like a local telephone call. Stu was unable to reduce his power enough to determine the absolute threshold, but at about 18 dB S/N (as low as he could go), it was starting to miss some syllables.

I also tried over longer distances with the help of Carl Leutzelschwab, K9LA, in Fort Wayne, Indiana. He reported similar results. During an evening test on 75 meters, we had marginal S/N. He could copy me in digital mode, but with the 9 dB S/N at my end, I did not copy him at all. We tried the next day during daylight on 20 meters and found we had perfect copy until QRM crept in at the same signal strength as his signal. An interesting problem is that with the payload transmissions sounding like white noise, stations don't necessarily know you are on frequency unless you identify from time to time in analog mode.

There are some aspects of this kind of transmission that require getting used to. Each transmission starts with about a one second synch burst after the PTT is pressed. If the other station misses that, the transmission sounds like analog "white noise." Therefore, you cannot just "tune around" looking for a digitized signal. You have to be on frequency at the beginning of a transmission. I would think as a practical matter, communication would have to start with an analog exchange and then switch to digital. Another result of this, which we observed, was that if a fade or interference results in missing the synch burst, there is no copy of the rest of the transmission.

AOR reports that a new firmware upgrade, in current production units and available without charge from AOR, will allow a forced reacquisition during transmission. We did not have this version and were unable to test this feature.

In summary, the unit seems to do what it does quite well. It would seem a natural for some applications, such as phone patching, where toll quality voice would be desirable. The first edition of the manual was a bit difficult to follow in spots, particularly as to set up and level adjustments. A manual upgrade is now available on the AOR Web site.

AOR USA Inc, 20655 S Western Ave, Ste 112, Torrance, CA 90501; tel 310-787-8615; **www.aorusa.com**. Price $549. Optional video memory with software $99.

TECHNICAL CORRESPONDENCE

ELECTROVOICE 66x SERIES MICROPHONES

By Michael Kiley, WA9ZPM, 5445 137th Pl, Crestwood, IL 60445-1525; **mikejkiley@juno.com**

◊ In "The Doctor is IN" (Sep 2001, p 57), you answered a reader question about using an Electrovoice 664 microphone with an ICOM IC-706MKII transceiver. I have used the EV 664 for public address and Amateur Radio for years. First, let me explain the 664. The Electrovoice 664 is a variable-D cardioid design, which, unlike most other cardioids, does not boost the low frequencies when speaking closely into it. Other EV models of this design are the 660, 666, 674 and 676. The 664 has a transformer with two secondary windings, so it can match both high and low-impedance inputs. The older versions of this microphone have a four-pin Amphenol connector, making the impedance selection by connecting to the appropriate pins. Pin 1 is ground; it connects to the case and to the return of the high-impedance output, while pin 2 is the "high" side of this output. The high-impedance output is intended to match inputs of 50 kΩ or more and will produce about 10-20 mV_{rms} of signal under normal speech conditions. Pins 3 and 4 of this connector are the low-impedance output; this is isolated from the case and is intended for balanced inputs. The level here is 1-2 mV_{rms} and will work with input impedances of 100 Ω to 1 kΩ. If you are using this mic to feed a low-impedance unbalanced input, tie pins 1 and 3 to the shield (ground) and use pin 4 for the high side.

Back in the 1960s, the Electrovoice 664 was touted as a high quality microphone for amateur use; it was advertised in *QST* and the *Handbook*. I have heard varied opinions from different amateurs about its performance on the air, but I have had good results with it. The only problem is that the low output voltage in the low-impedance connection may not fully drive most radios, and the high-impedance hookup may not suit the relatively low impedance of the microphone input on most rigs. Try the low-impedance hookup first; if you need more gain, switch to the high impedance arrangement.

You will need to provide an external push-to-talk switch for the 664 since it does not have one built in. Do not, I repeat, do not attempt to add a PTT switch to it by drilling or otherwise modifying the microphone body housing. In the EV variable-D mikes in particular, the case forms an important part of the acoustical design of the mike, and alterations to it will adversely affect its response and pickup pattern characteristics. Also, the inner workings of the 664 are quite delicate and could be easily destroyed in the process. I have seen this mike sell at hamfests for $50 to $100, so if you have one that is working and in good cosmetic condition, by all means preserve it.

RE "EMERGENCY POWER AT W1ZR"

By Joel R. Hallas, W1ZR, ARRL Assistant Technical Editor

◊ My comment (*QST*, Dec 2003, pp 41-44) about smart battery charger RFI raised some eyebrows at ARRL HQ. I decided to look into the subject a little deeper. With the efforts of Mike Gruber, W1MG, and Mike Tracy, KC1SX, from the ARRL Lab, I was able to get data on the conducted emissions on the power line from my Guest ChargePro. The level with no filtering was in the range of 40 to 60 dBµV across the HF spectrum. No wonder I was hearing it! I spent some time on the phone with the technical teams at some of the other vendors and thought, based on my conversations, that the Xantrax TrueCharge charger had the best hope of being better. We brought one into the Lab and found essentially the same kind of response! These devices exceed the normal levels for residential use; on the other hand they are designed to be used on boats and just barely meet the industrial (Class A) rating.

An alternative I didn't try, but may be worth considering, is an "old technology" linear charger. A&A Engineering (**www.a-aengineering.com**) offers a 5 A linear "smart charger" that promises noise-free operation and is designed for both standard and gel-cell batteries (thanks to K5NT for the pointer). Charles Industries makes a dual 5 A linear (nonswitching, non"smart") charger that is specified at a float charge voltage of 13.7. This is high for a gel electrolyte battery, but should be in range for either an AGM or liquid-electrolyte battery. My Douglas AGM battery specifies 13.5 to 13.8 as the float voltage, for example. This kind of charger has nothing in it to generate RFI, is in the same price range and may be a good choice if you are not using gel-cell batteries and don't mind a bit more weight. Notice that we have not tested either of these units.

As mentioned in the article, I had concentrated my filtering on the dc leads (something the Lab wasn't prepared to measure with their ac-line test fixture) and was successful at eliminating problems from that source with my brute force filter. Since it was clear that the ac leads were now the problem, I tried wrapping seven turns of the power cable around an Amidon FT-240-43 toroid core, as close to the charger as practical. I won't go so far as to say that there is no noise, but I was unable to identify any noise on any band above ambient noise level. If additional filtering were required, I would add a commercial line filter such as those made by Corcom between the toroid coil and the ac line. I would appreciate hearing from anyone who has had similar experiences or who has come up with a better solution.

Among the correspondence I have received about this article was a note from N9SFX noting that many rigs stop operating at a higher voltage than my Ten-Tec Paragon. In fact, Pete reports that some will not even operate at 12 V! He has solved that problem by devising a scheme using a home constructed battery composed of seven, rather than the usual six, cells to make a nominal 14 V battery system. Chip, K7JA, notes that there is a company providing a different solution—a power regulator that provides 14 V output even when the battery drops as low as 9 V (watch the battery specifications for the lowest safe voltage from your battery). These products are manufactured by Jacobs Electronics **www.jacobselectronics.com/products/caraudio/caraudio.htm** and are designed for car audio fans (presumably those who don't mind walking home). They make 375, 750 and 1500 W models.

HOW AC RMS VOLTAGE RELATES TO DB ON VOM SCALE

By Lionel Mordecai, K6CEQ, 78 Vallecito Way, Chula Vista, CA 91910; **l_mordecai@hotmail.com**

◊ I recently bought a small volt-ohmmeter and was curious about the little table in the lower-right corner. Here's what I learned: The relationship between ac rms voltage and power dissipated in a resistor is given by:

$$\text{Power} \quad \frac{V_{rms}^{2}}{\text{Resistance}} \qquad \text{[Eq 1]}$$

For example, a 600 Ω resistor[1] with

[1]This is not arbitrary. In audio work, 600 Ω is a common system impedance, just as 50 Ω is for RF work. A voltage of 0.775 across a 600 Ω load dissipates 1 mW, and audio folks call it a dBm, although it takes only 0.224 V to dissipate a milliwatt across 50 Ω.—*Bob Schetgen, KU7G*

Bob Schetgen, KU7G ♦ Senior Assistant Technical Editor ♦ tc@arrl.org

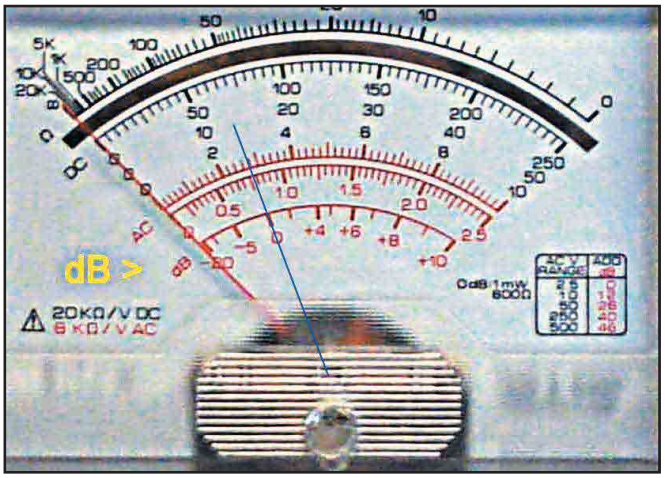


Figure 1—The author's VOM display. Notice that the divisions of the 2.5 V scale do not align with those for 10-500 V. We've added a line through 0 dB to indicate the values in column 2 of Table 3.

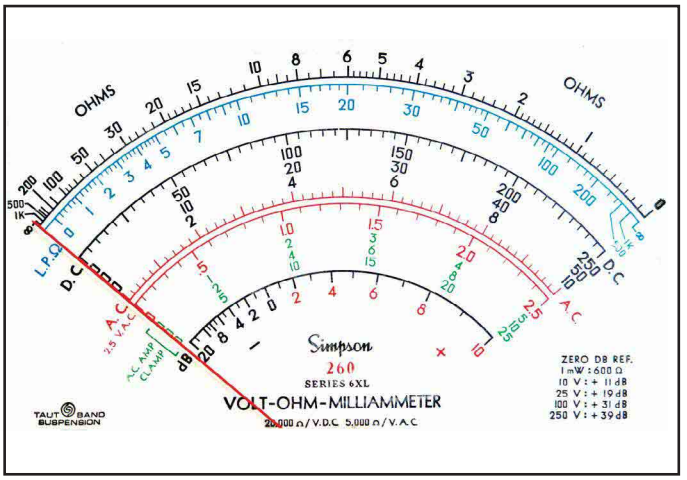


Figure 2—A Simpson 260 meter from the ARRL Lab has a table much closer to the "Actual dBm" column of Table 3.

Table 1

AC V_{rms}	*dBm (600 Ω)*
0.5	–3.8
0.7	–0.9
0.9	1.3
1.1	3
1.3	4.5
1.5	5.7
1.7	6.8
1.9	7.8
2.1	8.7
2.3	9.5
2.5	10.2

Table 2

AC V Range	*Add dB*
0 dB: 1 mW 600 Ω	
2.5	0
10	12
50	26
250	40
500	46

Table 3

AC Range	*Read V@0 dB*	*Actual dBm*	*Computed V@ 0dB*	*dBm*
2.5			0.775	0
10	2.7	10.8	3.1	12.04
50	14	25.1	15.5	26.02
250	68	38.8	77.5	40
500	135	44.8	155	46.02

0.775 V_{rms} across it dissipates:

$$\text{Dissipation} \quad \frac{0.775^2}{600} \quad 0.001, \text{or } 1\,\text{mW} \qquad \text{[Eq 2]}$$

A VOM decibel scale is then related to two parameters: rms voltage and the resistance used to calibrate the decibel scale against voltage. Analog VOMs are still in use. Have you ever wondered how to use the decibel scale on yours? Let's look at the relationship between the ac voltage and the power decibel scales.

Theory: Calculating Power in Decibels

A relationship between ac rms voltage and a dBm is defined by the equation:

$$\text{dBm} \quad 10\log\left(\frac{\text{Power}}{0.001}\right) = 10\log\frac{\left(\frac{V^2}{\text{Resistance}}\right)}{1\,\text{mW}} \qquad \text{[Eq 3]}$$

Table 1 shows rms voltage versus decibels referenced to 1 mW into 600 Ω calculated from:

$$\text{dB(V)} \quad 10\log\left(\frac{V^2}{600}\times 10^3\right) \qquad \text{[Eq 4]}$$

[That's dB as a function of V, not dB times V!—*Ed.*]

An Example: SOLTEC HM-102S

This instrument is being sold at various discount outlets for less than $10. It has ac voltage ranges with maximums of 2.5, 10, 50, 250, 500 V_{rms}. Table 2 reproduces the table on its scale. The red color indicates that you should read values of ac voltage and power decibels from the red multimeter scales. The meaning of this table is revealed when we compare values in the right-hand column to those in the left-hand column. What is meant by "Add 12 dB" or "Add 26 dB"?

Look at Figure 1 and notice how the same pointer covers several ac voltage ranges and one decibel range. The decibel range can't be the same for all of the scales, but it can serve all of the scales with some adjustment to its 0 dB reference point. By computing the decibel level for the ac rms value on each scale at the 0 dB point, we can make a table of adjustment values. The results are in Table 3, shown in the "Read V@0 dB" and "Actual dBm" columns. Unfortunately, the table on the meter face does not accurately present the values in Table 3.[2] This is the hidden price of an inexpensive meter; a Simpson 260 (Figure 2) is more accurate.

I'd like to thank Howard, KR6AH, for the hint that 0.775 V across 600 Ω is 0 dB.

[2]If the voltage scales on the meter face were linear, the proportion of the 0 dB voltage to the scale maximum voltage would be fixed. That proportion (0.31) is defined by ratio of the 0 dB voltage (0.775 V from Eq 2) to the scale maximum, 2.5 V. So a 0 dB reading on the 10 V scale is 10×0.31 = 3.1 V. The decibel difference between 3.1 V and 0.775 V is the "dB to Add." Table 3 was taken from a small spreadsheet that performs these calculations. The manufacturer apparently based the table on the meter face on these assumptions.—*Bob Schetgen, KU7G*

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

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

FEMA: BPL will "Severely Impair" Essential HF Operations

A proverbial monkey wrench in the works for BPL? Expressing "grave concerns" about likely interference from unlicensed Broadband over Power Line (BPL) systems, the Federal Emergency Management Agency (FEMA) told the FCC in December that BPL could "severely impair FEMA's mission-essential HF radio operations in areas serviced by BPL technology." FEMA was responding to last April's FCC BPL *Notice of Inquiry*, ET Docket 03-104. Now part of the Department of Homeland Security, FEMA said its primary worry is BPL's potential impact on the FEMA National Radio System (FNARS) on HF. FNARS is FEMA's primary command and control backup network under the Federal Response Plan.

"FEMA has concluded that introduction of unwanted interference from the implementation of BPL technology into the high frequency radio spectrum will result in significant detriment to the operation of FEMA radio systems such as FNARS," FEMA asserted, adding that the network's radio operators often must work with signals barely above ambient noise levels. FNARS HF stations, FEMA said, typically are in residential areas of the sort that BPL might serve.

As part of the Department of Homeland Security, FEMA's perspectives on BPL could carry substantial weight at the FCC, which may issue a *Notice of Proposed Rule Making* as early as this month. As of press time, the FCC's BPL *Notice of Inquiry* in the matter had attracted more than 5100 comments—many from the amateur community.

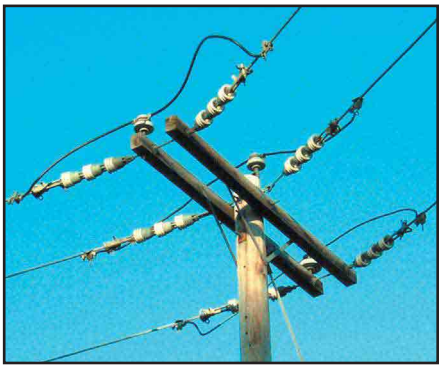
FEMA said BPL also could render useless such "essential communications services" as the Radio Amateur Civil Emergency Service (RACES), the Military Affiliate Radio System (MARS) and the Civil Air Patrol (CAP). FEMA and ARRL last year signed a *Memorandum of Understanding* that focuses on how Amateur Radio and FEMA may coordinate in disasters and emergencies.

Calling the HF spectrum "an invaluable and irreplaceable public safety resource," FEMA said there's no current alternative to HF in terms of meeting national security and emergency preparedness requirements at the national, state and local levels. The agency advised the FCC to beef up its Part 15 rules to ensure no increase in interference levels to existing FCC or NTIA-licensed communication systems. Otherwise, FEMA predicted, "any noise increase inevitably would diminish the ability to maintain essential communications" and would "directly impair the safety of life and property."

Likewise, FEMA pointed out, amateur HF transmitters could possibly interfere with and interrupt BPL service, leading consumers unfamiliar with Part 15 to blame licensed radio services.

Concluded FEMA: "The purported benefits of BPL in terms of expanded services in certain communications sectors do not appear to outweigh the benefit to the overall public of HF radio capability as presently used by government, broadcasting and public safety users."

An ARRL-sponsored independent engineering study is under way to explore how BPL might affect HF and low-VHF amateur operation as well as how Amateur Radio operation could affect BPL systems.



A form of power line carrier (PLC) technology, BPL would use low and medium-voltage power lines to deliver broadband and Internet service to homes and businesses.

Additional information about BPL and Amateur Radio is on the ARRL Web site, **www.arrl.org/tis/info/html/plc/**. To support the League's efforts in this area, visit the ARRL's secure BPL Web site, **https://www.arrl.org/forms/development/donations/bpl/**.

North Carolina Utility Reaches Out to Hams on BPL

Amateurs in southeastern North Carolina have gained the attention of an electric utility that's planning additional Broadband over Power Line (BPL) testing and possible deployment. Wake County Amateur Radio Emergency Service Public Information Officer Gary Pearce, KN4AQ, reports Progress Energy initiated a dialogue with the amateur community in response to many calls and e-mails from concerned amateurs. Technical personnel from the Raleigh-based utility later met with Amateur Radio representatives, and the company promised to include Amateur Radio in its next testing phase.

"The meetings were friendly," Pearce said. Progress Energy Network Engineer Bill Godwin met with him and Wake County ARES Emergency Coordinator Tom Brown, N4TAB, Pearce added, and he also spoke by telephone with ARRL Technical Specialist Frank Lynch, W4FAL. One issue the utility personnel had not yet considered, he learned, was the possibility of interference *from* Amateur Radio *to* BPL systems.

Amateur Radio was not involved in Progress Energy's Phase I testing, primarily a hardware test. No Amateur Radio interference monitoring was conducted, but the utility has been hearing from hams steadily, and stridently, ever since, Pearce pointed out. Phase II will be a larger test and focus more on marketing than technology. Both Phase I and II tests involve mostly underground wiring.

"Amateurs in the territory served by Progress Energy now have a cordial, official relationship with the company," Pearce said. "But even with a friendly start, what might happen in the future is not clear."

SPECTRUM PROTECTION ACT COSPONSOR LIST TAKES A GIANT STEP

Encouraging news from Washington! The list of House cosponsors for the Amateur Radio Spectrum Protection Act, HR 713, reached 77, just as Congress recessed in December. ARRL President Jim Haynie, W5JBP, said he was pleased with the progress since October, when he'd expressed his frustration over a lack of cosponsors. Since that time, the list has grown by 25. The Senate version of the legislation, S 537, has attracted eight cosponsors.

"I'm cheered up that we've got new representatives to sign on, but we can't just

Rick Lindquist, N1RL ♦ Senior News Editor ♦ n1rl@arrl.org

stop," Haynie said. "We've got to keep at it." He continues to encourage ARRL members to urge their senators and representatives not only to cosponsor HR 713 and S 537 as well as the so-called "CC&R bill," HR 1478, but to actively support the measures. "This is something that's important to the future of Amateur Radio," Haynie reiterated.

Sponsored in the House by Rep Michael Bilirakis (R-FL) and in the Senate by Sen Michael Crapo (R-ID), the identically worded Spectrum Protection Act bills would require the FCC to provide "equivalent replacement spectrum" to Amateur Radio if the FCC reallocates primary amateur frequencies, reduces any secondary amateur allocations, or makes additional allocations within such bands that would substantially reduce their utility to amateurs.

Meanwhile, the cosponsor count on the CC&R bill—known formally as HR 1478, the Amateur Radio Emergency Communications Consistency Act of 2003—is holding at 29. Sponsored by Rep Steve Israel (D-NY), the CC&R bill would require private land-use regulators such as homeowners' associations to "reasonably accommodate" Amateur Radio antennas consistent with the PRB-1 limited federal preemption. The ARRL is seeking a sponsor for a companion bill in the US Senate.

HR 713 and HR 1478 have been referred to the House Subcommittee on Telecommunications and the Internet. S 537 has been referred to the Senate Committee on Commerce, Science, and Transportation.

For guidance on the best methods of contacting your members of Congress, see "Communicating with Congress," by Derek Riker, KB3JLF, in the April 2003 issue of *QST*.

Additional information—including the bills' texts, sample letters and information on how to write members of Congress—is on The Amateur Radio Spectrum Protection Act of 2003 Web page, **www.arrl.org/govrelations/arspa.html**, and on the HR 1478, The Amateur Radio Emergency Communications Consistency Act of 2003 Web page, **www.arrl.org/govrelations/hr1478/**.

Those writing their lawmakers on behalf of the Spectrum Protection Act are asked to copy their correspondence to the League via e-mail to **specbill03@arrl.org**. Those writing on behalf of the Amateur Radio Emergency Communications Consistency Act, HR 1478, are asked to copy their correspondence to **ccr-bill@arrl.org**.

ISS, HAM RADIO IN SPACE MARK MILESTONES

In November, the International Space Station celebrated five years in space, while the first permanent Amateur Radio station in space, NA1SS, marked three years. Since attaining orbit in 1998, the ISS has grown from a lone, uninhabited module into a continuously staffed, house-sized research facility. Amateur Radio on the International Space Station (ARISS), a part of the ISS since November 2000, continues to grow along with the ISS. ARISS

FCC News

FCC DENIES ARRL REQUEST IN ADDING 5-GHz PART 15 SPECTRUM

The FCC has amended its Part 15 rules to make another 255 MHz of spectrum available in the 5.470-5.725 GHz band for unlicensed National Information Infrastructure (U-NII) devices, including Radio Local Area Network (RLAN) devices. In a *Report and Order* (*R&O*) in ET Docket 03-122 released November 18, the FCC said it was taking the action to alleviate crowding in existing allocations and to align US U-NII bands with those in the rest of the world. The FCC turned down an ARRL request to keep U-NII devices out of the 5.650 to 5.670 GHz segment to avoid interference with the Amateur Satellite Service. Amateur Radio has a secondary allocation from 5.650 to 5.925 GHz.

FCC ANNOUNCES UNIVERSAL LICENSING SYSTEM MAKEOVER

The FCC in mid-December unveiled a new on-line filing interface for its Universal Licensing System (ULS), **wireless.fcc.gov/uls**, which includes the Amateur Service. Among other features, the ULS's new look includes easier-to-read on-screen forms that guide users through filing and simplify such routine tasks as applying for license renewal, address change or vanity call sign. The FCC says the introduction of its new system, called "ULS License Manager," concludes phase one of an ongoing ULS overhaul by the Wireless Telecommunications Bureau (WTB).

ULS License Manager is compatible with most, if not all, major Web browsers and computer platforms and no longer will require downloading *Java* and *Java Script* files. Screens also are to be compliant with Web screen-to-voice reader software.

The ULS requires all filers to log into the system using an FCC Registration Number (FRN) and Commission Registration System (CORES) password. The FCC said it would no longer accept Taxpayer Identification Numbers (TINs) for log-in purposes.

There's also a new paper version of FCC Form 605, dated December 2003. The FCC says Amateur Service applicants may continue to use the March 2001 (or later) edition of Form 605, but it encourages use of the newest version. All licenses and applications in the ULS database will be converted to the new ULS License Manager filing environment.

Amateur Enforcement

♦ **FCC sets aside former amateur's GMRS license:** The FCC has set aside the General Mobile Radio Service (GMRS) license of Jack Gerritsen, ex-KG6IRO, of Bell, California. The FCC wrote Gerritsen October 15 that the Wireless Telecommunications Bureau took the action based on Gerritsen's alleged "continuing unlicensed operation and complaints of deliberate interference from transmitters you operate." Amateur Radio repeater operators in the Los Angeles area have complained to the FCC that Gerritsen has been attempting to access their machines using the ham radio call sign he'd held for about a week in 2001. Gerritsen also held the GMRS call sign WPYR 527.

Gerritsen's GMRS and Amateur Radio license applications have reverted to pending status. FCC Special Counsel Riley Hollingsworth told Gerritsen that the FCC will make the GMRS application part of the record when it holds a hearing to determine if Gerritsen is qualified to be a Commission licensee. Hollingsworth reminded Gerritsen that he has no authority to operate radio transmitting equipment.

NASA

An artist's conception: **The International Space Station as it will look when completed.**

NASA

Testing, testing! **Expedition 8 Commander Mike Foale, KB5UAC, checks out the Phase 2 Kenwood transceiver in the *Zvezda* Service Module.**

reached a new milestone in December with the installation of Phase 2 gear, which provided a second ham station aboard the ISS.

"Together with our international partners we have learned how to build, operate and maintain a very complex spacecraft, through the good times and the bad," NASA Space Station Program Manager Bill Gerstenmaier said in marking the ISS's fifth birthday. The US, Russia, Canada, Japan and Europe have cooperated in guiding the ISS from concept to reality as well as in making ARISS a success.

Using the initial ham station gear, Expedition 1 crew of William Shepherd, KD5GSL—who dubbed the ISS "Space Station Alpha"—made the first ARISS school group contact on December 21, 2000, answering questions posed by students at Luther Burbank Elementary School near Chicago. To date, 22 crew members have staffed the ISS. The current Expedition 8 crew of Commander Mike Foale, KB5UAC, and Alex "Sasha" Kaleri, U8MIR, arrived at the ISS in October.

Foale took the controls of NA1SS November 25 for the 119th ARISS school group contact and his first. During the QSO with youngsters at the Renmark Primary School in South Australia, he predicted that humans would one day colonize the moon.

"People should be living on the moon in another 10 years," Foale told the youngsters, "and I hope some of them will be you."

The February 2003 shuttle *Columbia* tragedy and the subsequent grounding of the NASA shuttle fleet at least until later this year has slowed construction and trimmed crew complements from three members to two. The ISS' scientific capacity will triple with components awaiting the space shuttle's return to flight. NASA says more than 80 tons of equipment and hardware are awaiting launch at Kennedy Space Center.

The grounding of the shuttle fleet so far has not held back ARISS' plans to expand the space outpost's ham radio capabilities. December saw the addition of a Kenwood TM-D700E VHF/UHF transceiver, although the gear had not been cleared for on-air use by press time. Activation of the Phase 2 gear in the ISS Service Module will mean a power boost for the NA1SS downlink signal, which could prove helpful in school group contacts. The new gear also opens up new operational possibilities.

"Clearly, we've got multiop, multistation capability," ARISS International Chairman Frank Bauer, KA3HDO, told ARRL. The ARISS Japan Team donated the Kenwood radio to ARISS and made specific hardware and firmware modifications—including limiting its power output to a maximum of 25 W—to prepare it for flight.

The Phase 2 station will use four antennas installed on the Service Module in 2002 to specifically support Amateur Radio operation. Waiting in the wings is a Yaesu FT-100 HF/VHF/UHF transceiver that was set to possibly go into space in January along with new SSTV gear.

Bauer says the second ham station with the Kenwood transceiver is near the Service Module's dinner table and the window. "This prime location will allow the crew to more conveniently use the ISS ham radio system," he said. "They'll be able to look out the window while operating." Complementing the Kenwood TM-D700A will be an Ericsson 70 cm handheld.

"Our intention is to operate SSTV on 70 cm with the Ericsson equipment," Bauer said. The crew will use the Kenwood transceiver for ARISS school group contacts as well as for casual QSOs on 2 meters, he added. The Kenwood radio incorporates a TNC and can support the RSØISS packet system.

The Phase 1 "initial station" Ericsson 2 meter handheld installed in the ISS *Zarya*

Media Hits

■ *The Ellsworth (Maine) American* reported on a public ham radio demonstration by members of the Ellsworth Amateur Wireless Association. The article covered a wide range of topics, including emergency communications, ham radio in space and educational outreach. Interviewed were Rob Collins, W8HAP, William Townsend, W1WCT, and Bruce Worcester, N1VLQ.

■ A recent article in *Electronic Design* magazine, "Potential Spectrum Loss, BPL in Hams' Way," covered the negative effects of Broadband over Power Line technology on the Amateur Service. The monthly column, "Beyond Technology," also touched on ARRL's legislative activities and its connection with the Department of Homeland Security through federal emergency communications training grants. Columnist Ron Schneiderman told ARRL that many hams e-mailed him to comment.

■ Jackson, Mississippi, NBC television affiliate WLBT aired a story about the National Weather Service/ARRL SKYWARN Recognition Day December 6, 2003. Representing the Jackson Amateur Radio club, Ron Brown, AB5WF, talked about club SKYWARN activities during weather emergencies.

Functional Cargo Block (FGB), which has served as the only NA1SS gear for more than three years, remains in place.

TENNESSEE, ALABAMA GET NEW SECTION MANAGERS

New ARRL Section Managers have taken the reins in Tennessee and Alabama, while incumbent SMs are continuing in seven other ARRL sections. Ballots in contested races were counted November 18 at ARRL Headquarters. Two-year terms for successful candidates began January 1.

In Tennessee, Larry W. Marshall, WB4NCW, of Fayetteville beat back a challenge from Mark T. Wills, AG4OA, 664 to 191. An Extra class licensee and ARRL Net Manager, Marshall replaced Terry Cox, KB4KA, who decided not to run for another term.

In Alabama, Greg Sarratt, W4OZK, of Harvest, was the only nominee for SM and was declared elected. An ARRL Alabama Technical Coordinator, Sarratt succeeded Bill Cleveland, KR4TZ—Alabama SM since 1999—who did not stand for re-election.

In the only other contested race, incumbent Kansas SM Ron Cowan, KBØDTI, outpolled Steve Hamilton, KBØJYL, 430 to 122. Appointed Kansas SM in January 2003, Cowan had been completing the term of Orlan Cook, WØOYH, who stepped down.

Six incumbent ARRL Section Managers ran unopposed and were declared elected: David Stevens, KL7EB, Alaska; Randall Carlson, WBØJJX, Delaware; Ti-Michelle Connelly, NJ6T, East Bay; Bill Weatherford, KM5FT, New Mexico; Rob Griffin, K6YR, Santa Barbara; and Bill Voedisch, W1UD, Western Massachusetts.

In Brief

• **Foundation for Amateur Radio solicits scholarship applications:** The non-profit Foundation for Amateur Radio Inc (FAR) of Washington, DC, plans to administer 59 scholarships for the 2004-2005 academic year to assist radio amateurs. Comprised of more than 75 Amateur Radio clubs, FAR fully funds seven scholarships with income from grants and its annual hamfest. The Foundation administers the remaining 52 without cost to the donors. FAR invites Amateur Radio licensees planning to pursue a full-time course of study beyond high school and now enrolled in or accepted at an accredited university, college or technical school to compete for these scholarships. Awards range from $500 to $2500. Preference in some cases goes to residents of specific geographical areas or to those pursuing certain programs of study. Additional information and an application form is available by sending a letter or QSL card postmarked prior to April 30, 2004, to FAR Scholarships, PO Box 831, Riverdale, MD 20738.

• **Robert York Chapman, W1QV, SK:** Former ARRL New England Director Robert York Chapman, W1QV, of Groton, Connecticut, died November 21. He was 96. Chapman served as New England Division Director from 1965 until 1975, when the ARRL Board of Directors elected him an ARRL Honorary Vice President. Chapman also was president emeritus of the ARRL Foundation, which he helped to found in 1973. During his ARRL Board tenure, Chapman championed ARRL life membership (he was a Charter Life Member) and, at the Board's May 1968 meeting, proposed the ARRL Five-Band DXCC Award as the epitome of DX achievement. An ARRL member since 1923, Chapman was first licensed as 1QV in 1924. The family invites memorial donations to the Poquonnock Bridge Baptist Church, South Rd, Groton, CT 06340.

• **Stephen E. McCallum, W2ZBY, SK:** Former ARRL Kentucky Public Information Coordinator Steve McCallum, W2ZBY (ex-K4URX), of Lexington died November 30. He was 91. An ARRL Life Member, McCallum was first licensed in 1947 following a stint as a US Coast Guard radio officer. After graduating from college, McCallum worked mostly as a newspaper journalist, and during his years with General Electric, he edited the bi-monthly *GE HAM NEWS*. Former ARRL Southeastern Division Vice Director Evelyn Gauzens, W4WYR, said that when McCallum, then K4URX, was living in Key West, Florida, he always made himself available to help the League. "When he departed the area, he left large shoes to be filled," she added.

• **Vote on *QST* Cover Plaque Award:** The winner of the *QST* Cover Plaque Award for October was Del Schier, K1UHF, for "The Ins and Outs of a Sound Card." The winner of the *QST* Cover Plaque Award for November was Ron D'Eau Claire, AC7AC, for "The Simple Superhet." Congratulations, Del and Ron! The winner of the *QST* Cover Plaque award—given to the author(s) of the best article in each issue—is determined by a vote of ARRL members. Voting takes place each month on the *QST* Cover Plaque Poll Web page, **www.arrl.org/members-only/qstvote.html**.

SECTION MANAGER ELECTION NOTICE

To all ARRL members in the Illinois, Indiana, Maine, Northern Florida, Oregon, Santa Clara Valley, Vermont, and Wisconsin ARRL sections: You are hereby solicited for nominating petitions pursuant to an election for Section Manager (SM). Incumbents are listed on page 16 of this issue.

To be valid, a petition must contain the signatures of five or more full ARRL members residing in the section concerned. Photocopied signatures are *not* acceptable. No petition is valid without at least five signatures, and it is advisable to have a few more than five signatures on each petition. Petition forms (FSD-129) are available on request from ARRL Headquarters but are not required. We suggest the following format:

(Place and Date)

Field & Educational Services 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 for this section for the next two-year term of office.

(Signature___ Call Sign___ City___ ZIP__)

Any candidate for the office of Section Manager must be a resident of the section, a licensed amateur of Technician class or higher and a full member of the League for a continuous term of at least two years immediately preceding receipt of a petition for nomination. Petitions must be received at Headquarters by 4 PM Eastern Time on March 5, 2004. Whenever more than one member is nominated in a single section, ballots will be mailed from Headquarters on or before April 1, 2004, to full members of record as of March 5, 2004, which is the closing date for nominations. Returns will be counted May 18, 2004. Section Managers elected as a result of the above procedure will take office July 1, 2004. If only one valid petition is received from a section, that nominee shall be declared elected without opposition for a two-year term beginning July 1, 2004. If *no* petitions are received from a section by the specified closing date, such section will be resolicited in the July 2004 *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 Field & Educational Services Manager. You are urged to take the initiative and file a nomination petition immediately.—*Rosalie White, K1STO, Field & Educational Services Manager*

REPEAT NOMINATING SOLICITATION

Since no petitions were received for the Michigan Section Manager election by the deadline of September 5, 2003, nominations are herewith resolicited. See the above for details on how to nominate.

Amateur Radio at the Twin Cities Marathon

By Erik Westgard, NY9D, ARRL PIO
ny9d@arrl.net

Urban marathon races are a perfect showcase for our Amateur Radio public service capabilities. When you combine a sprawling, 26.2 mile/42.2 kilometer course venue, thousands of runners and tens of thousands of spectators, these events present serious communications challenges. The very real medical needs of so many runners pushing the limits of endurance adds realism and a sense of urgency that is hard to simulate in practice.

The annual Twin Cities Marathon, labeled "The most beautiful marathon in America" by a leading running magazine, hosts 8500 marathon runners and 3500 10-kilometer race runners for a weekend of events usually in early October in Minneapolis-St Paul, Minnesota.

The weather is often ideal for running, and runners and spectators are treated to a nice display of fall colors and a chance to see urban lakes and the Mississippi River as the course winds through the metropolitan area. This event has been rated in the top 10 of United States marathons and is a leading "destination" marathon for world-class runners.

Fifteen years ago, the rapidly growing Marathon began to recruit Amateur Radio operators to help with medical communications to supplement a limited supply of communicators provided by the Civil Air Patrol. Today, 125 radio amateurs provide all medical communications support for a network of 33 medical aid stations along the course, the medical headquarters/hospital at the finish line, and several fleets of vans and buses to transport the tired or injured runners.

When Amateur Radio moved into the leading support role for the Marathon, a comprehensive communication plan was developed, using the framework of the Incident Command System (ICS). This system provides for the decentralized nets, each controlling an area or aspect of the event. There is a hierarchical structure so events needing higher-level attention are routed to a higher-level net.

With over 40 amateur FM repeaters to choose from in the Twin Cities, the communications planners set up a system of nets using five primary repeaters and five backups—one for each net.

Net 1: Covers miles 1 to 18.5. This net is run by Mike Sigelman, KØBUD, and draws heavily from the Twin City FM Club for operators.

Net 2: Covers miles 19-22.5. This net is run by Al Dietz, WØDEK, who draws from a range of operators including members of the Hennepin Sheriff Mobile Corps.

Net 3: Covers miles 23-26. This net is run by Bill Hughes, NØQHP, and has a range of operators, including those affiliated with Ramsey County Emergency Services.

NY9D

Jeremy Gillis, KBØZEW, Assistant Communications Manager (left), Bill Cross, WØNK, Race Communications Manager (center) and Julie McDonald, Twin Cities Marathon Liaison, confer during the 2002 running of the marathon near the Metro Area Repeater Association trailer that serves as headquarters for race communications.

NY9D

The State Capitol area, north of downtown St Paul, is the site of the Twin Cities Marathon's finish line.

Steve Ewald, WV1X ♦ Public Service Specialist ♦ sewald@arrl.org

Net 4: Covers the finish line and is run by the Marathon Communications Manager, Bill Cross, WØNK.

Bus Net: There is a bus and a "SAG Wagon" (vans for tired or injured runners back to the finish line) dispatch net. The Marathon Committee may be taking this over themselves in future years in order to focus the Amateur Radio operations more on the medical/emergency communications support aspects of the race.

We also use AX.25 packet radio and the ARES/Data application for keeping track of runners who drop out of the race or are entered into the medical system. As a runner drops out, packet operators at each of the net control stations for Nets 1 through 3 enter the runner's number into the database. This allows queries from the finish line or family medical information tent on the status of a runner who does not appear as expected at the finish line.

In 2003 we used a *Linux* program, *trivnetdb*, that looks like ARES/DATA but supports TCP/IP in addition to AX.25 packet. It also allowed us to use 802.11b-equipped laptops near the finish line. See Dennis Boone, KB8ZQZ's Web site, **msuarc.egr.msu.edu/kb8zqz/packet**.

The Metro Area Repeater Association communications trailer is backed up to the medical tent in the finish line area and serves as the command center. With a 65 foot crank-up tower, Net 4, packet antennas can reach out of the low-lying finish line compound. The other nets are run out of various club stations and emergency operation centers throughout the Twin Cities to allow the net control teams to operate uninterrupted.

For those who are used to serving in a secondary communications role, this event provides a chance to handle primary communications support for the health and welfare aspects of the race. Operator recruiting, led by the net control stations, is made easier by the strong camaraderie that develops between radio amateurs and the other volunteers on the course—such as the medical teams at each mile marker. "Amateurs want to go back to the same milepost each year," says Mike Sigelman, KØBUD.

HELP ARRL DOCUMENT PUBLIC SERVICE ACTIVITIES

Amateur Radio operators donate thousands of hours of public service communications in emergencies, scheduled tests or drills and events such as parades and marathons each year. These activities help to show Amateur Radio in its best light, and it is critically important that ARRL bring documentation of this public service work to the attention of the Congress, the FCC and other public officials. We can do it with your help!

The ARRL Public Service Activity Report form is a convenient way to help document Amateur Radio's public service and emergency-response activities. An on-line version of this form, FSD-157, is conveniently available at this ARRL Web page: **www.arrl.org/FandES/field/forms/fsd-157-online-form.php**. You also may access the form by linking to it through the Field Services Forms Web page: **www.arrl.org/FandES/field/forms/**.

If you are an ARRL Emergency Coordinator, District Emergency Coordinators, Section Emergency Coordinator or other leader of an Amateur Radio public service communications group, you are especially encouraged to fill out and submit this form on behalf of your group after each public service activity, emergency operation or alert. You are also invited to supplement your reports with any photographs of radio amateurs in action or other supporting data. Have questions about this form? If so, please contact Steve Ewald, WV1X, at ARRL Headquarters (**sewald@arrl.org**). Thank you.

ARES TRAINING TAKES MANY FORMS

Tennessee ARES District Eight, covering eastern Tennessee, recently sponsored a day-long training event at the Knoxville Chapter of the American Red Cross. Participants learned about emergency applications for digital modes (APRS, PSK31, RTTY and packet), portable antennas and power connectors. ARRL Tennessee Section Emergency Coordinator Sheila Tallent, KB4G, and Mike Winters, AG4OT, organized the event and invited session presenters to bring in their equipment to show and allow participants to gain hands-on experience.

RADIO AMATEURS SEND WEATHER DATA TO NOAA

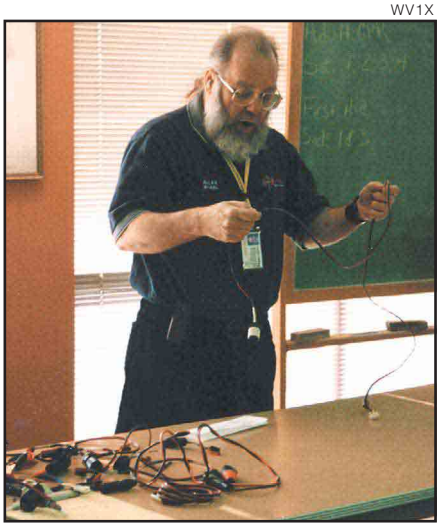
By Joe Schmidt, W4NKJ

Even if they can't change the weather, over 1200 hams from 23 countries are helping make forecasts more reliable. Members of the Citizen Weather Observer Program (CWOP), they use APRS or the Internet to send "real time" observations from home weather stations to the Forecast System Laboratory of NOAA (National Oceanic and Atmospheric Administration). A data stream from FSL is available to government agencies and laboratories including NASA, the National Hurricane Center and the National Weather Service. The observations are valuable for improving the accuracy of weather prediction models developed by these agencies.

According to Patty Miller, a Branch Chief at FSL, "NOAA maintains one of the world's largest databases of real-time surface observations. This information may be seen on the NOAA Web page: **www-frd.fsl.noaa.gov/mesonet/**." Data from radio amateurs is displayed under the designation APRSWXNET.

During last summer's Hurricane Isabel, radio amateurs at the National Hurricane Center used the Mesonet site to provide dozens of supplemental observations for the forecasters. The large volume of data even made it possible to track the eye as it moved inland.

WV1X



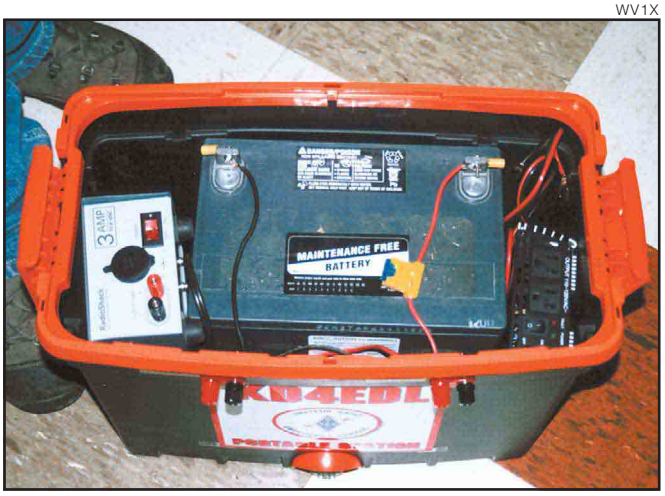
Allan Kaplan, W1AEL, ARRL Emergency Coordinator for Sevier County, Tennessee, demonstrates how to assemble Anderson Powerpole connectors.

WV1X

Charlie Solomon, K4CRS, presented a seminar on antenna theory with special emphasis on emergency and portable operations. He is the Roane County (TN) ARRL Emergency Coordinator.

WV1X

WV1X



(Left) At the ARES Training Event, Brian Decker, KD4EDL, of the Washington County (TN) ARES, shows his portable packet station carrier that's complete with radio, laptop computer, terminal node controller, battery and all the accessories needed for emergency operation.

According to industry sources, over 100,000 home weather stations have been sold. The advent of computers and high speed Web access has contributed to the rapid growth of CWOP membership. W1AW at ARRL was one of the earliest participants in the program.

Information on joining the Citizen Weather Observer Program (CWOP) and a free communication program are available from WX4NHC at the National Hurricane Center, **www.fiu.edu/orgs/w4ehw/CWOP-Main.html**. The software operates seamlessly without affecting normal computer operation.

Many commercial weather display programs now include features designed to send data to NOAA. Complete information and support is usually available from the manufacturer.

Developing CWOP required literally a worldwide effort by NOAA, private individuals and corporations. The first software was developed by Brian Hamilton, a dairy farmer in New Zealand. Promotion of the program has been coordinated by Joe Schmidt, W4NKJ, under the auspices of WX4NHC at the National Hurricane Center. The server network used to collect and forward data to NOAA was organized by Steve Dimse, K4HG, and CWOP Web sites are maintained by Russ Chadwick, KBØTVJ, and David Helms (**www.wxqa.com**; **mywebpages.comcast.net/dshelms/cwop.html**).

More than 20 manufacturers of weather stations and weather display software now participate in the program.

Field Organization Reports

Compiled by Linda Mullally, KB1HSV

Public Service Honor Roll
November 2003

This listing is to recognize radio amateurs whose public service performance during the month indicted qualifies for 70 or more total points in the following 6 categories (as reported to their Section Managers). Please note the maximum points for each category:
1) Participating in a public service net, using any mode. —1 point per net session; maximum 40.
2) Handling formal messages (radiograms) via any mode. —1 point for each message handled; maximum 40.
3) Serving in an ARRL-sponsored volunteer position: ARRL Field Organization appointee or Section Manager, NTS Net Manager, TCC Director, TCC member, NTS official or appointee above the Section level. —10 points for each position; maximum 30.
4) Participation in scheduled short-term public service events such as walk-a-thons, bike-a-thons, parades, simulated emergency tests and related practice events. This includes off-the-air meetings and coordination efforts with related emergency groups and served agencies. —5 points per hour (or any portion thereof) of time spent in either coordinating and/or operating in the public service event; no limit.
5) Participation in an unplanned emergency response when the Amateur Radio operator is on the scene. This also includes unplanned incident requests by public or served agencies for Amateur Radio participation. —5 points per hour (or any portion thereof) of time spent directly involved in the emergency operation; no limit.
6) Providing and maintaining a) an automated digital system that handles ARRL radiogram-formatted messages; b) a Web page or e-mail list server oriented toward Amateur Radio public service —10 points per item.

Amateur Radio stations that qualify for PSHR 12 consecutive months, or 18 out of a 24- month period, will be awarded a certificate from Headquarters upon written notification of qualifying months to the Public Service Branch of Field and Educational Services at ARRL HQ.

680
N2LTC

555
W2MTA

450
W7TVA

430
N9TVT

400
KC2HUV

395
AB2IZ

385
N9VE

325
KA2ZNZ

310
KC2DAA

260
KA2GJV

246
N2YJZ

241
KA9HRO

240
KB2KOJ

230
KB2SNP

227
NN2H
WA1QAA

224
N2IK

220
KB2CCD
W2LC

210
WA9ZTY
KB5ILY

204
K8CQF

199
KG4ZID

193
NØZIZ

189
KB2ETO

187
K2ABX

185
W7ADZ

180
W3ZQN
WI2G

179
K9JPS

175
WB1CHU
N2HQL

170
W7ARC
AG4DL

165
W2DWR

160
K4RLD
KK3F

157
W5ARS

150
AC5VN
KE4JHJ
W3YVQ

149
NN7H

145
N2GJ
AC5XK

140
W5OMG
K7BFL
KAØO

139
KA2YKN
KAØDBK

138
N1IST

134
KA2BCE

133
N2RTF

131
KB2RTZ

130
AG9G
KB2VRO
WB5ZED
K4WWV
N2JBA
KØIBS
WA2YL
KE4UOF
KA5KLU

125
K9FHI
KB5JBV
N7EIE
N8IO

124
W5IM
N5NAV

123
WB2KNS

120
W8YS
W6IVV
KD1LE
N1LKY
W1GMF
KW1U
WBØTAQ
N5IKN
W6QZ
AB4XK
KB8ZYY
W4EAT
K4IWW
AA3SB
N5WSW
KO4SY

119
N3YTD

118
N3WAV
K5ER

117
KA4FZI

115
KK1A
N2JRS
KD4GR
WB8RCR
WA9JWL

113
KW7DSP
K4BEH

112
N4TAB

111
WB2LEZ

110
AD5KE
KC5OZT
K5UPN
N7YSS
W7QM
N7YSS
N8NMA
WB6UZX
W7GB
N2JWW
N1IQI
NJ5M
N3KB
N3SW
AD5IS
K5MC
K2UL
AF4NS
N8FPN
N5OUJ
W5GKH

109
K3JL

107
N3RB

105
K9LGU
KB9KEG
W4NTI
W1PLW
N2AKZ
K7UGT
W3CB
ABØWR

104
KB8NDS

W4ZJY
KBØDTI

103
KA7TTY
W4LN

101
K4DND
K5DPG
W4CC

100
W9CBE
N5BSD
KB5TCH
N7CM
W7LG
N8FXH
K7GXZ
W7GHT
NR2F
WX4H
N9MN
WNØY
KB1JEC
K4SCL
WA8SSI
WA2YBM
AF2K
KC2EOT
WB2QIX
W3BBQ
KG4OTL
K3SS
NF5B
K5IQZ
KC2GOW
KB2KLH
WA4EIC
W9NXC
AA8SN
KA4UIV
KF4OCU
N5SIG
N7TOD
W1QU

99
W5PY
WA1JVV
W7TC

98
W9BHL

96
AL7N

95
KJ7SI
WX4J
W5CU

W2GUT

94
N2ECR
KG4CHW
KC8VOA

92
N8OD
K4FQU

90
W5RDM
KC7SGM
WD8DHC
KA8WNO
W8IM
K1JPG
KF4WIJ
N1JX
W4CKS
N8DD
KC8UTL
KG2D
WB2IJH
K3CN
K2VX
KV4AN
W4DLZ
WA2CUW
W2QOB
KF6OIF
WB4PAM
W4WXA
K1FP
K4FUM
WB4GGS
AA3GV
N3OR

89
W7DPW
WØHXB
K4KAM
W2CC
WØHXB
K3IN
W3GQJ

88
W7VSE
WA2GUP
K4WKT
N3WK

87
N1TPU
KO4OL

86
W4AUN
KE2SX

85
KL7OR
W7RRC
W8CPG
W1ALE
KB3GFC

83
WA2WMJ
N2YBB
AA4BN

81
W5XX
KG4FXG

80
K2YYF
K8KV
W2MTO
W4DGH
K4DZM
KC4ZHF
AA2SV
AA4YW
KF7GC
WAØLYK

79
WB7VYH

77
KA9RZL
WB4BIK
KC8SZR
N4VVX

76
KG4MLC
K4BG

75
KF7CG

74
K8ZJU
ABØUY

73
K2PB
WAØKAQ
K4GA
KA4LRM

72
AD4BL
KGØGG
KC6NBI
WA2EDN

71
KC6SKK
K8KHZ

70
WA5OUV
W5NK

The following stations qualified for PSHR in previous months, but were not recognized in this column: (October) WB2UVB 120, WBØTAQ 120, W1QU 100. (September) KG2D 90. (August) W2GUT 109, N2IK 99.

Section Traffic Manager Reports
November 2003

The following ARRL Section Traffic Managers reported: AK, AL, AR, CO, DE, EB, EMA, ENY, EPA, EWA, GA, ID, IL, IN, KS, KY, LA, MDC, ME, MI, MN, MO, MS, NC, NE, NFL, NH, NLI, NNJ, NTX, NV, OH, OK, OR, ORG, SB, SC, SD, SDG, SFL, SJV, SNJ, STX, TN, VA, VT, WCF, WI, WMA, WNY, WPA, WV, WWA, WY.

Section Emergency Coordinator Reports
November 2003

The following ARRL Section Emergency Coordinators reported: AK, AR, ENY, EWA, GA, IL, IN, KS, KY, LA, MDC, MO, MN, NC, NE, NLI, SC, SD, SFL, SJV, SNJ, SV, TN, WMA, WNY, WTX, WV.

Brass Pounders League
November 2003

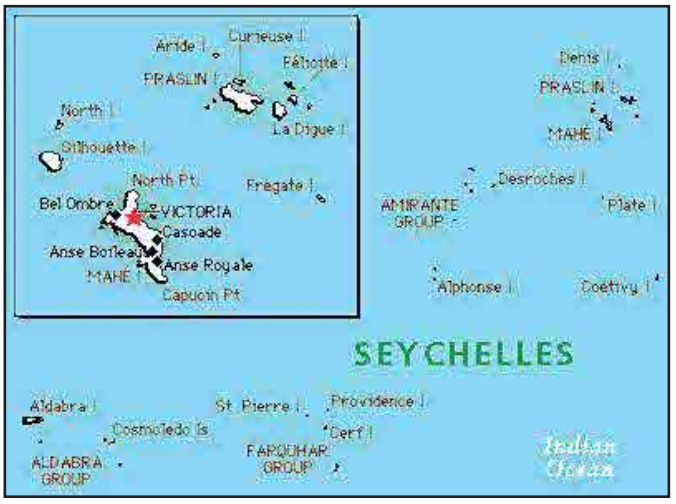
The BPL is open to all amateurs in the US, Canada and US possessions who report to their SMs a total of 500 points or a sum of 100 or more origination and delivery points for any calendar month. All messages must be handled on amateur frequencies within 48 hours of receipt in standard ARRL radiogram format.

Call	*Orig*	*Rcvd*	*Sent*	*Dlvd*	*Total*
KK3F	25	2488	2444	42	4999
W4ZJY	0	1781	1854	0	3635
W1GMF	0	900	2401	39	3340
KA5KLU	0	1246	1251	38	2535
WB5ZED	29	1170	1157	18	2374
N2LTC	0	1040	1052	50	2142
W4EAT	0	937	916	1	1854
W6IVV	0	739	763	1	1503
KW1U	0	824	664	8	1496
K7BDU	36	686	756	4	1482
N5SIG	8	656	707	46	1417
WX4H	0	464	540	9	1013
W7RRC	270	17	590	2	879
N1IQI	555	284	27	0	866
K9JPS	0	367	32	359	758
KF4WIJ	2	350	343	18	713
W6DOB	0	183	500	28	711
W7TVA	41	291	220	112	664
W7QM	15	274	337	8	634
KA2ZNZ	34	276	274	36	620
ABØWR	0	292	312	2	606
K5UPN	14	215	310	4	543
AK6DV	0	257	250	8	515
W2MTA	1	270	229	0	500

BPL for 100 or more originations plus deliveries: W9IHW 193, N9VE 161, NJ5M 151, KK5GY 129, K8GA 122, N8IO 120, and K9GU 108.

Why the Seychelles became my Favorite Holiday Destination

By Kurt Bindschedler, HB9MX/S79MX



In 1979 we visited the main island of Mahe for the very first time and for a second time in 1983. Before these visits I had several contacts with VQ9 call holders and after independence in 1976 with only a few S79 stations. During our first two holidays we joined in some conducted tours and excursions to see more of the flora and fauna of the island and experience the lifestyle of the Creoles.

During our first 30 minute bus ride from the air port to the hotel, I noticed a ham radio beam on the roof of a house. A few days later, curious as to who might live there, I went to inspect the house to gain more information. As there was no nameplate at the entrance I couldn't find out who was the owner or resident. I stood at the open door and called "Hello." After a while, a Creole woman came and asked, "Are you looking for somebody?" Yes, I answered, "I would like to talk to the radio operator." She invited me to take a seat and called upstairs "Bill, a visitor for you." Shortly after this, a man came downstairs. After I told him my call sign, he introduced himself as S79WHW (ex-W8AJS). After several contacts I knew him as "Wild Horse William." He wanted me to come upstairs and he showed me his "radio room," which doubled as his bedroom.

I saw a lot of "old goodies"—a coil winding appliance, Heathkit transceiver, army Vibroplex, grid dip oscillator and cardboard boxes with hundreds of resistors and capacitors. He tried to make a contact and a Russian station replied. A little while afterward I heard another man's voice as footsteps were heard on the stairs. A ham who lived in the neighborhood came by to see Bill. In his hand he had a bundle of QSL cards for S79WHW. It was a most exciting moment for me. I recall an officer I had met in army uniform in 1951 in Trieste (DXCC entity at that time). His call was MF2AA. I hadn't spoken with Robert (Bob) Carragher, a major in the British Forces, after that meeting. He told me he had been enjoying his retirement in the Seychelles for several years, and his call was S79MC. He invited me to visit him the next day. He owns a comfortable house on large property not far from our hotel.

Bill (William) once came to our hotel, where we had a long talk. We got to know more about all the other foreign hams who were active from Mahe. Guests always wondered about the very large dishes situated on the summit of the mountain, where a US crew had set up and operated a USAF satellite tracking station. Three of the radio operators took retirement but decided to remain on the nice island.

By coincidence, Marquise, my future Creole hostess who was Bill's wife, had two sisters. After several parties, the unmarried Americans established a relationship with the sisters. It is unusual for such relationships to end in marriage in the Seychelles. Later, I got to know the two hams and their female companions. During each stay, I was invited for parties and visits. Sad to say, these nice friends passed away as time went on.

Possible Change of Scene

The time came when we got to thinking about a possible change of scene (residence) after my retirement. For a time, my wife agreed to consider the Seychelles. As soon as we had come to a decision, my wife brought forward a lot of objections, which disappointed me a little.

Regardless of this situation, I continued having contacts with S79WHW and S79MC until Bill reached the age of 85 and became a Silent Key in 1988. Months later, I wrote to Bill's widow asking about the possibility of an Amateur Radio holiday. She replied saying that I'd be welcome, adding that she had some older radio equipment. To make sure, in 1988 I brought my own transceiver. Subsequently, I learned that all the radios in good condition, antennas and linears had gone to local hams.

In the backyard I found some coaxial cable and a waterlogged three band ground plane. After cleaning and drying out the antenna parts, I installed Bill's antenna on the wall of the house and connected some radials. S79MX was on the air on 21 MHz for 12 days. Luckily, only one local medium-wave transmitter was heard for a few hours during the day. A few well-off families were proud owners of a TV receiver, but only one local channel could be watched so there was no BC/TV interference.

Gradually I got to know Marquise's children, adults and other family members living at various places on Mahe and in other countries. During a later stay, my hostess asked me if I would like to visit other islands. We drove to the domestic airport and took a 15 minute flight to Praslin. On this island visitors discovered a unique Nature Reserve. In the park you can see thousand year old trees, Coco-de mer, largest fruit in the world (up to 30 kg in weight) and exceptional birds, for example paille-en-queue. On our 30 minute walk down to a ferry port, Marquise showed me various spice plants and exotic fruit trees. A two-masted sailing boat brought us to the smaller neighboring island of La Digue in about half an hour.

Uncomplicated Lives

The three inner Seychelles Islands are composed of granite. Many large round polished rocks stand on the lovely beaches and along the shore. There are no cars to be seen on this very green La Digue Island. Marquise's mother, now 94 years old, still

Bernie McClenny, W3UR ♦ 3025 Hobbs Rd, Glenwood, MD 21738-9728 ♦ w3ur@arrl.org

lives in this paradise. We went to see her. I wanted to see more of this island so I suggested we should remain there overnight. The next day, in shorts and slippers, I took a bike and toured the trails across the island. Here only a few people speak English or French. The inhabitants all smile in a friendly manner. There is no rush and no stress. They have time to chat. There are few health problems and they need no dentures. I realized the people live very uncomplicated lives and are perhaps more fulfilled than we are.

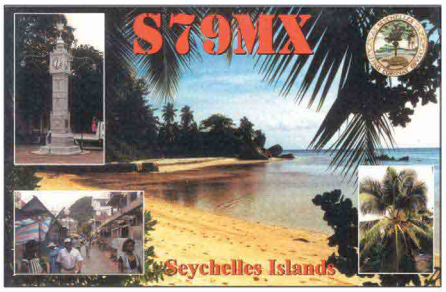
The Ministry of Information and Education issued my 1988 Amateur Radio license. A year later the Seychelles licensing authority was responsible and new radio telecom regulations came into effect.

Marquise's two sons came home often for short chats. Germain runs a racing boat charter. He offers boat trips with game fishing, island hopping and visits to marine reserves. Now and again he sailed with me to islands in the immediate vicinity. Maxime, a high ranking police officer, was very helpful at Customs clearance, application for import permission, residence permit extension and appointments with authorities.

The following year I realized I must have better antennas for the next stay. A nine meter solid aluminum telescopic mast, a 3 element beam, an antenna rotator, baluns and new coax cable were sent to the island by air cargo. I didn't know at that time that cars, luxury products like antennas (which are not vital essential goods) are levied with 50% duty. Finally, with the help of my friend Maxime I got all my equipment out of Customs for $150.

Each year I made more and more contacts mostly on 20 and 15 meters. When a lodge opened on Desroches Island (Amirante group) I spent a week there in 1991. The atoll lies 250 km to the south of Mahe. Besides making some 1500 contacts, I explored the location and took every opportunity to chat with the islanders. Only minimal "beach life" was evident but it's a comprehensive name for all kinds of underwater sports.

I had made several attempts to visit the rare IOTA location Aldabra. In 1992 a dream became a reality. Aldabra is a wildlife preserve in the Indian Ocean about 1200 km to the southwest of Mahe. On October 25 I went aboard a supply vessel. We carried fuel, water, basic food, beverages, timber, water pumps, mattresses, among other items. The ship had to call at 11 atolls. The voyage took 15 days. When a longer stop was planned, I immediately set up the station ashore, having obtained prior permission from the skipper and the island manager. I operated from three IOTA locations: Farquhar AF-035, Cosmoledo AF-026 and finally Aldabra AF-025. I also went ashore during other stops always taking time for observations of the natural surroundings.



The S79MX QSL card provides several enticing views of the Seychelles Islands.

A Nice Surprise

The following year brought a nice surprise. The topmost floor of the building was extended. Another bedroom, a small radio shack, separate shower facilities and a living space was furnished. I got something like my own flat.

My wife joined me again during another stay. Her final decision was to holiday at her own chosen location in the future. This decision solved some difficulties for me. During the next few years, five radio friends and a Swedish female op spent ham holidays here and enjoyed the hospitality of my hostess.

After seven years I realized that the location wasn't good enough for low-band activities. When walking along the shore I discovered a clear space of about 70 meters between two 30 meter high Takamaka trees that were suitable to hang a dipole for 160 meters. About 30 meters from there was a residential building. It's well-known that low-band activities take place during normal rest time. You must consider that there are no countries with low-band activities within a range of 2000 km from the Seychelles. Contacts on 160 meters always occur with stations of a minimum distance of 5000 km.

Once again, a pallet was loaded with house tent, folded bed, table, chair, 50 meters of coaxial cable, trapped dipole for 160 and 80 meters and on top of that, 50 meters of power cable were all sent to the island. At the beginning I was on 160 meters barefoot; nevertheless, the first contact was with VE1ZZ, one of the top 160 meter enthusiasts.

At the bequest of S79MC I noticed a faulty Collins 30L-1 linear. I modified the equipment to work only on 160 meters. From then on I was heard in all six continents. The logs show over 1400 contacts. For most stations it was a first contact with Seychelles on 1.8 MHz.

On one hand I enjoyed the lonely beach location as there was no man-made or high power line noise and on the other hand I missed both sanitation facilities and other comforts. One morning toward the end of my stay a woman from a neighboring family came to the tent. She asked if I would come again the next year. If such was the case she could offer me a room and en suite bathroom in her house. I inspected the accommodation and worked out how it would be possible to move the 160 meter antenna.

The Gear is Moved

The following year a pick-up car carried all my radio equipment from the previous to the present location with the new host family. The people living in this roomy house are the mother Leone, who is 70 years old, her sons Eddy and Jose in their 40s, and other children are married in Australia and England. We planned the setting up of the 3 element beam and hanging up of dipoles for lower bands. Due to the presence of a few coconut palms on the large property, we couldn't erect the antenna in a clear free space. I got to know that landlords are allowed to chop down coconut trees, but it is strictly forbidden to cut down all other hardwood trees that belong to the government. The trunks of the coconut trees are hollow and the wood is useless.

We needed a climber. Within a day three more trees were cut down. Four strong pulleys were fixed at heights of 25 meters and the dipoles were pulled up. I needed nearly 100 meters of coaxial cable and about 150 meters of 4 mm nylon rope. The beam was set up at the retaining wall with clear takeoff to the ocean.

In 1998 I made an application to the Ministry of Communication to release the 50 MHz band for amateur test transmissions. A new band allocation was published. In 1999 I established the first legal 50 MHz transmissions from the Seychelles. Although I was a beginner in this field, I was able to work among the other stations in the Caribbean basin and South America. The distances worked were greater than 14,000 km. These were exciting moments for me. A special event happened during my stay from March to April 2002. I have confirmation of a unique contact with French Polynesia on 50 MHz, which may be the top distance world record of 23,000 km.

It would be boring for me to relate all my achievements. A few ham friends again made use of my new operating location. So far, all my 14 stays have included enjoying the beach and taking long walks. It was never my main objective to make as many contacts as possible. From then on, I walked every day to the hotel for breakfast, ignoring the bus.

Altogether I have spent more than a year in the Seychelles Islands and I have experienced every month and season of the year. Due to health concerns of my wife I felt compelled to end my Amateur Radio activities in Seychelles in September 2003. Gentle readers, maybe you can understand my love for the Seychelles. QST

Flares in October…

…and November as well. Beginning with the last week of October and extending into November, we have witnessed the most intense geomagnetic activity of Cycle 23. This ultimately led to one of the largest auroral events of the past 20 years. This month we will discuss what happened during that event and why we didn't see even more auroral radio contacts associated with other flares.

In order to support radio auroras, a number of events must come together. There must be an inciting event on the sun, like a coronal mass ejection (flare). The particles from the event must be directed towards the earth. The Bz component of the Earth's magnetic field—the vertical component pointing toward the zenith—should be negative. And the optimal time of day for the arrival of the particles should be during the afternoon phase of the aurora between 1500 and 1900 local time. If any of these first three conditions are not present, there may be no aurora. If the particles arrive at a time other than late afternoon/early evening the radio aurora may be of weaker quality.

So a substantial CME is not enough to produce auroral reflections. This was the case for the X.5 flare of October 23. When the CME moved earthward, the K index reached 7, but the Bz remained positive. Even for the massive X.28 flare on November 4 (see Figure 1), which was on the limb of the sun so most of the particles missed the earth. A spot this size is a rare event probably occurring most probably only once in tens of years.

On October 28, an X.17.2 flare generated a CME that struck Earth at 0630Z the next day. There was little or no AU activity because the Bz was still positive. About 1800Z the Bz turned negative with strong AU signals reported on frequencies up to 432 MHz. Signals initially peaked at 20°-30° from my location in FM19jd and even farther east by Shelby, W8WN (EM77). Rapidly, they moved west to about 300°-310° and a long-distance AU event was underway. Another X class flare, X.11, on October 29 generated still another AU session on October 30 as the Bz component turned negative again. The confluence of all the necessary factors can be seen from the unusually high Kp values generated during these two days (Figure 2).

Radio conditions rank this event with some of the premier auroras since 1980—those of 7/82, 2/86, 3/89 and 7/00. Auroral activity both days focused on the "afternoon" aurora at times between 1800Z and 0100Z. Sam, K5SW, believes this AU was not as southerly as the one of March 1989, when he worked stations in Georgia and Florida with his beam due east and stations in Nevada and Arizona with his beam due west. Let's see what happened.

144 MHz

Major auroras always feature partici-

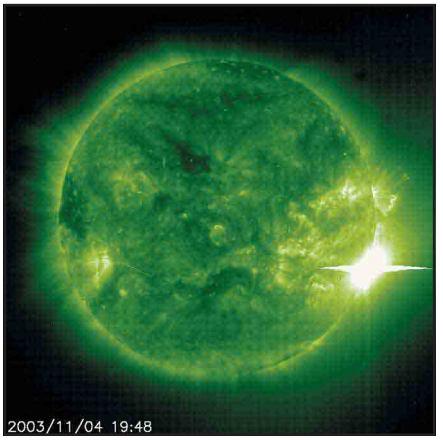


Figure 1—The X.28 flare from Region 486 on November 4, 2003. [sohowww.nascom.nasa.gov/data/realtime/javagif/gifs 20031104_1948_eit_195.gif; courtesy of SOHO/EIT consortium. SOHO is a project of international cooperation between ESA and NASA.]

Table 1
Auroral Contacts on 144 MHz by Selected Station in Far Southern Locations

Station (Grid)	*ODX (station, grid, km)*	*Q/Grid*
W5UWB (EL17ax)	K5CM (EM25ir) 896	EM25—EM15, 35, 36 heard
NW5E (EL98kr)	K2SMN (FN20oj) 1418	FM06, 07, FN20
N5BLZ (EL29ew)	W4MYA (FM07xq) 1837	FM06, 07, EM15, 25, 27, 55, DM65, 78
K5QE (EM31cj)	VE3AX (FN02cw) 1780	19 Q/15 grids
NEØP (EM04to)	W4MYA (FM07xq) 1858	FM06. 07, EN70, EM31, 35, DM78, DN91

Table 2
Selected Long-distance Contacts on 144, 222 and 432 MHz, October 29-30, 2003

Contact	*ODX (km)*
144 MHz	
W1COT (FN31st)-K5CM (EM25ir)	2089
K1TEO (FN31jh)-K5CM (EM25hr)	2017
K5SW (EM25hr)-K2SMN (N20oj)	1874
K4QI (FM06ja))-AE5B (EM02kl)	1873
K1JT (N20pi)-K5CM (EM25ir)	1873
K2TXB (FM29pu)-K5SW (EM25hr)	1872
W3ZZ (FM19jd)-K5JL (EM15dp)	1852
K5MA/1 (FN41qo)-AD4OK (EM54kf)	1816
222 MHz	
W3ZZ (FM19jd)-W5LUA (EM13qc)	1867
VE3AX (FN02cw)-W5LUA (EM13qc)	1832
K5SW (EM25hr)-W3ZZ (FM19jd)	1649
NØLL (EM09os)-VE3AX (FN02cw)	1625
KE8FD (EM84kn)-NØLL (EM09os)	1490
432 MHz	
K2TXB (FM29pt)-WRØF (EM29tc)	1683
N3FZ (EN90xh)-W9ZIH (EN51nw)	763

This Month

Jan 31-Feb 9	WSJT Six Meter Mileage Marathon
*Feb 8	Good EME conditions

*Moon Data from W5LUU

Gene Zimmerman, W3ZZ ♦ 33 Brighton Dr, Gaithersburg, MD 20877 (tel 301-948-2594) ♦ w3zz@arrl.org

pation by stations in the southern states, beam headings that are almost due east or west, and long-distance contacts approaching 2000 km. This one was no exception. Auroral activity was heard at latitudes as far south as the 27th parallel (see Table 1). John, W5UWB, worked K5CM while hearing three other stations. Reports from Gary, NW5E, and Ed, N5BLZ, below the 30th parallel also indicated considerable success and long-distance contacts as well. Gary worked up the coast into New Jersey (K2SMN) and Ed to the outskirts of Richmond, Virginia (W4MYA). There are two other impressive reports from Marshall, K5QE, with 19 contacts from EM31 in the eastern edge of Texas and from John, NEØP, in western Oklahoma, who worked stations in all directions. In addition, mining the propagation reflectors at **dxworld.com** reveals a large number of far-southern stations who normally never encounter an aurora: KC4PX (EL98), N5HYV (EL59), W3XO/5 (EM00), K5LLL (EM10), K4KAE (FM02), KA5DWI (EM12), N5ITO (EM12) and AF4OD (EM72). An event this strong drives the auroral oval southward to the point that those quite far north often are unable to make many contacts. Surprisingly, those stations did quite well this time although Paul, N1BUG, thought it was too far south for optimal conditions from FN55.

Long distance and large volumes of contacts were quite common (see Table 2). Geometry dictates that best AU distances (ODX) via normal (perpendicular) reflection be limited to ~2100 km in an east-west direction and about half that due north and south. This boundary fence is oval in shape so even deviating a small amount from due north-south expands the distance considerably toward the east-west limit. To exceed these limits requires off-normal scattering, a topic discussed by DF5AI at **www.df5ai.de/ArticlesDL/ONScatter/ONScatter.html**. The table shows contacts mostly in a NE-SW direction. Reports from New England were scarce, so there may have been ones longer than these. There were some serious numbers although I wish I were sent more data. Russ, K4QI (FM06), at 135 QSOs and 68 grids leads the pack, with Tim, N4GN (EM78), at 145/60 MHz and Chet, K3TV (FN20) >100/62.

The West Coast often does not see reasonable conditions even in big auroras, but this time they seemed to be well represented. In particular Dave, N7DB (CN85), picked up 10 grids as far as W1IPL (DN62) before he departed for 6 meters. Doug, W7MQY, had 17 contacts and one new grid from CN82. Larry, K6AAW, notes that he never heard a station south of him in CN80 although he worked 17 stations in Oregon, Washington, Idaho, Montana and VE7. Big problems there are the ocean to the west, the sparse population to the east and the fact that the magnetic latitude is about 7° farther south than the East Coast.

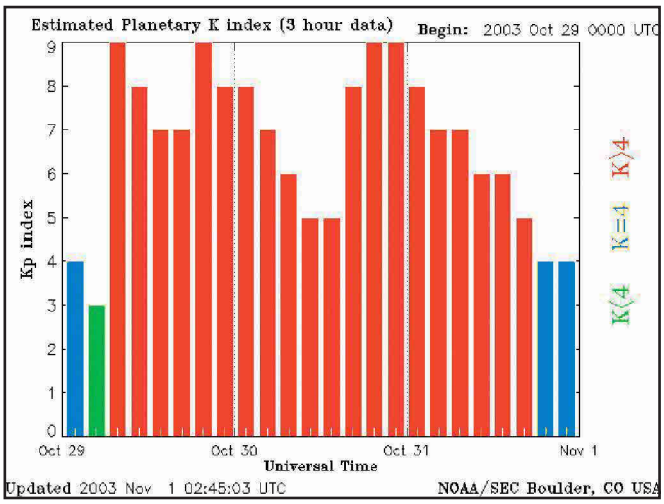


Figure 2—Planetary K [Kp] indices for October 29-31, 2003. [www.sel.noaa.gov/ftpdir/plots/2003_plots/kp/20031031_kp.gif; Information from the Space Environment Center, Boulder, Colorado; National Oceanic and Atmospheric Administration (NOAA), US Dept. of Commerce]

This was an event with some interesting stories. It was a spectacular visual sight in many parts of the country, particularly if you were tracking it from the air as Pete, N6ZE, did—he's a commercial airline pilot. If you ask how good it was, Andy, KØSM/2 (FN13), reports working K3TV (FN20) from downtown Rochester with 25 W and a 10-meter magnetically mounted vertical whip on a fire escape. Ed, W3EKT, worked five new grids putting him over the VUCC mark. There were even some indications of near pure-tone auroral E from KAØRYT to the east, K5MA/1 (FN41) to Mississippi, K2AXX (FN12) to Wisconsin and NØPB (EM39) to Connecticut. The best report came the first day as the AU was fading: Paul, N1BUG (FN55), heard Terry, WØVB (EN34), with pure tones. Interestingly, Terry was using vertical polarization. He finds that longer distance (>800 km) east-west auroral propagation does not appear to suffer from cross polarization.

222 MHz

Conditions and activity to the south were excellent on 222 MHz (see Table 2). I concentrated on long-distance contacts and had 21 in 19 grids from FM19jd including W5LUA (EM13), K5CM (EM25), W5RCI (EM44), K5SW (EM25), WØEKZ (EM17) as well as two new grids (now 105). Al, W5LUA, had 13 contacts including an ODX of 1867 km to W3ZZ. K4QI had eight contacts, all north of him. Larry NØLL (E09) worked south to K5VH (EM00), southeast to KE8FD (EM84) and northeast to VE3AX (FN02). Gary, KE8FD (EM84), made several contacts to the northeast as far as FN42 and westward to EM09 and K5SW (EM25) for Sam's 33rd state on 222. Joe, K1JT, worked westward to N9LR (EN50). Finally Peter, VE3AX, had 33 contacts in 26 grids from W5LUA (EM13) to WD5AGO (EM16), K5UR (EM36) and WRØF (EM29).

432 MHz

The lack of 432 MHz information seems to indicate that not many contacts were made and most of those were over fairly short ranges that people do not want to report. Any 432 MHz auroral contact is unusual, and I wish more reports had been sent. The ODX was between Russ K2TXB (FM29) and WRØF (EM29)—again see Table 2. Jack, N3FZ (EN90), heard eight stations on 432 and worked W9ZIH (EN51), W4DEX (EM95) and K1FO (FN31). Peter, VE3AX, worked as far as K1WHS (FN43) in Maine, and Bill W3IY, roving in FM19ha, worked several stations, including K1FO. All participants noticed Doppler-shift displaced signals 5 kHz down or more. Perhaps a reason for so few 432 MHz AU contacts is that we do not look far enough off frequency or remember that the Doppler can be positive or negative depending on the event. Doppler tends to be in the same direction, so if we find 222 MHz AU signals answering 2-3 kHz low, we can expect 432 MHz signals to be twice as low.

50 MHz

A big CME event always produces both auroral and usually E and F layer events including TE on 6 meters. Au conditions on 6 meters were very good, with limited stations like Mark, K2MRK (FN30), working several stations with an IC-746PRO to a Cushcraft R5 vertical. KH6s reached almost all areas of the US southward to Florida and northeast to VE1, 2 and 3 miss-

ing only the immediate East Coast. TV Channel 2, KHON, in Honolulu was seen in Louisiana. Several stations commented on the huge amount of scatter including a few KH6 contacts via sidescatter. Several lucky people worked Hawaii for state 50 including Chuck, KØTVD (EN21), and Bob, W5LBT (EM40), while Joey, W5TFW (EM40), now needs only Alaska for WAS. Bob, K6QXY (CM88), and WA6KLK (CM89) report contacts with ZL2TPY. Several stations as far eastward as W6JKV (EM00) received the V73SIX beacon. Finally, after seeing several more reports and particularly the logs of Steve, K6UM (CM88), and Pat, WA5IYX (EL09), I must now agree with Pat about the nature of the short but intense opening at 2130-2200Z on October 30 between the Texas area and the Pacific Northwest/northern California. There was no sign of E_s at that time, so the propagation must have been a very short 2400 km F2 opening—for example, CM88 into EL09. At that time, stations in the western and far-western US were working into Central America by what appeared to be F2.

ON THE BANDS

Only a limited amount of F2 DX was evident at these sunspot levels, but still there were some interesting happenings in November on 6 meters and above, driven in part by high solar field levels, which continued into a good part of November.

6 Meters

F2 openings were limited but not absent this month. John, W5UWB, writes that FK8EB was running only 10 W to a Swiss quad during his contact on October 21. Between 0030 and 0100Z on November 1, there was a rare opening between the Pacific Northwest and central/western Australia with CN84/85 stations KB7WW, NN7J, WX7R and W7EW into VK8MS (PH57kp). WX7R and W7EW seem to be the only ones to work VK6JQ (PH12cc) at 0055Z. On November 2, Hatsuo, JA1VOK, worked Argentina and Uruguay, his first South Americans of the season; N6XQ, W6KK, W6YM, XE2ED worked into central Japan via an F2 scatter path and Hatsuo worked Argentina/Uruguay again on November 10. He comments that the latter was done with a solar flux under 100 and a sunspot number less than 50, very unusual conditions indeed for such a distance. Bob, K6QXY (CM88), worked into New Zealand, as did Pat, W5OZI (EM00), on November 18. Most of the southern Caribbean, central America and northern South America reported this month on November 13, 16, 20 and 21 by widely separated stations like Jon, NØJK (EM18); Dave, N3DB (FM18); Mark, K5AM (DM62) and Bob (FN00) were via F2. All events except the 16th probably driven by solar disturbances and CMEs. E_s/TE links developed on November 6 and 7 and again on the 20th and 21st from places as far northward as NØJK (EM18) and N3DB (FM18), mostly to Brazil but also to Argentina. In particular, K7BV reports that Doug, ZP6CW, worked six lucky stations in the northeast via an E_s/TE path skewed 15°-35° east of true path on November 20. Unlike other TE areas, we hear Doug only once a year or so in the East—if that. November 6 and 7 featured straight E_s from the Midwest to the Carolinas to Florida and Chuck, KØTVD, supplied some contacts to the northeast during the aurora of November 20. Finally, Jon operating as HC8/NØJK had the initial contact between the Galapagos and 9Y on November 28 probably via some type of equatorial E, which is recurring rather than sporadic.

Tropospheric Ducting

Gary, KE8FD (EM84ku), reports outstanding tropo conditions to Texas and Oklahoma both the morning and evening of November 22, resulting in three new grids on 144, 222 and 432 MHz. ODX on 2 and 222 was W5III (DM91sj) at 1600 km and AE5B (EM02kl) at 1505 km. The next day, Atlantic coastal ducting produced a contact with AA3ID (FM25) for WB2AMU (FN30) and others in the New York metro area with only 35 W to a small beam. Van, W4VC (EM81), worked up the coast as far as K1TEO (FN31) while getting a new state on 222 and two on 432. The opening culminated with a rare opening between Nova Scotia, VO1TJM (GN08md), and a few fortunate US stations WZ1V (FN31), W1ZC (FN42), K1WHS (FN43) and K2TXB (FM29pt), the latter at 1562 km. On November 25-26, K4QI operating portable in EM85xu at 2000 meters worked numerous stations in central and northern Florida. Finally, LAØBY/p (JO59ix) reports that he encountered an extraordinary tropo duct just prior to the Nordic Activity Contest when he worked UA4UK (LO14ma) for a new ODX of 2050 km.

Aurora

Selby's (W8WN) "Hot News" page summarizes the auroral event of November 20 the best. Signals first appeared in the morning in the US becoming established by 1530Z and lasting until ~0200Z on November 21. Peak times were 1800-2200Z on the 20th. While not as southerly as the October 29-30 AU, it was an excellent event. K5SW (EM25) was the southernmost report I received, working as far northeast as VE3AX (FN02) and K2TXB (FM29). 222 MHz was less active, but I worked seven stations as far westward as WØEKZ (EM17) from FM19. Wayde, K3MF (FM19), reported a contact with W9ZIH (EN51) on 432 MHz. It was better in Europe where Alex, IWØGPN (JN62fb), just north of Rome, had 13 contacts on 2 meters with an ODX of 2200 km to OH2NK (KP20of). Also of interest was GW4DGU (IO71sv) to 9A2SB (JN95gm) at 1825 km on 70 cm, F5VHX's first AU contacts from southwestern France (JN04ft) and G8IZY (IO91vc) with 72 contacts in 36 grids on 2 meter SSB!

Leonids

Like many others, I looked on both the 13th and the 19th. Alas neither I nor anyone else heard much, if anything. According to Shelby, W8WN, even *WSJT* schedules were not particularly effective. The next big peaks should occur in about 100 years. I don't think anyone reading this column should hold his breath.

Microwaves

On November 11, 2003, at 0215Z, WA1ZMS/4 reports the first QSO above 400 GHz in the US, working W4WWQ/4 on 403 GHz over a distance of 0.521 km using new 30-cm dishes. Both were in FM07ji and the total atmospheric loss was 14.4 dB/km. The same two operators extended the 241-GHz record twice in the last month, on November 14 to 34.9 km from FM07fm to FM07ji and on December 3 at 0148Z to 61.8 km from W2SZ/4 (WA1ZMS op) FM07fm to W4WWQ/4 EM97xe with atmospheric loss at 0.541dB/km. Congratulations, Brian!

HERE AND THERE

WSJT 6 Meter Mileage Marathon

Sponsored by the Six Meter Worldwide DX Club, the marathon runs from 0000 UTC January 31 through 0000 February 9, 2004. The contest uses only *WSJT* transmission modes (FSK441, JT6M, JT44, JT63). For more information see **6mt.com/club.htm**.

JT65

Joe, K1JT, has released Version 4.2.1 of his *WSJT* software that contains JT65, a 63 data tone system of 180 Hz bandwidth with strong forward error correction. Designed for EME and troposcatter, JT65 will work signals significantly weaker than JT44. QST

VHF/UHF CENTURY CLUB AWARDS

Compiled by Eileen Sapko
Awards Manager

The ARRL VUCC numbered certificate is awarded to amateurs who submit written confirmation for contacts with the minimum number of Maidenhead grid locators (indicated in *italics*) for each band listing. The numbers preceding call signs are the assigned award numbers, issued in order of date received. The numbers following the call signs indicate claimed endorsement levels. The totals shown are for credits given from October 9 to December 5, 2003.

The VUCC application form, field sheets and complete list of VHF Awards Managers can be found on the VUCC Web site at **www.arrl.org/awards/vucc**. An SASE to ARRL is required if you cannot download these forms. If you have questions relating to VUCC, send an e-mail to **vucc@arrl.org**.

50 MHz
100

1336	VE7DXG
1337	K3TC
1338	CF3VRQ
1339	W1PX
1340	AA4ZZ
1341	K4SLC
1342	KB0PE
1343	KC5POV
1344	N0RQ
1345	KF4DVG
1346	EH4BPJ
1347	KE4SCY/fm06
K1SIX	975
KB1DMX	300
W2OO	250
W4SW	200
WB4KTF	225
KD5HIO	225
W5HEZ	250
W5TFW	300
K5UR	1025
KG6EG	350
N8II	475
WO9S	375

144 MHz
100

622	KD5HIO
623	K3TC
624	KB0PE
625	K5CZD
K5UR	475
NL7CO	175

222 MHz
50

116	WA1ECF
117	N3RN
K5UR	200

1296
25

K5UR	90

3.4 GHz
5

65	VE2PIJ
66	VE3SMA
67	VE2JWH
68	W4SW

5.7 GHz
5

46	W4SW

10 GHz
5

145	VE2JWH
146	VE2PIJ
147	KT1J
148	KG6EG
N1JEZ	15

24 GHz
5

KM0T	10

47 GHz
5

3	NU7Z

Satellite
100

131	W0EEC
132	N5VHO
K5OE	875
K9YKL	225

QST

William B. Gould III, Radio Pioneer

Seeking freedom under the cover of darkness on September 21, 1862, eight slaves rowed a boat 21 miles down the Cape Fear River from Wilmington, North Carolina, to the Atlantic Ocean. It was daybreak when they reached the mouth of the river where the USS *Cambridge*, a US Navy ship blockading the Confederate fort there picked them up. Once on board, the slaves were termed "contrabands of war."

They were offered a chance to join the US Navy and fight in the Civil War. One of them, William B. Gould, a literate slave, would keep a diary of his Civil War service. His great grandson William B. Gould IV recently published this diary as *Diary of a Contraband: The Civil War Passage of a Black Sailor*. (More information about the book is available at **www.amazon.com**, and more on the diary may be found at **www.law.stanford.edu/library/goulddiary/**.)

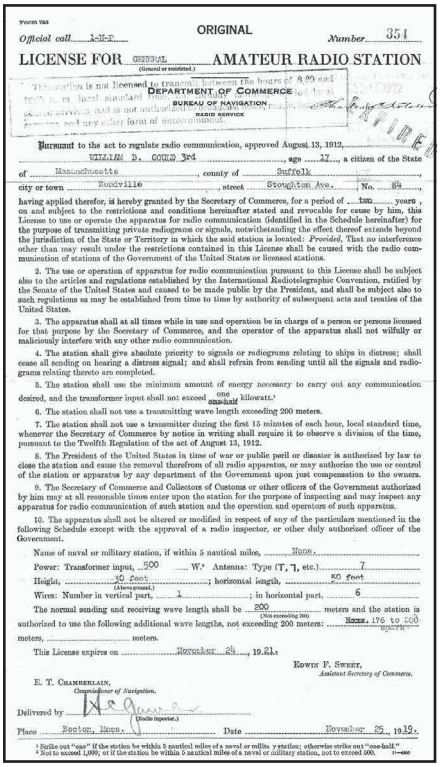
After the war William B. Gould married and settled in Dedham, Massachusetts. He was first employed as a plasterer, a trade he had learned in Wilmington, and later became a contractor. He was a dedicated family man who strongly believed in education. His grandson would become a ham radio pioneer and an electrical engineer.

1NP

Born on March 14, 1902, young William B. Gould III (Bill) would have his first two-way radio contact at the age of 13 using a buzzer as a transmitter. He used the call WG. Later in 1919 at the age of 17, he would pass his Amateur Radio test and be issued the call 1NP. His license (see Figure 2) authorized him to transmit spark not exceeding 500 W into an antenna with a single lead-in wire, an "L" shaped antenna 30 feet high, 50 feet long and made up of 6 wires. See Figure 3. He was very active on ham radio from the beginning, contacting stations all the time.

I'm sure it was due to his location and ham radio activities that he decided to enroll in the Worcester Polytechnic Institute (WPI). This was in 1920 or 1921. WPI was the third college in the country with a wireless club, starting in 1909, and used the call letters WPI. In 1913 the government issued the call 1YK and required that only licensed operators would be able to use the

Figure 1—William B. Gould III, 1NP, in a photo taken on November 22, 1929 as he went to sea.



ORIGINAL

Official call 1NP Number 354

LICENSE FOR GENERAL AMATEUR RADIO STATION

DEPARTMENT OF COMMERCE
BUREAU OF NAVIGATION
RADIO SERVICE

Pursuant to the act to regulate radio communication, approved August 13, 1912,
WILLIAM B. GOULD 3rd, age 17, a citizen of the State
of Massachusetts, county of Suffolk,
city or town Roxbury, street Brompton Ave., No. 84,
having applied therefor, is hereby granted by the Secretary of Commerce, for a period of two years,
on and subject to the restrictions and conditions hereinafter stated and revocable for cause by him, this
License to use or operate the apparatus for radio communication (identified in the Schedule hereinafter) for
the purpose of transmitting private radiograms or signals, notwithstanding the effect thereof extends beyond
the jurisdiction of the State or Territory in which the said station is located: *Provided*, That no interference
other than may result under the restrictions contained in this License shall be caused with the radio communication of stations of the Government of the United States or licensed stations.

2. The use or operation of apparatus for radio communication pursuant to this License shall be subject also to the articles and regulations established by the International Radiotelegraphic Convention, ratified by the Senate of the United States and caused to be made public by the President, and shall be subject also to such regulations as may be established from time to time by authority of subsequent acts and treaties of the United States.

3. The apparatus shall at all times while in use and operation be in charge of a person or persons licensed for that purpose by the Secretary of Commerce, and the operator of the apparatus shall not wilfully or maliciously interfere with any other radio communication.

4. The station shall give absolute priority to signals or radiograms relating to ships in distress; shall cease all sending on hearing a distress signal; and shall refrain from sending until all the signals and radiograms relating thereto are completed.

5. The station shall use the minimum amount of energy necessary to carry out any communication desired, and the transformer input shall not exceed one-half kilowatt.[1]

6. The station shall not use a transmitting wave length exceeding 200 meters.

7. The station shall not use a transmitter during the first 15 minutes of each hour, local standard time, whenever the Secretary of Commerce by notice in writing shall require it to observe a division of the time, pursuant to the Twelfth Regulation of the act of August 13, 1912.

8. The President of the United States in time of war or public peril or disaster is authorized by law to close the station and cause the removal therefrom of all radio apparatus, or may authorize the use or control of the station or apparatus by any department of the Government upon just compensation to the owners.

9. The Secretary of Commerce and Collectors of Customs or other officers of the Government authorized by him may at all reasonable times enter upon the station for the purpose of inspecting and may inspect any apparatus for radio communication of such station and the operation and operators of such apparatus.

10. The apparatus shall not be altered or modified in respect of any of the particulars mentioned in the following Schedule except with the approval of a radio inspector, or other duly authorized officer of the Government.

Name of naval or military station, if within 5 nautical miles, None.
Power: Transformer input, 500 W.[2] Antenna: Type (T, ┐, etc.) T
Height, 30 feet; horizontal length, 50 feet.
(Above ground.)
Wires: Number in vertical part, 4; in horizontal part, 6
The normal sending and receiving wave length shall be 200 meters and the station is (Not exceeding 200)
authorized to use the following additional wave lengths, not exceeding 200 meters: None. 176 to 200 meters.
meters, meters.

This License expires on November 24, 1921.

EDWIN F. SWEET,
Assistant Secretary of Commerce.

E. T. CHAMBERLAIN,
Commissioner of Navigation.

Delivered by
(Radio inspector.)
Place Boston, Mass. Date November 25, 1919.

[1] Strike out "one" if the station be within 5 nautical miles of a naval or military station; otherwise strike out "one-half."
[2] Not to exceed 1,000; or if the station be within 5 nautical miles of a naval or military station, not to exceed 500.

Figure 2—The original 1919 license for 1NP.

station. The Wireless Association immediately started radio classes for the students. On the air almost every day, it's logical that Bill would have been in frequent communications with 1YK at WPI and would have made many friends there.

The 1922 Transatlantic Tests at WPI

During the December 1921 tests, Godley heard 1YK in Scotland. This came somewhat as a surprise to the Wireless Association, as they were only using 20 W at the time. They later attributed their success to the experimental antenna system they were using.

By 1922 Bill had a "Radio Operator, Commercial First Class" license, as he was the Chief Operator at 1YK for the years 1922 and 1924; this was a requirement. Under Bill's leadership in December 1922, 1YK was invited to participate in the Transatlantic Tests. The WPI Wireless Association had been experimenting with their antennas during that year, and had qualified earlier, with their 50 W transmitter being heard clearly in the Mississippi valley.

From the original letters sent out by ARRL Traffic Manager F. H. Schnell, 1YK, was assigned to transmit under group "N" at very specific times. (You can see the original assignment letter and schedule on my Web site, **www.eht.com/oldradio/arrl/index.html**.) From the handwritten notes, Bill participated in the Transatlantic Tests with his assignment to send on Thursday, December 14, 1922 from 0515-0530 GMT.

A Career in Radio

Bill's first job after college was as Engineer with Worcester's radio station WTAG; this was from 1925 to 1929. During this time he also enlisted in the US Naval Reserve as a Radioman. He served on the USS *Eagle*.

In 1929 he followed the path of so many other young radio operators, that of going to sea. Figure 4 shows his *Service Record and Identification Certificate of Radio Operator*. His first assignment was on the SS *Edith*, a coastal steamer that also traveled to the Caribbean. He stayed here until December 1930. Bill also served for a short time on the SS *Gov John Lind* in 1931. Figure 5, scanned

John Dilks, K2TQN ♦ 125 Warf Road, Egg Harbor Township, NJ 08234-8501 ♦ k2tqn@arrl.org

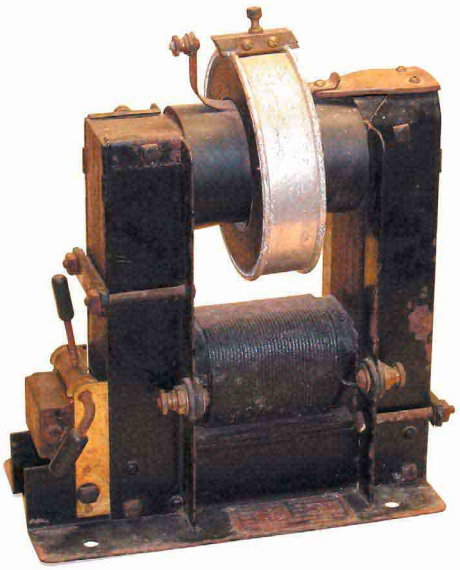


Figure 3—This spark transformer belonged to 1NP and dates back to 1919.

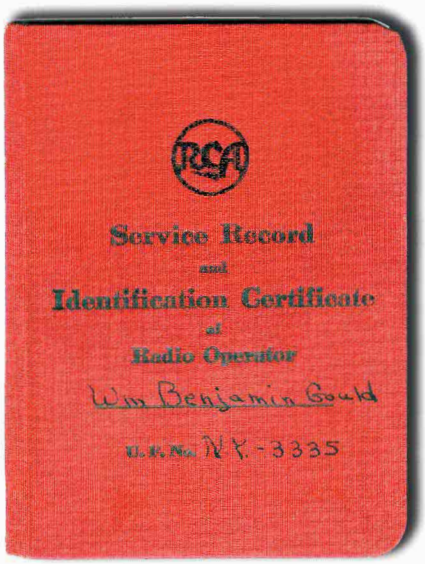


Figure 4—Gould's *Service Record* book. All Radiomarine Corporation of America radio operators carried this book.

Figure 6—The newspaper is dated Monday October 7, 1957. Engineers in the Countermeasures Division, US Army Engineering Laboratories, have been pinpointing the satellite orbit with radio direction finders. On the left is Walter T. J. Day, operating the oscilloscopes, and on the right is William B. Gould III, who is directing the operation.

Vessel	From	To	RATE	Division Controlled By	Supt. or Manager's Signature
S/S ~~Evelyn~~ EDITH	10/14/29	1/20/30	#	Eastern	[illegible] Gould
Edith	2/4/30	3/7/30	#	Eastern	[illegible] Gould
Resigned to accept employment with					
A. W. Bull and Co.					

SERVICE RECO

Figure 5—The Vessel Record form from Gould's *Service Record* book.

from a page in Bill's *Service Record*, shows his ship assignments. He remained active with the Naval Reserve for a few more years, attaining the rank of Chief Radioman.

His next big job was with the Metropolitan District Police Radio in Boston 1936-1940. I understand he was instrumental in setting up the communications system for the Boston police.

In 1940 he moved his family to New Jersey, where he was to begin a long career in the government, with the Signal Corps Labs in Fort Monmouth. He worked on the Army's first radars and supervised the design and development of the first weather radar equipment. It was here he would come to work with Dr Harold Zahl, the Director of Research from 1948 to 1966 at Fort Monmouth's Camp Evans.

October 4, 1957

On October 4, 1957, *Sputnik* was put into orbit by the Soviet Union. Dr Zahl was awakened by a telephone call from co-workers Hans Ziegler and Bill Stroud. Hearing the news, Zahl joined them for a ride to the home of Edward Rich in Farmingdale, New Jersey. There on a Collins R-390 they heard the *beep-beeps*, as they called them, for the first time. They listened all night, calling their team one by one, until all were alerted. Those who were hams ran to their stations, as Bill did, and listened.

The next day the entire team was in place, tracking the satellite for the government. Figure 6 shows a newspaper dated October 7. Dr Zahl would later say:

> But perhaps most important of all during these early hours on October 5 were the efforts of a few of our Countermeasures people operating an experimental direction finding station at Collingswood, N. J. In the open, and in freezing weather, Bill Gould, Harold Jaffe and associates, day after day, all through the long nights, week after week, gave out bearing information—information vitally needed by the Vanguard Computing Center at NRL to determine orbits and make predictions. Yes, the Soviets had kicked off, but before we could really play in the game, we first had to find the ball.

Retiring to Ham Radio

Bill's calls changed over the years. 1NP became W1NP. Eventually, after moving to New Jersey, he changed his call to K2NP. Retiring in 1969, Bill and his wife Leah enjoyed many trips around the country and around the world. They would always find time to visit ham radio friends, friends who were made on the air. Bill continued to be on the air and active with many organizations, including Life Member of the IEEE, director and vice president of the Old Old Timers Club, member of the Quarter Century Wireless Association and the Antique Wireless Association, where he was a close friend of founder Bruce Kelley, W2ICE. Bill remained active and on the air until the end. He became a SK on August 15, 1983.

His obituary would read:

William B. Gould III, Radar, Radio Expert

William Benjamin Gould III, now deceased, was also one of the early Black electronic engineers at Fort Monmouth. Coming to Fort Monmouth in 1940, he was responsible for the installation and operation of early warning radar systems on the West Coast of the US. During the 1950s, Mr. Gould directed research involving instrumentation of long-range guided missiles at Cape Canaveral. Before his retirement in 1969 he was a section chief in the Electronic Warfare Laboratory, directing research and development involving the application of radio and radar for meteorological purposes. During his 29-year career he contributed to the development of radar equipment from the old spark gap transmitter to the vacuum tube and the modern solid state devices.

(August 16, 1983, *Asbury Park Press*, Asbury Park, New Jersey.)

Check my Web site for more photos and information about 1NP and links about the book: **www.eht.com/oldradio/arrl/index.html**.

Finding a Place to Operate Phone on a Contest Weekend

By Richard Webb, NF5B

Contesters and public service operators need to start doing more than pointing fingers and saying the same old things when the subject of contests usurping entire bands comes up. Statements such as: "Well, you have the 30, 17 and 12 meter bands" don't really cut it. Thirty meters is quite limited in spectrum and CW/digital only. 17 meters doesn't always afford us the propagation that the 20 and 40 meter bands do.

I've been a longtime SWL, and a public service communicator for the last three years or so. I recall back in the '70s when contests such as the ARRL November Phone Sweepstakes had subbands set aside for contesting. There was still some grousing among ragchewers and other users of the bands then, but not nearly at the level we hear today.

I've been a region net manager, a regular liaison to the NTS area nets and a section traffic manager. I'm also an active station on the Maritime Mobile Service Net on 14.300 MHz. I even enjoy some contesting. I participated last year in the November Phone Sweepstakes (although I didn't turn in a log as I had to go to work unexpectedly that weekend), but plan to really devote some time to it this year. I also participate in Field Day, which is not really a contest, in my estimation. But please don't tell me that I see no value in contesting or that I'm a rabid anti-contester. Such statements are untrue and would be skirting the issues I raise here.

Every year during the fall contest season tempers grow short and the usual nondialogue takes place between contesting community leadership and public service and humanitarian aid communicators on this topic. Tempers grow short both among the folks trying to carry out their public service duties and contesters. You'll hear comments such as, "Another net—well, I ain't moving!" after the net's been occupying a frequency and a contest station was asked politely to please change frequency. Public service communicators' tempers grow short as well, making an already bad situation even worse.

I have a modest proposal that should cause everybody to give a little and yet be able to enjoy their flavor of Amateur Radio on a contest weekend. It goes like this:

Reserve the area between 14.297 and the top of the 20 meter band for noncontest operation during contests. This gives public service nets, and so on, the top usable 50 kHz on 20 meters. Note I say that it gives nets and other users the top 50 kHz, even though effectively it's 53. Remember your rules and regs? A single-sideband signal isn't supposed to occupy more than 3 kHz of bandwidth. On 20 meters we use upper sideband, which means that you really shouldn't transmit with a frequency center higher than 14.347 unless you want to risk an OO notice. This also gives those who don't do contests a window of 3 kHz below the Maritime Mobile Service Net on 14.300 MHz. Almost everybody who reads *QST* has heard about some rescue or assistance rendered by the Maritime Mobile Service Net over the years, and it should be understandable why we'd appreciate the room during a contest weekend.

On 40 meters I propose allowing noncontesters the top 50 kHz as well. Some nets might have to move their operations in this band during a contest weekend, but having a plan to move within a band that usually allows reliable communications is preferable to not being able to conduct net activities at all due to interference or using an unsuitable frequency. For the most part, however, giving noncontest operations the upper 50 kHz of 40 meters would be a reasonable compromise.

For 75 meters I would propose the top 100 kHz be set aside for noncontest operations. This band is our busiest band during the nighttime hours with many section traffic nets and other public service nets during the night hours here in North America. Even General class operators who wish to participate in the contest should have ample room on the 75 meter band to pursue their interest.

That's my proposal. I'd like to hear something from the contesting community other than the usual "You already have a couple of (rather limited) bands for activities other than contesting." Many of us are hoping to establish some meaningful dialogue with an eye toward solving this knotty problem.

Note: The reason I have focused here on the phone subbands is that I spend the bulk of my time on phone. In addition, many nets, such as the Maritime Mobile Service Net and others that serve missionaries abroad and maritime travelers are phone operations. It also seems to me that the CW contesters are a little more savvy about such things as nets.

Licensed since 1995, Richard Webb, NF5B, of New Orleans, Louisiana, has been an active SWL and radio buff for over 30 years. He has held positions in the ARRL Field Organization as region and area net manager, as well as section traffic manager for the Iowa section. Currently net manager for central area net cycle 2 NTS and a net control station on the Maritime Mobile Service Net, Richard is also active in ARES and RACES. You can reach the author at **elspider@bellsouth.net**.

QST Op-Ed Policy

The purpose of Op-Ed is to air member viewpoints that may or may not be consistent with current ARRL policy.

1) Contributions may be up to two-thirds of a *QST* page in length (approximately 900 words).

2) No payment will be made to contributors.

3) Any factual assertions must be supported by references, which do not necessarily have to be included in the body of the article to be published.

4) Articles containing statements that could be construed as libel or slander will not be accepted.

5) The subject matter chosen must be of general interest to radio amateurs, and must be discussed in a way that will be understandable to a significant portion of the membership.

6) With the exception that the article need not be consistent with League policy, the article will be subject to the usual editorial review prior to acceptance.

7) No guarantee can be made that an accepted article will be published by a certain date, or indeed, that it will be published at all; however, only articles that we intend to publish will be accepted, and any article we have decided against publishing will be returned promptly.

8) Send your contributions to ARRL Op-Ed, 225 Main St, Newington, CT 06111.

SILENT KEYS

It is with deep regret that we record the passing of these amateurs:

KB1AAM, William F. MacDonald, Orleans, MA
**W1QV, Robert Y. Chapman, Groton, CT
K2IC, Earl W. Korf, Lincroft, NJ
*KB2TC, Gary J. Keeney, Clearwater, FL
WA2UIA, Edward J. Kulesa, West Seneca, NY
N3AZK, Norman M. Bock, Southampton, PA
N3DYY, Owen C. Coho, Baltimore, MD
W3FFX, Lewis L. Nagy, Fair Oaks, CA
W3IRZ, Michael A. Branca, Conyers, GA
W3ZQS, George J. Bablak, Erie, PA
KB4AXJ, Eugene K. Kelly Sr, Savannah, GA
W4BZX, Robert D. Lambert Jr, Columbia, SC
WA4GPW, Carl Beckett, Berry, KY
KA4GRR, Mary Calzaretta, Hudson, FL
W4HCU, Ellis J. Wilmoth, Helena, AL
KS4HR, Bryan Todd, Spout Spring, VA
*WB4KYC, William T. Mitchell Jr, Paige, TX
W4MSF, Clarence C. Lovell, Birmingham, AL
W4ROV, Gramon L. Anderson, Columbus, GA
WB4SOA, John R. Farr, Pulaski, TN
W4TMT, Don H. Lovelace, Spruce Pine, NC
W4VOX, Carl D. Ward, Cullowhee, NC
WA4WOM, John C. Pennington, Charleston, SC
W4YEP, J. Wayne Gable, Pinson, AL
W4ZHM, Robert E. Schliestett, Cedartown, GA
WB5CWZ, Ira E. Cowen, Tulsa, OK
WD5EIZ, Charlotte M. Fife, Point, TX
WB5FAX, Fahey Widerstrom, Houston, TX
*W5FHW, Alonzo M. Powell, Fort Worth, TX
*K5HWI, Hank Richroath, Gainesville, TX
W5ICU, Morgan W. Franklin, Bay City, TX
K5JG, James D. Green, Tupelo, MS
WA5PAE, Billy G. Pickard, West Chester, OH
KF5QS, Roy N. Sheets Sr, Marshall, TX
W6AJJ, G L. Rigg, Pollock Pines, CA
K6CAY, Otho Lawrence, Saratoga, CA
WB6CMG, Robert G. Gee, Yucaipa, CA
KF6HJQ, Bonita M. Fuge, Pahrump, NV
W6JNX, Norman D. Nash, Downey, CA
W6LCT, Lawrence E. Seaman Jr, Vista, CA
KD6PTM, Robert W. Connell, Burbank, CA
W6QGX, Harryette G. Barker, Mountainburg, AR
KA6VKE, Melody A. Anderson, Green River, WY
*W7RUJ, Nils A. Hallstrom, Seatac, WA
W7TLA, Orville J. Schmidt, Great Falls, MT
KC7YOA, Aubrey C. Baker, Portland, OR
W7ZTG, Dennis R. Salatino, Tacoma, WA
*N8AES, Earl J. Roberts, Bloomfield Hills, MI
K8AHU, Edwin J. Scarth, La Feria, TX
N8EKW, Harry P. Campbell Sr, Greenville, OH
N8FBB, Douglas A. Francis, Carlisle, OH
W8IJR, Lawrence K. Parker, Beverly Hills, FL
WD8KFN, Richard G. Fuller, Zanesville, OH
WB8KVL, Stephen M. Nichols, Odessa, TX
*K8KWG, Donald A. McMillan, Traverse City, MI
N8MAA, James A. Miller, Louisville, OH
K8NL, Jack L. Luneke, Medina, OH
W8OHS, Morrie Wright, Sterling Heights, MI
W8PNR, Bernard H. Clark, Charleston, WV
W8WFH, William C. Louden, South Euclid, OH
K8WOS, William Starks, Nitro, WV
K8YNG, Norris D. Phillips, Buckhannon, WV
W9BNM, Louis J. Vogl, Oak Creek, WI
W9KOP, Jack Flory, Decatur, AL
W9LVM, Walter J. Schemmel, McHenry, IL
W9OIB, Butler Beattie, Cedar Park, TX
N9PQV, Keith E. Tonn, Marinette, WI
W9PYG, Loren R. Norberg, Addison, IL
WB9QFC, James E. Summers, Onalaska, WI
*W9TGN, George R. Hill, Evanston, IL
KA9UGL, Gilbert J. Serafini, Mark, IL
KC9YQ, John W. Daebelliehn, Gassville, AR
KAØBBZ, Charles V. Colovin, Zephyrhills, FL
KOØKX, Eugene V. Weiner, Woodinville, WA
*WØJHS, Philip De Jarlais, Champlin, MN
WØMOV, Earl G. Peterson, Minneapolis, MN
WØOUD, Letha A. Dangerfield, Joplin, MO
NØRKH, Orvin L. Wilson, Osborne, KS
WØSSL, Michael G. Pavicich Jr, Kansas City, KS
KØVLB, Virginia L. Bridgman, Bemidji, MN
G3OLY, John E. Boylett, Herts, Great Britain
VE4VQ, Vernon Leroy Dutton, Winnipeg, MB, Canada

*Life Member, ARRL
**Charter Life Member, ARRL
‡Call sign has been re-issued through the vanity call sign program.

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. QST

Kathy Capodicasa, N1GZO ♦ Silent Key Administrator ♦ n1gzo@arrl.org

STRAYS

DO YOU USE THE ARRL OUTGOING QSL SERVICE?

◊ A couple of tips that will help ensure that your cards are handled expeditiously and efficiently once they arrive at ARRL HQ:

• Before mailing your cards to us, sort the cards *in alphabetical order by country prefix*. Presort your DX QSLs alphabetically by parent call-sign prefix (for example: AP, C6, CE, DL, ES, EZ, F, G, JA, LY, PY, UN, YL, 5N, 9Y). Canadian and Australian cards should be sorted by numerical call sign (VE1, VE2, VE3 and VK1, VK2, VK3, etc). Some countries have a parent prefix and use additional prefixes. For example: G (parent prefix)=M, 2E, 2I, 2M, 2W. When you are sorting countries that have multiple prefixes, keep that country's prefixes grouped with the parent prefix in your alphabetical stack. Cards for the former Soviet countries should not be mixed in with Russian cards.

• Addresses are not required.

• Please do not separate the country prefixes with paper clips, rubber bands, slips of paper or envelopes.

You can find detailed information at **www.arrl.org/qsl/qslout.html**. Another resource is the Frequently Asked Questions page at **www.arrl.org/qsl/qsl-faq.html**.

An e-mail to **buro@arrl.org** or a telephone call to 860-594-0274 will provide full information.

Limited staff resources require us to put unsorted cards aside to be sorted "as time permits." Thank you for your cooperation. *—Martin Cook, N1FOC, ARRL QSL Service Manager*

US ISLANDS YEAR-LONG SPECIAL EVENT

◊ In honor of its 10th anniversary, the United States Islands (USI) awards program will host special event "island operations" from Alaska and all over the lower 48 throughout 2004. Look for KA3USI, K3USI, W4USI, K4USI, KL7USI and others on/near 14.260. Commemorative QSLs and certificates will be available. See **www.eng.mu.edu/~usi** for details.—*John Reisenauer, KL7JR*

QEX INCLUDING: COMMUNICATIONS QUARTERLY

In the January/February issue:

• Dave Rutledge, KN6EK; Kent Potter, KC6OKH, and Takahiro Taniguchi from Caltech in beautiful Pasadena, California, present a modern 200-W PA design. Bill Young, WD5HOH, returns with a *cascade* regenerative receiver design. Although some consider "regens" to be old technology, enthusiasts continue to improve the breed.

• Brian Cake, KF2YN, describes "Twin Cs Antennas." It opens a two-article description of some seemingly original antenna designs. Check it out.

• Leif Åsbrink, SM5BSZ, presents a fifth article of his continuing series on *Linrad*: the software radio system for *Linux*. He has a few things to say about receiver measurements, too. So does Klaus Eichel, DL6SES/KF2OO. Former *QEX* Editor Rudy Severns, N6LF, tells how to get the most from half-wave slopers. Slopers may be among the most misunderstood of all antennas; Rudy sets the record straight.

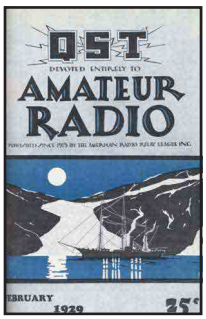
• Stu Downs, WY6EE, explains the secondary side of modern automotive ignition systems and the primary causes of automotive RFI. Dave Lyndon, AK4AA, shows how to make accurate measurements of small inductances. Bob Kopski, K3NHI, contributes a simple RF calibrator to go with his Advanced VHF Wattmeter originally presented in May/Jun 2002. In RF, Contributing Editor Zack Lau, W1VT, writes about power dissipation in baluns.

QEX is edited by Doug Smith, KF6DX, (**dsmith@arrl.org**) and is published bimonthly. The subscription rate (6 issues) for ARRL members in the US is $24. For First Class US delivery, it's $37; elsewhere by surface mail (4-8 week delivery) it's $31. In Canada by airmail it's $40. Elsewhere by airmail it's $59. Nonmembers add $12 to these rates.

Would you like to write for *QEX*? It pays $50/printed page. Get more information and an *Author's Guide* at: **www.arrl.orgwriting.html**. If you prefer "snail mail," send an SASE (6×9 inches, minimum) with 55 cents postage to Maty Weinberg, ARRL, 225 Main St, Newington, CT 06111-1494, and request an *Author's Guide*.

75, 50 AND 25 YEARS AGO

February 1929



♦ The cover drawing shows the schooner *Bowdoin* in an Arctic setting, with Don Mix, W1TS, likely in its WNP radio shack. The editorial discusses the Federal Radio Commission report issued in late December, which confirms the amateur service's exclusive use of 1715-2000 kc. and 3500-4000 kc. The FRC's annual report to Congress notes that there are now 16,926 licensed amateurs.

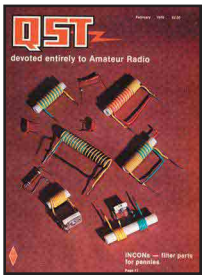
Ross Hull presents an 11-page discussion of "The Requirements of Transmitter Keying," as dictated by the new 1929 requirements. In another article, Ross provides "A Discussion of A. C. Plate Supply," also relating to the new regulations. O. W. Pike and H. T. Maser report on "A New Type of Rectifier Tube for Amateur Use"—the mercury vapor tube. Paul Hendricks describes "A '1929' Receiver." Joe Gish takes a humorous look at hams who are not quite in tune with the new radio regulations, in "Let's Get Serious." D. R. Clemons discusses "The Design of Inductor Coils." Harold Westman, W1AL, describes "The UV-861," a new high-power screen-grid transmitting tube, and Clark Rodimon, W1SZ, puts "The UV-861 in Action" with a 500-watt crystal-controlled rig. In "Correspondence," Dow Inskeep points out the fact that long-distance telephone lines carry a 24.3-kc. "pilot channel" that can be heard within a mile of the line, using a T.R.F. receiver. Dow goes on to suggest that, in the current absence of radio navigation beacons for mail and express airplanes flying West Coast routes, airplanes could use those pilot-channel signals as navigation aids.

February 1954

♦ The cover shows Ed Tilton, W1HDQ, climbing W1ATE's 110-foot tower that supports 10- and 40-meter beams. Another photo in "How's DX?" shows a view of the multi-tower W1ATE antenna farm. The editorial announces the sad news that "For the first time in the history of domestic radio licensing, it now appears likely that some time later this year U. S. amateurs will be required to pay a federal fee for the issuance of their licenses."

Bill Wrigley, W4UCW, discusses the "Impedance Characteristics of Harmonic Antennas." Ed Tilton, W1HDQ, and Mason Southworth, W1VLH, help the reader upgrade from a modulated-oscillator transmitter, in "Crystal Control on 220 Mc." Howard Morrison, W7ESM, presents information on "'Phone Selectivity for the BC-312," a popular military surplus receiver. Marvin Bernstein, W2PAT, describes some novel VFO features, in "Amplitude Limiting for the VFO." Calvin Hadlock, W1CTW, tells about "Bandpass Circuit Design for Crystal-Controlled Converters," producing a 10-meter converter whose output is tunable on his AM car radio. Albert Newland, W2IHW, describes "A Simple 144-Mc. Rig for C.D. Work." Lew McCoy, W1ICP, again works with the newcomer ham, with "A Beginner's Code-Practice Set."

February 1979



♦ The cover photo shows some INCONs, with the note, "filter parts for pennies." The editorial discusses "Good News—and Disappointments—in FCC WARC Proposals" for WARC-79.

"Introducing the INCONs," by A. C. Doty, K8CFU, and Alan Macnee, ex-W1JIR, tells about a new family of components that act as both inductor and capacitor. Doug DeMaw, W1FB, discusses "Antenna Accessories for the Beginner." Ken Gleszer, W1KAY, provides details on "Upgrading Your SB-220 Linear Amplifier." Mike Hiehle, W6RZ, makes the WB4VVF keyer even more valuable to the operator by adding "A 24-Hour-Clock Bonus from the Accu-Memory." Doc Lask, K6CUF, tells how to build "A Noise Blanker for the Collins S-Line." With space limitations, Roy Lehner, WA2SON, designs a rotatable loaded dipole that he calls "A 40-Meter Midget." Dave Shafer, W4AX, asks "Why QSK?" and explains the advantages of full break-in operation. In "FCC WARC Proposals Finalized," David Sumner, K1ZZ, discusses the good news and the bad news of the FCC proposal. QST

Al Brogdon, W1AB ♦ Contributing Editor

W1AW Schedule

PACIFIC	MTN	CENT	EAST	MON	TUE	WED	THU	FRI
6 AM	7 AM	8 AM	9 AM		FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
7 AM-1 PM	8 AM-2 PM	9 AM-3 PM	10 AM-4 PM	VISITING OPERATOR TIME (12 PM-1 PM CLOSED FOR LUNCH)				
1 PM	2 PM	3 PM	4 PM	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
2 PM	3 PM	4 PM	5 PM	CODE BULLETIN				
3 PM	4 PM	5 PM	6 PM	TELEPRINTER BULLETIN				
4 PM	5 PM	6 PM	7 PM	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE
5 PM	6 PM	7 PM	8 PM	CODE BULLETIN				
6 PM	7 PM	8 PM	9 PM	TELEPRINTER BULLETIN				
6:45 PM	7:45 PM	8:45 PM	9:45 PM	VOICE BULLETIN				
7 PM	8 PM	9 PM	10 PM	FAST CODE	SLOW CODE	FAST CODE	SLOW CODE	FAST CODE
8 PM	9 PM	10 PM	11 PM	CODE BULLETIN				

W1AW's schedule is at the same local time throughout the year. The schedule according to your local time will change if your local time does not have seasonal adjustments that are made at the same time as North American time changes between standard time and daylight time. From the first Sunday in April to the last Sunday in October, UTC = Eastern Time + 4 hours. For the rest of the year, UTC = Eastern Time + 5 hours.

♦ **Morse code transmissions:**
Frequencies are 1.8175, 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 practice text is from the pages of *QST*. The source is given at the beginning of each practice session and alternate speeds within each session. For example, "Text is from July 2001 *QST*, pages 9 and 81," indicates that the plain text is from the article on page 9 and mixed number/letter groups are from page 81.

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 on approximately 3.590 MHz by K6YR. See "Contest Corral" in this issue. At the beginning of each code practice session, the schedule for the next qualifying run is presented. 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. The fee structure is $10 for a certificate, and $7.50 for endorsements.

♦ **Teleprinter transmissions:**
Frequencies are 3.625, 7.095, 14.095, 18.1025, 21.095, 28.095 and 147.555 MHz. Bulletins are sent at 45.45-baud Baudot and 100-baud AMTOR, FEC Mode B. 110-baud ASCII will be sent only as time allows.
On Tuesdays and Fridays at 6:30 PM Eastern Time, Keplerian elements for many amateur satellites are sent on the regular teleprinter frequencies.

♦ **Voice transmissions:**
Frequencies are 1.855, 3.99, 7.29, 14.29, 18.16, 21.39, 28.59 and 147.555 MHz.

♦ **Miscellanea:**
On Fridays, UTC, a DX bulletin replaces the regular bulletins.
W1AW is open to visitors from 10 AM until noon and from 1 PM until 3:45 PM on 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.

Headquarters and W1AW are closed on New Year's Day, President's Day, Good Friday, Memorial Day, Independence Day, Labor Day, Thanksgiving and the following Friday, and Christmas Day and the following day. QST

COMING CONVENTIONS

WALLY BYAM CARAVAN CONVENTION

February 10-15, Christmas, FL

The Wally Byam Caravan Convention (28th Annual Florida Ham-A-Rally), sponsored by the ARC of the Wally Byam Caravan Club International, will be held at the Christmas Airstream RV Park, 25525 Colonial Dr; Hwy 50, E of Christmas. Features include recreational vehicles, VE sessions, dinner ($10 per day). Talk-in on 146.97, 146.43. Rally fee is $28 per person (under 12 free); rate for rally parking is $15.05 per night (from Feb 9 through Feb 15). Contact Richard Stroud, W9SR, 3139 S Main, Box 73, Liberty Center, IN 46766; 260-694-6660; **dikw9sr@citznet.com**; **www.rvweb.net/club/wbcciarc/index.html**.

SOUTHEASTERN DIVISION CONVENTION

February 13-15, Orlando, FL

The Southeastern Division Convention (Orlando HamCation and Computer Show), sponsored by the Orlando ARC, will be held at the Central Florida Fairgrounds, 4603 W Colonial Dr (Rte 50); 3 miles W of I-4. Doors are open Friday noon to 7 PM, Saturday 9 AM to 6 PM, Sunday 9 AM to 1 PM. Features include swap tables, commercial booths ($225), vendors, tailgating ($15 for 1 day, $25 for 3 days; plus admission), "Bring and Buy" area (only radio items permitted), DXCC card checking, RV camping with water and limited electricity ($18 per night), VE sessions, forums, Special Event Station, foxhunt, handicapped parking, free parking. Talk-in on 146.76, 147.015. Admission is $8 in advance, $10 at the door (good for the entire 3 days); under 12 free with paid adult. Tables are $35. Contact Cindy Radice, KD4NLV, c/o 2004 Orlando HamCation, Box 547811, Orlando, FL 32854-7811; 407-273-1406; **hamcation@oarc.org**; **www.oarc.org**.

VIRGINIA STATE CONVENTION

February 22, Richmond

The Virginia State Convention (Frostfest 2004), sponsored by the Richmond Amateur Telecommunications Society (RATS), will be held at The Showplace, 3000 Mechanicsville Tpke; I-95, Exit 75 to I-64 E, then Exit 192 (Rte 360), go 1/2 mile on left. Doors are open 8:30 AM to 3:30 PM. Features include Amateur Radio and Computer Show, flea market, indoor national and local vendors, major manufacturers, new and used electronics, computers, interesting exhibits, demonstrations of new products, forums (ARES/RACES, MARS, Digital Operations), guest speakers, QSL card checking, free parking, refreshments. Talk-in on 146.88. Admission is $6 (on-line tickets: **tickets.frostfest.com**); special VIP tickets before Jan 31 for early admission and special entrance; reservation hotline 804-330-3165. Tables are $20 (flea market), $40 (commercial booth space). Contact Pat Wilson, W4PW, Box 14828, Richmond, VA 23221-0828; 804-932-9424 or Frostfest Info Hotline 804-790-0077 (option 4); **w4pw@frostfest.com** or **frostfest@rats.net**; **www.frostfest.com**.

VERMONT STATE CONVENTION

February 28, Milton

The Vermont State Convention, sponsored by the Radio Amateurs of Northern Vermont, will be held at Milton High School, Rte 7, 5 miles N of I-89, Exit 17. Doors are open 8 AM to 1 PM. Features include flea market, vendors (please call for setup information), dealers, book sales, demonstrations, forums (ARRL, QRP, Contesting, Satellites, Antennas), VE sessions (noon, no pre-registration necessary), commercial radio exams, QSL card checking, refreshments. Talk-in on 145.15, bulletins on 146.67. Admission is $5, under 18 free. Tables are free while they last. Contact Mitch Stern, W1SJ, 802-879-6589; **w1sj@arrl.net**; **www.ranv.org**.

January 18
New York City/Long Island Section, Oyster Bay*

February 6-7
Mississippi State, Jackson*

February 7-8
Florida State, Miami*

March 13-14
North Carolina Section, Charlotte

March 19-20
Oklahoma Section, Claremore

March 26-27
Maine State, Lewiston

March 27-28
Maryland State, Timonium

April 4
North Carolina State, Raleigh

***See January *QST* for details.**

Attention Hamfest and Convention Sponsors:

ARRL HQ maintains a date register of scheduled events that may assist you in picking a suitable date for your event. You're encouraged to register your event with HQ as far in advance as your planning permits. Hamfest and convention approval procedures for ARRL sanction are separate and distinct from the date register. Registering dates with ARRL HQ doesn't constitute League sanction, nor does it guarantee there will not be a conflict with another established event in the same area.

We at ARRL HQ are not able to approve dates for sanctioned hamfests and conventions. For hamfests, this must be done by your division director. For conventions, approval must be made by your director and by the executive committee. Application forms can be obtained by writing to or calling the ARRL convention program manager, tel 860-594-0262.

Note: Sponsors of large gatherings should check with League HQ for an advisory on possible date conflicts before contracting for meeting space. Dates may be recorded at ARRL HQ for up to two years in advance. QST

HAMFEST CALENDAR

Attention: The deadline for receipt of items for this column is the **1st of the second month preceding publication date**. For example, your information must arrive at HQ by **February 1** to be listed in the **April** issue. Hamfest information is accurate as of our deadline; contact sponsor for possible late changes. For those who send in items for Hamfest Calendar and Coming Conventions: Postal regulations prohibit mention in *QST* of prizes or any kind of games of chance such as raffles or bingo.

(Abbreviations: *Spr* = Sponsor, *TI* = Talk-in frequency, *Adm* = Admission.)

Arizona (Phoenix/Sun City)—Feb 2. Phil Walker, W1PW, 623-640-5724. (Auction)

†Arkansas (Russellville)—Mar 6, 8 AM. *Spr:* Arkansas River Valley AR Foundation. Hughes Community Center, Parkway and Knoxville; from Hwy 7 turn E on Parkway, go E on Parkway to junction of Parkway and Knoxville. ARRL forum, technical forums, VE sessions. *TI:* 146.82. *Adm:* $5. Tables: $10. Margaret Alexander, KC5MCS, 1511 N Jackson Ave, Russellville, AR 72801; 479-968-7270; **ealexand@cswnet.com**; **www.cswnet.com/~arvarf/hamfest.htm**.

†California (Seaside/Monterey)—Feb 28, 7 AM to 3 PM. *Spr:* Naval Postgraduate School ARC. General Stilwell Community Center, Ord Military Community (old Fort Ord), 4260 Gigling Rd; take CSU Monterey Bay Exit from Hwy 1, go right at first traffic light, go left at next stop sign, Center on right. Flea market, numerous dealers, vendor booths, seminars, AR demonstrations, VE sessions (free), guest speakers, free parking. *TI:* 146.97 (94.8 Hz). *Adm:* Free. Tables: first $35, each additional $30. Brian Broggie, W6FVI, Box 7368, Carmel, CA 93921-7368; 831-626-1501; **w6fvi@arrl.net**; **www.radiofest.org**.

†Colorado (Brighton)—Feb 15, 9 AM to 2 PM. *Spr:* Aurora Repeater Assn. Adams County Fairgrounds, 9755 Henderson Rd; US 85 to 124th Ave, go W on 124th Ave which becomes Henderson Rd, continue W to the Fairgrounds Complex on N side of road. VE sessions (10 AM). *TI:* 147.15. *Adm:* $4. Tables: advance $10, door $15 (plus admission). Wayne Heinen, NØPOH, c/o ARA, Box 471802, Aurora, CO 80047-1802; 303-699-6335; **n0poh@arrl.net**; **www.qsl.net/n0ara/**.

Florida (Christmas)—Feb 10-15, Wally Byam Caravan Convention. See "Coming Conventions."

Florida (Orlando)—Feb 13-15, Southeastern Division Convention. See "Coming Conventions."

†Florida (Port Charlotte)—Mar 6; set up Friday noon to 8 PM; public Saturday 7 AM to 2 PM. *Sprs:* Englewood ARS and Peace River Repeater Assn. Charlotte County Fairgrounds, 2333 El Jobean Rd; opposite Charlotte Sports Park, SR 776, 2 miles W of US 41 and approximately 10 miles W of I-75. Swap tables, tailgating ($10 per space, includes 1 admission), demonstrations (APRS, Echolink, and more), DXCC card checking, VE sessions (all classes), overnight self-contained RV parking ($10, no hookups), free parking, refreshments. *TI:* 147.255. *Adm:* advance $4, door $5; under 17 free. Tables: $10. George Shreve, KA4JKY, 13591 Martha Ave, Port Charlotte, FL 33981; 941-697-3445; **gshreve@ewol.com**; **www.fcrosby.com/hamfest**.

†Florida (Sebring)—Feb 21, 7 AM to 2 PM. *Spr:* Highlands County ARC. Highlands County Agriculture Center, 4509 George Blvd; from Sebring go S on Hwy 27 about 2 miles to flashing yellow light (George Ave), on right at intersection of George and Hwy 27. Free tailgating with purchase of admission ticket, VE sessions, free parking. *TI:* 147.045. *Adm:* $5. Tables: $10 (includes 1 admission). Ben Wilbanks, KA6R, 2003 Flower Terr, Sebring, FL 33875; 863-314-0963; **ka6r@arrl.net**; **www.strato.net/~hamradio**.

†Georgia (Dalton)—Feb 28; set up 7 AM; public 8 AM to 2:30 PM. *Spr:* Dalton ARC. North Georgia Fairgrounds, 500 Legion Dr; from I-75

†ARRL Hamfest

Gail Iannone ♦ Convention Program Manager ♦ giannone@arrl.org

take Exit 336 to Hwy 41 S, go 5 red lights, turn right on Glenwood, go 3 red lights, turn left on Legion Dr to hamfest behind Wendy's. Dealers, vendors, unlimited free tailgating, VE sessions (1 PM), refreshments. *TI:* 145.23. *Adm:* $5. Tables: $5. Marvin Cooper, N2MC, 144 Danny Cir, Calhoun, GA 30701; 706-629-1480 (days); **n2mc@pointlink.net**; or Harold Jones, N4BD, 706-673-2291 (after 6 PM only); **n4bd@ocsonline.com**.

†Maine (Chelsea)—Feb 14, 8 AM. *Spr:* Augusta ARA. Crystal Falls, Rte 17; from Augusta, take Rte 17 E, 1 mile past Togus Veterans Administration Hospital. Flea market. *TI:* 146.7 (100 Hz). *Adm:* $5; under 16 free when accompanied by paying adult. Tables: Free. Bill Crowley, K1NIT, 150 Maple St, Farmingdale, ME 04344; 207-623-9075 (mornings); **k1nit@arrl.net**.

†Massachusetts (Marlborough)—Feb 14; set up 7 AM; public 9 AM to 1 PM. *Spr:* Algonquin ARC. Marlborough Middle/Intermediate Elementary School, 25 Union St; Rte 495 to Rte 85 Connector in Hudson, take Rte 85 S about 2 miles to school on left. Flea market, dealers, vendors, VE sessions. *TI:* 146.61 (146.2 Hz). *Adm:* $3. Tables: advance $12, door $15. Ann Weldon, KA1PON, c/o AARC, Box 258, Marlborough, MA 01752; 508-481-4988; **ka1pon@amsat.org**; **www.qsl.net/n1em/**.

†Michigan (Traverse City)—Feb 14, 8 AM to Noon. *Spr:* Cherryland ARC. Immaculate Conception Middle School, 218 Vine St; from US 31 turn W on Randolph St, first street on left is Vine, go S on Vine to school parking lot on left. Swap-n-Shop, VE sessions. *TI:* 146.86. *Adm:* $5. Tables: $8. Joe Novak, W8TVT, 201 S Spruce St, Traverse City, MI 49684; 231-947-8555; **jnovak@traverse.net**.

†Minnesota (St Cloud)—Feb 28; set up 8 AM; public 9 AM to 2 PM. *Spr:* St Cloud ARC. National Guard Armory, 1710 8th St N. Vendors, on-site VE sessions (10 AM to Noon), refreshments. *TI:* 147.015. *Adm:* $5. Tables: $10. Scott Hall, KAØDAQ, 3001 8th St N, St Cloud, MN 56301; 320-252-4498; **lscotth@aol.com**; or Fred Duke, WØDOM, 320-255-1410; **www.w0sv.org**.

†New York (Hicksville)—Feb 29; set up 8 AM; public 9 AM to 3 PM. *Spr:* Long Island Mobile ARC. Levittown Hall, 201 Levittown Pkwy; located E of Wantagh Pkwy (Exit W2 E), 1/2 mile S of Old Country Rd. Hamfair and Electronics Show, flea market, vendors, parts and equipment, computers, free VHF tune-up clinic, ARRL info, VE sessions (10 AM prompt, $12; Al Bender, W2QZ, 516-623-6449; **w2qz@limarc.org**), free parking, refreshments. *TI:* 146.85 (136.5 Hz). *Adm:* $6, under 12 free when accompanied by paying adult. Tables: $20 (advanced registration only, includes 1 admission). Diane Ortiz, K2DO, c/o LIMARC, Box 392, Levittown, NY 11756-0392; 631-286-7562; **hamfest@limarc.org**; **www.limarc.org/fest.htm**.

†New York (Williamsville)—Mar 7. *Spr:* Lancaster ARC. Main Transit Fire Hall, 6777 Main St (Rte 5); 1/16 mile W of Transit Rd (Rte 78); I-90, Exit 49 (Depew/Lockport Exit). Greater Buffalo Winter Hamfest and Computer Show, all-you-can-eat pancake breakfast. *TI:* 147.255 (107.2 Hz). *Adm:* $6. Tables: $12. Luke Calianno, N2GDU, 1105 Ransom Rd, Lancaster, NY 14086; 716-634-4667; **luke@towncountryflorist.com**; **larc.hamgate.net**.

North Dakota (Bismarck)—Feb 28. Dennis Murphy, KØGRM, 701-258-6747.

†Ohio (Lorain)—Feb 1; set up 6 AM; public 8 AM to 2 PM. *Spr:* Northern Ohio ARS. Gargus Banquet and Catering Hall, 1965 N Ridge Rd (also known as Rte 254 or Detroit Rd); follow I-90 or I-80 to Rte 57, go N for 1/2 mile, turn W at Detroit/N Ridge Rd, proceed 1/2 mile to driveway of Hall. All indoor commercial space (reservations required), vendor display booths, new and used equipment, electronics, computers, free pancake breakfast (8-11 AM). *TI:* 146.7 (110.9 Hz), 444.8. *Adm:* $5. Tables: $10 (6 ft). Clark Beckman, N8PZD, 3407 W 135th St, Cleveland, OH 44111; 216-671-8795; **electro7@apk.net**; **www.apk.net/noars/winterfe.htm**.

†Oregon (Rickreall)—Feb 21, 9 AM to 2 PM. *Spr:* Salem Repeater Assn. Polk County Fairgrounds, 520 S Pacific Hwy W; W of Salem where Hwy 22 meets 99W; take Exit 260A (the Salem Parkway Rte from I-5 S); Mission St Exit from I-5 N, follow signs to Hwy 22/Ocean Beaches. Computer/Electronics Swapmeet, commercial dealers, swap tables, Country Store (Dan Bathurst, WA7ABU, 503-364-3672; **danbath@attbi.com**), ARRL and ARES/RACES meetings, self-contained RV camping ($15 per night), handicapped accessible, refreshments. *TI:* 146.86 (186.2 Hz), 146.46. *Adm:* advance $6, door $8; under 13 free. Tables: swap without power $19 ($13 for each additional table), with power $21 ($15 for each additional table); includes 1 admission; commercial $40 (2 tables). Denis Miller, WC7M, Box 17803, Salem, OR 97305; 503-507-6523; **wc7m@arrl.net**; **www.qsl.net/w7sra**.

†Pennsylvania (Castle Shannon/Pittsburgh)—Feb 29, 8 AM to 3 PM. *Spr:* Wireless Assn of South Hills. Castle Shannon VFD Memorial Hall, 3600 Library Rd (State Rte 88); Rte 51 to Rte 88, 1 1/4 miles S of Rte 51. *TI:* 146.955 (131.8 Hz). *Adm:* $5. Tables: $10. Steve Lane, W3SRL, 897 Lovingston Dr, Pittsburgh, PA 15216; 412-341-1043; **w3srl@yahoo.com**; **www.washarc.org**.

†South Dakota (Rapid City)—Feb 21, 9 AM to 5 PM. *Spr:* Black Hills ARC. Canyon Lake Senior Citizen's Center, 2900 Canyon Lake Dr; near intersection of Canyon Lake and Soo San. Auction, flea market, VE sessions (8 AM; School of Mines), dinner (Elk's Country Club). *TI:* 146.94. *Adm:* Free. Tables: $5. Frank Shaw, NUØF, Box 94, Rapid City, SD 57709-0294; 605-923-4877; **nuzerof@rushmore.com**; **www.w0blk.org**.

Tennessee (Knoxville)—Mar 6. Paul Baird, K3PB, 423-986-9562.

†Tennessee (Memphis)—Feb 14-15; set up Fri eve or Sat morning; public Saturday 9 AM to 5 PM, Sunday 9 AM to 2 PM. *Spr:* DixieFest Committee. Shelby County Building, Mid-South Fairgrounds, 955 Early Maxwell Blvd; easy to get to from I-40 (E and W) or I-55 (N and S), Hwys 70, 72, 78, 51, 61, 64. Flea market, dealer booths, vendors, manufacturers, special forums, VE sessions (both days), DXCC QSL card checking, refreshments. *TI:* 146.82, 146.88. *Adm:* $7, under 12 free. Tables: flea market $20 (power $10 extra); dealer $60. Ben Troughton, KU4AW, 3144 Ingleside Dr, Bartlett, TN 38134-3610; 901-372-8031; **bktrough@bellsouth.net**; or Randy Wilder, WB4LHD, 901-853-3187; **www.dixiefest.org**.

†Texas (El Paso)—Feb 28, 8 AM to 4 PM. *Spr:* El Paso ARC. Club House, 2100 San Diego Ave; from I-10 W, exit at Cotton St, go N to San Diego Ave; from I-10 E, exit at Piedras St, go N to San Diego Ave, W to Cotton. Tailgating, dealers, ARRL Forum, VE sessions, refreshments. *TI:* 146.7 (162.5 Hz). *Adm:* Free. Tables: $10. Clay Emert, K5TRW, 109 Pasodale Rd, El Paso, TX 79907; 915-859-5502; **k5trw@elpn.com**; **www.qsl.net/w5es**.

†Texas (Georgetown)—Feb 1, set up 10 AM; public noon to 3 PM. *Spr:* Williamson County ARC. San Gabriel Park Community Center, Morrow St; from IH-35 going N to Georgetown, take Andice Rd Exit 261A or from IH-35 going S to Georgetown, take Andice Rd Exit 262, turn E on Williams Dr and go to the T intersection, turn left on Austin Ave, go 0.2 mile, turn right on Stadium Dr, at stop sign turn left on Morrow St, go past barns and ball fields, Center on left. Swapfest, vendors, VE sessions (8:30 AM, prior to swapfest), refreshments. *TI:* 146.64 (162.2 Hz), 145.13. *Adm:* Free. Tables: $10/$15. Lori Schmidt, KM5MQ, 903 Fieldstone Pl, Round Rock, TX 78664; 512-255-6753; **km5mq@arrl.net**; **www.wcarc.com**.

†Texas (Orange)—Feb 28. *Sprs:* Orange ARC and Jefferson County ARC. VFW Hall, Hwy 87 N; Exit I-10 at Hwy 87, go N for approximately 1 mile, VFW on left. Dealers, forums, VE sessions, plenty of paved parking. *TI:* 147.18. *Adm:* None. Tables: individuals $10, dealers $15. Joan Lexa, WA5LFT, Box 232, Orange, TX 77630; 409-886-1892; **wa5lft@pnx.com**.

†Texas (Smithville)—Feb 21, 8 AM. *Spr:* Bastrop County ARC. Riverbend Park, Hwy 71; 45 miles E of Austin or 45 miles W of Columbus. Covered tailgate spaces, commercial dealers, RV hookups. *TI:* 145.35 (114.8 Hz), 443.75 (114.8 Hz). *Adm:* Free. Tables: $10. Lynn Fisk, K5LYN, 167 Hudson Rd, Smithville, TX 78957-9579; 512-360-4809; **bcarchams@yahoo.com**; **www.austinhams.org/bcarc**.

Vermont (Milton)—Feb 28, Vermont State Convention. See "Coming Conventions."

†Virginia (Annandale)—Feb 29, 8 AM to 2 PM. *Spr:* Vienna Wireless Society. Northern Virginia Community College, 8333 Little River Tpk; I-495 (Capital Beltway) to Exit 52, then westbound on Rte 236 (Little River Turnpike), NVCC campus is 1 mile on left. Ham Radio, electronics and computer parts; paved tailgating ($15 per space, includes 1 admission; opens at 6 AM), exciting guest speakers; VE sessions (Saturday, Feb 28, 9 AM, on-site, walk-ins accepted); QSL card checking until noon (WAS, DXCC, VUCC); free parking; refreshments. *TI:* 146.91. *Adm:* $6. Tables: 8 ft $25 (Len, KG6ZR, 703-366-3979; **tablesales@viennawireless.org**). Jim Richey, AG4MA, 4402 Roundhill Rd, Alexandria, VA 22310; 703-971-4812; **jimrichey2@juno.com**; or Jim Parsons, W4JTP, 703-392-0150; **winterfest@viennawireless.org**; **www.viennawireless.org**.

Virginia (Richmond)—Feb 22, Virginia State Convention. See "Coming Conventions."

†Washington (Puyallup)—Mar 6, 9 AM to 3 PM. *Spr:* Mike and Key ARC. Western Washington Fairgrounds Pavilion Exhibition Hall, 9th Ave S and S Meridian; Hwy 512 to Meridian St South Exit, go N on Meridian to NE corner (Gold Gate) of Fairgrounds. Commercial booths, computers, parts, club info, consignment store, VE sessions, free parking, refreshments. *TI:* 146.82 (103.5 Hz). *Adm:* $6. Tables: $27. Michael Dinkelman, N7WA, 22222 148th Ave SE, Kent, WA 98042; 253-631-3756; **mwdink@eskimo.com**; **www.mikeandkey.com**.

†West Virginia (Fayetteville)—Feb 29, 9 AM. *Spr:* Plateau ARA. American Legion Hall, 205 W Maple St (across the street from Fayette Cty Memorial Bldg); from the intersection of Rtes 19 and 16 at Fayetteville turn left (N) or turn right (S) onto Court St, at 2nd traffic light on Court St turn right onto Maple, go 2 blocks to Hall. VE sessions. *TI:* 146.79. *Adm:* $5. Tables: $5. Wes Holstein, N8WBR, Box 96, Fayetteville, WV 25840; 304-574-0004; **n8wbr12@aol.com**; **www.qsl.net/kc8lob**.

STRAYS

CODE PROFICIENCY AWARDS

◊ Evaluate your Morse code ability through the ARRL Code Proficiency program. Copy one of W1AW's qualifying runs (see Contest Corral in this issue), and submit one minute of solid copy (legible) along with a fee of $10 for the initial certificate or $7.50 for an endorsement to ARRL HQ. Your submission will be checked directly against the official W1AW text, and if you pass, you'll get your initial Code Proficiency certificate. From then on, endorsement stickers are issued for speeds up to 40 wpm. Non-hams and hams alike are eligible for the Code Proficiency program.

CONTEST CORRAL

W1AW Qualifying Runs are 7 PM EST Wednesday, Feb 4 (0000Z Feb 5), and 4 PM EST Thursday, Feb 19 (2100Z Feb 19). The K6YR West Coast Qualifying Run will be at 9 PM PST Wednesday, Feb 11 (0500Z Feb 12), 40-10 wpm. Check the W1AW Schedule elsewhere in this issue for details.

SO—Single-Op, M2—Multiop, 2 Transmitters, MO—Multi-Op, MS—Multi-Op, Single Transmitter, MM—Multi-Op, Multiple Transmitters, AB—All Band, SB—Single Band, S/P/C—State/Province/DXCC Entity, HP—High Power, LP—Low Power, Entity—DXCC Entity, HP—High Power >150 W, LP—Low Power >5 W and <150 W, QRP is <5 W

No contest activity on 30, 17 and 12 meters. Refer to the contest Web sites for information about awards. Unless stated otherwise, regional contests only count QSOs with stations in the region. Publication deadline for Contest Corral listings is the first of the second month prior to publication. In order to publicize the maximum number of contests, readers will be referred to an earlier issue of *QST* if the rules have been published within the past year.

Jan 31-Feb 9

6-Meter Mileage Marathon—*WSJT* modes, sponsored by the Six Club, 0000Z Jan 31-0000Z Feb 9. SOLP (<200 W), SOHP. Use JT44, FSK441, JT6M modes. Exchange: full call signs, four-digit grid square, and acknowledgement. Score: sum of distances between stations for all QSOs. For more information: **6mt.com**. Logs due Apr 1 to **contests@6mt.com** or Wayne Lewis, W4WRL, Contest Director, 3338 South Cashua Dr, Florence, SC 29501-6306.

North American Sprint—CW—sponsored by the *National Contest Journal*, from 0000Z-0400Z, Feb 1. (SSB is Feb 8.) Frequencies (MHz)—3.540, 7.040, 14.040, work stations once per band. North American stations work everyone; others work NA stations only. Exchange: other station's call, your call, serial number, name, S/P/C. QSY rule: Stations calling CQ, QRZ, etc, may only work one station in response to that call; they must then move at least 1 kHz before working another station or 5 kHz before soliciting another call. Once you are required to QSY, you may not make a new QSO on the previous frequency until you have made a contact at least 1 or 5 kHz (as required) away. (See **www.contesting.com/articles/198** for beginner's guide.) Score: QSOs × S/P/C (count each only once). For more information: **www.ncjweb.com**. Logs due 7 days after the contest to **cwsprint@ncjweb.com** or Boring ARC, 15125 Bartell Rd, Boring, OR 97009.

Spartan Sprint—CW—sponsored by the Adventure Radio Society, 0200Z-0400Z Feb 3 (Monday). The contest is held on the first Monday (local time) of every month. Frequencies (MHz): 3.560, 7.040, 14.060, 21.060, 28.060. Categories: SOAB. Exchange: RST, S/P/C, and power output. For more information: **www.arsqrp.com/**. Logs due following Wednesday afternoon to **hjohnc@core.com** or via automated scoring system on ARS Web site.

Feb 7-10

School Club Roundup—all modes, 1300Z Feb 9-1300Z Feb 14 (see Jan *QST*, p 102).

Minnesota QSO Party—CW/Phone—sponsored by the Minnesota Wireless Association, 1400-2359Z Feb 7. Frequencies (MHz): CW— 1.810, 3.550, 7.050, 14.050, 21.050, 28.050, SSB—1.870, 3.890, 7.230, 14.290, 21.390, 28.420. Categories: QRP, SOLP, SOHP, VHF, MN Mobile/Portable and MN MS. Exchange: Name and MN county or S/P/C. QSO Points: SSB—1 pt, CW—2 pts. Score: QSO points × MN counties (87 max, MN stns add States and Provinces), each counted only once. For more information and MN QSO Party software: **www.w0aa.org**. Logs due Mar 15 to **WA0MHJ@arrl.net** or MNQP, 4745-170th Ln NE, Ham Lake, MN 55304-5233.

FYBO (Freeze Your Butt Off) Winter QRP Field Day—CW—sponsored by the AZ ScQRPions from 1500Z-2300Z Feb 8. Use QRP calling frequencies on HF bands, work stations once per band. Categories are SO, MS, MM and Novice/Tech—indicate home or field. Exchange: RST, S/P/C, name, power and temperature °F at operating position. Score: total QSOs × S/P/C (counted only once) × Temperature multiplier ×4 (if field location) ×2 (if alternative pwr) ×2 (if QRP). Temp mult—65+ ×1, 50-64 ×2, 40-49 ×3, 30-39 ×4, 20-29 ×5, <20 ×6. Add 10,000 points for a QSO with NQ7RP. For more information: **www.extremezone.com/~nk7m**. Logs due 30 days after the contest to **AzScQRPions@covad.net** (e-mail only).

Ten-Ten International Winter Phone QSO Party—sponsored by Ten-Ten, International, from 0001Z Feb 7-2359 Feb 8, 10 meters only. Exchange: Call sign, name and 10-10 number (if a member). QSO Points: nonmembers—1 pt, members—2 pts. Score: total points. For more information: **www.ten-ten.org**. Logs due Feb 23 to **tentencontest@alltel.net** or Steve Rasmussen, NØWY, #68684, 312 N 6th St, Plattsmouth, NE 68048.

Vermont QSO Party—CW/Phone/Digital—sponsored by the Central Vermont Amateur Radio Club, 0000Z Feb 7-2400Z Feb 8. Frequencies: 160-10 meters and VHF/UHF, CW—40 kHz up from band edge (20 kHz Novice/Tech bands), Phone—lowest 25 kHz of the General privileges and entire Novice/Tech 10-meter band, VHF SSB—50.200 and 144.200 MHz, FM—146.49 and 146.55 MHz. Categories: SOAB, MO, Club and Rover. Exchange: RST and VT county or S/P/C. QSO Points: Phone—1 pt, CW or digital—2 pts. Work stations once per mode up, up to 4 QSOs per band. Score: QSO points × VT/NH/ME counties + Vermont club stations + S/P/C (VT only), each counted only once. For more information and list of club stations: **Davidca@wpgate1.ahs.state.vt.us**. Logs due Mar 1 to Steven Board, KA1LHZ, Vermont QSO Party Coordinator, Central Vermont Amateur Radio Club, PO Box 1817, Roxbury, VT 05669.

North American Sprint—SSB—from 0000Z-0400Z, Feb 8. Frequencies (MHz)—3.850, 7.225, 14.275. Logs due 7 days after the contest to **ssbsprint@ncjweb.com** or Jim Stevens, K4MA, 6609 Vardon Ct, Fuquay-Varina, NC 27526.

XE International RTTY Contest, sponsored by FMRE, from 1800Z Feb 7 to 2400Z Feb 8. Frequencies: 80-10 meters. Categories: SO-1 Radio, SO-2 Radio. Exchange: RST and serial number or XE state/district. QSO Points: within own country—2 pts, DX—3 pts, XE stations—4 pts. Score: QSO points × XE states + DXCC entities from each band. For more information: **www.fmre.org.mx**. Logs due Mar 8 to **xe1j@ucol.mx** or Jose Levy, XE1J, Dirección de Concursos FMRE, Clavel 333, Colima, Col 28030, Mexico.

Delaware QSO Party—CW/Phone/Digital/RTTY—sponsored by the First State ARC (FSARC), 1700Z Feb 7 to 0500Z Feb 8 and 1300Z Feb 8 to 0100Z Feb 9. Frequencies (MHz): CW—1.825, 3.550, 7.050, 14.050, 21.050, 28.050, Phone—1.860, 3.960, 7.260, 14.260, 21.360, 28.360, Novice and Technician—25 kHz above the sub-band edge. One class for all entries, no time limit. CW/Digital/RTTY count as separate modes. Exchange: RST and DE county or S/P/C. QSO Points: CW/RTTY/digital—2 points, phone—1 pt, work each station once per band and mode (CW/RTTY/digital are separate modes). Score: total of QSO points (no multiplier). For more information: **www.fsarc.org**. Logs due Mar 11 to **QSOparty@fsarc.org** or Contest Chairman—FSARC, Inc, PO Box 1050, Newark, DE 19715.

Classic Exchange—CW/Phone—from 1400Z Feb 8 to 0800Z Feb 9. Frequencies (MHz): CW—1.810, 3.545, 7.045, 14.045, 21.135, 28.180; AM—1.890, 3.880, 7.290, 14.280, 21.380, 28.320, 29.000; SSB—3.870, 7.280, 14.270, 21.370, 28.490. Exchange: Name, RST, S/P/C, and mfr/model of transmitter and receiver. Work stations again with different radios. Score is determined by the age of your equipment. For complete information: **qsl.asti.com/CX**. Send logs and comments to **WQ8U@arrl.net** or J. D. "Mac" MacAulay, WQ8U, 6235 Wooden Shoe Ln, Centerville, OH 45459.

CQ World Wide RTTY WPX Contest, sponsored by *CQ Magazine*, 0000Z Feb 7 to 2400Z Feb 8. Frequencies: 80-10 meters. Categories: SOLP (<150 W), SOHP, SOSB, MS, MM. SO work 30 hours max. Use of spotting assistance allowed for all categories. Exchange: RST and serial number. QSO Points: own country—1 pt, own continent—2 pts, different cont—3 pts, double points on 80 and 40 meters. Score: QSO points × WPX prefixes. For more information: **www.cq-amateur-radio.com.** Logs due 13 Mar to **wpxrtty@kkn.net** or CQ Magazine-WPX RTTY Contest, 25 Newbridge Rd, Hicksville, NY 11801.

QRP ARCI Winter Fireside SSB Sprint, sponsored by the QRP ARCI, 2000Z-2400Z, Feb 8. Frequencies (MHz): 3.865, 7.285, 14.285, 21.385, 28.385. Send logs to the *new* QRP ARCI Contest Manager at **wb5khc@2hams.net** or Tom Owens, WB5KHC, 1916 Addington St, Irving, TX 75062-3505. (See Dec *QST*, p 84, for QRP ARCI Sprint rules.)

Feb 14-15

RSGB 1.8 MHz Contest—CW—sponsored by RSGB, 2100Z Feb 14 to 0100Z Feb 15. Frequencies (MHz): 1.820-1.870. Categories: SO only. Exchange: RST + serial number and UK district. QSO Points: 3pts/QSO + 5 pts for first QSO with a UK district. Score: QSO points. For more information: **www.rsgbhfcc.org**. Logs due 16 days after the contest to **1st160.logs@rsgbhfcc.org** or RSGB-G3UFY, 77 Bensham Manor Rd, Thorton Heath, Surrey, CR7 7AF, England.

Asia-Pacific Sprint—CW—sponsored by the AP Sprint Contest Committee, 1100Z-1300Z Feb 14. Frequencies: 20 and 40 meters, NA stations work Asia-Pacific countries only. Categories: SO only, 150 W max. Exchange: RST and serial number. Score: total QSOs × WPX prefixes (counted once). For more information: **jsfc.org/apsprint/aprule.txt**. Logs due 7 days after the contest to **apsprint@kkn.net** (no paper logs).

FISTS CW Winter Sprint—CW—sponsored by FISTS International CW Club, 1700Z until 2100Z Feb 14. Frequencies: 80-10 meters, work US/VE stations. Categories: SOAB-QRP (<5 W), SOAB-QRO, Club. Exchange: Name, RST, S/P/C, members send FISTS number, nonmembers send power output. QSO Points: FISTS members—5 pts, nonmembers—2 pts. Score: QSO points × S/P/C (count each only once). For more information: **www.FISTS.org**. Logs due 30 days after the contest to **W8PIG@yahoo.com** or Dan Shepherd, N8IE, 1900 Pittsfield St, Kettering, OH 45420.

Dutch PACC Contest—CW/SSB—sponsored by the Vereniging voor Experimenteel Radio Onderzoek in Nederland (VERON) from 1200Z Feb 14-1200Z Feb 15. Frequencies: 160-10 meters according to IARU band plan, no SSB on 160, work stations only once per band. Categories: SO, SO-QRP, MO, SWL. Exchange: RS(T) + serial number (Dutch stations send province). QSO Points: 1 pt/QSO. Score: QSO points × Provinces (counted once per band). For more information: **www.dutchpacc.com**. Logs due Mar 31 to **pa0adt@dutchpacc.com** or Ad van Tilborg, PAØADT,

H. Ward Silver, NØAX ♦ 22916 107th Ave SW, Vashon, WA 98070 ♦ n0ax@arrl.org

Schepenenveld 141, 7327 DB Apeldoorn, Netherlands.

OMISS QSO Party—SSB—Sponsored by the Old Man International Sideband Society, 1500Z Feb 14-0459Z Feb 15. Frequencies (MHz): 3.940, 7.263, 14.290, 21.360, 28.665. Categories: SO, Mobile. Exchange: RS, S/P/C and OMISS # (DX stations send DX). QSO Points: OMISS members—2 pts, nonmembers—1 pt. Score: QSO points × States + Provinces + 1 DXCC entity, each counted only once. For more information: **www.omiss.net**. Logs due Mar 15 to Don Banta, K5DB, 3407 Diana St, Springdale AR 72764.

Feb 21-22

ARRL International DX Contest, CW, 0000Z Feb 21—2400Z Feb 22 (see Dec *QST*, p 96).

YL International QSO Party—CW—sponsored by YL International SSB System, 0000Z Feb 21-2400Z Feb 22 (SSB is 0000Z Mar 13-2400Z Mar 14), two 6-hr off times required. Frequencies: 160-10, no US-US contacts on 14.332 MHz except handicapped. Categories: SOAB. Exchange: Call sign, RST, State, County, YLISSB member number. Score: Number of QSOs. For more information: **www.qsl.net/yl-issb/**. Logs for both modes due Mar 31 to **2hamsrus@comcast.net** to N4KNF/N4ZGH, 2160 Ivy St, Port Charlotte, FL 33952.

CQC Winter QSO Party—CW/Phone—sponsored by the Colorado QRP Club, 2200Z Feb 22 to 0359Z Feb 23. Frequencies (MHz): CW—1.825, 3.560, 3.710, 7.040, 7.110, 14.060, 21.060, 21.110, 28.060, 28.110, SSB—1.910, 3.985, 7.285, 14.285, 21.385, 28.385. Categories are SOAB, SOSB, SO-Homebrew. Exchange: RST, S/P/C, name, CQC member number or power output (5W max). QSO Points: CW—CQC member—6 pts, nonmember—4 pts, Phone—members—3 pts, nonmembers—2 pts. Score: QSO Points × S/P/C (count once per band) × names (one name from each letter of the alphabet) + 1000 pts for QSO with WØCQC. For more information: **www.cqc.org/contests/winter04.htm**. Logs due 30 days after the contest to **ki0rb@idcomm.com** (ASCII text only) or CQC Contest, PO Box 17174, Golden, CO 80402-6019.

REF French Contest—Phone—from 0600Z Feb 21-1800Z Feb 22 (see Jan *QST*, p 98).

Feb 28-Mar 1

CQ WW 160-meter SSB Contest, 0000Z Feb 28-2400Z Feb 29 (see Jan *QST*, p 98).

UBA Contest—CW—from 1300Z Feb 28-1300Z Feb 29 (see Jan *QST* p 98).

North Carolina QSO Party—CW/Phone—sponsored by the Forsyth Amateur Radio Club, 1700Z Feb 29-0300Z Mar 1. Frequencies (MHz): CW—3.540, 3.740, 7.040, 7.140, 14.040, 21.040, 21.140, 28.040, 28.140, Phone—3.860, 7.260, 14.260, 21.360, 28.360 and any VHF/UHF, note no 160 meter QSOs. Categories: SO, Mobile, Club, all stations 100 W max output. Mobiles may be worked again as they change counties. Exchange: RST and NC county, ARRL/RAC section, or DX prefix. QSO Points: phone—2 pts, CW—3 pts, NC mobile—3 pts (either mode). Score: NC stations—QSO points × NC counties + ARRL/RAC sections + 1 DXCC entity, others—QSO points × NC counties (max 100). 50 bonus points for working Cherokee or Dare counties (150 for working both) and 50 points for working W4NC or W4WS (150 points for both). Mobiles add 100 bonus points for each NC county activated. For more information: **www.w4nc.com**. Logs due April 1 to **henry@summitschool.com** or NC QSO Party, c/o W2DZO, 934 Franklin St, Winston-Salem, NC 27101.

Mississippi QSO Party—CW/Phone—sponsored by the Vicksburg Amateur Radio Club, 1500Z Feb 28-0300Z Feb 29. Frequencies (MHz): CW—3.545, 7.045, 14.045, 21.045, 28.045; Phone—3.862, 7.238, 14.275, 21.375, 28.375. Work stations once per mode. Categories: Fixed Station, Mobile. Mobiles may be worked again as they change counties. Exchange: RST and MS county or S/P/C. QSO Points: phone—1 pt, CW—2 pts. Score: QSO points × MS counties or S/P/C. For more information: **w5xx@vicksburg.com**. Logs due Apr 27 to Vicksburg ARC, 14 Lake Circle Dr, Vicksburg, MS 39180. QST

SPECIAL EVENTS

Lubbock, TX: Buddy Holly Memorial, W5B. 1600Z **Jan 31**-0400Z **Feb 4**. 45th Anniversary of the death of Buddy Holly. 28.336 21.360 14.260 7.260. QSL. W5B Buddy Holly QSL, c/o Bryan Edwards, 3801-68th St, Lubbock, TX 79413. **www.amcrc.com/W5B**.

Nacogdoches, TX: Nacogdoches Amateur Radio Club, W5NAC. 1300Z-2400Z **Feb 1**. Shuttle *Columbia* Recovery Effort. 14.250 14.050 7.250 7.050. QSL. NARC, 167 County Rd 2093, Nacogdoches, TX 75965. **www.andersoft.com/narc**.

Chicago, IL: Metro Amateur Radio Club, K9Y. 1600Z **Feb 7**-2359Z **Feb 8**. Chicago Harbor Brkw South Light (ARLHS 1185). 40, 20, 15, 10 m CW and SSB. QSL. Bill Borgstrom, 1330 W Columbia Ave, Chicago, IL 60626. **www.qsl.net/mac/**.

Saranac Lake, NY: NCC Red Cross Radio Quick Response Team, W2C. 1500Z **Feb 7**-2000Z **Feb 15**. Celebrating over 100 years of Winter Carnival. 14.257 14.030 7.250 7.045. QSL. American Red Cross, KC2KEQ, 36 Broadway, Saranac Lake, NY 12983. **www.saranaclake.com/carny.shtml**.

Orlando, FL: Orlando Amateur Radio Club, K4H. 1700Z **Feb 13**-1800Z **Feb 15**. Commemorating 57th Orlando HamCation. 28.400 21.250 14.250. QSL. John Melchiori, K4JBM, 1840 Cleek Ct, Orlando, FL 32835.

Alexandria, VA: Mount Vernon Amateur Radio Club, K4US. 1600Z **Feb 14**-2100Z **Feb 15**. Commemorating George Washington's Birthday. 18.080 10.110 14.240 7.240. Certificate. Mount Vernon ARC, PO Box 7234, Alexandria, VA 22307.

Plymouth, MI: Plymouth Historical Museum Radio Station, KC8SWR. 1500Z **Feb 14**-2100Z **Feb 15**. Commemorating President Lincoln's Birthday. SSB: 14.270 7.270; 146.490 FM. Certificate. Plymouth Historical Museum, c/o KC8SWR Radio Station, 155 S Main St, Plymouth, MI 48170.

Ft Myers, FL: Ft Myers Amateur Radio Club, Inc, W4LX. 1500Z **Feb 16**-2100Z **Feb 20**. The Edison Festival of Light and Thomas Edison's Birthday. 28.430 21.330 14.230 7.230. Certificate and QSL. Ft Myers Amateur Radio Club, PO Box 61183, Ft Myers, FL 33906.

Raleigh, NC: United States Power Squadrons Amateur Radio Net, N9T. 1300Z **Feb 20**-2200Z **Feb 21**. Ninetieth Anniversary of the United States Power Squadrons. 28.367 21.367 14.267 7.267. Certificate. Donald Stark, N3HOW, 65 Stark Spur, Eighty Four, PA 15330. **www. usps.org/national/Ham/**.

Marquette, MI: Hiawatha Amateur Radio Association, K8LOD. 2000Z **Feb 20**-2000Z **Feb 22**. 15th Annual Running of the UP 200 Sled Dog Championship. 21.355 14.255 7.255 3.900. Certificate. Rich Schwenke, N8GBA, 21 Smith La, Marquette, MI 49855.

Washington, IA: Washington Area ARC, WAØMNA. 1500Z-2100Z **Feb 21**. Celebrating George Washington's birthday. General portions 10/15/20 m band. QSL. Vance Davisson, WAØMNA, 420 E 2nd St, Box 283, Riverside, IA 52327.

Binghamton, NY: Binghamton University Radio Organization, KC2HNB. 1300Z **Feb 21**-2100Z **Feb 22**. Watson School of Engineering 20th Anniversary. 28.450 21.375 14.270 7.225. Certificate. Robert Mess, Watson School Binghamton University, POB 6000, Binghamton, NY 13902.

Baton Rouge, LA: USS *Kidd* ARC/Baton Rouge ARC, W5KID. 1500Z-2300Z **Feb 28**. 60th anniversary of the launching of USS *Kidd*, DD-661. General class bands, 14.250-14.320; CW QRP subbands. QSL. W5KID, c/o USS *Kidd* Museum, 305 S River Rd, Baton Rouge, LA 70802. **www.brarc.org**.

Rapid City, SD: QCWA Dakota Chapter 102, WØDAK. 1500Z **Feb 28**-0300Z **Feb 29**. Commemorating the Chapter's 27th anniversary, from home station in North Dakota and South Dakota. 28.400 21.350 14.250 7.255. Certificate. Frank Shaw, NUØF/WØDAK, 118 E Van Buren, Rapid City, SD 57701.

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 self-addressed, stamped business envel-ope along with your QSL card and QSOinformation.

Special Events Announcements: For items to be listed in this column, you must be an Amateur Radio club, and use the ARRL Special Events Listing Form. Copies of this form are available via Internet (**info@arrl.org**), or for an SASE (send to Special Requests, ARRL, 225 Main St, Newington, CT 06111, and write "Special Events Form" in the lower left-hand corner). You can also submit your special event information on-line at **www.arrl.org/contests/spevform.html**. Submissions must be received by ARRL HQ no later than the 1st of the second month preceding the publication date; that is, a special event listing for **Apr** *QST* would have to be received by **Feb 1**. Submissions may be mailed (Attn: Maty Weinberg), faxed (860-594-0259) or e-mailed (**events@arrl. org**) to ARRL HQ. QST

Maty Weinberg, KB1EIB ♦ Special Events ♦ events@arrl.org

By Carl Luetzelschwab, K9LA

2003 IARU HF World Championship Results

Oh, conditions outside are frightful
And the rate is not delightful.
But despite the aurora's glow,
QSO, QSO, QSO!

That little ditty, contributed by Ward, NØAX, and sung to the Christmas tune *Let It Snow*, summed up this year's IARU HF World Championship. Actually, Saturday was the problem day, with propagation pretty much returning to normal on Sunday. There's a short summary of propagation at the end of this article, with a plot on the Web version of the predicted response of the F region showing why Saturday wasn't too good.

The IARU Contest

There's no doubt that the IARU contest is a fun event. PAØMIR echoes this statement with "Always fun to participate in the IARU test. This year I even planned my holiday to start just a day after the contest, so really in a hurry to prepare the log." HA5X chimes in, "It was great fun! I used a new call sign and a brand new radio from my brand new apartment."

Another aspect of the IARU test is it's a great way to get back into contesting if you've been away for a while. For example, NR9A comments "After being off the air since 1997, it was great to be back in the contesting mode, even though it was a casual effort."

One more thing about IARU—it reminds everyone that the fall contest season is rapidly approaching.

Contest Summary

The number of logs received for this year's contest was up about 9% from last year. The largest increases in participation came from Poland (113 logs last year, 241 logs this year) and European Russia (87 logs last year, 116 logs this year).

This year 51 ITU zones (out of 90 total) sent in logs. That's one more zone than last year.

By continent, Europe led the pack with 1058 logs. By zone, zone 28 sent in the most logs—648. And by country (more properly *entity*), US stations submitted 394 logs. See the accompanying tables for a more detailed breakdown of these three categories.

Expanded Results, Line-Score Printouts Available

For complete contest results online, please visit **www.arrl.org/contests/results**. ARRL members without Internet access may obtain a printout of the complete line scores by sending a self-addressed, stamped envelope to ARRL Contest Results, 225 Main St, Newington, CT 06111. Please be sure to include the contest name and year.

Close Competitions

This year's results are broken out into World, Europe, North America W/VE, North America non-W/VE, Asia, South America, Oceania, and Africa by the four categories: Single Op Mixed, Single Op Phone, Single Op CW and Multiop.

Table 1
Top Scores

World

Single Op Mixed

OL5Y	3,504,774
5B4AGM (RW3QC, op)	3,404,544
3V8BB (YT1AD, op)	3,394,912
EA8/OH4NL (OH2BYS, op)	3,315,312
RK4FF	2,783,048

Single Op Phone

FY5FY	2,792,467
ZX5J (PP5JR, op)	2,663,117
ZX2B (PY2MNL, op)	1,761,218
EA5DFV	1,680,200
S57UN	1,228,016

Single Op CW

PYØFF (YU1RL, op)	3,290,760
YT6A	2,511,486
TA2ZF	2,430,492
S58A	2,131,800
OH2BH (OH2UA, op)	2,038,462

Multiop

P3A	7,008,176
HG6N	3,574,831
HG1S	2,928,508
RT9W	2,650,673
RM6A	2,561,280

Europe

Single Op Mixed

OL5Y	3,504,774
RK4FF	2,783,048
OR3T (RA3AUU, op)	2,505,594
UT5UGR	2,481,210
LY2FY	2,203,032

Single Op Phone

EA5DFV	1,680,200
S57UN	1,228,016
IO3P (IZ3EYZ, op)	1,170,350
LA9DFA	968,792
RN4LP	854,382

Single Op CW

YT6A	2,511,486
S58A	2,131,800
OH2BH (OH2UA, op)	2,038,462
LY7Z (LY2TA, op)	1,709,392
HA8DU	1,628,206

Multiop

HG6N	3,574,831
HG1S	2,928,508
RM6A	2,561,280
RL3A	2,166,570
OE2S	1,950,480

W/VE

Single Op Mixed

VE3EJ	1,427,280
K4ZW	1,344,108
K3ZO	1,301,740
CK3AT	1,174,547
N1UR	945,567

Single Op Phone

VE3EY	627,750
K9SD	598,416
K6XX	511,836
N9AG	423,640
K6NR	414,194

Single Op CW

W1WEF	1,312,170
K5GN	1,183,930
WC1M	974,592
K4VX (AG9A, op)	960,375
AA3B	917,800

Multiop

KH7X	1,905,930
K4JA	1,287,516
NØNI	978,267
K5KG	869,302
NA5S	852,432

North America non-W/VE

Single Op Mixed

ZF2AH	354,203

Single Op Phone

6Y4Y	58,432
TI2KAC	21,358
HP3XBS	15,312

Single Op CW

VP9/K1YR	371,070
XE2AC	84,750

Multiop

TG9ADV	44,775

Asia

Single Op Mixed

5B4AGM (RW3QC, op)	3,404,544
RG9A (UA9AM, op)	2,277,633
UA9ZZ	1,446,564
UA9CLB	1,404,271
RMØA (UAØANW, op)	1,337,777

Single Op Phone

JA6GCE	637,777
JE2HCJ	553,700
RA0AM	552,906
JM1LPN	532,167
YMØT (TA2RC, op)	512,732

Single Op CW

TA2ZF	2,430,492
UP4L (UN7LZ, op)	1,203,018
RW9TA	1,158,840
UA9YAB	1,119,807
TA3DD	874,692

Multiop

P3A	7,008,176
RT9W	2,650,673
RF9C	2,144,645
RKØAXX	1,189,377
JH4UTP	513,825

South America

Single Op Mixed

PY2NY	1,156,064
LU5FF	234,728
PY2OMS (PY5EG, op)	192,072
PY1NB	183,134
PY8AZT	119,070

Single Op Phone

FY5FY	2,792,467
ZX5J (PP5JR, op)	2,663,117
ZX2B (PY2NML, op)	1,761,218
ZW5B (PT2FM, op)	1,073,518
AY8A (LU8ADX, op)	653,744

Single Op CW

PYØFF (YU1RL, op)	3,290,760
LU7EE	612,612
LU1EWL	522,879
PY2EMC	493,584
PY2NDX	412,104

Multiop

LT1F	2,112,750
LVØN	1,321,173
LR7A	1,238,952
LO7H	1,097,980
PQ2Q	974,482

Oceania

Single Op Mixed

YBØWWW	13,464
DU1EV	6,486
VK7GN	5,444

Single Op Phone

DU9RG	436,020
DU1UTD	108,071
VK4DMP	44,138

Single Op CW

VK1AA	1,047,654
VI8NT	253,456
ZL1AIH	94,080

Multiop

KHØNX	209,628

Africa

Single Op Mixed

3V8BB	3,394,912
EA8/OH4NL (OH2BYS, op)	3,315,312
ZS4TX	2,125,893
CT3KN	61,659

Single Op Phone

5U7JB	938,994
CT3FQ	178,267
8Q7LC (VK6LC, op)	123,938

Single Op CW

SU9US	560,367
ZS1EL	50,297
CN8YR	20,384

Multiop

ZSØM	542,260
ZS5NK	282,982

K3LR

A group of tired, weary, warriors…Under normal circumstances they masquerade as K3LR. In this year's IARU HF Championship they morphed themselves into W1AW/3. Seated: K8NZ, N3GJ, K3UA, K8AZ, K8MR. Standing: K3LR, N3RA, W9ZRX, W9RE, N9RV.

BA4RF

Dave, BA4RF, busily operating the B4HQ Headquarters station.

IT9ORA

Gianni, IT9ORA, relaxes at his station after the contest.

Table 2
Logs Received by Continent

EU	1058
NA	448
AS	242
SA	79
OC	26
AF	19
AN	1

Table 3
Logs Received by Country (Top 5)

US	394
Poland	241
Germany	143
Japan	117
European Russia	116

Table 4
Logs Received by Zone (Top 5)

Zone 28	648
Zone 29	224
Zone 8	219
Zone 45	117
Zone 27	103

Table 5
IARU Officials

G3BJ	1,553,930
K1ZZ	1,222,604
PT2ADM	425,964
PA7BT	150,629
9V1UV	29,205
LA2RR	25,665
VK3ADW	14,760
LZ1US	3,375

Table 6
Headquarters Stations

Call	*Score*	*Call*	*Score*
R7HQ	20,817,380	SK9HQ	3,892,030
IUxHQ	17,824,836	PJ2HQ	3,650,725
DA0HQ	16,507,800	CT1REP	2,448,459
GB5HQ	15,705,914	B4HQ	2,302,128
TM0HQ	15,394,425	LZ0HQ	2,184,028
SN0HQ	14,483,480	OZ1HQ	2,019,580
EM5HQ	13,425,363	ZA1A	1,922,032
9A0HQ	13,085,082	4L0HQ	1,405,170
YT0HQ	11,662,121	EI0HQ	1,100,284
S50HQ	11,311,048	YM0KA	1,024,200
OL3HQ	11,254,590	HB9A	904,720
OH2HQ	10,880,332	YE0HQ	821,289
PA6HQ	10,689,448	VA3RAC	717,576
OExXHQ	10,651,968	4X4ARC	675,750
YL4HQ	10,625,768	CX1AA	655,020
LY0HQ	9,721,125	YV5AJ	606,152
YR0HW	9,081,457	P40HQ	368,198
ES9A	7,950,063	HS0AC	341,582
W1AW/3	7,778,210	ZL6A	302,562
T90HQ	7,420,350	LN2HQ	268,332
HG0HQ	7,143,168	EW5HQ	189,290
JY6ZZ	6,229,730	AT0HQ	61,857
NU1AW	4,954,896	ZS6SRL	12,636
ER7HQ	4,784,976	HR2RCH	2,354
8NxJHQ	4,368,462	ZW2HQ	1,080

There were several tight races in this year's event.

The closest race was between OL5Y, 5B4AGM (RW3QC, op) and 3V8BB, in the World Single Op Mixed category. OL5Y took the winner's honors from 5B4AGM by only 2.9%. YT1AD operating 3V8BB was only 0.3% out of second place!

The next closest race was between FY5FY and ZX5J (PP5JR, op) in the South America Single Op Phone category. FY5FY ended up on top by 4.8%. These two stations also placed first and second in the World Single Op Phone category.

The closest race in North America was between VE3EJ and K4ZW in the W/VE Single Op Mixed category. VE3EJ took first place from K4ZW by 6.2%, with K3ZO not too far behind in third place.

This year's contest also had a couple repeat winners. The multi-op team at P3A repeated in the World Multi-Op and Asia Multi-Op categories. Their score this year was up 40% from last year. And the HG6N team repeated in the Europe Multi-Op category. Good show, guys!

IARU Officials

A big "thanks" to all the IARU officials who participated in this year's event. G3BJ came out on top, followed by K1ZZ and PT2ADM. See Table 5 for all the IARU Officials.

HQ Stations

As expected, the battle between the

Headquarters Stations was intense. The R7HQ team ended up on top by a nice margin. Second place went to the Italian team, with DAØHQ holding down third place. See Table 6 for the scores from these true multi-multis.

WRTC-Style Operating

A new twist to this year's contest was the addition of WRTC-style team competition. This idea came directly from WRTC 2002 in Finland, and it attracted 18 teams—8 from Europe, 1 from South America, and 9 from North America. I suspect that next year's contest will add even more WRTC-style teams to the competition. See NØAX's story about this aspect of this year's contest on the Web version of this article.

Other Stories on the Web

For interesting narratives of IARU operations, please go to the Web version of this article. There you'll find links to the W1AW/3 effort (told by K3LR), the GB5HQ effort (told by G4BUO), the four WRTC-style Slovenia/Croatia entries (told by 9A6XX), the SNØHQ effort (told by SP5UAF), the N3BB effort (told by N3BB and K5PI), the W5KFT effort (told by WM5R), and the B4HQ effort (told by BD5RV).

Propagation

I was a bit disappointed in band conditions during the first 12 hours of the contest but things did manage to pick up during the last half.—K6WC

When I started to work the contest on Saturday around 9AM PST, I wasn't sure if the propagation conditions were bad or if I had just done a bad job fixing the R7!—KG6RJ

Poor start on Saturday, but conditions improved during the contest.—DH5ST

We didn't even hear a European for the first six hours of the contest.—NØAX

With Cycle 23 in its decline, the smoothed sunspot number was around 60 for this year's contest. That's a far cry from the peak of 121 in April 2000 (which was followed by a great second peak of 116 in November 2001). This level of solar activity took its toll on the higher bands, with 10 meters suffering the most.

And if a low number of sunspots keeping the higher bands marginal wasn't enough, a coronal hole high-speed stream began on July 11 (the day before the contest). This drove the planetary Ap index to 46, and caused a reduction in the F region ionization at all latitudes on the first day of the contest. Fortunately, the F region recovered on the second day.

The predicted response of the F region to this high-speed stream is shown in the plot in the Web version of this article. The plot comes from the SEC (Space Environment Center) STORM model. The data is in the format of a scaling factor that is to be applied to the quiet time F region critical frequency for F2. For more information about the STORM model, see **sec.noaa.gov/storm**.

Decline in W/VE Top Scores

Among US and Canadians, scores as a whole tended to be lower in 2003 compared to 2002. VE3EJ's Mixed Mode score of 1.4 megs, while good enough to take top honors in 2003 would have only placed eighth last year, while K5TR's Phone Only winning score of 959k would only have placed sixth in 2002. In CW only, W1WEF's 1.3 Megs would not have cracked last year's Top Ten. The KH7X 1.9 Meg Multioperator score was the only winning W/VE score that would have also taken the category in 2002. Don't get us wrong—winning any category in the contest is tough. It just goes to show how much difference in propagation and conditions a year can make.

John, VE3EJ held off a tough challenge from runner-up Ken, K4ZW, in the Single Operator Mixed Mode category. Fred, K3ZO, and Ron, CK3AT, were the only other W/VE entries to top the 1 million point barrier in 2003. Top Ten scores in the category were posted from the ON, VA, MDC, WMA, IL, SCV, OH and ORG sections.

In the Single Operator Phone Only category there was George, K5TR, then there were the rest of the operators, as George managed to post the largest margin of victory among W/VE stations in his category. Dan, W7WA put up a valiant challenge to hold onto second place while Ken, K6HNZ, operated from VE1JX and placed third. The sections of STX, WWA, MAR, MDC, SFL, NH, GA and WI appear in the category Top Ten.

Jack, W1WEF in CT, and David, K5GN in STX, dueled to a one-two finish in the Single Operator CW Only category. These were the only two stations to top the 1 megapoint barrier in 2003. Dick, WC1M, and Mark, AG9A operating from the K4VX station, finished less than 15,000 points apart to take the next two places. Ten different sections—CT, STX, NH, MO, EPA, TN, IN, ON, EB and WMA—are represented in this particular Top Ten.

While the top three Multioperator entries in 2003 would have made the Top Ten last year, the rest of the 2003 Top Ten box residents would have come up a bit short. The KH7X team in the PAC section continued to roll right along, posting another great effort while winning among W/VE multioperator entries. K4JA placed second and NØNI followed up their 2002 win with a strong third place show. The category also featured 10 different sections—PAC, VA, IA, WCF, NM, VT, CT, IL, SFL and STX—among the Top Ten entries.

On the Other Hand...Worldwide Winners

While W/VE scores tended to decline, the top World scores did not. In fact 30 of the 40 Top Ten World scores in 2003 would have appeared in the 2002 boxes, including all 10 of the Single Operator Mixed Mode scores.

Martin, OL5Y, was the winning score among the Single Operator Mixed Mode entries in 2003. Jack, RW3QC, operating the 5B4AGM station was second, only 10,000 points ahead of Hrane, YT1AD, operating the 3V8BB station. Ten different DXCC entities appear in this category Top Ten. No W/VE stations appeared in this category's worldwide box.

South Americans led the way in the Single Operator Phone only category with Didier, FY5FY, heading the list. Next was a pair of Brazilians—Sergio, PP5JY, using ZX5J, and Wanderly, PY2MNL, using ZX2B. Eight DXCC countries are represented in this category Top Ten, with George, K5TR, being the only W/VE station to make the worldwide category box.

Sasa, YU1RL, ventured down to PYØFF and brought home top honors in the Single Operator CW only worldwide box score. Ranko, YT6A, finished a strong second about 80,000 points ahead of Sergiy, TA2ZF. You will find 10 different DXCC entities among this Top Ten, with Jack, W1WEF, representing the W/VE stations.

Seven DXCC countries are found among the Top Ten Multioperator category scores. Cyprus again was a hot spot of operations, as the P3A station showed location and skill can be a powerful combination. A pair of Hungarian multis—HG6N and HG1S—took second and third. The KH7X multi was the only W/VE Top Ten in the category, with no mainland multi being able to crack the box.

2004 Contest

The 2004 IARU HF World Championship will be held the weekend of July 10-11. The announcement will be published in the April 2004 issue of *QST* (and the full rules will be found on-line at **www.iaru.org/contest.html**). Hope to see you in the 2004 event!

ANAHEIM, CA
(Near Disneyland)
933 N. Euclid St., 92801
(714) 533-7373
(800) 854-6046
Janet, KL7MF, Mgr.
anaheim@hamradio.com

BURBANK, CA
2416 W. Victory Bl., 91506
(818) 842-1786
(800) 854-6046
Eric, KA6IHT, Mgr.
Victory Blvd. at Buena Vista
1 mi. west I-5
burbank@hamradio.com

OAKLAND, CA
2210 Livingston St., 94606
(510) 534-5757
(800) 854-6046
Mark, WI7YN, Mgr.
I-880 at 23rd Ave. ramp
oakland@hamradio.com

SAN DIEGO, CA
5375 Kearny Villa Rd., 92123
(858) 560-4900
(800) 854-6046
Tom, KM6K, Mgr.
Hwy. 163 & Claremont Mesa
sandiego@hamradio.com

SUNNYVALE, CA
510 Lawrence Exp. #102
94085
(408) 736-9496
(800) 854-6046
Howard, KE6PWH, Mgr.
So. from Hwy. 101
sunnyvale@hamradio.com

NEW CASTLE, DE
(Near Philadelphia)
1509 N. Dupont Hwy., 19720
(302) 322-7092
(800) 644-4476
Rick, K3TL, Mgr.
RT.13 1/4 mi., So. I-295
newcastle@hamradio.com

PORTLAND, OR
11705 S.W. Pacific Hwy.
97223
(503) 598-0555
(800) 854-6046
Leon, N7IXX, Mgr.
Tigard-99W exit
from Hwy. 5 & 217
portland@hamradio.com

DENVER, CO
8400 E. Iliff Ave. #9, 80231
(303) 745-7373
(800) 444-9476
Joe, KDØGA, Mgr.
John, N5EHP, Mgr.
denver@hamradio.com

PHOENIX, AZ
1939 W. Dunlap Ave., 85021
(602) 242-3515
(800) 444-9476
Gary, N7GJ, Mgr.
1 mi. east of I-17
phoenix@hamradio.com

ATLANTA, GA
6071 Buford Hwy., 30340
(770) 263-0700
(800) 444-7927
Mark, KJ4VO, Mgr.
Doraville, 1 mi. no. of I-285
atlanta@hamradio.com

WOODBRIDGE, VA
(Near Washington D.C.)
14803 Build America Dr. 22191
(703) 643-1063
(800) 444-4799
Steve, N4SR, Mgr.
Exit 161, I-95, So. to US 1
woodbridge@hamradio.com

SALEM, NH
(Near Boston)
224 N. Broadway, 03079
(603) 898-3750
(800) 444-0047
Chuck, N1UC, Mgr.
sales@hamradio.com
Exit 1, I-93;
28 mi. No. of Boston
salem@hamradio.com

12 STORE BUYING POWER

HAM RADIO OUTLET®

WORLDWIDE DISTRIBUTION

CALL FOR YAESU SUPER WINTER SPECIALS!

YAESU

FT-897 VHF/UHF/HF Transceiver

- HF/6M/2M/70CM • DSP Built-in * Not including 60M band
- HF 100W (20W battery)
- Optional P.S. + Tuner

Call Now For Our Low Pricing!

FT-1000MP MKV HF Transceiver

- Enhanced Digital Signal Processing * Not including 60M band
- Dual RX
- Collins SSB filter built-in
- 200W, External power supply

NEW Low Price!

FT1000MP MKV field unit 100w w/built-in power supply in stock

FT-8800R 2M/440 Mobile

NEW!

- 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!

FT-817 HF/VHF/UHF TCVR * Not including 60M band

- 5W @13.8V ext DC • USB, LSB, CW, AM, FM
- Packet (1200/9600 Baud FM) • 200 mems
- built in CTCSS/DCS • TX 160-10M, 6M, 2M, 440
- Compact 5.3" x 1.5" x 6.5", 2.6 lbs
- 9.6v Nicad or 8 AA battery capable

Call Now For Low Pricing!

FT-2800M 2M Mobile

NEW!

- 65w • Ruggedly Built
- Alpha Numeric Memory System
- Direct Keypad Frequency Entry
- Bullet-proof Front End

Call Now For Low Intro Pricing!

VX-7R/VX-7R Black

50/2M/220/440 HT

- Wideband RX - 900 Memories
- 5W TX (300mw 220Mhz)
- Li-Ion Battery
- Fully Submersible to 3 ft.
- Built-in CTCSS/DCS
- Internet WIRES compatible

Now available in Black!

NEW Low Price!

VX-5R/VX-5RS

50/2M/440HT

- Wideband RX • 6M-2M-440TX
- 5W output • Li-Ion Battery
- 220 mems, opt. barometer unit
- Alpha Numeric Display
- CTCSS/DCS built-in

NEW Low Price!

VX-150

2M Handheld

- Direct Keypad Entry
- 5w output
- 209 memories
- Ultra Rugged

Call Now For Special Pricing!

FT-857

Ultra compact HF, VHF, UHF * Not including 60M band

- 100w HF/6M, 50w 2M, 20w UHF
- DSP • 32 color display
- 200 mems • Detachable front panel (YSK-857 required)

Call for Low Intro Price!

FT-7800R 2M/440 Mobile

NEW!

- 50w 2m, 40w on 440mHz
- Weather Alert
- 1000+ Mems
- WIRES Capability
- Wideband Receiver (Cell Blocked)

Call Now For Your Low Price!

FT-920 HF+6M Transceiver

- 100w 160-6M, 12VDC * Not including 60M band
- Built-in DVR, CW Memory Keyer
- DSP, Auto-Notch • 99 Memories
- Computer controllable, CAT System

Call For Low Pricing!

FT-8900R Quadband Transceiver

NEW!

- 10M/6M/2M/70CM • Wires capable
- 800+ memories • Built-in CTCSS/DCS
- Remotable w/optional YSK-8900

Call Now For Special Pricing

AZ, CA, CO, GA, VA residents add sales tax. Prices, specifications, descriptions, subject to change without notice.

Look for the HRO Home Page on the World Wide Web
http://www.hamradio.com

COAST TO COAST FREE SHIPPING
UPS - Most Items Over $100
Rapid Deliveries From The Store Nearest To You!

12 Store Buying Power!

HAM RADIO OUTLET®

WORLDWIDE DISTRIBUTION

DISCOVER THE POWER OF DSP WITH ICOM!

IC-706MKIIG

- Proven Performance
- 160-10M*/6M/2M/70CM
- All mode w/DSP
- HF/6M @ 100W, 2M @ 50W 440 MHz @ 20W
- CTCSS encode/decode w/tone scan
- Auto repeater • 107 alphnumeric memories

$20 ICOM COUPON!

IC-756PROII All Mode Transceiver

- 160-6M* @ 100W
- 32 bit IF DSP
- Enhanced 5 inch color TFT w/spectrum scope
- Selectable IF filter shapes for SSB & CW
- Enhanced Rx performance
- SSB/CW Syncronous tuning
- Multiple DSP controlled AGC loops
- Advanced CW functions
- 101 alphnumeric memories

IC-746PRO All Mode 160M-2M

- 160-2M* @ 100W
- 32 bit IF-DSP+ 24 bit AD/DA converter
- Selectable IF filter shapes for SSB & CW
- 102 alphnumeric memories
- Enhanced Rx performance

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
- 101 alphnumeric memories

IC-T7H 6W, Dual Band Transceiver

- 2M/70CM
- 70 alphnumeric memories
- 6W output
- CTCSS encode/decode w/tone scan
- Auto repeater
- Easy operation!
- Mil spec 810, C/D/E*1

IC-V8 2M Transceiver

- 5.5W output
- 107 alphnumeric memories
- Customizable keys
- Auto repeater
- PC Programmable
- CTCSS encode/decode w/tone scan
- Drop-in trickle charger included

IC-703/703 Plus HF QRP Transceiver

- HF or HF/6M versions
- 10W~0.1W @ 13.5V SSB, CW, RTTY, FM 4W~0.1W @ 13.5V AM
- Internal antenna tuner
- Detachable control panel
- DSP w/ auto notch filter & noise reduction

IC-T90A Triple Band Transceiver

- 6M/2M/70CM @ 5W
- Wide band receiver 495kHz - 999.999MHz**
- 500 alphnumeric memories
- Dynamic memory scan
- Backlit keypad & display
- CTCSS/DTCS encode/decode w/tone scan
- Weather Alert

IC-2100H 25N 2M Mobile Transceiver

- Cool dual display
- 50 watts
- CTCSS encode/decode w/tone scan
- Backlit remote control mic
- Mil spec 810, C/D/E*1
- Auto repeater
- 113 alphnumeric memories

IC-V8000 2M Mobile Transceiver

- 75 watts
- ICOM DMS scanning
- CTCSS/DCS encode/decode w/tone scan
- Weather alert
- Weather channel scan
- 200 alphanumeric memories
- Backlit remote control mic

IC-2720H Dual Band Mobile

- 2M/70CM
- VV/UU/VU
- Wide band RX inc. air & weather bands
- Dynamic Memory Scan (DMS)
- CTCSS/DTCS encode/decode w/tone scan
- Independent controls for each band
- DTMF Encode
- 212 memory channels
- Remote Mounting Kit Included

IC-208H Dual Band Mobile

- 55 watts VHF (2M), 50 watts UHF (70CM)
- Wide Band RX**
- 500 alphanumeric memories
- CTCSS/DTCS encode/decode w/tone scan
- Detachable remote head
- DMS w/linked banks

ICOM®

*Except 60M Band. **Cellular blocked, unblocked OK to FCC approved users. ✦Limited time only. Check with HRO for details or restrictions on any offers or promotions. *1For shock & vibration. © 2004 Icom America Inc. February 04. The Icom logo is a registered trademark of Icom Inc.

CALL TOLL FREE

Phone Hours: 9:30 AM – 5:30 PM
Store Hours: 10:00 AM – 5:30 PM Closed Sun.

Toll free, incl. Hawaii, Alaska, Canada; call routed to nearest store; all HRO 800-lines can assist you, if the first line you call is busy, you may call another.

West	800-854-6046
Mountain	800-444-9476
Southeast	800-444-7927
Mid-Atlantic	800-444-4799
Northeast	800-644-4476
New England	800-444-0047

Look for the HRO Home Page on the World Wide Web
http://www.hamradio.com

AZ, CA, CO, GA, VA residents add sales tax. Prices, specifications, descriptions, subject to change without notice.

ANAHEIM, CA
(Near Disneyland)
933 N. Euclid St., 92801
(714) 533-7373
(800) 854-6046
Janet, KL7MF, Mgr.
anaheim@hamradio.com

BURBANK, CA
2416 W. Victory Bl., 91506
(818) 842-1786
(800) 854-6046
Eric, KA6IHT, Mgr.
Victory Blvd. at Buena Vista
1 mi. west I-5
burbank@hamradio.com

OAKLAND, CA
2210 Livingston St., 94606
(510) 534-5757
(800) 854-6046
Mark, WI7YN, Mgr.
I-880 at 23rd Ave. ramp
oakland@hamradio.com

SAN DIEGO, CA
5375 Kearny Villa Rd., 92123
(858) 560-4900
(800) 854-6046
Tom, KM6K, Mgr.
Hwy. 163 & Claremont Mesa
sandiego@hamradio.com

SUNNYVALE, CA
510 Lawrence Exp. #102
94085
(408) 736-9496
(800) 854-6046
Howard, KE6PWH, Mgr.
So. from Hwy. 101
sunnyvale@hamradio.com

NEW CASTLE, DE
(Near Philadelphia)
1509 N. Dupont Hwy., 19720
(302) 322-7092
(800) 644-4476
Rick, K3TL, Mgr.
RT.13 1/4 mi., So. I-295
delaware@hamradio.com

PORTLAND, OR
11705 S.W. Pacific Hwy.
97223
(503) 598-0555
(800) 854-6046
Leon, N7IXX, Mgr.
Tigard-99W exit
from Hwy. 5 & 217
portland@hamradio.com

DENVER, CO
8400 E. Iliff Ave. #9, 80231
(303) 745-7373
(800) 444-9476
Joe, KDØGA, Mgr.
John N5EHP, Mgr.
denver@hamradio.com

PHOENIX, AZ
1939 W. Dunlap Ave., 85021
(602) 242-3515
(800) 444-9476
Gary, N7GJ, Mgr.
1 mi. east of I-17
phoenix@hamradio.com

ATLANTA, GA
6071 Buford Hwy., 30340
(770) 263-0700
(800) 444-7927
Mark, KJ4VO, Mgr.
Doraville, 1 mi. no. of I-285
atlanta@hamradio.com

WOODBRIDGE, VA
(Near Washington D.C.)
14803 Build America Dr.
22191
(703) 643-1063
(800) 444-4799
Steve, N4SR, Mgr.
Exit 161, I-95, So. to US 1
virginia@hamradio.com

SALEM, NH
(Near Boston)
224 N. Broadway, 03079
(603) 898-3750
(800) 444-0047
Chuck, N1UC, Mgr.
Exit 1, I-93;
28 mi. No. of Boston
salem@hamradio.com

ANAHEIM, CA
(Near Disneyland)
933 N. Euclid St., 92801
(714) 533-7373
(800) 854-6046
Janet, KL7MF, Mgr.
anaheim@hamradio.com

BURBANK, CA
2416 W. Victory Bl., 91506
(818) 842-1786
(800) 854-6046
Eric, KA6IHT, Mgr.
Victory Blvd. at Buena Vista
1 mi. west I-5
burbank@hamradio.com

OAKLAND, CA
2210 Livingston St., 94606
(510) 534-5757
(800) 854-6046
Mark, WI7YN, Mgr.
I-880 at 23rd Ave. ramp
oakland@hamradio.com

SAN DIEGO, CA
5375 Kearny Villa Rd., 92123
(858) 560-4900
(800) 854-6046
Tom, KM6K, Mgr.
Hwy. 163 & Claremont Mesa
sandiego@hamradio.com

SUNNYVALE, CA
510 Lawrence Exp. #102
94085
(408) 736-9496
(800) 854-6046
Howard, KE6PWH, Mgr.
So. from Hwy. 101
sunnyvale@hamradio.com

NEW CASTLE, DE
(Near Philadelphia)
1509 N. Dupont Hwy., 19720
(302) 322-7092
(800) 644-4476
Rick, K3TL, Mgr.
RT.13 1/4 mi., So. I-295
newcastle@hamradio.com

PORTLAND, OR
11705 S.W. Pacific Hwy.
97223
(503) 598-0555
(800) 854-6046
Leon, N7IXX, Mgr.
Tigard-99W exit
from Hwy. 5 & 217
portland@hamradio.com

DENVER, CO
8400 E. Iliff Ave. #9, 80231
(303) 745-7373
(800) 444-9476
Joe, KDØGA, Mgr.
John, N5EHP, Mgr.
denver@hamradio.com

PHOENIX, AZ
1939 W. Dunlap Ave., 85021
(602) 242-3515
(800) 444-9476
Gary, N7GJ, Mgr.
1 mi. east of I-17
phoenix@hamradio.com

ATLANTA, GA
6071 Buford Hwy., 30340
(770) 263-0700
(800) 444-7927
Mark, KJ4VO, Mgr.
Doraville, 1 mi. no. of I-285
atlanta@hamradio.com

WOODBRIDGE, VA
(Near Washington D.C.)
14803 Build America Dr. 22191
(703) 643-1063
(800) 444-4799
Steve, N4SR, Mgr.
Exit 161, I-95, So. to US 1
woodbridge@hamradio.com

SALEM, NH
(Near Boston)
224 N. Broadway, 03079
(603) 898-3750
(800) 444-0047
Chuck, N1UC, Mgr.
sales@hamradio.com
Exit 1, I-93;
28 mi. No. of Boston
salem@hamradio.com

12 STORE BUYING POWER

HAM RADIO OUTLET®

WORLDWIDE DISTRIBUTION

CALL FOR KENWOOD WINTER SPECIALS

KENWOOD

APRS, TNC Features Built In!

TH-D7A(G) 2M/440

- 2M/440 Dual Band
- Built-in 1200/9600 Baud TNC
- APRS Compatible
- DX Packet Cluster Monitor
- 200 Mems., CTCSS
- VC-H1 Messaging Control

Call Now For Low Pricing!

TH-F6A

NEW!

2M/220/440

Dual Chanel Receive • .1 - 1300 mHz (cell blocked) Rx • FM, AM, SSB • 5w 2M/220/440 TX, FM • 435 Memories • Li-Ion Battery •

Call For Low Price!

TH-G71A 2m/440

- 2m/440 Dual Band HT
- 200 Mems
- PC Programmable
- 6w 2m, 5.5w UHF @13.8 VDC
- Alphanumeric Display
- CTCSS Built It
- Backlit Keypad

Call For Low Price!

NEW!

TH-K2AT

2M Handheld

2m 5W • VOX • CTCSS/DCS/1750 Burst built in • Weather Alert •

Call For Special Low Price!

TM-V7A 2M/440Mhz

- 50W/35W • 280 Mems • Visual Scan
- Alpha Numeric • Enc/Dec & Duplexer Built-in
- Computer Programmable • 9600 Baud Ready
- Cool-blue Reversible LCD • Backlit Mic

Call Now For Low Price!

TS-2000 HF/VHF/UHF TCVR

- 100W HF, 6M, 2M • 50W 70CM
- 10W 1.2 GHz w/optional UT-20 module
- IF Stage DSP • Built-in TNC, DX packet cluster
- Backlit Front Key Panel

NEW!

Call Now For Special Price!

TM-271A 2Mtr Mobile

NEW!

- 60 Watt, 200 Mems, CTCSS/DCS
- Mil-Std specs, Hi-Quality Audio

Call Now For Special Low Price!

TS-570DG/TS-570SG DSP Enhanced

- 100w HF, (100w on 6M TS-570SG only)
- QSK, CW Auto Tune • Autotuner incl 6M
- DSP • Large LCD Display • Elect. Keyer
- RCP2 Radio Control Program Compatible

Call Now For Your Low Price!

TM-D700A 2M//440 Dualband

- 50w VHF 35w UHF • Opt. Voice Synthesizer
- Receives 118-1300 mHz (cell blocked)
- Remote Head Inst. only (kit included)
- 200 Memories • Built In 1200/9600 baud TNC
- Advanced APRS Features
- Dx Packet Cluster
- Tone Scan • GPS/VC-H1/PC Ports

TS-480SAT/HX HF+6M Transceiver

- 480SAT 100w HF & 6M w/AT
- 480HX 200w HF & 100w 6M (no Tuner)
- DSP built in
- Remotable w/front panel/speaker

NEW!

Call Now For Your Low Price!

TM-742AD 2M/440Mhz

- Optional 3rd band available • Back-lit mic
- Up to 303 memories • 101 per band
- PL Encode Built in • Detachable front panel

Call Now For Your Low Price!

AZ, CA, CO, GA, VA residents add sales tax. Prices, specifications, descriptions, subject to change without notice.

Look for the HRO Home Page on the World Wide Web
http://www.hamradio.com

COAST TO COAST FREE SHIPPING
UPS - Most Items Over $100
Rapid Deliveries From The Store Nearest To You!

12 STORE BUYING POWER

HAM RADIO OUTLET

WORLDWIDE DISTRIBUTION

KANTRONICS

KAM '98

- Single port VHF or HF
- RTTY, CW, Packet, GTOR, AMTOR, WEFAX
- GPS, NMEA-0183 compatible
- 6-16 VDC, DB-9 connector port

Call Now For Your Low Price!

KAM XL

- DSP modem offers great performance on Packet 300/1200,G-tor,Pactor, Amtor,PSK-31
- RTTY, Navtex, ASCII, Wefax, CW, GPS NMEA-0183 and more!

Call Now For Special Pricing!

KPC-3 Plus/KPC-9612 Plus

High-performance, low power TNC. Great for packet, and APRS compatible.

Call For Special Low Price!

Detailed illuminated map shows time, time zone, sun position and day of the week at a glance for any place in the world.Continuously moving – areas of day and night change as you watch.

- Mounts easily on wall. Size: 34 1/2" x 22 1/2".

Reg $1295. SALE $999.95

ICOM

IC-R8500 Wide Band Receiver

- 100 kHz - 2.0 GHz*
- Commercial Grade • All Mode
- IF Shift • Noise Blanker
- Audio Peak Filter (APF)
- Selectable AGC Time Constant
- Digital Direct Synthesis (DDS)
- 1000 Alphanumeric Memories
- PC Controllable w/Optional Equipment

Call For ICOM Receiver Specials

IC-R75 Wide Band Receiver

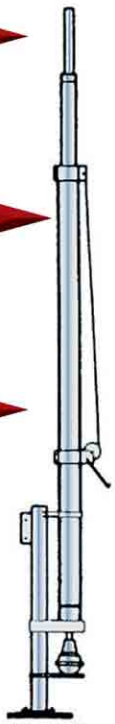
- 100 kHz - 60 MHz*
- Commercial Grade • All Mode
- Synchronous AM Detection (S-AM)
- Optional DSP w/Auto Notch Filter
- Triple Conversion
- Twin Passband Tuning (PBT)
- 1000 Alphanumeric Memories
- Up to Two Optional Filters
- PC Controllable w/Opt. Equipment

IC-R3 Wide Band Receiver

- 500 kHz - 2.45 GHz*
- 450 Alphanumeric Memories
- CTCSS w/Tone Scan
- 4 Level Attenuator
- Telescoping Antenna w/BNC Connector
- Lithium Ion Battery
- 2" Color TFT Display
- Audio/Video Output
- Four Way Action Joystick
- PC Programmable w/Optional Cable & Software

*816-901.995 MHz blocked; unblocked versions available to FCC approved users. FM video range for the IC-R3 is 900-1300 MHz & 2250-2450 MHz

US TOWER



Shown with Optional Rotor Base

MA-40

40' Tubular Tower

REG. $1205.00
SALE $999.95

MA-550

55' Tubular Tower

Handles 10 sq.ft. at 50mph
Pleases neighbors with tubular streamlined look

Reg.$1868.00
SALE $1569.95

TX-455

55' Freestanding Crank-Up
Handles 18 sq. ft. @ 50 mph
No guying required
Extra-strength const.
Can add raising and motor drive acces.

Towers Rated to EIA Specifications
Other Models at Great Prices!

Reg.$2098.00
SALE $1699.95

Buy From HRO, World's Largest U.S. Tower Dealer

All US Towers shipped by truck; freight charges additional

CALL TOLL FREE

Phone Hours: 9:30 AM – 5:30 PM
Store Hours: 10:00 AM – 5:30 PM Closed Sun.

Toll free, incl. Hawaii, Alaska, Canada; call routed to nearest store; all HRO 800-lines can assist you, if the first line you call is busy, you may call another.

West	800-854-6046
Mountain	800-444-9476
Southeast	800-444-7927
Mid-Atlantic	800-444-4799
Northeast	800-644-4476
New England	800-444-0047

Look for the HRO Home Page on the World Wide Web
http://www.hamradio.com

AZ, CA, CO, GA, VA residents add sales tax. Prices, specifications, descriptions, subject to change without notice.

ANAHEIM, CA
(Near Disneyland)
933 N. Euclid St., 92801
(714) 533-7373
(800) 854-6046
Janet, KL7MF, Mgr.
anaheim@hamradio.com

BURBANK, CA
2416 W. Victory Bl., 91506
(818) 842-1786
(800) 854-6046
Eric, KA6IHT, Mgr.
Victory Blvd. at Buena Vista
1 mi. west I-5
burbank@hamradio.com

OAKLAND, CA
2210 Livingston St., 94606
(510) 534-5757
(800) 854-6046
Mark, WI7YN, Mgr.
I-880 at 23rd Ave. ramp
oakland@hamradio.com

SAN DIEGO, CA
5375 Kearny Villa Rd., 92123
(858) 560-4900
(800) 854-6046
Tom, KM6K, Mgr.
Hwy. 163 & Claremont Mesa
sandiego@hamradio.com

SUNNYVALE, CA
510 Lawrence Exp. #102
94085
(408) 736-9496
(800) 854-6046
Howard, KE6PWH, Mgr.
So. from Hwy. 101
sunnyvale@hamradio.com

NEW CASTLE, DE
(Near Philadelphia)
1509 N. Dupont Hwy., 19720
(302) 322-7092
(800) 644-4476
Rick, K3TL, Mgr.
RT.13 1/4 mi., So. I-295
newcastle@hamradio.com

PORTLAND, OR
11705 S.W. Pacific Hwy.
97223
(503) 598-0555
(800) 854-6046
Leon, N7IXX, Mgr.
Tigard-99W exit
from Hwy. 5 & 217
portland@hamradio.com

DENVER, CO
8400 E. Iliff Ave. #9, 80231
(303) 745-7373
(800) 444-9476
Joe, KDØGA, Mgr.
John, N5EHP, Mgr.
denver@hamradio.com

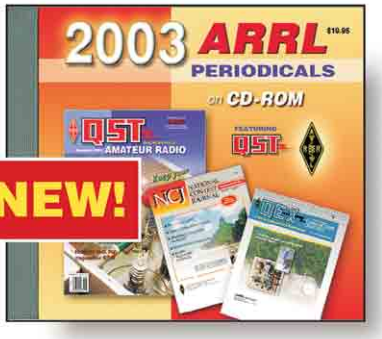
PHOENIX, AZ
1939 W. Dunlap Ave., 85021
(602) 242-3515
(800) 444-9476
Gary, N7GJ, Mgr.
1 mi. east of I-17
phoenix@hamradio.com

ATLANTA, GA
6071 Buford Hwy., 30340
(770) 263-0700
(800) 444-7927
Mark, KJ4VO, Mgr.
Doraville, 1 mi. no. of I-285
atlanta@hamradio.com

WOODBRIDGE, VA
(Near Washington D.C.)
14803 Build America Dr. 22191
(703) 643-1063
(800) 444-4799
Steve, N4SR, Mgr.
Exit 161, I-95, So. to US 1
woodbridge@hamradio.com

SALEM, NH
(Near Boston)
224 N. Broadway, 03079
(603) 898-3750
(800) 444-0047
Chuck, N1UC, Mgr.
sales@hamradio.com
Exit 1, I-93;
28 mi. No. of Boston
salem@hamradio.com

ARRL CD-ROM Collections



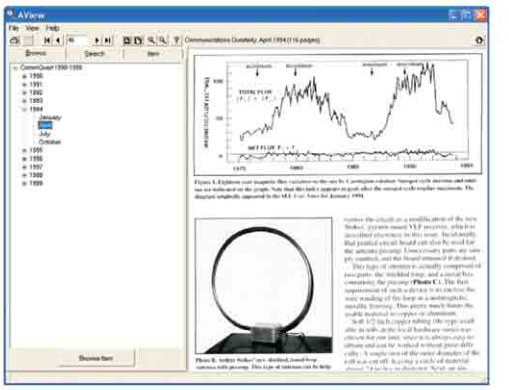
ARRL Periodicals on CD-ROM are fully-searchable collections of popular ARRL journals. Every word and photo published throughout the year is included!

SEARCH the full text of every article by entering titles, call signs, names—almost any word. **SEE** every word, photo (including color images), drawing and table in technical and general-interest features, columns and product reviews, plus all advertisements. **PRINT** what you see, or copy it into other applications. **WEB LINKS** appearing in any article can be used to launch your existing Web browser to view additional information (feature available for versions beginning with 1996).

System Requirements: Microsoft *Windows*™. 1999, 2000, 2001, 2002, and 2003 editions support *Windows* and Macintosh systems, using the industry standard Adobe *Acrobat Reader*® (included).

Communications Quarterly CD-ROM

This CD-ROM collection covers volumes of *Communications Quarterly* published from 1990-1999. Gain access to advanced technical topics in articles which cover transmitter, receiver and transceiver projects, theory, antennas, troubleshooting and much more. High quality black-and-white page scans can be read on your computer screen or printed. Quickly **search** for articles by title and author, **select** specific year and issue, and **browse** individual articles and columns. Requires Microsoft *Windows*™.



ARRL CD-ROM Collections

ARRL Periodicals CD-ROM
(includes *QST*, *QEX*, *NCJ*)
NEW! #9124 Year 2003 **$19.95**
#8802 Year 2002 **$19.95**
#8632 Year 2001 **$19.95**
#8209 Year 2000 **$19.95**
#7881 Year 1999 **$19.95**
#7377 Year 1998 **$19.95**
#6729 Year 1997 **$19.95**
#6109 Year 1996 **$19.95**
#5579 Year 1995 **$19.95**

QST View CD-ROM
#7008 Years 1915-29 **$39.95**
#6710 Years 1930-39 **$39.95**

QST View CD-ROM (cont.)
#6648 Years 1940-49 **$39.95**
#6435 Years 1950-59 **$39.95**
#6443 Years 1960-64 **$39.95**
#6451 Years 1965-69 **$39.95**
#5781 Years 1970-74 **$39.95**
#5773 Years 1975-79 **$39.95**
#5765 Years 1980-84 **$39.95**
#5757 Years 1985-89 **$39.95**
#5749 Years 1990-94 **$39.95**
#8497 Years 1995-99 **$39.95**
#QSTV (all 12 sets) **$399**

#8780 **Communications Quarterly CD-ROM** (1990-1999) **$39.95**

Ham Radio Magazine CD-ROM*
#8381 Years 1968-76 **$59.95**
#8403 Years 1977-83 **$59.95**
#8411 Years 1984-90 **$59.95**
#HRCD (all three sets) **$149.85**

#7660 **QEX Collection CD-ROM** (1981-1998) **$39.95**

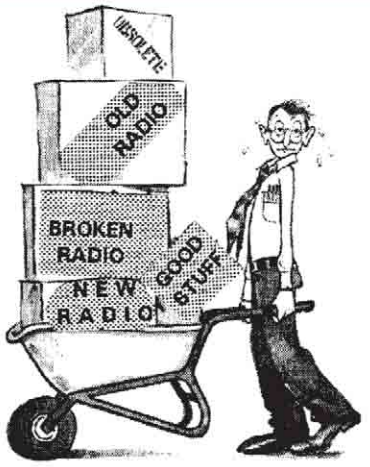
#7733 **NCJ Collection CD-ROM** (1973-1998) **$39.95**

www.arrl.org/shop
1-888-277-5289 (US)

*Ham Radio CD-ROM, © 2001, American Radio Relay League, Inc.
Ham Radio Magazine © 1968-1990, CQ Communications, Inc.

Shipping & Handling charges apply: US orders add $6 for one CD, plus $2 for each additional CD ($12 max.). International orders add $5.00 to US rate ($17.00 max.) Or, contact ARRL to locate a dealer. **Sales Tax** is required for orders shipped to CA, CT, VA, and Canada.

NEED SOME HELP WITH THAT?



DONATE YOUR RADIO

Turn your excess Ham Radios and related items into a tax break for you and learning tool for kids.

Donate your radio 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. Radios you can write off - kids you can't.

Call (516) 674-4072
FAX (516) 674-9600
crew@wb2jkj.org
http://www.wb2jkj.org

WB2JKJ

THE RADIO CLUB OF
JUNIOR HIGH SCHOOL 22
P.O. Box 1052
New York, NY 10002

Need a Match?

Even the best transceiver and the best antenna probably don't match.

Solution: The **SGC Smartuner™** is the Essential link between your HF transceiver and antenna. They operate independently to provide the best match between the feed line and the antenna, totally eliminating SWR problems. They are fully automated, intelligent enough to select the match you need in seconds and remember it so they can recall it in milliseconds.

SGC Smartuners

There is a Smartuner to fit your needs. Choose from 5 models ranging from 1.5 to 500 watts and 1 to 60 Mhz. Buy one for your car, your home, or your portable station — or better yet, buy one for each. Smartuners set the standard. They are the original and still the best.

SG-231 *Coupler*
Cat. # 54-17

SG-237 *Coupler*
Cat. # 54-18

SG-239 *Coupler*
Cat. # 54-22

Once you've learned how the Smartuner works, you won't want anything else!

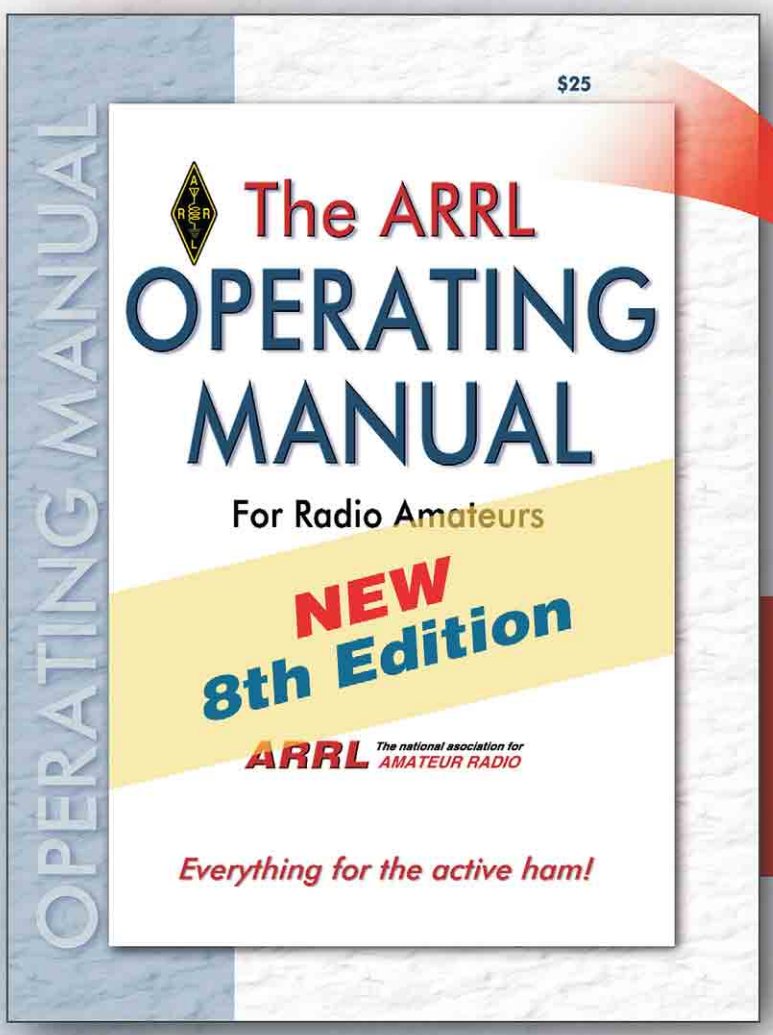
Visit **www.sgcworld.com** for more information on the entire line of Smartuner antenna couplers.

Smart Choice! Smartuner!

phone us at
800.259.7331

SGC
Your HF Solution

The most complete book about AMATEUR RADIO operating



Only $25*

ARRL Order No. 9132

Available from **ARRL Dealers** Everywhere!

February 2004

Rules and Regulations—updated and including 60 meters

FM operating—including repeaters, EchoLink and IRLP

VHF and HF digital—with new emphasis on sound-card based operating modes and APRS

Other VHF/UHF modes—including meteor scatter and weak signal software applications

DXing, Contesting and Award Hunting—featuring ARRL's *Logbook of The World*

Emergency communications—updated for the post-September 11, 2001 environment

Traffic Handling

Image Communications—including innovations using sound cards

Satellites

...and many additional References

*Shipping and Handling charges apply. Sales Tax is required for orders shipped to CA, CT, VA, and Canada.

Prices and product availability are subject to change without notice.

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 2/2004

ICOM®

AES®
AMATEUR ELECTRONIC SUPPLY

IC-W32A User-friendly, independent controls. (right) Full-function W32A HT meets the demands of both novice and experienced: simple use and advanced features. This 2M/440MHz 5W has separate tuning and volume for each band. It offers simultaneous receive. 2.25"w x 5.41"h x 1.31"d, 1 lb.....© **$249.99**

IC-T7H Powerful output and ample receive audio. (left) A 6W amp circuit provides superior transmit on both VHF and UHF when 13.5 V DC is supplied. In addition, a full 500mW of AF is output from the speaker – easy to copy in noisy environments. Separate CTCSS tone encoder and en/decoder are standard. Single push action makes it simple. This 2M/440MHz meets MIL SPEC. 2.25"w x 4.34"h x 1.06"d, 10 oz ...© **$169.99**

IC-V8 Quality, simplicity, anywhere. This 144MHz FM transceiver's front panel and chassis are constructed of tough polycarbonate and die-cast aluminum for durability. The 5.5W V8 offers a 16-button keypad and 100 alphanumeric memories. CTCSS, DTCS and DTMF encoder are standard. 2.13"w x 5.19"h x 1.38"d, 12.3 oz.....© **$114.99**

IC-2720H Twice the versatility, twice the fun! The 2M/440MHz, 50/35W 2720H offers simultaneous receive, independent controls, and DMS with 212 memories. It also features CTCSS and DTCS, wideband receive, weather alert, auto repeater, remote control mic, and compact remote control head (mountable to unit with optional MB-85). 5.5"w x 1.56"h x 7.38"d, 3 lbs (main).....© **$349.99**

IC-208H High power dualbander, wideband receive. This 2M/70cm mobile provides 55/50W for long distance contacts, plus reduced power for local. The 208H covers 118-173, 230-549 and 810-999MHz (cell blocked) rx as standard. With improved DMS, detachable front, and 500 memories, mobile communications just got better. 5.56"w x 1.56"h x 7.31"d, 2.65 lbs.....© **$289.99**

IC-V8000 75W of "base station" power. The 75W V8000 also offers selection of 25, 10 and 5W as needed. With the operator-facing speaker, audio is clear even during mobile use. The 144-148MHz V8000 also features CTCSS and DTCS, standard DTMF encoder (optional decoder), 207 memories, FM narrow mode, and remote control mic. 5.9"w x 1.97"h x 5.9"d, 2.22 lbs.....© **$169.99**

IC-703 For QRP enthusiasts. The 160-10M 703 is capable of 5/10W and focuses on QRP performance. A portable HF unit, it features a relay-type antenna tuner, low current consumption, DSP, memory keyer and 105 memories. Ideal for distant contact when normal set up is absent. 6.56"w x 2.28"h x 4.88"d, 4.4 lbs.....© **$609.99**

IC-703PLUS The 703, plus 6M.....© **$679.99**

IC-706MKIIG Base station features, mobile size. The 160-10M + 6M, 2M, 70cm Mark II G is constructed for stable, quality output with low IMD and spurious emissions. It features tone squelch, DSP, auto repeater, and 107 alphanumeric memories. 6.56"w x 2.28"h x 7.88"d, 5 lbs, 6 oz..... NOW! FREE RMK706 included © **$739.99**

IC-746PRO 32-bit DSP takes you even higher. All-mode operation, 100W, 102 alphanumeric memories, and a multi-function LCD are impressive in the HF/50/144MHz 746PRO. Its floating point DSP and 24-bit AD/DA converter make it a must-have. Also has memory keyer, built-in antenna tuner and digital noise reduction. 11.3"w x 4.7"h x 12.5"d, 19 lbs, 13 oz..... NOW! FREE PS-125 included © **$1329.99**

IC-756PROII A leap forward for the digital revolution. An all-mode, HF, 50MHz transceiver designed to include customer-suggestions. The PROII not only offers a 32-bit Floating DSP, but also has built-in 24-bit AD/DA converter, enhanced backlighting, selectable IF shape, adjustable noise blanker, and improved audio fidelity. 13.38"w x 4.38"h x 11.19"d, 21 lbs, 1 oz..... NOW! FREE PS-125 included © **$2249.99**

5710 W. Good Hope Rd.
Milwaukee, WI 53223
414-358-0333
1-800-558-0411
Fax 414-358-3337
Service 414-358-4087
milwaukee@aesham.com

621 Commonwealth Ave.
Orlando, FL 32803
407-894-3238
1-800-327-1917
Fax 407-894-7553
orlando@aesham.com

28940 Euclid Ave.
Cleveland, OH 44092
440-585-7388
1-800-321-3594
Fax 440-585-1024
cleveland@aesham.com

4640 South Polaris Ave.
Las Vegas, NV 89103
702-647-3114
1-800-634-6227
Fax 702-647-3412
lasvegas@aesham.com

Store Hours
Mon–Fri • 9am to 5:30pm
Saturday • 9am to 3pm

1-800-558-0411
www.aesham.com

Prices subject to change without notice.
© w/Instant Coupon, coupons expire 1/31/04

KENWOOD

TH-K2AT A triumph of advanced engineering and design. (middle) This 2M 5W HT is equipped with internal VOX, weather alert/RX, auto simplex checker, auto repeater offset and multiple scans. The K2AT also offers built-in CTCSS, DCS and 1750Hz tone burst. The K2AT charges up to 3X faster than others and meets MIL-STD-810 for resistance to rain, vibration, shock and humidity. 2.44"w x 4.38"h x 1.13"d, 12.5 oz..... **$159.99**

TH-D7A(G) Explore APRS with an HT built for the future. This 5W, 2M/440MHz FM is equipped with a TNC and provides a range of data communications options. Along with simple packet, the D7A(G) with APRS and a GPS unit can send positioning data to a friend, pinpointing the location. 4.75"h x 2.25"w x 1.5"d, 12 oz..... **$354.99**

TH-G71A The brighter side of handy communications. (right) This FM dualbander (144/440MHz) boasts an illuminated keypad and LCD, high-performance antenna, and a stylish yet ergonomic design. The 5W G71A also offers convenience with menu mode, PC compatible and 200 memories. 2.31"w x 4.44"h x 1.44"d, 11.6 oz.. **$229.99**

TM-271A All-terrain performance. On or off road, the 144MHz, 60W 271A delivers powerful mobile performance and other features such as multiple scan functions, 200 memories, NOAA weather rx, and CTCSS/DCS. Yet, this MIL-STD transceiver goes easy on you, providing high quality audio, illuminated keys and large LCD **$189.99**

TM-G707A The essence of ease. From the extra-large panel to Kenwood's Easy Operation mode, the G707A is extraordinarily user-friendly. In addition to its regular profile, it can store four others for instant recall. This 50W/35W, FM dualband (144/440MHz) offers 180 multi-function memories with name function to identify each. 5.5"w x 1.56"h x 7.44"d, 2.65 lbs..... **$269.99**

TM-V7A Cool Blue: The look of mobile communication. The V7A 144/440MHz FM transceiver marks a departure in ergonomic design with its easy-to-operate control panel and reversible LCD. The "5-in-1" programmable memory, 50/35W, DTSS and pager functions, and dual receive on one band make it a pace-setter. 5.5"w x 1.56"h x 7.44"d, 2.65 lbs..... © **$364.99**

TM-D700A Harnessing APRS®, GPS and SSTV. This FM 144/440MHz mobile features a built-in TNC offering options including simple packet. However, the brightest spot of the 50/35W D700A is its ability to enable APRS® without a computer. It also has 200 memories, dual receive, built-in CTCSS/DCS, and DX cluster monitoring. 5.5"w x 1.58"h x 7.68"d, 3 lbs..... **$509.99**

TS-480SAT New compact all-mode. This 100W HF/50MHz can operate on DC 13.8V and offers two power terminals. The 480SAT also features AF DSP, RX dynamic range, separate LCD control panel with speaker and 100 alphanumeric memories. The unit can be controlled from a PC and is PSK31 compatible **$1369.99**
TS-480HX 200W version without auto tuner..... **$1499.99**

TS-2000 Distinctive, packed for performance. The all-mode, HF, 2M, 6M, 70cm 2000 is serious about DSP. Its advanced digital technology converts analog waveforms into digital data, enabling digital processing like IF filtering, slope tune, and auto notch. 10.63"w x 3.75"h x 12.5"d..... NOW! FREE Heil mic **$1689.99**

TS-2000X Distinctive by design, packed for performance. The all-mode, HF, 2M, 6M, 70cm, 1.2GHz 2000X is serious about DSP. Kenwood's advanced digital technology converts analog waveforms into digital data, enabling such digital processing as IF filtering, slope tune, auto notch and AGC. 10.63"w x 3.75"h x 12.5"d..... NOW! FREE Heil mic **$2289.99**

AES
AMATEUR ELECTRONIC SUPPLY

5710 W. Good Hope Rd.
Milwaukee, WI 53223
414-358-0333
1-800-558-0411
Fax 414-358-3337
Service 414-358-4087
milwaukee@aesham.com

621 Commonwealth Ave.
Orlando, FL 32803
407-894-3238
1-800-327-1917
Fax 407-894-7553
orlando@aesham.com

28940 Euclid Ave.
Cleveland, OH 44092
440-585-7388
1-800-321-3594
Fax 440-585-1024
cleveland@aesham.com

4640 South Polaris Ave.
Las Vegas, NV 89103
702-647-3114
1-800-634-6227
Fax 702-647-3412
lasvegas@aesham.com

Store Hours
Mon–Fri • 9am to 5:30pm
Saturday • 9am to 3pm

1-800-558-0411
www.aesham.com

Prices subject to change without notice.
© w/Instant coupon, coupon expires 1/31/04

VX-150 Designed to perform under the most difficult conditions. (left) This 2M 5W HT provides exceptional receiver performance with clean, clear transmit. Built to withstand outdoor use, the 150 is constructed to MIL-STD, with commercial-grade speaker and Omni-Glow™ keypad. 4.3"h x 2.3"w x 1"d, 11.5 oz..... **$119.99**

VX-1R Power out of the pocket. (mid-left) This 500mW dualband (144/430MHz) handheld gives the user wide receiver coverage in a small package. The 1R offers 291 memories, ARTS™, internal speaker, SmartSearch™, and dual watch. It also provides one-touch emergency access and built-in CTCSS/DCS enc/decoder while operating for more than 11 hours on a single charge. 1.9"w x 3.2"h x 1"d, 4 oz .....Closeout **$139.99**

VX-5R/VX-5RS Setting water resistance standards. (mid-right) Offering 5W (4.5W on 430MHz), the 5R/5RS cover 50/144/430MHz while providing short to microwave reception. Great for outdoors with optional barometric pressure unit. Black or silver. 2.3"w x 3.4"h x 1.1"d, 8.9 oz..... **$239.99**

VX-7R/VX-7RB The first submersible amateur HTs. (right) Water protected, the 50/144/430MHz, 5W 7R/7RB are rated for 3', 30-minute submersions. Magnesium bodies make them ideal for outdoors. Include dual/wide-band rx, status strobe, and WIRES™ key. Silver or black. 2.4"w x 3.5"h x 1.1"d, 9.2 oz..... **$309.99**

FT-2800M Cool and quiet 65W operation. The most rugged 2M transceiver ever provides 65/25/10/5W with an extensive 221 memories, alphanumerics and CTCSS/DCS. The 2800M also features NOAA with weather alert, WIRES™ access, SmartSearch™, and excellent receive performance. With a bullet-proof front end and direct keypad entry, it's a dream come true. 6.3"w x 2"h x 7.3"d, 4 lbs ... **$159.99**

FT-7800R Get "back to basics." This FM, 144/430MHz mobile boasts 50/40W output and 1000 memories. It also offers one-touch hyper memories, full-featured CTCSS/DCS, WIRES™ internet linking and wide receiver coverage. The 7800R has a large LCD and NOAA weather alert. 5.5"w x 1.6"h x 6.6"d, 2.2 lbs..... **$279.99**

FT-8800R Easy operation, ultimate dualband. This 144/430MHz 50/35W mobile offers simultaneous monitoring of one band while operating the other. Besides extended receive, the 8800R provides 1000 memories, CTCSS/DCS, and versatile scan. 5.5"w x 1.6"h x 6.6"d, 2.2 lbs **$369.99**

FT-840 Performance forward. Blending high performance digital frequency techniques with operating convenience, the 840 is a base station that beginners and seasoned operators will appreciate. In addtion to 100W on 160-10M, the 840 adds a choice of two optional remote auto antenna tuners and a wealth of functions. 9.4"w x 3.7"h x 9.6"d, 12 lbs..... **$599.99**

FT-857 The smallest HF/VHF/UHF multi-mode. The 100W (HF/6M), 50W (2M), 20W (70cm) 857 provides wide frequency coverage, outstanding receive, and convenient remote-head use (optional). Includes 200 memories, easy feature access, advanced DX, and CW operating flexibility. 6.1"w x 2"h x 9.2"d, 4.6 lbs NOW! FREE DSP2 included **$774.99**

FT-897 All-in-one portable base. The all-mode, multi-band 897 features high output 100W (HF/6M), 50W (2M), 20W (70cm), rugged construction, 200 memories, and optional internal power supply and external antenna tuner. 7.87"w x 3.15"h x 10.3"d, 8.6 lbs..... **$899.99**

FT-897PACK1 The 897 packaged with ATAS120 and FNB78 (a 50% savings on these accessories)..... **$1099.99**

FT-1000MP MK V Improving the 1000 series. Building on the success of the 1000 series, the Mark V offers five new developments. This HF all-mode adds 200W and features Class-A PA operation, interlocked digital bandwidth tracking system, a variable RF front-end filter, and enhanced ergonomics. 16"w x 5.3"h x 13.7"d, 31 lbs **$2049.99**

AES®
AMATEUR ELECTRONIC SUPPLY

5710 W. Good Hope Rd.
Milwaukee, WI 53223
414-358-0333
1-800-558-0411
Fax 414-358-3337
Service 414-358-4087
milwaukee@aesham.com

621 Commonwealth Ave.
Orlando, FL 32803
407-894-3238
1-800-327-1917
Fax 407-894-7553
orlando@aesham.com

28940 Euclid Ave.
Cleveland, OH 44092
440-585-7388
1-800-321-3594
Fax 440-585-1024
cleveland@aesham.com

4640 South Polaris Ave.
Las Vegas, NV 89103
702-647-3114
1-800-634-6227
Fax 702-647-3412
lasvegas@aesham.com

Store Hours
Mon–Fri • 9am to 5:30pm
Saturday • 9am to 3pm

YAESU

Prices subject to change without notice.

1-800-558-0411
www.aesham.com

▪ Ham PROs ▪ Ham PROs ▪ Ham PROs ▪ Ham PROs ▪

Visit Your Local

Ham PROs!

Visit our new Web site www.hampros.com for group specials and links to your local dealer! Whether it's over the counter or over the phone, we're your home town dealer!

Daiwa CN-101L SWR/ Wattmeter

1.8 - 150 MHz
15W/150W/1.5KW

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

Be Sure to Call for Latest Coupons, Rebates and Special Offers!

Mark-V FT-1000MP
200W HF
Dual Receive
Class A PA

Mark-V Field
100W HF
Built-In Power Supply
Class A PA

VL-1000 Quadra System
Solid State HF/6M Amplifier
160-15M (1KW) & 6M (500W)
10 & 12M Capable

FT-920
100W HF and 6M
Dual Watch
Digital Voice Recorder

FT-897
HF, 6M, 2M, 440
100W HF and 6M
50W on 2M, 20W
on 440

FT-857
HF, 6M, 2M, 440
100W HF and 6M
50W on 2M, 20W on 440
Compact Mobile

FT-8900R
10M, 6M, 2M, 440
Dual Receive
Expanded Receive

FT-8800R
2M, 440
True Dual Bander
Optional Remote Head Mount

FT-7800R
2M, 440
50W on 2M, 40W on 440
NOAA WX w/Alert

FT-2800M
2M FM Mobile
65W Max
Large Display
preset NOAA WX

VX-7R/7RB
2M, 6M, 440 and
300 mW on 222
Dual RX, Water
Resistant

VX-5R
2M, 6M, 440
Ultra Compact
Wide Band RX

VX-2R
2M, 440
Ultra Compact
Wide Band RX

MasterCard VISA DISCOVER

Prices, products and policies may vary between dealer locations. Not all dealers have all product lines. All prices and products subject to change. Not responsible for typographical errors.

Associated Radio
800-497-1457
Local (913) 381-5900
FAX (913) 648-3020
8012 Conser
Overland Park, KS 66204
www.associatedradio.com

ComDaC Radio
800-382-2562
Local (269) 982-0404
FAX (269) 982-0433
1051 Main Street
St. Joseph, MI 49085
www.comdac.com

Universal Radio, Inc.
800-431-3939
Local (614) 866-4267
FAX (614) 866-2339
6830 Americana Pkwy.,
Reynoldsburg, Ohio 43068
www.universal-radio.com

Radio City, Inc.
800-426-2891
Local (763) 786-4475
FAX (763) 786-6513
2663 County Road I
Mounds View, MN 55112
www.radioinc.com

Lentini Communications, Inc.
800-666-0908
Local (860) 666-6227
FAX (860) 667-3561
21 Garfield Street
Newington, CT 06111
www.lentinicomm.com

Austin Amateur Radio Supply
800-423-2604
Local (512) 454-2994
FAX (512) 454-3069
5325 North I-35
Austin, Texas 78723
www.aaradio.com

Burghardt INC.
AMATEUR CENTER

Technical & Info 605-886-7314

Fax 605-886-3444

1-800-927-4261

710 10th Street SW, Watertown, SD 57201

Buy these 'SUPER PRICED' HF Transceivers and receive MORE!!!

HEARD IT.
WORKED IT.
LOGGED IT!

Icom IC-756PROII

Plus Free PS-125*

FREE
PS-125
Power Supply
When you buy a new 'PROII or '746PRO*

Call for your best price!

*This is a limited time offer. Call for details.

SUPERCHARGED PERFORMANCE!

Icom IC-746PRO

*Plus Free PS-125**

Great Radios and Great Service... only at Burghardt!

WE WANT TO BE "YOUR" RADIO DEALER

Check us out on the web (updated daily!)

www.burghardt-amateur.com

or e-mail us at
hamsales@burghardt-amateur.com

Call for Repack Special Pricing!

GO QRP!

Icom IC-703

Shown with Optional LC-156 Backpack

PROVEN PERFORMANCE!

Icom IC-706MKIIG

*Plus Free RMK-706 Remote Mount Kit**

GET INTO HF!

Icom IC-718

*Plus Free UT-106 DSP**

Serving Amateur Radio Operators Since 1937

Burghardt INC. AMATEUR CENTER

MFJ Dummy Load/Wattmeter

1.5 kW Dry Dummy Load has built-in precision, true peak-reading SWR/Wattmeter switchable to external antenna!

World's most versatile 1.5 kW dummy load has a *built-in* true peak reading SWR/Wattmeter that you can switch and use independently!

You'll find tons of uses!

Tune up your transceiver, linear amplifier or antenna tuner into a safe 50 Ohm dummy load at *full power*. Then instantly switch to your antenna and monitor SWR, forward and reflected power.

Use for testing/tuning transmitters, transceivers, amplifiers, antenna tuners, baluns, transformers, filters, matching networks, coax, stubs, transmission lines and antennas.

The 50-Ohm dry dummy load works DC to 60 MHz. SWR is below 1.3:1 at 30 MHz. Can handle 100 Watts for ten minutes or 1500 Watts for ten seconds. Comes with power derating curve.

MFJ-267 **$149.95**

Extra-large three-inch lighted Cross-Needle meter reads SWR (1:1 to 8:1), forward and reflected power *simultaneously*.

Reads *true peak* PEP or average power on 300/3000 Watts forward and 60/600 Watts reflected power ranges 1.8-54 MHz.

High accuracy comes from a carefully designed directional coupler, an accurate active-peak reading circuit and a precision d'Arsonval meter movement.

RF tight perforated aluminum cabinet. 4½Wx3½Hx10½D inches. Uses 12 VDC or 120 VAC with MFJ-1312D, $14.95.

Find Power Line Noise Fast!

Walk or drive around with this *handheld power line noise meter* to search out leaky insulators, loose hardware and corroded ground lines quickly. Track noise source right down to the pole, transformer or insulator. Sensitive .3 uV, 135 MHz superhet AM receiver has 70 dB range noise field-strength meter. Telescopic, direction-finding dipole is optimized and balun-isolated to give sharp, clearly defined null. Plug in headphones or tape recorder.

MFJ-852 **$99.95**

Field Strength Meters

Shows radiated antenna relative field strength. Determine radiation pattern. **MFJ-802** has huge 3 inch meter. Telescoping dipole reduces influence of surrounding objects and is more reliable, repeatable than monopole. Sensitivity control. Jack for remote sensor, MFJ-802R, $24.95. **MFJ-801** has 1¾ inch meter, sensitivity control, 20 inch extended telescoping monopole antenna.

MFJ-802 **$39.95**

MFJ-801 **$19.95**

81 dB Step Attenuator

MFJ-762 **$69.95**

81 dB Attenuator in 1 dB steps. 50 Ohms. Usable to 500 MHz. 250 milliwatt maximum input. BNC connectors. Shielded stages. Connect between receiver and antenna and use S-meter as a precision calibrated field strength meter. Prevent receiver blocking, cross-modulation. Determine gain/loss, ideal for fox hunting. Evaluate linearity. Isolate circuits. Extend range of sensitive equipment. Measure input/output level differences.

MFJ Frequency Counters

MFJ-886 **$119.95**

MFJ-886 covers 1 MHz to 3 GHz with 300 MHz direct count, 0.1 Hz resolution. 4 gate times. 10-digit high-contrast 3/4 inch LCD display. Lock display button. Bargraph shows RF field strength. Includes rechargeable Ni-Cad batteries, charger, telescopic antenna. Black anodized aluminum. 2¾x2¼x1¼ in. **MFJ-888**, like MFJ-886, but covers *10 Hz*-3 GHz. Measures frequency/period, has 50/1M Ohm input, auto hold, LED backlight, beeper. 2¾x4¼x1¼ in.

MFJ-888 **$184.95**

MFJ Wireless Weather Station . . . $59.95!

Display

Remote Sensor

MFJ-192 **$59.95** *New!*

You're ragchewing with a G3 in England . . . *"Temperature outside is a cool 53 degrees with falling barometric pressure -- looks like a rainstorm may be coming. Humidity here is 73%."* . . . while noticing it's 1900 hours GMT.

This informative MFJ Wireless Weather Station receives and displays outside temperatures from up to 3 remotes every 30 seconds up to 100 feet away.

You'll get barometric pressure trends, weather forecasting, severe storm detection with visual and audible alarms -- great for severe weather nets.

You can read inside and outside F/C degrees, relative humidity, forecast icons, pressure trend, hour, minutes, seconds, day, date and month *simultaneously*.

Has upper/lower temperature limit alarms, backlight. Read time in two zones -- local and GMT or other -- in 12/24 hour format.

Display (4x7x1") uses 2 AA, remote (2¼x3½x1") uses 2 AAA batteries, not included. *Includes one remote*, extra **MFJ-192S** remotes are $19.95 each.

MFJ CW Reader/Keyer

MFJ-464 **$179.95**

(Keyboard, paddle not included.)

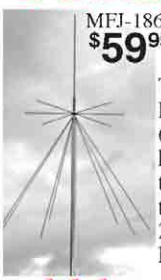
Plug MFJ's CW Reader with *built-in* Keyer into your transceiver's phone jack and key jack. Now you're ready to compete with the world's best hi-speed CW operators -- and *they won't even know you just passed the code test!* Sends and reads 5-99 WPM. Automatic speed tracking. Large 2-line LCD shows send/receive messages. Use paddle or computer keyboard. Easy menu operation. Front panel speed, volume controls. 4 message memories, type ahead buffer, read again buffer, adjustable weight/sidetone, speaker. RFI proof.

MFJ Atomic Wrist Watch

MFJ-186RC **$29.95**

Receives atomic time signal WWVB and sets your watch automatically -- always accurate to milliseconds. Select 12/24 hour format and pacific, mountain, central, eastern time zones. Displays hour, minutes, seconds, day and date. Displays year, month and day in calendar mode. Alarm, stopwatch functions. Brilliant blue backlight. Water-resistant.

25-1300 MHz Discone Antenna



MFJ-1868 **$59.95**

Ultra wide-band antenna receives 25-1300 MHz. Perfect for scanners. Transmit 50-1300 MHz. Handles 200 Watts. Ideal for 6/2/1¼ Meters, 70/33/23 CM ham bands. Excellent for testing various transmitters on single coax. SO-239, 50 feet coax, stainless steel elements.

Free MFJ Catalog
and Nearest Dealer . . . 800-647-1800
http://www.mfjenterprises.com

• 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 . . . the world leader in ham radio accessories!

MIRAGE . . . 160 Watts on 2 Meters!

Turn your mobile, base or handheld into 160 Watt powerhouses and talk further, longer, clearer . . . All modes: FM, SSB, CW . . . Superb GaAsFET preamp . . . Overdrive, high SWR, Over-temperature protection . . . Remote controllable . . .

The MIRAGE B-2518-G gives you 160 Watts of brute power for 25 Watts input on all modes -- FM, SSB, or CW!

B-2518-G **$329** Suggested Retail

Ideal for 10 to 35 Watt 2 Meter mobile or base. Hear weak signals -- low noise GaAsFET preamp gives you excellent 0.6 dB noise figure. Select 15 or 20 dB preamp gain.

B-2518-G has legendary ruggedness. *We know of one that has been in constant use since 1979!*

Heavy-duty heatsink spans entire length of cabinet -- prevents overheating. Power transistors protected by MIRAGE's *Therm-O-Guard*™.

Fully protected from high SWR and excessive input power, warning LED.

Smooth adjustable Transmit/Receive switch with remote external keying.

Draws 17-22 Amps at 13.8 VDC. Measures a compact 12x3x5½ inches.

MIRAGE RUGGED!

RC-2, $45. Remote Controls most Mirage amps. On/Off, preamp On/Off, selects SSB/FM. With 18 foot cable (longer available with special order).

More 160 Watt, 2 Meter Amplifiers . . .

B-5018-G, $329. Same as B-2518-G but for 20 to 60 Watt mobile or base. 160 Watts out for 50 Watts in. Gives you 160 Watts out for 50 W in.

B-1018-G, $409. MIRAGE's most popular *dual purpose* HT or mobile/base amplifier. 160 Watts out for 10 Watts in. For 0.2-15 Watt rigs.

***Power Curve** -- typical output power in Watts*

B-1018-G	40	60	140	150	160	160	--	--	--	--	--
B-2518-G	--	0.5	30	56	91	111	135	153	160	160+	--
B-5018-G	--	--	--	52	99	119	125	130	135	145	160
Watts In	0.25	0.5	3	5	8	10	15	20	25	35	50

100 Watts for 2 Meter HTs

B-310-G **$199** Suggested Retail **MIRAGE RUGGED!**

***Power Curve** -- typical B-5016-G output power*

Watts Out	25	50	75	95	100	100	100	100
Watts In	¼	½	1	2	4	6	7	8

- ***100 Watts out with all handhelds up to 8 Watts***
- ***All modes: FM, SSB, CW***
- ***Great for ICOM IC-706***
- ***15 dB low noise GaAsFET preamp***
- ***Reverse polarity protection***
- ***SWR Protection***
- ***FREE mobile bracket***
- ***Auto T/R Switch***
- ***FREE handheld BNC to B-310-G patch cable***
- ***Ultra-compact 4¾x1¾x7¼ inches, 2½ pounds***
- ***One year MIRAGE warranty***

***Boost** your 2 Meter handheld to 100 Watts!* Ultra-compact all mode B-310-G amp is perfect for all handhelds up to 8 Watts and multimode SSB/CW /FM 2 Meter rigs. *Great for ICOM IC-706!*

35 Watts for 2 Meter HTs

B-34-G **$89.95** Suggested Retail

***Power Curve** -- typical B-5016-G output power*

Watts Out	18	30	33	35	35	35	35+
Watts In	1	2	3	4	5	6	8

- ***35 Watts Output on 2 Meters***
- ***All modes: FM, SSB, CW***
- ***18 dB GaAsFET preamp***
- ***Reverse polarity protection***
- ***Includes mobile bracket***
- ***Auto RF sense T/R switch***
- ***Custom heatsink, runs cool***
- ***Works with handhelds up to 8 Watts***
- ***One year MIRAGE warranty***

MIRAGE RUGGED!

35 Watts, FM only . . . $69.95

B-34, $69.95. 35 Watts out for 2 Watts in. Like B-34-G, FM only, less preamp, mobile bracket. 3½x1¾x4¼ inches.

MIRAGE Dual Band 144/440 MHz Amp

BD-35 **$159.95** Suggested Retail

***Power Curve** -- typical B-5016-G output power*

Watts Out *2 Meters*	30	40	45	45	45	45	45+
Watts Out *440 MHz*	16	26	32	35	35	35	35+
Watts In	1	2	3	4	5	6	7

- ***45 Watts on 2 Meters/35 Watts on 440 MHz***
- ***Auto Band Selection***
- ***Auto T/R Switch***
- ***Full Duplex Operation***
- ***5x1¾x5 inches***
- ***FREE mobile bracket***
- ***"On Air" LEDs***
- ***Single Connector for dual band radios and antennas***
- ***Reverse polarity protection***
- ***Works with all FM handhelds to 7 Watts***
- ***One year MIRAGE warranty***

Add this Mirage dual band amp and boost your handheld to a powerful mobile or base -- 45 Watts on 2 Meters or 35 Watts on 440 MHz! Mirage's exclusive *FullDuplexAmp*™ lets you talk on one band and listen on the other band at the same time -- just like a telephone conversation. *(Requires compatible HT).*

6 Meter Amplifier

FCC Type Accepted

The A-1015-G, $389, is the *world's most popular* all mode FM/SSB/CW 6 Meter amplifier. 150 Watts out for 10 in. For 1 to 15 Watt transceivers.

70 cm Amplifiers (420-450 MHz)

D-3010-N, $389 -- 100 W out/30 in. For 5 to 45 Watt *mobile/base*. **D-1010-N, $419**, 100 W out/10 in. *Dual purpose* -- for handhelds or mobile/base. **D-26-N, $289**, 60 W out/2 in, for *handhelds.*

Amateur TV Amps

Industry standard ATV amps -- **D-1010-ATVN, $439**, 82 Watts PEP out / 10 in. **D-100-ATVN, $439**, 82 Watts PEP out/2 in. (without sync compression).

Remote Control Head for Amps

RC-1, $45, remote controls most MIRAGE amps. Check with Mirage for compatibility. Power On/Off, preamp On/Off, switch for SSB/FM. 18 foot cable (longer available). Tiny 1¾x3¾x2½ inches.

Repeater Amps

11 models -- continuous duty all mode FM/SSB/CW repeater amps for 6, 2, 1¼ Meters, 70 cm, 450 MHz, ATV.

Low noise GaAsFET preamps

High gain ultra low noise GaAsFET preamps for receiving weak signals. Selectable gain prevents receiver intermod. 15 to 22 dB gain. Less than 0.8 dB noise figure. Automatic RF switching up to 100 Watts.

Choose *In-Shack* model or *Mast Mount* (includes remote control) model to reduce loss. Rugged die-cast enclosure.

Frequency (MHz)	*In Shack $139*	*Mast Mount $195*
28-30	KP-1/10M	KP-2/10M
50-54	KP-1/6M	KP-2/6M
144-148	KP-1/2M	KP-2/2M
220-225	KP-1/220	KP-2/220
430-450	KP-1/440	KP-2/440

1¼ Meter Amps (223-225 MHz)

Choose from 10 models -- 20 to 220 Watts out for 2 to 50 Watts in, $169 to $739.

Commercial Amps ($159 to $429)

FCC Type Accepted

Commercial Amps for 150-174, 450-470 MHz and VHF marine bands, 70-130 Watts out.

Accurate SWR/Wattmeters

Read SWR directly and Forward/Reverse, Peak/Average power. Remote coupler. 1.8-30, 50-200, 420-450, 1260-1300 MHz band models.

One Year Mirage Warranty

Call your dealer for your best price!
Nearest Dealer/Free Catalog: 800-647-1800

http://www.mirageamp.com

Technical: 662-323-8287 **Fax:** 662-323-6551

MIRAGE

COMMUNICATIONS EQUIPMENT
300 Industrial Park Road
Starkville, MS 39759, USA

MIRAGE . . . the world's most rugged VHF/UHF amplifiers!

Big Savings on Radio Scanners

Uniden® SCANNERS

Bearcat® 785DGV APCO P-25 Digital Ready with free deluxe scanner headset
CEI on-line or phone special price $339.95
1,000 Channels • 27 bands • CTCSS/DCS • S Meter
Size: 6 15/16" Wide x 6 9/16" Deep x 2 3/8" High

New Product. **Scheduled for initial release January 10, 2003. Order now.**
Frequency Coverage: 25.0000-512.0000 MHz., 806.000-823.9875MHz., 849.0125-868.9875 MHz., 894.0125-956.000, 1240.000-1300.000 MHz.

When you buy your Bearcat 785D state-of-the art Digital Capable Trunktracker III package deal from Communications Electronics, you get more. The GV means "Great Value." With your BC785D scanner purchase, you also get a **free deluxe scanner headphone** designed for home or race track use. The Bearcat 785D has 1,000 channels and the widest frequency coverage of any Bearcat scanner ever. When you order the optional **BCi25D, APCO Project 25 Digital Card** for $299.95, when installed, you can monitor Public Safety Organizations who currently use conventional, trunked 3,600 baud and mixed mode APCO Project 25 systems. APCO project 25 is a modulation process where voice communications are converted into digital communications similar to digital mobile phones. You can also monitor Motorola, EDACS, EDACS SCAT, and EF Johnson systems. Many more features such as S.A.M.E. weather alert, full-frequency display and backlit controls, built-in CTCSS/DCS to assign analog and digital subaudible tone codes to a specific frequency in memory, PC Control with RS232 port, Beep Alert, Record function, VFO control, menu-driven design, total channel control and much more. Our CEI package deal includes telescopic antenna, AC adapter, cigarette lighter cord, DC cord, mobile mounting bracket with screws, owner's manual, trunking frequency guide and one-year limited Uniden factory warranty. For maximum scanning enjoyment, operate your scanner from your computer running Windows. Order Scancat Gold for Windows, part number **SGFW** for $99.95 and magnetic mount antenna part number **ANTMMBNC** for $29.95. Not compatible with 9,600 baud APCO digital control channel with digital voice, AGEIS, ASTRO or ESAS systems. For fastest delivery, order on-line at www.usascan.com.

Bearcat® 895XLT Trunk Tracker
Manufacturer suggested list price $499.95
Less -$320 Instant Rebate / Special $179.95
300 Channels • 10 banks • Built-in CTCSS • S Meter
Size: 10 1/2" Wide x 7 1/2" Deep x 3 3/8" High
Frequency Coverage: 29.000-54.000 MHz., 108.000-174 MHz., 216.000-512.000 MHz., 806.000-823.995 MHz., 849.0125-868.995 MHz., 894.0125-956.000 MHz.

The Bearcat 895XLT is superb for intercepting trunked analog communications transmissions with features like TurboScan™ to search VHF channels at 100 steps per second. This base and mobile scanner is also ideal for intelligence professionals because it has a Signal Strength Meter, RS232C Port to allow computer-control of your scanner via optional hardware and 30 trunking channel indicator annunciators to show you real-time trunking activity for an entire trunking system. Other features include Auto Store - Automatically stores all active frequencies within the specified bank(s). Auto Recording - Lets you record channel activity from the scanner onto a tape recorder. CTCSS Tone Board (Continuous Tone Control Squelch System) allows the squelch to be broken during scanning only when a correct CTCSS tone is received. For maximum scanning pleasure, order the following optional accessories: **PS001** Cigarette lighter power cord for temporary operation from your vehicle's cigarette lighter $14.95; **PS002** DC power cord - enables permanent operation from your vehicle fuse box $14.95; **MB001** Mobile mounting bracket $14.95; **EX711** External speaker with mounting bracket & 10 feet of cable with plug attached $19.95. **CAT895** Computer serial cable $29.95. The BC895XLT comes with AC adapter, telescopic antenna, owner's manual and one year limited Uniden warranty. Not compatible with AGEIS, ASTRO, EDACS. ESAS or LTR systems.

Bearcat® 245XLT Trunk Tracker II
Mfg. suggested list price $429.95/**CEI price $189.95**
300 Channels • 10 banks • Trunk Scan and Scan Lists
Trunk Lockout • Trunk Delay • Cloning Capability
10 Priority Channels • Programmed Service Search
Size: 2 1/2" Wide x 1 3/4" Deep x 6" High
Frequency Coverage:
29.000-54,000 MHz., 108-174 MHz., 406-512 MHz., 806-823.995 MHz., 849.0125-868.995 MHz., 894.0125-956.000 MHz.

Our Bearcat TrunkTracker BC245XLT is the world's first scanner designed to track Motorola Type I, Type II, Hybrid, SMARTNET, PRIVACY PLUS and EDACS® analog trunking systems on any band. Now, follow UHF High Band, UHF 800/900 MHz trunked public safety and public service systems just as if conventional two-way communications were used. Our scanner offers many new benefits such as Multi-Track - Track more than one trunking system at a time and scan conventional and trunked systems at the same time. 300 Channels - Program one frequency into each channel. 12 Bands, 10 Banks - Includes 12 bands, with aircraft and 800 MHz. 10 banks with 30 channels each are useful for storing similar frequencies to maintain faster scanning cycles or for storing all the frequencies of a trunked system. Smart Scanner - Automatically program your BC245XLT with all the frequencies and trunking talk groups for your local area by accessing the Bearcat national database with your PC. If you do not have a PC simply use an external modem. Turbo Search - Increases the search speed to 300 steps per second when monitoring frequency bands with 5 KHz. steps. 10 Priority Channels - You can assign one priority channel in each bank. Assigning a priority channel allows you to keep track of activity on your most important channels while monitoring other channels for transmissions. Preprogrammed Service (SVC) Search - Allows you to toggle through preprogrammed police, fire/emergency, railroad, aircraft, marine, and weather frequencies. Unique Data Skip - Allows your scanner to skip unwanted data transmissions and reduces unwanted birdies. Memory Backup - If the battery completely discharges or if power is disconnected, the frequencies programmed in your scanner are retained in memory. Manual Channel Access - Go directly to any channel. LCD Back Light - An LCD light remains on for 15 seconds when the back light key is pressed. Autolight - Automatically turns the backlight on when your scanner stops on a transmission. Battery Save - In manual mode, the BC245XLT automatically reduces its power requirements to extend the battery's charge. Attenuator - Reduces the signal strength to help prevent signal overload. The BC245XLT also works as a conventional scanner. Now it's easy to continuously monitor many radio conversations even though the message is switching frequencies. The BC245XLT comes with AC adapter, one rechargeable long life ni-cad battery pack, belt clip, flexible rubber antenna, earphone, RS232C cable, Trunk Tracker frequency guide, owner's manual and one year limited Uniden warranty. Not compatible with AGEIS, ASTRO, ESAS or LTR systems. Hear more action on your radio scanner today. Order on-line at www.usascan.com for quick delivery. For maximum scanning satisfaction, control your Bearcat 245XLT from your computer running Windows. Order Scancat Gold for Windows, part number **SGFW** for $99.95 or the surveillance enhanced version with audio recording part number **SGFWSE** for $159.95.

More Radio Products

Save even more on radio scanners when purchased directly from CEI. Your CEI price after instant rebate is listed below:

Bearcat 895XLT 300 ch. Trunktracker I base/mobile scanner	$179.95
Bearcat 785D 1,000 channel Trunktracker III base/mobile	$339.95
Bearcat BCi25D APCO Project 25 digital software card	$299.95
Bearcat 278CLT 100 ch. AM/FM/SAME WX alert scanner	$139.95
Bearcat 250D 1,000 ch. Trunktracker III handheld scanner	$339.95
Bearcat 245XLT 300 ch. Trunktracker II handheld scanner	$189.95
Bearcat 248CLT 50 ch. base AM/FM/weather alert scanner	$84.95
Bearcat Sportcat 200 alpha handheld sports scanner	$159.95
Bearcat Sportcat 180B handheld sports scanner	$139.95
Bearcat 80XLT 50 channel handheld scanner	$99.95
Bearcat 60XLT 30 channel handheld scanner	$74.95
Bearcat BCT7 information mobile scanner	$139.95
AOR AR16BQ Wide Band scanner with quick charger	$199.95
Sangean ATS909 306 memory shortwave receiver	$209.95
Sangean ATS818 45 memory shortwave receiver	$139.95
Uniden WX500 Weather Alert with S.A.M.E. feature	$39.95

AOR®

AOR® AR8200 Mark IIB Radio Scanner
AOR8200 Mark IIB-A wideband handheld scanner/**SPECIAL $539.95**
1,000 Channels • 20 banks • 50 Select Scan Channels
PASS channels: 50 per search bank + 50 for VFO search
Frequency step programmable in multiples of 50 Hz.
Size: 2 1/2" Wide x 1 3/8" Deep x 6 1/8" High
Frequency Coverage:
500 KHz to 823.995 MHz, 849.0125-868.995 MHz, 894.0125-2,040.000 MHz
(Full coverage receivers available for export and FCC approved users.)

The AOR AR8200 Mark IIB is the ideal handheld radio scanner for communications professionals. It features all mode receive: WFM, NFM, SFM (Super Narrow FM), WAM, AM, NAM (wide, standard, narrow AM), USB, LSB & CW. Super narrow FM plus Wide and Narrow AM in addition to the standard modes. The AR8200 also has a versatile multifunctional band scope with save trace facility, twin frequency readout with bar signal meter, battery save feature with battery low legend, separate controls for volume and squelch, arrow four way side rocker with separate main tuning dial, user selectable keypad beep/illumination and LCD contrast, write protect and keypad lock, programmable scan and search including LINK, FREE, DELAY, AUDIO, LEVEL, MODE, computer socket fitted for control, clone and record, Flash-ROM no battery required memory, true carrier reinsertion in SSB modes, RF preselection of mid VHF bands, Detachable MW bar aerial. Tuning steps are programmable in multiples of 50 Hz in all modes, 8.33 KHz airband step correctly supported, Step-adjust, frequency offset, AFC, Noise limited & attenuator, Wide and Narrow AM in addition to the standard modes. For maximum scanning pleasure, you can add one of the following optional slot cards to this scanner: **CT8200** CTCSS squelch & search decoder $89.95; **EM8200** External 4,000 channel backup memory, 160 search banks. $69.95; **RU8200** about 20 seconds chip based recording and playback $69.95; **TE8200** 256 step tone eliminator $59.95. In addition, two leads are available for use with the option socket. **CC8200A** personal computer control lead $109.95; **CR8200** tape recording lead $59.95. Includes 4 1,000 mAh AA ni-cad batteries, charger, cigarette lighter adapter, whip aerial, MW bar antenna, belt hook, strap and one year limited AOR warranty. For fastest delivery, enter your order on-line at http://www.usascan.com.

Buy with Confidence

Order on-line and get big savings

For over 33 years, millions of communications specialists and enthusiasts worldwide have trusted Communications Electronics for their mission critical communications needs. It's easy to order. **For fastest delivery, order on-line at www.usascan.com.** Mail orders to: Communications Electronics Inc., P.O. Box 1045, Ann Arbor, Michigan 48106 USA. Add $20.00 per radio receiver for UPS ground shipping, handling and insurance to the continental USA. Add $15.00 shipping for all accessories and publications. For Canada, Puerto Rico, Hawaii, Alaska, Guam, P.O. Box or APO/FPO delivery, shipping charges are two times continental US rates. Michigan residents add sales tax. No COD's. Your satisfaction is guaranteed or return item in unused condition in original packaging within 61 days for refund, less shipping, handling and insurance charges. 10% surcharge for net 10 billing to qualified accounts. All sales are subject to availability, acceptance, verification and authentication. Prices, terms and specifications are subject to change without notice. We welcome your Discover, Visa, American Express, MasterCard, IMPAC and Eurocard. Call anytime 1-800-USA-SCAN or 800-872-7226 to order toll-free. Call +1-734-996-8888 if outside Canada or the USA. FAX anytime, dial +1-734-663-8888. Dealer and international inquiries invited. Order your radio products from CEI today at www.usascan.com.

For credit card orders call
1-800-USA-SCAN

e-mail: cei@usascan.com

www.usascan.com

PO Box 1045, Ann Arbor, Michigan 48106-1045 USA
For information call 734-996-8888 or FAX 734-663-8888

Price schedule effective December 2, 2002 AD #120202 © 2002 Communications Electronics Inc.

COMMUNICATIONS ELECTRONICS INC.
Emergency Operations Center

Visit WWW.USASCAN.COM • 1-800-USA-SCAN

MFJ *IntelliTuner*™ Automatic Tuner

Automatically tunes any antenna balanced or unbalanced . . . Ultra fast . . . 2000 memories . . . Antenna Switch . . . Efficient L-network . . . Matches 6-1600 Ohms at 300 Watts . . . 1.8-30 MHz . . . 4:1 current balun . . . Cross-Needle and Digital SWR/Wattmeter . . . Aural SWR meter . . . Backlit LCD . . . Remote control port . . . Radio interface . . .

MFJ-993

$259.95 **New!**

The MFJ-993 *IntelliTuner*™ lets you tune any antenna *automatically* balanced or unbalanced -- *ultra fast*.

It's an automatic antenna tuning *console* complete with SWR/Wattmeter, antenna switch for two antennas and 4:1 current balun for balanced lines.

MFJs exclusive *IntelliTuner*™, *Adaptive Search*™ and *InstantRecall*™ algorithms give you *ultra fast* automatic tuning with over 2000 *non-volatile* revolving memories.

You get a highly efficient L-network, wide 6-1600 ohm matching at *full* 300 Watts SSB/150 Watts CW, 1.8-30 MHz coverage, Cross-Needle and *digital* meters, aural SWR meter, *backlit* LCD display, remote control port, radio interface, heavy-duty 16 amp/1000 volt relays and more.

It learns while you're having fun

As you're ragchewing, contesting or DXing, *your MFJ-993 is learning!*

When you transmit, the MFJ-993 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!*

Each of two antennas can learn and remember over a thousand frequencies and tuner settings. They are safely stored in *non-volatile* revolving memory.

Highly Intelligent ultra fast tuning

MFJ *InstantRecall*™ first checks its memory to see if you have operated this frequency before. If so, tuning is instantaneous and you're ready to operate.

If not, MFJ's *IntelliTuner*™ algorithm -- based on MFJ's famous SWR Analyzer technology -- kicks in. It *measures* the complex impedance of your antenna. Next, it *calculates* the components it needs and instantly *snaps* them in. Then, it fine tunes to minimize SWR -- you're ready to operate. It's all done in a *fraction* of a second.

When the impedance is within its measurement range, the MFJ-993 is the *fastest automatic antenna tuner in the world.*

If it can't accurately determine impedance, MFJ's *AdaptiveSearch*™ algorithm goes into action. Frequency is measured and relevant components values are determined. Only those values are searched for ultra-fast tuning.

For even faster searches, you can set the target SWR to 2 (settable 1.0 to 2.0).

You can manually tune when you can't transmit (for listening out of ham bands).

Cross Needle and Digital Meters

Lighted Cross-Needle and *digital* SWR/Wattmeters lets you accurately read SWR, forward and reflected power at a glance.

An *aural* SWR meter lets you *hear* the tuned SWR when you can't see or read the meters.

Turn on a highly visible, instant response SWR LCD bargraph when you need it.

Backlit LCD Display

An easy-to-read *backlit* LCD displays SWR, forward/reflected power, frequency, antenna 1 or 2, L and C tuner values, on/off indicators and other information.

Remote Control Port

Plug in the **MFJ-990RC, $39.95**, remote control and put your tuner at your antenna or elsewhere and control it remotely.

The MFJ-993 supports radio tuner interfaces such as the ICOM 706 series. *Interface cables are available.*

The MFJ-993 is a compact 10Wx2¾ Hx9D inches. Use 12-15 VDC/1 amp or 110 VAC with **MFJ-1316, $19.95**.

Tune any Antenna

You can tune any antenna -- dipoles, verticals, beams, phased arrays, inverted vees, quads, random wires, mobile antennas, limited space antennas -- any antenna.

A 4:1 true current balun lets you tune any *balanced* antenna -- horizontal loops, vertical loops, multi-band doublets, quads, folded dipoles, Zepps.

150 Watt Automatic Tuner

New!

MFJ-991, **$219.95**

MFJ-991, *150 Watt IntelliTuner*™ automatic antenna tuner. Similar to MFJ-993 but handles 150 Watts SSB/100 Watts CW, matches 6-3200 Ohms. Does not have digital SWR/Wattmeter/LCD display, aural SWR meter/audio feedback, antenna switch or 4:1 current balun for balanced lines.

600 Watt MFJ Automatic Tuner

MFJ-994, **$359.95** **New!**

MFJ-994, *600 Watt IntelliTuner*™ automatic antenna tuner. Similar to MFJ-993 but handles 600 Watts SSB/300 Watts CW, matches 12-800 Ohms. Does not have digital SWR/Wattmeter/LCD display, aural SWR meter/audio feedback, antenna switch or 4:1 current balun for balanced lines. Tuning must be done at low transceiver power with the amplifier bypassed.

Free MFJ Catalog
and Nearest Dealer . . . 800-647-1800

http://www.mfjenterprises.com

• 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 . . . the World Leader in Ham Radio Accessories!

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 $1.25 per word. Individuals selling or buying personal equipment: ARRL member 65¢ per word. Non-ARRL member $1 per word. **Bolding** is available for $1.75 a word. 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 860-594-0231 or hamads@arrl.org for further information or to submit your ad.

5. No Ham-Ad may use more than 100 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.

QST Ham Ads on the Web – Updated Monthly!
www.arrl.org/ads/ham-ads.html

Sell Your Radio TODAY!
Check out **RADIOS On-Line** on the ARRL web site:
www.arrl.org/ads/RadiosOnline/

Club/Hamfests/Nets

FRIEND OF BILL W.?? - Join HAAM net Saturdays at 12:30 Eastern on 14.290; Sundays at 09:30 Pacific on 14.340/2. K6LX

Join the **LAMBDA AMATEUR RADIO CLUB** (LARC) since 1975 the only open and visible public service oriented ham club for gay and lesbian hams. Newsletter, skeds, hamfest meetings, listserv, and full service web site http://www.lambdaarc.com Write LARC, POB 21669, Cleveland, OH 44121-0669 or email larc@lambdaarc.com

MFJ *Balanced Line* Antenna Tuner

Superb balance . . . Very wide matching range . . . Covers 1.8-54 MHz . . . Cross-Needle SWR Wattmeter . . . Handles 300 Watts . . . Compact size . . .

The MFJ-974H is a* fully balanced true *balanced line antenna tuner. It gives you superb current balance.

New!

Johnson Matchbox

For decades, the Johnson Matchbox has been the standard of comparison for balanced line antenna tuners. But, it had a severely limited matching range and covered only 80, 40, 20, 15 and 10 Meters.

***The** MFJ-974H is its successor.* It meets today's needs and even surpasses the Johnson Matchbox outstanding performance.

Everything You Need

The MFJ-974H gives you excellent current balance, very wide matching range(12-2000 Ohms) and covers 1.8 through 54 MHz *continuously* including all WARC bands, 160 Meters, 6 Meters and the new 60 Meter band. Handles 300 Watts SSB PEP and 150 Watts CW.

Tuning is fast and easy - - just three tuning controls. You can adjust for highly efficient broadband low-Q operation or use higher Q when you encounter extreme loads.

A large three-inch lighted Cross-Needle SWR/Wattmeter lets you read SWR, peak or average forward and reflected power *all at a glance* on 300/60 or 30/6 Watt ranges.

A ground post is provided to ground one output terminal so you can also tune random wires and coax fed antennas.

Compact 7½Wx6Hx8D in. fits anywhere.

Tunes any Balanced Line

The MFJ-974H tunes any balanced lines including 600 Ohm open wire line, 450/300 Ohm ladder lines, 300/72 Ohm twin lead - - shielded or unshielded.

Superb current balance minimizes feedline radiation that can cause troublesome TVI /RFI, painful RF bites, mysterious RF feedback problems and radiation pattern distortion.

Excellent Balance, Excellent Design

The MFJ-974H is a *fully balanced* wide range T-Network. *Four* 1000 Volt air variable capacitors are gear driven. A high-Q air wound tapped inductor is used for 80-10 Meters with separate inductors for 6 and 160 Meters. The tuning components are mounted symmetrically to insure electrical balance.

A 1:1 *current* balun is placed on the low impedance 50 Ohm input side to convert the balanced T-Net-work to unbalanced operation. An efficient balun is made of 50 ferrite beads on RG-303 *Teflon*™ coax to give very high isolation. It stays cool even at max power.

MFJ-974H **$189.95**

Balanced Line = Extremely Low Loss

Balanced lines give extremely low loss.

Doublet, horizontal loop, vertical loop, quad, double extended Zepp, Lazy H, W8JK antennas all give efficient multi-band operation when fed with balanced lines.

6-80 Meter Balanced Line Tuner

MFJ-974 **$169.95** New!

MFJ-974, $169.95. Same as MFJ-974H but for 6-80 Meter operation (no 160 Meters).

160-6 Meters All Band Doublet Antenna

MFJ-1777, $49.95. 102 feet doublet antenna covers 160-6 Meters with balanced line tuner. Super strong custom fiberglass center insulator provides stress relief for 450 Ohm ladder line (100 feet included). Authentic *glazed ceramic* end insulators. Handles 1500 Watts.

New!

MFJ *High Current* DC Multi-Outlet Strips

Choose super versatile 5-way binding posts AND/OR Anderson PowerPole® connectors

Anderson PowerPole® is a registered trademark of *Anderson Power Products.*

Provide multiple high current DC outlets for transceivers and accessories from your main 12 VDC power supply – keeps you neat, organized and safe. Prevents fire hazard. Keeps wires from tangling up and shorting. Outlets are fused and RF bypassed.

All MFJ DC power strips have *built-in* six foot, eight gauge, flexible color-coded cable with ring tongue terminals -- *no extra cost. RF-tight* aluminum cabinet has mounting ears and ground post with wing nut.

Choose MFJ's *super versatile* super heavy duty 5-way binding posts (spaced for standard dual banana plugs) and/or *Anderson PowerPole®* outlets.

Each *Anderson PowerPole®* is individually fused as needed. Standard color coded automobile fuses plug in externally. Extra *PowerPole®* connectors, contacts, fuses are included at *no extra cost.*

Versatile 5-Way Binding Posts

MFJ-1118 **$74.95**

Power two HF and/or VHF rigs and six accessories from your main 12 VDC supply. *Built-in 0-25 VDC voltmeter.* Two pairs 35 amp 5-way binding posts, fused and RF bypassed for transceivers. Six pairs RF bypassed binding posts with master fuse, ON/OFF switch, and "ON" LED provide 15 Amps for accessories. 12½x2¾x2½ in.

All PowerPoles®

MFJ-1128 **$99.95**

12 outlets, each fused, 40 Amps total. Three high-current outlets for transceivers. Nine *switched* outlets for accessories. Mix and match in-cluded fuses as needed (one-40A, one-25A, four-10A, four-5A, three-1A fuses installed). *Built-in 0-25 VDC Voltmeter.* Includes *extra* 12 pairs of *PowerPole®* contacts and *extra* 10 fuses (2 each: 1, 5, 10, 25, 40A) -- *no extra cost.* 12Wx1¼Hx2¾D in.

MFJ-1126 **$79.95**

8 outlets. each fused, 40 Amps total. Factory installed fuses: two 1A, three 5A, two 10A, one 25A, one 40A. *Built-in 0-25 VDC Voltmeter.* Includes *extra* 6 pairs of *Anderson PowerPole®* contacts and *extra* 5 fuses (1, 5, 10, 25, 40A) -- *no extra cost.* 9Wx1¼Hx2¾ inches.

PowerPoles® AND 5-Way Binding Posts

MFJ-1129 **$109.95**

The best of both worlds! ***10 outlets, each fused, 40 Amps total.*** Three high-current outlets for rigs -- 2 *PowerPoles®* and 1 versatile high-current 5-way binding post. Seven *switched* outlets for accessories (20A max) -- 5 *PowerPoles®* and 2 versatile binding posts. Mix and match included fuses as needed (1- 40A, 2-25A, 3-10A, 3-5A, 2-1A installed). *Built-in 0-25 VDC Voltmeter.* Includes *extra* 7 pairs of *PowerPole®* contacts, and 10 fuses (2 each,1,5,10, 25, 40A) -- *no extra cost.*12½Wx1¼Hx2¾D in.

MFJ-1124 **$59.95**

6 outlets, each fused, 40 Amps total. Four *PowerPoles®* and two high-current 5-way binding posts, Installed fuses: 1-40A, 2-25A, 2-10A, 1-5A, 1-1A. Includes 4 pair *PowerPole®* contacts, and 5 fuses -- *no extra cost.*

•1 Year *No Matter What*™ warranty •30 day money back guarantee (less s/h) on orders direct from MFJ.

Free MFJ Catalog
& Nearest Dealer . . . 800-647-1800
http://www.mfjenterprises.com

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 . . . The World Leader in Ham Radio Accessories!

MARCO The Medical Amateur Radio Council Ltd. is a charitable non-profit group of health care professionals who meet weekly at 10:00am Eastern on Sunday for "Grand Rounds" 14.308 MHz. All are welcome. Membership inquiries to WE1MD@arrl.net or CBA. SASE for newsletter to: MARCO, 144 Head of the Tide Road, Belfast, ME 04915. http://www.marco-ltd.org

RAINBOW AMATEUR RADIO ASSOCIATION Serving the gay/lesbian community. ARRL affiliated. Privacy respected. Active weekly HF nets, monthly newsletter, e-mail server, chat room, VE teams, Dxpeditions. Web site: www.rara.org. Information: PO Box 18541, Rochester, NY 14618-0541.

THE ARRL LETTER — The League's news digest for active amateurs, professionally produced and edited and available in a weekly electronic edition via the World Wide Web at www.arrl.org/arrlletter. Members may sign up for free email delivery of The ARRL Letter while registering on the Members Only Web Site, or by visiting their "Member Data page" after registering.

THE Veteran Wireless Operators Association, a 76-year old, non-profit organization of communications professionals invites your inquiries and application for membership. Write VWOA, Edward Pleuler, Jr., Secretary, 46 Murdock Street, Fords, NJ 08863. Visit our web site for activities, history, membership: http://www.vwoa.org

WORK GEORGIA'S 159 COUNTIES: New award, with progress certificates for 50 and 100 counties. Atlanta Radio Club, http://www.w4doc.org

Property/Vacation/Rentals

A BERMUDA HAM QTH awaits you. YL/XYL friendly. Email edkelly@logic.bm or phone VP9GE at 1-441-293-2525.

ADVENTURE, RADIO, TRAVEL for HAMS and families - Arctic - Antarctica - Falklands - S. Georgia - Azores & other remote Atlantic locations. Join K9PET on "M/S Endeavour" **www.CASUALDX.com**

ALASKA DX VACATION RENTAL - plus fishing and hunting in Homer, Alaska. 2br/2 bath deluxe accommodations + ham shack. Rigs, KW amps, antennas. AL7DB@ARRL.NET, DiamondRidgeCottage@webtv.net, 1-907-235-7526

BORNEO/9M6AAC - http://www.qsl.net/9m6aac

COLORADO CHALET with ham gear, www.lostcreekcabin.com. WØLSD, Buena Vista, CO.

CURACAO - PJ2T Oceanfront 2BR house, 11 yagis, all watersports. ghoward@kent.edu, www.pj2t.org

DXshack FG, J6, 3W, XU, XW TRX+kWAMP+Beam ANT & Bed. URL: // qth.com/dxshack email: xu2a@fsinet.or.jp

MFJ tiny Travel Tuner

Tiny 4½x2¼x3 inch tuner handles full 150 Watts! Covers 80-10 Meters, has tuner bypass switch, tunes nearly anything!

MFJ brings you the *world's smallest* full power 150 Watt 80-10 Meter Antenna Tuner. Extra wide matching range lets you tune nearly any antenna.

It's no toy, its got guts! Built with real *air* variable capacitors (600 Volt, 322 pF) and *three* stacked powder iron toroids to handle real power -- not just QRP. Bypass switch lets you bypass tuner when you don't need it.

You can use nearly any transceiver at full power with nearly any coax fed or random wire antenna for portable, home or mobile operation.

It's perfect for compact rigs like Icom IC-706MKIIG, Yaesu FT-100D, Kenwood TS-50, QRP rigs and others with a built-in SWR meter.

Operate anywhere, anytime with a quick easy set-up! Tune out SWR on your mobile whip from inside your car. Operate in your apartment with a wall-to-wall antenna or from a motel room with a wire dropped from a window or from a mountain top with a wire over a tree limb. Great for DXpeditions or field day. Be prepared for emergencies.

MFJ-902 is so small and handy, you'll rely on it wherever you go! It's easy to pack away in your briefcase, suitcase, backpack, glove compartment or desk drawer. It's tiny enough to slide in your back hip pocket! 4½Wx2¼Hx3D in.

MFJ-902
$79.95 **New!**

Tiny Travel Tuner with 4:1 Balun

MFJ-902H, same as MFJ-902 *Tiny Travel Tuner* but has *4:1 balun* for balanced lines and 5-way binding posts for balanced lines and random wire. 5¾Wx2¼Hx 2¾D inches.

MFJ-902H
$99.95

Tiny Travel Tuner with Cross-Needle SWR/Wattmeter

MFJ-904, same as MFJ-902 *Tiny Travel Tuner* but has *Cross-Needle SWR/Wattmeter.* Read SWR, forward and re-flected power all at a glance in 300/60 and 30/6 Watt ranges. 7¼Hx2¼Hx2¾D in.

MFJ-904
$109.95

ALL-in-one *Tiny Travel Tuner* with 4:1 Balun *and* SWR/Wattmeter

ALL-in-one! MFJ-904H, same as MFJ-902 *Tiny Travel Tuner* but has *4:1 balun for balanced lines* and Cross-Needle SWR Wattmeter. Read SWR, forward and reflected power all at a glance in 300/60 and 30/6 Watt ranges. Has 5-way binding posts for balanced lines and random wire. 7¼Hx2¼Hx2¾D inches.

MFJ-904H
$129.95

Long 10/12 foot Telescoping Whips

MFJ-1954
$19.95
10 Feet

MFJ-1956
$29.95
12 Feet

10 foot extended, 19 inches collapsed, MFJ-1954, $19.95. 12 foot extended, 22.5 inches collapsed. MFJ-1956, $29.95. Standard 3/8 inch by 24 threaded stud for use with all standard mounts. Durable 1/2 inch diameter plated brass. Telescopes for full 1/4 wave operation 2 to 12/15 Meters. Cover 17, 20, 30, 40, 60, 80, 160 Meters with loading coil. Use two for multi-band dipoles. Replace screwdriver antenna whip for highly efficient *fixed* mobile operation.

MFJ RF Isolator

MFJ-915 *RF Isolator*

MFJ-915
$29.95

prevents unwanted RF from traveling on the outside of your coax shield into your transceiver. This unwanted stray RF can cause painful RF "bites" when you touch your microphone or volume control, cause your display or settings to go crazy, lock up your transceiver or turn off your power supply. In mobile installations, stray RF could cause your car to do funny things even blow your car computer. Clear up these problems, plug an MFJ-915 between your antenna and transceiver. *Don't operate without one!* 5x1½ inches. For 1.8 to 30 MHz.

Portable Collapsible Antenna Tri-Pod

Holds 66 pounds of antenna steady. Black *steel* base forms strong braced equilateral triangle 40 inches on a side. Non-skid feet. One inch diameter steel mast extends height to six feet. Strong base and mast locks. Easily add antenna mount or mast extension for greater heights. Collapses to 38 inches by 4 inch diameter. 6¾ pounds.

MFJ-1918
$39.95

40-10M G5RV Junior
MFJ-1778M, $34.95.
Half-size 52 foot *G5RV Jr* 40-10 Meters, 1500 Watts.

1500 Watt Lightning Surge Protector

MFJ-272
$39.95

Protect your expensive transceiver from static electricity and lightning induced surges with an ultra-fast gas discharge tube. Plug between rig and antenna, attach ground. DC to 1000 MHz. SO-239s.

All-Band G5RV Antenna

MFJ-1778
$39.95

Cover all bands, 160-10M with tuner. 102 ft. long, 1.5kW. Custom fiberglass insulator stress relieves 450 Ohm ladder line. Use horizontally, as inverted vee or sloper. Marconi on 160M.

Glazed Ceramic Antenna Insulator

MFJ-16C06
$3.95
Package of six. (69 cents each)

Authentic *glazed ceramic* antenna insulator. Extra-strong -- will not break with long antennas and will not arc over or melt even under full legal power. Molded ridges give extra-long high voltage path to prevent high-voltage breakdown. Smooth wire holes prevent wire damage. Use as center or end insulator for dipoles, doublets, G5RVs, guy wires and others.

Current Balun/Center Insulator

MFJ-918
$24.95

True *1:1 Current Balun/Center Insulator* forces equal currents into dipole halves to reduce coax feedline radiation and field pattern distortion. Reduces TVI, RFI and RF hot spots in your shack. 50 ferrite beads on *Teflon*(R) coax. 1.5kW, 1.8-30 MHz. Stainless steel hardware. *Direct* antenna connection. 5x1½ in.

Free MFJ Catalog

and Nearest Dealer . . . 800-647-1800

http://www.mfjenterprises.com

• 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 . . . the world leader in ham radio accessories!

FOR SALE IN MORRIS COUNTY, NEW JERSEY: 2 family income property on approximately 1 1/2 acres. Main house approximately 2500 sq ft, 3 bedrooms, 2 1/2 baths, living room, dining room, great room with fireplace. Separate 3 car garage with 4 room apartment above and separate radio room. 2 towers. Big monobanders on 10, 15 and 20. $525,000. E-mail wb2ghv@optonline.net. Convenient to Routes 23, 15 and 80.

Enjoy great Caribbean ham fellowship/vacation on the island of Martinique at the 2004 Hamboree! April 9-13: Forums, tours, DX operating. See www.caribbeanhamboree.org or www.fairs.org

SUN CITY WEST AZ: Beautiful 2-bedroom luxury home with family room plus utility/hobby room. 2103 Sq. ft. on 77' x 125' property, suitable for antenna. Double garage, all appliances included. $174,900. Taxes $834. Active adult community, safe, quiet and affordable. N7RH@azqth.com. Don Steele, Ken Meade Realty, 623-521-5254

TO BUY A HOME for that antenna tower or any type of home in Palm Beach county, Florida, call me, **Mort Penn, K1MP, Realtor with Coldwell Banker,** 561-642-1900 or 561-308-6676 mortpenn@bellsouth.net

TURKS AND CAICOS "HAM-LET" VACATION: House with station, highspeed internet. **Providenciales** above ocean. VP5JM, 649-946-4436 or E-mail: jody@tciway.tc

TURKS AND CAICOS: 3br/2 bath; pristine beach; XYL approved deluxe accommodations; rigs; amps; antennas. www.qth.com/vp5 270-259-4530; k4isv@k105.com **For rent or sale**

VY2TT www.peidxlodge.com

Antique/Vintage/Classic

ANTIQUE RADIO CLASSIFIED. Free sample copy! Antique radio's largest-circulation monthly magazine. Old radios, TVs, ham equip., 40s & 50s radios, telegraph, books & more. Ads & articles. Free 20-word ad monthly. Subscribe today. Six-month trial: $19.95. Yearly rates: $39.49 ($57.95 by 1st Class). Foreign: write. ARC, PO Box 802-B22A, Carlisle, MA 01741. Phone: 978-371-0512, Fax: 978-371-7129, Web: www.antiqueradio.com

ANTIQUE WIRELESS ASSOCIATION. The organization for all enthusiasts of antique and historical radio! Publishes OLD TIMER'S BULLETIN, 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 $20/year USA, $25 elsewhere. Antique Wireless Association, Box E, Dept. 1, Breesport, NY 14816. Check our Website: http://www.antiquewireless.org

APPLE 1 microcomputer for sale. Very rare. PO Box 179, Floyd, VA 24091. KK4WW, 1-540-763-2534 or Land@swva.net

MFJ TUNERS

MFJ-989C *Legal Limit* Antenna Tuner

MFJ uses super heavy duty components to make the world's finest legal limit tuner

MFJ uses super heavy duty components -- roller inductor, variable capacitors, antenna switch and balun -- to build the world's most popular high power antenna tuner.

MFJ-989C
$359.95

The rugged world famous MFJ-989C handles 3 KW PEP SSB amplifier input power (1500 Watts PEP SSB output power). Covers 1.8 to 30 MHz, including MARS and WARC bands.

MFJ's *AirCore*™ roller inductor, new *gear-driven* turns counter and weighted spinner knob gives you exact inductance control for absolute minimum SWR.

You can match dipoles, verticals, inverted vees, random wires, beams, mobile whips, shortwave -- nearly any antenna. Use coax, random wire or balanced lines.

You get everything you've ever wanted in a high power, full featured antenna tuner -- widest matching range, lighted Cross-Needle SWR/Wattmeter, massive transmitting variable capacitors, ceramic antenna switch, built-in dummy load, *TrueCurrent*™ Balun, *scratch-proof* Lexan front panel -- all in a sleek compact cabinet (10¾Wx4½Hx15D in).

MFJ AirCore™ Roller Inductor gives high-Q, low loss, high efficiency and high power handling.

MFJ's exclusive *Self-Resonance Killer*™ keeps damaging self-resonances away from your operating frequency.

Large, self-cleaning wiping contact gives good low-resistance connection. Solid 1/4 inch brass shaft, self-align bearings give smooth non-binding rotation.

MFJ *No Matter What*™ Warranty

MFJ will repair or replace your MFJ-989C (at our option) *no matter what* for one year.

More hams use MFJ tuners than all other tuners in the world!

MFJ-986 Two knob *Differential-T*™

MFJ-986
$329.95

Two knob tuning (differential capacitor and *AirCore*™ roller inductor) makes tuning foolproof and easier than ever. Gives minimum SWR at only one setting. Handles 3 KW PEP SSB amplifier input power (1.5 KW output). Gear-driven turns counter, lighted peak/average Cross-Needle SWR/Wattmeter, antenna switch, balun. 1.8 to 30 MHz. 10¾Wx4½Hx15 in.

MFJ-962D *compact* Tuner for Amps

MFJ-962D
$269.95

A few more dollars steps you up to a KW tuner for an amp later. Handles 1.5 KW PEP SSB amplifier input power (800W output). Ideal for Ameritron's AL-811H! *AirCore*™ roller inductor, gear-driven turns counter, pk/avg lighted Cross-Needle SWR/Wattmeter, antenna switch, balun, Lexan front, 1.8-30MHz. 10¾x4½x10⅞ in.

MFJ-969 300W *Roller Inductor* Tuner

MFJ-969
$199.95

Superb *AirCore*™ Roller Inductor tuning. Covers *6 Meters* thru 160 Meters! 300 Watts PEP SSB. *Active* true peak reading lighted Cross-Needle SWR Wattmeter, *QRM-Free PreTune*™, antenna switch, dummy load, 4:1 balun, Lexan front panel. 3½Hx10½Wx9½D inches.

MFJ-949E *deluxe* 300 Watt Tuner

MFJ-949E
$149.95

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, $129.95.** Economy version of MFJ-949E, less dummy load, Lexan front panel.

MFJ-941E *super value* Tuner

MFJ-941E
$119.95

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-945E HF+6 Meter *mobile* Tuner

MFJ-945E
$109.95

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, $4.95,** mobile mount.

MFJ-971 *portable/QRP* Tuner

MFJ-971
$99.95

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 inches.

MFJ-901B *smallest* Versa Tuner

MFJ-901B
$79.95

MFJ's smallest (5x2x6 in.) and most affordable wide range 200 Watt PEP Versa tuner. Covers 1.8 to 30 MHz. Great for matching solid state rigs to linear amps.

MFJ-16010 *random* wire Tuner

MFJ-16010
$49.95

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-906/903 *6 Meter* Tuners

MFJ-906
$79.95

MFJ-906 has lighted Cross-Needle SWR/Wattmeter, bypass switch. Handles 100 W FM, 200W SSB. **MFJ-903, $49.95**, Like MFJ-906, less SWR/Wattmeter, bypass switch.

MFJ-921/924 *VHF/UHF* Tuners

MFJ-921 or MFJ-924
$69.95

MFJ-921 covers 2 Meters/220 MHz. **MFJ-924** covers 440 MHz. SWR/Wattmeter. 8x2½x3 inches. Simple 2-knob tuning for mobile or base.

MFJ-922 144/440 MHz Tuner

MFJ-922
$79.95

Ultra tiny 4x2½x1¼ inch tuner covers VHF 136-175 MHz and UHF 420-460 MHz. SWR/Wattmeter reads 60/150 Watts.

MFJ-931 *artificial* RF Ground

MFJ-931
$89.95

Creates artificial RF ground. Also electrically places a far away RF ground directly at your rig by tuning out reactance of connecting wire. Eliminates RF hot spots, RF feedback, TVI/RFI, weak signals caused by poor RF grounding. **MFJ-934, $169.95**, Artificial ground/300 Watt Tuner/Cross-Needle SWR/Wattmeter.

Free MFJ Catalog
and Nearest Dealer . . . 800-647-1800

http://www.mfjenterprises.com

1 Year *No Matter What*™ warranty 30 day money back guarantee (less s/h) on orders from MFJ

MFJ ENTERPRISES, INC.
Box 494, Miss. State, MS 39762
(662) 323-5869; 8-4:30 CST, Mon.-Fri.
FAX: (662) 323-6551; **Add s/h**
Tech Help: (662) 323-0549

BROADCAST MICROPHONES and accessories (call letter plates, stands) wanted: early carbon, condenser, ribbon, dynamic models. Cash or trade. James Steele, Box 610, Kingsland, GA 31548. 912-729-6106. jsteele@k-bay106.com; http://www.k-bay106.com/mics.htm

CODE PRACTICE OSCILLATOR MUSEUM: http://www.n4mw.com

COLLINS REPAIR - Specializing in S-Line and KWM2. Precision Collins Services, N6HK 661-822-6850. n6hk@csurfers.net

FOR SALE: Collins KWM2-30L1. One owner. WB4VKL, 478-955-3000

NEED: 4 small knobs and bandwith knob for NC 270 receiver, WB0MPG

OUR Asheville, NC ~Southern Appalachian Radio Museum~ keeps history alive! - www.saradiomuseum.org Donations appreciated.

TELEGRAPH KEYS wanted by collector. Bugs and unusual or unique straight keys or sounders, and tube electronic keyers. Also pre-1950 callbooks. Vince Thompson, K5VT, 3410 N. 4th Ave., Phoenix, AZ 85013. 602-840-2653.

TELEGRAPH MUSEUM / COLLECTOR'S INFORMATION: http://w1tp.com

W4QCF MANUALS - buy/sell, www.w4qcfmanuals.com

WANTED: Hickok 539C tube tester, E.H. Scott radios. Carter Elliott, WD4AYS, 1460 Pinedale Road, Charlottesville, VA 22901, 434-979-7383, CElliott14@aol.com

WANTED: pre-1925 battery radios, crystal sets, and vacuum tubes. Also early telegraph keys and pre-1900 electrical apparatus. Jim Kreuzer, N2GHD, 1541 Bronson Road, Grand Island, NY 14072. 716-773-4999. wireless@pce.net

QSL Cards/Call Sign Novelties

100 QSL CARDS $10.00 postpaid. We also print color QSL cards, eyeball cards etc. Send stamp for sample. Vaso Nagl, KD4WVK, 832 Woodcraft Drive, Nashville, TN 37214

AFFORDABLE QSL CARDS available in small quantities with lots of options. Parma Graphics, K2BKA, 5 Rondout Harbor, Port Ewen, NY 12466. 845-339-1996.

CALL SIGN NAME BADGES Club logos our specialty. Certified ARRL engraver. Capital Engraving, 3109 Marigold St, Longview, Washington 98632-3415. Al, WA7UQE. capengrave@kalama.com. http://www.kalama.com/~capengrave/

ENGRAVING: Callsign/name badges by WØLQV. Send for price list. Box 4133, Overland Park, KS 66204-0133. E-mail: LQ225147@juno.com

FREE SAMPLES: The QSLMAN®, Box 73, Monetta, SC 29105. Phone/FAX (803) 685-7117 anytime. Email: w4mpy@qslman.com. Always 100% satisfaction guarantee on anything we do. Check the web site at: http://www.qslman.com

1.8-170 MHz *plus* 415-470 MHz
MFJ HF/VHF/UHF Antenna Analyzer

All-in-one handheld antenna test lab lets you quickly check and tune HF, VHF, UHF antennas anywhere. Covers 1.8-170 MHz and 415-470 MHz

Measures: SWR...Return Loss...Reflection Coefficient...Antenna Resistance(R), Reactance(X), Impedance(Z) and Phase Angle(degrees) ... Coax cable loss(dB) ... Coax cable length ... Distance to short or open in coax ... Inductance ... Capacitance ... Resonant Frequency ... Bandwidth ... Q ... Velocity Factor ... Attenuation ... Has: LCD readout ... frequency counter ... side-by-side meters ... Ni-MH/Ni-Cad charger circuit ... battery saver ... low battery warning ... smooth reduction drive tuning ... One year No Matter What™ warranty...

NEW

MFJ-269 **$359.95**

You can instantly get a complete picture, check and tune any antenna from 1.8 to 170 MHz and 415 to 470 MHz -- an MFJ-269 exclusive -- with this rugged easy-to-use handheld antenna test lab! You can measure virtually every antenna parameter.

You won't believe its capability and versatility. This rugged handheld unit literally replaces a workbench full of expensive delicate test equipment.

SWR Analyzer

You can read SWR, return loss, reflection coefficient and match efficiency at any frequency simultaneously at a single glance.

Complex Impedance Analyzer

Read Complex Impedance (1.8 to 170 MHz)as series equivalent resistance and reactance (Rs+jXs) or as magnitude (Z) and phase (degrees). Also reads parallel equivalent resistance and reactance (Rp+jXp) -- *an MFJ-269 exclusive!*

Coax Analyzer

You can determine velocity factor, coax loss in dB, length of coax and *distance to short or open in feet (it's like a built-in TDR).*

CoaxCalculator™ lets you calculate coax line length in feet given electrical degrees and vice versa for any frequency and any velocity factor -- *an MFJ-269 exclusive!*

Use any Characteristic Impedance

You can measure SWR and loss of coax with *any* characteristic impedance (1.8 to 170 MHz) from 10 to over 600 Ohms, including 50, 51, 52, 53, 73, 75, 93, 95, 300, 450 Ohms -- *an MFJ-269 exclusive!*

Inductance/Capacitance Meter

Measures inductance in uH and capacitance in pF at RF frequencies, 1.8-170 MHz.

Frequency Counter/Signal Source

You can also use it as a handy frequency counter up to 170 MHz and as a signal source for testing and alignment.

Digital and Analog displays

A high contrast LCD gives precision readings and two side-by-side analog meters make antenna adjustments smooth and easy.

415 to 470 MHz Range features

Just plug in your UHF antenna coax, set frequency and read SWR, return loss and reflection coefficient simultaneously. You can read coax cable loss in dB and match efficiency.

You can adjust UHF dipoles, verticals, yagis, quads and others and determine their SWR, resonant frequency and bandwidth.

You can test and tune stubs and coax lines. You can manually determine velocity factor and impedances of transmission lines.

You can adjust/test RF matching networks and RF amplifiers without applying power.

Has easy-to-read LCD *logarithmic* SWR bargraph and SWR meter for quick tuning.

Much Better Accuracy

New 12-bit A/D converter gives much better accuracy and resolution than common 8-bit A/D converters -- *an MFJ-269 exclusive!*

Super Easy-to-Use

Select a band and mode. Set frequency. Your measurements are instantly displayed! Smooth reduction drive tuning makes setting frequency easy.

Take it anywhere

Take it anywhere - to remote sites, up towers, in cramp places. Fully portable -- battery operated, compact 4Wx2Dx6¾ in., weighs 2 lbs. *Free* "N" to SO-239 adapter.

Has battery saver, low battery warning and built-in charging circuit for rechargeables.

Use 10 AA Ni-MH or Ni-Cad or alkaline batteries (not incl.) or 110VAC with MFJ-1315, $14.95.

MFJ SWR Analyzer Accessories

MFJ-39C, $24.95.

Tote your MFJ-269 anywhere with this *genuine* MFJ custom carrying case. Has back pocket with security cover for carrying dip coils, adaptors and accessories. Made of special foam-filled fabric, the MFJ-39C cushions blows, deflects scrapes, and protects knobs, meters and displays from harm.

Wear it around your waist, over your shoulder, or clip it onto the tower while you work -- the fully-adjustable webbed-fabric carrying strap has snap hooks on both ends.

Has clear protective window for frequency display and cutouts for knobs and connectors -- use your MFJ *SWR Analyzer™* without ever taking it out of your case. *Authentic MFJ leather logo distinguishes the real thing from imitators!*

MFJ-66, $19.95.

Plug these MFJ dip meter coupling coils into your MFJ *SWR Analyzer™* and turn it into a sensitive and accurate *band switched* dip meter. Set of two coils cover 1.8-170 MHz depending on your MFJ-269 *SWR Analyzer™*.

MFJ-99C, $34.95.

SWR Analyzer Power Pack. 10 Pack MFJ *SuperCell™* Ni-MH batteries, and MFJ-1315 Power supply for MFJ-269 SWR analyzers. ***Save $5!***

MFJ-98, $54.85.

MFJ-269 Accessory Pack. MFJ-39C *custom* Carrying Pouch, MFJ-66 dip coil adapters, MFJ-1315 power supply for MFJ-269. ***Save $5!***

MFJ-98B, $77.85.

MFJ-269 Deluxe Accessory Pack. Complete accessory pack! MFJ-39C Pouch, 10 Ni-MH batteries, dip coils, power supply. ***Save $7!***

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

General

#1 AMATEUR CALLSIGN CD-ROM. "HamCall" contains 1.7+ million world wide callsigns. Works with logging programs. Six FREE monthly Internet updates. Check/Visa/MC. $50, $5 ship/handling. Buckmaster, 6196 Jefferson Hwy., Mineral, Virginia 23117. 800-282-5628, http://hamcall.net/

"EVERYTHING FOR THE MORSE ENTHUSIAST." **Morse Express**. Keys, keyers, kits, books. 303-752-3382. http://www.MorseX.com

2004 **CALLBOOK** CD-ROM: $39.95. ARRL books/CDs **DISCOUNTED**. AA6EE@amsat.org; www.radiodan.com/aa6ee

3300+ DIFFERENT AWARDS online. Annual subscription $6. http://www.dxawards.com/offer.html

ADVANCED PCB DESIGN offers schematic capture and PCB layout services. Analog, Digital and RF circuits. Commercial and Military applications. Over 20 years experience. Reasonable rates. Call W2FGV at 1-888-618-7267.

ALUMINUM CHASSIS AND CABINET KITS. UHF-VHF Antenna Parts, Catalog E-mail: k3iwk@flash.net or http://www.flash.net/~k3iwk

AMATEUR RADIO PAINTS www.nctotalelectronics.com 336-229-5671 or ke4lgx@yahoo.com

AMATEUR RADIO SERVICE/ALIGNMENT. Authorized Kenwood, ICOM & Yaesu Service Center including: Amplifiers & Tuners. <N1IMO Bernie, W1ZC Dick, KA1SU Jim> Beltronics, Inc., Hollis, NH, 603-465-2422 www.beltronics.net hamrepairs@beltronics.net

ANDERSON POWER POLES 25 sets $18.95 + 2.50 shipping. KG6POY, www.hamneeds.com

MFJ *Switching* Power Supplies

Power your HF transceiver, 2 meter/440 MHz mobile/base and accessories with these new 25 or 45 Amp MFJ MightyLite™ Switching Power Supplies!

No RF hash . . . Super lightweight . . . Super small . . . Volt/Amp Meters . . .

MFJ's new adjustable voltage switching power supplies do it all! Power your HF or 2M/440 MHz radio and accessories.

MFJ's *MightyLites*™ are so light and small you can carry them in the palm of your hand! Take them with you anywhere.

No more picking up and hauling around heavy, bulky supplies that can give you a painful backache, pulled muscle or hernia.

MFJ's 25 Amp *MightyLite*™ weighs just 3.7 lbs. -- that's *5 times lighter* than an equivalent conventional power supply. MFJ's 45 Amp is even more dramatic -- *8 times lighter* and weighs just 5.5 pounds!

No RF hash!

These babies are clean . . . Your buddies won't hear *any* RF hash on your signal! *None* in your receiver either!

Some competing switching power supplies generate objectionable RF hash in your transmitted and received signal.

These super clean MFJ *MightyLites*™ meet all FCC Class B regulations.

Low Ripple . . . Highly Regulated

Less than 35 mV peak-to-peak ripple under 25 or 45 amp full load. Load regulation is better than 1.5% under full load.

Fully Protected

You won't burn up our power supplies!

No RF Hash!

MFJ-4225MV
25 Amp
$149.95
plus s&h

MFJ-4245MV
45 Amp
$199.95
plus s&h

No RF Hash!

They are fully protected with Over Voltage and Over Current protection circuits.

Worldwide Versatility

MFJ *MightyLites*™ can be used anywhere in the world! They have switchable AC input voltage and work from 85 to 135 VAC or 170 to 260 VAC. Replaceable fuse.

MightyLites™ . . . Mighty Features

Front-panel control lets you vary output from 9 to 15 Volts DC.

Front-panel has easy access five-way binding posts for heavy duty use and cigarette lighter socket for mobile accessories. MFJ-4245MV has two sets of quick-connects on the rear for accessories.

Brightly illuminated 3 inch meters let you monitor load voltage and current.

A whisper quiet internal fan efficiently cools your power supply for long life.

Two models to choose from . . .

MFJ-4225MV, $149.95. 25 Amps maximum or 22 Amps continuous. Weighs 3.7 pounds. Measures 5¾Wx4½Hx6D in.

MFJ-4245MV, $199.95. 45 Amps maximum or 40 Amps continuous. Weighs 5.5 pounds. Measures 7½Wx4¾Hx9D in.

NEW! 25 Amp MightyLite™

Super light, super compact switching power supply delivers 25 Amps maximum/ 22 Amps continuous at 13.8 Volts DC. Low ripple, highly regulated. ***No RF Hash!*** Five-way binding posts for high current. Quick connects for accessories. Over voltage/current protection. 110 or 220 VAC operation. Meets FCC Class B regs. 3.5 lbs. 5½Wx2½Hx10¾D in.

MFJ-4125
25 Amp
$109.95
plus s&h

MFJ 35/30 Amp Adjustable Regulated DC Power Supply

Massive 19.2 pound transformer . . . No RF hash . . . Adjustable 1 to 14 VDC . . .

MFJ-4035MV
$149.95
plus s&h

MFJ's heavy duty conventional power supply is excellent for powering HF or 2 Meter/440 MHz transceiver/accessories.

A massive 19.2 pound transformer makes this power supply super heavy duty! It delivers 35 amps maximum and 30 amps continuous without even flexing its muscles. Plugs into any 110 VAC wall outlet.

It's highly regulated with load regulation better than 1%. Ripple voltage is less than 30 mV. *No RF hash* -- it's super clean!

Fully protected -- has over voltage protection, fold back short circuit protection and over-temperature protection.

You get front panel adjustable voltage from 1 to 14 VDC with a convenient detent set at 13.8 VDC. A pair of front-panel meters let you monitor voltage and current.

Three sets of output terminals include a pair of heavy duty five-way binding posts for HF/VHF radios, two pairs of quick-connects for accessories and a covered cigarette lighter socket for mobile accessories.

A front-panel fuse holder makes fuse replacement easy. Whisper quiet fan speed increases as load current increases -- keeps components cool. 9½Wx6Hx9¾D inches.

MFJ *High Current* Multiple DC Power Outlets

Power two HF/VHF transceivers and six or more accessories from your 12 VDC power supply

MFJ-1118
$74.95
plus s&h

MFJ-1116
$49.95
plus s&h

MFJ-1112
$34.95
plus s&h

New!
MFJ-1117
$54.95

MFJ-1118, $74.95. This is MFJ's most versatile and highest current *Deluxe Multiple DC Power Outlet.* Lets you power two HF and/or VHF transceivers and six or more accessories from your transceiver's main 12 VDC supply.

Two pairs of super heavy duty 30 amp 5-way binding posts connect your transceivers. Each pair is fused and RF bypassed. Handles 35 Amps total.Six pairs of heavy duty, RF bypassed 5-way binding posts let you power your accessories. They handle 15 Amps total, are protected by a master fuse and have an ON/OFF switch with "ON" LED indicator.

Built-in 0-25 VDC voltmeter. Six feet super heavy duty eight gauge color-coded cable with ring tongue terminals. Binding posts are spaced for standard dual banana plugs. Heavy duty aluminum construction. 12½x2¾x2½ in.

MFJ-1116, $49.95. Similar to MFJ-1118. No 30 amp posts. Has "ON" LED and 0-25 VDC voltmeter. 15 amps total.

MFJ-1112, $34.95. Similar to MFJ-1116. No on/off switch, LED, meter, fuse.

NEW! MFJ-1117, $54.95. For powering four HF /VHF radios (two at 35 Amps each and two at 35 Amps combined) simultaneously. Tiny 8x2x3 inches.

Free MFJ Catalog
Nearest Dealer . . . 800-647-1800

http://www.mfjenterprises.com

• 1 Year *No Matter What*™ warranty • 30 day money back guarantee (less s/h) on orders direct from MFJ

MFJ ENTERPRISES, INC.
Box 494, Miss. State, MS 39762
(662) 323-5869; 8-4:30 CST, Mon.-Fri.
FAX: (662) 323-6551; **Add s/h**
Tech Help: (662) 323-0549

All are protected by MFJ's famous No Matter What™ one year limited warranty.

MFJ Sound Card-to-Rig Interface

Use sound card and rig for all digital modes!

Plug and Play -- includes software, all cables, AC power supply . . . RFI-proof . . . Isolation transformers -- no hum, noise, distortion . . . Operate PSK-31, packet, APRS, AMTOR, RTTY, SSTV, CW, Meteor Scatter, others . . . Use as Voice Keyer, CW Contest Memory Keyer . . . Monitor On/Off Switch . . .

MFJ1275/M/T
$99.95

New! *Includes AC power supply, RS-232 cable!*

Plug this new MFJ-1275/M/T sound card interface between your transceiver and computer and enjoy operating all digital modes.

Everything you need is included -- software, audio cables, RS-232 serial cable and AC power supply.

Provides fully automatic operation with audio and push-to-talk control. It matches sound card audio, eliminates ground loops and provides microphone override.

Models available for all transceivers with 8-pin round, 8-pin modular (RJ-45) or 4-pin round microphone plugs.

Operate PSK-31, packet, APRS, AMTOR, RTTY, SSTV, CW, high speed CW Meteor Scatter and many others. Also use as Contest Voice Keyer and CW Contest Memory Keyer.

Digital Modes or Normal Operation

Select the ON digital mode -- all connections are made between your rig and computer for instant digital operation.

Select BYPASS normal mode -- your transceiver and computer connections are restored for their normal operation.

Audio Isolation Transformers

Audio isolation transformers and relay eliminate ground loops, audio hum, noise and distortion.

RFI-Proof

Extensive RF suppression and line isolation eliminates RF feedback problems.

Automatic Microphone Override

Transmit mic audio at any time by pressing PTT to override digital modes -- great for SSTV and Contest Voice Keyer.

More Impressive Features

Serial port -- lets computer control radio to override/interrupt digital transmissions.

VOX Control -- lets you use VOX control when not using computer serial port control.

Level Controls -- for transmitter drive and for receiver-to-sound card drive level. No need to adjust microphone gain or sound card level when you change modes.

Stereo or Mono Audio Input -- A front panel switch selects left, right, or both sound card audio output channels to accommodate various programs.

Off-the-air recording -- for replaying or for use with spectrum analyzer programs.

Monitor on/off switch lets you have a normal QSO and receive SSTV pictures at the same time in the *"monitor on"* position. This is great for modes like SSTV and Voice Keyer operation that may require listening to receive audio during operation.

Rugged Construction -- All aluminum cabinet and surface-mount construction gives you years of trouble-free service.

Use any Transceiver

Internal jumpers program microphone wiring for any brand or model radio -- no soldering required. Order **MFJ-1275** for 8-pin *round* mic plug. Order **MFJ-1275M** for 8-pin *modular* mic (RJ45) plug.

NEW! Order MFJ-1275T, for *4-pin round* mic plug, for Ten-Tec and others.

Plug and Play!

Everything you need is included --audio and RS-232 cables, AC power supply and a CD with a collection of the most popular amateur radio software to operate PSK-31, RTTY, SSTV, PACKET, AMTOR, CW, HSCW Meteor Scatter, Contest Voice Keying and other modes. Use 12 VDC or 110 VAC.

No Matter What™ Warranty

Protected by MFJ's famous *No Matter What*™ one year limited warranty. MFJ will repair or replace (at our option) your MFJ-1275/M/T *no matter what* for one full year.

Try it for 30 Days

Order from MFJ and try it -- no obligation. If not delighted, return it within 30 days for refund less shipping.

New! *Super* Sound Card Interface

MFJ-1279/M/T
$129.95

This *super* sound card interface has all of the features of the MFJ-1275 ***plus . . .***

- **Auxiliary Input Jack:** Lets you switch your sound card from MFJ-1279 so you can use your sound card for something else. No more plugging/unplugging!
- **Direct CW/FSK Keying Jack:** Allows direct CW or FSK keying operation.
- **Headphone Jack:** Use your stereo headphones so you won't disturb your XYL (also turns off external speaker).
- **Footswitch:** Use footswitch or other for PTT (push-to-talk) when not using VOX.

Plug and Play! Includes software CD, RS-232 and audio cables, AC power supply.

Order MFJ-1279 for 8-pin round mic, MFJ-1279M for 8-pin modular (RJ-45) mic, MFJ-1279T for 4-pin round mic.

Add "X" suffix for 220VAC.

New! *Basic* Digital Interface

MFJ-1273B
$59.95

Plug and Play! Has sound card, radio, speaker, RS-232 jacks. Includes: software CD and RS-232, audio, mic cables. No external power needed. Has no mic jack or mic switch. **Order** MFJ-1273B for 8 pin round mic, MFJ-1273BM for 8-pin modular (RJ-45) mic, MFJ-1273BT for 4-pin round mic.

DSP Sound Card Programs

MFJ-1296, $129.95. *RadioCom4* integrates PSK31, SSTV, FAX/Sat FAX, RTTY, SITOR, DSP audio filters and radio control.

MFJ-1298, $199.95. *RadioCom5* -- all features of *RadioCom4* plus DSP Audio Filter analyzer, Spectrum Analyzer, Dual Scope Display, Sound Recorder, Time and Frequency Management, Frequency Analyzer, 3D Scanner, Satellite tracking, Rig Control for over 80 radios, more! **Free demo at:** ***www.mfjenterprises.com/freedemo.php***

Free MFJ Catalog

and Nearest Dealer . . . 800-647-1800

http://www.mfjenterprises.com

• 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 . . . the world leader in ham radio accessories!

10 Bands -- 1 MFJ Antenna!

Full size performance . . . No ground or radials

Operate 10 bands: 75/80, 40, 30, 20, 17, 15, 12, 10, 6 and 2 Meters with one antenna Separate full size radiators . . . End loading . . . Elevated top feed . . . Low Radiation Angle . . . Very wide bandwidth . . . Highest performance no ground vertical ever . . .

Operate 10 bands -- 75/80, 40, 30, 20, 17, 15, 12, 10, 6 and 2 Meters with this MFJ-1798 vertical antenna and get *full size performance* with no ground or radials!

Full size performance gives high efficiency for more power radiated. Results? Stronger signals and more Q-5 QSOs.

Full size performance also gives you exceptionally wide bandwidths so you can use more of your hard earned frequencies.

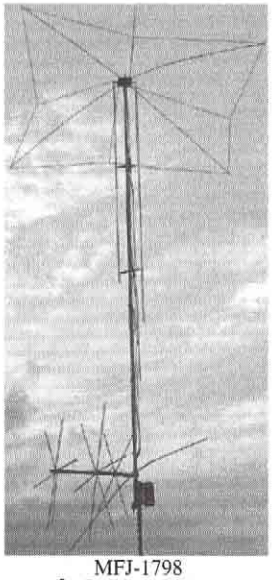
Full size performance is achieved using separate full size radiators for 2-20 Meters and highly efficient end loading for 30, 40, 75/80 Meters.

Get very low radiation angle for exciting DX, automatic bandswitching, omni-directional coverage, low SWR. Handles 1500 Watts PEP SSB.

MFJ's unique *Elevated Top Feed*™ elevates the feedpoint *all the way to the top* of the antenna. It puts the maximum radiation point high up in the clear where it does the most good -- your signal gets out even if you're ground mounted.

It's easy to tune because adjusting one band has minimum effect on the resonant frequencies of other bands.

Self-supporting and just 20 feet tall, the MFJ-1798 mounts easily from ground level to tower top -- small lots, backyards, apartments, condos, roofs, tower mounts.



MFJ-1798
$289.95
Ship Code F

Separate Full Size Radiators

Separate *full size* quarter wave radiators are used on 20, 17, 15, 12, 10 and 2 Meters. On 6 Meters, the 17 Meter radiator becomes a 3/4 wave radiator.

The active radiator works as a stub to decouple everything beyond it. *In phase* antenna current flows in all parallel radiators.

This forms a very large equivalent radiator and gives you incredible bandwidths.

Radiator stubs provide automatic bandswitching -- absolutely *no loss* due to loading coils or traps.

End Loading

On 30, 40, 75/80 Meters, end loading -- the most efficient form of loading -- gives you highly efficient performance, excellent bandwidth, low angle radiation and automatic bandswitching.

MFJ's unique *Frequency Adaptive L-Network*™ provides automatic impedance matching for lowest SWR on these low bands.

Tuning to your favorite part of these bands is simple and is done at the *bottom* of the antenna.

No Ground or Radials Needed

You don't need a ground or radials because an effective counterpoise that's 12 feet across gives you *excellent* ground isolation.

You can mount it from ground level to roof top and get awesome performance.

No Feedline Radiation to Waste Power

The feedline is decoupled and isolated from the antenna with MFJ's exclusive *AirCore*™ high power current balun. It's wound with *Teflon*® coax and can't saturate, no matter how high your power.

Built to Last

Incredibly strong solid fiberglass rod and large diameter 6061 T-6 aircraft strength aluminum tubing is in the main structure.

Efficient high-Q coils are wound on tough *low loss* fiberglass forms using highly weather resistant *Teflon*® covered wire.

MFJ's Super High-Q Loop™ Antennas

MFJ-1786
$379.95
Ship Code F

MFJ's *tiny* 36 inch diameter loop antenna lets you operate 10 through 30 MHz *continuously* -- including the WARC bands!

Ideal for limited space -- apartments, small lots, motor homes, attics, or mobile homes.

Enjoy both DX and local contacts mounted vertically. Get both low angle radiation for excellent DX and high angle radiation for local, close-in contacts. Handles 150 watts.

Super easy-to-use! Only MFJ's super remote control has *Auto Band Selection*™. It auto-tunes to desired band, then beeps to let you know. No control cable is needed.

Fast/slow tune buttons and built-in two range Cross-Needle SWR/Wattmeter lets you quickly tune to your exact frequency.

All welded construction, no mechanical joints, welded butterfly capacitor with no rotating contacts, large 1.050 inch diameter round radiator -- not a lossy thin flat-strip -- *gives you highest possible efficiency.*

Each plate in MFJ's tuning capacitor is welded for low loss and polished to prevent high voltage arcing, welded to the radiator, has nylon bearing, anti-backlash mechanism, limit switches, continuous no-step DC motor -- gives smooth precision tuning.

Heavy duty thick ABS plastic housing has ultraviolet inhibitor protection.

NEW! **MFJ-1788, $429.95.** Same as MFJ-1786 but covers 40 Meters-15 Meters continuous. Includes super remote control.

MFJ-1782, $339.95. Like MFJ-1786 but control has only fast/slow tune buttons.

MFJ-1780, $249.95. *Box Fan* Portable Loop is about the same size (2x2 foot) as a box fan, complete with handle. Covers 14-30 MHz. Control has fast/slow tunes.

MFJ Portable Antenna

MFJ-1621 **$89.95** Ship Code A

MFJ-1621 lets you operate in most any electrically free area -- apartment, campsite, hotel, the beach, etc. DXCC, WAZ, WAC, WAS have been won with MFJ-1621! Work 40, 30, 20, 17, 15, 12 and 10 Meters with a telescopic whip that extends to 54 inches. Mounted on a sturdy 6x3x6 inch cabinet. Built-in antenna tuner, field strength meter, and 50 feet of RG-58 coax cable. Handles 200 Watts.

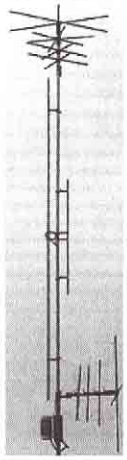
MFJ's G5RV Antenna

MFJ-1778, Ship Code A **$39.95**

Covers all bands, 160-10 Meters with antenna tuner. 102 feet long, shorter than 80 Meter dipole. Use as inverted vee or sloper to be more compact. Use on 160 Meters as Marconi with tuner and ground. Handles full legal limit power. Add coax feedline and some rope or other nonconductor and you're *on the air!*

MFJ halfwave vertical

6 bands: 40, 20, 15, 10, 6, 2 Meters . . . No radials or ground needed



MFJ-1796
$209.95
Ship Code F

Only 12 feet high and has a tiny 24 inch footprint! Mount anywhere -- ground level to tower top -- apartments,small lots, trailers. Perfect for vacations, field day, DXpedition, camping.

Efficient end-loading, no lossy traps. Entire length is always radiating. Full size halfwave on 2/6 Meters. High power *air-wound* choke balun eliminates feedline radiation. Adjusting 1 band has minimum effect on others.

MFJ-1792, $169.95. Full size 1/4 wave radiator for 40 Meters. 33 feet, handles 1500 Watts PEP. Requires guying and radials.

MFJ-1793, $189.95. Like MFJ-1792 but has full size 20 Meter 1/4 wave also.

Free MFJ Catalog
and Nearest Dealer . . . 800-647-1800

http://www.mfjenterprises.com

1 Year *No Matter What*™ warranty 30 day money back guarantee (less s/h) on orders from MFJ

MFJ ENTERPRISES, INC.
Box 494, Miss. State, MS 39762
(662) 323-5869; 8-4:30 CST, Mon.-Fri.
FAX: (662) 323-6551; **Add s/h**
Tech Help: (662) 323-0549

MFJ . . . the world leader in ham radio accessories!

TECH TALK

IC-746PRO - How to tweak your DSP

Ready for new radio thrills and excitement? Gear up with Icom's new IC-746PRO and experience a totally new dimension in amateur radio enjoyment!

This new generation transceiver delivers unsurpassed DSP performance on all bands and modes, it is affordably priced, and it can also be tweaked to fit your particular operating needs or band conditions at the time. This Tech Talk overviews that concept.

Receive DSP Tweaks. First, you can select a built-in filter bandwidth that is fully adjustable from 3.0kHz to 50Hz for superb sounding SSB audio, copying weaker stations and dodging QRM or working CW in high style, as desired. Second, you can use the Twin PassBand Tuning controls to further tweak a selected filter's center frequency and width. By adjusting the concentric controls together, a received station's bass, mid range or treble tones can be emphasized. By adjusting them separately (one up, one down), a chosen filter's bandwidth can be sharpened to eliminate "side QRM" lower and/or higher in frequency. You can also menu-adjust the upper edges or shoulders of a filter's response curve and tweak the receiver's bass/treble equalization to mate with your hearing preference. Add in multiple AGC loops which, combined with the IC-746PRO's excellent DSP system, prevent strong adjacent frequency interference from reducing receiver sensitivity or causing "pumping" of receive audio, and you have new millennium performance supreme!

IC-746PRO
Supercharged Performance!

As Ray Novak, Icom's National Amateur Sales Manager, discovered during DXpedition operations from A52RN/Bhutan, copying a weak (S3) signal only 200Hz from a strong (S9+) signal is a cinch with the IC-756PROII... which uses the same DSP engine as the IC-746PRO. Now that is impressive!

SSB Transmit Tweaks. Three choices of transmit filter bandwidths, 2.8, 2.4 and 2.2 kHz plus adjustable microphone equalization let you custom-tailor the IC-746PRO's transmit audio to match your particular voice characteristics. By selecting a wide filter and boosting bass, mid range and/or high tones in that chosen bandwidth, your voice can sound extra-rich and full-bodied – even better on the air than "in person." By selecting a narrow filter and emphasizing upper range/treble tones, you can produce a remarkably strong signal with maximum "talk power" for DXing or communicating under adverse band conditions. Additionally, all filter and equalizer settings are easily changed so the IC-746PRO "has a different face to fit every need."

The Digital Difference. Some amateurs may understandably question how the IC-746PRO's performance is superior to other transceivers of similar power and bandwidth. The answer is using IF level DSP plus ultra-steep skirted filters. Combined, they ensure you hear good and sound great yet stop interference and "splatter" like a brick wall. That is the PRO's advantage and it is terrific! Test-tune an IC-746PRO at your favorite dealer and see for yourself!

Why not? You deserve it!
www.icomamerica.com

ICOM

C&S Sales

We stock hundreds of electronic products. Visit our web site to view our complete lines, and to place orders.

www.cs-sales.com

CALL TOLL FREE (Orders Only)
800-292-7711
SE HABLA ESPANOL

CALL, E-MAIL OR WRITE FOR OUR
FREE CATALOG
800-445-3201

Basic Tools, and a Means to Develop the Skills to Use Them!

Elenco M1750 $24.95

11 Functions:
- Freq. to 20 MHz
- Cap. to 20µF
- AC/DC Voltage
- AC/DC Current
- Beeper
- Diode Test
- Transistor Test
- Free Holster
- Meets UL-1244 safety specs.

Elenco LCM1950 $59.95
- Large 1" X 3¾" LCD
- Freq. to 4 MHz
- Inductance to 40H
- Cap. to 400µF
- Logic Test
- Resistance to 4,000MΩ
- Diode & Transistor Test
- Audible Continuity Test

Elenco Soldering Stations

Electronically controlled, ideal for professionals, students, and hobbyists. Available in kit form or assembled, with or without an iron.

Features:
- Cushion Grip Handle Soldering Iron (optional) with Grounded Tip for Soldering Static-Sensitive Devices. Easily Replaceable. Uses Long-Life, Plated Conical Tip.
- Heavy Steel, Non-Slip Base. • Sponge Pad.
- Iron Holder Funnel - Reversible, left or right side.
- Steel Tray for Sponge Pad.

Four versions are available (assembled or kit):

SL540/540K	With 40W UL Iron	$29.95
SL5/5K	Without Iron	$24.95

These work with any iron! Turn any soldering iron into a variable iron.

Electronic Snap Circuits

As Featured in a July 2003 *QST* "Short Takes" Review!

Assembling simple, and even fairly advanced, experimental circuits is as easy as snapping together toy building blocks. Follow the colorful pictures in the manual to build exciting projects such as AM and FM radios, digital voice recorders, burglar alarms, doorbells, and more! (Depending on the specific model) No tools required!

Snap Circuits, Jr, (SC-100) $29.95
Contains over 30 parts. Build over 100 different circuits!

Snap Circuits, Standard (SC-300) $59.95
Contains over 60 parts. Build over 300 different circuits!

Snap Circuits, Standard (SC-300S) Includes Computer Interface $74.95
Contains over 60 parts. Build over 300 different circuits and **20 computer interfaced projects!**

Snap Circuits, Pro (SC-500) NEW! $89.95
Contains over 75 parts. Build over 500 circuits!

Advanced Test Equipment for the Serious Experimenter!

Elenco GF8046
3MHz Sweep Function Generator with built-in 60MHz frequency counter
$199.95

This sweep (linear/log) function generator with counter is an instrument capable of generating sine square, triangle ramp, plus pulse, minus pulse, TTL, and CMOS pulse over a frequency range from 0.5Hz to 3MHz.

GF8025 - without counter Special! $99.95

Elenco F2800 $99

Handheld Universal Counter 1MHz - 2.8GHz

Features 10 digit display, 16 segment and RF signal strength bargraph.

Includes antenna, NiCad battery, and AC adapter.

Resolution to 10Hz.

C2800 Case with Belt Clip $14.95

Elenco RF Generator Model SG9500 $239

100kHz-250MHz (to 450MHz on harmonics) with counter (100kHz - 150kHz)

Features internal AM mod. of 1kHz, RF output 100mV to 35MHz. Audio output 1kHz @ 1V RMS.

SG9000 (analog, without counter) $135

Elenco Oscilloscope Model S1325 30MHz Special $325

Free Dust Cover and x1, x2 Probes – 2 Year Warranty

S1330	30MHz	Delayed Sweep	$439
S1340	40MHz	Dual Trace	$475
S1345	40MHz	Delayed Sweep	$569
S1360	60MHz	Delayed Sweep	$725
S1390	100MHz	Delayed Sweep	$895

Digital Scope Super Specials

DS203	20MHz/10Ms/s	Analog/Digital	$695
DS303	40MHz/20Ms/s	Analog/Digital	$850
DS603	60MHz/20Ms/s	Analog/Digital	$950

Elenco Quad Power Supply Model XP581 $75

- Fully Regulated and Short Protected
- Voltage and Current Meters
- All Metal Case

4 DC Voltages:
3 fixed; +5V @ 3A, +12V @ 1A, -12V @ 1A
1 variable; 2.5-20V @ 2A

C&S Sales, Inc.

150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: 847-541-9904
TEL: 847-541-0710

www.cs-sales.com
e-mail: sales@cs-sales.com

Guaranteed Lowest Prices
UPS SHIPPING: 48 STATES 6% ($6 min.) – OTHERS CALL FOR DETAILS
15 DAY MONEY BACK GUARANTEE – 2 YEAR FACTORY WARRANTY
IL Residents add 8.5% Sales Tax
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

Jobs

MICROWAVE/RF ENGINEER: Hands-on experience on transmitter/receiver, laser and optics, computer data taking. Resumes to: jpatton@hipas.alaska.edu

Personal Emergency Response Company (www.link-to-life.com) looking for part time installers in the following states: California (Fresno, Madera, Merced, San Diego, Los Angeles & San Francisco counties), Delaware (Wilmington, New Castle), Georgia (Columbia & Richmond counties), Missouri (Gentry county), New York (Albany, Erie & Sullivan counties), New Mexico, Oklahoma (Comanche, Cotton, Jefferson, McCurtain, Choctaw, Pushmataha & Le Flore counties), West Virginia (Cabell, Mason, Wayne & Putnam counties), Washington (San Juan, Yakima counties), Vermont, Texas (Brazos county), Illinois (Sangamon county), & Indiana. Installs take approximately 1 hour. Reimbursed monthly. Please email jh@link-to-life.com

WANTED FOR SUMMER OF 2004: Instructors in electronics, ham radio, computers and all other sciences. Small boys' science camp in Pennsylvania. Apply: Donald Wacker, P.O. Box 356, Paupack, Pennsylvania 18451. 570-857-1401.

Index of Advertisers

Advertising Department Staff

Debra Jahnke, Sales Manager
Joe Bottiglieri, AA1GW, Accounts Manager
Carol Patton, KB1GAT, Advertising Traffic Coordinator
Diane Szlachetka, Advertising Graphic Designer

Toll Free 1-800-243-7768

Direct Line: 860-594-0207 Fax: 860-594-4285
E-mail: ads@arrl.org Web: www.arrl.org/ads

Advertising Deadlines:

Issue	Reservation Date	Materials Due Date
March 2004 Issue	Tuesday, January 13, 2004	Friday, January 16, 2004
April 2004 Issue	Wednesday, February 11, 2004	Monday, February 16, 2004

Advanced Receiver Research: 115
Advanced Specialties: 115
Alinco: 11
All Electronics Corp: 155
Alpha Delta Communications: 133
Amateur Electronic Supply LLC: 119, 121, 123
ARRL: 6, 26, 27, 112, 114, 115, 116, 118, 124, 129, 130, 131, 132, 133, 134, 138, 140, 142, 144, 146, 148, 150, 152, 153, 154, 156, 157
Ameritron: 17
AMSAT: 122
Antique Radio Classified: 132
AOR: 8
Array Solutions: 114
Associated Radio Communications: 125
Atomic Time: 134
Austin Amateur Radio Supply: 125
Autek Research: 122
B & D Enterprises: 156
BetterRF Co, The: 122
Bilal Co: 146
Buckmaster Publishing: 115, 132
Burghardt Amateur Center: 126, 127
Buylegacy.com: 133
C.Crane Company: 133
C & S Sales: 154
Circuit Specialists: 113
Code Quick: 156
ComDaC: 125
Command Technologies: 132
Communications Concepts Inc: 122
Communications Electronics: 136
Computer International: 152
Cubex Company: 115
Cutting Edge: 133, 148, 153
Datamatrix: 153
Davis Instruments: 122
Diamond Antenna: 3
Digital Communications: 133
DX Engineering: 140
Elecraft: 129
Electric Radio Magazine: 156
Fluidmotion Inc: 138
FX Rotor Works: 153
GAP Antenna Products: 148
Greater Baltimore Hamboree: 124
Ham PROs: 125
Ham Radio Outlet: 108, 109, 110, 111
High Sierra Antennas: 146
Hy-Gain: 2, 10
ICOM America: Cover II, 1, 153, 155, 157
IIX Equipment Ltd: 140
International Radio Corp: 115
Intuitive Circuits LLC: 156
Jun's Electronics: 116
K1CRA Radio WebStore: 150, 153
K2AW's "Silicon Alley": 140
Kanga US: 140
Kenwood Communications: Cover IV, 19
KK7TV Communications: 133
LDG Electronics: 22
Lentini Communications: 125
Log Window/SCO Inc: 156
Logic: 146
M & S Computer Products: 156
Mayberry Sales & Service Inc: 150
MFJ Enterprises: 128, 137, 139, 141, 143, 145, 147, 149, 151
Micro Computer Concepts: 132
Mike's 2-Way Radio Shop: 146
Mirage: 135
Mr NiCd: 158
N3FJP Software: 115
N4XM, XMatch Antenna Tuners: 152
National RF: 153
New Communications Solutions: 132
Nifty Ham Accessories: 148
Palomar Engineers: 131
PC Electronics: 150
Peet Bros Company: 124
Personal Database Applications: 146
PROLOG: 153
Pulver: 146
Quicksilver Radio Products: 131
QSLs By W4MPY: 148
R & L Electronics: 18
Radio Amateur Callbook: 134
Radio Bookstore: 140
Radio City: 125
Radio Club Of JHS 22 NYC: 117
Radio Daze: 115
Radio Era Archives: 132
Radio Works: 120
Rapidan Data Systems: 113
RF Parts Co: 3, 25, 113
Richmond Frostfest 2004: 142
Ross Distributing Co: 113
SGC: 117, 148
SkySweep Technologies: 134
Spi-Ro Manfacturing: 131
SSB Electronic: 152
Star Quality QSLs: 146
SteppIR Antennas: 138
Surplus Sales of Nebraska: 156
Tashjian Towers: 133
TE Systems: 120
Ten-Tec: 23
Teri Software: 140
Texas Towers: 159, 160
TGM Communications: 122
The Mast Company: 150
Tigertronics: 150
Tower * Jack: 113
Universal Manufacturing Co: 113
Universal Radio: 125
Vibroplex: 133
Vintage Manuals, LLC: 115
W & W Manfacturing Co: 114
W2IHY Technologies: 113
W3FF Antennas: 142
W5YI: 152, 156
W9INN Antennas: 132
Warren Gregoire & Associates: 113
West Mountain Radio: 131
Wheeler Applied Research: 156
Yaesu USA: Cover III, 7
Yost & Co, EH: 158

Your Customers are Reading...QST!

If your company provides products or services of interest to our Members, please contact the ARRL Advertising Department today for information on building your business.

SAVE BIG ON ANTENNAS, TOWERS & CABLE

TELESCOPING ALUMINUM TUBING

DRAWN 6063-T832

.375	$.70/ft	1.375"	$1.75/ft
.500"	$.80/ft	1.500"	$1.95/ft
.625"	$.90/ft	1.625"	$2.25/ft
.750"	$1.00/ft	1.750"	$2.50/ft
.875"	$1.10/ft	1.875"	$2.75/ft
1.000"	$1.20/ft	2.000"	$3.00/ft
1.125"	$1.35/ft	2.125"	$3.50 /ft

In 6' or 12' lengths, 6' lengths ship UPS. Call for 3/16"& 1/4" rod, bar stock, and extruded tubing.

CUSHCRAFT ANTENNAS

13B2/A148-10S	$159/89
A270-6S/A270-10S	$79/99
A3S/A4S	$459/549
A50-3S/5S/6S	$99/169/269
A6270-13S	$199
AR2/ARX2B	$55/69
AR270/AR270B	$89/99
R6000/R8	$309/459
X7/X740	$649/269
XM240	$679

Please call for more Cushcraft items.

FORCE 12–MULTIBAND

C3	10/12/15/17/20m, 7 el	$599
C3E	10/12/15/17/20m, 8 el	$649
C3S	10/12/15/17/20m, 6 el	$539
C3SS	10/12/15/17/20m, 6 el	$559
C4	10/12/15/17/20/40m, 8 el	$759
C4S	10/12/15/17/20/40m, 7 el	$679
C4SXL	10/12/15/17/20/40m, 8 el	$979
C4XL	10/12/15/17/20/40m, 9 el	$1119
C19XR	10/15/20m, 11 el	$959
C31XR	10/15/20m, 14 el	$1299

Please call for more Force 12 items.

TRYLON "TITAN" TOWERS

SELF-SUPPORTING STEEL TOWERS

T200-64	64', 15 square feet	$1209
T200-72	72', 15 square feet	$1429
T200-80	80', 15 square feet	$1649
T200-88	88', 15 square feet	$1949
T200-96	96', 15 square feet	$2249
T300-88	88', 22 square feet	$2189
T400-80	80', 34 square feet	$2089
T500-72	72', 45 square feet	$1979
T600-64	64', 60 square feet	$1869

Many more Trylon towers in stock!

BENCHER / BUTTERNUT

Skyhawk, Triband Beam	$1129
HF2V, 2 Band Vertical	$249
HF5B, 5 Band Minibeam	$359
HF6VX, 6 Band Vertical	$339
HF9VX, 9 Band Vertical	$369
A1712, 12/17m Kit	$54
CPK, Counterpoise Kit	$129
RMKII, Roof Mount Kit	$159
STRII, Roof Radial Kit	$125
TBR160S, 160m Kit	$139

More Bencher/Butternut–call

M2 VHF/UHF ANTENNAS

144–148 MHz

2M4/2M7/2M9	$95/109/129
2M12/2M5WL	$165/209
2M5-440XP, 2m/70cm	$179

420–450 MHz

440-470-5W/420-450-11	$139/95
432-9WL/432-13WLA	$179/239
440-18/440-21ATV	$129/149

Satellite Antennas

2MCP14/2MCP22	$169/239
436CP30/436CP42UG	$239/279

ROHN TOWER

25G/45G/55G	$89/189/239
25AG2/3/4	$109/109/119
45AG2/4	$209/225
AS25G/AS455G	$39/89
BPC25G/45G/55G	$75/99/110
BPL25G/45G/55G	$85/109/125
GA25GD/45/55	$68/89/115
GAR30/GAS604	$35/24
SB25G/45/55	$39/89/109
TB3/TB4	$85/99

Please call for more Rohn prices.

US TOWER

MA40/MA550	$999/1549
MA770/MA850	$2599/3999
TMM433SS/HD	$1349/1649
TMM541SS	$1789
TX438/TX455	$1279/1749
TX472/TX489MDPL	$2899/7299
HDX538/HDX555	$2099/2549
HDX572MDPL	$6669

Please call for help selecting a US Tower for your needs. Shipped factory direct to save you money!

COMET ANTENNAS

GP15, 6m/2m/70cm Vertical	$149
GP6, 2m/70cm Vertical	$139
GP9, 2m/70cm Vertical	$169
B10NMO, 2m/70cm Mobile	$36
SB14, 6m/2m/70cm Mobile	$59
SBB224NMO,2m/220/70cm	$69
SBB2NMO, 2m/70cm Mobile	$39
SBB5NMO, 2m/70cm Mobile	$49
SBB7NMO, 2m/70cm Mobile	$69
UHV4/UHV6	$109/135

Much more Comet in stock–call.

M2 ANTENNAS

50–54 MHz

6M5X/6M7JHV	$209/269
6M2WLC/6M9KHW	$459/499

10/12/15/17/20m HF

10M4DX, 4 Element 10m	$399
12M4DX, 4 Element 12m	$399
15M4DX, 4 Element 15m	$449
17M3DX, 3 Element 17m	$399
20M4DX, 4 Element 20m	$529

More M2 models in stock–please call.

GLEN MARTIN ENGINEERING

Hazer Elevators for 25G

H2, Aluminum Hazer, 12 sq ft.	$359
H3, Aluminum Hazer, 8 sq ft	$269
H4, HD Steel Hazer, 16 sq ft	$339

Aluminum Roof Towers

RT424, 4 Foot, 6 sq ft	$159
RT832, 8 Foot, 8 sq ft	$239
RT936, 9 Foot, 18 sq ft	$389
RT1832, 17 Foot, 12 sq ft	$519
RT2632, 26 Foot, 9 sq ft	$869

UNIVERSAL ALUMINUM TOWERS

4-40'/50'/60'	$539/769/1089
7-50'/60'/70'	$979/1429/1869
9-40'/50'/60'	$759/1089/1529
12-30'/40'	$579/899
15-40'/50'	$1019/1449
23-30'/40'	$899/1339
35-30'/40'	$1019/1569

Bold in part number shows wind-load capacity. Please call for more Universal models. All are shipped factory direct to save you money!

DIAMOND ANTENNAS

D130J/DPGH62	$79/139
F22A/F23A	$89/119
NR72BNMO/NR73BNMO	$39/54
NR770HBNMO/NR770RA	$55/49
X200A, 2m/70cm Vertical	$129
X500HNA/X700HNA	$229/369
X510MA/510NA	$189/189
X50A/V2000A	$99/149
CR627B/SG2000HD	$99/79
SG7500NMO/SG7900A	$75/112

More Diamond antennas in stock.

MFJ

259B	$219
269	$299
941E	$109
945E	$99
949E	$139
969	$169
986	$289
989C	$309
1798, 80–2m Vertical	$249
1796, 40/20/15/10/6/2m Vert.	$189

Big MFJ inventory–please call

COAX CABLE

RG-213/U, (#8267 Equiv.)	$.36/ft
RG-8X, Mini RG-8 Foam	$.19/ft
RG-213/U Jumpers	Please Call
RG-8X Jumpers	Ple ase Call

Please call for more coax/connectors.

TIMES MICROWAVE LMR® COAX

LMR-400	$.59/ft
LMR-400 Ultraflex	$.89/ft
LMR-600	$1.19/ft
LMR600 Ultraflex	$1.95/ft

TOWER HARDWARE

3/8"EE / EJ Turnbuckle	$11/12
1/2"x9"EE / EJ Turnbuckle	$16/17
1/2"x12"EE / EJ Turnbuckle	$18/19
3/16" / 1/4" Big Grips	$5/6

Please call for more hardware items.

HIGH CARBON STEEL MASTS

5 FT x .12" / 5 FT x .18"	$35/59
10 FT x .18" / 11 FT x .12"	$129/80
16 FT x .18" / 17 FT x .12"	$179/129
20 FT x .25" / 21 FT x .18"	$315/235
22 FT x .12" / 24 FT x .25"	$149/379

GAP ANTENNAS

Challenger DX	$289
Challenger Counterpoise	$29
Challenger Guy Kit	$19
Eagle DX	$299
Eagle Guy Kit	$29
Titan DX	$329
Titan Guy Kit	$29
Voyager DX	$409
Voyager Counterpoise	$49
Voyager Guy Kit	$45

Please Call for Delivery Information.

LAKEVIEW HAMSTICKS

9106	6m	9115	15m	9130	30m
9110	10m	9117	17m	9140	40m
9112	12m	9120	20m	9175	75m

All handle 600W, 7' approximate length, 2:1 typical VSWR... $24.95

HUSTLER ANTENNAS

4BTV/5BTV/6BTV	$129/169/199
G6-270R, 2m/70cm Vertical	$169
G6-144B/G7-144B	$109/179

Hustler Resonators in stock–call.

ANTENNA ROTATORS

M2 OR-2800P	$1249
Yaesu G-450A	$249
Yaesu G-800SA/DXA	$329/409
Yaesu G-1000DXA	$499
Yaesu G-2800SDX	$1089
Yaesu G-550/G-5500	$299/599

ROTATOR CABLE

R62 (#18)	$.32/ft.
R81/82	$.25/ft./.39/ft.
R84	$.85/ft

PHILLYSTRAN GUY CABLE

HPTG1200I	$.45/ft
HPTG2100I	$.59/ft
PLP2738 Big Grip (2100)	$6.00
HPTG4000I	$.89/ft
PLP2739 Big Grip (4000)	$8.50
HPTG6700I	$1.29/ft
PLP2755 Big Grip (6700)	$12.00
HPTG11200	$1.89/ft
PLP2758 Big Grip (11200)	$18.00

Please call for help selecting the Phillystran size for your application.

WEEKDAY HOURS:
9 AM–5 PM CST

SATURDAY HOURS:
9 AM–12 NOON CST

CREDIT CARDS:
M/C, VISA, DISCOVER

TEXAS TOWERS

A Division of Texas RF Distributors, Inc. • 1108 Summit Avenue, Suite #4 • Plano, TX 75074

(800) 272-3467

LOCAL CALLS:
(972) 422-7306

EMAIL ADDRESS:
sales@texastowers.com

INTERNET ADDRESS:
www.texastowers.com

HUGE ICOM DEALS ★ HUGE YAESU DEALS

IC-756PROII..... Icom Special!
The Icom IC-756PROII is an all mode HF and 6m transceiver featuring 32-bit digital signal processing, auto antenna tuner, 100 watts RF output, digital twin PBT, 5" multifunction color TFT LCD display with band scope function, built-in CW and SSB memory keyers, and more. Supplied with hand mic and DC power cord.

PW-1..... In Stock!
The Icom PW-1 is a 1000 watt solid state linear amplifier for HF and 6m operation, featuring a high power automatic antenna tuner, built-in power supply, and a removable front control panel, and more.

IC-746PRO..... In Stock!
The Icom IC-746PRO is an all mode HF/6m/2m XCVR with 32-bit IF level DSP. The radio features a built-in auto tuner, built-in RTTY demodulator and decoder (reads out on the radio's LCD display), auto notch, digital twin PBT, and more. Supplied hand mic and DC power cord.

IC-910H ..... In Stock!
All-mode 2m/70cm dual band transceiver, featuring dual data inputs, CTCSS encode/decode, CW keyer, satellite mode, scan, sweep display function, optional 23cm module, optional DSP, and more. Supplied with hand mic and DC power cord.

FT-1000MP-V..... Yaesu Special!
Competition class HF DSP transceiver with auto tuner, 200 Watts RF output, and more!

FT-1000MP-V Field .....Special!
Low power (100W) version of the FT-1000MP-V, with built-in power supply.

FT-920..... Yaesu Special!
All mode HF/6m XCVR featuring DSP, auto tuner, and more. With up/down hand microphone and DC power cord.

Quadra System ..... In Stock!

FT-897..... In Stock!
"Backpack" all-mode HF/6m/2m/70cm XCVR offering 100 watts of output power! The radio can be run from optional internal batteries with reduced output of 20 watts, or an optional internal power supply can be installed instead. An optional bolt-on external auto tuner is also available. The FT-897 is a truly self-contained portable!

FT-847..... Yaesu Special!
Great all-mode XCVR covering HF/6m/2m/70cm! The radio is perfect for satellite operation, and features DSP, CTCSS tone encode/decode, and more. Supplied with microphone and DC power cord.

IC-703 ..... New, In Stock!
IC-703PLUS..... New, In Stock!
The Icom IC-703 is a compact HF XCVR, with built-in auto tuner, DSP, and more! The IC-703PLUS adds 6m coverage.

IC-706MK2G..... Icom Special!
The Icom IC-706MK2G is a compact HF/6m/2m/70cm all mode XCVR with DSP, CW keyer, built-in CTCSS encode/decode/scan, 107 memoriess and more. A detachable front panel offers convenient mounting, even in compact vehicles.

IC-718 ..... New Lower Price!

IC-2720H..... New!
Dual band 2m/70cm FM XCVR. Features remote control panel, CTCSS tone encode/decode/scan, cross band repeat, data jack, dual RX, extended RX, 212 memories, and more. Supplied with a DTMF hand mic, separation cable, mounting brackets, and a fused DC power cord.

IC-V8000..... In Stock!
Great 75W 2m mobile XCVR. Features CTCSS tone encode/decode/scan, 207 memories, front panel mounted speaker, and more. Supplied with a DTMF hand mic, mounting bracket, and DC cord.

FT-8900R..... In Stock!
Quad band mobile XCVR covers 10m/6m/2m/70cm, with cross-band repeat.

FT-8800R..... New, In Stock!
Great 2m/70cm dual band mobile, 45/35 Watts, removable front panel, and more!

FT-7800R..... New, Please Call!
New, 2m/70cm dual band mobile XCVR.

FT-2800M ..... In Stock!
Rugged, 50W 2m mobile transceiver.

FT-857..... Now In Stock!
Ultra-compact all mode XCVR for HF/6m/2m/70cm. Features CW memory keyer, CTCSS encode/decode, 200 memories, optional DSP, and more. Supplied with a hand microphone, a fused DC power cord and mounting bracket.

FT-817..... In Stock!
A truly tiny self-contained all mod e HF/6m/2m/70cm QRP XCVR featuring tone encode/decode, 200 memory channels, VOX, and more! With hand microphone.

IC-T2H Sport.... Great Low Price!
IC-Q7A..... Great Low Price!
IC-T7H..... Icom Special!
IC-V8..... Great Low Price!
IC-W32A..... Now In Stock!
IC-T90A..... New, In Stock!

IC-208H..... Great Low Price!
A great 2m/70cm dual band mobile XCVR, featuring CTCSS tone encode/decode, 500 memories, removable control panel, and more. With a back-lit DTMF hand mic, mounting bracket, and a DC power cord.

IC-2100H..... Great Low Price!
Rugged 2m mobile XCVR with CTCSS tone encode/decode/scan, DTMF paging/squelch, 113 memories, and more.

IC-PCR1000..... In Stock!
IC-R8500/R75..... In Stock!
IC-R3/R5/R10..... In Stock!

G-2800DXA..... $1089
Heavy duty antenna rotator handles 34 sq. ft. of antenna load, and features 450° rotation, preset and variable speed.

G-1000DXA..... $499
G-800SA/DXA..... $329/409
G-450A..... $249
G-5500 ..... $599
G-550 ..... $299

FT-50RD..... New Lower Price!
VR-120D ..... In Stock!
VR-500 ..... In Stock!
VX-2R..... New, In Stock!
VX-5R..... New Lower Price!
VX-7R ..... New Lower Price!
VX-150..... New Lower Price!

WEEKDAY HOURS:
9AM–5PM CST

SATURDAY HOURS:
9AM–NOON CST

CREDIT CARDS:
M/C, VISA, DISCOVER

TEXAS TOWERS

A Division of Texas RF Distributors, Inc. • 1108 Summit Avenue, Suite #4 • Plano, TX 75074

(800) 272-3467

LOCAL CALLS:
(972) 422-7306

EMAIL ADDRESS:
sales@texastowers.com

INTERNET ADDRESS:
www.texastowers.com

Get "Back to Basics" with YAESU's New FM Dual Band Mobile
One-Touch Operation / Wide Receiver Coverage Included

High Power Output
(50 W VHF/40 W UHF)

Wide Receiver Coverage
including AM Aircraft Reception,
NOAA Weather Alert Broadcasting* *USA Version

Five One-Touch "Hyper Memory"
Transceiver Configuration Keys

Over 1000 Memory Channels
with Alpha-Numeric Labels,
Twenty Memory Groups

WiRES™ Internet Linking Compatibility

144/430MHz DUAL BAND

ACTUAL SIZE
*Simulated LCD display

YAESU FM Mobile Series

FT-8900R 29/50/144/430MHz QUAD BAND
29/50/144/430 MHz FM QUAD BAND TRANSCEIVER

FT-8800R 144/430MHz DUAL BAND
144/430 MHz FM DUAL BAND TRANSCEIVER

DUAL BAND

FT-7800R
144/430 MHz DUAL BAND
FM TRANSCEIVER

YAESU
Choice of the World's top DXers™

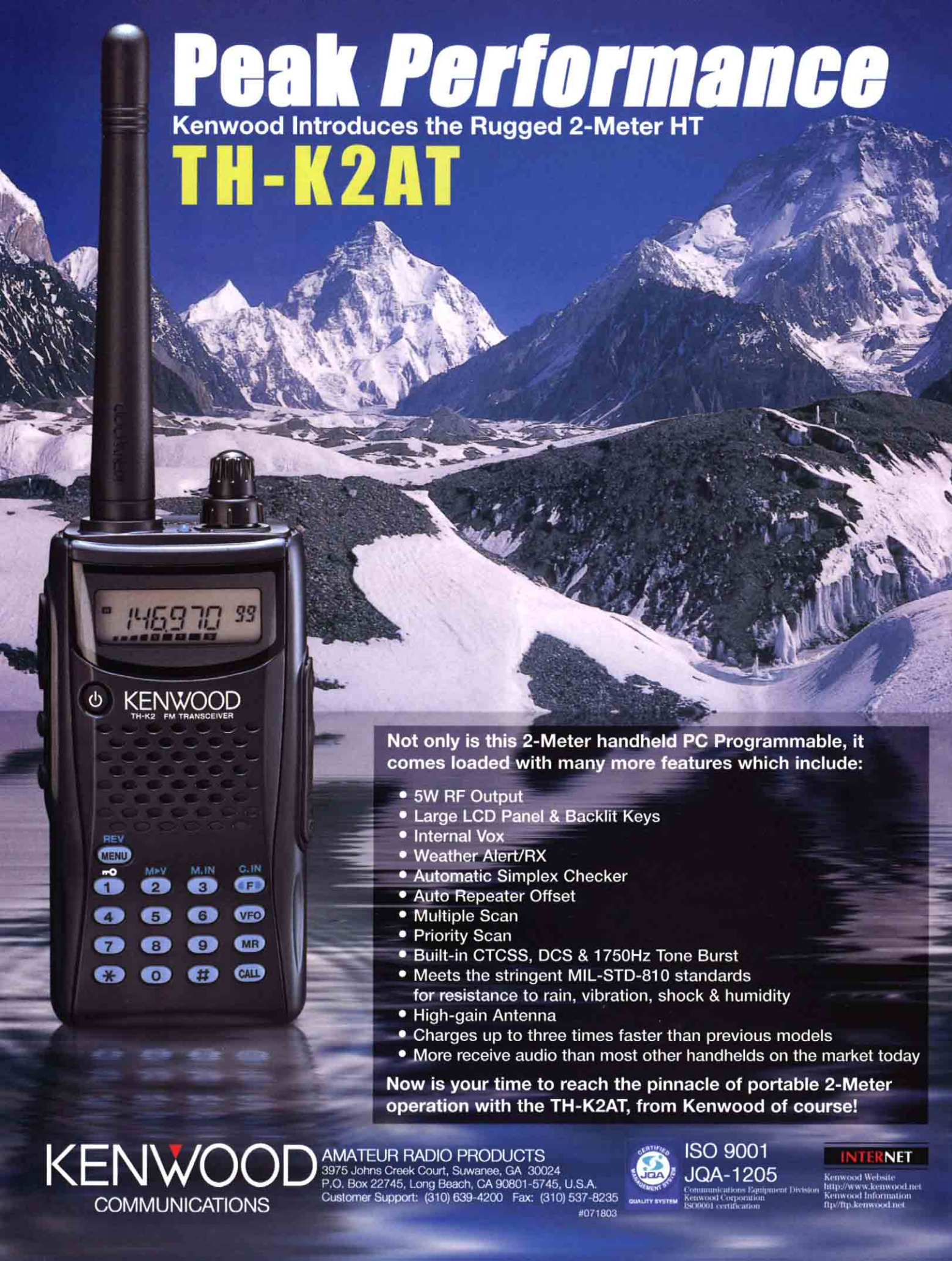
Vertex Standard
US Headquarters
10900 Walker Street
Cypress, CA 90630 (714)827-7600

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

Peak Performance

Kenwood Introduces the Rugged 2-Meter HT

TH-K2AT



Not only is this 2-Meter handheld PC Programmable, it comes loaded with many more features which include:

- 5W RF Output
- Large LCD Panel & Backlit Keys
- Internal Vox
- Weather Alert/RX
- Automatic Simplex Checker
- Auto Repeater Offset
- Multiple Scan
- Priority Scan
- Built-in CTCSS, DCS & 1750Hz Tone Burst
- Meets the stringent MIL-STD-810 standards for resistance to rain, vibration, shock & humidity
- High-gain Antenna
- Charges up to three times faster than previous models
- More receive audio than most other handhelds on the market today

Now is your time to reach the pinnacle of portable 2-Meter operation with the TH-K2AT, from Kenwood of course!

KENWOOD
COMMUNICATIONS

AMATEUR RADIO PRODUCTS
3975 Johns Creek Court, Suwanee, GA 30024
P.O. Box 22745, Long Beach, CA 90801-5745, U.S.A.
Customer Support: (310) 639-4200 Fax: (310) 537-8235
#071803

ISO 9001
JQA-1205
Communications Equipment Division
Kenwood Corporation
ISO9001 certification

INTERNET
Kenwood Website
http://www.kenwood.net
Kenwood Information
ftp://ftp.kenwood.net