Official Journal of
ARRL
The national association
for AMATEUR RADIO

QST AMATEUR RADIO

December 2003

QST reviews

Fluidmotion SteppIR SmallIR
vertical antenna

Heil Pro-Set Plus
headset with boom microphone

Build your own condenser microphone

Designing an emergency power system

Field Day 2003 Results

Season's Greetings

$4.99 U.S. $6.99 Can.
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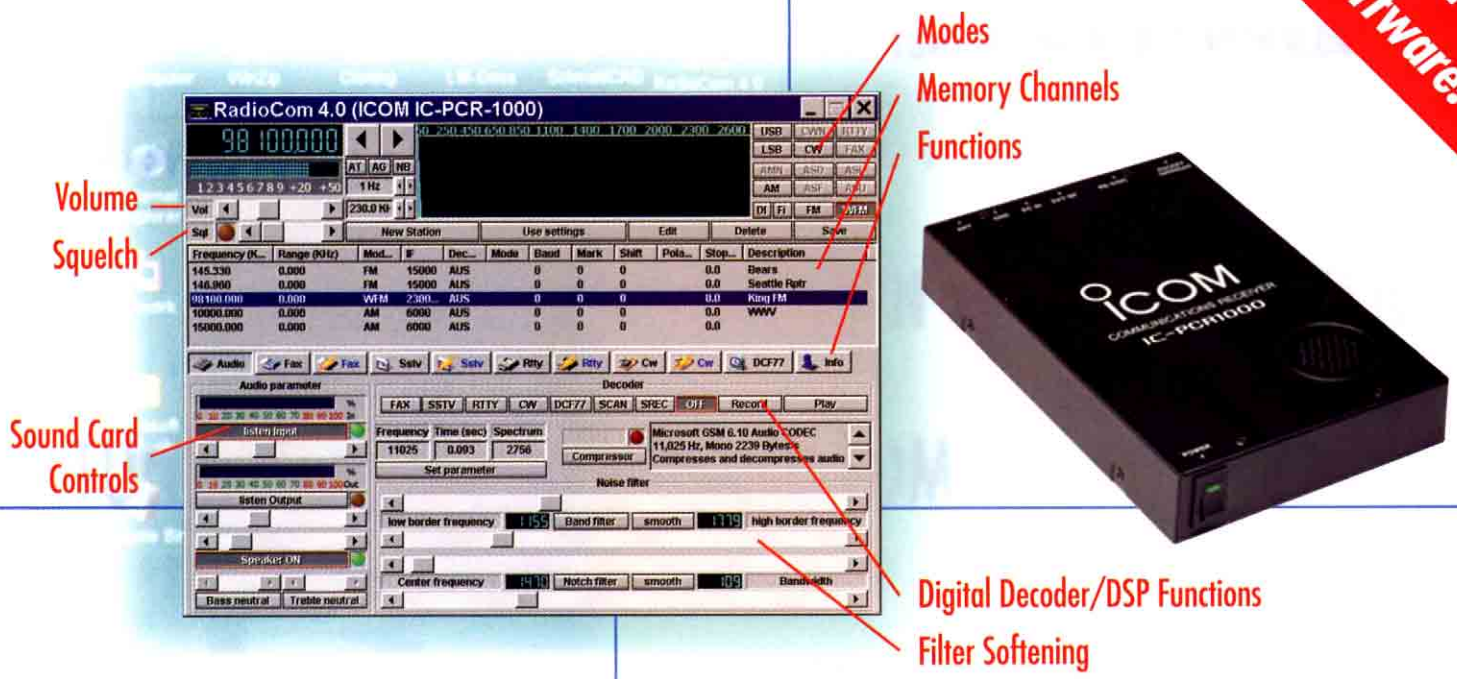
IC-PCR1000

TURN YOUR PC INTO A WIDE BAND RECEIVER WITH ICOM'S LITTLE BLACK BOX!

Now with Bonito Software!



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

Turn your PC into a Wide Band Receiver! Icom's IC-PCR1000 uses the power of your computer to open a new world of listening and viewing pleasure. Compatible with most PCs and laptops running Windows™ software, the 'PCR1000 connects externally – in just minutes! The new Bonito software (BON CS40) expands and enhances the 'PCR1000's versatility with the following features:

Basic Radio Control functions with spectrum scope

Computer Controlled DSP for tailoring your audio with separate bass & treble controls

Filter Smoothing for the upper and lower ends of the audio spectrum

Notch Filter reduces annoying pops, buzzes, & other interference for a crisp, clear signal. Use the power of your computer's sound card DSP to bring out the beauty of the signal for hours of enjoyable listening

Digital Decoding Package transforms your computer into a decoding machine. You no longer have to purchase an external decoder for receiving non-encrypted digital modes. Digital Decoding allows you to decode: **RTTY**, **FAX** *with Zoom, Synchronize, Slant Correction, Cut a Picture, Picture Invert and Rotate*, **CW**, **SSTV** *with Auto Sync, Slant Corrections*, **Sitor-B**, **PSK31**

Audio Record function allows you to record your favorite radio programs, local traffic, or almost anything else with your computer's sound card and hard drive. Save for friends and family to listen at a later time

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IC-756PROII

IC-746PRO

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IC-746PRO ADDITIONAL FEATURES • LCD Display • 9600 Baud Packet Capable • Digital Meter • RX Audio Equalizer • SWR Analyzer • Sweeping Scope

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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$9^{3}/_{16}$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
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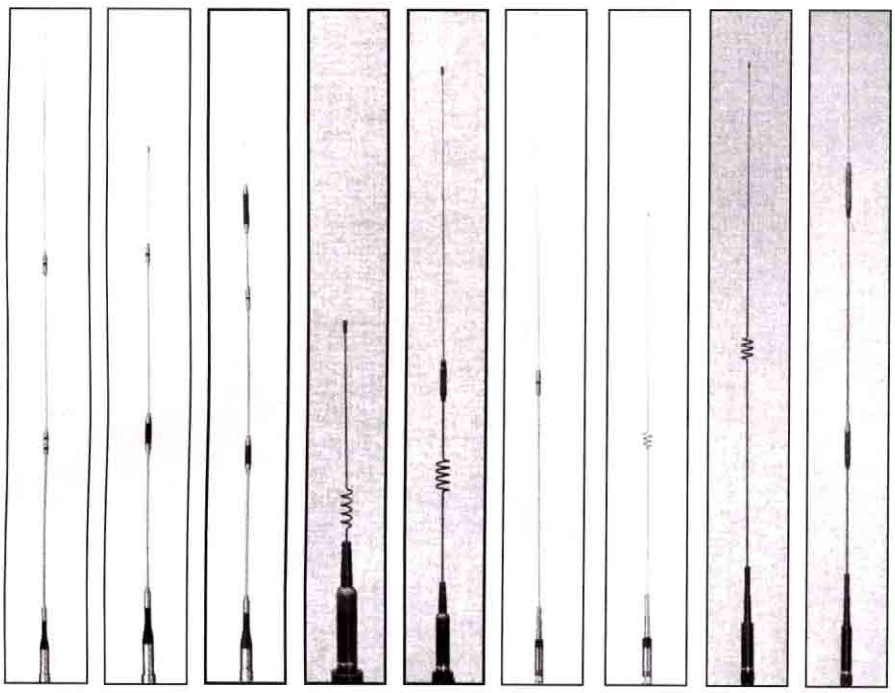


SG2000HD | SG7500A SG7500NMO | SG7900A | NR72BNMO | NR73BNMO | NR2C | NR770HA NR770HB | NR770HNMO NR770HBNMO | CR627B CR627BNMO

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

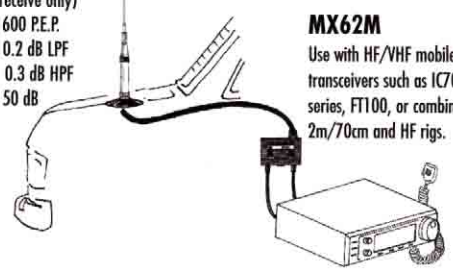
MX62M Duplexer

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.

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QST

December 2003 ♦ Volume 87 Number 12

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News and Features

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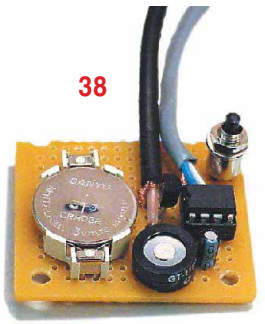
QST Workbench



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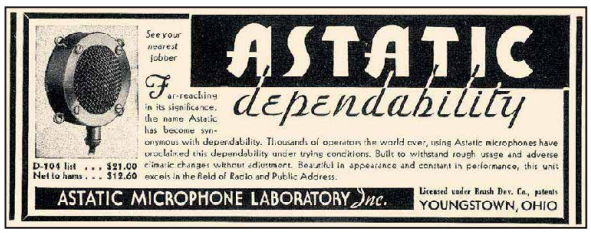

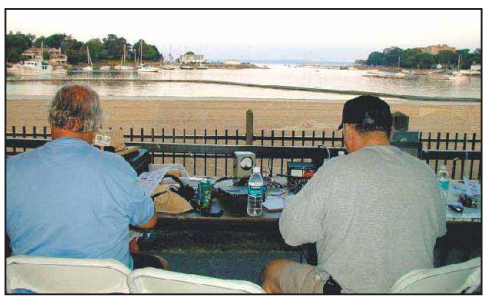

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Operating

Departments

Our Cover
There was beauty to be found even during the harsh winter of 2002-2003, and N1NAS managed to find it—right at his place of employment! When he's not taking photos, David Pingree is ARRL Senior Technical Illustrator. From the ARRL family of volunteers and Headquarters staff to you and yours—Season's Greetings and Best Wishes for the New Year!

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.

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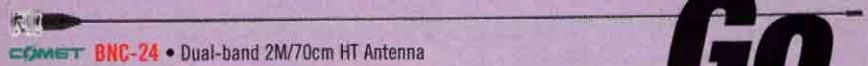
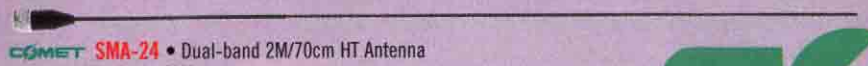


COMET **BNC-24** • Dual-band 2M/70cm HT Antenna
Length: 17" • Conn: BNC
Super flexible featherweight whip



COMET **SMA-24** • Dual-band 2M/70cm HT Antenna
Length: 17" • Conn: SMA
Super flexible featherweight whip

Maldol **MH-209** (BNC Conn) • 2M/70cm Dual-band HT Antenna
Maldol **MH-209SMA** (SMA Conn)
Wave: 1/4 wave • Length: 3" Soft flexible rubber

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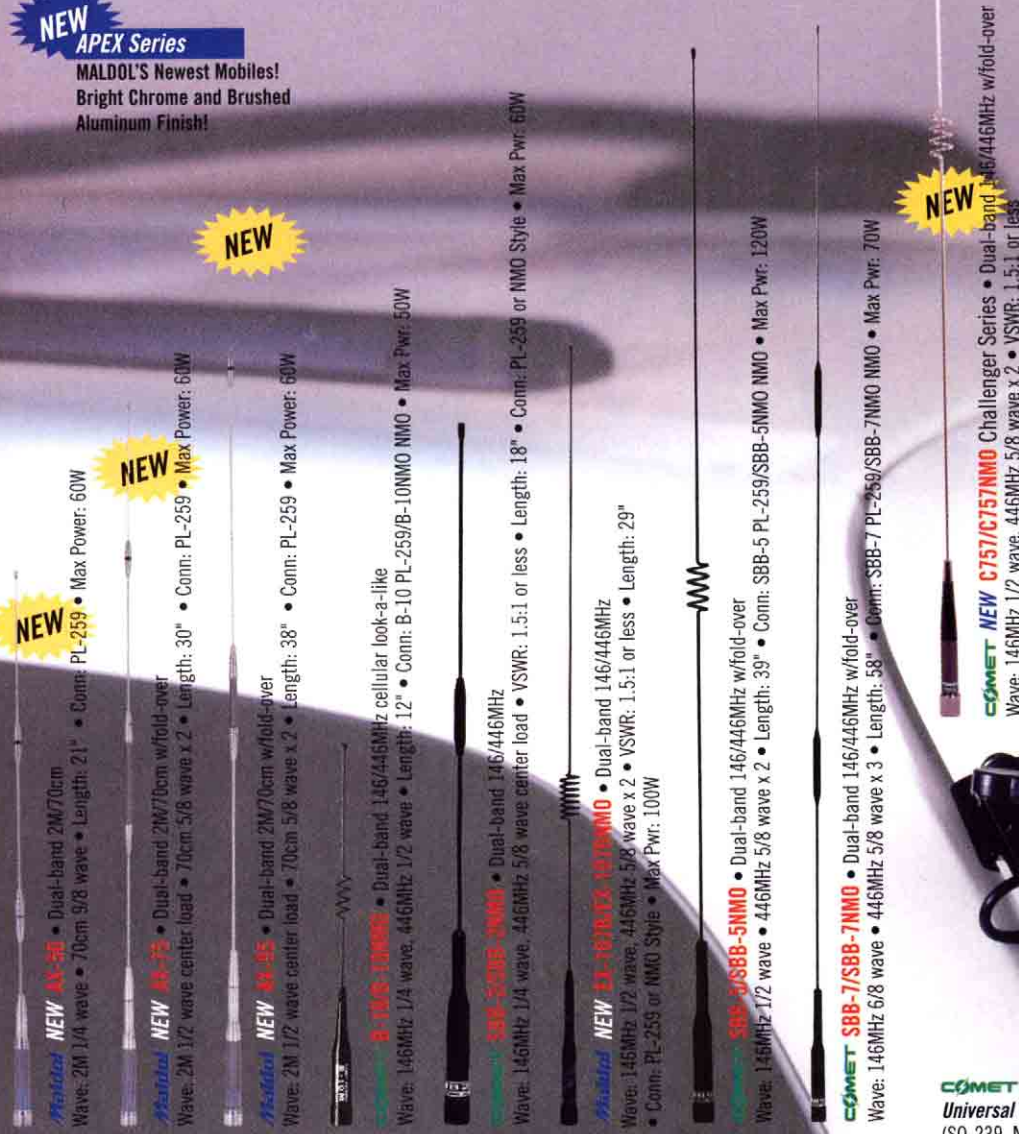

NEW Maldol **AX-55** • Dual-band 2M/70cm
Wave: 2M 1/4 wave • 70cm 9/8 wave • Length: 21" • Conn: PL-259 • Max Power: 60W

NEW Maldol **AX-75** • Dual-band 2M/70cm w/fold-over
Wave: 2M 1/2 wave center load • 70cm 5/8 wave x 2 • Length: 30" • Conn: PL-259 • Max Power: 60W

NEW Maldol **AX-85** • Dual-band 2M/70cm w/fold-over
Wave: 2M 1/2 wave center load • 70cm 5/8 wave x 2 • Length: 38" • Conn: PL-259 • Max Power: 60W

COMET **B-10/B-10NMO** • Dual-band 146/446MHz cellular look-a-like
Wave: 146MHz 1/4 wave, 446MHz 1/2 wave • Length: 12" • Conn: B-10 PL-259/B-10NMO NMO • Max Pwr: 50W

COMET **SBB-5/SBB-5NMO** • Dual-band 146/446MHz
Wave: 146MHz 1/4 wave, 446MHz 5/8 wave center load • VSWR: 1.5:1 or less • Length: 18" • Conn: PL-259 or NMO Style • Max Pwr: 60W

Maldol **DX-107B/TX-107BNMO** • Dual-band 146/446MHz
Wave: 146MHz 1/2 wave, 446MHz 5/8 wave x 2 • VSWR: 1.5:1 or less • Length: 29"
• Conn: PL-259 or NMO Style • Max Pwr: 100W

COMET **SBB-5/SBB-5NMO** • Dual-band 146/446MHz w/fold-over
Wave: 146MHz 1/2 wave • 446MHz 5/8 wave x 2 • Length: 39" • Conn: SBB-5 PL-259/SBB-5NMO NMO • Max Pwr: 120W

COMET **SBB-7/SBB-7NMO** • Dual-band 146/446MHz w/fold-over
Wave: 146MHz 6/8 wave • 446MHz 5/8 wave x 3 • Length: 58" • Conn: SBB-7 PL-259/SBB-7NMO NMO • Max Pwr: 70W

NEW COMET *NEW* **C757/C757NMO** Challenger Series • Dual-band 146/446MHz w/fold-over
Wave: 146MHz 1/2 wave, 446MHz 5/8 wave x 2 • VSWR: 1.5:1 or less
• Length: 38" • Conn: PL-259 or NMO Style • Max Pwr: 80W

NEW COMET *NEW* **C767/C767NMO** Challenger Series • Dual-band 146/446MHz w/fold-over
Wave: 146MHz 1/2 wave center load, 446MHz 5/8 wave x 2 center load • VSWR: 1.5:1 or less
• Length: 40" • Conn: PL-259 or NMO Style • Max Pwr: 80W

COMET *NEW* **CP-5M/5NMO/3/8-24**
Universal mount and coax cable combos. (SO-239, NMO, 3/8-24/PL-259) Heavy-duty, adjustable RS-730 trunk/van/ SUV/truck door mount and deluxe cable assembly. 16' 6" length w/18" mini RG-188A/U type coax. Max antenna 70". 3 different models.

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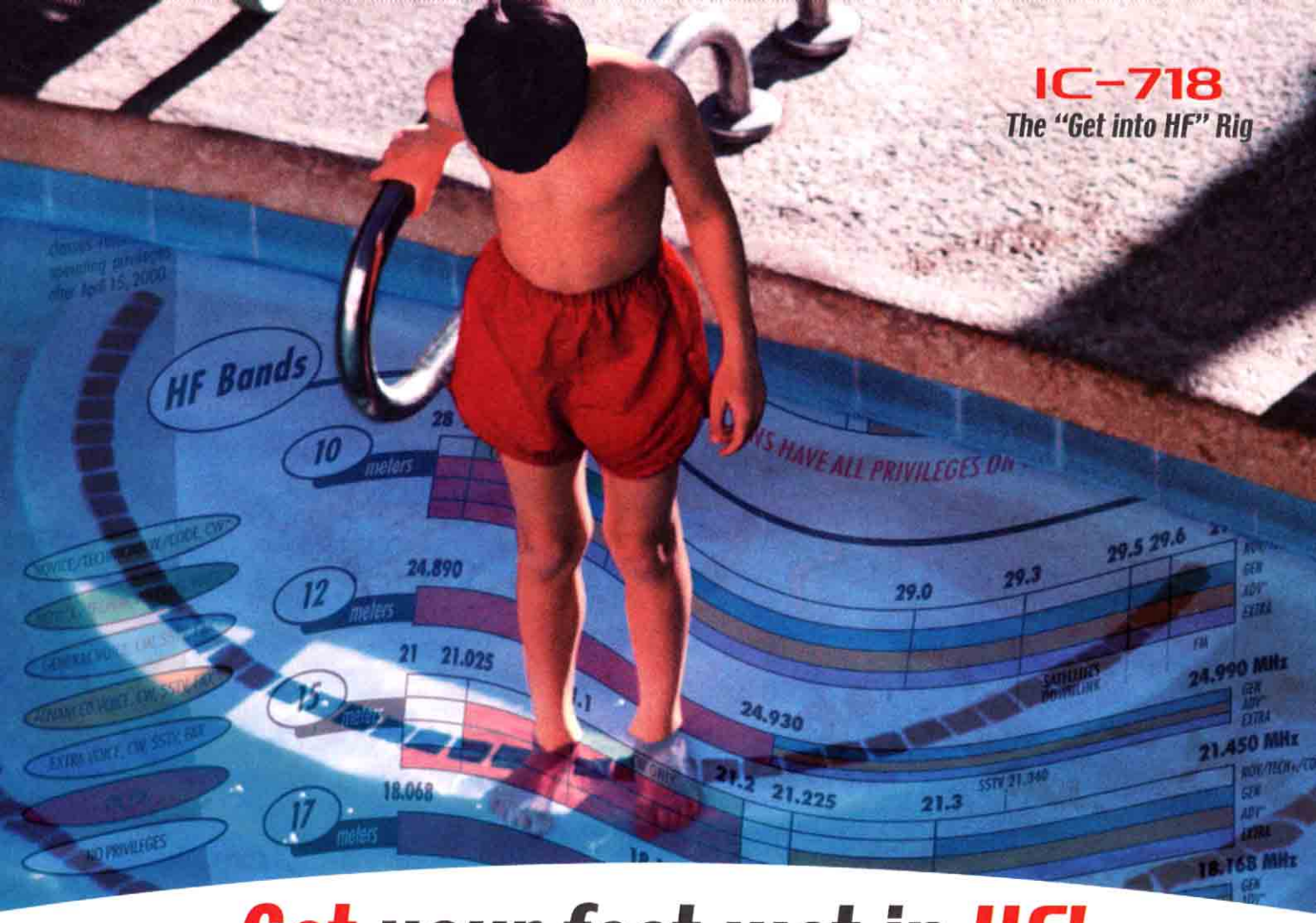

Get your feet wet in HF!

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!

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Convert Your Analog Transceiver to Digital Voice & Image

In One Easy Step!

No transceiver modifications are necessary.

- **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**

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 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

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*Image feature requires optional memory module.
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"IT SEEMS TO US..."

The Diamond Club

By the standards of most membership associations, ARRL dues are quite modest: $39 per year, or $34 if you are at least 65 years old and request the lower rate. That's about a dime a day. Still lower rates are available for youth, blind and family memberships. Nearly 20,000 members have paid-up Life Memberships and no longer pay annual dues at all. Especially for those of us who took this option a couple of decades ago, Life Membership has proved to be a very good deal.

There are good reasons to keep ARRL dues as low as possible.

While money is a vital and essential resource, an association's "people power" is more important than the size of its bank account. We have a fine professional staff in Newington and Washington, but membership dues could never fund the staff size required to do everything that must be done to protect, promote, and advance Amateur Radio. Volunteers do most of the League's work—and volunteers come from the membership.

Membership is a measure of an association's clout. As part of a 155,000-strong chorus, your voice is heard loud and clear in Washington. We don't want to lose your voice from the chorus because you can't afford to belong.

It's difficult to separate cause and effect, but we know that ARRL members are far more likely to be active radio amateurs than non-members—and activity is good for Amateur Radio. ARRL members are more likely to turn out for public service and emergency communications events. You are more likely to attend conventions, hamfests, and club meetings. You are more likely to patronize the companies that serve Amateur Radio's needs, and therefore to encourage the introduction of new products that increase amateurs' capabilities and enjoyment of radio. Every month we hear from members who have become excited about radio all over again because of something they read in that month's *QST*. Even if your interest is temporarily on the wane, we want you to maintain your membership because that makes it more likely you'll become more active in the future.

Maintaining a strong membership base isn't easy. For unavoidable reasons, every month we lose hundreds of long-time, loyal members. They must be replaced if we're just to stay even, and that means persuading hundreds of others to join or to rejoin. They are drawn from the ranks of amateur licensees whose interest has been newly rekindled as well as from among new and prospective licensees. It's costly, but absolutely essential, for us to reach out to them with our message, and with an invitation to join that offers good value to them.

For all of these reasons, we try to keep the dues low. We want the ARRL to be as inclusive as possible of people who care about Amateur Radio.

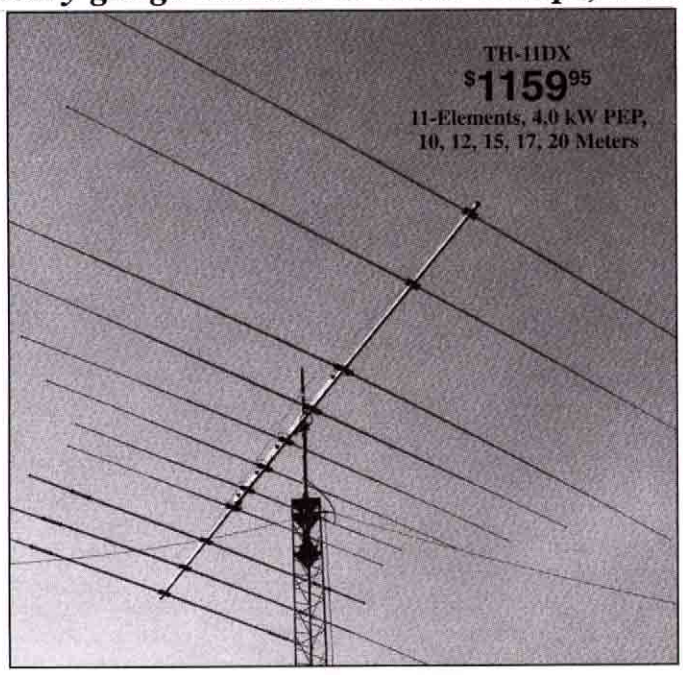
On the other hand, there are many thousands of ARRL members for whom Amateur Radio means far more—and who can afford far more—than a dime a day. In recent years we have offered members opportunities to make voluntary contributions in support of specific ARRL programs and projects. Thousands of you have responded generously, especially for the Fund for the Defense of Amateur Radio Frequencies, because you know that spectrum defense is a never-ending, ever-escalating battle. You shared in the success on 40 meters earlier this year in Geneva; quite literally, we couldn't have done it without you. Similarly, the Education and Technology Program, which has already brought Amateur Radio into 50 schools, would not exist if it were not for the dedication of thousands of individual contributors.

Last year we introduced a new program called The ARRL Diamond Club to recognize members who are able and willing to make an annual commitment above and beyond the basic membership dues to help meet the ARRL's revenue needs. Beginning at $75 per year including basic membership ($50 for Life Members), the Diamond Club offers increased recognition and benefits in steps commensurate with contributions. More than 800 already have signed up, but we need more of you to become Diamond Club participants if we're to be able to continue doing the job for all of Amateur Radio. Please consider joining the Diamond Club; you can find the details about the program at **www.arrl.org/diamondclub**.

While every ARRL member should join in appreciation for those who are able to make this extra commitment, rest assured that we cherish every member, Diamond Club donor or not. We know there are increasing numbers of members for whom even the basic dues is a budget stretch. Through their willingness to do a bit more because they can, Diamond Club participants help the ARRL do more for Amateur Radio while keeping membership as accessible as possible for everyone. It's a worthy and important program; if you can, please give it your support.—*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.

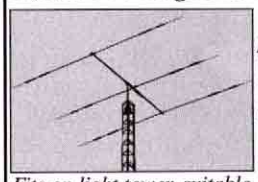
Hy-Gain's *patented* broadbanding *Para Sleeve* gives you less than 2:1 VSWR. 1.5kW PEP.

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.

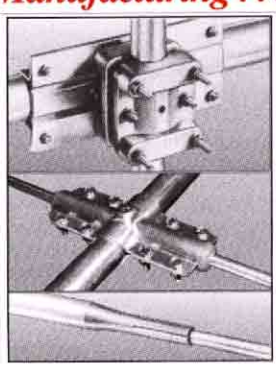
Model No.	No. of elements	avg Gain dBd	avg F/B dB	MaxPwr watts PEP	Bands Covered	Wind sq.ft. area	Wind (mph) Survival	Boom (feet)	Longest Elem. (ft)	Turning radius(ft)	Weight (lbs.)	Mast dia O.D.(in.)	Recom. Rotator	Retail Price
TH-11DX	11	*For Gain and F/B ratio--See...*		4000	10,12,15,17,20	12.5	100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

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• **TECH:** 662-323-9538 • **FAX:** 662-323-6551
http://www.hy-gain.com

Extreme Radio Activity!!!

Put the "X" in Xcitement

and take your on-air radio activity to new levels with these mobile transceivers from Alinco. Whether you choose a single band, dual band or "all mode" HF + 6m radio, Alinco delivers superb audio quality and low noise.

Single Band Commandos

Choose DR-135T MKII VHF, DR-235T 222MHz, or DR-435T MKII UHF FM *Mobile/Base Transceiver*

Whichever band you choose, these rugged single band mobile transceivers are ready for serious use in demanding conditions. You'll enjoy the large illuminated mic and easy-to-read alphanumeric display. The well-designed functions are user-friendly and include 100 memories, high stability TCXO, ignition key on/off feature, theft alarm, autodial memories, alphanumeric channel labels, CTCSS encode+decode, DCS, tone bursts, theft alarm, direct frequency input, optional internal TNC or optional internal digital voice module.

Double Duty Dynamos

DR-620T VHF/UHF *Wide Band Receive Mobile/Base FM Transceiver*

This Xciting VHF/UHF dual band radio will actually change to meet your needs! The removable remote-mount head allows you to invert the transceiver for optimum speaker placement and extra flexibility when installing in a vehicle. Plus, the large alphanumeric display lets you change display colors so you can select the color that works best for you. Enjoy wide band broadcast FM signals, AM Airband, weather and other public safety frequencies in addition to VHF and UHF operations. Add the optional internal TNC for packet or APRS operations or be among the first to engage in digital voice communications with the optional digital module. Other features include a large illuminated mic, internal duplexer, CTCSS encode+decode, DCS and more.

DR-605TQ VHF+UHF *Dual Band Mobile/Base FM Transceiver*

Alinco's Xcellent value in a dual band, dual watch transceiver with crossband repeat at a price that's amazingly low. This popular dual band features CTCSS encode+decode, 50 memories per band, internal duplexer, large easy-to-use controls and a massive heat sink for quiet fan-free operation. Xtreme value in a VHF+UHF transceiver!

All Mode Action

DX-70TH HF+6M *Mobile/Base Transceiver*

Rugged and reliable, this radio is a proven performer with 100 watts output and all mode performance on HF bands and the 6M "magic band". The removable remote mount control head makes mobile installation easier and the big display with a wide choice of operator parameters and full QSK CW operation makes getting on the air easy. Whether you enjoy HF action or the challenge of 6M, the DX-70TH is ready to deliver on-air Xcitement!

For more details on feature-rich, value-packed transceivers for your favorite bands, call or stop by your favorite 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

Logbook of The World Continues to Grow

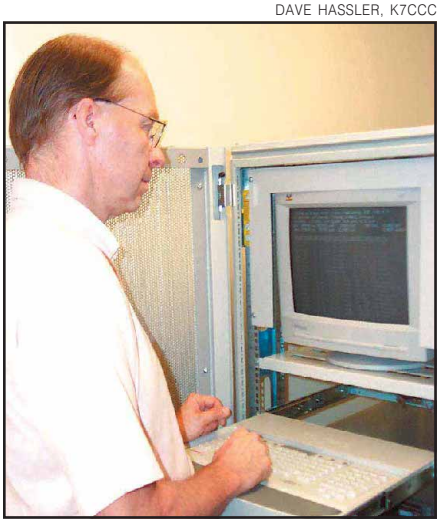
While a great deal of effort and time went into rolling out Amateur Radio's premier online QSO-awards credit system—ARRL's Logbook of The World—a number of ARRL Headquarters staffers are working to make it even better. "A lot of people worked very hard to get the system on-line by the September 15 deadline," said ARRL Web and Software Development Manager Jon Bloom, KE3Z, Logbook's chief programmer. "Now, we're working to improve the software based on user feedback and we continue to work with logging software authors on compatibility issues."

ARRL Membership Services Manager Wayne Mills, N7NG, and Assistant to the CEO David Patton, NN1N, have handled a lot of that user feedback. Out of the comments has come a greatly expanded "Frequently Asked Questions" file on the ARRL Web site (**www.arrl.org/lotw/faq**), an improved user interface and a download feature to allow users to consolidate QSO data on their home computers.

In the first month of operation, 14 million QSOs were uploaded to the system. Response to Logbook has been very positive: "Congrats on a great launch of the Logbook of the World!" wrote one enthusiastic member. "As a computer professional for 30 years, I know that what you've accomplished is no small task. Further, I don't think anyone realizes how big this is going to get—It's great!"

Bloom said that even more new features are in the works, including the capability for users of Logbook to display their current credit standings for a variety of ARRL operating awards. Bloom is also updating the system's administrative software to allow for smoother and more efficient operation.

DAVE HASSLER, K7CCC



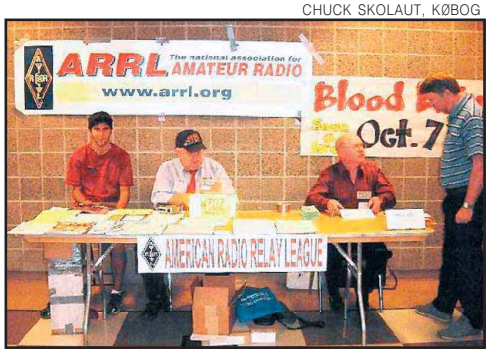
ARRL Web and Software Development Manager Jon Bloom, KE3Z, reviews system statistics on the Logbook of The World server at ARRL Headquarters. The system took in over 14 million QSOs in its first month of operation.

Skolaut, Milnes Discuss Illegal 10 Meter Operation, WRC-2003 Results

Eastern Washington hams voiced concerns over unlicensed 10 meter operation at the Eastern Washington Section Convention, held at University High School in Spokane, Washington on September 27. ARRL Field and Regulatory Correspondent Chuck Skolaut, KØBOG, was on hand to let convention attendees know that the ARRL's Official Observers and the FCC Amateur Auxiliary were monitoring the problem.

"At a forum on the program, I gave some background on the history of the Official Observers and what we're doing now, especially in regard to how solid documentation is gathered while monitoring ongoing problems such as unlicensed 10-meter use," Skolaut said.

CHUCK SKOLAUT, KØBOG



At left, Ben Schupack, NW7DX, and Northwestern Division Director Greg Milnes, W7OZ, staff the ARRL table at the Eastern Washington Section Convention, while LaMar Ray, WA7LT discusses an application with an award applicant.

Northwestern Division Director Greg Milnes, W7OZ, hosted a general ARRL forum. Topics included an overview of the coming changes brought on by decisions made at World Radiocommunication Conference 2003 this past summer. He addressed questions and comments on such topics as the timetable for broadcasters shifting up from the 7100-7200 kHz segment of 40 meters, the removal of the international Morse code testing requirement for HF access and broadband Internet delivery over power lines (BPL).

Activity buzzed around the ARRL table throughout the event, Skolaut said, and attendees appreciated the handouts, as well as the opportunity to meet Ben Schupack, NW7DX, the recipient of the first William Goldfarb Memorial Scholarship as well as the Hiram Percy Maxim Award.

Foundation Scholarships Available

The ARRL Foundation is now accepting scholarship applications for the 2004-05 school year. A full list of scholarships is available on the ARRL Web site at **www.arrl.org/arrlf/scholgen.html**. Applicants can use one application for the main pool of scholarships; additional paperwork is required for the William R. Goldfarb Memorial Scholarship.

Regulatory Information Web Pages Get Facelift

Constantly changing times call for adaptation, and federal radio regulations are no exception. To that end, ARRL Regulatory Information Specialist John Hennessee, N1KB, has spent time over the last several months combing through the ARRL Web site's regulatory pages and updating a lot of the content.

"There's new material on international operating, 1x1 call sign special event stations, equipment authorizations, and more," Hennessee said. "We've been going through the pages one at a time to ensure that the information there is current and correct."

The International Operating page within the Regulatory area of the ARRL Web site contains everything a ham needs to know to use Amateur Radio overseas. It also has information for foreign hams visiting the US who wish to operate.

Another major improvement is in the format of the regulatory pages. Hennessee said he restructured the Web pages to make the flow from one link to the next more logical, so that information is presented to the user in the most obvious, expedient and accessible manner. He based the new structure on the popular ARRL Technical Information Service (TIS) database Web site.

Two "frequently asked questions" documents have also been updated: the 60-Meter Operating FAQ and the Vanity Call Sign FAQ. "There have been a lot of questions about how to renew an Amateur Radio license, so we've added more material on that," Hennessee said. "The object is to have everything online so that hams can find what they need fast. Of course, they're still most welcome to call or e-mail me at **reginfo@arrl.org** with a question."

You can find the ARRL regulatory Web pages at **www.arrl.org**. Click on the "Support" link on the top menu bar and then select "Regulatory Information."

North Texas Amateurs Showcase Ham Radio to Thousands at Technology Expo

Amidst the latest cell phones, PDAs, computer games and high definition TV displays at the *NBC 5 Technology & Lifestyles Expo*, local Dallas/Fort Worth hams brought Amateur Radio front-and-center by setting up a large ARRL booth September 27 and 28.

North Texas Section volunteers and members of several area ARRL affiliated clubs put together a large display of Amateur Radio equipment and information, said ARRL North Texas Section Manager Roy Rabey, AD5KZ. Several thousand Expo goers visited it. "The 30-by-30 [foot] booth was one of the largest on the show floor and drew the attention of many interested visitors," he said. "A large assortment of printed information was handed out in an effort to educate and inform the public on the many educational, public service and social aspects of Amateur Radio."

Demonstrations were provided using several live operating stations running AM; VHF and UHF using local FM repeaters; EchoLink, IRLP and APRS; and a demonstration of the National Traffic System. Doug Kilgore, KD5OUG, presented a program on ham radio's involvement in the *Columbia* shuttle recovery efforts in East Texas. This turned out to be one of the most popular programs presented at the Expo, Rabey said.

"This was a major PR event," Rabey stated. "The volunteers working the booth did an awesome job of promoting Amateur Radio. All of the clubs involved came together to make this event a big success. We'll be looking forward to another chance to promote Amateur Radio to the general public at next year's Expo."

For those in other parts of the country who have large technology shows in their area, an e-mail or phone call to your section manager can be a good place to start to get the ball rolling for an Amateur Radio display in your neck of the woods. All section managers' e-mail addresses and phone numbers are listed on page 16.

WCF Convention Issues a BPL Challenge

You know the old saw: "Put your money where your mouth is." The hams down in the West Central Florida section have taken that adage to heart when it comes to protecting Amateur Radio spectrum.

With a convention theme of "In Defense of Amateur Radio," ARRL West Central Florida Section Manager Dave Armbrust, AE4MR, said one dollar of the price of each admission ticket would be donated to the ARRL BPL fund, to aid in the fight against the specter of broadband data delivery over power lines. Further, he issued a challenge to other hamfests and Amateur Radio conventions to also donate a dollar from the price of admission to those events.

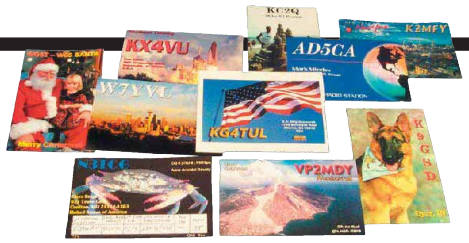
"Florida amateurs realize how devastating the BPL proposals would be to our HF bands," Armbrust said. "We rely heavily on these bands whenever disaster strikes our state. We are united and fully engaged in this BPL fight, and we are ready to do what it takes to win."

ARRL Laboratory Manager Ed Hare, W1RFI, will speak at the WCF Section Convention December 6 and 7 in Tampa, Florida on the threat to HF and lower VHF frequencies from BPL. Armbrust added that there will be special donation opportunities set up during the convention when amateurs—and vendors, too—can contribute more to the defense fund, if they wish.

AMSAT-NA Outlines Amateur Space Activities

Along with a couple of hundred other satellite enthusiasts, *QST* Assistant News Editor Dave Hassler, K7CCC, attended the Radio Amateur Satellite Corporation (AMSAT-NA) annual Space Symposium and General Meeting October 17-19 in Toronto. At the meeting, AMSAT officials announced that launch of the AMSAT-OSCAR-E micro-satellite, commonly known as Echo, has been moved up to March 31, 2004, from mid May.

Guide to ARRL Member Services



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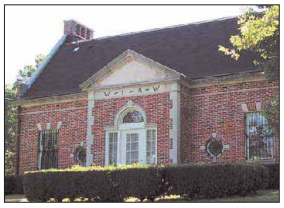
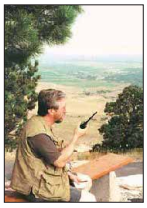



www.arrl.org/services.html/ **860-594-0200**

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), M-F only, 8 AM to 8 PM Eastern Time.

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 . . .

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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.

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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.

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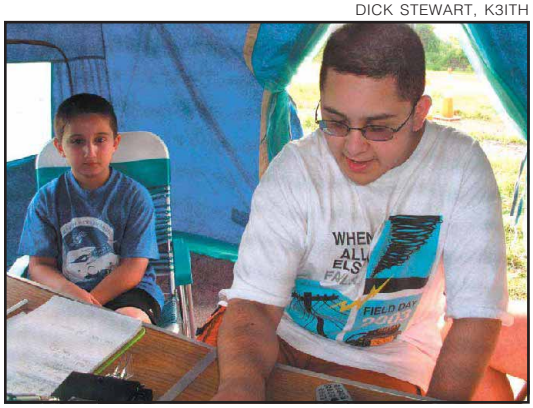
Field Day 2003

And what a Field Day it was! You can find the complete results starting on page 86 of this issue. An expanded Soapbox is available on the ARRLWeb at **www.arrl.org/contests/soapbox/**.

STEVEN SEWALD, N7OZN

N7PAQ (1B), in Kitsap, County, Washington, made use of an unusual antenna support to enhance their effort. As Steven Sewald, N7OZN, reports: "We had an A3S beam assembled, duct-taped to a backhoe bucket and were on the air in almost no time. The weather was beautiful in Washington that weekend!"

DICK STEWART, K3ITH



After a scary-looking storm cell had threatened the Brainerd (MN) Area Amateur Radio Club Field Day operation June 28, Mark Persons, WØMH, was glad he had a camera handy to capture the picturesque aftermath.

Matt Melachrinos, KB3JVV, who's 9, watches Leland Berman, N3LJB, who's 14, operate from the Mid-Atlantic Amateur Radio Club's Field Day event (W3NWA, 4A).

CORNEL TOPALA, KK9DX

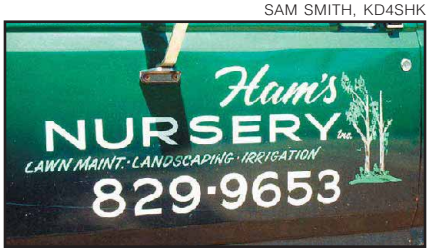
Have snorkel truck—will lift: **The CorTek Radio Association, W9CA (2A) from Illinois made their first FD operation a memorable one. The group effort included a GOTA station, K9MY.**

MARK PERSONS, WØMH

CARL RAWLINGS, KB8YZZ

Carl Rawlings, KB8YZZ, of Charleston, West Virginia, found another spare lawnmower engine—as well as a generator from an old Chevy—in his basement recently, and the result is the 12 V generator in the photo. (For a look at what he did with his first spare engine, see October 1997 *QST*, page 20.) When he found the spare, "it came to me that I could build another one," he writes. "I built this one in an old rocket ammo box I had picked up at a yard sale. It really works great—no vibration, real smooth!"

SAM SMITH, KD4SHK



Daddy, where do hams come from? **Sam Smith, KD4SHK, of Sharpsburg, Georgia, spotted this apparent spawning ground for new ops while on his honeymoon in St Augustine, Florida. Sam's new bride is Nicole, KG4WUW.**

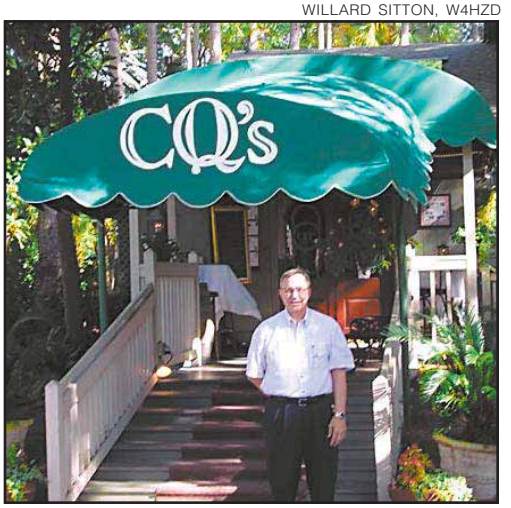
Ham Volunteers Assist with California Wildfires

When a rash of wildfires hit Santa Clara County in late August, the Volunteers in Prevention of the Santa Clara Unit of the California Department of Forestry and Fire Protection jumped into action. On the 28th, two hams were dispatched to set up a CDF portable repeater on Pacheco Peak, in the Coast Range near the largest fire. Another repeater was set up to the east of the fire in the "black"—the burned-over area—and both repeaters were successfully linked on UHF so that firefighters on both sides of the Coast Range could communicate with the Emergency Communications Center at the Unit headquarters. In all, 14 of the 21 Volunteers who participated are hams, and those on the communications team did such good work that several were certified as incident radio dispatchers under the requirements of the federal National Wildfire Coordinating Group. *—John Amos, KC6TVM*

BEN VICKERS, WB6FRM

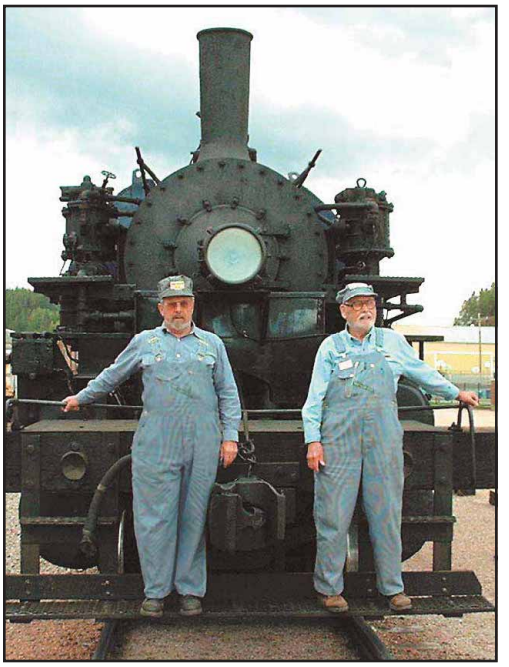
A total of 14 ham volunteers, including Jim Dethlefson, KA6YRK; Brad Horak, N6BDE, and Carl First, N6CKV, shown here setting up a portable UHF repeater in a burned-out area, enabled firefighters to maintain communications during an outbreak of wildfires in California in late August.

WILLARD SITTON, W4HZD



This restaurant (on Hilton Head Island, South Carolina) is named CQ's for the owner's initials, not for what hams might be seeking inside, according to Willard Sitton, W4HZD, of Knoxville, Tennessee.

BUTCH KRUSE, NØDUX



On September 20 and 21, four South Dakota Black Hills area ARCs operated a Special Event Station in conjunction with the Black Hills Central (BHCR) Railroad Days Celebration in Hill City, South Dakota. About 20 local hams operated on 20 and 40 meters. Two of the operators are employees of the BHCR—Butch, NØDUX, a fireman (at left), and Roger, KØROG, a train host. Jiggs, WAØFGV, demonstrated vintage telegraphy equipment, using the real deal—American Morse code.

DICK ARNOLD, AF8X

The Sea Cadet ship *Pride of Michigan* served as an Amateur Radio training ground for an enthusiastic group of teens in August, thanks to the demo arranged by Dick Arnold, AF8X, and the support of Captain Luke Clyburn.

Sea Cadets See Ham Radio Close Up: **In early August, Dick Arnold, AF8X, of Clinton Township, Michigan, set up a station aboard the Sea Cadet ship *Pride of Michigan* and made some CW contacts before a group of Cadets. Dick writes: "This activity was not only fun for me, but I think I accomplished something by exposing these young men to Amateur Radio and what it could mean to them. I have been invited back to the ship and will be installing an inverted-V HF antenna so that they can communicate while on their cruises. The Sea Cadet program is a wonderful thing for teens; I only wish it had been available when I was that age. Check their Web page for details: www.prideofmichigan.org/Pride.htm."**

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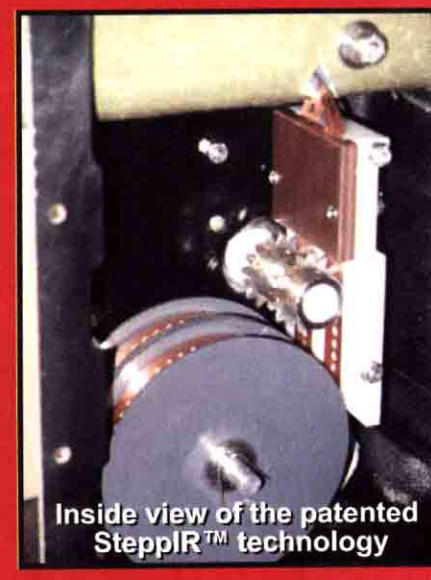

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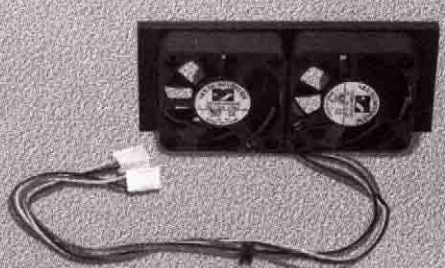

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WAS PORKY A HAM?

♦ I was watching a Porky Pig cartoon called "Porky's Railroad," and heard a railroad telegrapher send the following Morse code message to the cartoon's namesake: QST QSL LEON SCHLESINGER IN HOLLYWOOD FOR PICTURE OF PORKY. Leon Schlesinger was the producer of many cartoons, including this one, which came out in 1937.—*Robin Finesmith, AA3NJ, Herndon, Virginia*

MORSE PRESERVATION NOT "HYPE"

♦ I certainly respect the view of some—that if we do not test for other modes—it's clearly not fair to test for Morse skills for all HF license classes. However, Morse does require skills that are unique, and it is still recognized as a valuable basic mode of operation for many situations. Would it not then be prudent to maintain at least one license class that could distinguish those who are skilled in it?

Such a distinction of "pride-incentive" could indeed help to preserve this very special heritage in our history. Can we ignore that, according to one survey, nearly half of our license amateurs do in fact use Morse?

There does seem to be a real fear that if we lose the distinction of a Morse incentive, we will then become vulnerable to invasion and compromise of our precious CW spectrum by other modes and commercial interests. This cannot possibly be in the best interest of our unique ability to communicate without dependence upon paid-for public utilities, or the more complex (and expensive) modes of amateur technology.

Are we not primary guardians and caretakers of a unique American freedom and/or privilege to communicate without dependence upon (and promotion of) commercial interests and profit motivations?—*Richard Taesch, K6TOB, Newhall, California*

NATURE OF THE BEAST?

♦ There are amateurs among us who are handicapped in various ways. As a result, their speech and alertness are strained or somewhat flawed when they are on the air. Sad to say, but there are a few amateurs who find this annoying. Chalk it up to a weakness in human nature.

To those who are emotionally and/or physically challenged, Amateur Radio is much more than a Service. It is therapeutic, it is medicine, it's a chance to heal, it is a chance to associate with friends, it is a chance to grow/contribute, it is a window on the world. Imagine how they feel when certain hams quickly end a conversation when they join the group or do not respond to their general call at all.

To those who show intolerance, I could fall back on the old adage, "It is the nature of the beast," but that would be too easy. No, they will have to try harder. It is ironic because it is the person with a disability who must be admired due to the difficulties they have to overcome to earn a license compared to others.

When the time is right, talk to them at length, get to know them better and listen to what they have to say. And when you hear the lift in their voice because you are talking to them as peers, and detect improvement in their communications because you cared to help, you will know you did the right thing.

To those who already practice this, you have my highest respect.

Tolerance—make it your personal part of Amateur Radio.—*Murray Green, K3BEQ, Cheverly, Maryland*

MORE ON THE DANGERS OF CATHODE KEYING

♦ The article on the dangers of cathode keying by Sam Karty, KD4VRS, in the November 2003 issue of *QST* ["The Dangers of Cathode Keying," pp 28-30], is timely considering the renewed interest in the restoration and use of older gear. Although the solutions posed are good and to the point, there are some other approaches that can solve or mitigate the problem.

One approach is to use keys without exposed contacts or terminals. I know of two in this category; perhaps there are others. The Nye Viking Master Key (see **www.nyeviking.com**) activates internal contacts through an insulating shaft driven by the key arm. This is in current production and available from dealers. The other type is the generic military "flameproof" key that was made for use in explosive environments and have sealed contacts. Surplus flameproof keys can be found at hamfests and on auction sites.

A not totally satisfactory solution, but one that is worth mentioning, is the fact that regular keys have an implied "polarity." Even though the terminals are not identified, in most keys one terminal is connected to the key frame while the other goes to the contact point. A quick inspection or check with a meter will determine which is which. By connecting the leads so that the key frame is connected to the radio chassis, the cathode voltage is only exposed at the lower key contact and the terminal itself. This makes it much less likely that an accidental contact will occur.—*Joel R. Hallas, W1ZR, Assistant Technical Editor,* QST

NEVER SAY DIE

♦ Love him, hate him, think he's a genius, think he's a wacko, Wayne Green's editorials would always get you thinking—if you were of a mind to think about the topic at hand. In all honesty, I can't think of a W2NSD editorial that I thought was even one quarter within this universe, but I also can't recall one that I thought wasn't worth reading.

Wayne is an integral part of Amateur Radio; in particular, he was an ardent supporter, cheerleader and innovator in RTTY—my favorite mode—before I was even born. We should all wish him well in his future adventures.—*Tom Kopec, W1PF, Amherst, Massachusetts*

[*73 Amateur Radio Today* recently ceased publication after 43 years. W2NSD founded *73* in October 1960.—*Ed.*]

WHY GO SPLIT?

♦ I'd like to thank H. Ward Silver, NØAX, for his article in the October 2003 issue of *QST*, "A Contest Primer" (pp 48-51) and congratulate ARRL for running such an excellent piece of work. I just got my first lesson this evening on why DX stations work split frequencies, and his operating tips on how to do it were very helpful to me.

I've been a ham for some 30-plus years, but never had much interest in DXing because it seemed like so much work—and such pandemonium. This evening I heard TR8JCV in Gabon and, at first, it was quite orderly. All of a sudden there was an incredible pileup, with stations calling him over and over and over so that he had no chance of answering anyone through the pileup. Eventually some-

one told him to go "split." Things settled down after that. But I found there were still a lot of stations who obviously didn't understand split frequency operation and were still calling him on his TX frequency, making it very difficult for the station he was actually answering to hear his reply.

Now that I've experienced the reason first-hand, I may give split-frequency DXing a try. Thanks again to NØAX and ARRL for this excellent tutorial. *—Dave Cook, WAØTTN, Mercer Island, Washington*

LONG OVERDUE

♦ The article by Sam Karty, KD4VRS, is one article that has been long overdue! When I saw the title of the article, I had an immediate flashback. It was 1956 and I was attempting my first QSO as DL4TPO in southern Germany. I answered a CQ and was shaking like a leaf. My hands were sewating and everything I had learned had left.

My fingers slipped off the J-38 key knob and in an instant I received a teeth-rattling shock from the Heath AT-1 cathode circuit. Needless to say, things went downhill from there.

I can only imagine what could have happened if the current path had been across my chest. With the present interest in old transmitter rebuilding, Sam's article is very timely.*—Allen T. Poland Jr, K8AXW, Keyser, West Virginia*

A PERSONAL FD PERSPECTIVE

♦ On June 28, 2003 I attended my first Field Day. All I can say is: "What a marvelous wonderful terrific fantastic time I had"—one of the best times of my life!

My deepest heartfelt thanks to the Chicago FM Club, which sponsored the Field Day. This is what Amateur Radio is about.

A special thanks to Paul Tuttle, N9LXF, for programming my RadioShack HTX-202 and my Realistic HTX-404. I would also like to thank Fred, WD9GAD, for the excellent advice he gave me.

The Village of River Grove let us use a bucket truck to put the triband and 40 meter antennas up. Paul and others assembled the antennas. It took all of us to put the antennas in the bucket truck when fully assembled.

Each of us who attended the Field Day had our own talents. Each of our talents was used to make the Field Day a success.

I did make a few contacts on 2 meters using the call N9PA. I felt like a real Amateur Radio operator after I made the contacts. I never knew what fun Amateur Radio could be!

If you've never attended a Field Day, you do not know what you're missing. Get there early! Half the fun is in setting up the antennas and the equipment—hooking up the computer, the wireless network, solar cells, generator, power supplies, radios, and running all the extension cords and power strips to make everything work.

Again, I would like to thank the Chicago FM Club for showing me the time of my life!*—William Prize, KB9YEK, River Grove, Illinois*

APPALLED

♦ I am absolutely appalled at the picture that appears on page 52 of the October 2003 issue of *QST* ["RV Radio"]. Mounting radios, or any object for that matter, on the dash of a vehicle is extremely unsafe and a formula for disaster. I have a ham friend who earlier this year was nearly killed by a flying transceiver that struck him in the head. Even if the equipment in question is supposedly securely mounted, in the event of an impact it may come loose. (All of this in addition to the fact that so much radio gear up front is more distracting than a cell phone and reduces the visibility of the road.)

This word of caution also applies to objects in other parts of the vehicle, such as in Figure 2 (page 53), which tend to come forward in a crash. Please let's not encourage any unsafe practices in our love for "going mobile."*—Jim Hoffer, KW8T, Smithsburg, Maryland*

[The author replies: "KW8T brings up some good points that apply to any mobile installation, be it RV or other. Any loose or improperly mounted equipment could become a lethal projectile in case of an accident. Many RV hams do not operate HF while actually in motion. The 'loose' equipment is stowed for driving for the very reason Jim mentions, and are put in place for use when arriving at a campground or roadside rest park, etc. The equipment is shown in the operational mode. For instance, in Figure 2 of the article all equipment except the amplifier is stowed while driving. The amplifier is protected from forward travel by the wood frame just visible at the lower left of the amplifier in the photo."*—Dick Stroud, W9SR*]

BEST IN YEARS

♦ The October *QST* is the best issue in several years. I know that one's interest determines to a large extent whether an issue is good or "bad." I wanted to mention a couple of articles that I thought were very good, but then I realized I would have to make my letter a table of contents for the October issue. And I have not even read all the articles yet.

Bottom line is that anybody who doesn't get *QST* had better hurry and order while back issues are available.*—R. Alfred Whiting, K3BRS, Silver Spring, Maryland*

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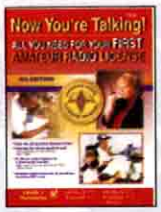

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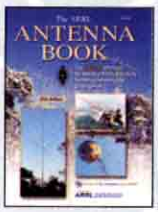

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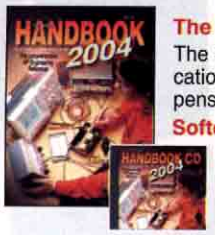

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By Sam F. Kennedy Jr, KT4QW

A Homebrew Condenser Microphone

Build a condenser microphone that will perform like the costly commercial units...plus, you won't need an expensive equalizer. Sounds good!

With modern commercial amateur transceivers becoming increasingly difficult to work on, most ham builders have turned to other endeavors. Looking around for a fresh project, and one that had a reasonable chance of success, I decided to build a "scratch-built" condenser microphone. One of my friends had been working on piezoelectric homebrew microphones, so the condenser microphone seemed like a good choice. I know that this is 1920s technology and that you can buy a very good microphone reasonably, but it is interesting, challenging and educational to retrace some of the development processes of those "times gone by." I set the following objectives for my new homebrew microphone:

- Sound as good or better than the Heil Goldline microphone
- Work directly into a transceiver without external equalization or processing
- Require no special tools to fabricate
- Use no manufactured microphone parts
- Use no special materials—only those found in the "junk box" or local store
- Be attractive and complementary to my station
- Be inexpensive

I'll not bore you with all the things I tried that didn't work—I will simply explain the final model that met all my objectives. The final product, pictured here, is the result—a condenser microphone with a very large diaphragm (1.6 inch diameter). The coarse screen mesh "cricket cage" serves as a combination windscreen and Faraday shield for the element. Adequate shielding is very important to ensure that no RF enters the audio stream. Because of the high gain required to amplify a condenser element, RFI can be a problem, so I shielded all the components thoroughly.

Some Basic Theory

Condenser microphones use a thin lightweight conducting membrane as a diaphragm and a fixed plate closely spaced behind it. The two facing surfaces become the plates of an air dielectric condenser (or capacitor if you prefer). Sound pressure against the thin membrane causes it to move. This movement changes the spacing between the plates and therefore the capacitance. When the condenser is polarized (charged or biased) with an external voltage, it causes a changing electrical output proportional to the sound pressure. The source impedance of the condenser element is very high, several megohms being typical. A built-in field effect transistor furnishes the impedance step-down necessary to deal with input to typical solid-state amplifiers. The FET has the capability of accepting a very high impedance input and producing a reasonably low output impedance of 1-2 kΩ, while producing moderate gain.[1]

When considering commercial studio type condenser microphones, "phantom power" is the term normally used for an externally supplied bias or polarizing voltage. A microphone of this type is said to be a "pure condenser" type as contrasted with an "electret condenser" microphone, which requires no external polarizing voltage.[2] The homebrew microphone under

[1]Notes appear on page 32.

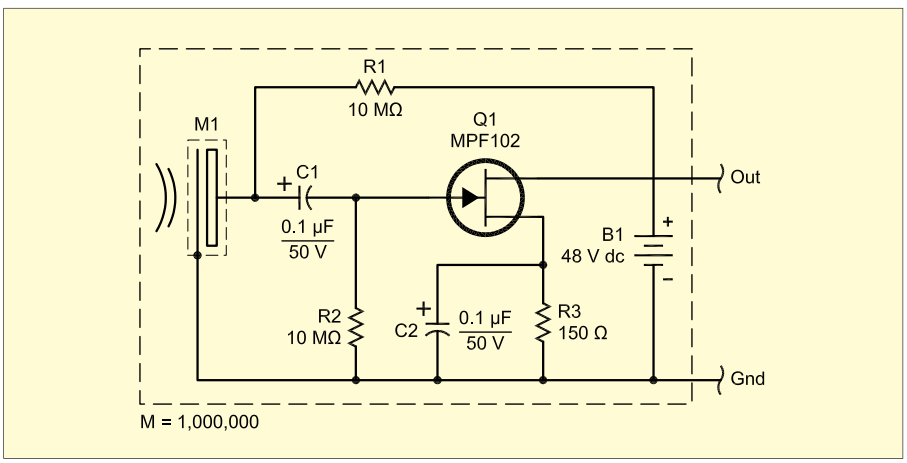


Figure 1—The microphone amplifier schematic together with the parts required for construction. Note that the polarizing or bias battery is fabricated from multiple cells, as described in the text. R1 and R2, the 10 MΩ resistors, can be made of two 4.7 MΩ, 1/4 W resistors if 10 MΩ resistors prove difficult to locate. C1 is used to keep the microphone polarizing voltage from appearing at the FET gate and C2 is used to bypass the FET source resistor. M1 is the microphone element and its construction is described in the text.

B1—48 V battery (see text).
C1, C2—0.1 µF, 50 V capacitor.
M1—Fabricated element (see text).
Q1—MPF-102 JFET, RadioShack 276-2062.
R1, R2—10 MΩ, 1/4 W resistor.
R3—150 Ω, 1/4 W resistor.

discussion uses a polarizing voltage derived from a very small internal 48 V battery mounted within the microphone housing. It does not use an external phantom power system. As is the case with an electret microphone, it does require a small voltage for the FET impedance transforming circuit inside the microphone. And, as in many electret microphones, the FET's drain load resistor and voltage source are located downstream, in the amplifier. No specific power supply is therefore necessary when operating this microphone with an electret-compatible circuit, such as that used by ICOM. As an example, this operating mode provides adequate microphone drive to satisfy the IC-756PRO transceiver. Figure 1 is the schematic of the microphone amplifier and the parts required.

In critical sound applications, the condenser microphone is often preferred for its uniform frequency response and its accurate response to transient sounds. The natural design of a condenser microphone ensures an outstanding low-frequency response, and the low mass and high tension of the diaphragm allows a smooth high-frequency response. This results in a clean, natural and clear sound. It is said to produce outstanding "transparency and detail." These characteristics make the condenser microphone a natural choice for professional use or other demanding applications.

Some manufacturers produce condenser microphones with diaphragms that are less than 1/10,000th of an inch thick. For amateur service use, not all of these characteristics are relevant. Since most amateur transmitters roll off most audio frequencies above 3 kHz, the high frequency characteristic of the microphone is not overly important. Condenser microphone design does provide the opportunity to shape the audio response without the use of external equalizers and processors. In the case of the homebrew micro-

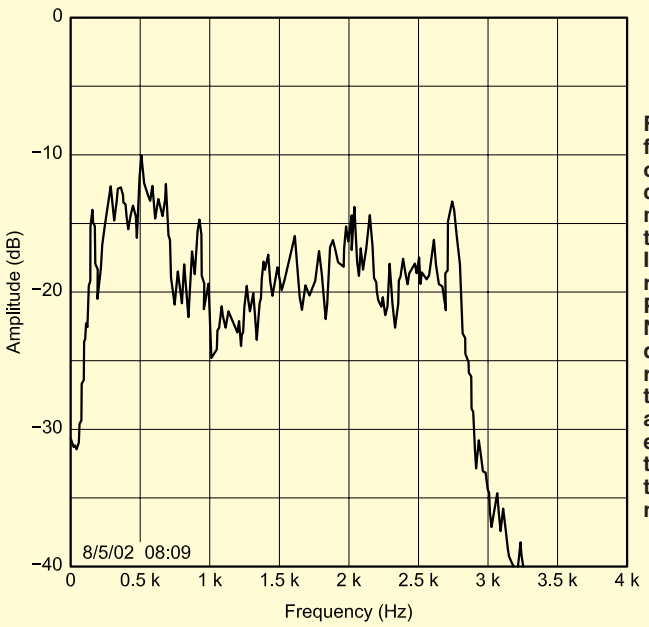


Figure 2—The overall frequency response of the homebrew condenser microphone as transmitted by an ICOM IC-756PRO and received by a Ten-Tec Pegasus transceiver. Note that the frequency response ranges from 100 Hz to 2750 Hz. The hump at the low frequency end is a typical ICOM transmitter characteristic. See editor's note in text.

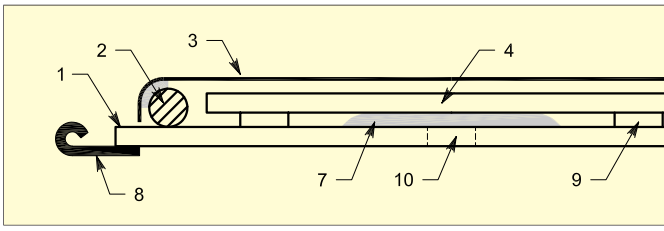


Figure 3—The microphone element mechanical details and basic construction steps. More detail can be found in the text.

1. The microphone base is made of a round disk of 1/16 inch double-sided PC board.
2. The spacer ring is made of 1/8 inch brazing rod, bent into a 1.6 inch diameter circle and soldered to surface of the base.
3. The diaphragm is 0.001 inch aluminum foil (lightweight household foil).
4. The condenser plate (inner) consists of 1/16 inch double side PC board and positioned 0.002-0.003 inch below the diaphragm.
5. The diaphragm is attached to spacer ring with epoxy cement. Stretch foil as tightly as possible without tearing. The foil must make good electrical contact with the spacer ring.
6. Flexible wire is connected to front surface of the condenser plate. Connects to the input coupling capacitor and to the JFET transistor and the polarizing voltage (bias) resistor.
7. Epoxy mix holds inner condenser plate in position.
8. Dress hooks soldered in place for elastic band suspension of the microphone element (4 hooks soldered with 90° spacing around element perimeter).
9. Foam rubber doughnut (see text).
10. Pour hole, 1/4 inch, for pouring epoxy mix into cavity to hold the condenser back plate in position.

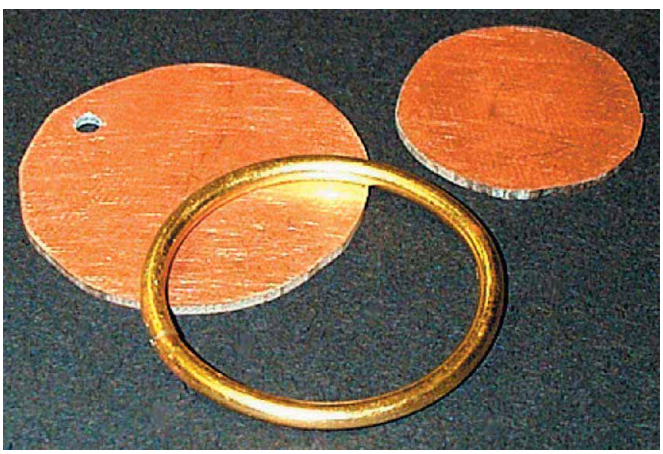


Figure 4—The main parts of the microphone element.

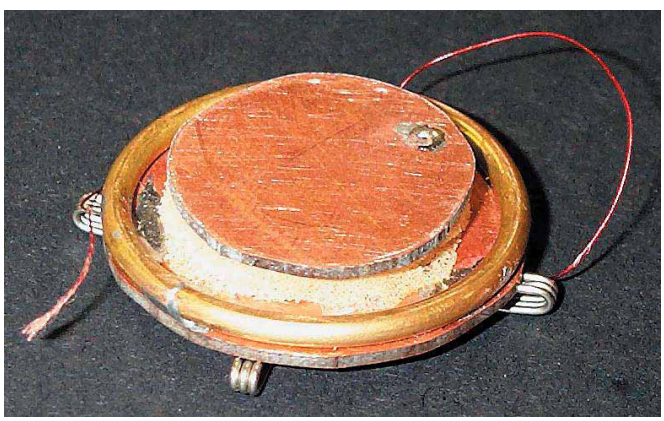


Figure 5—The assembled microphone element.

phone under discussion, a very large diaphragm (1.6 inches) is made of 0.001 inch thickness aluminum foil. The large diaphragm increases the low frequency response and the thickness of the material does limit the high frequency response, but the microphone operates very well within the frequency range we are concerned with.

Transmitted Spectral Content

Using a *HamAlyzer*[3] FFT audio spectrum analyzer on my notebook computer, I was able to test for frequency response and to "tweak" the microphone to achieve best results. Figure 2 shows a *HamAlyzer* trace of the microphone's over-the-air response when used with my ICOM IC-756PRO transceiver. This trace was captured by W5TOM, using his Ten-Tec Pegasus.

[Editor's Note: A bit of caution here. The *HamAlyzer* records a *system* spectral response that includes both the transmitter modulation and the receiver demodulation characteristics. If that measurement is taken by a distant station, it will also include any RF path characteristics that affect the transmit/receive audio frequency response. It includes, too, the sound card characteristics of the particular computer used, unless that is taken into account in the calibration procedure. Additionally, the output impedance variations of the microphone over frequency can contribute to audio "coloring" with a particular transceiver. And, the sonic characteristics of the room will further influence the measurement results. For accurate objective spectral response measurements of a microphone, an audio spectrum analyzer with an accurate audio frequency transducer driven by a calibrated audio sweep generator is required. The microphone should be tested in an anechoic chamber (a test chamber free of echoes and reverberation). Commercial microphone manufacturers do extensive measurements on their products, using sophisticated audio test equipment in laboratory environments. While relative basic measurements can be interesting, the fact that a microphone "sounds" good or bad with one transceiver may, in fact, be misleading, unless accurate testing is done under carefully controlled and calibrated conditions.]

After extensive testing, I discovered that this microphone had the best "presence" and overall sound quality when the element was suspended in air with no enclosure other than the element itself. It produces a cardioid pattern over the whole frequency range, but the pattern is less pronounced at low frequencies. It does pick up room noise and it shows less "proximity" effect than other microphones I have used. I did not concern myself with frequencies above 4 kHz, in that my transmitter cuts off everything above about 3 kHz anyway.

Building the Element

By referring to Figures 3, 4 and 5 you can see that the element is constructed by building four main subassemblies, then combining them. These are:

1. The base plate, a circular, 1.7 inch diameter disk of double sided $^1/_{16}$ inch printed circuit board. I used a school-type compass for layout and sawed the base plate out using a small jigsaw. Note that a $^1/_8$ inch hole is drilled into this part. This serves two purposes. One is to furnish an exit path for the wire that connects to the inner condenser plate and the second is to relieve some of the acoustical back pressure. It is important that the element is vented to atmospheric pressure to avoid an internal pressure differential and thus distort the diaphragm. The hole in the center of the back plate is $^1/_4$ inch in diameter. This hole is for pouring in epoxy behind the condenser back plate and is filled in later.

2. A 1.6 inch diameter brass ring is made of $^1/_8$ inch brazing rod. It is formed into a circle by wrapping it around a $^3/_4$ inch schedule 40 PVC pipe coupling which is clamped in a vise. The coupling is only 1.3 inch OD, but the rod springs back to form a somewhat larger circle. It is formed around the coupling for about a turn and a half and then adjusted so that it forms a 1.6 inch circle. The brazing rod behaves much better if you anneal it by heating it with a propane torch to discoloration and then letting it air cool. After the bending operation, clamp the loop in a vise and cut the both ends at the same time with a hacksaw. Solder it together being very careful to align the two ends to ensure a smooth circle.

3. The back plate of the condenser is a circular 1.25 inch diameter disk made of double sided $^1/_{16}$ inch printed circuit board. The layout for this was also done with a simple school-type compass and then the back plate was sawed out using a small jigsaw. Since most of the diaphragm motion is in the center, there is very little advantage realized by using all the outer space under the diaphragm. The 1.25 inch diameter leaves plenty of room around the edges for assembly and alignment.

4. A foam rubber doughnut the same OD as the back plate is required. While not critical, the doughnut's center hole should leave about $^1/_4$ inch of foam and the height should be about $^1/_4$ inch. This will allow it to be compressed to approximately $^1/_8$ inch in the final assembly. This doughnut, or "O-ring," serves to contain the epoxy poured in from the back and produces pressure on the back plate so that it will align with the brass ring when clamped to a hard smooth surface.

Smooth the edges and the flat surfaces

Figure 6—Applying the aluminum foil diaphragm to the element using a homebrew test fixture. Notice the bead of epoxy cement around the edge of the spacer ring. The diaphragm is held in this position until the glue dries fast. It is then trimmed, close to the ring.

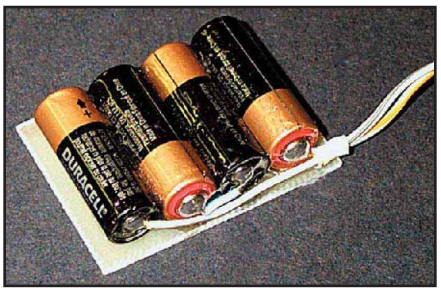


Figure 7—The 48 V polarizing (bias) battery assembly and parts list.

2 each, 12-V packs (RadioShack Keyless Entry System, RS 23-279 [GP27A]. Each pack contains two batteries for a total of four).
1 each, fiberglass board, 1.25×1.75×1/16 inches.
1 each, Velcro patch 3/4×3/4 inch. Apply to back of board for mounting.

Misc

Short length of very small gauge stranded hookup wire for interconnects and external leads.
Small quantity of 5 minute epoxy to affix the batteries to the board and to clear coat the finished unit for insulation.
Small section (0.5 inch) of shrink tubing to contain the two battery wires.

Figure 8—An example of a typical microphone housing, with parts and fixtures.

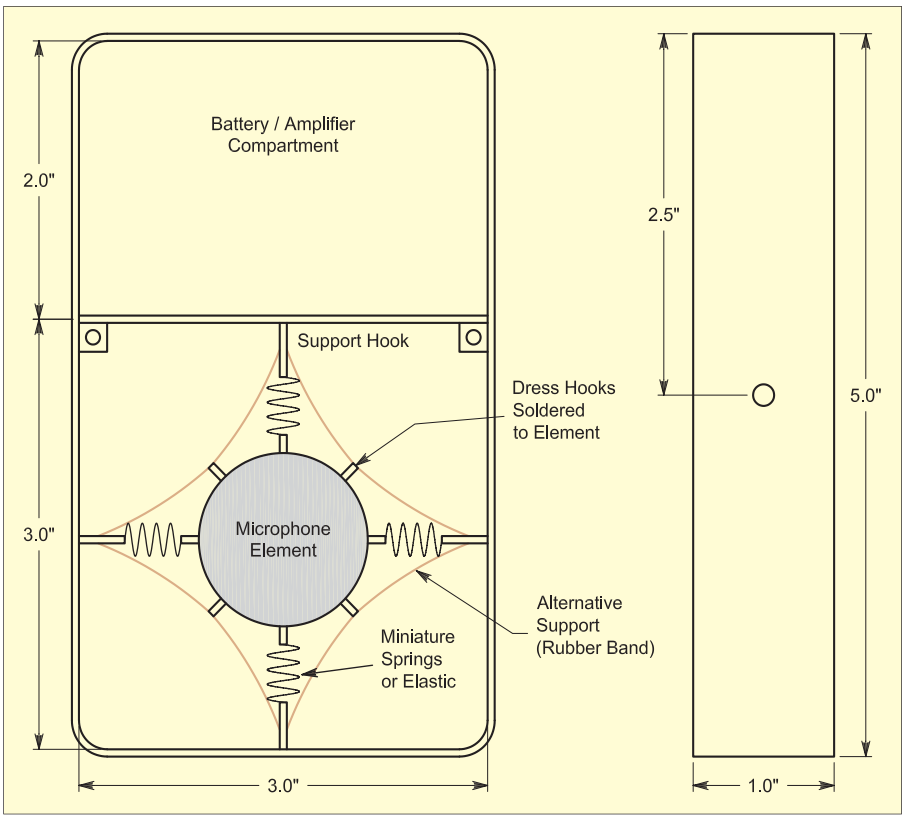


Figure 9—The dimensions of the microphone housing example. Note that the element is suspended by hooks and elastic. An alternative element support can be a rubber band, also shown. Use either method for support.

with 400 grit wet-dry sandpaper. Place the sandpaper on a firm, flat surface and lap the surfaces carefully to make certain they are flat and have no rough spots or burrs.

The following steps are necessary to assemble the element:

1. Solder a small, flexible insulated wire to the condenser back plate. This connection must be made to the front surface of the disk in such a manner so as to avoid disturbing the flatness of the front surface. I drilled a 1/16 inch hole from the back but not all the way through the front copper. Then press a dimple in the copper over the hole and drill a hole through the copper large enough to terminate the small connecting wire. Carefully sand the surface to make certain the solder does not protrude above the back plate front surface.

2. Solder the brass ring to the base plate (large disk) in three places. Use a large soldering iron and a minimum amount of solder and make sure that the solder flows to both ring and plate. See Figure 6 for the proper position of the ring.

3. The most critical operation of the entire project is mounting the condenser back plate so that it is 0.002-0.003 inch below the plane of the lip formed by the brass ring. This is done by temporarily using a piece of transparency film (used to make overhead graphics) as a shim between the front surface of the condenser back plate and the diaphragm. This shims the surface of the plate a controlled distance behind the plane of the lip. When both surfaces are pressed firmly onto a flat surface and glued in place, the proper spacing will have been established. The objective of this operation is to establish the minimum spacing possible while ensuring enough clearance, to avoid shorting of the condenser plates when stimulated with high sound pressure levels. The closer the spacing, the higher the microphone's output level and the better the signal to noise ratio. [A higher polarizing (bias) voltage might work to advantage here.—*Ed.*]

Application of the Diaphragm

Initially, I had difficulty applying the aluminum foil diaphragm to the base ring of the element. Figure 6 illustrates a fixture I built to make the task easy. Remember that the foil must be tensioned to the maximum extent possible without bursting. The following procedures will make this critical operation easy. Note that it is not essential to use a special fixture. A drill press that can be locked into position or a similar device will work equally well.

The fixture allows a larger than needed piece of foil (lightweight aluminum foil from the kitchen) to be held smoothly and tightly while the element is pressed into

it. A large-mouth plastic jar with a threaded top is used to hold the foil. The center portion of the jar top is removed with a sharp pocket knife. With a little care and experimentation, it becomes a very simple operation to form a "drum head" with the jar. The foil need not be tensioned, just clamped into place smoothly with no ripples. Lubricate the threads on the jar and the lid with a very light application of non-staining oil or petrolatum. This makes it much easier to get the foil in place. Make certain that the lubricant does not get on the foil in the center area or it will interfere with the cementing operation.

Once the element is pressed into the center of the "drum head," apply a light coat of epoxy cement around the edge with a small brush. Just a few bristles of an old brush held together with a piece of masking tape works fine and can be discarded when finished. Allow the epoxy to set (I used fast set epoxy but you may need more working time to avoid rushing) and then remove the excess foil by simply rough-cutting the excess foil from around the element. When it's removed, carefully trim the edges, being careful not to injure the tensioned diaphragm. Verify that the foil has a stable electrical contact with the ground portion of the element and that it does not make contact with the back plate of the condenser.

Polarizing (Bias) Battery

The 48 V battery assembly is made up of four 12 V batteries wired in series and mounted on a small fiberglass board. Since the condenser microphone uses this voltage to furnish only element bias, there is no current drawn from the battery and you should expect many years of full output potential—essentially the normal shelf life of the battery. The internal battery was used rather than an external power supply for economy and simplicity. Figure 7 shows the wired battery assembly.

The Microphone Housing

Because everyone has different mechanical capabilities and facilities at their disposal, I have not attempted to furnish exact mechanical details for construction of a housing. A number of satisfactory designs are possible. The housing shown in Figure 8 was constructed by W5TOM, using no more than simple hand tools and equipment. Figure 9 gives the overall dimensions for the housing. While I didn't intend to furnish exact construction details for the microphone housing, these photos and notes should provide some basic ideas for the construction techniques used to make a suitable housing. Since I use a boom microphone, my construction followed that path. A very nice desk mount could probably be constructed without much difficulty. So, sit back and enjoy your new condenser microphone—you'll be proud to say, "The mic here is totally homebrew!"

Notes

[1] *Editor's Note:* The condenser microphone was invented by Dr Edward C. Wente, of Bell Laboratories, in 1916, with a patent granted on March 16, 1920. The condenser element is a current source, with the current dependent upon the rate of change of capacitance (by sound pressure) multiplied by the applied bias voltage, which is a constant ($Q = C \times V$, so $d[Q]/dt = I = d[C]/dt \times V$). Sensitivity does depend on bias voltage and some commercial units run the bias voltage as high as 200 V dc, depending on diaphragm size, material and structure. The high impedance current source is converted to a voltage by a bias resistor and an impedance converter, which can be a FET or a vacuum tube.

[2] *Editor's Note:* That polarizing voltage comes from a permanently charged electret "battery" which is part of the microphone element. An electret is a solid dielectric material that has a near-permanent electrostatic charge. Electrets are similar to permanent magnets, but they are electrostatic rather than magnetic. They are made by heating certain dielectric materials (special plastics, Teflon compounds and waxes) and then letting them cool while they are in a strong electric field.

[3] **www.hamalyzer.com**.

All photos by the author.

Sam Kennedy, KT4QW, has been interested in radio since the age of 7 (65 years ago) but was actually first licensed in the 1950s as K4DEP. Relicensed in 1996, when he was assigned his current call, he earned the Amateur Extra ticket shortly thereafter. Sam has attended both commercial and US Navy electronics schools and has worked with military radio, radar and navigation equipment. He enjoys the technical aspects of ham radio and, as can be seen from this article, he has a special interest in microphones. You can contact him at 57 Huxley Pl, Newport News, VA 23606 or at **kt4qw@arrl.net**.

NEW PRODUCTS

NEW RADIO KITS FROM KENNEKE COMMUNICATIONS

◊ Kenneke Communications has announced a new line of radio kits. The three band shortwave receiver kit lets you build a radio designed to pull in stations from distant places. This kit will receive local AM radio stations as well.

AM receivers and AM, FM, shortwave and Amateur Radio transmitters are also available. They also offer a full line of antennas for these kits.

Manufacturer: Kenneke Communications, LLC, PO Box 3126, Albany, OR 97321; tel 541-619-6490; **www.kenneke.com/radiokits.html**.

DIAMOND MX610 HF/6 METER DUPLEXER

◊ The MX610 duplexer is designed to split HF and 6 meter signals. This is appropriate for HF/VHF radios with a single antenna port for both HF and 6 meters. The MX610 will allow separate antennas for HF and 6 meter operation on such radios as the ICOM IC-706 series and the Yaesu FT-100.

Advertised Specifications:

Frequency:	1.3-30 MHz (LPF), 49-470 MHz (HPF)
Connectors:	UHF type
Rated Power:	600 W (PEP)
Isolation:	45 dB
VSWR:	1.2:1 or better
Attenuation:	Less than 0.25 dB

Price: $69.95. For more information see your local dealer or contact Diamond Antenna, 435 S Pacific St, San Marcos, CA 92069; 760-744-0900; **www.diamondantenna.net**.

DXTREME *STATION LOG—MULTIMEDIA EDITION*

◊ DXtreme Software has released a new logging program in its Amateur Radio product line: DXtreme *Station Log—Multimedia Edition*. Like other logging programs, *Station Log* lets hams log their contacts and import ADIF files from popular contest programs. *Station Log* also provides multimedia and advanced features that can add functionality to Amateur Radio logging activities.

This program features an embedded audio facility that lets hams create and maintain an audio archive of selected contacts. *Station Log* also includes an integrated QSL imaging facility, which lets hams scan the physical QSL cards they receive from regular mail and capture the electronic QSLs they receive from the Internet. Both types of QSLs are saved as compatible digital images that hams can view at any time.

Station Log integrates with Microsoft *Word* to create customized, rich-text-formatted QSL card labels. It also produces ADIF-based electronic QSLs for uploading to Web sites that specialize in the delivery of eQSLs.

To help hams track the performance of their stations, *Station Log* can generate a variety of reports and output them to printers, as well as to the *DXtreme Active Report Viewer*. The viewer lets hams view and sort reports within Microsoft *Internet Explorer*.

Station Log retails for $79.95 in North America and $82.95 elsewhere, including shipping and handling. For more information, see **www.dxtreme.com** or e-mail **bob.raymond@dxtreme.com.**

By Miles B. Anderson, K2CBY

Your Uncle's Meters

Mix Uncle Sam's red, white and blue with green, gray and yellow and put a great meter on the bench and in your emergency kit!

A few years ago, our Uncle Sam decided to go digital in a big way. The result is that the surplus dealers, swap meets, flea markets and eBay have been swamped with first-quality US military surplus analog meters at very attractive prices. I'll discuss a few of the general purpose multimeters most commonly found on the surplus market and offer a few hints on their care and feeding. As you may be aware, the multimeter is one of the most useful pieces of test equipment a ham can have on the workbench. Multimeters measure resistance, voltage and current and, properly used, can also determine semiconductor faults. They are usually the first piece of test equipment the ham turns to in order to diagnose trouble.

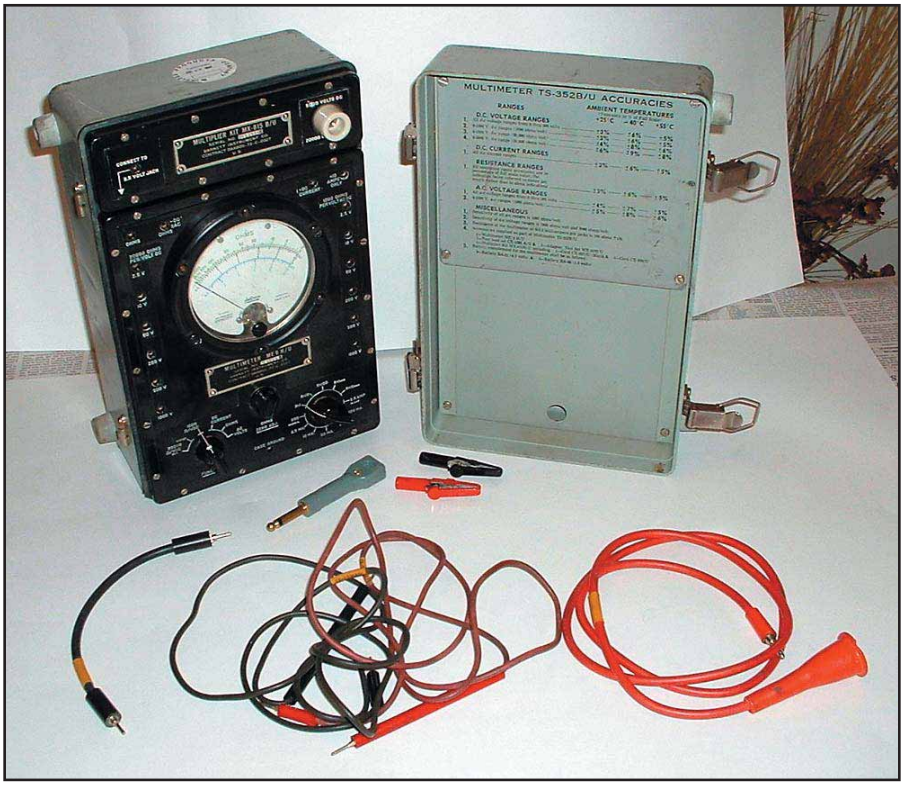


Figure 1—The TS-352 with its removable cover containing the test leads and accessories. The high voltage test lead plugs into the ceramic socket at the upper right. The patch cord just below and left of the meter connects the pin jack at the upper left to the +2.5 V dc 20 kΩ/V jack.

Let's Begin with the TS-352 ME-9/U

This is the oldest of the lot, with a design that dates from the early 1960s. Its chief advantages are mechanical ruggedness and reliability. Its disadvantages are size and weight. The instrument comes in a heavy duty, watertight cast aluminum case with removable cover—generally painted gray—that measures $11^{3}/_{8} \times 8^{1}/_{4} \times 6$ inches overall and weighs almost 14 pounds. An example of the TS-352 ME-9/U and its test leads is shown in Figure 1.

The voltmeter measures dc voltage on ranges of 2.5, 10, 50, 250, 500 and 1000 V at a sensitivity of either 1000 Ω per V (1.0 mA load) or 20,000 Ω/V (50 μA). AC voltage is measured on the same ranges at 1 kΩ/V only. At the top of the meter, there is an accessory multiplier resistor that extends the dc range to 5 kV at 20 kΩ/V. DC current ranges are 250 μA, 2.5 mA, 10 mA, 100 mA, and 500 mA, 2.5 A and 10 A full scale. Resistance ranges are R×1, R×10, R×100, R×1k, and R×10k, permitting useful measurements to about 1 MΩ. The rated accuracy at normal temperatures is ±3% on dc current and voltage ranges below 1 kV ±3% on resistance and ±4% on ac voltage. Frequency response is rated as flat from 25 Hz to 5 kHz ±5% and at ±7% to 20 kHz. The indicator is a $3^{1}/_{2}$ inch round meter with separate ac and dc scales and a nonlinear resistance scale.

Unique to this meter is that the voltage ranges are changed by plugging the positive test lead into a series of jacks located along the edges of the meter case, rather than by rotating a switch. Current and resistance ranges are switch selected.

The only powered feature is the ohmmeter. Batteries are accessible via a removable panel at the back of the instrument secured by two screws. All ranges except R×10k are powered by a single size D flashlight cell. The R×10k range originally used three military type BA-31 4.5 V batteries connected in series with two shorting straps. These do not seem to be available anywhere, but the battery compartment is large enough to install two holders for four AA or AAA cells each[1] plus one single-cell holder[2] (or three holders for three cells each[3]). If you can do without the R×10k scale, all you need is the D cell.

Original accessories included: Two test prods CX-331A/U (red and black) terminating in pin plugs; two detachable insulated alligator clips; one 5 kV high voltage lead (CX-927/U) with a banana plug at one end and a hippo clip with a heavy rubber boot at the other; an $8^{1}/_{2}$ inch patch cord with pin jacks at either end to connect the

[1]Notes appear on page 37.

5 kV multiplier accessory to the meter itself (CX-939/U), and an adapter consisting of a male 1/4 inch phone plug at one end and pin jacks at the other (MX-1572/U). All the accessories are contained behind a sliding panel in the meter cover.

The TS-352 was built in a couple of versions that differ in detail only. The only adjustment other than the front panel OHMMETER ZERO control is an internal calibration control for the ac voltage ranges. This should be set so that the meter reads full scale on the 10 V range with 10.00 V_{rms} at 60 Hz applied. The Maintenance Manual TM 11-6625-366-15 is available online from several Web sites.

Mechanically, the ME-9/U is built like the proverbial brick backyard convenience and is practically indestructible. It's just the thing to throw in the trunk of the car or in the boat toolbox. On the other hand, it has no electrical protection at all—not even a fuse in series with the common or shunt diodes across the meter.

One other caution should be observed. The meter is covered with a heavy plastic lens that seems particularly susceptible to static electricity. Run your hand across the meter face on a dry day and watch the pointer develop a serious case of static cling. A damp paper towel cures the problem instantly.

I've seen the TS-352 ME-9/U selling at hamfests for as little as $5. On the Internet with a full complement of accessories the price will be closer to $20, plus almost as much again for shipping charges.

Type ME-77/U AN/URM-105C

If the TS-352 is the heavyweight champ, the ME-77 is a featherweight. It's an ac/dc voltmeter-ohmmeter (no current ranges) that's small enough to fit in a large pocket. The case and cover are gray molded plastic with a watertight gasket and a stainless steel handle that doubles as a prop. Test leads are integral with the meter and terminate in pin probes with the usual military-style detachable alligator clips. The case is $6^5/_8 \times 4 \times 3^1/_4$ inches and the instrument weighs only 2 pounds. Figure 2 shows the ME-77/U with its front cover removed. Note that the test leads are not detachable.

The meter measures dc voltage on ranges of 1, 10, 100 and 1000 V full scale at 20 kΩ/V with an accuracy of ±3% and ac voltages on ranges of 10, 100 and 1000 V full scale, 1000 Ω/V and a rated accuracy of ±4%. Resistance ranges are R×1, R×10, R×100, R×1k and R×10k, permitting measurements up to about 20 MΩ. The components are mounted on a pc board, and there is absolutely nothing to adjust other than the mechanical zero of the meter and the front panel OHMS ADJ pot.

There are three principal disadvantages. The first is batteries. On the ×1, ×10 and ×100 scales, the ohmmeter uses two garden variety size AA cells, but on the ×1k and ×10k ranges a 22.5 V battery (military type BA-261/U) is required. The latter is equivalent to the Energizer No. 412, which is still available but somewhat hard to find and retails new for about $8 (I tried substituting two 9 V batteries in series, but 18 V just doesn't provide enough "oomph" to zero the ohmmeter). The second problem is the meter scale, which can only be described as bizarre and difficult to read since it is nonlinear for both voltage and resistance. Finally, winding the leads and getting the test prods nestled so that the cover goes on is a little like stuffing toothpaste back in the tube.

Although I began by saying that the URM-105C does not measure current, that is not strictly true. The tech manual refers to something called an "MX-1471/U Multirange Instrument Shunt." This is a piece of accessory equipment consisting of low-resistance shunts that can be connected in parallel with the ME-77 meter movement to permit measurement of current in decade ranges from 100 μA to 10 A. The only problem is that I've never actually seen one of these either in the flesh or advertised for sale. If anybody comes across one of these, let me know, since it is designed to work with any meter that has 250 mV sensitivity—not just the ME-77/U.

The tech manual also identifies two voltage multiplier accessory probes that can be connected in series with the meter to extend the dc range to 10 kV (MX-1472/U) and 50 kV (MX-2005/U). Again, I've never seen the units themselves and, considering what the passage of time and inhospitable environments can do to the qualities of insulation, I'm not at all sure I want to give them a try.

The maintenance manual is TM 11-6625-203-35, and it is readily available from a number of sources.

If you're willing to put up with its idiosyncrasies, the ME-77 URM-105C makes a decent little instrument. I've seen them at flea markets on the order of $10 and on the Internet at five meters for somewhere around $45. At least you won't have to spend a fortune in postage.

Type ME-297/U AN/USM-223

I've sometimes seen this model referred to in advertisements as a "Transistorized Multimeter" or "FET Multimeter." Although there is a collection of solid-state devices inside the case, this description is a little misleading since, with one exception I will discuss later, they don't play an active role in taking measurements. I prefer to think of the ME-297 as an idiot-proof Simpson. It is shown in Figure 3 with its top cover removed.

While the ME-6 seems to have been designed to avoid damage if a competent technician dropped it off a ladder onto a concrete floor, the ME-297 took the op-

Figure 2—The ME-77/U with the cover open. The range switch is to the right. The round knob to the left is the ohmmeter adjustment. Notice that the test leads are integral to the meter and cannot be detached.

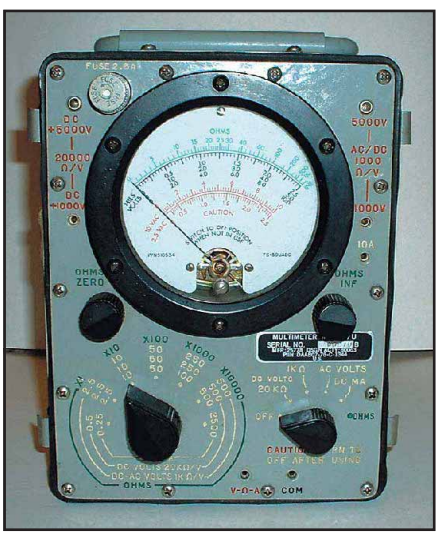


Figure 3—The ME-297/U. The line fuse is at the top left. The round knobs are OHMS ZERO (left) and OHMS INF (right). The range switch is to the left and the function switch to the right. A removable cover (not shown) contains the test leads.

posite tack. The case is lightweight gray molded plastic and hardly "bulletproof," but the circuit was designed so that a total klutz couldn't fry the innards no matter what he or she connected the meter to.

The unit is fairly compact. It measures $8^{3}/_{4}\times7^{3}/_{8}\times6$ inches overall and weighs just under 6 pounds. The indicator is a ruggedized $3^{1}/_{2}$ inch round meter with a glass face and an easy-to-read scale. DC voltage is measured at a sensitivity of either 1 kΩ/V or 20 kΩ/V with an accuracy of ±3%. AC voltage is measured at 1 kΩ/V with 4% accuracy from 25 Hz to 10 kHz and ±7% to 20 kHz. The ac and dc voltage ranges are 2.5, 20, 50, 250, 500, 1 k and 5 kV at 1 kΩ/V with an additional range of 0.5 V at 20 kV dc only. DC current ranges are 2.5, 10, 50, 100, and 500 mA as well as 2.5 A and 10 A with ±3% accuracy. Resistance ranges are ×1, ×10, ×100, ×1000 and ×10k at ±3% of full scale.

The design dates from the mid-1970s, and the tech manual, TM 11-6625-654-14, provides a real education in how to design a burnout-proof instrument.[4] To begin with, the meter is shunted with protection diodes. The rest of the circuit is liberally sprinkled with zener diodes designed to detect overvoltage in the voltmeter multiplier ladder and over-current in the ammeter shunts. When something goes awry, the signal passes to a hefty silicon controlled rectifier connected as a crowbar across the input terminals; it fires and blows the line fuse that is thoughtfully placed in a fuse-holder on the front panel. (The incompetent technician who blew the fuse obviously can't be trusted to open the box to replace it.) In addition, the internal multiplier and shunt resistors are deliberately oversized to compensate for the time it takes the crowbar circuit to act. It should be noted that all of the protection circuitry is passive, and it is effective even if the batteries are dead or removed from the instrument.

In the world of high voltages and high currents the only concern is what the equipment under test could do to the instrument. With solid-state electronics we also have to consider the effect that the test equipment might have upon the circuit it was applied to. The designers of the ME-297 tried to take this into account by providing a low voltage ohmmeter and then protecting the ohmmeter from the application of excessive external voltages. The open circuit voltage of the ohmmeter is limited to 120 mV. The current flow through the ohmmeter circuit is amplified by a FET and further amplified by a bipolar transistor that forms one arm of a bridge across which the meter movement is connected. These are the only active semiconductors.

This results in an ohmmeter that has two front panel adjustments, OHMS ZERO and OHMS INF, and a scale opposite to that of a conventional ohmmeter (0 to the left, ∞ to the right). The procedure is as follows: 1) Set the desired resistance range. 2) Short the test leads together and set OHMS ZERO until the meter reads 0. 3) Separate the test leads and set OHMS INF until the meter deflects to full scale "∞." Then take the measurement. The two front panel adjustments hold pretty well from range to range without re-tweaking.

The problem is that the designers of the ohmmeter went a little too far. Low voltage is fine if, for example, you want to measure the value of a resistor connected between the base and emitter of a transistor without biasing the transistor into conduction. The trouble is that with only 120 mV available at the ohmmeter terminals, it is impossible to make any silicon device conduct. Thus, while you can test a semiconductor junction for short, you can't test for open. The note inside the meter cover confirms this. "This is a SAFE OHMMETER; does not function as a semiconductor tester (refer to TM.)."

There is one other shortcoming, and that concerns batteries. The AN/USM-223 ohmmeter circuit was designed to use one ordinary size C cell and six 1.30 V mercury cells connected to form two batteries of three cells each. These were in a compartment at the rear of the meter case with the C cell in the center and the mercury cells on either side. Unhelpfully, the polarity is not marked, but the C cell properly installed faces down. For very sound environmental reasons, the mercury cells originally supplied with this instrument are no longer manufactured.

There are two ways to solve the battery problem. The holder for mercury cells will also accommodate a size AA battery (0.57 inch diameter×1.99 inch long) and 3.6 V lithium batteries are available in this size.[5] Alternatively, there is plenty of elbow room inside the case to install two three-cell holders for AA batteries.[6] While these produce 4.5 V per battery rather than the original 3.9 V, the instrument doesn't seem to mind the difference. The batteries are on complementary legs of the ohmmeter bridge circuit, so it doesn't affect accuracy. There is the disadvantage of having to remove 14 screws and a rubber gasket to change batteries, but the batteries have a long life if you remember to turn the function switch OFF when the meter isn't in use.

The AN/USM-223 was obviously designed to replace the TS-352, and the accessories are identical. The test leads, except for the 5 kV lead use pin plugs; and there is even the MX-1572/U phone plug adapter. The tech manual is TM 11-6625-654-14. It comes complete with a full schematic and a description of both the ohmmeter and protective circuits. The one thing the manual doesn't tell you is how to calibrate the instrument. Complete calibration instructions are available on the Web.[7] You can also download a zipped file of the operator's manual (but not the maintenance manual) at a link on the same Web address.

I get the impression that the USM-233 wasn't in service very long. Most of the units that come on the market carry calibration tags from the mid-1990s and are in excellent condition, complete with accessories. Many have already been converted to use AA cells. These units are quite popular and widely available. Plan on spending $35 plus postage on the internet and $45 or so from a surplus retailer.

And Finally...the ME-418 AN/PSM-37

As far as I am concerned, the PSM-37 is the cream of the crop. Essentially, it's a USM-233 with all the problems fixed and some really cool new features. It also comes in two colors—army green and Tonka Toys bright yellow. From the size standpoint, it's about the same as its predecessor: essentially the same height, about half an inch narrower and almost an inch shallower (most of which is because of a shallower cover). It weighs maybe half a pound more than the USM-233. A closeup of the ME-418 AN/PSM-37 can be seen in Figure 4.

Figure 4—The front of the ME-418/PSM-37. To the right of the meter face are the OVERLOAD flag and the red RESET button. Below the meter are the OHMS adjustment (left) and the Polarity Switch—power OFF, +DC, –DC and AC (right). At the bottom right is the RANGE switch and bottom left is the FUNCTION switch.

The basic meter has fewer ranges than the ME-297/U. AC and dc voltage ranges are 0.5, 2.5, 10, 50, 250, 500 and 1000 V, selectable at 1000 Ω/V or 20 kΩ/V. The big innovation is that there is also an electronic voltmeter (a solid state VTVM) with an input impedance of 10 MΩ/V. The milliameter has exactly the same ranges as the voltmeter and works not only on dc but on ac as well (just like a DMM but without the "D"). The ohmmeter has the usual R×1 through R×10k scales and an extra R×100k scale has been added. More importantly, the ohmmeter can be set to deliver either reduced power (100 mV with the FUNCTION switch set to LP) or a full 1.0 V (with the switch set to STD) for checking semiconductor junctions. Accuracy for dc and resistance measurements is rated at ±3% and ac accuracy at ±4% with a frequency response of 20 Hz to 30 kHz. There is also a SPECIAL mode for 100 μA or 100 mV (series resistance 1000 Ω).

The only things "missing" are the 2.5 A and 10 A current ranges and the 5 kV voltage range, but they aren't really missing. Among the accessories included with every original PSM-37 was one "Shunt, Instrument, Multirange MX-1927/PSM-37." This device was simply a plastic box with pin jacks at one end to connect the meter via the normal test leads and three binding posts on top to connect the circuit being measured. It contained 200 mV shunt resistors for 2.5 A and 10 A that allowed these two values to be measured on the meter's 2.5 mA and 10 mA ranges.

The 5 kV range was handled the same way with a "Prod, Test, MX-1410/U: 0 to 5000 V, 20,000 ohms per V, Voltage Range Multiplier." This is an external probe, allowing 5 kV to be measured on the 500 V range at 20 kΩ/V, with a female receptacle for the low voltage test prod at one end and a hippo clip with rubber boot at the other and a 90 MΩ resistor in between.

There is a third accessory described as "Adapter, Test, MX-9128/PSM-37" (not pictured) that is intended to provide 100 Ω total series resistance on the 2.5 mA range so that the meter can be used to measure crystal detector current. The device is just a phone plug with a 20 Ω series resistor feeding two pin jacks.

These accessories tended to get left on the test bench when the military packed off the meters for disposal with the result that most of the PSM-37s on the surplus market have no accessories at all—some even lack covers. An example of the PSM-37 with its test leads and homemade shunts can be seen in Figure 5.

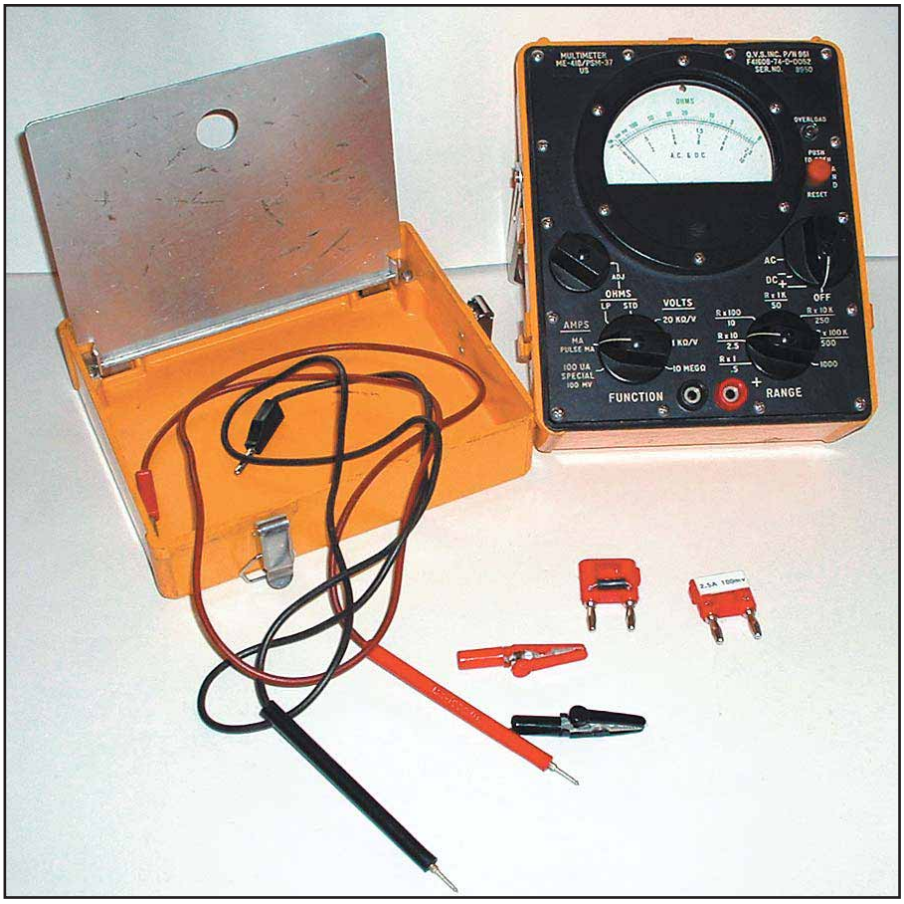


Figure 5—ME-418/PSM-37 with cover. At the left are the test leads. Note that the ME-418 uses banana plugs rather than the pin plugs universally used on earlier instruments. The homemade current shunts can be seen below the meter.

If you can't live without 2.5 A and 10 A measurement capabilities, it is easy to make substitutes for the external shunts. Just take a stackable dual banana plug[8] and connect the required shunt resistor across the pins where the cable would normally be attached. You will have to make a separate shunt for each range. If you want to emulate the original current shunts so that they function with the meter set to 2.5 mA and 1.0 mA, the resistance values are 0.08 Ω (>1/2 W)[9] for the 2.5 A shunt and 0.02 Ω (>2 W) for the 10 A shunt.[10] I preferred to use the 100 mV SPECIAL position with both of the external shunts, so the values become 0.04 Ω (>1/4 W)[11] and 0.01 Ω (>1 W),[12] respectively. Just plug the homemade shunt into the front panel jacks of the meter, set the appropriate range, and connect the test leads to the female of the shunt.

As far as the protective circuits are concerned, the ME-418 resembles the ME-297. Instead of a fuse, there is a circuit breaker, resettable from the front panel, together with a pop-up flag that indicates when the breaker has tripped. (It looks like a miniature lamp beneath a clear plastic dome, but is completely mechanical.) The 1 kΩ/V, the 20 kΩ/V and the current measuring circuits are also similar, in that they are entirely passive and will function whether or not the meter is equipped with batteries. The 10 MΩ/V electronic voltmeter uses a pair of operational amplifiers and the ohmmeter uses a constant current source—both of which require batteries. Here the designers hit another home run, since the meter uses just four AA cells—plain, cheap and available everywhere.

Apart from its special features, the ME-418 has a few unusual qualities. First, in contrast to all the earlier military multimeters, the test leads are connected to the instrument via banana plugs rather than pin plugs. Second, if your meter has a cover, don't try to attach it without shutting off the power. The power meter's FUNCTION switch has a flat on one side, and the cover won't fit unless the switch is off. Third, there are no internal adjustments whatsoever. The only potentiometer in the entire instrument is the front panel OHMS ADJ control. Finally, if you don't want to lose track of the cover and accessories stored in it while the instrument is in use, you can

clip the cover to the back of the meter case.

Be careful of the screws that attach the knobs. The boss within each knob is oblong, and the mating shaft of the switch has flats milled on both sides. The fit between the knob and the shaft is loose, and there is about 10° of play in the knob. If you are tempted to eliminate the play by overtightening the machine screw at the center of the knob, don't try it with the original equipment screws. They are black nylon and shear off easily, leaving the switch shaft plugged with a hard-to-dislodge shard. Replace the nylon screws with stainless or brass before tightening.

You are going to have to learn to use the PSM-37 on your own. As far as I am aware, the tech manual is not available from any of the usual sources. There is a schematic pasted to the inside back cover that can be gently pried loose, photocopied and enlarged, but it isn't going to do you much good if something critical lets go. The two op-amps and the constant current source are just unmarked black plastic cubes, and your guess is as good as mine what you would replace them with.

I've gotten really attached to the PSM-37, and it replaced both the Simpson 260 and the ancient TS-505 VTVM on my test bench. It also seems to be something of a "sleeper" in the marketplace. I have bought two recently on eBay—one with cover and one without—and didn't pay more than $35, plus shipping, for either one. I should stress that these seem to have been a favorite among service personnel, and they got pretty rough usage. While it is no great trick to find a "creampuff" USM-233 with all accessories and a neat calibration sticker, most of the PSM-37s tend to be cosmetically dinged up and plastered with sticker residue.

If you are looking for an analog meter I would give serious consideration to buying one of Uncle's castoffs. Pop one of these beauties out of its case, and you know you are dealing with quality—massively oversize precision resistors, ceramic rotary switches the size you'd use to bandswitch a 100 W transmitter and clean, well-laid-out circuit boards. Most of the later units are internally pristine—I suppose because the protective circuitry made it unnecessary for an army technician to wander around inside with a 150 W soldering iron. I shudder to think what these must have cost new, but every time I see one at a hamfest my wallet itches—and I look at them as a dividend on my tax dollars.

Notes

[1]Keystone Electronics Corp, 31-07 20th Rd, Astoria, NY 11105; tel 800-221-5510; **www.keyelco.com**. Available from Mouser Electronics, 1000 N Main St, Mansfield, TX 76063, tel 800-346-6873; **www.mouser.com,** stock no. 534-148 (4 AA cells in series). Equivalents available at RadioShack and many other sources.

[2]Keystone Electronics. Available from Mouser Electronics, stock no. 534-139 (1 AA cell). Equivalents available at RadioShack and many other sources.

[3]Keystone Electronics. Available from Mouser Electronics, stock no. 534-147 (3 AA cells in series). Equivalents available at RadioShack and many other sources.

[4]There are a couple of inaccuracies in the "how it works" diagrams, centered around the fact that the connection to the anode of SCR1 is not shown and what is drawn as the anode is actually the gate connection. Once you absorb the theory, check the full schematic for the details.

[5]Manufactured by Tadiran US Battery Division, 2 Seaview Blvd, Port Washington, NY 11050; tel 800-537-1368; **www.tadiranbat.com**. Available from Mouser Electronics, stock no. 667-TL2100S (between $6 and $7 each).

[6]Keystone Electronics. Available from Mouser Electronics, stock no. 534-147 (3 AA cells in series). To install holder, do the following:

Disconnect the white, orange, gray and red wires that go to the battery case. Leave the yellow and blue wires connected; they go to the C cell (yellow to –, blue to +). Connect the white wire to the – side of the first three-cell holder and the red wire to the + terminal. Connect the orange wire to the – side of the second three-cell holder and the gray wire to the + side.

[7]**www.acadiacom.net/nlee/me-297.html**.

[8]Manufactured by Pomona Electronics, available from Mouser Electronics, stock no. 565-MDP-0.

[9]0.080 Ω, 2 W ±1%, Mouser Electronics, stock no. 588-12FR080.

[10]0.020 Ω, 5 W ±1%, Mouser Electronics, stock no. 588-15FR020.

[11]0.040 Ω, 1 W ±1%, Mouser Electronics, stock no. 71-LVR1-0.04 0.

[12]0.010 Ω, 3 W ±1%, Mouser Electronics, stock no. 588-13FR010.

Miles Anderson, K2CBY, was first licensed as a Novice at age 11. He worked as a part-time technician for several broadcast stations during college and spent two summers at sea as a ship's radio operator for Woods Hole Oceanographic Institution. Miles, who holds a BA from Amherst College and a law degree from Columbia University, has been practicing law for the past 30 years. He's been an active ham all those years and particularly enjoys designing, building and repairing electronic test equipment. Other hobbies include aviation history, model building and working with machine tools. You can contact him at 16 Round Pond Ln, Sag Harbor, NY 11963 or at **k2cby@arrl.net**.

NEW PRODUCTS

PIEPER MORSE DECODING SOFTWARE WITH AUTO-SPACING

◊ The *MRP40* CW decoder includes a feature that automatically corrects the word spacing of unspaced incoming text messages. With other CW decoders copying imperfectly sent code, the decoded text often appears without proper word spacing. The result can look like the following:

TNXFERALLINFOESUFBCPIFBURRIGFBSIGS-RIGHEREABT8ØWATTOUTPUTESANTDIPOLE 9MTRSUPLAZYVEE-

MRP40 performs a real-time word recognition and word spacing correction to result in:

Tnx Fer All Info Es Ufb Cpi Fb Ur Rig Fb Sigs- Rig Here Abt 8Ø Watt Output Es Ant Dipole 9 Mtrs Up Lazy Vee-

MRP40 is said to recognize more than 6000 words and optionally translate more than 400 CW abbreviations. For information or for a 15 day trial version, contact Norbert Pieper, Max-Planck-Str 11, D-59399, Olfen, Germany, **www.polarelectric.com/Morse/MRP40-EN/TextFormatting.html**.

HY-GAIN AV-18AVQII MULTIBAND HF VERTICAL

◊ MFJ has reintroduced the AV-18AVQII multiband HF vertical antenna as part of its line of Hy-Gain antenna products. This antenna covers 10, 12, 15, 17, 20, 30, 40 and 80 meters. A new design includes three separate air dielectric traps for 10 through 40 meters rated at 1.5 kW PEP. A loading coil is used for 80 meters with a rating of 1 kW PEP. The antenna is 18 feet tall and weighs 12 pounds. Wind survivability is rated at 70 mph when installed with guys. A 12 inch heavy duty mast support bracket is included.

Price: $229.95. To order or to locate a dealer, contact Hy-Gain, 308 Industrial Park Rd, Starkville, MS 39759; tel 800-973-6572; **www.hy-gain.com**; fax 662-323-6551.

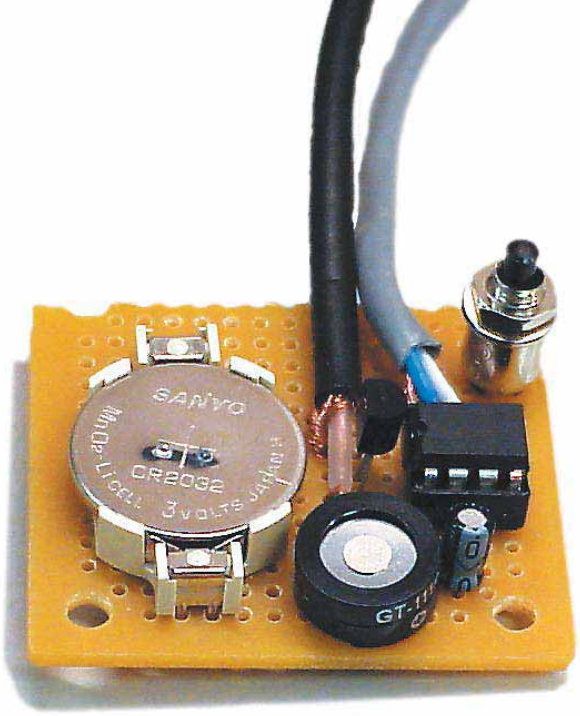
DSWK REPLACEMENT PIC CHIP FOR SMALL WONDER RADIOS

◊ Jackson Harbor Press has announced the DSWK, a replacement PIC chip for the Small Wonder Labs DSW series of transceivers. The DSWK adds a nonvolatile (settings saved after power off) memory keyer to the DSW monoband rig and also includes an XIT (transmitter incremental tuning) mode, an optional 10 Hz resolution tuning and readout and other new features.

The DSWK is priced at $9 postpaid in the US and $12 postpaid for other regions. For more information or to order the DSWK, see **jacksonharbor.home.att.net/dswk.htm**.

By Dale Botkin, NØXAS

The PicoKeyer—An Ultra Low Power CW Memory Keyer



NØXAS redefines "low power" for us with a keyer that draws 4 nA (that's 0.004 microamperes!) at idle.

For most of the time I have been active on the HF bands, I have used various electronic keyers with a Vibroplex paddle. While I have spent time operating with a straight key, I have never really enjoyed it or gotten good at it. I have used built-in keyers in several brands of gear, including a few from well-known low-power kit manufacturers. All have worked well…some better than others.

I recently had the opportunity to upgrade my home HF station to a Kenwood TS-930S/AT. While I enjoy the rig, it lacks an internal CW keyer—so it was back to the straight key. I felt sorry, frankly, for some of those operators on 40 meters who were subjected to my fist during those first few weeks. I wasn't getting better, and I decided it was time to go back to the paddle and the keyer. Being a hacker at heart, however, I wasn't going to go out and buy what I could build in an evening! I decided I would build a very simple, barebones keyer to do nothing more than generate dots and dashes with proper timing and spacing. Like many other projects, this was a good idea until it got out of hand.

I knew I had all the parts I would need. One of my hobbies involves building projects with embedded controllers, mostly using Microchip's PIC processors.[1] For me, the perfect project is one that involves an absolute minimum of parts. First of all, I like to be able to build without ordering anything, and my "junk box" is pretty well stocked, but it doesn't have everything. Ideally, I like to use a small microcontroller with as close to zero external components as can be achieved. I am also a big fan of designing for as little current consumption as possible, mainly because I don't like changing (or buying) batteries and because power supplies are always a pain to build. I guess I've gotten lazy in my old age, but it does make for some interesting design challenges!

The Design

I wanted to use nothing more than one chip for the keyer, with a single pushbutton for any features that got added along the way. I also wanted to play with one of the latest 8-pin designs from Microchip, the 12F629. These little processors cram a lot of features into a very small package! 1024 words of program memory, 64 bytes of RAM, 128 bytes of nonvolatile EEPROM, interrupts, counter/timers, an internal oscillator, an analog comparator, and more. The 12F675 shares the 12F629's features and adds a 10 bit, four channel analog to digital converter. These chips are a major leap ahead compared to the older 8 pin 12C5XX-type devices and their power requirements show it as well. The new pair will operate down to 2.0 V, and their SLEEP mode lets them power down and run on not much more than a cool breeze.

The hardware design was the simple part, requiring nothing more than connections from the key to the PIC and a single transistor to key the rig. I added the SPST pushbutton switch and decided to use one pin for an LED during debugging, leaving one pin unused. I assembled the project on a solderless breadboard and wired up the paddle. Now came the tough part—the software—the heart of the project.

One of the first steps was to determine the timing to be used when sending Morse code. An hour or so of reading various pages found with a simple Internet search and I had the "magic numbers" needed to determine the dot and dash timing for any given code speed. A couple of hours of programming later and the chip was generating properly spaced code from 5 WPM to as fast as I could send, with the upper limit set at 60 WPM. The next step was to add a setup mode for changing the code speed. While I was at it, I added functions for setting the weight and selecting Mode A or Mode B timing.

When I was reasonably satisfied with the performance, it was time to move from the solderless breadboard to a "real" setup and try it out on the air. I used half of a small RadioShack perfboard and wired it up as a prototype assembly. On-air results were good, but there were a few key things still missing.

The project took on a life of its own

[1]Notes appear on page 40.

over the next couple of weeks. The LED was replaced with program-generated audio sidetone that could be turned on and off, and I managed to find a tiny speaker with low enough current requirements to drive directly from one of the PIC pins. I added message memory, beacon mode with variable repeat delay, then variable pitch for the sidetone, then paddle reversing for left-handed ops or miswired paddles. A few bugs were uncovered and fixed along the way, as I logged more operating hours with the keyer.

Redefining "Low Power"

Along the way, I got curious about the current consumption of the chip. I had the PIC in its low power sleep mode any time it was not actively doing something like keying the rig or generating a sidetone. Although it has now been updated, at the time, the data sheet for the 12F629 was pretty sketchy about sleep current. I knew it would be low, but I needed to determine whether the CR2032 PC motherboard clock lithium cell I was using would last long enough to be practical as I salvaged the battery from a defective old PC motherboard I was scrapping. While it was still reading a healthy 3.1 V, I was planning to switch to a couple of AAA alkaline cells if needed. After connecting my Fluke 77A meter in series with the battery I was surprised to see it reading 0.00 mA while the chip was idle. Thinking the meter was simply not accurate at low currents, I tried my Micronta bench meter on the 3 µA range. I was quite surprised to see it read 0.004 µA or 4 nA while sleeping! I abandoned the thought of alkaline cells—that little lithium battery would last quite a while! I've been using that same salvaged cell for a few months now, and it still reads a tad over 3 V when the keyer is idle.

Construction

I built my keyer on a small piece of RadioShack perfboard. The few connections required are pretty simple and straightforward. Power to the PicoKeyer chip, U1, is supplied on pin 1, while pin 8 is ground. The photo on the previous page shows the completed keyer as it appears before packaging. Figure 1 is a view of the finished product in a mini plastic case. Its size relative to a standard 1/4 inch phone plug reveals how small this keyer really is—and that's complete with power supply and speaker! The complete schematic and parts list is shown in Figure 2.

Pin 2 is the sidetone output. If you are building a standalone keyer you will probably want a small piezo or low current magnetic speaker connected to the chip through a capacitor. I used a small magnetic speaker with a drive requirement of only 15 mA. Other piezo or magnetic speakers can be used—but be careful not to exceed the 20 mA current capacity of the PIC output pin. If you are building the keyer into a rig, you can simply inject the sidetone signal into the radio's audio stages. A volume control might be a good idea. If you need more audio than the PIC can provide directly, a small audio amp like an LM386 could be used for more punch. This would of course require a more robust power source. The signal produced is a square wave; some filtering can be used to approximate a sine wave, if desired.

Q1 is a 2N7000 MOSFET, and is used to key the radio. You can use a 2N2222A or a similar NPN transistor with a current limiting resistor on the base or emitter. This works, but it requires more current. Since the MOSFET is a voltage, rather than current, operated device, it is ideal for super low power designs such

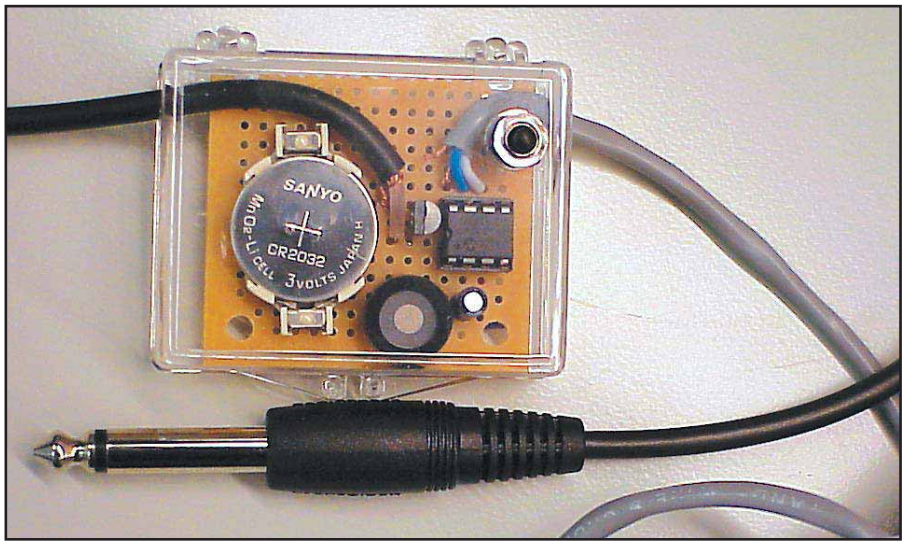


Figure 1—The completed PicoKeyer in a plastic case. A 1/4 inch phone plug is shown for comparison.

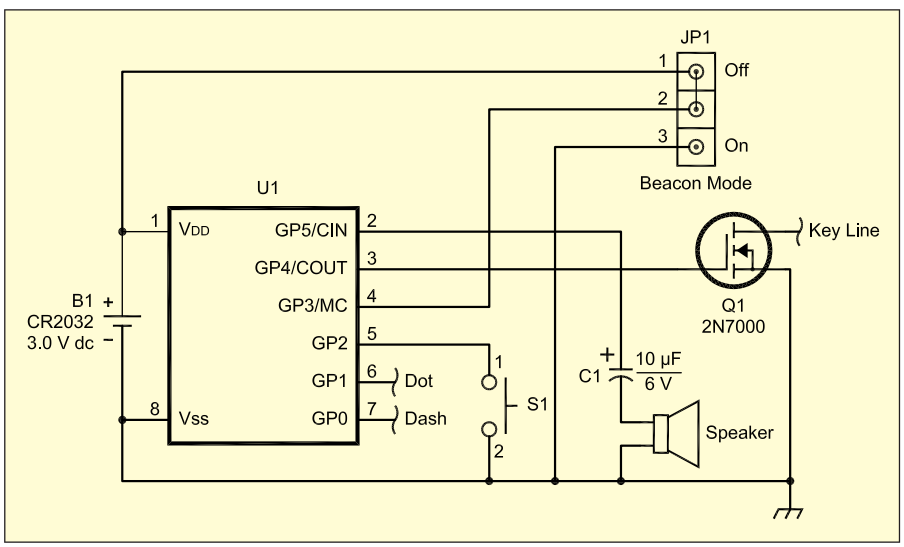


Figure 2—The schematic and parts list for the PicoKeyer. The battery is a PC clock motherboard cell, but any 3 V dc cell can be used.

B1—CR2032 lithium battery with holder or any 3-5 V dc cell (AA or AAA cells okay).
C1—10 µF, 6 V electrolytic capacitor.
JP1—Beacon mode switch or jumper (see text).
Q1—2N7000 MOSFET, Digi-Key 2N7000FS-ND (Digi-Key Corp, 701 Brooks Ave South, Thief River Falls, MN 56701; tel 800-344-4539; www.digikey.com).
S1—SPST pushbutton, momentary.
SPK—Soberton GT-111PS, Digi-Key 433-1023-ND (see text).
U1—Microchip PIC12F629 with PicoKeyer code. Available blank from Digi-Key (part no. PIC12F629-I/P-ND) or preprogrammed from the author.[2]

as this one. Q1's gate is connected to pin 3 of the keyer chip, with its source connected to ground. The drain lead is used to provide positive keying for the radio.

Pin 4 is used to select beacon mode. If you do not intend to use the beacon feature, you may simply connect pin 4 to the positive supply on pin 1. If you wish to be able to use beacon mode, install an SPDT switch or a jumper to connect pin 4 to either the positive supply or to ground.

The pushbutton switch is connected to pin 5 of the chip. Since the 12F629 has internal pull-up resistors, no external resistor is needed to keep the input from floating.

Pins 6 and 7 are the paddle inputs. When grounded (or driven low by other circuits), the keyer will produce a continuous stream of dits or dahs with proper spacing. If both inputs are grounded, alternating dits and dahs are sent.

Once all the connections are made, apply power to the keyer. You should hear the keyer send 73 in Morse code at 13 WPM via the sidetone only. This indicates that the chip is powered up and healthy. If you do not hear 73, recheck your wiring and reapply power. If everything is okay, you're all set to start using the keyer! The default settings are 13 WPM, normal weighting, message memory empty, Mode B timing and a beacon delay of five seconds.

If you have experience programming PIC processors, the HEX code is available at the ARRL Web site: **www.arrl.org/files/qst-binaries/picokeyer.zip**. A programmed version of the processor with the latest revisions is available from the author.[2]

Operation

Operating the PicoKeyer is simple and straightforward. To use it as a normal iambic keyer, simply apply power and connect the paddles. Dual or single lever paddles can be used. To send the contents of the message memory, press and quickly release the pushbutton once. While the message is being sent, any paddle or pushbutton input will immediately end the transmission.

To enter setup mode, press and hold the pushbutton. The keyer will step through the setup menu choices, with about a one second delay in between. When you hear the character for the item you want to check or change, release the button immediately. You may then verify or change that item. A short press of the button will exit setup mode, or you may press and hold the button to keep cycling through the choices. When you exit the menu the keyer will end with the Morse prosign SK.

Menu Selections

The menu selections are as follows:

U (tUne/straight key mode): In this mode, either paddle input will act as a straight key. This is useful for sending a steady carrier for tuning.

S (Speed): Use the paddles to raise or lower the speed. After each paddle hit the keyer will send the new setting.

T (Tone): Turns the sidetone output ON (Y), OFF (N), or sets RIG (R) mode. In either the ON or OFF settings, the rig is not keyed when in setup mode. RIG mode is useful if you wish the transmitter output to be active even in setup mode.

M (Message): Hitting either paddle will play the current message, followed by the Morse prosign AR. To record a new message, hit either paddle again. The keyer sends K and waits for your input. Enter the message, making sure to exaggerate word spacing. When you're finished sending the message, press and release the pushbutton, and the keyer will send R to confirm. You may then replay the message by hitting either paddle. It may take a couple of tries to get the hang of the timing, but it's not too picky unless you send the characters too slowly.

W (Weight): Adjusts the weight. Adjustment range is from 0 (50% "light") to 9 (50% "heavy"), with 5 being the normal weight setting.

C (Curtis mode): Selects Mode A or Mode B timing. This determines the behavior of the keyer when the paddles are released after a "squeeze." In Mode A, the keyer will complete the element (dit or dah) currently being sent. In Mode B, the keyer will "remember" seeing the other paddle, and will send one last element. For example, say you are sending the letter C. In Mode A, you would not release the dit paddle until the start of the last dit. In Mode B you would need to release both paddles as soon as the second dah has started. The keyer will "remember" to send the last dit.

P (Paddle): Selects the dit paddle. Simply hit the paddle you wish to use for dits. Note that in the menu mode, the "normal" dit and dah paddle inputs are used regardless of whether the paddles have been reversed or not.

B (Beacon delay): Sets the delay between message transmissions while in beacon mode, from 0 to 99 seconds.

A (Audio tone): Sets the audio sidetone frequency. After each paddle hit, a slightly long dash is sent.

When you are finished altering the keyer settings, press and release the pushbutton. The keyer will save all settings to its internal nonvolatile EEPROM memory and send SK. At that point you are back in iambic keyer mode, ready to go!

I have been using this keyer for a few months now and several other hams have built them as well. One of the things I like is the ability to change features very quickly; it took about an hour of revising the program code to make a version pin compatible with the popular RockMite transceiver.[3] Another couple of hours and I had a version that used a potentiometer to set the speed instead of the menu; it was even less time to produce one to replace another 8-pin keyer chip that used a different pinout. While I still enjoy soldering, I also like this facet of our wonderfully diverse hobby. Besides, I can write code while in an airline seat—an environment in which a soldering iron is somewhat impractical!

Notes

[1]**www.microchip.com**.

[2]A pre-programmed version of the 12F629 PIC processor with the author's latest HEX code is available from the author for $8.95 (**www.hamgadgets.com**).

[3]D. Benson, K1SWL, "The RockMite—A Simple Transceiver for 40 or 20 Meters," *QST*, Apr 2003, pp 35-38.

Photos by the author.

Dale Botkin, NØXAS, was first licensed in 1981 as KA5MSS, although that call and HL9CA both lapsed without ever having been used. Dale was relicensed as a Technician in 1994, with subsequent upgrades to General and Amateur Extra. He enjoys casual operation using low power CW and PSK31 on the HF bands. He also operates VHF and UHF mobile and makes an occasional FM satellite contact. As is obvious, Dale is an avid radio experimenter, especially with embedded microcontrollers. You can contact him at 16624 Elm St, Omaha, NE 68130 or at **n0xas@arrl.net**.

STRAYS

I would like to get in touch with . . .

◊ amateurs who hold an elected office. —*Charlie Trice, K8IJ;* **k8ij@arrl.net**

◊ amateurs who became licensed after retirement.—*Bruce Atchison, VE6XTC;* **ve6xtc@telusplanet.net**

◊ anyone with a photocopy of a schematic for a Pace Communicator II synthesized 2 meter mobile radio.—*Ron Eckton, W7RE, PO Box 508, Maple Falls, WA 98266-0508;* **ecktonrj@wmconnect.com**

◊ members, former members and friends of the Texas A&M University Radio Club, W5AC, for information on a Club reunion.—*Glen Reid, K5FX;* **k5fx@arrl.net**

By Joel R. Hallas, W1ZR

Emergency Power at W1ZR

Remember the recent Northeast power failure? Operate your station from battery power all the time and be ready for similar emergencies without operator intervention.

The review of the West Mountain Radio RIGrunner in the October 2002 issue of *QST*[1] finally stirred me into action to redo my station's 12 V dc power system. This had been under consideration for some time as a means to allow easy test of mobile and portable equipment. I was also getting tired of all the "wall wart" power supplies that seem to come with more and more accessories (TNC, keyer, RIGblaster, handheld radio charger), all of which seem to tie up at least two outlet receptacles due to their size.

By the time I was finished, I had deployed a complete emergency power system in addition to meeting my original objectives. The ability to operate HF and VHF on emergency power fits nicely into our regional ARES program. And, my recent completion of the excellent Level I ARRL Emergency Communication Course was in the back of my mind as I was doing this. The resulting system was configured in a way that made it a "no break" or "uninterruptible power supply" (UPS), so I don't even know there's a power failure unless I turn on the lights. As I went through the design, interesting issues arose that I wanted to share with others.

The System Concept

The basic concept is simple and can be divided into three pieces, as described below.

1. Provide a proper dc distribution system so that all necessary equipment can be powered by a single 12 V dc source (RIGrunner 4012 with Anderson PowerPole connectors).

2. Provide a 12 V rechargeable (battery) power source suitable for inside use (deep cycle, recombinant lead-acid, as described later).

3. Add a charging system that will keep the battery charged while in use and bring it back from discharge after power is restored (three-stage, 10 A, automatic).

The system is shown graphically in Figure 1. Some observations are in order. Consider the battery and charger as a replacement for the power supply that you would buy to run your radio from ac mains power. The battery acts a bit like a very large final filter capacitor with the result that a charger need only supply the average current of all the simultaneously operating equipment, while the battery provides for the peaks (much like the change in power supplies required for a 1950s-era 100 W AM transmitter, compared to today's low duty cycle SSB transmitter, if you go back that far!).

In my case, the HF radio needs (key down) a 20 A supply and the VHF radio, 10 A. The various dc powered accessory equipment (keyer, RIGblaster, TNC) perhaps another 1-2 A. If my HF and VHF radios both transmit together (as they do when on VHF packet while operating HF), I would need a 35 A supply to power everything from a single source. With the charger/battery arrangement, however, I need only provide about 5-6 A from the charger to keep the battery supplied during the time I am operating.[2]

A 10 A charger and a 12 V recombinant (described later) deep cycle battery cost more than a 35 A commercial supply, but less than the combined supplies from the two radio manufacturers. Unlike either of those, however, my system continues to operate W1ZR at full performance for about 11 hours without ac power. This is with no switching or reconnecting of cables—in other words, without operator intervention. Figure 2 shows the operating position at W1ZR.

What About the Battery?

The battery is at the core of this arrangement. For a number of years I had considered doing something like this, but was put off by the byproducts a lead-acid battery emits while under charge (hydrogen gas and a sulphuric acid). This was not a showstopper, but either seemed to require moving the batteries outside the house (with long connections), or the construction of a forced venting system from near the basement shack location to outside. Otherwise, hydrogen gas would fill the corner of my basement and could be detonated by the furnace pilot light, requiring a new ham station at a minimum!

Fortunately, technology came to my rescue. In the past few years, while most hams were watching the development of new solid-state devices, the lead-acid battery makers were quietly having a revolution of their own. There are now several technologies that provide for "recombinant" operation of storage batteries. In a recombinant battery, most of the hydrogen is not released, but recombines with oxygen within the battery to form water. Thus, you not only avoid the threat of explosion, but you never need to add water.

The recombinant technologies are found in batteries labeled AGM (absorbed glass mat), VRLA (valve-regulated lead-acid) or gel cell. These batteries hold the electrolyte against the plates in a way that avoids (but doesn't quite eliminate) the release of

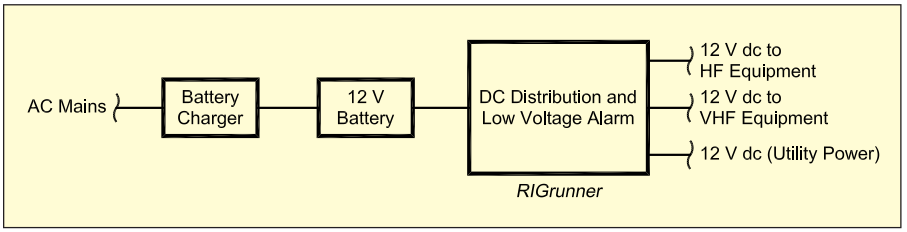


Figure 1—A system diagram of the uninterruptible battery power system at W1ZR.

[1]Notes appear on page 44.

Figure 2—The operating position at W1ZR.

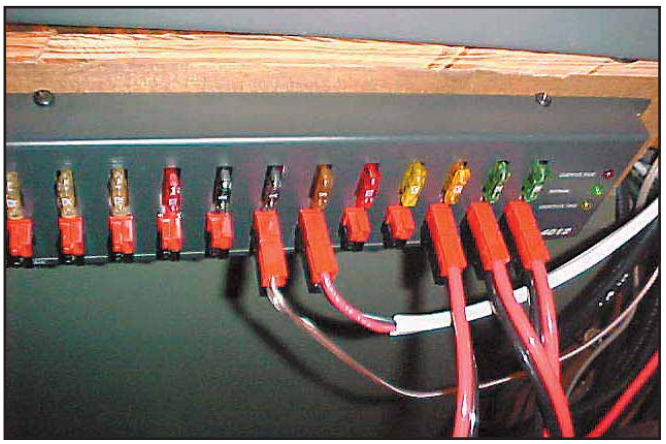


Figure 3—RIGrunner located on right end of the operating position. The battery and charger are on the other side of the wall in the basement utility room.

hydrogen during the charging cycle. A small amount of gas is released, but it is considered sufficiently small that these batteries can be used with normal household ventilation. They are used to power indoor computer UPS systems and motorized wheelchairs, for example. They also do not freeze or spill and will not leak acid.

Fortunately, these batteries are also of "deep cycle" design. A deep cycle battery, unlike the usual auto or marine "starting battery," is designed so that it can be 75% discharged hundreds of times, rather than just a few times, and still be recharged to provide full capacity.[3]

When selecting a battery, watch the description carefully, as not all "sealed" or "no maintenance" batteries are recombinant. Some simply have no ports for water addition and provide a bit more water to start with, but emit all the hydrogen of an open top battery. When the water level finally falls below the top of the plates they start to fail. They are not good for deep cycle use—or for avoiding explosion! Look for "AGM," "VRLA" or "gel cell" if you want to minimize hydrogen emission.

Once you have settled on the battery "family," there is a range of sizes and capacities to consider. The most important parameter for our application is "capacity" in ampere hours (Ah). My battery is rated at 80 Ah. Generally, the higher the Ah capacity, the higher the cost and weight. In an ideal world, 80 Ah would mean I could draw 1 A for 80 hours or 80 A for one hour. Looking at the fine print, one determines that this rating is for a given current. Mine is rated for 80 Ah at 4A, close to our design load.[4]

The RIGrunner has an alarm that can be set to let you know when the input voltage has dropped to 11.5 V. It may be a good idea to take advantage of that and stop transmitting before everything dies. With my HF transceiver, I received a report that I had keyclicks 100 kHz from my carrier just before the transceiver ceased operation at less than 11 V. I recommend, therefore, that you research the characteristics of your transmitter when it is operated below rated voltage, before you operate at low dc input voltages.

Charger System

The design of most chargers is such that they are current limited at their rated output. Thus, when drawing a load greater than the charger can supply, the excess current will come from the battery, not the charger. Still, the charger output should be fused at its rating (mine is fused at 10 A) to protect the charger from excessive load if something goes awry.

In order to be able to achieve the battery life described above, the charger needs to be able to support multiple phases of recharge, as well as different characteristics for different families of batteries (most gel cells should not be charged above 14.1 V, for example). The following description of a three-phase charger is from the Guest Company, the maker of the charger I selected.[5]

Stage 1: Bulk—When the battery is at 75% capacity or lower the charger pumps high amps at a relatively low voltage.

Stage 2: Absorption—As the battery is charged to 75% capacity, the charger lowers the amps and increases voltage (never exceeding battery's designed voltage maximums) to gradually bring the batteries to full charge.

Stage 3: Maintenance (often called "float")—When batteries are fully charged, the charger drops voltage to a maintenance level and gently maintains the battery at a full charge.

The alternative, again from Guest literature (no doubt with their product in mind):

Linear Chargers—When the battery is fully charged, units shut off until battery drops to 90% capacity and then turns on to bring it back to full charge. Result—Deep cycles have limited cycles built into them thereby reducing life of the batteries. Other types of batteries are charged at a higher voltage rate, which also reduces life. [There are linear 2 and 3 mode "smart" chargers available, however, that do not use microprocessor control. These use analog comparators to sense voltage and current.—*Ed.*]

For my station, I chose a Guest model 2610 that provides up to 10 A or two independent 5 A outputs to charge two batteries simultaneously. The charge current is applied in the three stages defined above. I have permanently mounted this adjacent to my station. A portable style charger could also be used and moved to the garage, boat or RV, as needed. One downside to a so-called "smart" charger: I note hash around 3.58 MHz, likely due to an internal processor clock. The conducted (radio on dummy load) level was S4, lower than the typical background noise at my location. I reduced it to the internal noise level by using a brute force choke[6] on the dc output. I still note some radiated noise, again on 80/75 meters when the antenna is connected, so shielding all wires and filtering on the ac line side would likely solve the problem. If it proves to be troublesome, a quick fix is to pull ac power off and run solely on dc power. There may be other chargers with similar charging characteristics but without this problem; however, I was not prepared to undertake an exhaustive study of all the available options. Analog "smart" chargers are available, however,

Table 1
Copper Wire System Loss

Wire Gauge (AWG)	*Resistance (W /1000 Feet)*	*20 A Loss for 4 Conductors × 6 Feet = 24 Feet Total (V)*	*Voltage at Load for 13.8 V Battery Terminal Voltage*	*Voltage at Load for 12 V Battery Terminal Voltage*
8	0.640	0.307	13.5	11.7
10	**1.018**	**0.489**	**13.3**	**11.5**
12	1.619	0.777	13.0	11.2
14	2.575	1.236	12.6	10.8
16	**4.094**	**1.965**	**11.8**	**10.0**
18	6.510	3.125	10.7	8.9
20	10.35	4.968	8.8	7.0

that do not use microprocessor control and hence avoid the clock noise problem. A useful site with several informative application notes is Ibex Manufacturing, Inc.[7] An alternative marine brand with a good reputation is Xantrex[8] (formerly Heart).

Watch that "Copper Loss"!

Everyone "knows" that wire has resistance, however, we are a bit conditioned into thinking that if there is 12 V at one end of a pair of wires, it will also be at the other end. While the difference is slight in the realm of low power stages, we're talking real amperes here with a significant resulting voltage drop. If we have 6 feet of wire between the battery and the RIGrunner and another 6 feet to the radio(s), that's 12 feet of two wires in series or 24 feet of wire resistance to consider. Table 1 illustrates the results for a 20 A load.

I have highlighted the entries for both 10 gauge and 16 gauge wire to make the point. What this says is if your radio draws 20 A and you have it connected via 6 plus 6 feet of 16 gauge wire to a typical 13.8 V dc power supply, it will still see 11.8 V at the equipment and will likely work fine. It may work fine on the battery if the charger is holding the voltage up well above 12, but when the charger is off and the battery is on its way down, it is very unlikely for the radio to work at the 10 V it will see! Move to 10 gauge wire and it is likely to work, but you'd still better check! My deep cycle battery specification says it will deliver 12 V until discharged 50% and then 11.5 V at a 75% discharge level.

Note that in Table 1 that half (for equal lengths) of the voltage drop shown is in the wire between the battery and RIGrunner and half the drop is between RIGrunner and the radio. If we connect a low power accessory to the RIGrunner (for the 10 gauge wire case) the voltage at the RIGrunner will be half the drop shown,or 12 V at the battery, 11.75 V at the RIGrunner and 11.5 V at the radio. The low powered accessory can use smaller wire from the RIGrunner (11.75 V) to it without a problem. For example, if the accessory draws 0.5 A, the drop in 6 feet (multiplied by 2 wires) of even 20 gauge wire between the RIGrunner and the accessory is only about 0.06 V, so even wire that small should work. This calculation should be made for the current drawn by each of the equipment types.

Please note that if your HF radio draws 20 A and your VHF radio draws 10 A and they will be both transmitting (key down) at the same time, you will have 1.5 times the "drop" shown on the wire from the battery to the RIGrunner, so take that into account, as well. Of course, if you follow the rules and "…use the minimum transmitter power necessary to carry out the desired communications" you may be able to use even less current. Unfortunately, the HF radios that I have checked do not reduce input current as fast as they reduce output power, although that may still be a significant benefit to dc power reduction. This same kind of analysis should also be made for any mobile or shipboard installation, especially if you operate with the engine off.

What can you do to circumvent these pitfalls? Use as large a gauge wire as you can find/afford/terminate/bend. Make it as short as possible. West Mountain Radio[9] provides 10 gauge and 12 gauge wire in various lengths, preterminated, at attractive prices. Marine supply dealers have nice tinned, extra flexible, red/black "duplex" wire in an outer jacket in various sizes. By the way, they also have all the other pieces you need for this project with the exception of the RIGrunner. Auto supply dealers may be another source for parts for the dc system, but I am more familiar with marine dealers in my area. Marine dealers also have "primary" wire in much larger sizes such as 2, 1, 1/0 and 2/0 gauge, for longer runs (to outside battery sheds, for example). If you go to a larger gauge than 10, you will have to have an intermediate connection block (a "barrier strip," for example) to transition to a size that will fit in a PowerPole to connect to the RIGrunner. Figure 3 is a view of the RIGRunner, installed near the operating table. Figure 4 shows the battery and charger.

Related Issues

Battery Safety

We tend to think of 12 V systems as safe (compared to the 1000 V to 3000 V behind the panels of our linear amplifiers, for example). They certainly are from the point of view of an electrocution hazard, but storage batteries of this sort have significant energy and can do serious thermal damage to people and objects. Our usual 12 V power supply will often "crowbar" to 0 V when shorted. The battery, however, will expend all of its energy in dramatic ways including possibly an explosion! Early in my career I vaporized part of my wedding ring by getting it between a wrench on a battery terminal and a steel floor in a military installation. Since my finger was in the ring, it was quite traumatic. Fortunately both my finger and my marriage survived (40 years to the lovely W1NCY). Please follow the following rules for battery safety.

- Always wear safety glasses when working around storage batteries.
- Do not have open flames near batteries, especially while under charge.
- Never use metallic tools long enough to reach between the battery terminals or connections.
- Install fuses as close to the battery terminals as possible.
- Protect the top of the battery (plastic battery box with lid, for example) so wires or equipment can't fall onto the terminals.
- Wash hands immediately following contact with the battery.
- Use proper size ring terminals on all battery connections. I use crimp-type connectors and solder them after crimping.
- Remove all metallic hand jewelry (rings, bracelets…see above!).

- Think twice; act once!

Other Applications

You may want to consider other types of loads depending on your environment. A key possibility is lighting. I did consider including dc lighting in my plan, but I've deferred that for the moment. Marine dealers (probably not the cheapest source of dc lights) have various boat cabin lights available. High efficiency focused lights typically draw 2 A, while a 50 W standard (12 V) bulb will draw more than 4 A…almost as much as the radio equipment! This will reduce your operating time by about half. I have some dry battery lanterns I thought I'd use and I may go to some kind of fuel-powered light in the future to save battery energy for the radios.

I also have not yet provided an inverter to generate 120 V ac. This is something that I will consider, but they are known as RFI generators. I don't see them as significant to radio work at my station. In a non-emergency power failure, I can imagine a request to run the refrigerator or furnace from time to time, and that may be a capability worth having if the load is reasonable.

While the TNC is on UPS power, my regular station computer is not. I do have a battery-operated laptop, which can be used for a number of hours once power is off. I have APC UPS systems (model CS500) for both of the main household computers. These do a great job of keeping the machines up for about half an hour and then gracefully shut them down via a serial (USB) connection to the PC. Unfortunately they, too, generate some conducted radio hash, so I opted not to use one for the station computer. There is also a UPS on the house Ethernet hub and DSL firewall router that keeps external Internet communications up while the laptop is operational.

Cost Considerations

This approach is straightforward, but I was surprised how thin my credit card was after buying all this! By the time I was done I could have purchased a new two-band VHF-FM radio for what I spent. If you are not ready to commit to this level of effort or expense, I think you could sneak up on it. Perhaps you already have a charger for other purposes and could find a partially used recombinant battery to use for a few years.

Another thought (thanks to Del Schier, K1UHF) is to use your current radio supply to keep a battery charged (on float). The "float voltage" level of the Douglas battery I have is 13.5 to 13.8 V dc, which is the typical output of an HF radio power supply. As with the charger, you need to confirm that the peak current divides between the battery and supply so that the maximum rating of the supply is not exceeded.

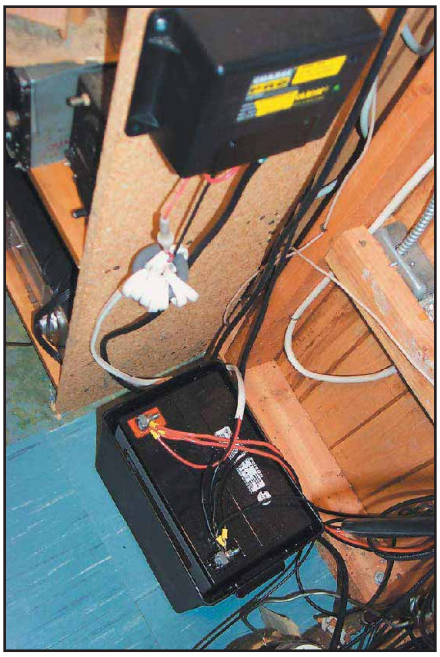


Figure 4—The battery and charger. Note the ferrite choke on the charger leads. The battery is normally covered to enclose its terminals.

The use of "any old" battery is not recommended for this application—unless you can obtain a surplus recombinant battery from a medical supply house or other source, or you are willing to provide a specially vented battery area. In my opinion, the risk of hydrogen gas explosion is not worth any possible savings.

Notes

[1]S. Ford, WB8IMY, "The RIGrunner," *QST*, Oct 2002, p 59.

[2]I calculated the average current requirements considering the duty cycle of transmit periods. In a typical operating hour, I listen more than I talk and use mostly CW (SSB is similar). My specified receive current for each radio is 1 A (confirmed by measurement). My peak HF current is about 15 A, once tuned. If I actually transmit 10 minutes in an operating hour and with CW used at a 50% duty cycle while transmitting, the result is, for HF: 1 A receive × 50/60 + 15 A × 0.5 × 10/60 = 2 A average. For VHF packet, I estimate that there are 30 ten second transmit bursts in an hour (I haven't confirmed this; if you use a DX cluster, you may want to check). During key-down, full power is used. So, for VHF packet: 1 A receive × 57/60 + 10 A × 1.0 × 3/60 = 1.45 A average. (Note that with 2 meter FM voice, the full transmit power is used the entire time the mic button is held down.) The total average current during an operating hour is therefore 2 A + 1.45 A + accessory A = 4.5 to 5.5 A.

[3]For more information about auto and deep cycle batteries, check **www.uuhome.de/william.darden**, which seems an authoritative source. The battery I purchased was a Douglas DG 12-80 available through marine dealers. They also have the best specification sheet I have found (**www.douglasbattery.com/gproducts/pdf/dg12-80.pdf**). This provides all relevant data on their battery's charge-discharge operation, the output voltage as a function of discharge and anticipated life.

[4]For my Douglas DG-12 battery, 80 Ah is specified at a 4 A load or 20 hours of operation at 4 A. At a 7 A load, we can draw current for 10 hours or get 70 Ah. For one hour of discharge, we can only draw 49 A, so the rating drops to 49 Ah. Interpolating, our 5.5 A load should discharge in about 15 hours. When the battery manufacturers talk about discharge, they are specifying the time to discharge to a terminal voltage of 10.5 V. This is the minimum safe terminal voltage for a lead-acid battery. When the per cell voltage reaches 1.7 V (10.2 V for a 12 V battery) permanent chemical and physical damage to the battery can occur. This is probably a lower voltage than we can use, especially considering copper losses (below). If we pick 11.5 V as our minimum usable voltage 75% of the 10.5 V Ah rating should be about right. You can find your minimum voltage using an adjustable supply connected at the battery location and observing when your radios stop being able to transmit ("stop being able to transmit" should be interpreted as "stop being able to transmit *cleanly*") but the receive function will generally continue to a lower battery voltage. The battery will last longer at this rate as well. For 100% discharge, my battery can repeat the charge-discharge cycle almost 200 times (to 60% capacity retention, 100 times to stay at 100%). At 75% discharge, this increases to 300 (200 for 100% retention), 400 at 50% and 1200 cycles for a 30% discharge each cycle. The use of two batteries will permit continued operation during an extended outage, with batteries alternately charged by an automotive or other outside system.

[5]The Guest Company, 95 Research Pky, Meriden, CT 06450; **www.guestco.com/Chargepro/chargepro.html**.

[6]See any recent *ARRL Handbook* for the description of a "brute force filter." I used a pi-section with 0.01 µF, 50 V (RadioShack 272-131) capacitors on the output of the charger and across the battery. For the series inductance I wound 8 turns (as many turns as I could fit) of 14 gauge "marine duplex" wire (from the charger to the battery) on a CWS (formerly Amidon) FT-240-61 toroid core. A future project will be to make a more permanent version for both dc and ac connections to the charger, mounted right at the charger terminals.

[7]Ibex Manufacturing, Inc, PO Box 294, Francestown, NH 03043; tel 603-547-6209; **www.ibexmfg.com**.

[8]**www.xantrex.com**.

[9]West Mountain Radio, 18 Sheehan Ave, Norwalk, CT 06854; tel 203-853-8080; **www.westmountainradio.com**.

All photos by the author.

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By Chip Margelli, K7JA

Field Day 2003 from Cuba

The COØUS/T42FD story—a groundbreaking Field Day experience

Field Day is an immensely popular operating event built upon the premise of demonstrating Amateur Radio's ability to provide emergency communications during emergencies. This year, our group strengthened this foundation in another manner: utilizing Field Day to demonstrate how hams from nations with vastly different political systems can work together to demonstrate emergency preparedness and international goodwill at the same time. This is the story of the first-ever joint Cuban-American Field Day effort: the COØUS/T42FD story.

"Why Not Cuba?"

Two years ago, a group of us started looking for something different in our FD activities. One thing led to another, and we flew down to Puerto Rico to join forces with NP4A and friends from the northwest coast of their beautiful island. Whether it was the swim in the Caribbean Friday night after setup, or the 6000+ QSOs we made with simple antennas on the beach, we knew we were on to something. So the Monday after FD 2002, in a restaurant in San Juan, the Piña Colada Contest Club was founded. And we immediately began pondering the classic OH2BH question: "Where Do We Go Next?"

After considering a number of possibilities, I blurted out, "Why not Cuba?" The idea was immediately met with disbelief among the other members, but as the strategy wheels started spinning in our heads, we knew this concept had promise. But great challenges lay ahead.

The Potential, and the Problems

We were tantalized by the knowledge that there had never been a joint Cuban-US Field Day effort, at least not in the past 40+ years. There are many reasons for this, of course. Since the early 1960s, the United States has enforced a strict economic embargo of Cuba. Tourism of any kind by US citizens is strictly prohibited, as is business activity. Our two countries do not have diplomatic relations. And the general tone of governmental press releases, speeches by government officials and shortwave broadcasts from both sides can only be described as "hostile" over the years.

But we are Amateur Radio operators, and I was reminded of the poignant statement by the Soviet scientist in the opening scene from the Arthur C. Clarke movie, *2010—The Year We Make Contact*: "*Our governments are enemies, we are not.*"

A warm greeting at Havana Airport. From the left: Oscar, CO2OJ; Bill, W1HIJ; Dan, N6PEQ, and Kristin, K6PEQ. Note the cool retro taxi behind them!

Against this backdrop, I approached my longtime friend Oscar Morales Jr, CO2OJ, via e-mail, describing our idea from a conceptual standpoint. His response was predictable: *"Chip, as you know it would be impossible. So why not? Let's try!"*

Getting Licensed

We knew that our plans could not proceed unless we could gain permission, from our own government, to travel to Cuba in a manner consistent with both the letter and intent of the regulations enforcing the economic embargo. The Treasury Department's Office of Foreign Assets Control is responsible for all aspects of the embargo, including licensing of travel by US citizens. There are two general classes of licenses issued: One is called a "General" license, and the other is called a "Specific" license (there is no Extra Class!). The General license is one that involves no paperwork, but is designed for full-time journalists, political figures, sports teams traveling under the auspices of their national sporting authority, academicians and relatives of Cuban nationals returning for a family visit.

The other category of license, the Specific license, is crafted so as to allow OFAC to permit certain categories of travel that it knows are in compliance with the intent of the embargo and trade sanctions. Religious groups, teachers or students participating in an exchange program, freelance journalists, and researchers are the types of people who typically apply for

Strong backs get FD antennas up in Cuba, too! Author K7JA and CO2II give CM2KL a boost during assembly of the COØUS 40 meter Yagi.

Kristin, K6PEQ, is having too much fun at the helm of the T42FD GOTA station. Janet, KL7MF, looks on approvingly.

Specific licenses. Not many are granted.

There is one more category within the "Specific License" regulations. This is the "Public Performance" category, and the regulations state:

> Public Performances, Clinics, Workshops, **Athletic and Other Competitions**, and Exhibitions — Persons traveling to participate in a public performance, clinic, workshop, **athletic or other competition** (that does not meet the requirements of the general license described above), or exhibition. The event must be open for attendance, and in relevant situations participation, by the Cuban public, and all profits from the event after costs must be donated to an independent nongovernmental organization in Cuba or a US-based charity, with **the objective, to the extent possible, of promoting people-to-people contacts or otherwise benefiting the Cuban people**.

Here was our opportunity. After all, Field Day is a competition, with scoring and publication of the scores in *QST*. Bonus points are awarded for operation from a public location, and for dissemination of information about Amateur Radio to the general public. Underpinning the entire Field Day concept is the notion of preparing the communications infrastructure of a region for assistance to the homeland in time of need. And isn't Field Day all about "people-to-people" contacts? We call them QSOs!

One of our members, Bill Scholz, W1HIJ, prepared our application for a Specific license pursuant to these unique-to-Field Day concepts, and in February 2003 the Treasury Department granted us what we believe to be the first-ever Specific license issued for "public performance" activities related to an Amateur Radio operating event.

Arrival in Havana

Less than 24 hours before Field Day's setup time began, we arrived at the Jose Martí Airport in Havana, and were greeted with many hugs and tears by Oscar, CO2OJ, who shared our disbelief that all this was actually happening. We were whisked off to our operating site, called Guanabito, about 50 miles east of Havana. En route, we marveled at the dozens upon dozens of 1950s-era American cars that we observed on the roads, seemingly in showroom quality on the outside. We pondered whether a lot of the "under the hood" components might be traced to defunct Soviet military vehicles!

Upon arrival in Guanabito, we unpacked the mountain of luggage we had carried, including 44 feet of stackable mast, a 2 element homebrew 20 meter Yagi, a 3 element homebrew 15 meter Yagi, a 2 element 15 meter Moxon Rectangle wire beam (supported by fiberglass fishing poles), 2 element W6MMA "Super Antennas" Yagis for 10 and 6 meters, an Arrow antenna for satellite use, three Yaesu FT-857s and a pair of FT-897s, and about a thousand feet of RG-8X. Needless to say, we paid a wee bit of excess baggage charges on our Gulfstream charter flight (on a Continental Airlines 737), where the baggage allowance was 44 pounds per person, including carry-on bags!

We soon met our Cuban counterparts, and found them to be as crazy about Field Day as we are! Besides Oscar, CO2OJ, we were privileged to work with Roberto, CM2KL, who is quite the computer whiz and designated "mast monkey." Osmani, CM2OY, was our master electrician, who always managed to keep the generator purring while generating QSOs on our GOTA ("Get On The Air") newcomer station. And Jorge, CO2II, is the classic "gentle giant" who really knows why things work, and he was a tremendous help in assembling the stations and antennas, and keeping them all working.

Setup Friday was probably like your Field Day: we had rain, we had hot sun, we had mosquitoes, we slipped and fell into the mud and discovered fire ants...just like in countless years past. Only this time, we cursed the mosquitoes in both English and Spanish! Our new Cuban friends were in constant motion while antennas were built, then muscled up into position, and we were amazed at how quickly our five-transmitter station came together.

Friday night, the anticipation of the excitement to come was made even more feverish when we copied the W1AW Field Day message. Tipped off by our last-minute press release, the Headquarters staff kindly included information about our operation for all to copy, and as we read the text to our Cuban teammates, they all erupted in a loud cheer! Guanabito was on the Field Day map!

Field Day Begins!

At the appointed hour of 1800 UTC, we had a brief opening ceremony led by the President of the Cuban Radio Federation, Mr Pedro Rodriguez, CO2RP, who delivered a most eloquent speech to a large crowd of hams and non-hams who had gathered at the site. Pedro spoke of how important it is to have exchanges of this kind, so as to demonstrate to the world how everyday people, working together, can solve problems in ways that governments often cannot. His speech, delivered in Spanish, was expertly translated by our friend Arnie Coro, CO2KK, known to thousands of shortwave DXers as the host of the "DXers Unlimited" program on Radio Havana. We were honored also to

The ARRL and FRC banners festoon the T42FD GOTA station cabana.

Dan, N6PEQ, Chip, K7JA, and Bill, W1HIJ, working the difficult propagation conditions.

have in attendance the Deputy Minister of Telecommunications for Cuba, who was most interested in Amateur Radio. Oscar and Pedro promised to help him work on his code speed!

Nobody had warned me in advance, but sure enough, I was asked to deliver some greetings on behalf of the US contingent, and fortunately I had come prepared with some brief remarks. It truly was an amusing scene to see Arnie translating *my* Spanish into *English*, and I am pleased to report that he got it all 100% correct!

Then it was off to the races! Conditions were quite poor, but high QSO rates were enjoyed by all in the first few hours, as our special call sign "Charlie Oscar Zero Uncle Sam" hit the airwaves. Bill, W1HIJ, and Dan, N6PEQ worked the pileups down on 20 CW and SSB, respectively, while Kristin, K6PEQ, and Osmani, CM2OY, worked the T42FD GOTA newcomer station, spending a lot of time trying to convince others that we weren't on Christmas Island (T32)! It was great to receive the "Congratulations" and "Glad you're there" comments from many who called, and we were easily able to overlook the occasional, deplorable jamming attempts by those among us who sought to disrupt our international goodwill demonstration.

Night fell, and we rotated crews in and out of stations to ensure that everyone got at least one good "run" on a hot band, as the poor conditions were making it tough to get any rate. And the "visitors" kept on appearing as it got later and later: Guanabito is in the middle of a jungle area, so our operating positions resembled *Wild Kingdom* at times. Janet, KL7MF, was running a nice string on 20 SSB when a tree frog hopped right on to her log sheet, apparently demanding some operating time. He claimed to be from Reunion Island (FRØG), but didn't have his license, so Janet didn't relinquish the microphone.

Conditions didn't improve on Sunday. But we didn't care; once we had made the first QSO on Field Day, we knew we had accomplished our goal...the rest was gravy. Some 3500 QSOs later, Field Day ended, and as a group we almost collapsed from the exhaustion, joy and relief that it was all over. Or so we thought...

About an hour into the tear-down process, the brilliantly hot tropical sun became obscured by dark, menacing clouds. The temperature dropped by at least 20 degrees, and suddenly we had overhead lightning, loud thunder and horizontal rain! Tropical Storm Bill was moving over northern Cuba, demonstrating what Field Day is all about. We huddled inside our operating location for almost two hours as the wind howled and the rain pelted the site, turning it into a 6-inch-deep lake! Only one antenna was damaged, our marginally guyed R7 vertical that buckled when struck by a tree branch, but our generator kept working flawlessly even though all power in the surrounding area had been knocked out.

The Aftermath

In the days that followed, we joined in several wonderful meetings with Cuban Amateurs in both the CO2 and CO3 call areas. At a gala reception at the Cuban Radio Federation headquarters, many speeches were delivered, and old on-the-air friendships were renewed. And talk about "public performance": we were all interviewed for Arnie, CO2KK's "DXers Unlimited" show that aired the Fourth of July weekend. Arnie asked about our Field Day experiences, relating them to daily life, and we all contributed our own ideas. Emily, KF6SGV, offered her perspective on Amateur Radio communications helping the hospital where she works. Several of us mentioned the irony of Tropical Storm Bill making an appearance at the end of FD. And whatever he was saying at the moment, one couldn't help but notice the look of disbelief in the eyes of long-time SWL Dan, N6PEQ, as he realized that he wasn't listening to Radio Havana—he was *on* Radio Havana!

Everywhere we met with Cuban hams and non-hams alike, we were met with warmth and instant friendship. Our Cuban teammates were among the most enthusiastic, hard-working and knowledgeable amateurs one could ever hope to meet, and we are proud to count them among our friends. We sincerely look forward to the day when the political situation between our countries permits us to join together in joint contest operations without the complications of today, and we are honored to have been given the opportunity to experience a little bit of the joy and sadness that is Cuba today.

Acknowledgments

We in the Piña Colada Contest Club (KP2AA) are deeply indebted to Mr Pedro Rodriguez, CO2RP, and Oscar Morales Jr, CO2OJ, for their tireless work in facilitating this amazing weekend. We also wish to thank Jorge, CO2II; Roberto, CM2KL, and Osmani, CM2OY, for being fantastic teammates. Dan Henderson, N1ND, and the ARRL are to be commended and thanked for providing Field Day and GOTA pins, which were distributed to the public at our FD site. And we appreciate the cooperation of the Office of Foreign Assets Control, who understood the nature of our proposed visit and issued the necessary license to allow it to be carried out. See you next year from (*Top Secret!*).

All photos by the author.

Chip Margelli, K7JA, of Garden Grove, California, has been an active DXer for more than 35 years. His articles have been published in QST, CQ *and* CQ VHF. *You can reach the author at* **k7ja@dxer.com**.

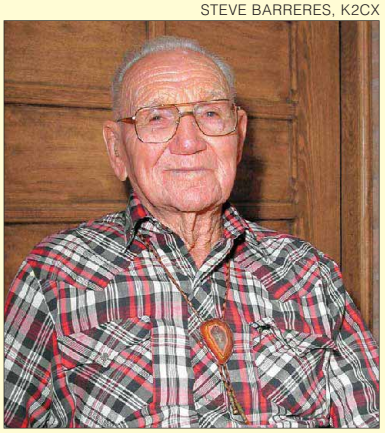
By Steve Barreres, K2CX

A Voice from the Ether—B. H. "Tex" Burdick, W5BQU

Still active after 70 years of hamming, Tex is not your typical 103 year old.

Reputed "oldest ham in the US" turns 103 *(Sep 26, 2003)—The man thought to be the oldest Amateur Radio operator in the US—Byrl "Tex" Burdick, W5BQU, of El Paso—turned 103 on September 25. First licensed in the fall of 1930, Burdick is on the air every day—most recently on 15 meters (look for him on or about 21.314 MHz), and he enjoys ragchewing. On behalf of the League, ARRL President and fellow Texan Jim Haynie, W5JBP, this week wrote Burdick to extend congratulations and best wishes. Burdick is an ARRL member and a routine QSLer. Happy Birthday, Tex!*

STEVE BARRERES, K2CX



Portrait of W5BQU taken on his 102nd birthday.

This recent news item, which appeared on the ARRL Web site, commemorates Tex Burdick's 103rd birthday. It's one thing to be that age, and it's a whole other thing to remain active and as friendly as ever—to new acquaintances and old friends alike. Whether it's 1930, when he was first licensed, or the digital age we now inhabit, Tex is the embodiment of The Amateur's Code.

Those who have had the pleasure to work him on the amateur bands will surely remember contacting W5BQU. His southwest Texas soft-spoken and unassuming nature make him a ham one cannot forget. An 18 inch tall pile of logbooks and the thousands of QSLs he has received and sent is a testament to his continuous 73 years of amateur operation. He fondly keeps a small quantity of QSL cards he received that have a one cent stamp affixed. At 103 years of age, Tex is more than active by anyone's standards and has the honor of being, as far as anyone can tell, the oldest Amateur Radio operator in the United States.

From Photography to Drilling to Ham Radio

Born in 1900 to parents from Minnesota who decided they should relocate to the desert southwest, Tex spent most of his youth in San Angelo and El Paso, Texas. In 1918 he spent some time away from Texas in search of a career and for his education. He soon became homesick and returned to El Paso. With no work to be had there, young Tex lived for a time in New Mexico, working in a zinc mine. At about this time, he became interested in photography. He purchased a Kodak No. 2-C and, without any formal training, began photographing the rustic landscape. He found his part of the country so picturesque he wanted to preserve the images he saw.

COURTESY TEX BURDICK, W5BQU

High above the desert floor, Tex's crew poses for a group photo after an irrigation project has been completed.

Again returning to El Paso, with few paying jobs to be found, he worked for the city without compensation except for the experience he received drilling wells for water. After a few months, he and a friend built themselves their own drilling rig made of stripped down parts from an old Mack truck. Tex was in the well business.

One day, being a curious fellow, Tex saw a gentleman driving his car and talking on some sort of radio set. He followed this man for a while when, all of a sudden, the mobile operator pulled to the side of the road. "Did I do something wrong?" the fellow asked. Tex replied, "No. I am just very interested in how I could talk on a radio like you." After going to the Post Office, making application and taking the necessary tests, Tex became a licensed ham radio operator in 1930. "My first rig was a homebrew transmitter and receiver, each made with one 201A tube," Tex recalls. "As soon as I could find me another tube, I made the transmitter into a two-tube arrangement."

By the time Tex started his radio hobby, he was already running a large business that had grown out of his original well drilling labors. Burdick & Burdick, as he named it, sold windmills and water supply products to the ranchers of southwest Texas and New Mexico. In 1931 his firm was approached by a rep-

resentative from the Challenge Company and struck a deal that made Tex's firm an exclusive supplier for their windmill product line.

"They say that the six-shooter won the West, but that is not so," Tex explains. "The windmill and barbed wire was the real tamer of the West." Without electricity, windmills delivered water, allowing ranchers to graze their herds on vast stretches of open land. Barbed-wire fence permitted the selective breeding of their stock, a process that strengthened and ensured future generations of healthy cattle. During the busiest of years, Burdick & Burdick sold eight railroad cars full of Challenge Model 27 mills. Of course they installed what they sold, and Tex's firm had three full erection crews on the road during peak seasons.

With his original Kodak camera, he documented many of his crews and their labors for his personal record. *Blades in the Sky*, a book written by T. Lindsey Baker, displays Tex's images. The author describes windmilling using Tex's photos combined with his personal stories.

An Aeronautical Mobile Pioneer

While running his shop and visiting installation crews around the area, Tex thought it might be a good idea to learn to fly. With a small plane he would be able to cover many more miles in a day and, when necessary, deliver emergency repair parts to remote customers. It also would be a good public relations tool. In the late 1940s Burdick & Burdick purchased their first airplane, a Stinson Station Wagon. It was no surprise that soon thereafter Tex installed ham radio equipment onboard. "It was very interesting to use amateur equipment air mobile," Tex recalls. "At a few thousand feet I could work anyone on the band for miles. Climbing to a high altitude there was some real interesting DX."

Tex also was one of the charter members of the El Paso Amateur Radio Club. He acted as a trustee during the club's early years and helped during their fundraising drive that would help build their clubhouse. With his always pleasant, "How can I help you?" attitude, Tex donated a windmill tower for the new clubhouse for use as an antenna support structure. One should not be surprised to learn that he too uses a metal windmill derrick for his triband Yagi at his home today.

To meet W5BQU for the first time, you would never guess his age. He does not look to be a person who recently celebrated his 103rd birthday. His son, Byrl H. Burdick Jr, is also blessed with his dad's youthful appearance. Today Byrl Jr's two sons run the family business; Tex's grandchildren are at the helm of Burdick & Burdick. The 75 year old firm continues to supply southwest Texas with irrigation equipment and piping. The Amateur Radio ranks now boast another licensee from the Burdick clan, Byrl H. Burdick III, KC5HFE.

COURTESY TEX BURDICK, W5BQU

Tex Burdick and his son B. H. Burdick Jr, with their company's first plane. It didn't take long for Tex to discover the fun of operating aeronautical mobile.

"A Landmark and Icon"

All who have had the pleasure to speak to W5BQU hold their experience in high regard. When asked about Tex, Kenneth W. Kuhblank Jr, W6KWK, said: "He is a landmark and icon to our great hobby. You will not meet a more courteous operator. One grand OM." The many contacts, with youngsters and old-timers alike, are memorable and you can be certain you will receive a QSL card confirming the encounter.

"Tex does not have much sense of feel in his hands," his wife, Juanita, admits. "I help out with the QSL cards by writing down all of the information on the back." During a QSO, Tex uses a computer to look up the call sign of a station but still prefers an old style paper log for the details of a contact. Each day he operates his Ten-Tec rig recently purchased by his wife as a gift. He can be found on 10, 15 or 20 meter phone, conditions allowing. Lately he has been operating around 21.314 MHz.

Amateur Radio continues to play a very important part in Tex Burdick's life. As a longtime retiree he enjoys his daily tune around the bands. He is a proud great-grandfather of a lovely family, and a successful businessman enjoying his golden years. His interest in flying and photography is only a close second place to his love of our radio hobby. Starting with a single tube transmitter in 1930 and now, at more than 100 years old, using the computer—he is a remarkable ham.

Tex enjoys the many friends he makes on the air, and they are pleased to make his acquaintance, too. In closing out a contact, Tex is known to close with a new friend, "May you live as long as you want and never want as long as you live." Look for his signal, and you too will have a chance to make contact with—A Voice in the Ether.

STEVE BARRERES, K2CX

No surprise here—Tex's antenna is supported by a windmill derrick.

Steve Barreres, K2CX, is a two-time Emmy Award winning broadcast engineer who has been employed in network television for the last 20 years. Licensed since 1971, he enjoys many of the numerous facets of our hobby, having a special interest in the study of early radio history. He is currently a trustee of Friends of Long Island Wireless History and Interplex Group, an Amateur Radio association promoting New York State emergency communications capability. You can reach the author at **k2cx@arrl.net**.

By Jean Wolfgang, WB3IOS

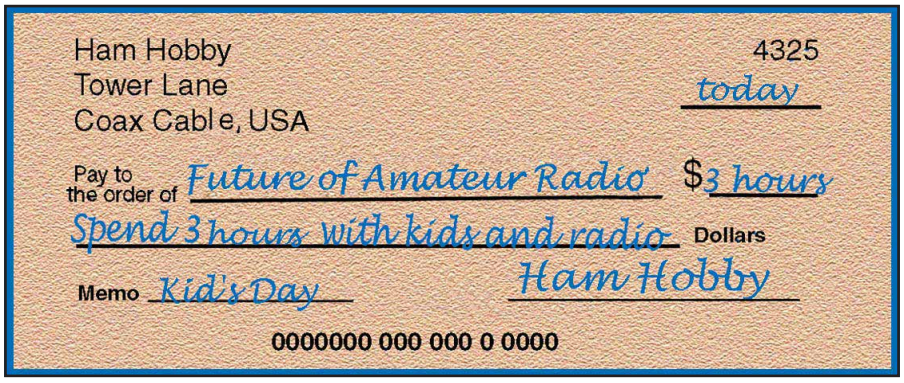
Kid's Day 2003—The No Cost Investment in Amateur Radio

The future of Amateur Radio would be secure if we could all write checks for a few thousand dollars. Kid's Day is an investment we can all make...and you don't need to touch your checkbook!

Make a New Year's resolution to share ham radio with the kids in your life. Throughout the year, you will have opportunities to invest some time in the next generation of ham radio operators. There are scouts looking for radio merit badge councilors and someone to help with Jamboree on the Air. Science and math teachers are always looking for a new and different way to teach their subjects.

Can't spend the time to set up and develop something along those lines? You're still in luck. Kid's Day is just around the corner and all you need to do is invite the kids to your shack! All the information you need to make the event a wise investment (and a success) is in this article. In the rules you will find the date, frequencies, how to call CQ and the suggested exchange.

Some participants and prospective participants suggested that we consider a Sunday event for those who have work or other Saturday commitments. This year we are going to hold the winter event on *Sunday*, January 4, and the mid-year event on *Saturday*, June 19. Please let us know how the Sunday event works for you. You can join ham radio operators all over the US who are willing invest some time with kids while they experience firsthand the excitement of ham radio. Who knows what the future may hold for these kids? You may find yourself sitting beside the future "Ham of the Year"!



This is one investment we can all make!

Soapbox

It was a lot of fun talking to Kirstie. I wish that there was more time to do it and I wished that my dad fixed his antenna before kids day!!!—*Veronica, age 8*

My son, Greg, 7, and I operated the contest for about 90 minutes. It was his first real experience with Ham Radio and he enjoyed it very much. I started him off with a little S&P, but he found it was more fun to call CQ. I controlled the radio and did the logging and let him do the on-air operating. Thanks for a neat event for the kids.—*Mark, KØMS*

I finally got to call and talk to people that I didn't already know. It was really nice. I am 9 years old and have only had my license for 1 week.—*KI4AXL*

My daughter Maria enjoyed calling CQ KIDS DAY and *then* hearing someone call her back. She was most excited to make a contact with a 6 year old boy named Mike (the rest were adults—all very patient and encouraging). Thanks so much for organizing the event. I hope we have interested a new ham.—*Her Dad, N3LTV*

Kid's Day Rules

Purpose: Kid's Day is intended to encourage young people (licensed or not) to enjoy Amateur Radio. It can give young people on-the-air experience so they might develop an interest in pursuing a license in the future. It is intended to give hams a chance to share their station with children.

Dates: *Sunday*, January 4, 2004 (please note the date change) and *Saturday*, June 19, 2004.

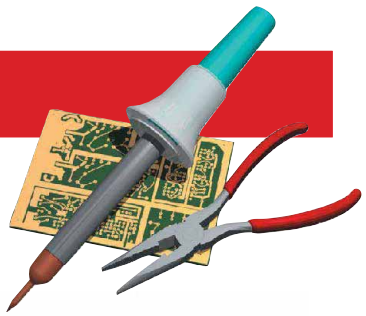
Time: 1800 to 2400 UTC. No limit on operating time.

Suggested exchange: Name, age, location and favorite color. You are encouraged to work the same station again if an operator has changed. Call CQ KIDS DAY.

Suggested Frequencies: 28,350 to 28,400 kHz, 21,380 to 21,400, 14,270 to 14,300 kHz and 2 meter repeater frequencies with permission from your area repeater sponsor. Observe third party traffic restrictions when making DX QSOs.

Awards: All participants are eligible to receive a colorful certificate (it becomes the child's personalized sales brochure on ham radio. Please visit **www.arrl.org/FandES/ead/kids-day-survey.html** to complete a short survey and post your comments. You will then have access to download the certificate page or send a 9×12 SASE to Boring Amateur Radio Club, PO Box 1357, Boring, OR 97009.

Jean Wolfgang, WB3IOS, is ARRL Educational Programs Coordinator. She can be reached at **jwolfgang@arrl.org**.



The Doctor is IN

Q Austin, W9DKT, asks: For normal CW operation what are the advantages of using an iambic key over a vibrating type key?

A An iambic keyer is an electronic keyer that contains digital logic that allows the operator to squeeze the paddle levers to form a series of alternating dots or dashes. As an example, consider the letter "c," which in Morse code is *dah-di-dah-dit*. Simply holding both levers of the paddle together and releasing them after the proper interval produces that character. Depending upon which paddle is activated first, the element series can be started with either a dot or a dash. The advantage of iambic operation is that fewer paddle (key) strokes are required for alternate sequence characters like a period (*di-dah-di-dah-di-dah*) or the ending prosign $\overline{\text{AR}}$ (*di-dah-di-dah-dit*). It does take a bit of practice to master iambic sending and not all operators like it or use it. Those who do, however, agree that the fewer number of keystrokes (or "paddlestrokes") required makes for easier sending.

Iambic operation can usually be programmed in two modes, so-called Mode A or Mode B, and some iambic keyers offer that choice. Mode A operation will complete a dash or a dot after its appropriate paddle lever is released, exactly like most electronic keyers do (the character is said to be "self-completing"). Mode B operation results in the opposite code element being sent after a paddle lever is released. In other words, if I were sending the letter "c" in iambic Mode B, I would start by squeezing both levers *almost* simultaneously, but with slightly more delay given the dot side. The sequence would begin, therefore, with a dash, as that lever has been activated first. I would then *release* both paddles after the second dash started (*dah-di-dah...*) and then the final dot generation (*dah-di-dah-dit*) would be automatic. The amount of motion required to activate the paddle has thus been reduced considerably, instead of going back and forth 4 times for the character "c," the operator need only squeeze the paddle levers once and let go (providing his or her timing is correct!).

A non-iambic keyer does not have the "squeeze" feature. Some operators, including myself, don't use the iambic feature. It's a matter of personal preference—and one that, as I said, takes some practice to master. It also requires that the keyer have the necessary logic to accommodate iambic keying modes. Additionally, the paddle (key) must be a dual-lever design, one lever dedicated to dots and another to dashes.

A mechanical key, usually called a *bug*, uses one or several weights on the end of a spring arm to *vibrate* the arm (hence its commercial name) and forms dots with a set of contacts mounted to the arm. These are called *semi-automatic keys*—they send only dots automatically; dashes still need to be made manually. Characters are formed as if you were using a straight key, only the motion is sideways (horizontal) instead of up and down. In the case of a right-handed key, the operator's right thumb makes the dots and the index finger (usually) makes the dashes. There's considerably less effort in sending with a bug compared to a straight key, as the dots are made automatically.

Figure 1—A "bug" or semi-automatic key (Vibroplex) is shown at the left. Note the long spring arm with weight and the arm contacts to the left of the arm. The vibrating arm makes automatic dots when the key knob is moved to the right by the operator's thumb. An electronic iambic keyer with a dual-lever paddle is shown to the right. Iambic operation is described in the text.

This, too, requires practice, although many operators prefer the sound of "machine code" sent from an electronic key. However, the bug does impart a certain style or "swing" to one's sending that can't be easily duplicated with an electronic key. Incidentally, the name "bug" derives from the term coined for an incompetent telegrapher. Poor landline operators of the early 1900s were known as "bugs," and when the semi-automatic key first appeared the keys were purchased and used by operators without practice (one can only imagine what that sounded like!). Hence, the key itself became known as a "bug."

The Vibroplex[1] is a good example of a commercial bug and one that has been in production since 1905. Bugs do not require any outboard electronics; the key itself takes care of all final contact closures in the character formation. A Vibroplex bug and an electronic keyer with dual-lever paddle are shown in Figure 1.

Q Allan, KF9RA, writes: Doctor, can this possibly work? My mag-mount antenna is on a steel plate about 6 inches square, just barely larger than the base. The plate is attached to the top of a plastic tool box that sits in the bed of the truck. The antenna is a long way from the center of the roof, but I have gotten favorable reports for the past 6 months. The SWR, as best as I can measure, is 1.4:1. I have to conclude that even though the antenna is separated from the body of the truck, the truck still acts as a suitable ground plane.

A A proper ground plane for a vertical antenna is essential for a low radiation angle and for a suitable match to the transmission line. In the case you show in your photos, it would not be possible to get an optimum or easily predictable pattern. I suppose some capacitive coupling to the truck body could work well enough to keep the SWR down, but the size of the plate and the distance it is from the truck bed pre-

cludes much coupling. While this is certainly not a desired or optimum situation, it may be good enough for nearby repeaters that have excellent receivers. That can be misleading, as repeaters frequently make even marginal signals sound good.

Another question is whether or not there is significant loss in the antenna or the coax. If the shield braid of the coax is simply left floating and not connected to the counterpoise or the plate, the mismatch would be significant. Even if it is connected to the plate, the plate area is too small and the spacing from the truck body is too great to be effective. This could result in a low SWR at the transmitter end of the cable—but a high SWR at the antenna end—not a good situation. I would suggest you measure the SWR as close as possible to the antenna, rather than at the transmitter. You'll then have a truer picture of what is going on.

I would not recommend the use of such a small ground plane. If you're forced to install the antenna this way, bring the plate as close to the truck or car body as you physically can.

Q Brian, KA7KUZ, writes: I have a question regarding batteries. I have 4 AA 1.2 V 1600 mAh nickel metal hydride batteries. I suspect that one of the batteries is not holding a charge. Using a simple volt-ohm-milliameter (VOM), what do I check for to determine if the battery is holding a charge? Thanks!

A The VOM would certainly be useful, but you would need to measure the terminal voltage of the cells under load. Charge the batteries for the recommended charge time and place a 5 Ω, 1 W resistor across the terminals. This will draw about 250 mA from the cell. If the measured voltage drops significantly under this load, that cell is not holding a charge. On a good battery the terminal voltage will drop slightly under load, but it will stabilize fairly quickly. On a bad cell the voltage will drop significantly and will keep decreasing rapidly. Good luck!

Q From K5GB comes the following: I found the recent *QST* article[2] about the maintenance of amplifiers both interesting and timely since I'm getting ready to reactivate an amplifier (pair of 3-500Zs) that hasn't been plugged in for at least 10 years. I seem to remember a suggestion I got a long time ago to bring the power up using a Variac variable ac transformer. I don't remember if this was to be used on the filaments (which I can't see any sense in) or just on the high voltage (which I can see great sense in). I would appreciate any comment you may have on this before I blow up a couple of tubes that have become quite expensive to replace.

A A Variac or Powerstat (a variable ac transformer) can be used effectively to bring life to an older piece of equipment, but be careful. Ever notice how ordinary light bulbs sometimes fail when they are turned on? The filament resistance of the bulb is measurably lower when the filament is cold; hence, the starting or "inrush" current will be much higher than normal. When a weak bulb filament fails, it will most likely fail during turn-on. As far as tube filaments are concerned, the same thing applies. A low start voltage limits the inrush current and it is, therefore, a "kinder, gentler" way to get the tube filaments up to temperature.

Along with the tube filaments, the power supply filter capacitors have also been idle on an older piece of equipment. Particularly in the case of an amplifier, those capacitors are generally high value electrolytics. The electrolyte (generally an aluminum oxide wet paste) of the capacitors may have dried out and full application of primary voltage could result in catastrophic failure of one or more capacitors. Many feel that a gradual application of voltage will "re-form" the electrolyte in the capacitor, extending its useful life. There's a useful editor's note about re-forming capacitors in the October 2003 issue of *QST*.[3]

There is a caveat to this technique, however. Many electromechanical components, such as relays or fans and blowers, do not take kindly to low voltage. They frequently draw excessive current when operated at low voltages—relays chatter and blowers hum. Also, circuit parameters are very different at low ac input voltages compared to the specified normal ac operating voltage. Bias voltages will not be proper and operating point characteristics will be all over the place. I would advise starting the equipment at its *minimum specified* ac line voltage setting, generally 85-90 V_{rms} ac, rather than at 0 V, then gradually bring the voltage up to the normal ac input voltage. By the way, many modern amplifiers have "inrush current protection" to limit the current drawn by the power transformer during the first second or so of power application.

Q Chuck, KT6P, has a speaker question: I have a Motorola TSN6000A speaker that I want to use with my Kenwood TM-V7 VHF/UHF transceiver. The speaker is 3 Ω and the radio asks for an 8 Ω speaker. Will I damage the radio by connecting the speaker as is? Or can I just put a 5 Ω, 5 W resistor in series with the speaker?

A It is usually best to use a speaker that properly loads an audio output amplifier. A proper load ensures maximum power transfer plus minimum distortion. Too low a speaker load impedance could severely tax the output characteristics of the audio amplifier. While adding a resistor in series with a speaker will increase the impedance seen by the amplifier, it will also mean that power will be wasted (driving a resistor!). You'll need more volume than normal—and this may increase distortion quite a bit.

All this being said, most audio amplifiers will work satisfactorily over a fairly wide range of impedances. The design latitudes are generally wide enough to accept reasonable load impedances. Whether a 3 Ω load is "reasonable" for this particular amplifier is difficult to say without extensive investigation. You might want to check with the manufacturer. My suspicion is, however, that he would tell you to avoid putting a lower impedance on the output line, because of his liability for failure of the output circuit. Accordingly, I would suggest that you get a low power audio output transformer having a 250-500 Ω primary and a 3.2 Ω secondary; it should be rated for about 2-3 W. The transformer will not load the output circuit and your output level should be more than adequate. A suitable part would be a 500-3.2 Ω transformer (45-709) from Ocean State Electronics[4] or a 250-3.2 Ω transformer (P-TK17) from Antique Electronic Supply.[5] Both are rated at about 2 W. You could try adding the resistor to see what effect that has on the audio output level and distortion, but almost half your power will be wasted as heat! A 2 W resistor should be adequate.

Notes

[1]The Vibroplex Co, Inc, 11 E Midtown Park, Mobile, AL 36606; tel 251-478-8873; **www.vibroplex.com**.

[2]H. Ward Silver, N0AX, "Amplifier Care and Maintenance," *QST*, Sep 2003, pp 33-37.

[3]Note 1 (Editor's Note), *QST*, Oct 2003, p 61.

[4]Ocean State Electronics, PO Box 1458, 6 Industrial Dr, Westerly, RI 02891; tel 800-866-6626; **www.oselectronics.com**.

[5]Antique Electronic Supply, 6221 S Maple Ave, Tempe, AZ 85283; tel 480-820-5411; **www.tubesandmore.com**.

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

Global Overlay Mapper

Tim Makins, EI8IC, has developed a unique approach to computer mapping for radio amateurs. His *Global Overlay Mapper* is a package that consists of detailed maps that can be literally overlaid one atop the other. Unlike many software packages, *Global Overlay Mapper* is *platform independent*, which means that you can run it under *Windows*, *Linux* or *MacOS* as long as you have a Web browser that supports *Javascript*. Most browsers support *Java*, although you may have to enable it through OPTIONS or SETTINGS menus. If in doubt, use *Internet Explorer* 5 or 6.

Using the *Mapper*

When you start the *Global Overlay Mapper*, it opens your Web browser and appears in the main window. This does *not* mean that the software is connecting to the Internet. On the contrary, *Global Overlay Mapper* simply uses your browser as a means to display information. Once the program is up and running, you are presented with a graphic menu offering your choice of seven continental maps and 27 subcontinental maps.

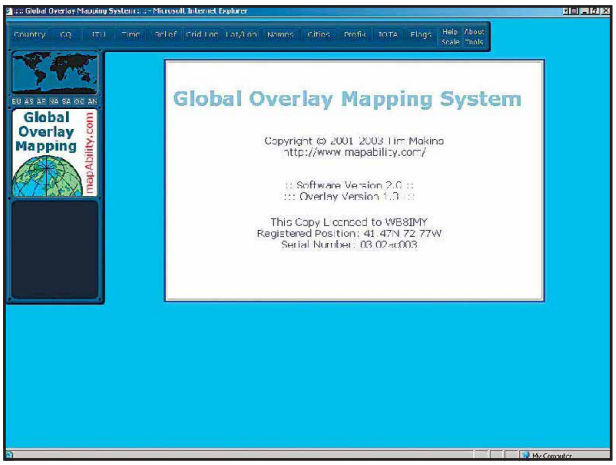
The fun starts when you select a country and begin choosing the overlays you want to display. Click your mouse along the tabs at the top of the window and you will see overlays of political borders, topography, time zones, CQ zones, ITU zones, IOTAs, grid locators, a latitude/longitude grid, ham prefixes, more than 2204 major cities and even flags. In the US map, the *Global Overlay Mapper* even showed state flags. You can select a single overlay display for clarity, or compare and reorder the information on several at once.

When you purchase the *Global Overlay* Mapper, you submit the latitude and longitude of your station, which is then incorporated into your version of the software. The result is a display of distance and beam headings at the bottom of the browser window. As you drag your mouse cursor across the maps, the distance and beam headings change. This makes the *Global Overlay Mapper* particularly useful to contesters and DXers.

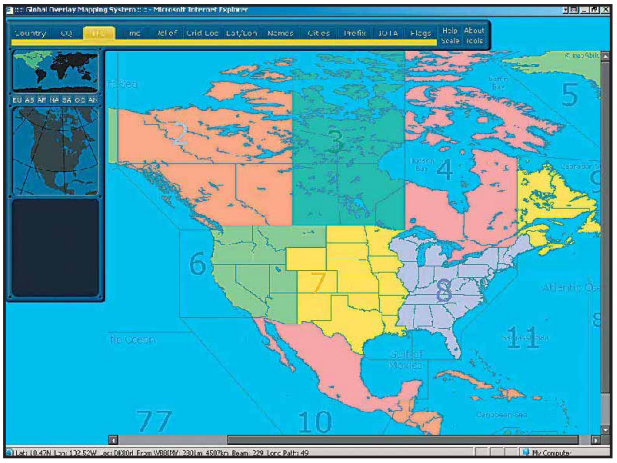
Well-Designed Software

Tim has put a lot of thought into the *Global Overlay Mapper* and it shows. The design is highly attractive and the software is remarkably easy to use. If you can drag and click a mouse, you can use the *Mapper*. With the ability to run on almost any computer that has a Web browser, the *Global Overlay Mapper* is bound to appeal to a wide audience. From my experience with the *Mapper*, I think it could also be an educational tool beyond its Amateur Radio applications.

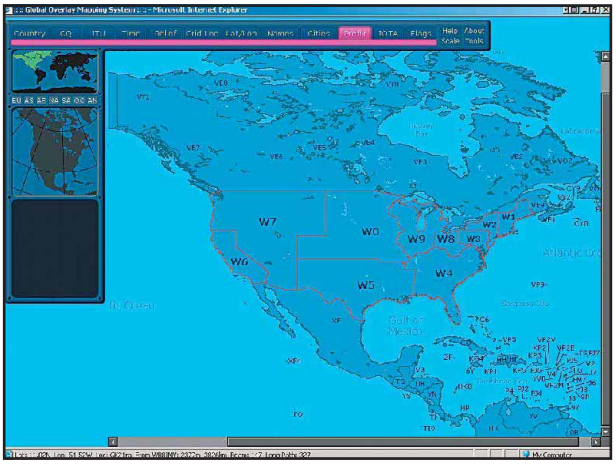
You can purchase and download the entire package on the Web for $23. It is a 17.5 Mbyte download split into five files for convenience. Or, you can order the *Mapper* on a CD-ROM for $29. Orders are accepted on-line at Tim's Web site at **www.qsl.net/ei8ic/** (where you'll also find an on-line demo), or by postal mail at MapAbility, Coolmeen, Ballyfarnon, County Sligo, Ireland. Be sure to include your call sign and latitude/longitude coordinates if ordering by mail.



The Mapper boots into your Web browser with this "home" window. You select continents and subcontinental areas at the left side of the window.

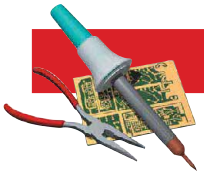


ITU zone overlay.



Amateur prefix overlay.

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



By Bob Kavanagh, VE3OSZ

Front Panel Layout—Another Approach

Here's one more way to make that homebrew project shine.

The technique described by K5LN for laying out and printing labels for front panels (B. Sepulveda, K5LN, "Panel Layout with Microsoft *PowerPoint*," *QST*, Dec 2002, p 61) made me think I should share with other hams my somewhat different approach to this problem.

My technique involves making a computer-printed paper cover for the front panel of a chassis. The paper cover is then covered by a sheet of Lexan [This is a polycarbonate plastic and is very resistant to scratching, impact and cracking damage. Other acrylic plastics (Plexiglas, for example) can be used, but they may not be as damage resistant.—*Ed.*] The fastening nuts for the potentiometers, switches and jacks secure the paper cover and the Lexan sheet to the front panel. No glue is needed.

Having decided upon the layout and labeling of the front panel controls, I produce a corresponding layout on a computer. I use Lotus *Freelance Graphics*, but other similar programs can be used. The layout is created to ensure that the paper sheet matches the desired control positions and labels on the panel. This is after laser printing and trimming the sheet to size. The font can be chosen to suit your taste. I place small circles (or crosses) at the locations where the holes for controls are to be drilled. The layout can be printed on paper of any suitable color and weight (thickness). It is a good idea to print several copies of the final layout.

The next step is to cut a piece of Lexan to correspond to the size of the front panel. I use $^1/_{16}$ inch sheets. Then, using one of the printed layouts as a template clamped between the Lexan and the panel, drill the Lexan and the panel at the same time with the required holes for the controls.

Finally, using a fresh copy of the paper layout (in case the first copy has been damaged during the drilling process) with the layout and the Lexan clamped in place, I pierce holes in the paper at the appropriate locations. This requires some care in order to not tear the paper while removing the excess paper from the holes. Controls with knobs will cover up any imperfections in the paper holes, but special care must be taken with holes like those for LEDs. The controls are then added and everything is fastened together with the control nuts.

Figure 1 shows two of my recent projects that have been packaged using this technique. The method works best for boxes that have an overhang at the front sides and top, as shown in the picture. The overhang conceals the edge of the Lexan sheet.

Figure 1—Two examples of completed projects that use VE3OSZ's front panel finishing technique.

The result is a professional looking front panel with lettering that is protected and will never wear off.

Bob Kavanagh, VE3OSZ, was first licensed as VE1YW in 1951 and since then he has held VE3AQO, VE1AXT and his present call. Bob has a PhD in electrical engineering and has taught at the University of Toronto and the University of New Brunswick. He was also a Director General at the Natural Sciences and Engineering Research Council of Canada. Bob's Amateur Radio interests include DXing (especially on 160 meters), contesting, experimenting with circuits, antennas and propagation. He is an authorized Amateur Radio examiner for Canada's licensing authority, Industry Canada. He can be contacted at 849 Maryland Ave, Ottawa, ON K2C 0H9, Canada or at **ve3osz@rac.ca**.

Experiment #11—Comparators

The *comparator* made an appearance in Hands-On Radio experiment #5 on timers. As a crucial part of the type 555 integrated circuit (IC), it made the decision about when it was time to change the timer's operation from one state to another. We'll now delve deeply into comparator functions including the mysterious property called *hysteresis*.

Terms to Learn

- *Hysteresis*—a shift in the switching threshold of a comparator purposely caused by positive feedback.
- *Chatter*—oscillations of a comparator output when the input signal is near the threshold.
- *Open-collector output*—an IC output consisting of the isolated collector of a bipolar transistor or FET drain.
- *Threshold*—the voltage at which a comparator circuit switches states.

Background

The basic function of a comparator is, surprisingly (!), to compare the magnitudes of two inputs and indicate which is greater. The comparator is found in many places around the shack—battery chargers, power supplies, antenna tuners and switches, just to name a few.

While there are lots of circuits that can compare voltages, the most common is a high-gain amplifier with two high-impedance inputs. If this sounds like an op-amp, it should—the comparator is basically an op-amp with an *open-collector output*. This is an NPN transistor with its collector connected to the OUTPUT pin, but nothing else. It allows the comparator to interface to digital circuits and drive switched loads better than an op-amp. It also supports a neat noise-control design trick, as we'll see later.

Figure 1 shows a comparator in a simple temperature control circuit. No feedback is used, so its full voltage gain (in the thousands at dc and low frequencies) turns the output transistor OFF if the + input voltage is greater than that of the – input (by even a few millivolts) and vice versa. The point at which the comparator changes state is called the *threshold*. The output states can be reversed by switching the input connections.

In this circuit, the negative input (–) voltage is fixed at a value representing the desired temperature (the system setpoint), V_{SP}. If the sensor's output voltage is lower than V_{SP}, the comparator's output transistor will be turned ON and the heater will be ON, raising the temperature. When the sensor is hotter than the desired temperature, the output transistor is turned OFF, turning the heater OFF. The system cycles between a little too hot and a little too cold.

Testing a Simple Comparator

Let's start with the simple voltage detector circuit of Figure 2, such as might be used in a power supply to detect overvoltage. We want the LED to turn ON whenever the variable input voltage is higher than the fixed input voltage (setpoint). Fixed resistors R1 and R2 form a resistive divider that creates the setpoint voltage, V_{SP}.

Use an LM311 with its V+ power supply pin connected to +12 V and its V– pin connected to ground. Be sure to connect pins 1 and 4 together so the emitter of the output transistor is grounded.

To keep current through the resistive divider small, assume R1 + R2 = 50 kΩ, and R1 = 50 kΩ – R2.

- Create a setpoint of V_{SP} = 5 V. Use the voltage divider equation: $V_{SP} = V+ \times [R2/(R1+R2)]=12\ V \times [R2/(50\ k\Omega)]$. So R2 =5 V×50 kΩ/12 V=20.8 kΩ. Use 22 kΩ for R2. R1=50 kΩ – 22 kΩ =28 kΩ, so use a 27 kΩ resistor.
- Build the circuit and vary the potentiometer while watching the LED. Measure the setpoint and variable voltages at threshold to be sure they agree with the calculated values. Redesign the resistive divider for different setpoint values or use a 10 kΩ potentiometer to change the setpoint.
- Adjust the variable input slowly through the setpoint value. Do you see the LED flicker or light dimly before staying ON or OFF? If you are using an oscilloscope, watch the LM311 output voltage as the setpoint is passed for rapid changes between ON to OFF before settling at the final value.
- Measure the comparator's output voltage, V_{OH}, with the LED turned OFF for use in the next part of the experiment. The forward voltage drop across the LED, even when OFF, will make V_{OH} about 1.5 V lower than V+.

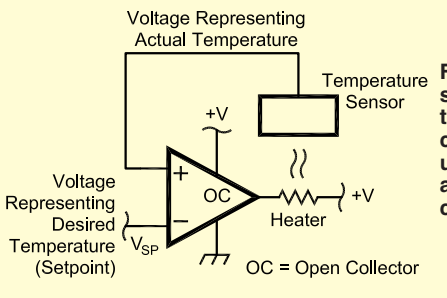


Figure 1—This simple temperature control circuit uses a comparator as an on/off controller.

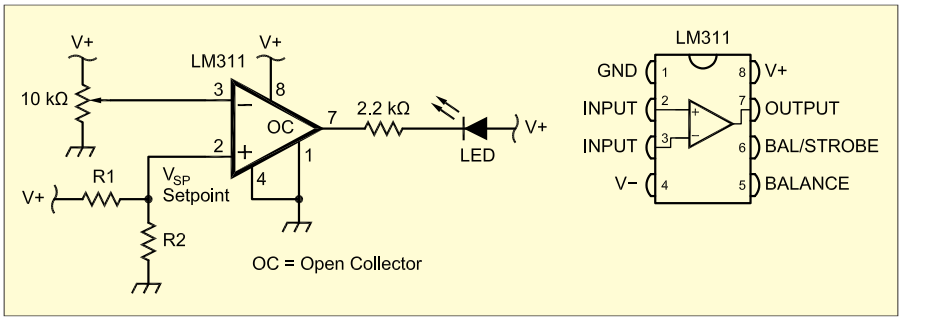


Figure 2—This voltage detector uses a resistive divider to create a fixed setpoint. Note that the input connections for the LM311 are reversed from those of the 741 op-amp.

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Hysteresis

Comparators are often used to drive relays. The audible noise of the relay contacts rapidly opening and closing as the comparator output switches states is called *chatter* and it is damaging to the relay and to the circuit it controls. Chatter is caused by noise on either the setpoint or the input voltage. As shown in Figure 3A, even small noise peaks can cause a temporary crossing of the threshold. When the input voltage is close to the threshold, the effect of the noise is multiplied by the comparator's high gain. The noise from the load current switching can also feed back into the inputs and cause extended oscillations.

Filtering the input signal (as we did in experiment #8) by adding a capacitor to the setpoint divider to reduce noise, can reduce chatter. A more reliable way is to use the comparator output to shift the threshold. It can be shifted a bit in the *opposite* direction of the input signal when the threshold voltage is crossed. This is illustrated in Figure 3B. By moving the threshold, chatter is eliminated.

This is accomplished by adding positive feedback from the output to the setpoint as shown in Figure 4. When the variable input voltage is less than the setpoint, V_{SP}, the output transistor is OFF and the voltage at the comparator's output is close to V+. As the variable input voltage increases past the setpoint, the output transistor turns ON, turning the LED ON. This circuit is called a *Schmitt Trigger*.

When the transistor is ON it places R3 in parallel with R2, lowering the setpoint voltage to V_{TL} and moving it away from the variable input voltage shown in Figure 3B. The reverse occurs when the threshold is crossed in the opposite direction so that the threshold is raised to V_{TH} as R3 is placed in parallel with R1. This shift in the setpoint depending on whether the input is increasing or decreasing is called *hysteresis*. The amount of hysteresis, $V_H = V_{TH} - V_{TL}$.

In designing a circuit to use hysteresis with specific values

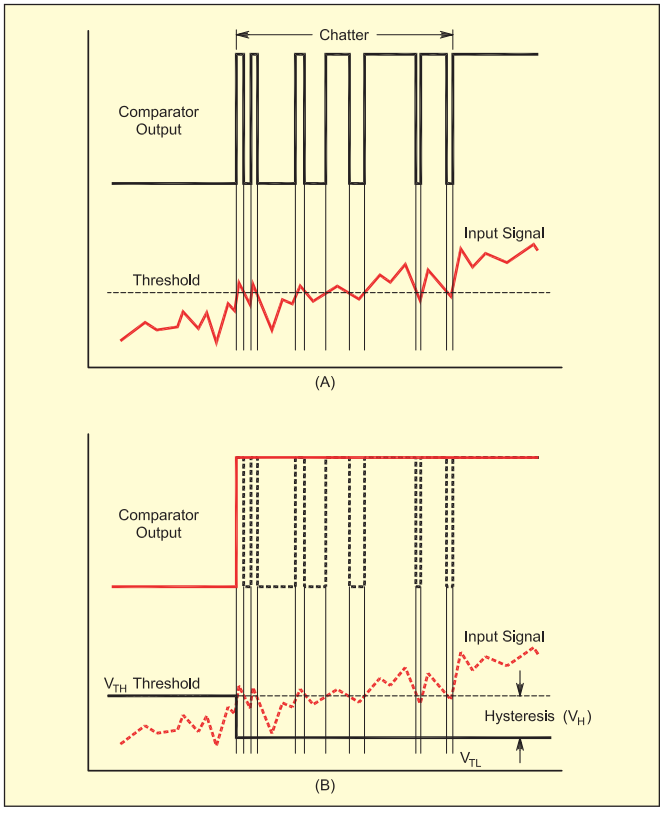


Figure 3—A shows chatter as the noisy input signal crosses and recrosses the comparator's switching threshold. B shows how moving the threshold after switching reduces chatter.

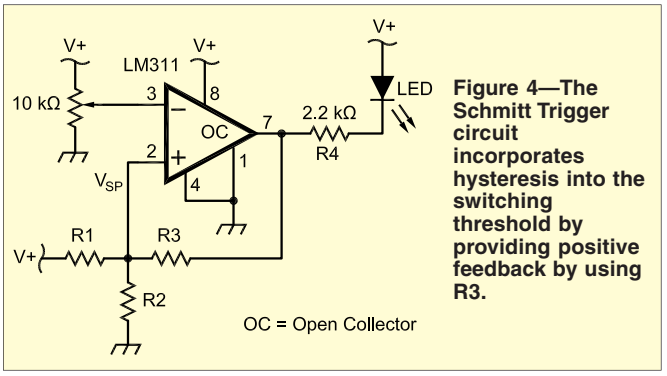


Figure 4—The Schmitt Trigger circuit incorporates hysteresis into the switching threshold by providing positive feedback by using R3.

for V_{TH} and V_{TL}, we can simplify the calculations considerably by making the following assumptions:

- V_{OL} (the comparator output with the output transistor ON) = 0
- R3 is much larger than the combination of R1 in parallel with R2
- R4 is much smaller than R3

You can calculate the amount of hysteresis by assuming that R3 only adds current to R2 or removes a little current from R2, depending on whether the comparator output is ON or OFF.

$$V_H \approx (V_{OH})\ (R1 \parallel R2)/[R3 + (R1 \parallel R2)] \quad \text{[Eq 1]}$$

Solving for R3 if the other values are known:

$$R3 \approx [(V_{OH})(R1 \parallel R2)/V_H] - (R1 \parallel R2) \quad \text{[Eq 2]}$$

Testing a Schmitt Trigger

Let's add 0.5 V of hysteresis to the voltage detector we just built, keeping the setpoint at 5 V, R1=28 kΩ, and R2=22 kΩ. Leave R4 at 2.2 kΩ, satisfying the assumption R4<<R3. I'll use V_{OH}=10.5 V, but you should use the value you measured earlier.

- Using Equation 2, R3 = [(10.5 V)(12 kΩ)/0.5 V]–12 kΩ = 240 kΩ. Use a 220 kΩ resistor. Remember to substitute your own value for V_{OH}.
- Monitor the variable input voltage as you slowly increase and decrease it through the 5 V setpoint. Record the point at which the LED turns ON and OFF. Subtract those two voltages to find the circuit's hysteresis voltage. For my circuit, I observed 400 mV (0.4 V) of hysteresis—pretty good for an approximate solution.
- Experiment with the circuit by increasing R3 to reduce hysteresis, and vice versa.

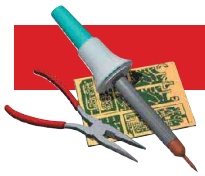
Suggested Reading

The Art of Electronics, by Horowitz and Hill, covers comparators in several sections, primarily 4.23 and 9.07. The National Semiconductor data sheet for the LM311 at **www.national.com/ds/LM/LM311.pdf** (and LP311 data sheet at **www.national.com/ds/LP/LP311.pdf**) includes numerous application hints and circuits.

Shopping List

- LM311 comparator (The LP311 comparator, RadioShack 900-6272, is available online only. An LM339, part number 276-1712, may be substituted using the pin connections at **www.national.com/ds/LM/LM339.pdf**. Note that V– and GND are connected together internally.)
- 2.2 kΩ, 22 kΩ, 27 kΩ, 220 kΩ 1/4 W resistors
- 10 kΩ potentiometer
- Red LED, RadioShack 276-026 or equivalent

Hands-On Radio Web site: **www.arrl.org/tis/info/html/hands-on-radio/**.



HINTS & KINKS

MORE ON AVIATION HEADSETS (JULY 2003)

◊ I received my July *QST* this afternoon and quickly noticed, with much interest, the "Hints and Kinks" article regarding the use of aviation headsets with Amateur Radio equipment.

I was appalled that W6JVE would mistreat his headset as he described and encourage others to do likewise! Many aircraft headsets can cost $1000, and even the less-expensive ones are priced at over $300.

The aviation industry has a standard and all of these expensive headsets are designed for a bias of 4 V at 15 mA of current! While headsets may not be perfect and are probably somewhat forgiving of improper use, why do so? Mr. Haynes is feeding his headset with approximately twice the normal bias. If that isn't enough, he suggests "Just use a 9 V battery" if nothing else is available. Wow! To operate properly with 9 V bias, R1 (see Figure 1) would be 333 Ω, 1/2 W.

I am a licensed pilot with commercial and instrument ratings. I've owned two airplanes and have 40 years experience. I'm also a licensed ham operator (K5ALQ, approaching 44 years), a licensed commercial technician (40+ years) and currently an FAA Navigational/Communications Technician (15+ years). I have been very active in the proper design, modification and application of aircraft microphones and headsets—as well as owning my own headset (which I would never plug into the circuit shown in July *QST*!).

A corrected circuit, shown in Figure 5, provides proper bias to an aviation headset, removes dc from the primary of the transformer, matches the impedance of the headset output and shows appropriate attenuation to provide the necessary match of level and impedance to an amateur transceiver. (I disagree with simply mismatching impedances as seems indicated by the "step-down" explanation in the article. It may yield a usable output level, but it must certainly ruin any chance of getting the desired audio response from the headset. This when it is so easy to attenuate the 30-40 dB of excess output and retain all the quality!) I think his circuit only gave the desired output because the mic was probably so saturated that it had little headroom to operate in the first place and probably had little frequency response as a secondary result. I hope that Jim hasn't ruined his headset.—*Ken Blevins, K5ALQ, 11983 Rivercrest Dr, Little Rock, AR 72212*

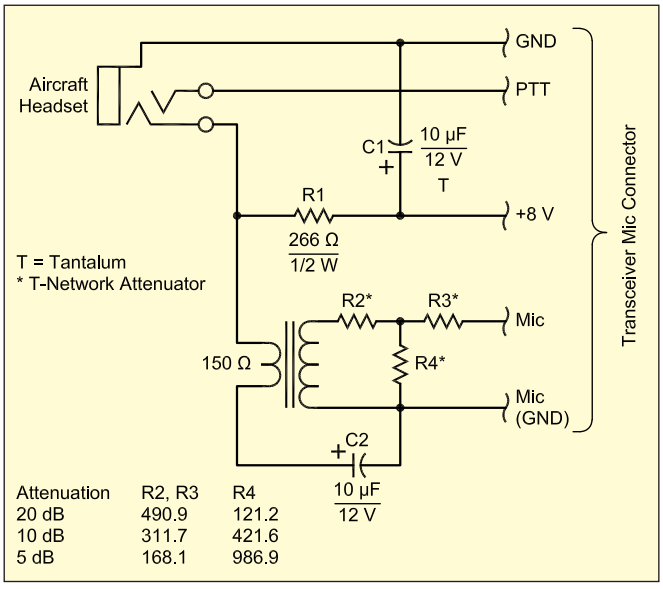


Figure 1—K5ALQ's aviation-headset interface circuit. C1 is "optional," but its use is "best practice." The headset requires a 150 Ω primary; the secondary must match the "load" of radio and use appropriate attenuation.

Example:

An amateur transceiver manual specifies the mic input impedance at 200-10 kΩ, 600 Ω nominal. The Digi-Key on-line catalog page 1098 (**dkc3.digikey.com/pdf/T033/1098.pdf**) shows a #237-1122ND with 600 Ω/150 Ω split primary and secondary windings. We can use the 150 Ω tap to match the headset and the 600 Ω secondary to match the radio. A Google search led me to a page with T-network attenuator values for 600 Ω systems (**www.mindspring.com/~crosstec/ctdes600.html**). For 20 dB of attenuation, R2 and R3 are 490.9 Ω each, and R4 is 121.1 Ω. Since these are not standardvalues, use resistors with close tolerances, handpick the resistors, combine parallel resistors to achieve these values or accept the attenuation yielded by standard-value resistors.—*Bob, KU7G*

MIC GAIN ON THE RADIOSHACK HTX-100

◊ A while back, I was discussing low mic-gain problems with my HTX-100 on the air and relating the fix I discovered. Several hams listening requested more information, with one sending me a letter on the subject. So, here is my fix.

It is only necessary to replace one resistor another value. If you can follow the tiny RadioShack schematic, you will find there is a 1 kΩ resistor connected from the mic input lead to ground. (The mic lead enters the main board schematic near the center of the right side.) I changed this resistor to 4.7 kΩ. It is convenient to do this by clipping the 1 kΩ resistor leads to remove it and soldering the new resistor across the mic element.

The new resistor can be any value from 1 kΩ to 5 kΩ,

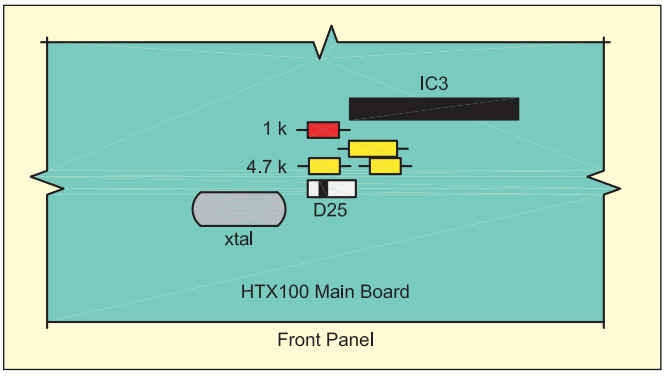


Figure 2—A partial PC board diagram of the HTX-100 showing the location of the 1 kΩ (brown-black-red) resistor to be removed. Only a few parts are shown to indicate the proper resistor. The actual board contains many more parts than shown here.

Bob Schetgen, KU7G ♦ Senior Assistant Technical Editor ♦ h&k@arrl.org

depending on how loudly you speak. I originally used a 5 kΩ pot.

The 1 kΩ resistor is on the board under the top cover, up and about 1/2 inch to the right of the crystal, "xtal" in Figure 2. Before the modification, RF power was about 4-5 W. Afterward, low power is 6 W and high power is 26 W, with no on-the-air distortion complaints.—*Jerry Turner, KØLSJ, 16298 Florida Way, Rosemount, MN 55068-1877*

ICOM IC-910H AMPLIFIER KEYING

◊ I recently retired my FT-736 and bought an IC-910H. This turned out to be somewhat of a challenge to say the least.

First, I found that there was no PTT jack on the rig, so I had no way to key my amplifiers for 2432 or 1296 MHz. (*QST* pointed this out in the Product Review a month after my purchase.) I figured that there is a way to do it by using a PTT voltage that switches from +3.8 to 0 V on the accessory jack, so I built the circuit in Figure 3 to use this feature.

Q1 and Q2 are small power-amplifier transistors from my junk box, but general-purpose switching transistors should work. Q1 needs moderate gain. It functions to conduct enough when the input from pin 3 on ACC(1) is high to stop Q2 from conducting (the relay contacts are normally open). When the pin 3 of ACC(1) goes low, Q1 stops conducting so the base of Q2 goes high and allows Q2 to activate the relay.

Q2 must handle the current required to reliably close the relay, and it should have a voltage rating consistent with the supply voltage. Choose the value of R1 as high as possible, while still allowing Q2 to cut off when the input to Q1 is high. A typical value might be 80 kΩ. Choose R2 so that the current through Q2 in conduction activates K1. A typical value might be 15 kΩ for a 50 mA relay.

I realize that it would be nice to state that Q1 and Q2 are certain specific parts. Yet, I think it is important to be able to build up something with the parts you have on hand and know how to figure out the value of the components to make it work.

The relay and D1 could be omitted and the collector of Q2 connected to the normal PTT terminals of outboard equipment, but then you would have no electrical isolation. R2 would then remain connected to the power source; in some cases, its current may be very high.

A second problem showed up when I tried driving the 1296 amplifier preamplifier combination via a sequencer. The antenna relays I use short the unused connection to increase isolation to the preamplifier. The IC-910H did not like this at all, because it was looking at a shorted coax and a reflected high SWR until the sequencer got around to opening the path to the antenna. The rig took a *long* time to decide that it was okay to start putting out power again.

The most obvious solution would be to key the sequencer with an external switch and have the sequencer, in turn, key the IC-910H when it was time. This would mean more wires and "stuff," so I gave up on that idea. The solution is to trick the IC-910 by using a stub in the line to reflect back and make it think it was not looking into a shorted coax. The stub, actually a cavity that was tuned, was inserted between the rig and input relay. This cavity was adjusted so the rig would not trip out and yet to provide reasonable impedance to the input of the amplifier once the switchover took place.—*Wally Lamb, WØPHD, 803 Second St N, Warren, MN 56762-1257;* **w0phd@arrl.net**

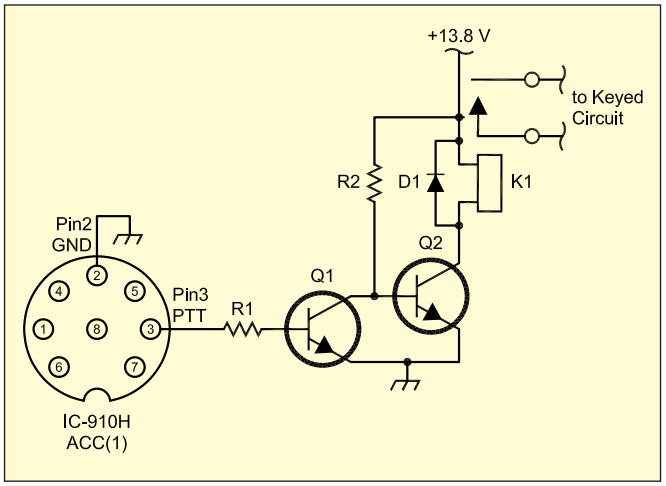


Figure 3—WØPHD's amplifier-keying circuit for the IC-910H. Component choices are explained in the text. The IC-910H ACC(1) socket pins are labeled as seen from the rear of a matching plug.

RESEAL CORROGATED BOXES EASILY

◊ Here's a great way to keep larger corrugated cardboard radio and electronic parts storage boxes neatly closed, yet easily opened when needed. Just staple two (non-sticky) hook and loop strips, about 2 1/2 inches long, to each side of one of the box's top flaps. Apply two-layers of packaging tape over the stapled part of the strips for extra strength. Next attach two self-stick 1 inch hook and loop mating strips (or glue the 1 inch mating non-stick variety) to the side of the box, so that the top hook and loop strip will mate with it when bent over. Leave a little open space at the bottom of the closure to grab onto, to facilitate disengaging the strip. Now do exactly the same thing to the other top flap and box sides.

The hook and loop strips keep the box tightly closed, yet it's easily opened when access is needed, without bending and wearing out the box flaps by over-and-under crossing them as is normally done with these boxes.—*Dave Miller, NZ9E, 1216 Terry Andrae Ave, Sheboygan, WI 53081;* **dmiller14@juno.com**

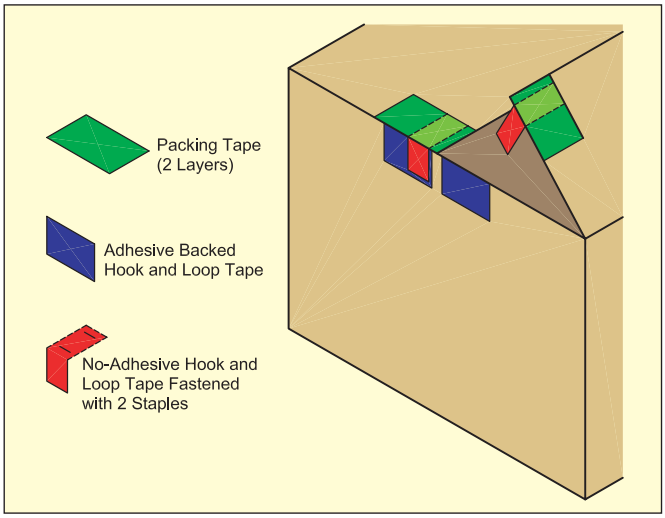


Figure 4—NZ9E's solution for resealing equipment boxes with hook and loop tape.

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. QST

Fluidmotion SteppIR SmallIR Vertical Antenna

Reviewed by Steve Ford, WB8IMY
QST *Editor*

I needed a stealthy, small-lot solution.

For years I've relied on tree-supported wire antennas for my HF and 6 meter work, but our trusty maple tree has seen better days. It has been shedding branches with alarming regularity and one recent collapse brought my latest wire concoction down with it.

A tower was out of the question, so I decided to look into a vertical antenna. There are *lots* of verticals to choose from, but I had some special requirements. The antenna would have to occupy a space that was almost surrounded by vegetation. Unfortunately, plants and antennas don't always get along well. Plants tend to modify the impedance of antennas in close quarters, thanks to their abundance of water and their annoying tendency to *grow*. My vertical antenna would have to offer remote tuning. I wasn't about to hack my way through a jungle every time the SWR changed.

Radial wires present another problem. Elevated radials were nonstarters because I couldn't have guests jumping through our yard like a military obstacle course (as amusing as that might be). Protruding spikes of various kinds were also *verboten*. The radial wires would have to be buried.

One by one my choices dwindled. Of the remaining contenders, there was one that particularly intrigued me: the Fluidmotion SteppIR SmallIR. This 1/4 wavelength end-fed vertical offered 20 to 6 meter operation in an antenna that was only 18 feet in height. I considered its big brother, the BigIR, that covers 40 through 6 meters, but a 32 foot antenna with guy wires was more than my circumstances allowed. Specifications for the SmallIR are shown in Table 1.

Figure 1—The aluminum mounting tube is anchored in concrete.

A Novel Approach

Fluidmotion SteppIR antennas remove all coils and capacitors from the antenna-tuning equation. Instead, their antennas *change element lengths* though the use of remote-controlled stepper motors. The motors use sprockets to extend or withdraw perforated copper strips inside fiberglass tubes. Your feed line is coupled directly to the strip. No coil or capacitor tuning networks are required—and no antenna tuner at the station.

What the Fluidmotion folks have created is the motorized equivalent of running outside with a pair of wire cutters whenever you need to trim your antenna for a 50 Ω match to your transceiver. But unlike you and your wire cutters, the SteppIR antenna can easily increase or decrease the length of the radiating element whenever you need to change frequency. It is one of those why-didn't-anyone-think-of-that-before ideas.

The antenna control box is installed at your station location, so you can press a single button to adjust the length of your antenna. The controller commands the stepper motor at the base of the antenna to raise or lower the copper strip as necessary. It doesn't get much more convenient than that.

Installation

SteppIR antennas are in high demand, which is why it took almost 8 weeks before my SmallIR arrived. As I opened the box, I was pleased to see that someone at Fluidmotion had the foresight to specify forest-green fiberglass tubing for the antenna. This would be a more spouse-pleasing color scheme than, let's say, fluorescent orange.

The fiberglass tubes fit one inside the other, "telescoping" from the widest diameter at the bottom to the narrowest tube at the top. You simply extend each segment until it is snug. Once the entire tube is deployed, you use a combination of self-vulcanizing tape and common black electrical tape to seal the segment joints against moisture. (Both spools of tape are thoughtfully included with the antenna.)

With the tube complete it was time to pick my target on the ground and start laying radials. The manual (it is actually a BigIR manual with an errata sheet for the SmallIR) offers an excellent discussion of radials, both buried and elevated. I couldn't bury several dozen radials, even though that would be best for optimum performance. My mounting location—not to mention my patience—could only accommodate about ten 12-foot wires buried in the soil.

After the radials were safely buried, I

Bottom Line

With the SmallIR, SteppIR extends their successful, remotely tuned antenna line into a range suitable for small lots and other restrictions.

Joel R. Hallas, W1ZR ♦ Assistant Technical Editor ♦ w1zr@arrl.org

Figure 2—The SmallIR motor housing. You'll notice the chokes I installed on the control cable and feed line to minimize common-mode currents.

Table 1
SmallIR Specifications

Weight	12 lb/5.44 kg
Maximum wind surface area	1.0 ft^2/.09 m^2
Unguyed wind survival	100 MPH
Element length	18 ft/5.49 m
Maximum power	2000 W PEP
Frequency coverage (MHz)	13.8–54.0
Tuning rate	1.17 MHz/second

considered how I was going to support the antenna. The SmallIR boasts 100-MPH wind survivability without guy wires. An aluminum mounting pole is included in the SmallIR package, and I suppose I could have simply driven it into the ground. I wanted something more robust, however, so I took the extra step of digging a small hole, inserting the mounting pole, carefully leveling and finally pouring concrete. The results are shown in Figure 1.

Twenty-four hours later I clamped the motor housing to the pole. The housing contains the stepper motor and associated circuitry as shown in Figure 2. It is ruggedly built, yet light. Jacks are provided for the coaxial cable and the control cable. A brass bolt serves as the attachment point for the radials.

I attached the control cable, feed line and radials. The fiberglass tube slid into the top of the motor housing and was held fast with a watertight clamp. At this point the copper strip is fully retracted inside the housing.

The finished SmallIR wasn't invisible, but it didn't look entirely out of place, either (Figure 3). Even my wife was surprised at its low visual profile.

Tuning

Fluidmotion ships its SteppIR antennas with specific band lengths preset in the microprocessor-based controller (Figure 4). The lengths are estimates based on antenna modeling.

It goes without saying that my installation departs significantly from most modeling scenarios. Some additional tuning and tweaking would be required. Starting at 20 meters, I moved up the bands, working the controller to adjust the antenna lengths to achieve the lowest SWR, and then saving the lengths in memory for each band. In addition to amateur band operation, this antenna can be effectively used on other frequencies within its operating range. This will be of particular interest to those with general coverage receivers who enjoy listening to international shortwave broadcasts, for example. In General Frequency mode, the band preset buttons can be programmed for your favorite non-ham frequencies.

I ran into problems on several bands, particularly 17 and 12 meters. Try as I might, I could not adjust the length for an SWR below 2:1. From the behavior I was seeing, I had a feeling that I had common-mode currents on the feed line, the control cable or both. The solution was a choke-balun on the coax at the antenna and a toroid choke on the control cable, also at the antenna. That did the trick. My rig and SWR meter behaved normally and I was able to adjust the SmallIR SWR to 1.5:1 or less on all bands.

Show Time

The SmallIR proved itself to be a good performer, despite my mediocre radial system. Reports on 20 through 6 meters were consistently good. If I could hear a station, I could work it. On a purely sub-

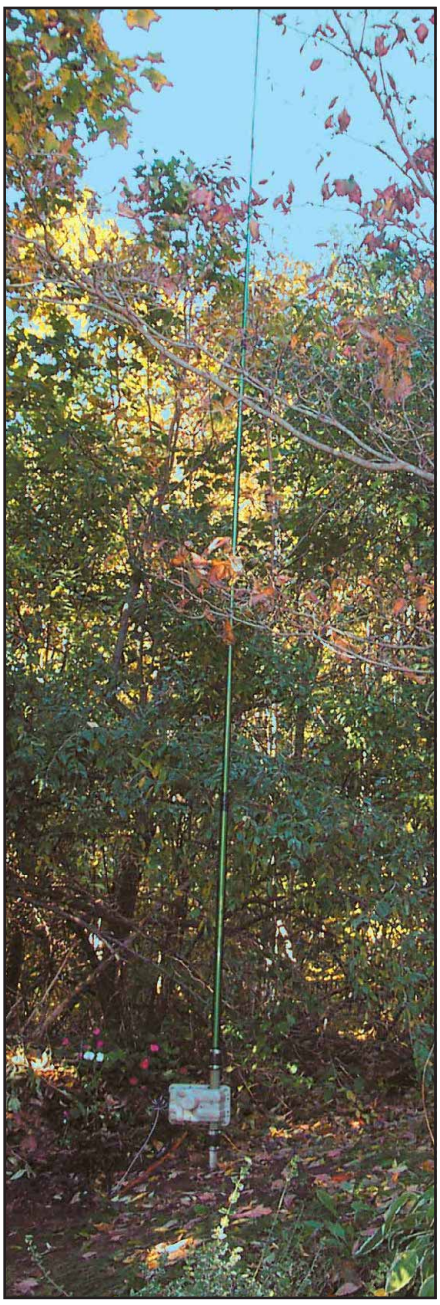


Figure 3—The SmallIR among the bushes.

Figure 4—The SteppIR controller is compact at only 6 inches in length. In this view, you see it sitting atop my station computer (the crinkled appearance of the display was caused by the fact that I hadn't yet removed the protective plastic film). All of the antenna tuning is accomplished here.

jective scale, the SmallIR seemed to be every bit as good as the wire antenna it replaced; possibly better.

The SmallIR offers a 3/4 Wave Mode in which the length will extend to 3/4 wavelength rather than the usual 1/4 wavelength for additional gain. I tried the 3/4 Wave Mode, but the resulting SWR was too high on every band except 6 meters. Fluidmotion has a reputation for excellent customer service, so I thought I would put it to the test. They responded to my e-mail inquiry within a couple of hours, telling me because of the shorter length of the SmallIR the 3/4 wavelength mode only works on 6 meters. This was omitted from the errata sheet, but they vowed to correct it (and have).

The SmallIR is outstanding in terms of convenience. When I change bands on the radio, I press the corresponding button on the SmallIR control box. Less than 30 seconds later, I'm good to go. If you want even more convenience, you can purchase the SmallIR with the transceiver-interface option (check with Fluidmotion to make sure your rig is compatible). With the interface in place, the antenna will change lengths automatically whenever you change bands at the transceiver.

Conclusion

If you need a vertical antenna that combines stealthiness, performance and convenience, the SmallIR deserves strong consideration. My only nit to pick is with the manual. Many of the photos are small and difficult to see. It would also help if the installation and setup descriptions were broken into discrete steps in separate paragraphs. The text makes use of long, unbroken paragraphs to discuss multiple steps. That made reading a bit confusing.

By the time you read this review, we'll be at the start of a New England winter. I'll be curious to see how the SmallIR withstands the ravages of wind, snow and ice. It is good to know that I can completely retract the copper strip into the base when the going gets rough. If the worst comes to pass, all I will lose is an easily replaceable fiberglass tube!

Manufacturer: SteppIR Antennas, 14135 233rd Pl SE, Issaquah, WA 98027; tel (toll free) 877-885-8700; **www.steppir.com**. $449. Transceiver interface: $59.95.

Heil Pro-Set Plus Headset with Boom Microphone

Reviewed by Joel Hallas, W1ZR
Assistant Technical Editor

Mark Wilson, K1RO, reviewed the Heil Sound BM-10 headset in the February 1992 issue of *QST* (pp 67-69) and the original Pro-Set model in the January 1992 issue (p 77). Mark found the Pro-Set an excellent performer, both for listening and talking. Both of those units are still available from Heil.

The original Pro-Set was available with either the Heil HC-4 "DX Dream Machine" element, designed with a strong mid-range for maximum DX or contest "punch," or with the HC-5 "full articulation" element, designed for everyday operating with a more balanced natural sound.

What's New with the "Plus"?

The Pro-Set Plus has *both* elements on the end of its microphone boom, as well as a switch to select between them. This allows a virtually instantaneous change in transmit audio characteristics, without having to change equipment or cabling.

The other operational change in the Plus is the ability to switch the phase of the earpieces between the usual (both ears in phase) and a new out of phase arrangement. Heil describes the usual connection as providing a signal centered between the ears. The out of phase connection is described as "spatially widened."

In addition to the operational changes, there are a few mechanical differences. Immediately obvious is the new self-adjusting cushioned headband. This is actually formed of two headbands: an outer spring band, which controls the inward pressure and an inner band, which allows the headset to adjust to rest on the top of the head. There are no actual adjustments required or available. The tension in both bands is intended to let you place the phones where you want them and they are supposed to stay there. As would be expected, the microphone enclosure is somewhat larger than that of the earlier model, and the boom itself has been made somewhat thicker.

The other mechanical change is more subtle. The boom adjustment mechanism has been changed from a single stud pivot to a wider rotating element. As before, the microphone can be adjusted to be on either the right or left side, or up out of the way for listening, operation on CW or with keyboard modes.

Bottom Line

Heil has added some useful features to a popular product. The Pro-Set Plus both "listens" and "talks" very well and now has additional flexibility in microphone response and headphone spatial distribution.

Hooking It Up

Like other Heil headsets, the unit is

equipped with a standard 1/4 inch stereo phone plug for the headphones and a miniature phone plug for the microphone. To match the mic plug to your radio, Heil offers an accessory adapter cable that can be ordered to fit most amateur products. Alternately, you could easily fabricate your own mic adapter, especially if you just wanted voice activated (VOX) operation. The Heil adapter cable includes an additional jack for a transmit/receive (TR) switch going to the radio's push-to-talk (PTT) line. Since boom microphones do not have a TR switch, the choices are to use VOX or to use an external switch.

Heil sells an accessory handheld PTT switch and a footswitch (step-to-talk?). The Pro-Set Plus is a natural for VOX, but to make the test a fair comparison to my current setup, I took advantage of the connection provided, and purchased the Heil FS-2 footswitch. (Besides, I always wondered if my feet were smart enough to use this kind of switch!) This switch is a new model as well, and provides two separate, time sequenced, contacts to allow switching a linear amplifier to transmit before switching the transceiver. I also purchased the AD-1-T4 adapter cable to interface with the mic connector to my old Ten-Tec Paragon HF transceiver.

ICOM IC-706 users please note that a special version, the Pro-Set Plus "ic," is available to match the special microphone level requirement of that radio.

How the "Plus" Plays

I was interested in testing this unit because I wanted to see how a boom microphone arrangement would help organize my station. I mostly operate CW, but like to be able to operate phone from time to time, and the desk microphone I had been using was taking up too much of my desktop. This was interfering with the operation of my keyboard, which I wanted to use more regularly for logging and other station tasks.

I was impressed with the construction and operation of this unit. Everything went together as advertised and, after a bit of the suggested "bending to fit," the headphones were quite comfortable. As Heil's literature suggested, I needed to advance the microphone gain a bit to modulate to my usual level, but the gain was still below halfway up on the control. So how did it all work?

The microphone provided solid audio. My "standard" shack microphone for this radio is the Ten-Tec 705 desk mic. This has won out over the other mics at W1ZR in many comparisons, based on naturalness of audio quality. I was prepared to have to give up something here, but reports from operators familiar with my "live" voice, using blind tests, couldn't tell much difference between the Heil using the HC-5 and my "reference standard" microphone. Some thought the Heil had an edge on sound quality. Tim, W1GIG, thought that the Ten-Tec was too bassey and that either of the Heils were an improvement. The HC-4 came out sounding as expected with less bass and more "punch," just as advertised. Tim was going to recommend the HC-4 to a friend with excessive bass in his voice.

W1NCY helping evaluate the Pro-Set Plus.

To complete the tests, I called in another test sample with different voice characteristics. I am fortunate (for many reasons) to have Nancy, my wife of 40 years, and now W1NCY, close at hand. Her results were similar, although Tim, who thought the Ten-Tec mic was too bassey for me, thought it gave Nancy some needed low-end presence.

The headphones were comfortable for long periods and had great sounding audio. The spatially widened position had an interesting and easy-to-get-used-to effect. The normal, in phase, position in comparison made me feel like the other station was in the middle of my head, while the out of phase position definitely placed the far end "outside" my head. I prefer the latter, but it's also nice to be able to switch easily to provide variety. The ear cushions came with an easily removable cloth cover that was more comfortable on hot days, or the inner, more typical, cushions could be used directly.

So what's the verdict? I like this headset a lot! It does provide excellent audio in both directions. It meets my original goal in that it really makes an improvement in desktop organization. The step-to-talk operation became a natural motion almost at once, making this arrangement feasible for me, not a fan of VOX. I also appreciate the flexibility provided by the mic and headphone options.

Heil customer service is worth mentioning here as well. As a test, I sent an e-mail to Heil Sound asking about headband adjustment on a Saturday afternoon. I received a reply sent around 1 AM on Sunday with all my answers from Bob Heil himself!

Just a Few Suggestions

One potential concern, is the headphone plug. As delivered, the plug is wired as a stereo plug with one earphone connected to the "tip" and one to the "ring" with common leads on the "sleeve" connection of the 1/4 inch stereo plug. This is fine if your radio provides an output to each channel. A stereo plug is a requirement for some radios and desirable with others, especially those with dual receivers. Older radios often have mono headphone jacks, and out of the box the Pro-Set Plus will provide sound only to one ear. With some stereo phones, it is a simple matter to open the plug and move the wire on the ring connection to the tip, in parallel with the other side. The Pro-Set Plus comes with a molded plug that can't be easily modified.

If you use an older radio, you can use a RadioShack stereo-to-mono plug adapter (RS part no. 274-348). Your other choices are to cut off the stereo plug and wire on a new mono plug, change the radio jack to a stereo type (both channels tied together) or make a second adapter cable (tending to negate the organized desktop theme). My Paragon had audio on both tip and ring so I didn't have the problem there, but I did with my older Drake 4C-twins. This would have been easier to resolve if the headphone plug had been the type with a screw-on cover so the connections could be moved within the existing plug.

The only other suggestion I have relates to the cable. My current headphones have a coiled cord that stays nicely on my desk. The Pro-Set Plus has a long (8 foot) uncoiled cord. This was great for moving around the shack while operating, but I always seemed to step on it and pull the phones off my head when standing up or get it wrapped around my chair wheels. I'm sure it's just a matter of getting used to it, or personal preference, but my preference is clearly for a coiled cord.

My thanks to KA1WYR, KA2OIG, ND1L, N1GUW, WT1I, W1GIG and W1NCY for their support and patience in this evaluation.

Heil Sound Ltd, 5800 North Illinois, Fairview Heights, IL 62208; tel 618-257-3000; **www.heilsound.com**. Price: $189; AD-1 microphone to radio adapter: $17; Pro-Set Plus ic (including adapter): $206; FS-2 footswitch: $38.

Going Once, Going Twice . . .

In order to present the most objective reviews, ARRL purchases equipment off the shelf from dealers. ARRL receives no remuneration from anyone involved with the sale or manufacture of items presented in the Product Review, Short Takes or New Products columns.—*Ed.*

The ARRL-purchased equipment listed below is for sale to the highest bidder. Prices quoted are the minimum acceptable bids, and are discounted from the purchase prices. All equipment is sold without warranty.

NCS 3240 Multiswitcher (see "Product Review," Jun 2003 *QST*). Minimum bid: $224.

Alinco DR-620T VHF/UHF FM transceiver (see "Product Review," Jul 2003 *QST*). Minimum bid: $272.

ICOM IC-703 HF transceiver with FL-52A CW filter (see "Product Review," Jul 2003 *QST*). Minimum bid: $688.

Yaesu VR-500 handheld receiver (see "Product Review," Sep 2003 *QST*). Minimum bid: $240.

ICOM IC-R10 handheld receiver (see "Product Review," Sep 2003 *QST*). Minimum bid: $240.

Yaesu VXA-700 2 meter handheld transceiver (see "Product Review," Sep 2003 *QST*). Minimum bid: $336.

MFJ-267 dummy load-wattmeter (see "Product Review," Oct 2003 *QST*). Minimum bid: $120.

Yaesu VX-2R dual-band handheld transceiver (see "Product Review," Oct 2003 *QST*). Minimum bid: $160.

ICOM IC-208H 2 band FM mobile transceiver (see "Product Review," Oct 2003 *QST*). Minimum bid: $264.

Alinco DR-235T 222 MHz FM transceiver (see "Product Review," Nov 2003 *QST*). Minimum bid: $200.

ADI AR-247 222 MHz FM transceiver (see "Product Review," Nov 2003 *QST*). Minimum bid: $168.

Kenwood TM-331A 222 MHz FM Transceiver (see "Product Review," Nov 2003 *QST*). Minimum bid: $400.

ICOM IC-703H HF/VHF transceiver with FL-52A CW filter (see "Product Review," Nov 2003 *QST*). Minimum bid: $744.

New Web-Based Solicitation

Future solicitations may be made on the ARRL members' Web page at **www.arrl.org/prauction** and will generally be opened for bidding upon posting of the product review, usually before the issue is delivered by mail. Links will often be provided directly from the posted product review. The above items will also be posted there with additional information on the available units.

Sealed bids must be submitted by mail or e-mail (**prbids@arrl.org**) and must be postmarked or received on or before January 1, 2004. Bids postmarked after the closing date will not be considered. Bids will be opened seven days after the closing postmark date. In case of equal high bids, the high bid bearing the earliest postmark will be declared the successful bidder.

In your bid, clearly identify the item you are bidding on, using the manufacturer's name and model number, or other identification number, if specified. Each item requires a separate bid and envelope. Shipping charges will be paid by ARRL. Please include a daytime telephone number and e-mail address. The successful bidder will be advised by telephone or by mail. Once the successful bidder has been notified, confirmation of intent to purchase the item must be made within two weeks. No response within this period will be interpreted as an indication of the winning bidder's refusal to complete the transaction. The next highest bidder will then have the option of purchasing the item. No other notifications will be made, and no other information will be given to anyone other than the successful bidders regarding the final price or the identity of the successful bidder. If you include a self-addressed, stamped postcard with your bid and you are not the high bidder on that item, we will return the postcard to you when the unit has been shipped to the successful bidder.

Please send mailed bids to Bob Boucher, Product Review Bids, ARRL, 225 Main St, Newington, CT 06111-1494.

NEW PRODUCTS

2003 "CHRISTMAS KEY" FROM MORSE EXPRESS

◊ Morse Express has released its 2003 Christmas Key, a gold-plated miniature brass telegraph key that can also be used as a tree ornament. This key is fully operational and is hand machined from solid brass before being plated. Its base dimensions are $2^3/_8 \times 1^1/_8$ inches and it weighs 5 ounces. All usual adjustments are provided and the knob is of hand turned olive wood. This key will be available in a limited edition of 200 and each will have its serial number engraved on the base. The price is $59.95 direct from Morse Express; **www.MorseX.com** or tel 800-238-8205.

20 MHz ARBITRARY WAVEFORM GENERATOR

◊ Agilent Technologies has introduced a 20 MHz function/arbitrary waveform and pulse generator. The model 33220A laboratory type generator includes the capability to generate pulses with variable edges and pulse width modulation (PWM).

This generator uses direct digital synthesis (DDS) techniques to create output signals, including 14 bit, 64k-point arbitrary waveforms. An optional external time-base reference provides a 10 MHz clock signal to synchronize multiple units together for multi-channel applications. access to basic functions and simplified access to arbitrary waveforms for faster test results. The generator provide universal serial bus (USB), Ethernet and general purpose interface bus (GPIB) interfaces as standard features. The Agilent 33220A function/arbitrary waveform generator is priced at $1850, the Opt-00 external time base reference is $450. Additional information is available at **www.agilent.com/find/33220A**; tel 800-452-4844, ext 7784.

ARRL Rebuts "Broadband Nirvana," While Broadcasters Join Anti-BPL Chorus

The ARRL this fall strongly objected to FCC Commissioner Kathleen Q. Abernathy's suggestion that Broadband over Power Line (BPL) technology will contribute to what she described as "broadband Nirvana." Addressing the United Powerline Council's annual conference September 22 in Arlington, Virginia, Abernathy expressed unabashed enthusiasm for BPL and recommended a combination of regulatory restraint and the elimination or substantial modification of existing rules as steps along the "path to Enlightenment," as she put it. In a terse response faxed September 25 on behalf of the League's 155,000 members, ARRL Chief Executive Officer David Sumner, K1ZZ, asserted that Abernathy overlooked some significant issues in her Nirvana analogy.

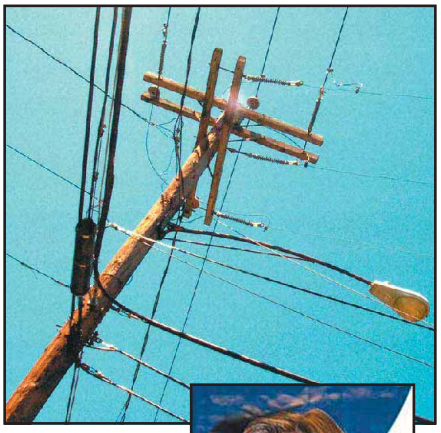
"Nightmare is more like it," Sumner declared. "The technical showings submitted by the ARRL and others in response to the Commission's *Notice of Inquiry* (*NOI*) in ET Docket No. 03-104 clearly establish that BPL is a significant source of radio spectrum pollution. It cannot be implemented without causing harmful interference to over-the-air radio services."

Sumner told Abernathy that while BPL industry groups, such as the one she addressed, prefer to deny the evidence, the FCC is obliged to work to a higher standard.

Abernathy's speech, "Reaching Broadband Nirvana," never broached the topic of BPL's potential to interfere with other radio services. Sumner reminded Abernathy that the radio spectrum is a precious natural resource.

"To squander that resource simply to add a redundant, unnecessary, and relatively poorly performing 'last mile' connection for consumers, is unconscionable," he said. Sumner requested that Abernathy give the League an early opportunity to explain its BPL concerns to her in person. The text of her prepared remarks is available on the FCC Web site.

Elsewhere, a subcommittee of an International Telecommunication Union (ITU) panel of technical experts responsible for terrestrial broadcasting issues has joined a growing chorus of concern about the interference potential of power line telecommunication (PLT)—better known in the US as BPL. ITU Radiocommunication Sector (ITU-R) Sub Working Group (SWG) 6E1 expressed the view that interference produced by systems employing PLT as well as by Industrial, Scientific and Medical (ISM) equipment and short-range devices, would compromise broadcast reception.



BPL would use low and medium-voltage power lines like these to distribute broadband services on frequencies between 2 and 80 MHz.

FCC

FCC Commissioner Kathleen Q. Abernathy.

"SWG 6E1 is of the opinion that any increase in the amount of noise due to these systems is unacceptable," said a statement from the group's chairman to the chairman of Working Party 6E (WP 6E). "In particular, broadcast services should be protected from unwanted emissions from PLT systems," the panel asserted, "as these emissions are a byproduct of a system that is not itself a user of the radio spectrum." The panel recommended the formation of a group representing all users of the radio spectrum "to coordinate development of limits to be imposed on the radiation from these systems."

Sumner expressed strong support and appreciation for the SWG's conclusions and the ongoing efforts of parent Working Party 6E to study the issue. "If BPL is a problem for broadcasters," Sumner said, "it's easy to see that it would be a disaster for us."

Broadcasters themselves also have exhibited increased concern about the potential of PLT/BPL to prevent their signals from reaching listeners. The Research and Development branch of the British Broadcasting Corporation (BBC) has released a White Paper reporting on a brief trial in Scotland of two competing PLT/BPL systems. Tests were conducted at four locations, and both systems interfered with HF reception.

BBC engineers described the interference as varying between "annoying" and "a level sufficient to make the broadcast completely unintelligible." Before commercially licensing PLT, the report advised, regulators need to undertake further study of other PLT systems and, among other issues, look into possible ways to make the PLT systems compatible with radio reception.

To date, more than 5000 comments—many from the Amateur Radio community—have been filed in response to the FCC's BPL *NOI*. They are available for viewing via the FCC's Electronic Comment Filing System (ECFS), **www.fcc.gov/cgb/ecfs/**.

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/**.

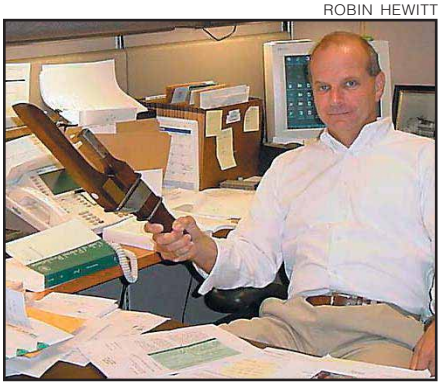
AMATEUR RADIO ENFORCEMENT "THE RILEY WAY" MARKS FIVE YEARS

Close to 1000 Amateur Radio enforcement cases have crossed his desk since Riley Hollingsworth was tapped five years ago to resurrect the FCC's Amateur Radio enforcement efforts. That doesn't include countless ham radio "situations" he's resolved through informal counseling on the telephone or through an exchange of e-mails. When he took the job in the fall of 1998, Hollingsworth—whose official title is Special Counsel for Enforcement—called it "a new day for Amateur Radio" after years of amateur enforcement neglect on the Commission's part. As he sees things today, rules compliance and on-air behavior have improved since the new sheriff rode into town, but there's still lots to do.

"I'm fairly satisfied with the progress

Rick Lindquist, N1RL ♦ Senior News Editor ♦ n1rl@arrl.org

ROBIN HEWITT



Wielding the Wouff Hong: **Riley Hollingsworth in his Gettysburg, Pennsylvania, office.**

Media Hits

■ A *Washington Post* story about ham radio's response in Maryland during Hurricane Isabel touted the importance of Amature Radio communications during all types of emergencies. The article quoted a communications officer with the Maryland Emergency Management Agency as saying, "When everything else fails, Amateur Radio capabilities are always available and they always get through." Local hams interviewed were Vic Curtis, WA3YUV, Gregory Jones, K3GJ, and Greg Dominguez, N3MPR. The report also mentioned the Year 2 federal grant to ARRL for emergency communications training.

■ Simulated Emergency Test (SET) activities in Baxter County, Arkansas, garnered some ink in the *Baxter Bulletin*. Al Hundley, K5ABH, of Baxter County ARES provided the paper with a press release on the SET, which simulated a statewide ice storm. ARES/RACES Emergency Coordinator Jim Godfrey, K5JFG, reports that the paper used Hundley's contribution nearly in full. Along with information on the SET, Hundley detailed how hams help during disasters and provided several recent examples of emergency service work.

■ In Worcester, Massachusetts, ham radio got a mention in a *Telegram & Gazette* article for its role during a mock bombing exercise sponsored by the Department of Homeland Security. Local ARES members were paired with emergency management and other agency officials to monitor radio communications and practice providing the sorts of communications that would be essential in the wake of a terrorist attack.

that we've made in five years," Hollingsworth said in modest acknowledgment of the milestone, "but I think we need at least five more years of this type—of this level—of enforcement, because the bands have quite a long way to go. It's no time to rest."

Five years ago, Hollingsworth began with a "top 10" list of alleged high-profile Amateur Radio offenders. By and large, he's slowly—and most would say successfully—worked his way to the point that many of today's cases appear comparatively mundane. But they get the same level of attention.

"The biggest problem we have now, I think, stems from conduct-type problems—lack of courtesy, taking serious offense and reacting to what is perceived as deliberate interference," Hollingsworth said this week. "Ninety percent of the interference that's reported to me is not deliberate." As he regards all enforcement cases, the remaining 10 percent are "serious."

"I think a lot of the 'radio rage' has subsided, but I wish that people would be a little more aware of just how valuable Amateur Radio is and how they sound on the air," said Hollingsworth. That's a message he's repeated often on the hamfest circuit.

"Maintenance mode" is a goal he'd like to see enforcement achieve. Hollingsworth explained that's when the number of enforcement cases is perceived to be in balance with the number of licensees. "I don't think we're there yet in the Amateur Service, but I think that we can get there," he said. Hollingsworth credits the amateur community's desire for strong, even stern, enforcement for his program's success.

"Probably 99 percent of the reason it's worked is everybody wants it," he said. "In this service they plead for enforcement. In every other service, they don't want to see you coming." This attitude, he believes, stems from a sincere desire by licensees to keep Amateur Radio a self-policing service. He counts keeping the support of the amateur community among his major accomplishments.

Looking out on the Amateur Radio enforcement horizon, Hollingsworth said he'll "keep pedaling" and chipping away at the enforcement workload. He'll also continue to look to the assistance and cooperation of his fellow radio amateurs, whom he called "just good people."

Amateurs "have got to stick together and cooperate and stay away from the infighting because they've got some very serious external threats," Hollingsworth said, citing BPL as just one example. "To the extent that they're not rowing together, it makes those threats more dangerous."

Hollingsworth said a realization of the value of Amateur Radio itself is a deter-

ARRL Recognizes Special Donors

ARRL's Development Office held its second donor recognition event of the year September 15 at the Kellogg Conference Center of Gallaudet University in Washington, DC. ARRL President Jim Haynie, W5JBP, CEO David Sumner, K1ZZ, and host Robert Weinstock, W3RQ, were among those on hand to greet donors and the guest of honor, US Rep Mike Ross, WD5DVR, of Arkansas. Ross is one of two Amateur Radio licensees serving in Congress (the other is Rep Greg Walden, WB7OCE, of Oregon).

In his remarks, Ross talked about the importance of Amateur Radio while he was growing up in Prescott, Arkansas, where, he said, he learned two things: How to ride a unicycle and how to be a radio amateur. Among the 680,000 voters Ross represents are many hams, whom he encounters as he tours his district.

Ross also discussed his commitment to education, based on his parents' careers as teachers, a message that resonated with attendees, some of whom are contributors to the ARRL Education and Technology Program ("The Big Project") that funds Amateur Radio in some 50 schools across the US.

Ross expressed his dedication to advocating on Amateur Radio's behalf and to working with ARRL to expand Amateur Radio's reach and voice in "Official Washington."

BROOKS BLUNCK, W3BCW

ARRL Chief Development Officer Mary Hobart, K1MMH, presents donor recognition reception host Robert Weinstock, W3RQ, with an ARRL Amateur Radio and Technology Program—"The Big Project"—T-shirt.

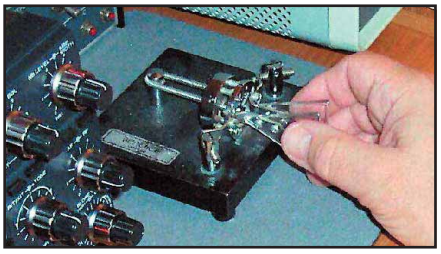
FCC News

FCC INVITES INPUT ON ADDITIONAL MORSE CODE-RELATED PETITIONS

The FCC sounded the bell October 8 to begin Round 2 of the Morse code debate by inviting public comment on another group of seven Morse-related petitions for rulemaking. Comments were due by November 7.

- Charles L. Young Jr, AG4YO, asked the FCC to delete the 5 WPM Morse code test (Element 1) for Technician-plus-Element 1 privileges (formerly "Tech Plus"). Designated RM-10805, his petition would retain Element 1 as an examination requirement for General and Amateur Extra applicants and give Technicians limited HF SSB privileges.
- Describing CW as "the purest, most accurate, efficient, reliable and economical form of radio communications ever devised," Frank Napurano, K2OKA, requests that the FCC retain the 5 WPM Morse requirement "in the interest of public safety, the preservation of a radio art and as a tribute of support for a prized and respected avocation." The FCC designated his filing as RM-10806.
- A petition by Robert G. Rightsell, AE4FA and Harry A. M. Kholer, NØPU, designated RM-10807, would continue Morse testing but give applicants up to 24 points of exam credit according to their success on Element 1. The final exam score would be the sum of earned Element 1 points and the written test score for a possible total of 100 points. Their petition also calls on the FCC to consolidate the Novice and Technician and the Advanced and Amateur Extra licenses, boost the number and range of written test questions and give new Technicians CW and data privileges.
- Joseph Speroni, AHØA, seeks to have the FCC delete Element 1 for applicants who want to operate phone on HF but retain Element 1 at 5 WPM for applicants who want to operate CW. Designated RM-10808, his petition would restructure the Amateur Radio testing regime so applicants would only have to pass mode-specific examination elements for modes they wish to operate.
- The Puerto Rico Amateur Radio League (PRARL) asks the FCC to delete Element 1 for Technician and General classes but to increase the rigor of the written elements for those two license classes. The petition, designated RM-10809, would keep the 5 WPM Morse exam for Extra applicants and eliminate same-session retesting, requiring 30 days between retakes.
- James Roux, W4YA, proposed in his petition, designated RM-10810, that the FCC cut the number of license classes to two—General and Amateur Extra—and the number of written examination elements to one—at the General level. Roux's petition would eliminate the 5 WPM Morse code exam for General but require Extra applicants to pass a 15 WPM test. Roux also would give Generals all currently available amateur privileges except the Extra class CW subbands.
- A petition filed on behalf of FISTS CW Club would delete the requirement to pass Element 1 to obtain Technician-plus-Element 1 (ie, "Tech Plus") HF privileges. Designated RM-10811, it would merge Tech and Tech Plus into a single class, emphasize technical content, including digital modes, on written examinations and extend digital mode privileges within Novice/Tech Plus subbands. It provided no additional HF phone privileges for Technicians, however. FISTS would retain a 5 WPM Morse exam for General applicants and raise the Morse exam to 12 WPM for Amateur Extra applicants while increasing the technical level on written examinations for both classes.

JEAN COLLIER, N1MJC



The FCC recorded a total of nearly 2300 comments during the first round of Morse-related petitions—RM-10781 through RM-10787. The tenor of many comments reflected the emotional nature of the issue within the ham radio community. As of press time a total of 1060 comments already had been filed on the second round, more than 400 of them on the FISTS Petition.

"The CW issue, as expected, is a very gut-wrenching issue for many hams," observed ARRL Great Lakes Director Jim Weaver, K8JE. "Sometimes we mortals let issues to which we have emotional ties rent to potential rule breakers, but he said Amateur Radio enforcement is "permanently ensconced" at the FCC.

While he's had some very interesting assignments and enjoyed nearly every day of his tenure with the FCC, he says the past five years have been the highlight of his 30 year FCC career.

"My greatest satisfaction is thinking that I may have paid back a debt," said Hollingsworth, who's been licensed since age 13. "It's the most rewarding thing I've ever done with the Commission."

W1ZR JOINS ARRL STAFF

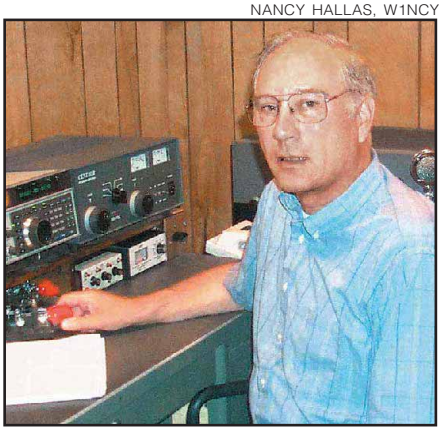
Joel Hallas, W1ZR, has joined the ARRL staff as an assistant technical editor. Hallas' primary responsibility is to oversee the process of reviewing new Amateur Radio equipment and to edit the "Product Review" column in *QST*. Hallas, 61, also serves as managing editor for *NCJ* (**www.ncjweb.com**) and as a member of the team that reviews technical articles submitted for *QST* publication. He began work at ARRL Headquarters in August.

"It's really important to keep *QST* readers informed about the current array of equipment available, to let them know what's out there and provide meaningful information to help them in the selection process," he says.

Hallas spent his early years in Garden City, New York, where he was first introduced to Amateur Radio at age 11. It all began after he traded his favorite cap pistol for a friend's crystal set. "I could hear a neighbor, Bob Griffith, W2ZUC, a couple blocks away coming through on 20 meter AM," Hallas recalled. "I went and saw his station, and then built a little one-tube regenerative receiver." He got his Novice ticket in 1954.

A US Army veteran (he once operated as DL5HC while stationed in Germany in the mid-1960s), Hallas holds degrees in electrical engineering. He enjoys CW, collecting and operating vintage ham gear, PSK31 and marine mobile while onboard his sailboat. He and his wife Nancy, W1NCY, live in Westport, Connecticut.

NANCY HALLAS, W1NCY



Joel Hallas, W1ZR

get out of perspective."

The ARRL has not commented on any of the 14 Morse code-related petitions. ARRL Chief Executive Officer David Sumner, K1ZZ, explained that there's no particular urgency to the issue and ample reason for the League to devote its attention to issues having more immediacy such as BPL.

Sumner predicted it would be "months, if not longer" before the FCC acts on any of the petitions. In the meantime, he said, "there is plenty of time for the ARRL to receive considered input from its members and either to formulate a reasoned proposal for change or a rationale for maintaining the status quo."

World Radiocommunication Conference 2003 (WRC-03) left it up to individual countries to decide whether or not they want a Morse requirement for HF privileges. In the wake of WRC-03, the ARRL Executive Committee has been working on its own comprehensive Amateur Radio licensing proposal, of which consideration of the Morse requirement would be a part. Once completed, the proposal will go to the ARRL Board of Directors for consideration at its January 2004 meeting.

"There is simply no urgency to address it any sooner than that," Sumner said.

ARRL members are encouraged to comment via their directors (see p 15 of any recent issue of *QST*).

To view comments on any petition, visit the FCC's Electronic Comment Filing System (ECFS), **www.fcc.gov/cgb/ecfs/**, click on "Search for Filed Comments" under "ECFS Main Links" and type in the complete RM number, including the hyphen, in the "Proceeding" field. "RM" must be in capital letters.

Amateur Enforcement

♦ **Amateur to yield ticket in police radio interference case:** The FCC says an Indiana amateur has agreed to relinquish his Amateur Radio operator license for two years as a result of allegations that he interfered with local police department radio transmissions. FCC Special Counsel Riley Hollingsworth outlined the terms of the agreement in a September 23 letter to Technician licensee Justin L. Whaley, KC9DCP, of Columbia City. According to the letter, the FCC notified Whaley last March that close-proximity direction finding evidence indicated that the licensee had interfered with the operation of the Columbia City Police Department radio system early this year.

During the voluntary suspension, Hollingsworth said, Whaley would not maintain an amateur station nor use anyone else's station. As of press time, Whaley had not yet signed the agreement.

The FCC meanwhile is seeking additional information from three other licensees who allegedly used ham gear to transmit on police or emergency frequencies.

Hollingsworth wrote General class licensee Tom L. Christman, KB2NAV, of Albany, New York, on September 22 regarding a complaint from the Albany County Sheriff's Department's Office of Professional Standards. The FCC asked Christman, a sheriff's department maintenance worker, to respond to allegations that he used his ham radio transceiver to make transmissions on sheriff's department frequencies last December "without a legitimate purpose." The sheriff's department has requested that the FCC suspend or revoke Christman's amateur license.

Hollingsworth also wrote two North Carolina Technician class amateurs—Daniel E. Buchanan, KF4LNE, of Montreat, and Joseph S. "Shannon" Hutchins, KG4SXD, of Swannanoa—concerning complaints from the Black Mountain Police Department alleging that both had transmitted on police frequencies last February. The transmissions apparently were made using a handheld transceiver while Buchanan and Hutchins were in the same vehicle.

Documents from the Asheville/Buncombe County District Attorney's Office assert that the Black Mountain police channel had experienced "numerous transmissions" earlier this year on a police frequency (156.01 MHz) "including verbal profanity and racial slurs." A police officer who questioned Buchanan and Hutchins said they admitted transmitting on police frequencies. They later voluntarily signed statements to that effect in which each blamed the other for making the racial slur.

The District Attorney's Office statement said that one transmission last February 8, while police were attempting to respond to an auto accident involving multiple injuries, "prevented officers from communication with dispatch or each other."

In Brief

• **New ARRL Section Manager named in Idaho:** Idaho got a new Section Manager September 23. ARRL Field and Educational Services Manager Rosalie White, K1STO, has appointed Doug Rich, W7DVR, of Boise to take over from John Cline, K7BDS, who stepped down "with regret" to pursue an advanced degree and begin a new job within the Idaho Bureau of Disaster Services (the "BDS" in his call sign suffix). An Amateur Extra class licensee, Rich will complete Cline's term, which runs through next September. Cline called Rich "highly respected with the ham radio community in southern Idaho." Rich serves as the Chief Radio Amateur Civil Emergency Service (RACES) Communications Officer for the State of Idaho. He's served two terms as president of the Voice of Idaho Amateur Radio Club.

• **Vote on *QST* Cover Plaque Award:** The winner of the *QST* Cover Plaque Award for September was H. Ward Silver, NØAX, for his article "Amplifier Care and Maintenance." Congratulations, Ward! The winner of the *QST* Cover Plaque award—given to the author—or authors—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**. Cast a ballot for your favorite article!

• **Rohn files for bankruptcy:** Rohn Industries filed a voluntary petition for Chapter 11 bankruptcy September 16 in the US Bankruptcy Court for the Southern District of Indiana. A well-known manufacturer of Amateur Radio towers and tower hardware, the company—in business since 1948—also serves the telecommunications industry. Rohn Industries President Horace Ward said the company will continue to do business as usual and is in discussions with a third party regarding a sale of assets. Last January Rohn consolidated its fabrication facilities into a single plant in Frankfort, Indiana. NASDAQ delisted Rohn Industries in July after Rohn was unable to meet its minimum bid price requirement.

ICS and Amateur Radio Communication Teams

By David W. Thorne, K6SOJ
ARRL Sacramento Valley Section
Emergency Coordinator

The Incident Command System, or simply "ICS," is the child of FIRESCOPE, which was developed nearly 25 years ago as a system for managing large-scale wildland fires involving multiple agencies and resources. While the implementation of the ICS may vary slightly from state to state (and occasionally between agencies within the same state), it is a standardized system of management. It is a structure to navigate within, and yet it allows for a degree of flexibility within individual agencies. ICS is advocated by the Federal Emergency Management Agency (FEMA), other federal agencies and an ever-growing list of public and private state and local agencies.

ICS is based upon the fact that one leader for every team of four to six members is the ideal ratio. More information about ICS is available at **training.fema.gov/EMIWeb/IS/is195.asp**, and at **www.nysemo.state.ny.us/TRAINING/default.htm**.

At the EMCOMMWEST 2002 Convention (see June 2002 *QST*), during the ICS training workshop a question was raised as to how Amateur Radio emergency communication (EMCOMM) teams might be better activated and utilized during major incidents and how could it be brought into compliance with the ICS structure.

Two schools of thought exist. The first is that it has been common for a served agency to activate an emergency and auxiliary communications team to provide EMCOMM service for (and at the direction of) the requesting agency. The notion of having separate amateur EMCOMM units, operational at the same location, is redundant and results in poor utilization of the often-limited Amateur Radio resource. If I may digress momentarily, just imagine how it would appear if each agency were to order, and have standing by, its "own" medical unit!

The second school of thought is, that during incidents involving multiple agencies, an EMCOMM team, whether at an emergency operations center (EOC), an emergency communications center (ECC), a field command post or staging area, a fire camp, or a Red Cross evacuation center, should exist and be available to serve whatever agency involved that may need a message delivered by Amateur Radio.

In either example, the amateur EMCOMM unit serves as a sub-unit in the logistics section under the communications unit leader. Of course for the second option to be effective, all EMCOMM operators not only need to be skilled in the technical aspects of field communications and tactical and formal message handling, but also they should be somewhat familiar with the individual needs of the agencies involved. They must also be experienced in operating as a team within the larger (ICS) structure. This underscores the importance of training, cross training and having the members of your team preregistered with as many of your local agencies as possible.

ICS uses a standardized terminology and four-character *mnemonics* to identify and order resources. Large incident "Overhead" or Incident Management Teams are called "Type 1" and may include up to 100 management personnel. Type 2 and or Type 3 Overhead Teams are smaller. The ICS OPERATIONS section does likewise. In wildland fires, a strike team engine is a STEN. A strike team consists of four or five engines, each with a crew of two or three firefighters. A typical task force is composed of four or five engines (STEN), two to three hand crews, a water tender, a bulldozer with operator (DOZ1) and other components.

Examples for LOGISTICS are: an Emergency Medical Technician Type I is EMT1, a Biologist is a BIOL and a Photographer is a FOTO. Heretofore, there has not been a mnemonic for Amateur Radio EMCOMM. After EMCOMMWEST 2002, a committee was formed to develop a mnemonic and a system to expedite ordering of Amateur Radio Communication Teams. ARCT was chosen as the mnemonic for Amateur Radio Communications Team.

The ARCT guide has been reviewed by radio officers and EMCOMM managers in several states. It is applicable to all Amateur Radio EMCOMM units. In some states, the term "auxiliary" is preferred over "amateur," since their volunteer EMCOMM resource plan has been expanded to include non-Amateur Radio communications, but often utilizing Amateur Radio operators in these services. (For example, ACS—Auxiliary Communications Service—is an expansion of RACES that includes public service radio and other electronic communications systems.)

Whether it is ARES, RACES or ACS, ARCT will make it less complicated for ICS managers to "order" amateur (or auxiliary) EMCOMM services. ICS personnel may not be familiar with all that is involved to establish a field EMCOMM station. ("Field operations" includes indoor locations.) It will take some time and some educational effort by ARES and other EMCOMM leaders to help ICS personnel become familiar with the ARCTs nomenclature.

Emergency Coordinators, DECs, SECs and other EMCOMM Managers must establish and maintain a working relationship with their local and state government officials as well as managers in nongovernment agencies (American Red Cross, for example). ICS purchasing personnel are historically budget minded (and rightly so). They may be hesitant to "order" an ARCT. It is the job of amateur EMCOMM leaders to inform them (in advance, if at all possible) that Federal law prohibits any payment or other compensation for Amateur Radio communications. Our services are free! While there is no cost to government or other organizations for our communications service, in certain instances, when a radio amateur is working under the direction of an agency, reimbursement for mileage, meals and other incidental expenses is acceptable. Worker's Compensation and/or liability insurance may be provided by a "served agency." This is at the option of the local or state agency or private organization served.

The ARCT guide is designed to be applicable to ARES, RACES, ACS, and/or other bona fide EMCOMM units. Think of it as a menu. ICS/Logistics officials may order one (or more) complete EMCOMM teams. For example, "We need one ARCT Type 1 by 0800 tomorrow at the county fairgrounds. Report to the communications chief at the CP" (Command post). Or, "We need one ARCT Type 2 and two ARCT Type 4 ASAP. Have them report to the fire camp at Jefferson High School."

When a request is received by an EC, DEC, SEC, RACES Officer, etc, it is important that they do not promise anything unless they know for sure that they can

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"deliver the goods" by the time specified. If the time frame is unrealistic, let the person placing the order know. If you, as an EC, need to check on the availability of mutual assistance personnel and equipment before you commit, tell the person when you will get back to them by a certain time. Do so in a timely manner, and *never* leave them wondering what happened! If you can only fill a part of the requested resource, let them know, and ask if that will suffice until you can activate mutual assistance.

The guide itself is just that...a guide. It is intended to allow for some flexibility. For example: A "Type 1" ARCT calls for a staff of 12 operators including 2 supervisors (one day shift/one night shift). The remaining 10 members might be split into 5 day shift/5 night shift. Or, 7 on day/3 on night, etc at the discretion of the team leader(s).

Suppose an incident needs a Type 1 ARCT, but only two mobile units. By ordering "one ARCT Type 2" and "two ARCTs Type 4," he/she has ordered only what they need. Later, more resources can be ordered, or some can be demobilized. The ARCT's planning officer should be looking ahead 12 to 24 hours, and making staffing recommendations to the ARCT leader, who will then advise the ICS communications chief.

An ARCT may be a pre-existing team. But in the real world of ICS, teams in all services are usually assembled from rosters of qualified and registered personnel when a request for activation is received or anticipated. EMCOMM leaders should notify and begin to place members on STANDBY ALERT, and get an ARCT ready to roll!

No specific lists or recommendation are made here as to specific equipment or supplies. Experienced EMCOMM managers know what will be required. Depending upon the type and location of an incident, the communication equipment and other gear your team will need will vary widely. Obviously, a deployment to a well-equipped ECC will require less than a "Field Day" type operation in a wilderness setting. Incident command personnel are not necessarily interested as to how an ARCT fulfills its requested mission. The bottom line is: "Can your team deliver third party messages on behalf of multiple agencies, tactical and formal, accurately, efficiently, and in a timely manner?" Remember that one leader with a team of four to six members is the ideal ratio. This ICS principle is recommended for the ARCT.

A Type 1 ARCT will have: a supervisor and an assistant supervisor; an ARCT operations officer (assigns and deploys operators); a logistics officer (responsible for the ARCT supplies and equipment such as generators, batteries, transportation); a Plans and Training Officer, and a Records and Reports Officer. All of these double as EMCOMM operators as needed. The remaining team members are, of course, skilled radio operators. "Apprentice" (trainee) operators are appropriate with permission and the proper clearance from the IC. Minors must also have a signed consent from a parent or legal guardian.

The time to implement this addition to the ICS protocol is now. ECs, DECs, SECs and other Amateur Radio leaders can begin by incorporating and using the ARCT designators in their local plans. Talk it up within your own team and promote it to your local agency and government emergency management officials.

[To be continued next month.]

Field Organization Reports

Compiled by Linda Mullally, KB1HSV

Public Service Honor Roll
September 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.

555 W2MTA W7TVA
500 N2LTC
490 AB2IZ KC4YGB
460 K7UGT WA2YL
440 N9TVT
425 K4RLD
420 W3YVQ
372 K5SFM
371 KB2RTZ
345 KA2ZNZ
338 W5ZX
322 N4TAB
305 N2YJZ
284 KA4YEB
267 KB3GFC
265 KØIBS
261 WB4UHC
250 KB2KOJ
248 K4DND
247 NN2H
240 KB2CCD KB8ZYY
237 W5OMG
231 KE3FL
225 KV4AN
222 KK3F
220 KB2SNP W2LC K9JPS
216 KB2ETO
210 AA3SB
209 WA1QAA
204 N5IKN
203 KA2GJV
195 K3SS
190 WB2UVB
189 KAØDBK K2ABX
180 KD1LE
172 KA9HRO
170 WA9ZTY AG4DL KG4OTL
168 KB5ILY
165 WI2G
160 VE3EUI
159 N2IK
155 N2JBA KD4EFM
151 N2ECR
150 N1LKJ W3BBQ
147 N7TOD
145 AA8SN AC5XK
144 KA2BCE
143 N2YIR
142 N2RTF NN7H
140 WB5ZED
139 N1IST N3WAV
138 W5PY KG4ZXK
137 N2GJ
136 N2LJD AF4MU
135 N3ZOC
134 N2OPJ
132 AC5VN
W4CAC
130 KA5KLU
127 KG4TVP
125 KD4GR KA9RZL AG9G KBØDTI
120 W4EAT K4IWW KW1U W1GMF KC2GXV N2JRS W6QZ AB4XK KA4FZI K9LGU K3JL WX4J W8YS WBØTAQ W5XX K5DPG N5OUJ
118 K4FQU
117 N3RB W4ZJY
116 W4AUN
115 W3CB WA9JWL
114 KJ9J
110 KEØXQ N2HQL K2UL N3SW W3ZQN KC5OZT K5UPN NJ5M WX4H W7QM N7YSS W7GB WA1JVV K5MC K8AE
N8FPN K4BEH AF4NS W5GKH K4WWV
108 N8NMA
107 W9BHL
106 W5ARS
105 NR2F
103 WD4LSS W2GUT KB9KEG W5IM
100 N8IO N8OD WA8SSI N1IQI AF2K KC2EOT WB2QIX N5BSD KB5TCH K4SCL WA4EIC WA9VND W9CBE KK5GY W8IM N9MN N7EIE W7LG W7ZIW W7GHT WØHXB AD5IS W1ALE K5IQZ K5ER ABØWR KC2GOW KB2KLH K3CN KA4UIV
99 W7TC AA4BN
97 KE4UOF
95 WA2YBM K7GXZ
94 KG4CHW W4NTI
93 KJ7SI
90 N1JX W2CC KC8UTL W4LN N1TPU KC2IYC WA2CUW WB2IJH N3KB WD9FLJ KF4WIJ KO4OL WD8DHC KA8WNO KF6OIF N3WK N3OR AA3GV W4DLZ WB8RCR W4CKS W4WXA K4FUM W9NXC K4BG WB4GGS WB2GTG NM4R WA4MIY K9PUI WB6UZX
89 W4FAL WA2GUP WB2LEZ N3YTD KA4LRM
88 AB2LF NF5B N8ZJU KE2SX
86 N8DD KG4OQA K4KAM W2DSX K9PUI
84 W1PLW K8CQF
N2AKZ
83 WB4PAM
82 KG4FXG
81 W4DGH
80 W2MTO AA2SV N2ULY KD5YMW KG4MLC WD9F W7DPW K3IN W5NK K8KHZ K8KV K8VFZ WAØLYK WB4BIK
79 KC9BHJ
77 KG4MLD WB7VYH KJ5YY
76 N5KWB K1FP
75 K2PB N8FXH KC6NBI
74 KC2JBZ
73 W2QOB NØZIZ
72 KCØHOX K8SH
71 KC6SKK KD5ITA K4WKT
70 AL7N N2VQA KA2YKN WA5OUV N4VVX

The following stations qualified for PSHR in previous months, but were not recognized in this column: (August) KB9KEG 180, NQ4U 116, W2GUT 109, WØHXB 100, K4WWV 100, N2IK 99, NØUJ 74. (July) WA9ZTY 170.

Section Traffic Manager Reports
September 2003

The following ARRL Section Traffic Managers reported: AK, AL, AR, DE, EB, EMA, ENY, EPA, EWA, GA, ID, IL, IN, KS, KY, LA, MI, MO, MS, NC, NH, NLI, NNJ, NNY, NTX, NV, ORG, SB, SC, SDG, SFL, SJV, SNJ, STX, TN, VA, VT, WCF, WI, WNY, WPA, WV, WWA, WY.

Section Emergency Coordinator Reports
September 2003

The following ARRL Section Emergency Coordinators reported: AK, AR, AZ, EWA, GA, IL, KS, KY, LA, MDC, MN, MO, NC, NFL, NLI, NNJ, NV, SFL, SJV, SNJ, SV, TN, WMA, WNY, WPA, WTX.

Brass Pounders League
September 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	41	3240	3168	72	6521
W1GMF	0	909	2465	40	3414
W4ZJY	0	1289	1347	0	2636
W4EAT	0	1103	1083	2	2188
KA5KLU	9	935	1223	27	2187
WB5ZED	58	1150	861	19	2088
N2LTC	0	750	754	48	1552
K7BDU	31	686	660	6	1383
N1IQI	520	275	533	0	1328
K9JPS	0	627	32	610	1267
KW1U	0	540	553	12	1105
WX4H	0	441	491	4	936
N1LKJ	3	313	271	95	682
W6DOB	0	284	351	20	675
AK6DC	0	290	245	48	583
W7TVA	53	237	190	100	580
KF4WIJ	6	266	271	8	551
K5UPN	22	246	238	6	512
ABØWR	9	354	147	2	512
W7QM	46	217	243	6	512
KA4FZI	0	278	220	3	501

BPL for 100 or more originations plus deliveries: W9IHW 174, NJ5M 171, K9GU 144, and KK5GY 102.

Records Galore: Tropo in September

Last month we tried to bid farewell to the summer season of 2003. But the marvelous propagation had one more surprise for us. By September 5, a large, slow moving system associated with high pressure centered in the Northern Plains had moved off the Massachusetts coast and in the next day or two reformed as a stalled front extending from southern Texas across northern Florida. At the same time Fabian, a Category 3 hurricane, came out of the Caribbean and curved northward striking Bermuda before moving out to sea after September 7. These are classic situations that often lead to tropospheric ducting. In this case the hurricane was some distance (>1000 km) off the US East Coast and the compression of the high-pressure system as it moved east was not as great as one might have wished. The main duct was clearly southwest to northeast, however, and clearly strong enough to produce long-distance enhancement.

I have previously mentioned the tropospheric ducting forecast maps generated by William Hepburn as an excellent source of potential tropo openings. The maps for the major days, September 6 and 7 (Figures 1 and 2) delineate the strength and extent of the opening quite well. Notice particularly how the extent of the opening initially favors stations in northern New York and along the Louisiana-Texas border, then extends westward into central Texas and eastward into New England. South of Pennsylvania was not favored, although stations as far south as K4QI in FM06 did force their way in with weak signals.

How good was it? Let's hear from the normally tropo-starved Northeast. Jeff, K1TEO, calls it "…the best tropo opening I've ever heard in my 30+ years on the air." Dick, W1ZC says, "I did not work the quantity of stations that others to my south and southwest worked, but it was still about as thrilling as it can ever get for the VHF operator." Finally K1WHS (at the eastern end of the duct) comments "…my best-ever tropo distance covered since I got on 2 meters in 1962 with my trusty 6360 rig with war surplus 'green' RG-59 coax and eight-element beam."

2 Meters

The extent of these contacts can be seen in Figure 3. The opening reached from K5VH (EM00xe) and NL7CO (EM04uo) to the west; W8MIL and K2YAZ (EN74) in the northern Midwest; K1WHS (FN43mj) to the northeast and K5MA (FN41qo) to the east; a line between K4QI (FM06jb) through northern Mississippi to Texas with K5BST (EL18qj) to the south. The festivities began on September 5 with the first penetration into Texas. W3UUM (EL29) was into the central Midwest—EM47, 55, 59 and 67. K5VH (EM00xe) reached K2AXX (FN12cs). K5QE (EM31) worked numerous stations in the Midwest and reached as far as K4QI (FM06) and K2PQI (FM09). By September 6, the opening was in full force. Some of the major players appear to be VE3DSS (FN03fq), VE3AX (FN02cw) and K2AXX (FN12cs) to the east and K5QE (EM31), K5UR (EM35), K5SW (EM25), W5LUA (EM13), N5TIF and KA5DWI (EM12) and K5VH (EM00) and NL7CO (EM04) to the west. To the east, the opening extended south to FM19 (K1RZ, W3EME) and K4QI (FM06). Particularly on the sixth and seventh, stations in New Jersey and throughout New England were much in evidence. These included K1JT and K2SMN (FN20), WZ1V (FN31mp), K1TEO (FN31jh), K5MA and N1DZ (FN41), K1CMF (FN42bq), W1ZC (FN42dr) and K1WHS (FN43mj), who was farthest northeast on the edge of the duct. While signals were rarely loud, it was not necessary to run high power to be successful. NØJK operating mobile with 10 W from EM18of worked K5MA (FN41qo) at 2259 km and W3EKT (FM19) worked W5FKN in Dallas with 100 W.

As of this writing and not yet confirmed by Al Ward, W5LUA (keeper of the North American distance records), the following appear the longest: K1WHS (FN43mq) to W5FKN (EM13ef) 2576

This Month

Dec 14	Good EME conditions*
Dec 14	Geminids meteor shower peaks at 1000 UTC
Dec 28	Good EME conditions*

*Moon Data from W5LUU

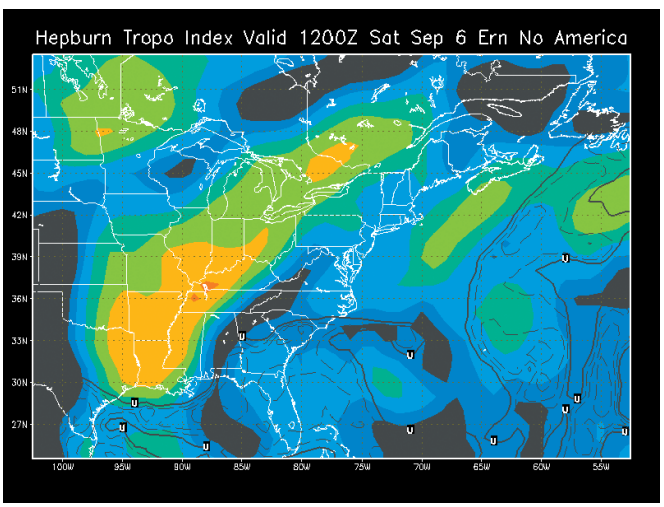

Figure 1—The Hepburn tropospheric ducting forecast map of September 6 (www.iprimus.ca/~hepburnw/tropo.html). Legend: yellow/green = good; yellow = strong; dark yellow = very strong. Reproduced with permission.

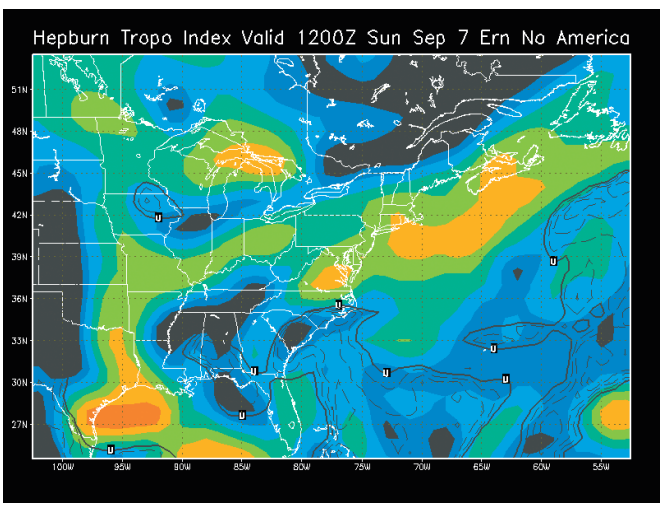

Figure 2—The Hepburn tropospheric ducting forecast map of September 7 (www.iprimus.ca/~hepburnw/tropo.html). Legend: yellow/green = good; yellow = strong; dark yellow = very strong. Reproduced with permission.

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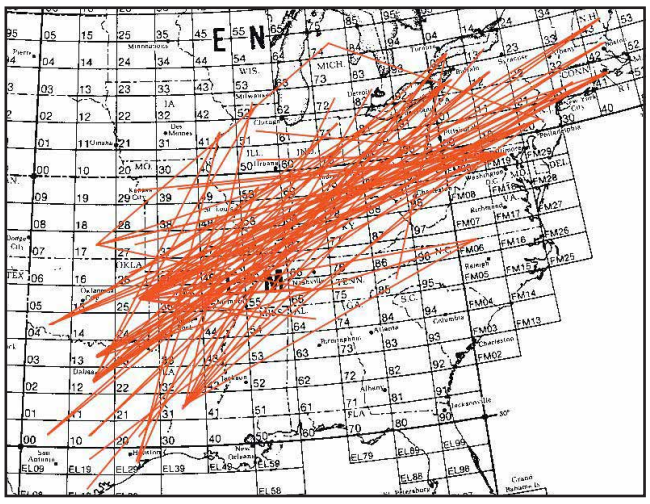


Figure 3—Map of the tropospheric opening of September 5-8. Contact paths are in red.

Figure 4—WW8M working KE8I on 24 GHz.

km, to KA5DWI (EM12ju) 2567 km and to W5MB (EM12ke) 2540 km; K5MA (FN41qo) to W5FR (EM12kx) 2524 km and W5LUA (EM13qc) 2477 km; and W1ZC (FN42dr) to NL7CO (EM04uo) 2470 km. Also notable was the longest Canadian contact VE3ESS (FN03fq) to K5BST (EL18qj) at 2282 km.

222 MHz and Above

In spite of the record-breaking distances covered and its reasonably long duration, this opening was notable for how poorly the bands above 222 MHz fared. Except for certain times and places in New England, northern New York, Texas and Oklahoma, signals were surprisingly weak. For instance, I worked about two-dozen contacts during this time from FM19; two meter signals were weak and 222 MHz signals were really weak. My three attempts to work W5 and WØ on 70 cm yielded no sign of signals on either side. 222 MHz produced many long-distance contacts, and a complete rewrite of the distance records including K1TEO to WB5AFY (EM04uo) 2421 km, the new Tropo C record; K5VH to K2AXX, 2279 km; W5LUA to K1TEO, 2259 km; and K5LLL (EM10kf) to K2AXX 2213 km. Numerous contacts were reported from the east into Texas/Oklahoma from K4QI, W4RX, W3ZZ, K2AXX, K1TEO, WZ1V and VE3AX. Western/southwestern stations included K5UR (EM35), WØEKZ (EM17), K5SW, W5LUA, K5LLL and K5VH. Curiously, K1WHS could not work past the near Midwest on 222 MHz.

Pickins were much slimmer on 70 cm and above. Stations in the southwest and the east both worked into the Midwest, but long-distance contacts were much rarer. The most successful appeared to be K5UR (EM35) and W1ZC (FN42dr) 2005 km and WZ1V 1875 km; W5LUA (EM13qc) and K2AXX 1966 km; K1TEO and WØRT (EM27ih) 1950 km; K1RZ and WØGR (EM38ax) 1446 km; and K5QE (EM31cj) and K4QI (FM06jb) 1445 km. On 33 cm, K8TQK (EM89je) worked W5LUA to the west at 1500 km, and K1WHS to the east at 1113 km. W5LUA notes that he worked WW8M (EN72xf) at 1500 km and KMØT (EN13vc) at 1110 km on 23 cm; K4TO (EM77wx) at 1255 km and K8TQK at 1381 km on 13 cm; and K4TO on 9 cm.

Summary

This certainly was one of the premier tropo events dating back many years. In terms of the area covered, I can remember only a few similar events, most particularly the Thanksgiving opening in 1986, which completely "skipped" over me but included much of the East Coast extending well to the southwest, and the fabled tropo opening during the September 1979 VHF QSO Party. The former was the result of a stagnant high pressure accompanied by above normal temperatures and the latter was the result of a high pressure system trying to squeeze between the remnants of Hurricane David over the Maritime Provinces and Hurricane Frederick south of Florida. To my way of thinking, there were two odd circumstances surrounding the present opening. Signals were not very strong, even though some low power and even QRP stations worked long distances. More unusual for an opening covering an area in excess of 2500 km, the cutoff frequency was surprisingly low. The duct solidly encompassed 144 and 222 MHz but excluded many areas on 70 cm and above. From the posts on the Internet 144 MHz Propagation Reflector and the NEWS Reflector, we know the geographical limits quite well. Stations at the edge of the opening were working NN5DX (DM80) and W5III (DM91), but they were outside the envelope. KMØT (EN13) appeared to be able to work into Texas but not far eastward. K1WHS heard no stations north and east of him reaching the duct and the opening was quite spotty for him.

As for volume among those who sent me more or less complete logs, K5SW reports 26 states on 2 meters and 10 states on 222 MHz. K5QE had 44 grids on 2 meters. K4QI had 34 grids on 2 meters. K1RZ had 28 grids on 2 meters, and W5LUA had 18 grids on 2 meters, 14 grids on 222 MHz and 10 grids on 432 MHz. All in all, it was an exciting few days—and we still have all of October and November ahead of us before the cold weather probably chokes off more tropospheric fun.

ON THE BANDS

After having enough information to fill six pages for the last three months, following the tropo opening this month was much quieter. September marks a transition away from the summer E skip season and the higher possibilities of tropospheric ducting. The equinoctial period is also often accompanied by increased auroral activity and with the appearance of transequatorial (TE) propagation. With the sunspot cycle now well on its way down, it is unlikely that we will encounter much, if any, F2 ionospheric propagation as we proceed into autumn. As we have seen, we have already encountered some outstanding tropo. Let's see what else there was.

6 Meters

The month started with an ordinary but strong single-hop opening on September first and second. Jim, KG4QWC (FM18), noticed that the skip appeared first to the northeast (FN42, FN75) and then moved south to Florida, Louisiana and Texas. Jon, NØJK, worked a number of W2s and W3s, and he reports that KØETC (EM27) worked VP9GE in Bermuda. Contacts were made from the Midwest as far westward as DN70 in Colorado. On September 8, K5IX (EL29) pulled out YN9HAU via E_S and CX4CR via TE. NH7RO reports the first TE of the season with Brazil, but the TE season so far has been very slow. Most activity has been between the Caribbean and Central America to Brazil. A few Florida stations have made it (like

50 MHz Standings

Published 50 MHz standings include call-area leaders as of October 1. For a complete listing, check the Standings Boxes on the World Above 50 MHz ARRLWeb pages at **www.arrl.org/qst/worldabove/**. To ensure that the Standings Boxes reflect current activity, submit reports at least every two years by e-mail to **standings@arrl.org**. Printed forms are available by sending a request with SASE to Standings, ARRL, 225 Main St, Newington, CT 06111.

Call Sign	QTH	States	DXCC	Grids	Best DX (km)†
K1TOL	ME	50	165	1145	—
W1JJ	RI	50	164	—	15,594
K1SIX	NH	50	162	1000	14,982
K1SG	MA	50	144	77	14,521
W3EP/1	CT	50	143	1003	15,750
W1JR	NH	50	143	650	14,455
K1GUN	ME	50	136	—	—
K1MS	MA	50	135	—	14,498
AA6TT/1	VT	50	132	681	14,589
K1GPJ	ME	50	131	800	14,595
KA1A	NH	50	131	—	14,533
K2ZD	NJ	50	153	—	15,502
K2MUB	NY	50	147	—	—
WA2BPE	NY	50	141	—	15,390
K2AXX	NY	50	126	800	14,444
W2MPK	NY	50	115	—	—
K2OVS	NY	50	110	441	13,124
K2YOF	NJ	50	105	406	14,807
K1JT	NJ	50	89	549	14,150
WB2AMU	NY	48	63	300	13,000
KB2YVC	NY	48	59	370	12,300
W3JO	PA	50	156	—	14,929
W3VZ	MD	50	148	700	14,038
W3BO	PA	50	145	733	12,840
K1HTV	MD	50	144	801	15,285
W3NZL	MD	50	140	—	15,835
W3ZZ	MD	50	132	822	15,769
W3TC	PA	50	130	681	14,945
AE3T	PA	50	129	—	15,538
N3DB	MD	50	121	700	15,083
W3OR	DE	50	119	965	14,996
N3II	MD	50	119	651	15,876
W4DR	VA	50	144	979	16,056
K4MM	FL	50	144	—	16,326
N4MM	VA	50	135	806	—
WA4LOX	FL	50	131	—	15,664
W4UM	FL	50	128	—	—
K6EID/4	GA	50	125	877	14,564
WA4NJP*	GA	50	122	985	13,171
W4TJ	VA	50	120	712	15,688
KE4WBO	FL	47	118	—	10,700
W4MW	NC	50	115	—	—
W4SO	FL	50	114	—	—
AC4TO	FL	50	113	650	14,760
NW5E	FL	50	112	554	13,376
K4RX	FL	—	110	—	—
K5CM	OK	50	160	—	—
W5OZI	TX	50	152	1029	15,141
W5EU	TX	50	150	—	16,278
N5KW	OK	50	146	—	—
WD5K	TX	50	140	1067	14,927
K5UR	AR	50	134	1013	—
K5AM	NM	50	134	842	17,861
K5SW	OK	50	130	—	10,500
WA5IYX	TX	50	123	384	14,592
AA5XE	TX	50	115	677	15,142
WA5JCI	TX	50	113	757	—
WB5HJV	TX	50	111	—	15,100
K6QXY*	CA	50	128	—	15,555
N6CA	CA	50	122	—	18,445
WA6PEV*	CA	50	116	—	18,246
W6BYA	CA	50	114	771	16,708
W6CPL	CA	50	104	—	18,422
KH6/K6MIO	HI	50	100	470	19,360
N6RZ	CA	50	82	—	14,778
KB6NAN	CA	50	81	665	16,638
NH7RO	HI	36	76	357	16,810
W6TOD	CA	50	72	—	—
W7RV	AZ	50	132	987	18,227
AA7A	AX	50	110	—	—
WA7JTM	AZ	50	106	—	18,138
W7KNT	MT	50	92	700	14,075
W7GJ*	MT	50	81	—	7534
W7MEM	ID	50	74	612	16,106
N7DB	OR	50	62	512	13,400
K8MFO	OH	50	149	—	—
WB8XX	OH	50	112	700	15,224
N8KOL	OH	50	107	624	13,163
W9VHF	OH	50	106	—	13,766
W8UV	OH	50	103	165	14,378
W8PAT	OH	50	101	440	13,495
WB8TGY	MI	50	91	472	13,939
W8TN	WV	50	89	447	12,436
K4OM	WV	50	71	—	15,355
K8ROX	OH	50	66	476	11,138
WA8JOC	OH	50	65	329	12,142
W9RPM	WI	50	111	467	14,092
K9LCR	IL	50	108	550	15,872
W9JUV	IL	50	102	362	15,865
W9VA	IL	50	90	400	13,964
N9NJY	IL	50	86	472	14,582
VE3CDP/W9	IL	50	83	—	13,897
W9GM	WI	50	53	363	10,200
WA9PWP	WI	50	45	384	10,400
K9MU	WI	50	43	370	10,447
KØFF	MO	50	120	740	16,246
NØLL	KS	50	118	774	14,901
KØAZ	MO	50	116	648	14,416
KMØA	MO	50	115	860	16,190
KØSQ	MN	50	114	349	16,106
WAØKBZ	MO	50	90	605	16,354
WØJRP	MO	50	88	607	14,310
WØBV	MN	50	85	—	15,168
KØCS	CO	50	84	530	17,204
NØVSB	CO	50	81	548	17,211
KØCJ	MN	50	78	—	15,500
Canada					
VE1YX		50	167	1082	—
VE3KKL	ON	50	114	618	15,302
VE3DSS	ON	50	106	120	15,230
VE3LBZ		50	96	—	—
VE3AX		50	93	—	—
VE2PEP	PQ	50	92	655	11,574
VE3KZ	ON	50	62	483	15,200
VE3TMG	ON	50	61	500	15,454
International					
SV1DH		29	225	892	16,600
EH7KW		44	214	1009	19,910
ON4ANT		46	212	1152	16,802
IKØFTA		37	212	1009	18,263
IK2GSO		37	211	1034	18,861
GØJHC		43	202	1040	15,951
SM7FJE		43	198	1063	15,912
IØWTD		30	195	775	18,262
SM7AED		42	191	997	15,931
F5LNU		40	188	863	19,183
SV1EN		—	181	552	16,558
PA4PA		36	180	906	16,292
IZ1EPM		—	171	621	18,813
9A1Z		—	168	—	—
GW4VEQ		48	165	916	15,498
PY5CC		48	161	569	18,257
SM7SCJ		31	159	550	15,780
G8BCG		23	150	654	14,670
F5DE		36	149	658	15,789

†Terrestrial
*Includes EME contacts
—Not given

K4RX in EM70), but there has been no TE/E_s links further north.

Tropospheric ducting

Sam, K5SW, noticed good tropo two days before the big opening of September 5-8. On September 3, he worked well into the Midwest including W8MIL in EN74 and eastward to VE3AX in FN02. "What happened with Hurricane Isabel?" you ask. Not much beyond some enhanced coastal tropo. Ray, WA4OMM (EM93), reports that he and Bill, W4OXA, worked K1WHS. Rick, AK3E (FM19), worked down into Georgia (EM84, 83 and 81) on the 25th. According to the Internet 144 MHz Propagation Reflector, there was tropo worked on five other days: September 17, 18, 20, 21 and 23. K4QI worked westward to EM39 and EM65 on the 17th, and farther north to K2DRH (EN41) on the 18th. Stations in EM63, 64 and 65 worked northward as far as W8MIL (EN72) on the 20th, and VE3AX (FN02) reached EM66 on the 21st. The 23rd featured east/west propagation to the south: KE8FD (EM84) to K5QE (EM31) and AF4OD (EM72) to W3XO/5 (EM00).

Aurora

This ought to have been a good month for aurora, but very little was noted beyond minor storms on September 16-18 and again on September 25. The only communications involved a few contacts in the Midwest between stations at high latitudes.

Microwaves

Enthusiasm for the high microwaves continues to grow. To whet your appetite for the results of the 10 GHz and Up Cumulative Contest, Joe, W3KJ, sings the praises of a strong tropo (evaporation duct?) enhancement between himself, WA3GFZ and K1DS at Stone Harbor, New Jersey (29pb) and the team of KB1VC (Block Island, Rhode Island) and AF1T and W1MKY at Martha's Vineyard, Massachusetts. Meanwhile Bob, K2YAZ, recounts that Don, WW8M, made VUCC on 24 GHz during the contest with his best DX to NE8I at about 104 km. Figure 4 shows Don and his station.

HERE AND THERE

Geminids Meteor Shower

This relatively dense (ZHR »100) collection of moderately slow meteors has been disappointing over the past few years, but remember that the meteor-scatter distance record between K5UR and KP4EKG was set during this shower. Predictions of the peak vary between sources but appear to be about 1000 UTC on December 14. This would be an excellent shower to try *WSJT*.

Six Club Sprints

Jerry, W9FS, relays the final results for the Six Club 2003 contests. Highest scores for all three contests went to NJ2F, N6HC, KE4KVW, YV4YC and KØHW. For more information, go to **www.6mt.com/sprint.htm**.

Results of the ARI X Italian EME Contest (Luigi Zorzino, I2COR, Memorial)

Mario, I1ANP, provides the results of this EME Contest held on May 10-11. Propagation was variable and US participation was limited. This contest features multiple classes, based on antenna size. Top scores were I2FAK, RU1AA and F3VS on 144 MHz; F2TU on 70 and 23 cm and on 10 GHz; and F2TU and JA4BLC on 13 cm. WB9UWA had the top US score on 144 MHz.

First US-Czech Republic Contact on 24 GHz EME

On their second scheduled attempt, Josef, OK1UWA, and Al, W5LUA, completed the initial 24 GHz EME QSO between the Czech Republic and the US on September 24 at 1400 UTC. Al notes, "This was Josef's first 24 GHz EME QSO, and he was my third initial on 24 GHz." Al has also worked Canada and Russia. OK1UWA runs 35 W to a 3 meter Prime Focus dish, vertically polarized. W5LUA's station is a 3 meter Prime Focus dish with 70 W at the feed, horizontally polarized to account for the spatial offset between North America and Europe. QST

3Y—Peter I Island

By Bob Allphin, K4UEE

The upcoming DXpedition to Peter I Island (3YØP), Antarctica will likely be the highlight of my ham radio experience. Although I have been with DXpedition teams that have activated seven "top ten DXCC entities," this one is different and very special. It is the southernmost DXCC country except for certain parts of the Antarctic continent. At almost 69° south latitude, it is 900 miles farther south than Bouvet (3YØC), 960 miles farther south than Heard Island (VKØIR), 600 miles farther south than Thule Island, South Sandwich Islands (VP8THU). What does that mean? It's going to be colder, windier and snowier.

The island is 95% covered by glaciers and the dominant feature is a mile high volcano named Mt Lars Christenhoppen. Glaciers sweep down from the mountain toward the sea and abruptly drop off, leaving 50 m high vertical ice cliffs. The only reasonably safe way on and off the island is by helicopter.

There have been only two Amateur Radio operations from Peter I. The first, in 1987, by LA1EE (3Y1EE) and LA2GV (3Y2GV) made more than 17,000 QSOs. The second operation was in 1994 and was led by Ralph Fedor, KØIR, my great friend and co-leader on this DXpedition. That fine operation netted over 60,000 QSOs, taking Peter I from the #1 most needed to completely off the most wanted list. It seems that there is about a 10 year cycle before a really difficult and rare DXCC entity works its way back into the "top 10" again. In January/February 2004, when the DXpedition is to take place, it will be 10 years since the last operation and sure enough, Peter I is ranked #7 by *The DX Magazine* and #4 by the *425 DXnews*. It's time to go back!

As you might imagine, this is an expensive undertaking. First, chartering a vessel large enough to transport the team of operators, their life support equipment including tents, cots, sanitation, personal gear and clothing, kitchen equipment and food, radio equipment, antennas, amplifiers, and generators is very, very expensive. Add the cost of leasing a helicopter, pilot and mechanic and you have a staggering price tag.

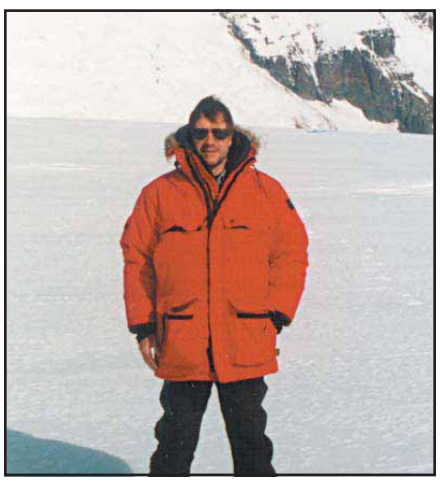
Because the cost of an expedition like this must be borne primarily by the operators themselves, you have the further complication of finding a team of 15 hams who are going to be compatible in close quarters and difficult circumstances. Also, they must be at least good operators, have six to seven weeks to be away from home and work, and can write a check large enough to buy a car.

The logistics are another challenge altogether. Planning for, accumulating and transporting everything a team of 15 people will need in a very hostile environment and sustain themselves up to two months is another incredible task. There aren't any 7-11s, Home Depots or RadioShacks for thousands of miles. You really don't want to forget anything!

So maybe you are asking yourself why someone would want to do this—go to Peter I? I guess the simple answer is it will be a great adventure. Everyone on the team wants to experience the thrill of setting foot on this desolate, faraway place. Not just that first step out of the helicopter onto the glacier but actually building a community on the ice and surviving there for three weeks and then leaving only our footprints behind.

Yes, the pileups are fun too. This will be a chance to test our own skills against the hundreds of stations calling and somehow get them all in the log. And lastly, there is a certain hard-to-describe camaraderie that grows among the team members. Regardless of whether they are from the US, Norway, France, Russia, Aruba or wherever, they will become best friends. They will share something that few people get to experience. It's like members of the same platoon that have been in combat together—a special bond. If you don't believe me, when you're next in Dayton and you see team members reunited, notice all the hugs. Does it always end this way? No. Sometimes, but not often, a team comes home and there are hard feelings among some members. This grows out of some unresolved disagreement that festered and grew out of proportion.

To try to avoid that kind of negative experience, our team was carefully selected. Either Ralph or I know or have been on DXpeditions with most of this Peter I team. Those team members who applied to join the team and we didn't know went through a rigorous screening process. First, they submitted a resume detailing their ham history, past DXpedition experience, mode and band likes and dislikes, and the skills, both radio and personal, that they would bring to the team. Second, they supplied a minimum of two personal references basically attesting to their good interpersonal skills and the fact that they are cool under pressure. Lastly, they were interviewed either face to face or on the telephone. If after passing these hurdles, and of course hav-



Ralph Fedor, KØIR, is a co-leader for the Peter I Island 2004 DXpedition. He was part of the 1994 team.

"Radiosletta" is a flat glacier on the east end of Peter I Island. It was the campsite for the 1994 DXpedition and will be the site of the 2004 operation. In the background you can easily see Mt Lars Christentoppen.

Bernie McClenny, W3UR ♦ 3025 Hobbs Rd, Glenwood, MD 21738-9728 ♦ w3ur@arrl.org

ing the six to seven weeks available and the necessary funds, they were invited to join the team. After that it all boils down to getting the job done and hoping you selected the right people. I think we have!

My purpose in writing this is to give you, the reader, some different insights into an operation of this magnitude. Too often, the DXpedition only represents a log entry or a QSL card. Hopefully, this will help you feel a part of the whole adventure that the men on the island are experiencing. Try to forgive the CW operators' poor fist; he may be shivering. If the SSB operator gets a little testy, maybe he hasn't slept in 24 hours and the wind is blowing at 60 MPH outside and he's worried about his tent blowing away. Through our Web site, **www.peterone.com** we hope to keep you informed as to what is happening on that little speck of an island off Antarctica. We will try to capture the adventure for you too! CU in the pileups.

Please consider a generous contribution to this project. Checks from individuals for $250 or more can be made out to the Northern California DX Foundation (NCDXF), and should be tax deductible (consult your tax consultant). All other checks should be made out to Bob Allphin/Peter I Expedition. Send all checks to Wes Lamboley, W3WL, 690 Hunterhill Way, Roswell, GA 30075.

MOUNT ATHOS

By Jim Boockholdt, N4AL/SV0JB

The DXCC entity of Mt Athos is located in northern Greece in the beautiful region called Halkidiki. If you look at a map of Greece, in the northern part just south of the Former Yugoslav Republic of Macedonia is Greece's second largest city—Thessaloniki. To the right and slightly below this city, three peninsulas jut into the Aegean Sea. The top, northernmost of these is the one containing Mt Athos. Admission to the monastic community there is through the port village of Ouranoupolis on the northern part of the southern coast of the peninsula.

Mt Athos is 56 km (34 miles) long and less than 8 km (5 miles) wide. The land on the peninsula gradually rises to a summit about 2 km high near the southern tip before it suddenly drops into the sea. It is inhabited by about 2000 Orthodox Christian monks, all men. Females are not permitted on Mt Athos.

History

According to Christian tradition, Mary the mother of Jesus was on a ship that took refuge from a storm in Mt Athos on the way to Cyprus. Mary, admiring the place, asked God to give her the mountain as a present. Since then, Orthodox Christians have considered the peninsula to be "Garden of the Virgin Mary." In the 5th century the first Orthodox monks came to the peninsula, and the first monasteries were established there during the 10th century. Today the monasteries of Mt Athos preserve medieval Christian traditions and constitute the largest museum of Byzantine art in the world.

Currently the monastic community contains 20 Orthodox monasteries, each surrounded by other smaller cloisters, cells and hermitages. The men living there are of many nationalities: Greek, Russian, Romanian, Cypriot, and others. The monks devote their lives to solitude, prayer and fasting. Most live communally in the monasteries, but some live solitary lives in the surrounding settlements. Monks living communally share in the food, work and worship of the monastery. Visitors are welcome in the community, but they must get advance permission and their stays are limited by the ability of the monasteries to accommodate them.

Government

Each monastery is self-governing and is headed by a Superior who is elected by the monks for life. The Superiors from the 20 monasteries form a Holy Assembly that has legislative authority within the community. Each monastery also elects a representative to the Holy Council, which has administrative authority. This self-governing administration, which has existed since Byzantine times, has given Mt Athos its status as a separate DXCC entity. Recognized internationally as a part of Greece, the monastic community is overseen by the Greek Ministry of Foreign Affairs. For religious purposes, Mt Athos is governed by the Patriarch of Constantinople in Istanbul, Turkey.

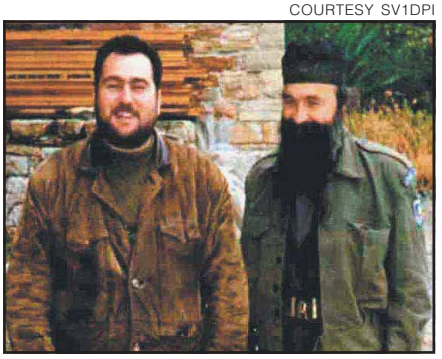
Amateur Radio

Amateur Radio operation in the monastic community is difficult. An operator from a nation that participates in the CEPT agreement can operate from Greece as SV/home call/P. Others must first obtain a Greek license from the Greek Ministry of Communication and Transportation. This permission is not difficult to obtain, but does require advance communication with the Ministry.

Operation from within the monastic community also requires the permission of the Holy Council, which is difficult to obtain. The Council is understandably hesitant to admit visitors who it thinks may distract from the community's religious purposes. Mt Athos is not a vacation destination, and its inhabitants do not want it considered as such.

Currently only one person, Monk Apollo, SV2ASP, has permission from both Greek authorities and the Holy Council to operate from Mt Athos. Monk Apollo lives in the Monastery of Docheiariou, located about halfway down the peninsula on its western side. Other licensed Greek amateurs are resident monks, but none have the permission of the Council to operate.

COURTESY SV1DPI



Kostas, SV1DPI, visiting Monk Apollo, SV2ASP/A, on Mount Athos.

Baldur, DJ6SI/SY, operated from Mt Athos in 1991 after obtaining permission from the Patriarchate in Istanbul, but not from the Holy Council. Following this operation, the ARRL decided that future operations should have the permission of the Holy Council. A number of Greek amateurs had operated from Mt Athos prior to Baldur's visit. Since then, no one has been able to get permission to operate from the Holy Council. According to ARRL DX Bulletin #37 issued in 1998, however, Dominic, DL5EBE, operated from Monk Apollo's QTH in September of that year.

The prognosis for future radio operation from Mt Athos is not good. Monk Apollo has been very cooperative and willing to operate and give a "new one" to many of us when he has time. But his duties at the monastery are understandably more important to him. Recently his rig quit functioning and he has been off the air completely. A number of concerned amateurs are attempting to raise money for a new rig to get him back on the air. Otherwise, DXers will have to be patient and hope for a change in the Holy Council.

For more information on Mt Athos, see **www.inathos.gr** or **www.macedonian-heritage.gr/Athos/intro.html**. To see some QSL cards from prior Mt Athos operations, see **hamgallery.com/qsl/country/MountAthos/**. For pictures from the 1979-80 DXpeditions by SV1DC, SV1IW and SV1JG, visit Cliff's Web site at **www.qsl.net/sv1jg/mtathos.htm**.

WRAP-UP

That's it for this month. A special thanks to Bob, K4UEE, and Jim, N4AL, for their articles. Don't forget to send your DXpedition announcements, photos and news to your DX editor. Until next month, see you in the pile-ups!—*Bernie, W3UR*

Microphones

Probably the best-known ham microphone is the D-104 by the Astatic Company. Since the 1950s, when I first became interested in ham radio, it is the one microphone that I remember best. It seemed like every older ham had one in his shack. I wanted a D-104, but of course I couldn't afford one at the time, which made it even more desirable.

Today I have a few of them and I feel much better now.

I'm not alone. Most of my collector friends have at least one in their collection. They are easy to find. At just about every hamfest they can be found for as little as $20, making them easy to bring home.

I remember one old-time ham who bought a D-104 every time he went to a hamfest. He had almost 30 of them on his shelf. It was impressive.

In preparing for this column, I searched on the Internet and found **www.astatic.com**. I found that Omnitronics LLC now owns Astatic. The Web page has good information about the D-104 and there is a support forum where you can ask questions. They also have a short history of the company compiled by Keith P. Graham from the 1946 Astatic Catalogue where I found the following information. Please visit the Astatic Web page for more.

In 1930 the Astatic Company was started in Youngstown, Ohio by two radio amateurs, Creed Chorpening, W8WR, and F. H. Woodworth, W8AHW. Before 1930 they had been using carbon microphones. When they learned about the new condenser microphones, they built a few. Soon friends were asking, could you build one for me? So they formed a partnership and went into business.

An old friend, Charles Semple of Cleveland, asked them to visit him at the Brush Laboratories, where he worked. He had been experimenting with phonograph pickups using Rochelle salts (sodium potassium tartrate), and thought they would be interested.

> Through [Charles] Semple, the two visitors met A. L. Williams, electrical and mechanical engineer, and Dr. C. B Sawyer, scientist, who demonstrated the action of these new elements in relation to microphones, phonograph pickups, speakers, recording heads, earphones and other devices where it was desired to transform mechanical energy into electrical energy or the reverse. Here, it seemed, they had found the answer to a simple, low-cost, dependable "mike" for the "ham rig."

In 1933 they incorporated and started building Crystal Microphones and Crystal Phonograph Pickups. Charles Semple joined the company as designer and later became the general manager.

The first advertising for Astatic I found was in the November 1933 issue of *QST* on page 83. It said:

> There is something new under the sun. It's the PIEZO-ASTATIC Crystal Microphone. A highly developed general-purpose microphone ruggedly constructed having excellent frequency response. Cannot be overloaded acoustically. No adjustments required. No carbon rush or internal noise. No blasting or freezing; no button or field current; no polarizing voltage. Connects direct to grid or may be used with matching transformer. Chrome plated, 3" diameter, 1" thick, with 6 ft. shielded cord. THE MOST PRACTICAL MICROPHONE EVER OFFERED. Licensed under Brush Development Co. patents.

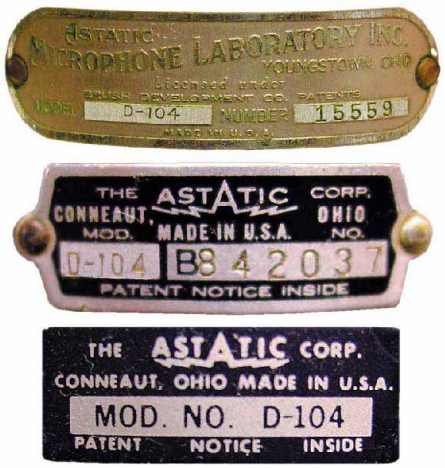


Figure 1—Three labels from various models of the D-104. The mikes are from 1935, 1960 and the 1970s or '80s.

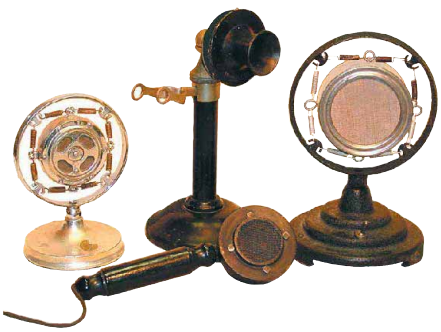


Figure 2— Two examples of a suspension microphone, a Shure 5B on the left and the Amplion GM on the right. The taller one is an old "Conn Tel & Elec Co" telephone converted into a mike, and the hand mike is an Amplion MH from the late 1920s or early 1930s.

They offered it initially for $17.50 in a suspension or stand mounting. By the following November the list price had risen to $21, but was offered to hams for a net price of $12.60.

By the end of 1934 they claimed thousands of sales to amateurs. I own one of the early D-104 microphones, serial 15,559, and based on Astatic's claims, I figure it was made in 1934 or 1935. It is the suspension mount version and was well used.

I remember reading in *QST*, I think, in the 1960s, that Astatic celebrated an anniversary and was searching for the earliest serial number still working. They offered some sort of a prize. I was not able to find this data, but it would be interesting to ask readers to let me know your early serial number, and whether it is still original and working. I'll print the best found in a future column.

How can you tell the early ones from the later models? Figure 1 shows three D-104 labels. The top one is my early 1935 version, the middle is from the 1960s and the bottom one is from the 1970s or 1980s. You can see the differences. The early ones have ID plates with a serial number and rivets, while the newer ones have a sticker label, without a serial number.

D-104s are still used on a regular basis in many ham stations today. Wiring diagrams and hook-ups are available on the Internet so they can be adapted to almost any radio. They are especially popular with the radios of the AM era and early SSB rigs. They often show up at garage sales, flea markets, antique shops and on the Internet, so good hunting. Replacement elements are available from many sources if yours doesn't work. And there is enough room inside to adapt almost any modern pickup in there.

Microphone Collecting

I've included several photos of microphones in groups, to help you identify mikes worth adding to your collection. If you aren't collecting yet, here's a great place to start. I'll begin with the earliest microphones, which tend to be fairly expensive as they become harder to find.

Suspension, or "ring" microphones, are

John Dilks, K2TQN ♦ 125 Warf Road, Egg Harbor Township, NJ 08234-8501 ♦ k2tqn@arrl.org

Figure 3—Several popular mikes designed for Amateur Radio use.

Figure 4—Several models of RCA microphones, which were popular in ham shacks for many years.

always fun to find. They look great displayed anywhere in your ham shack. Figure 2 shows two, a more common Shure 5B on the left and a rare Amplion GM on the right. The Amplion GM was probably used in commercial broadcasting. (It is serial number 4 by the way, very early). The taller one is an old "Conn Tel & Elec Co" telephone, which some ham adapted to his early 1920s transmitter. The hand microphone is an Amplion MH from the late 1920s or early 1930s.

Figure 3 contains a representation of popular "ham" mikes. These are available at most hamfests from time to time. From left, Shure 737A, Turner CX, Astatic 77, Electro Voice 630, Shure 555W, American D4TZ, Astatic D-104, Western Electric 633A (also known as the "Salt Shaker") and finally an Electro Voice 638. Each company mentioned has many models, so look for others.

Commercial grade microphones are really great to find. Most of these types originally cost a lot more than ham mikes, and will still cost you more today. Figure 4 shows some of the popular RCA microphones. From left, model 46 (also called the "Paintbrush"), MI-6226, a chrome "Aerodynamic," MI-6204 (an early ribbon mike), MI-2016 a two-tone Aerodynamic, model 45B, model 88 and an MI-12021. Note the stands they are on. The two chrome bases and the black stand under the 6204-ribbon microphone are early stands. You should look for these types to properly display your earlier mikes. The large stand in the center-front is modern, from the 1970s.

Art-deco microphones really stand out in your shack or display. In Figure 5, from the left, a Rauland W-1247C (also sometimes labeled Webster 1248), Amperite PGL "flying saucer," American D33 and an Altec 639B "Birdcage," also made earlier by Western Electric. Altec was a spin-off of Western Electric when they were made to divest themselves of the movie sound business. Altec later became Altec-Lansing.

Figure 5—A selection of cool Art Deco style mikes.

Figure 6—At the left and right, two inexpensive Japanese mikes, with a suspension mike in the center.

The saucer-like disc on the Amperite microphone was said to increase the output of the microphone 4 dB. It was typically used on stage where the speaker was more than 12 inches from the mike. This microphone was also popular in ham shacks, with and without the ring. The plastic ring snaps on and was sold as an accessory.

In 1958 when I was getting started in VHF, I needed a microphone. Still in high school, I found that the Japanese manufactured affordable microphones. Figure 6 shows two of them. On the left is a Crown MC-60 dual crystal element mike, designed to look like an expensive RCA model 77. It sold for under $10. On the right is a single element crystal mike, a Herald M105. This was available for under $5. Both of these mikes were sold by many of the chain stores, under several names: Aiwa, Argonne, Calrad, Fen-Tone, Midland, Olson and Philmore, to name a few. They all looked the same, except for the name labels, which were glued on.

In the center sitting on a coffee cup is an old suspension mike from Japan, supposedly brought home by a GI after WW II. I have not yet been able to find any information on it. The English lettering says "LA-1" and "NO 168." The rest is in Japanese. It is a heavy piece, with the body carved out of white marble, and the works set inside. I'm guessing it is from the 1930s.

Microphone 101

So there you have it—Microphone 101. I hope you will be successful finding suitable ones for your collection. One note though: I occasionally get e-mails asking how much a mike is worth. I'm not a good person to ask, as I have not researched prices. I go by the rule *if I like it, if it is reasonably priced and I can afford it at the moment, I purchase it*. What I would pay is probably different from what others would pay.

Look for my hat at the hamfests, and say hello.—*K2TQN* QST

The Best DCC Ever!

As I write this, the 2003 installment of the ARRL and TAPR Digital Communications Conference (DCC) has just ended. I had a great weekend at the conference and many of the DCC veterans in attendance agreed that it was one of the best, if not the best DCC ever.

I came away from the 2003 DCC with three thoughts:

1. Automatic Position Reporting System (APRS) is as popular as ever.
2. The trend of software replacing hardware in our radios is picking up speed.
3. There is a lot of interest, excitement and buzz about Amateur Radio's progress down the digital highway.

STEVE FORD, WB8IMY

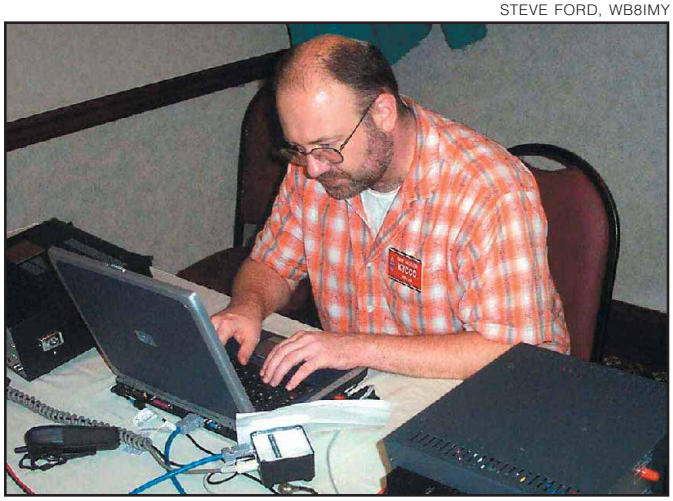


Figure 1—*QST* and ARRLWeb Assistant News Editor Dave Hassler, K7CCC, logs a Hellschreiber contact at the W1AW/1 special-event station that was in operation at the 2003 ARRL-TAPR Digital Communications Conference.

APRS made a big showing at the 2003 DCC. In addition to the variety of APRS-related papers that were presented and published, the two APRS seminars (one an introduction to APRS, the other a discussion about the state of APRS networking) drew approximately one-third of the DCC attendees to each session.

Yes, bits are replacing nuts and bolts. Software Defined Radio (SDR) also made its presence felt in a big way at the DCC. (In a nutshell, an SDR is a radio in which software emulates some radio hardware, thus eliminating that emulated hardware.) SDR was a popular topic among the presented and published papers, and a packed-house four-hour Sunday seminar by Matt Ettus, N1MJI, was devoted completely to SDR.

By the way, the printed *Proceedings* of the 2003 DCC were the largest ever, with 26 papers totaling 248 pages! Copies of the proceedings are available from TAPR (**www.tapr.org/tapr/cgi/genorder.cgi**) and ARRL (**www.arrl.org/catalog**).

APRS and SDR aside, it was the buzz at the DCC that really made an impression. No matter the subject, whether it was APRS, SDR, high-speed multimedia, DSP, PSK31, digital voice, voice over IP and even plain old AX.25 packet radio, people were truly excited about their favorite mode or modes and what the future holds in store for them.

For example, Bob Bruninga, WB4APR, left his home in Maryland that was without power courtesy of Hurricane Isabel and drove seven hours to spend 90 minutes at the DCC's APRS networking session. He was late for the session because of a traffic jam on the Cross Bronx (New York) Expressway, so he only caught the last half hour or so of the session. At the end of the session, he got back in his mobile and drove back home to join his wife in lighting candles (rather than curse the darkness).

WB4APR's experience was not typical for all the folks at the DCC, but it did typify the high level of interest that electrified the air throughout the Marriott Hartford/Windsor (Connecticut) Airport Hotel during DCC weekend.

Speaking of electrifying the air at the hotel, this year's DCC provided wireless access to the Internet for those with laptops or PDAs that were so equipped. Which brings up an interesting point: When you go to the Dayton Hamvention, the typical ham is carrying a handheld transceiver; when you go to the DCC, the typical ham is carrying a laptop computer!

How do you say "paradigm shift"?

MultiMode OSX Does A Lot

Being a member of the Macintosh Nation, I was very interested in the latest release of *MultiMode OSX*. As its name implies, *MultiMode OSX* is a Mac OS X program that supports multiple ham and shortwave radio modes.

Since *MultiMode OSX* runs on the Mac platform, "it don't need no stinkin' sound card." The built-in audio capabilities of the Mac are all that is required. Just connect the speaker output of your radio to the audio input of your Mac and connect the audio output of your Mac to the microphone input of your radio. The Data Terminal Ready (DTR) signal of the Mac's serial port controls your radio's PTT.

As of this writing, the latest release of *MultiMode OSX* is version 4.1, and it transmits and receives Morse code (CW), QRSS (slow-speed CW), RTTY (Baudot), ASCII, SSTV (slow-scan television), packet (300 and 1200 baud), PSK31, ICAO Selcal, Hellschreiber, DTMF, CCIR and EIA tone modes. It also receives weather/satellite fax, ACARS (aircraft communications addressing and reporting system), ALE (automatic link establishment), LORAN C, SITOR-A, SITOR-B/FEC/NAVTEX and FFT/spectrum audio display.

MultiMode OSX is the handiwork of Chris Smolinski, N3JLY, at Black Cat Systems. Go to their *MultiMode OSX* Web page (**www.blackcatsystems.com/software/multimodeOSX.html**) to find out more about the software and download a demonstration copy to try out today.

And One Other Thing

All the canines, felines and humans in the WA1LOU radio shack want to wish you all Happy Holidays and hope to work you in one of those newfangled digital modes real soon now. QST

Stan Horzepa, WA1LOU ♦ One Glen Ave, Wolcott CT 06716-1442 ♦ wa1lou@arrl.net, www.tapr.org/~wa1lou

Satellite Status: Staying Up-to-Date

With about 24 Amateur Radio satellite payloads orbiting the Earth, it isn't easy to keep up-to-date with the status of each bird. After all, satellites have a tendency to switch modes, go off the air temporarily or leave the air permanently. One way to stay in touch is to check the AMSAT News Service Weekly Satellite Report on the Web at **www.amsat.org/amsat/news/wsr.html**.

But Dave Carr, KD5QGR, has devised a new method. At **oscar.dcarr.org/** you'll find his OSCAR Satellite Status Page. This Web site acts as a repository for satellite activity reports that are only a few days old. These activity reports are submitted directly by your fellow amateurs. Think of it as a kind of "Webcluster" for satellites.

This is a *Java* application, so you'll need to have *Java* enabled on your Web browser. Check your SETTINGS or OPTIONS menu.

When you load the page (it may take a minute, depending on your connection), you will see a chart with a list of satellites along the left-hand vertical edge (see Figure 1). In the rows extending to the right, you'll notice a scattering of red, yellow, orange and blue blocks. Blue indicates a fully operating repeater or transponder. Yellow is a report of telemetry activity only. Red means no activity and orange indicates conflicting reports. As you move your mouse cursor over the colored blocks, you will see the call sign of the reporting station, plus other notes.

By creating this site, Dave has performed a great service for the satellite community, but his Status Page needs more reports from more stations. Remember that even a report of "nothing heard" is still valuable. At the bottom of Dave's page there is an easy-to-use form for submitting your reports. Please add your reports to the list—the more the better!

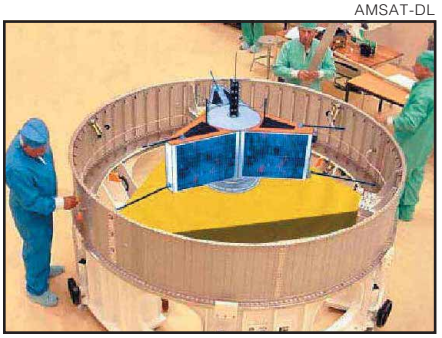
"Why Hasn't AO-40 Deployed Its 'Wings'?"

I've heard from several amateurs lately, all asking when OSCAR 40 will deploy its winged solar panels. The answer is "possibly never."

The reason has to do with how OSCAR 40 is stabilized in space. Right now the bird is spinning like a gyroscope. And like a gyroscope here on Earth, this spin keeps OSCAR 40 in a stable position. In fact, the technique is known as *spin stabilization*.

To deploy the solar panels, OSCAR 40 needs to stop spinning and use its internal reaction wheels to achieve *three-axis stabilization*. Some tests have been performed on the reaction-wheel system and it appears to be working, but considering the tremendous damage OSCAR 40 suffered during its first months in orbit, no one is 100% confident that the system will function as planned.

AMSAT-DL



An artist's concept of how the AMSAT-DL Phase 3E satellite might look in preparation for loading onto an Ariane 5 booster.

The OSCAR 40 controllers would be rolling the proverbial dice by stopping spin stabilization and switching to the three-axis system. If something goes haywire, would they be able to restore spin stabilization? No one knows for sure, and that uncertainty looms large.

Today we have a satellite that is functioning well with its 2.4 and 24 GHz downlinks. OSCAR 40 appears to be stable, almost miraculously so. Using three-axis stabilization would provide improved position control, resulting in longer operating times and better squint angles throughout the orbit. Opening the solar panels may provide some power benefits. On the other hand, if a three-axis stabilization attempt fails, and spin-stabilization cannot resume, we will likely lose our only long-range-communication satellite. The risk is too great.

AMSAT-DL is spearheading another long-range satellite known as Phase 3E ("E" stands for "express") and they hope to have it in orbit within a couple of years. AMSAT-NA is also working on its own long-range bird known as Eagle. Until either Phase 3E or Eagle are on station and working, the prudent course of action is to leave OSCAR 40 alone. It is better to wait a few years and have a backup satellite in orbit than take an unnecessary gamble now and risk losing our only DX bird.

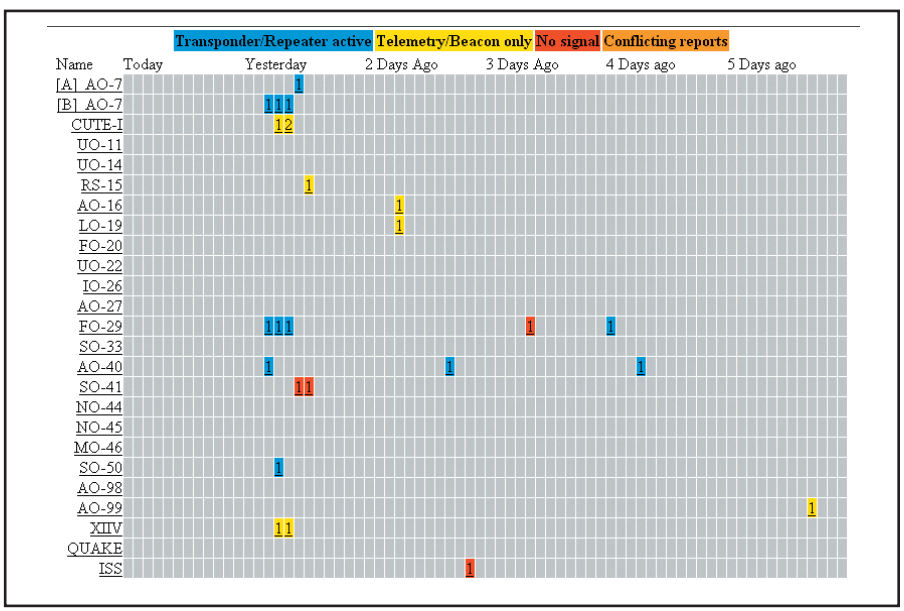


Figure 1— KD5QGR's satellite status page on the Web at oscar.dcarr.org/.

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

Peace on Earth

from the ARRL Staff and Contributing Editors

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Diane Ortiz, K2DO
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Dana Reed, W1LC
Paul Rinaldo, W4RI
Howard Robins, W1HSR
Janet Rocco
Kim Rochette
Eileen Sapko
Daniel Sayad, KB1IIP
Cathy Scharr
Bob Schetgen, KU7G
Joe Shea
Andrew Shefrin
Barry Shelley, N1VXY
H. Ward Silver, NØAX
Mark Simcik, WA1VVB
Jon Siverling, WB3ERA
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Cathy Stepina
Dean Straw, N6BV
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STRAYS


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NEW PRODUCTS

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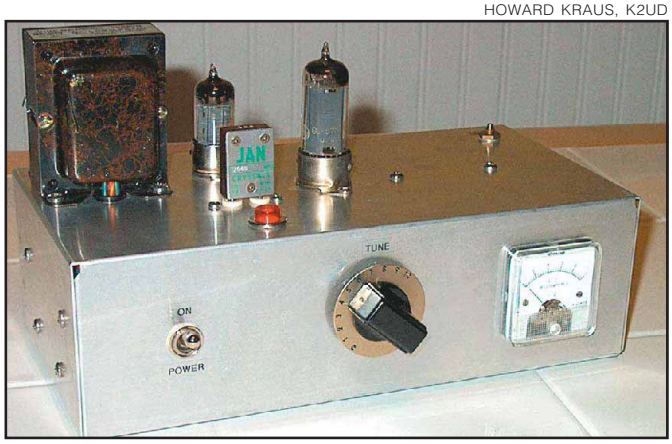
A 1:1 current balun is located on the input side to convert the balanced T-network to 50 Ω coax for connection to the radio. The power rating is 300 W PEP SSB or 150 W CW. Dimensions (HWD): 6×7½×8 inches. Price: $189.95. The MFJ-974 is the same but covers 80 through 6 meters only. Price: $169.95.

To order or to locate a dealer, call MFJ Enterprises at 800-647-1800, or order at **www.mfjenterprises.com**, fax 662-323-6551; or write MFJ Enterprises, Inc, 300 Industrial Park Rd, Starkville, MS 39759.

Homebrew QRP

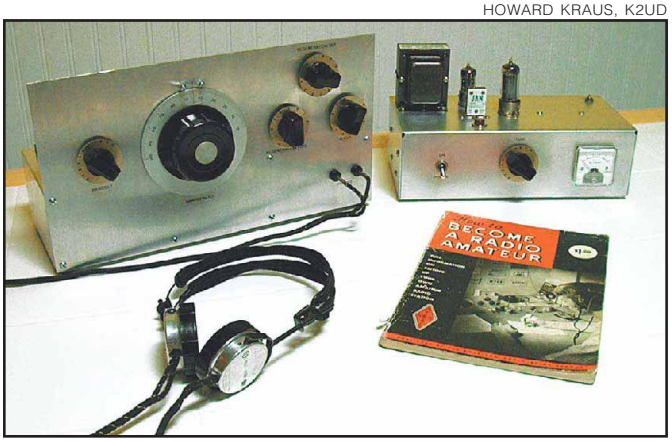
This month we present a conglomeration of handiwork—the products of the efforts and creativity of a group of talented QRP homebrewers. The variety and quality of workmanship speaks for itself.

HOWARD KRAUS, K2UD



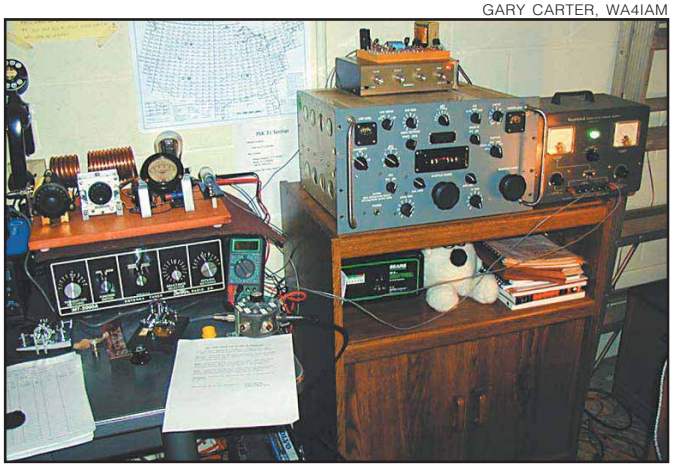
Howard Kraus, K2UD, built this two tube "Simple Transmitter for the Beginner" by Don Mix, W1TS, from the October 1968 issue of *QST*. It features a 6C4 as the crystal oscillator driving a 5763 PA tube. Power output is about 5 W on either 80 or 40 meters.

HOWARD KRAUS, K2UD

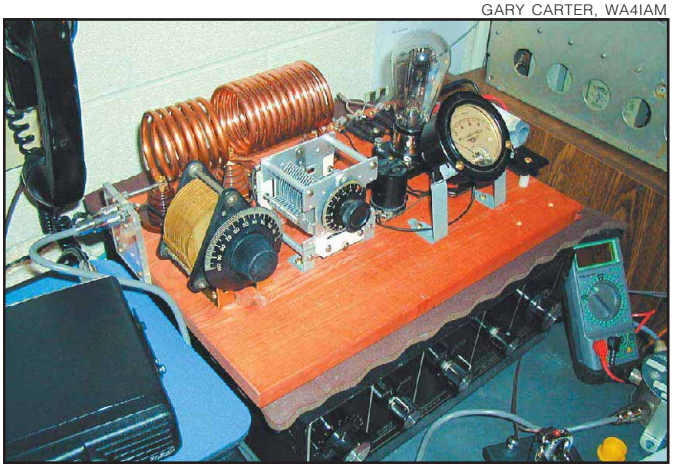


Howard's two tube TX paired up with the "Three Transistor Receiver" by Walter Lange, W1YDS, that appeared in March 1968 *QST*. This is a regen receiver covering 1.65 to 30 MHz. Howard says the receiver works amazingly well and it makes a nice companion for his Don Mix transmitter.

GARY CARTER, WA4IAM

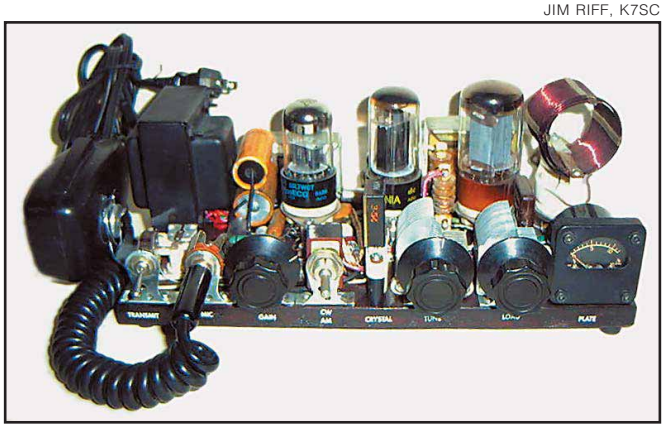


GARY CARTER, WA4IAM



Gary Carter, WA4IAM, shows off his building talents with this beautiful example of a TNT (tuned plate not tuned grid) transmitter from the 1920s. This is Gary's first homebrew project and what a job he did! This circuit was taken from the December 1929 issue of *QST* and features a single 210 tube yielding a whopping 2 W output. Gary made a few changes in the original design including shunt feeding the plate circuit. Gary also stayed true to form using square buss wire, rubber coated wire and as many "period vintage parts" as possible. Congratulations, Gary, on a beautiful rig.

JIM RIFF, K7SC



(Left) Jim Riff, K7SC, from Scottsdale, Arizona, constructed this nicely done 160 meter Hartley AM/CW transmitter. The rig features a 6L6 final amp and a 6K6 used as the modulator. The 6SN7 is used as the mic preamp. High level modulation in the plate circuit is achieved via a choke in the B+ line to the PA. Power output is up to 8 W. By using separate coils Jim can operate 160 through 10 meters on AM and CW. Nice job, Jim. QST

Rich Arland, K7SZ ♦ 25 Amherst Ave, Wilkes Barre, PA 18702 ♦ k7sz@arrl.org

SILENT KEYS

It is with deep regret that we record the passing of these amateurs:

W1BPK, Charles W. Manninen, Burlington, MA
WB1BYU, Harrison Alderson, Bristol, CT
K1MWU, Daniel Sudarsky, Stuart, FL
KA1OEH, William A. Dalgliesh Jr, Warwick, RI
W1PDM, Donald L. Snider, Coffeyville, KS
W1PXM, Aime A. Theberge, Winnisquam, NH
*W1SO, William P. Carpenter, Bristol, CT
‡W1VRP, John Amaral, Niantic, CT
W1XW, Anthony Szilagyi, Fairfield, CT
KB2BBB, Henry P. Enckler, Millville, NJ
N2DOV, William F. Christ, Rochester, NY
K2EAW, E A. Palmer, Webster, NY
WA2MSK, Jack Geiger, Parsippany, NJ
KE2QN, James B. Gerow, Toms River, NJ
N2RFZ, William A. Smith, Swain, NY
WA2Z, Joseph J. Perry, New Hartford, NY
WA3BUX, Richard Flanders, Du Bois, PA
KA3CJL, John Lengel, Columbia, MD
K3HCE, William B. McGeehan Jr, Baltimore, MD
N3IOU, Jerome G. Bricker, Suitland, MD
W3IWF, Calvin A. Hoerneman, Carlisle, PA
K3OZQ, Charles W. Parker, Greenville, KY
*W3XQ, J. Fredrick Strom, Saint Petersburg, FL
W4APE, John W. Pegues, Cheraw, SC
K4BVG, Marvin J. Uphaus, Mobile, AL
WB4DDR, Woodrow K. Brown, Lawrenceville, GA
W4DNR, Joseph G. Walker, Columbia, SC
K4ENA, Basil J. Gray, Cape Coral, FL
KU4GE, Michael L. Brown, Payneville, KY
K4IRD, Thomas J. Kelly Sr, Tryon, NC
K4JX, Matthew J. Deren, Andrews, NC
W4JXO, Robert J. Lake, Gainesville, FL
KU4P, Quincey L. Southerland, Southside, AL
AD4PW, Lawrence R. Fall, Okeechobee, FL
AD4RT, Sharon G. Farmer, Irvine, KY
W4SFF, Clifford R. Johnson, Winchester, TN
KG4SSI, Jim D. Carnathan, Fort Payne, AL
KD4TQ, Paul E. White III, Lexington, KY
N4WGF, Charles F. Poulnot Jr, Charleston, SC
K4YC, Charles J. McCook, McIntyre, GA
KD4YTO, Warren A. Scott, McAdenville, NC
KE4ZJC, Earl E. Hickle, New Market, TN
*W5AA, Richard J. Brown, Pensacola, FL
KA5ADB, Geraldine V. DeLong, Alamogordo, NM
KC5BOZ, Loyd J. Satterfield, Conchas Dam, NM
KA5BYB, Cleon Ligon, Amarillo, TX
W5DBJ, Neil E. Cleaver, Dallas, TX
W5DNE, Billy B. Terrell, Webster, TX
W5ERT, Floyd R. Gravitt, Fort Worth, TX
KK5FA, Michael L. McCoy, Brenham, TX
*W5FS, Fred F. Seifert, Albuquerque, NM
KC5FXZ, Patricia A. Coats, Trumann, AR
K5GMU, Durward E. McCain, Arlington, TX
WB5HGL, Judith A. Scheiderer, El Paso, TX
N5HGW, Fredrick R. Bossier, Mountain Home, AR
N5LXV, Sandra L. McCarter, Purdon, TX
W5NAL, Richard J. Goff, Shreveport, LA
N5PJN, Frank Tucker, Houston, MS
W5QYW, Graydon K. Eubank, San Antonio, TX
*N5RM, Robert H. Mitchell, Greenville, TX
N5SP, Stanley Hecker, Ocean Springs, MS
WA5WAR, Helen D. Smith, Harrison, AR
KG5XJ, Woodrow W. Finch, El Paso, TX
*W5YVT, Philip I. Goodman, Marietta, GA
KB5ZIS, Paul Scrutchins Jr, Fort Worth, TX
KE5ZT, Claude M. Sims, Carlsbad, NM
KB6GBP, Donald E. Gilbert, Rialto, CA
WA6HHR, Reuben A. Sprengel, Fresno, CA
W6IYY, Harold J. Ebury, Coalinga, CA
K6LKJ, Harold V. Clawson, Madera, CA
KB6NCE, Erin P. Harter, Fresno, CA
KB6RSB, John H. Kerner, Los Gatos, CA
K6VBB, Thomas A. Walker, San Luis Obispo, CA
WB6WUF, Robert S. Peart, Selma, CA
KF6ZPQ, Richard J. Pasturczak, San Diego, CA
W7AOB, John A. Nelson, Longview, WA
*W7CF, Robert W. Donovan, Bellingham, WA
WA7DNK, Fred D. Buttram, Jerome, ID
K7GOR, Edward N. Blake, Bellingham, WA
W7GX, Irvin Weinman, Phoenix, AZ
W7GYH, Edwin F. Goodman, Kennewick, WA
KD7NWI, Robert Hodges, Henderson, NV
*KB7UFM, Zita J. Hallstrom, Seatac, WA
K7WHY, Robert M. Webster, Rigby, ID
N7YCM, Earl D. Smith, Colville, WA
KB8APX, William C. Brown, Saint Albans, WV
W8GID, Warren Jackson Jr, Lyndhurst, OH
WD8IHP, Larry Rain, Mansfield, OH
W8LXE, Donald W. Hein, Saint Clair Shores, MI
WB8NFZ, Russell K. Ferrell, Huntington, WV
N8NQS, David Bostedor Jr, Jackson, MI
W8RF, James A. Purdy, Fayetteville, NY
W8UDN, Edward Kopp, Broadview Heights, OH
W8ZGN, Clifford E. Lien, Applegate, MI
KA9ALC, Ronald A. Boden, Lakefield, MN
W9EKK, George N. Spillman, South Bend, IN
WD9IWY, John A. Wilson, Cloverdale, IN
W9LAS, Linda A. Schulz, Downers Grove, IL
K9NH, Charles L. Luyster, Winneconne, WI
W9NHM, Howard T. Francis, Park Forest, IL
K9PGE, John H. Gibson, Milwaukee, WI
W9PQQ, Samuel G. Saar, Valparaiso, IN
KB9SCA, Jerry W. Armstrong, Geneva, IN
K9UQI, Richard K. Williams, East Moline, IL
*WA9ZLD, Gerald Marion, Fort Wayne, IN
KCØACQ, Steven C. Klenc, Jefferson City, MO
*NØBCI, Helen L. Grauer, Wilson, KS
WØGKU, Iris U. Boyd, Sioux Falls, SD
NØIEA, Maj John G. Strenge Jr, Kansas City, MO
KØQIQ, James D. Anderson, Raymore, MO
KØSIN, Clifford J. Hanson, Minot, ND
KCØTV, Donald J. Parrish, Lake City, MN
WØWAJ, Jerry V. Sergeant, Davenport, IA
PJ7RO, Orlando A. Rumnit, St Maarten
VE3TN, John Tunea, Windsor, ON

*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

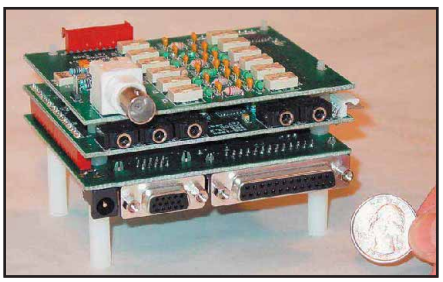
Kathy Capodicasa, N1GZO ♦ Silent Key Administrator ♦ n1gzo@arrl.org

NEW PRODUCTS

SOFTWARE DEFINED TRANSCEIVER FROM FLEXRADIO SYSTEMS

◊ FlexRadio Systems is now shipping the SDR-1000, a software transceiver based on AC5OG's *QEX* series, *A Software Defined Radio for the Masses* The radio consists of an assembled and tested three-board set, which provides general coverage reception from 11 kHz to 65 MHz and transmits at 1 W on all amateur bands within the range. The SDR-1000 connects to a PC sound card and a parallel port. The SDR-1000's modulation, demodulation and control are defined by software that is open to modification by the user. Since all functionality is defined in software, the radio allows the user to integrate new modes and control features.

Source code in Visual Basic 6.0, under GNU General Public License, comes with the purchase of the SDR-1000.



SDR-1000 three board set, $499. For more information, contact FlexRadio Systems; tel 512-250-5435; **www.flex-radio.com**.

STACKMATCH II FROM ARRAY SOLUTIONS

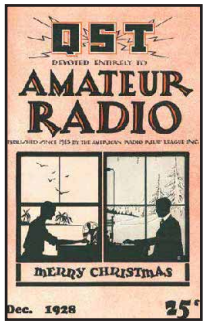
◊ Array Solutions of Sunnyvale, Texas, has recently added the StackMatch II to its line of stacked antenna RF management systems. The StackMatch II is designed to provide flexibility when directing RF to and from a stacked pair of monoband or multiband antennas. By stacking and combining multiple antennas, you can obtain gain over that of the individual antennas or modify the resultant pattern.

The StackMatch II provides control of the take-off angles of a two antenna stack, including splitting the beam into ones directed in two different directions. A desktop control box with a single four-position rotary switch and three LED indicators allows the user to select either the upper antenna, the lower antenna or both antennas in phase. An optional feature allows the user to feed both antennas out of phase, which results in a high angle lobe.

Two different versions of the StackMatch II are available. One works from 1.8 to 30 MHz and is rated for up to 3 kW CW. A second covers 7 through 54 MHz and is rated for up to 3 kW CW on HF and 2 kW CW on 6 meters. Contact Array Solutions, 350 Gloria Rd, Sunnyvale, TX 75182; tel 972-203-2008; fax 972-203-8811; **wx0b@arraysolutions.com**; **www.arraysolutions.com**.

75, 50 AND 25 YEARS AGO

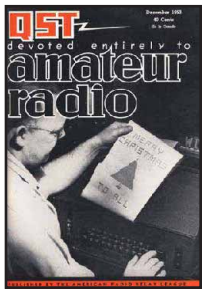
December 1928



♦ The cover silhouette drawing shows two hams exchanging "Merry Christmas" greetings—one in a tropical clime and the other in a northerly snowscape. The editorial reports that "The International Amateur Radio Union has adopted a new constitution whereunder it becomes an international federation of independent national amateur societies like our A.R.R.L." Bravo!

Earl Springer, W9BWI, tells about "The Construction and Operation of a 3500-kc. Crystal-Controlled Phone." In "Push-Pull Transmitters," James Lamb, W1CEI-W1SZ, discusses his 100-watt push-pull, tuned-grid, tuned-plate transmitter. "Radio on the Byrd Expedition" tells about the radio equipment used by the Commander, who "is at this moment somewhere between here and the South Pole." Lloyd Goldsmith and Earl Cullum describe "The Army-Amateur Transmitter W1WF, First Corps Area," built by MIT for their Signal Corps R.O.T.C. unit. J. M. Grigg discusses the advantages of having the receiver's intermediate-frequency amplifier just below the broadcast band, in "An Improved Superheterodyne." Eugene Woodruff, W8CMP (Director, Atlantic Division), tells how to build "A Frequency Meter Combined with Your Receiver." George Grammer, W3AIH, makes "Some Suggestions for the Monitor," used to check your transmitted signal.

December 1953



♦ The cover photo shows W1AW "Chief Op 'mp' printing out an RTTY Christmas Greeting for all hams, everywhere. The editorial looks at the Novice license at the end of its first two years of existence. Everything is positive, except that the new license class did not make much change to the number of people entering Amateur Radio. One astute comment notes that "It may well be that the key to amateur radio's growth lies not entirely in promotion and advertising and other printed media, but rather more fully in personal interest and guidance."

Bob Lenland, W8GBT, describes his very professional-looking rig, in "A De Luxe 5-Band Mobile Transmitter." John Ticen, W9UUV, tells how he modified a military surplus command transmitter to reduce the likelihood of TVI, in "Operating the BC-696 in TV Fringe Areas." Following another path to solving a TVI problem, "Strays" reports that "W2AOC, who has a first-floor apartment, tells W1HDQ he finally solved the third-floor TVI problem. He's marrying the complainant." Three large 2-meter arrays are pictured in "So-o-o Big!"—W3QKI's 104-element array, W1CCH's 60 elements, and W1VLH's 32 elements. Six bands with TVI suppression are featured in "A Two-Control Multiband Transmitting Unit," built by Hugh Herring, W3KMA.

December 1978

♦ The cover shows "The IARU Project Goodwill" transmitter as a partially unwrapped gift under the Christmas tree. The editorial discusses the upcoming "WARC-79" and what it means to the amateur service.

Jay Rusgrove, W1VD, describes a mate for the 20-meter, high-performance, direct-conversion receiver featured in April 1978 *QST*, in "A 20-Meter, VXO-Controlled, 6-Watt Transmitter. J. A. Hardcastle, G3JIR, reports on the results of "Some Experiments with High-Frequency Ladder Crystal Filters." Dick Simpson, W6JTH, piques the reader's interest with "What Next after Moonbounce? Venus Bounce!" Spencer Schubbe, N8AP, tells about a good radio club project to improve the receiver's CW performance, in "The Club Filter." Margaret Koerner, KØIQ, presents Part 2 of "Aerial Performers of the Radio Circuits," discussing why some antennas get out better than others. John Troster, W6ISQ, once again tickles our funny bones, this time with "The Contester." Stan Horzepa, WA1LOU, tells about hams helping out following massive flooding in Texas, in "Three Feet of Rain"—a 27-hour deluge in an area that averages only two feet of rain per year! In "Happenings," Bob and Ellen White, W1CW and W1YL, respectively, are shown receiving honorary PhD (Doctor of Amateur Radio) degrees from Kansas City Mayor Charles Wheeler at the Missouri State ARRL Convention. The photo is priceless! 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 1.818, 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

December 6-7
West Central Florida Section, Palmetto/Tampa*

January 10
SWOH Digital Symposium, Middletown, OH

January 18
New York/Long Island Section, Oyster Bay

February 6-7
Mississippi State, Jackson

February 7-8
Florida State, Miami

***See November *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 **December 1** to be listed in the **February** 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.)

Florida (Boca Raton)—Jan 10. Lew Lehman, K4LEW, **k4lew@juno.com**.

†Florida (Ft Myers)—Jan 10, 9 AM to 4 PM. *Spr:* Fort Myers ARC. Araba Shrine Temple, 2010 Hanson St; US 41 N or S to Hanson St, turn E onto Hanson St, Temple is 500 feet on right. Seminars, QSL card checking. *TI:* 146.88. *Adm:* $5. Tables: $15. Paul Horton, K4OVC, 4111 Hidden Acres Circle, N Ft Myers, FL 33903; 239-995-8951; **phorton@peganet.com**.

†Indiana (Greenfield)—Dec 14; set up Saturday 6-10 PM, Sunday 6-8 AM; public 8 AM to 2 PM. *Sprs:* Hancock ARC and Greenfield Central Tech Club. Greenfield Central High School (Pavilion Building), 810 N Broadway; I-70 to Exit 104 (St Rd 9), go S to first stop light past I-70, turn right (New Rd), turn S on Broadway, go past 4-way stop to school on right. Vendors, VE sessions. *TI:* 145.33. *Adm:* advance $4, door $5. Tables: 8-ft $13 (includes 1 admission); additional tables $10 each. Brad Hewson, KB9VZL, Box 822, Greenfield, IN 46140-0822; 317-326-1659; **kb9vzl@msn.com**; **www.w9atg.org**.

†ARRL Hamfest

†Michigan (Lowell)—Jan 3, 9 AM to 1 PM. *Spr:* AR Group of Youth in Lowell. Lowell High School, 11700 Vergennes, located 15 miles E of Grand Rapids; Lowell High School is 2 miles NW of the city of Lowell; take Lincoln Lake Ave for 1 1/2 miles N to Vergennes, then 1/2 mile W to High School. VE sessions, lots of free parking. *TI:* 145.27 (94.8 Hz). *Adm:* $5. Tables: $5. Al Eckman, WW8WW, 11700 Vergennes, Lowell, MI 49331; 616-897-4125; **AEckman@lowell.k12.mi.us**.

†Wisconsin (Waukesha)—Jan 3, 8 AM to 2 PM. *Spr:* West Allis RAC. Waukesha County Expo Center, 1000 Northview Rd; I-94 W to Exit 294 (Cty J), S to Cty FT, W to Expo Center. Ham Radio, Computer, and Electronics Swapfest; VE sessions (AMF Waukesha Lanes, across from Expo; bring your original license with photocopy, CSCEs with 2 photocopies, 2 IDs, 1 must be photo ID); QSO party. *Adm:* advance $4, door $5. Tables: advance $14 per 8-ft, door $16 (if available); electrical outlet $16 (advance only). Send business size SASE by Dec 27 to WARAC Swapfest, Box 1072, Milwaukee, WI 53201. Phil Gural, W9NAW, 414-425-3649; **janphil@execpc.com**; **www.warac.org**.

Attention All Hamfest Committees!

Get official ARRL sanction for your event and receive special benefits such as donated ARRL publications, handouts, and other support.

It's easy to become sanctioned. Contact the Convention and Hamfest Branch at ARRL Headquarters, 225 Main St, Newington, CT 06111. Or send e-mail to **giannone@arrl.org**.

Promoting your event is guaranteed to increase attendance. As an approved event sponsor, you are entitled to advertise your event in *QST* at special rates. Make your hamfest a success by taking advantage of this great opportunity. Call the ARRL Advertising Desk at 860-594-0207, or e-mail **ads@arrl.org**. QST

Gail Iannone ♦ Convention Program Manager ♦ giannone@arrl.org

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 August 9 to October 8, 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

1316	AB0CT	G8BQX	575
1317	W1DYJ	JF1IRW	200
1318	AC4Q	ZS6WB	600
1319	EI2JD	KØTLM	625
1320	K5VH	KU0A	175
1321	K7AWB	WA1MKE	200
1322	W5WVO	K1LH	575
1323	NL7AU	K1BD	200
1324	KØWYN	K1SIX	950
1325	K4KJZ		
1326	AB4GG	W3EP	925
1327	KC2HLI	K4RWP	625
1328	KT4HN	W5CIA	350
1329	KU4WW	AA5C	425
1330	AD6W	NEØP/5	250
1331	WA4JA	AC5DK	150
1332	N5KI	N6JV	550
1333	WA4QMQ	K6QG	400
1334	ZR6DXB	WO7GI	150
1335	KB3JGS	WX7M	450

144 MHz
100

621	AA4ZZ
K1LH	175
KU4WW	150
K5VH	175

222 MHz
50

115	KMØT
AA5C	70

432 MHz
50

304	KU4WW
305	NY2Z

1296 MHz
25

138	K5VH

2.3 GHz
10

70	K5VH

3.4 GHz
5

63	K5VH
64	W1AIM

5.7 GHz
5

45	KE7SW

10 GHz
5

140	N7MWV
141	K5VH
142	WB8TGY
143	KA1OJ
144	N6JV

24 GHz
5

22	N1JEZ
23	WW8M

Satellite
100

128	KC2HLI
129	NEØP/5
130	EB4AFK
XE2AT	625
N1HOQ	300
N5AFV	500
K5OE	850

QST

FEEDBACK

◊ In "The DBJ-1: A VHF-UHF Dual-Band J-Pole" (Feb 2003, pp 38-40), the length of the RG-174 matching stub should be shortened a bit to get the antenna closer to a 1:1 SWR. Using the formula for line length versus frequency and wavelength,

$L = (VF \times 984 \times N) / f$

where

L = length (in feet),
VF = velocity factor,
N = number of wavelengths and
f = frequency in MHz

◊ The velocity factor of RG-174 (Belden 8216) is 0.66 (Belden 7805 cable is 0.74) and N = 0.25 for a 1/4 wavelength stub. Using the above equation, the matching section becomes 4.33 inches, rather than the 5.25 inches shown. Thanks to Bruce, W3NJ, for pointing it out. He's using a stub length of 4.5 inches and getting 1:1 with that length. As was pointed out in the article, however, you should use an SWR analyzer or bridge for final tuning.

◊ "The Dangers of Cathode Keying" (Nov 2003, pp 28-30) states that the cathode of the keyed stage floats up to plate potential. Actually, the open-circuit cathode potential will be limited by the grid-cutoff voltage, which in most 1950s-era tube transmitters is about 100 V dc. Thanks to P. Bertini, K1ZJH, for pointing it out. This will, of course, be the open-circuit key voltage. It doesn't change the argument for safety, however. That key-line is a good current source, as the full final plate current passes through the key (and more, if the oscillator is also keyed). It's possible, therefore, to draw 50-100 mA by touching the key contacts with moist skin. The bottom line? Use a keying relay if you can and be careful around the key when you're using a vintage cathode-keyed tube rig.

◊ The Feedback for "The Doctor is IN" (Oct 2003, p 106) should read "…the formula for the LC constant should be used with L in µH and C in pF (not H and F) in addition to f in MHz." That derivation is straightforward if one accounts for the 10^{-6} term for µH, the 10^{-12} term for pF and the 10^{6} term for MHz.—*tnx Fred Grant, AA4NG*

CONTEST CORRAL

W1AW Qualifying Runs are 10 PM EST Thursday, Dec 4 (0300Z Dec 5) (10-40 WPM), and 9 AM Friday, Dec 19 (1400Z Dec 19). The K6YR West Coast Qualifying Run will be at 9 PM PST Wednesday, Dec 17 (0500Z Dec 18). Check the W1AW Schedule elsewhere in this issue for details.

Feedback

In the 2003 ARRL International DX Phone Contest, the Cabrillo log file submitted showed the operator of the **W3BGN** entry as **W2BGN**.

Dec 4

Top Band Sprint—CW/SSB, sponsored by QRP ARCI, 0000Z-1200Z Dec 4. Frequencies: 160 meters only. SO-CW, SO-SSB, SO Mixed-Mode categories, no time limit. Exchange: RST, S/P/C and Pwr or QRP ARCI number—work stations once per mode. QSO points: members—5 pts, nonmembers/different continent—4 pts, nonmembers/same cont.—2 pts. Score: QSO points × total S/P/C × power mult (<250 mW ×15, 250 mW—1 W × 10, 1-5 W ×7, >5 W ×1). For more information: **personal.palouse.net/rfoltz/arci/top.htm**. Logs due 30 days after the contest to **rfoltz@turbonet.com** or Randy Foltz, K7TQ, Attn: Top Band Sprint, 809 Leith St, Moscow, ID 83843.

Dec 5-8

ARRL 160-Meter Contest—2200Z Dec 5-1600Z Dec 7. See Nov *QST* p 112, or **www.arrl.org/contests**.

TARA RTTY Mêlée—sponsored by the Troy Amateur Radio Assn, 0000Z-2400Z Dec 6. Categories: SOAB-HP (>150 W), SOAB-LP (<150 W), MOAB, SWL, 10 min band change rule for MO. Frequencies: 80-10 meters, operate 16 hours max. Exchange: RS + state/province or serial number for DX. QSO points: 1 pt/QSO. Score: QSO points × S/P/C counted once only (US and VE only count as S/P). For more information: **www. n2ty.org/seasons/tara_melee_rules.html**. Summary sheets (no logs) due Dec 31 via on-line submission form at **www. n2ty.org/seasons/tara_melee_score.html**.

PSK31 Death Match—PSK31 and PSK63, sponsored by the Michigan DX Association, 0000Z-2400Z Dec 6. Frequencies: 80-6 meters, PSK31 and PSK63 count as separate "bands." Categories: SO, Class 1 (<100 W), Class 2 (<25 W), Class 3 (<10 W). Exchange: Name + S/P/C. QSO points: 20 meters—1 pt/QSO, 6 meters—3 pts/QSO, other bands—2 pts/QSO. Bonus points: W8DXI 500 pts (once) and 100 pts for uploading logs to LoTW within 30 days of contest. Score: QSO points × total S/P/C + bonus points. For more information: **www.geocities.com/mdxa1/deathmatch.html**. Logs due 30 days after the contest to **k8khz@yahoo.com** or Brian R. Pawloski W8BRI, PO Box 140012, Grand Rapids, MI 49514-0012.

Holiday Spirits Homebrew CW Sprint—sponsored by the QRP ARCI, 2000Z-2400Z Dec 7. Frequencies (MHz)—1.810, 3.560, 7.040, 14.060, 21.060, 28.060 kHz. Categories: SOAB, SOSB, SO20-10, SO160-40, MOAB, DX stations are SOAB only. Exchange: RST, S/P/C, and Power or QRP ARCI number. QSO points: members—5 pts, nonmembers/different continent—4 pts, nonmembers/same cont—2 pts. Score: QSO points × S/P/C (counted once per band) × power multiplier (<250 mW ×15, 250 mW—1 W ×10, 1—5 W ×7, >5 W ×1) + bonus points (2000 for homebrew (HB) xmtr, 3000 HB rcvr, 5000 HB xcvr). For more information: **personal.palouse.net/rfoltz/arci/holispr.htm**. Logs due 30 days after the contest to **rfoltz@turbonet.com** or Randy Foltz, K7TQ, Attn: Holiday Spirits Sprint, 809 Leith St, Moscow, ID 83843.

Dec 13-15

ARRL 10-Meter Contest—0000Z Dec 13-2400Z Dec 14. See Nov *QST*, p 112, or **www.arrl.org/contests**.

Great Colorado Snowshoe Run—CW, sponsored by the Colorado QRP Club from 0200Z-0400Z Dec 14. Frequencies: 40 meters only. Categories: SO-QRP (antenna classes of Wires, Verticals or Beam) Exchange: RST + S/P/C + Antenna Class + CQC no. or Power. The same station may be worked up to three times, with 30 minutes between QSOs. QSO points: 1st QSO with station—3 pts, 2nd QSO—2 pts, 3rd QSO—1 pt. Score: QSO points × S/P/C × CQC members. For more information: **www.mtechnologies.com/cqc/contests**. Logs due Jan 17 to **contest@cqc.org** (ASCII only) or Snowshoe, c/o CQC, PO Box 371883, Denver, CO 80237-1883.

DPX (Digital Prefix) Contest—PSK, MFSK, MT63, RTTY, Hellschreiber, Throb, Packet, sponsored by the Penn-Ohio DX Society, 0000Z-2400Z Dec 13. Frequencies: 160-6 meters. Categories: SO—Single Mode, and Multi-Mode (requires separate entries), SWL. Exchange: name, prefix and 070 Club member number or S/P/C. Score: QSOs × WPX prefixes × power multiplier (<100 W ×1, <20 W ×2, QRP ×3). For more information: **www.qsl.net/wm2u/070_dpx.html**. Logs due Jan 10 to **wm2u@arrl.net** or via the on-line form at **podxs.com/html/DPX_online_score.html** or Ernest Mills WM2U, 9 Morningside Dr, Ballston Lake, NY 12019-1531.

North American Meteor Scatter Contest—any mode, sponsored by the WSJTGROUP from 0000Z Dec 12- 0700Z Dec 15 (the Geminids meteor shower). Frequencies (MHz): 50, 144, 222, 432, via meteor scatter. Categories: SOSB, SOAB, (HP, LP <200 W). No QSOs with your own or adjacent grid squares, QSOs are counted as Scheduled or Random. Exchange: full call signs, grid square and QSOs must be acknowledged. QSO points: 50 and 144—1pt/QSO, 222—3 pts/QSO, 432—10 pts/QSO. Score: QSO points × grid squares counted once per band + random QSOs. For more information: **www.qsl.net/wa5ufh/Rally/NAHSMS. htm**. Logs due Jan 12 to **wa5ufh@ykc.com** or Randy Tipton, 778CR123, Edna, TX 77957.

Dec 20-21

OK DX RTTY Contest—sponsored by the Czech Radio Club, 0000Z-2400Z Dec 20. SOAB, SOSB, MOAB, SWL categories. Frequencies: 80-10 meters according to IARU band plan. Exchange: RS and CQ Zone. QSO points: 80 and 40—3 pts on same continent, 6 pts different cont., 20-10—1 pt same cont., 2 pts different cont. Score: QSO points × DXCC entities + OK stations (counted once per band). For information: **www.crk.cz/ENG/DXCONTE.HTM**. Logs due Jan 15 to **okrtty@crk.cz** or Czech Radio Club, OK DX RTTY Contest, PO Box 69, 113 27 Praha 1, Czech Republic.

Russian 160-Meter Contest—CW/SSB. sponsored by *Radio* Magazine, from 0000Z-0200Z Dec 20. Categories: SO, MO, SO and MO 18 years and younger, Mixed Mode only. Exchange: RST, serial number and square ID (see **www.radio.ru/cq/contest/rule/map-2.gif** for a map showing the squares). QSO points: own square—1 pt, adjacent sq—2 pts, 1 additional pt each additional square distant. Score: total QSO points. For more information: **www.radio.ru/cq/contest/rule** (Cyrillic only). Logs to **contest@radio.ru**, or *Radio* Magazine, Seliverstov per. 10, Moscow 107045, Russia.

Croatian CW Contest—sponsored by Hrvatski Radioameterski Savez (HRS), from 1400Z Dec 20-1400Z Dec 21. Frequencies: 160-10 meters. Categories: SOAB (HP >100 W, LP, QRP <5 W), SOSB (HP, LP), MO, SWL. Exchange: RST + serial number. QSO points: 9A stations—10 pts on 160-40, 6 pts 20-10; different cont—6 pts 160-40, 3 pts 20-10; own cont and country—2 pts 160-40, 1 pt 20-10. Score: QSO points × WAE countries on all bands. For more information: **www.inet.hr/~vzugcic/9acwtest.htm**. Logs due 30 days after the contest to **zmaticic@inet.hr** or Hrvatski Radioameterski Savez (HRS), Croatian CW Contest, PO Box 149, 10003 Zagreb, Croatia.

Dec 20-Jan 4

Lighthouse Christmas Lights QSO Party—all modes, sponsored by the Amateur Radio Lighthouse Society, 0000Z Dec 20-2400Z Jan 4, 2004. Frequencies (MHz): CW—1.830, 3.530, 7.030, 14.030, 21.030, 28.030, SSB—1.970, 3.970, 7.270, 14.270, 21.370, 28.370. Exchange: year first licensed or ARLS member number or ARLS Lighthouse number + name + S/P/C. QSO points: ARLS member—3 pts, ARLS Lighthouse—6 pts, 1 pt otherwise. Score is QSO points, stations activating light beacons multiply by 1.5. For more information: **arlhs.com/LCL-2003-guidelines.html**. Logs due Jan 31 to Dave Ruch, NFØJ, PO Box 20696, Bloomington, MN 55420-0696.

Dec 26

DARC Christmas Contest—CW/SSB, sponsored by the Deutscher Amateur Radio Club, 0830Z-1100Z Dec 26. Frequencies (MHz): CW—3.510-3.560, 7.010-7.040, SSB—3.610-3.650 and 3.700-3.775, 7.040. Categories: SO-Mixed, SO-CW. Exchange: RS(T) + DOK or Special Station code. QSO points: 1 pt/QSO. The station calling CQ must QSY after making a QSO. Score: QSO points × DOK codes + WPX prefixes. For more information: **www.darc.de/referate/dx/fedcx.htm**. Logs due 3 weeks after the contest to **xmas@darc.de** or Markus van Bergerem, Brandenberg 5, D-47533 Kleve, Germany.

Dec 27-28

RAC Winter Contest—CW/Phone, sponsored by the Radio Amateurs of Canada, 0000Z-2359Z Dec 27. Frequencies (MHz): CW—25 kHz up from the band edge (check on the half hour), Phone—1.850, 3.775, 7.075, 7.225, 14.175, 21.250, 28,500 kHz, 50 and 144 MHz. Categories: SOAB-LP, SOAB-HP, SOAB-QRP, SOSB, SO-NonVE, MS-LP, MO-HP, and MM. VE stations exchange RST + Province, VEØ and non-VE stations exchange RST + serial number. QSO points: Outside Canada—2 pts, VE/VEØ stations—10 pts, RAC stations—20 pts. Score: QSO points × VE provinces + territories (counted once per band and mode). For information: **www.rac.ca/CANWIN.htm**. Logs due Jan 31 to **ve7cfd@rac.ca** or Radio Amateurs of Canada, 720 Belfast Rd, Suite 217, Ottawa, ON Canada, K1G0Z5.

Stew Perry Top Band Distance Challenge—CW, sponsored by the Boring Amateur Radio Club, 1500Z Dec 27-1500Z Dec 28. Categories: SO and MS. Operate 14 hours max. Exchange: grid square only. QSO points: 1 pt + 1 pt for every 500 km distance calculated between grid centers (see Web page for calculation information), QSOs with QRP stations that submit a log count double QSO points. Score: QSO points × power mult (<5 W ×4, 5-100 W ×2, >100 W ×1). For more information: **jzap.com/k7rat/stew.rules.txt**. Logs due Jan 31 (Cabrillo format only) to **tbdc@contesting.com** or Boring Amateur Radio Club, 15125 SE Bartell Rd, Boring, OR 97009.

Dec 31

ARRL Straight-Key Night—see p 96 of this issue of *QST* or **www.arrl.org/contests**. QST

H. Ward Silver, NØAX ♦ 22916 107th Ave SW, Vashon, WA 98070 ♦ n0ax@arrl.org

SPECIAL EVENTS

Plymouth, MA: Whitman Amateur Radio Club, WA1NPO. 1400Z **Nov 29**-2000Z **Nov 30**. The first Pilgrim Landing at Plymouth, Massachusetts. 28.360 14.270 7.250 3.890. Certificate. Whitman ARC, PO Box 48, Whitman, MA 02382.

Quincy, IL: Western Illinois Amateur Radio Club, K9C. 0000Z **Dec 1**-2359Z **Dec 15**. Christmas Avenue of Lights, Quincy, Illinois. 28.350 21.350 14.250 7.250. Certificate. Robert G. Mitchell, 816 Long Drive, Quincy, IL 62305.

Orillia, ON Canada: The Wireless Set No. 19 Group, VC3F. 0001Z **Dec 1**-2359Z **Dec 31**. A Canadian celebration of the Centennial of Flight. 28.360 14.190 7.163. QSL. Bob Cooke, 424 Homewood Ave, Orillia, ON Canada L3V 3K8.

Winchester, VA: Mt Weather Amateur Radio Club, W4M. 2200Z **Dec 5**-2300Z **Dec 14**. 100th anniversary of Mt Weather Virginia. 28.400 21.365 18.145 14.028 7.245. Certificate. Robert Blankinship, AG4SO, 126 Kinross Dr, Winchester, VA 22602.

Brainerd, MN: Brainerd Area Amateur Radio Club, WØUJ. 1500Z-2300Z **Dec 6**. 80th Anniversary of the Milford Mine Disaster. 28.450 21.350 14.250. Certificate. BAARC, PO Box 801, Brainerd, MN 56401. **www.brainerdham.org**.

Grand Junction, CO: Western Colorado Amateur Radio Club, NØW. 1600Z-2300Z **Dec 6**. National SkyWarn Day. 28.360 21.260 14.260 7.230. QSL. Bob Vogel, WØRY, 155 Ponderosa Dr, Fruita, CO 81521. **www.wcarc.ws**.

Baltimore, MD: Historical Electronics Museum Amateur Radio Club, W3GR. 1300Z **Dec 6**-2100Z **Dec 7**. Commemorating the 1941 attack on Pearl Harbor. 14.241 14.041 7.241 7.041. Certificate. W3GR—HEMARC, PO Box 746, MS 4015, Baltimore, MD 21203. **www.qsl.net/w3gr**.

Northeast USA: East Coast Amateur Radio Service, W1E. 1200-2200Z **Dec 6**-1200-2200Z **Dec 7**. Celebrate the 35th Anniversary of ECARS. 7.255. Certificate. Jerry Rogich, AA2T, 69 Beth Ave, Leominster, MA 01453. **www.ecars7255.com**.

Baton Rouge, LA: USS *Kidd* ARC/Baton Rouge ARC, W5KID. 1500Z-2300Z **Dec 7**. Pearl Harbor Day. General class bands, 14.250 to 14.320; CW QRP subbands. QSL. W5KID, c/o USS *Kidd* Museum, 305 S River Rd, Baton Rouge, LA 70802.

Kitty Hawk, NC: North Carolina Special Events Group (NCSEG), W4B. 1700Z **Dec 12**-2000Z **Dec 17**. 100th anniversary of the Wright Brother's First Flight. 21.330 14.260 7.260 3.860. Certificate. W4B Special Event, PO Box 3228, Shelby, NC 28151. **ncseg.org**.

Nazareth-Bethlehem, PA: Christmas City ARC and Delaware-Lehigh ARC, WX3MAS. 1400Z **Dec 13**-0200Z **Dec 15**. Annual Christmas greetings from the twin Christmas Cities. 28.465 21.365 14.265 7.270 3.970. Certificate. CCARC/DLARC, WX3MAS, Greystone Building, Gracedale Complex, RR 8, Nazareth, PA 18064. **www.dlarc.org**.

McPherson, KS: McPherson Amateur Radio Club, WØT. 0601Z **Dec 15**-0600Z **Dec 23**. 45th anniversary of McPherson Club WØTWU. 21.280 14.280 7.280 3.928. QSL. Gerald Pelnar, 801 South Walnut, McPherson, KS 67460.

Vacaville, CA: Aeronautical and Maritime Radio Club of California, W1C. 0000Z **Dec 17**-0200Z **Dec 18**. 100th anniversary of Wright Brothers First Flight (from aircraft in flight if weather permits). 28.475 14.272 7.250 3.972. Certificate. Bill Alber, WA6CAX, PO Box 799, Suisun City, CA 94585.

Belen (Bethlehem), NM: Valencia County Amateur Radio Association, KC5OUR. 1400Z **Dec 18**-2400Z **Dec 25**. Celebrating Christmas Season from Bethlehem, NM. 28.370 21.370 14.270 7.270. QSL. KC5OUR, Valencia County ARA, PO Box 268, Peralta, NM 87042.

Salisbury, NC: Rowan Amateur Radio Society, W4EXU/250. 1300Z **Dec 28**-2400Z **Dec 31**. Celebrating the 250th anniversary of Rowan County's charter. 28.355 21.355 14.285 7.275. Certificate. Rowan Amateur Radio Society, PO Box 593, Salisbury, NC 28145.

Certificates and QSL cards: To obtain a certificate from any of the special-event stations offering them, send your QSO information along with a 9×12 inch self-addressed, stamped envelope to the address listed in the announcement. To receive a special event QSL card (when offered), be sure to include a self-addressed, stamped business envelope along with your QSL card and QSO information.

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 **Feb** *QST* would have to be received by **Dec 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

QEX INCLUDING: COMMUNICATIONS QUARTERLY

In the November/December issue:

- Jim Scarlett, KD7O, describes transmit functions in part 3 of the series about his software defined radio. Also, L. B. Cebik, W4RNL, tells us how to make reality converge with design goals in large multiband quad antenna arrays.
- Evidently, *QEX* is reaching Eastern Europe, as well as China and other formerly remote areas! We have an article from Oleg Skydan, UR3IQO, about fractional-N synthesizers. Oleg is in Ukraine. He has lately been able to obtain parts to build his unit, the performance of which is outstanding.
- Frank Brickle, Jr, AB2KT, offers his thoughts on how to accomplish automatic signal identification in software radios. In our view, this is an exciting area for experimentation for hams. Combined with antenna beamforming and other adaptive techniques, we think there is much promise for future development. John Gibbs, KC7YXD, finishes his series on D-STAR. The system fulfills many of the wishes expressed in response to the ARRL's Technical Working Group (TWG) survey conducted several years ago.
- Richard Kiefer, KØDK, brings us an EMI finder that incorporates some useful design techniques at UHF. Even though the design is not centered on a ham band, it does involve frequencies that are useful in looking for interference sources. In *RF*, Zack Lau, W1VT, tells us about building microwave quads and Yagis.

QEX is edited by Doug Smith, KF6DX/7, (e-mail **dsmith@arrl.org**) and is published bimonthly. Subscription rate (6 issues) for ARRL members is: US, $18; Canada, Mexico and US by First Class mail, $31; elsewhere by airmail, $51 or by surface mail (4 to 8 week delivery), $23. 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.org/writing.html**. If you prefer postal mail, send a self-addressed, stamped envelope (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*.

STRAYS

QST congratulates . . .

◊ Raymond C. Benedict, W8LYJ, of Columbia, Maryland, who was elected president of the Society of Broadcast Engineers in September. Benedict is director of spectrum management for Viacom, Inc.

◊ Ian Poole, G3YWX, of Staines, England, whose book, *Newnes Guide to Radio and Communications Technology*, has just been published. For more information, see **www.newnespress.com** or via e-mail, **directorders@elsevier.com**.

◊ SSG Brian Plesich, KA8RRP, of Steubenville, Ohio, a recipient of the Bronze Star for his service in Iraq. Brian also served in the Gulf War and in Bosnia.—*Joe Plesich, W8DYF*

STUDENT TV NETWORK CONVENTION IN JANUARY

◊ The Student Television Network, the only national organization that represents high school broadcasting students and teachers, will have its first national conference January 8-10, 2004 in Los Angeles. Fred Mann, N5IVZ, of McAllen, Texas, serves on the national steering committee for the conference, and just completed a two-year term as STN president. The STN Web site is at **www.studenttelevision.com**.

By **Dan Henderson, N1ND**
Contest Branch Manager

The Ham in The Hat—ARRL Field Day 2003

With apologies and homage to Theodor Geisel

The Sun it did shine as they started to play.

In some places it rained on that warm late June day.

The annual rite known as Field Day had come

Though it would mean work—It would also mean fun.

At thousands of places some walked and some sat

Some were lanky. Some tall. Some short. Some were fat.

But at each Field Day site like Babe Ruth with his bat

*Would be a great leader...**The Ham in The Hat***

When the summer solstice arrives, thoughts of the Amateur community throughout the Americas are fixed on what has perhaps become the greatest operating event each year—ARRL Field Day. In 2003, from near the Arctic Circle in Alaska to Palmer Station, Antarctica… Across the states of the US and the provinces and territories of Canada… With several DX stations participating (including the first-ever joint US-Cuban Field Day operation (see page 45 of this issue)… Field Day continued in the tradition of being a premier test of our hobby's emergency communications capability.

The Ham in The Hat said "Do not frown or be blue

To get this place ready there is so much to do.

We all know a trick we can use in this race

For all have some skill they can bring to this place."

Some hung their antennas from high-flying big kites

Some ran their transmitters by peddling their bikes.

Preparation for Field Day is rarely left to the last minute. Some groups book their site the day after the end of the previous Field Day. Recruiting band captains and operators…testing the generator… planning the site layout… advertising to the public...inviting special guests…The "to do" list for Field Day can go on and on. In 2003, entries were received from a total of 2080 groups and individuals. This is a slight decrease in logs from the previous year, but still marks the third highest number of reports ever received for the event.

Some sat inside trailers. Some sat inside tents

Some sat safe inside front of cold AC vents.

While ol' Mr Murphy at times got his kicks

'Twas Field Day that won with some twists and new tricks.

This year, a new entry class was added—**the Class F or EOC Station**. They accounted for a total of 8% of all entries received during 2004. This new category encouraged groups to coordinate their operations with their various local and state Emergency Operations Centers—a key interface in any emergency plan. Class A, as always, was the most popular category, accounting for about 59% of all entries. Among the Class A operations, over one-third (38%) operated with 2 transmitters, making it the most popular individual category (see Table 1).

There was a decline in the number of reported participants during this year's Field Day—32,100, down 7% from 34,398. One astute Field Day observer noted that this may not have been due to

The Ham in The Hat paid a visit to the AG4KM GOTA station of the W4BS Delta (TN) ARC and must have left his hat. KG4NBM (left) is control operator while W4RMV (right) and K3LK (behind) watch KG4NBM's stepdaughter operate from under the hat.

Table 1
Entries by Section

Class	Entries	Class	Entries	Class	Entries	Class	Entries	Class	Entries	Class	Entries
AB	5	EPA	52	MDC	46	NLI	21	QC	13	TN	37
AK	3	EWA	14	ME	12	NM	24	RI	10	UT	13
AL	23	GA	53	MI	81	NNJ	38	SB	19	VA	47
AR	23	IA	24	MN	27	NNY	9	SC	21	VI	2
AZ	38	ID	11	MO	37	NTX	47	SCV	28	VT	12
BC	25	IL	85	MS	17	NV	7	SD	15	WCF	10
CO	41	IN	55	MT	16	OH	105	SDG	15	WI	44
CT	25	KS	22	NC	57	OK	20	SF	13	WMA	12
DE	5	KY	30	ND	8	ON	52	SFL	27	WNY	29
DX	5	LA	15	NE	11	OR	33	SJV	27	WPA	40
EB	18	LAX	39	NFL	32	ORG	39	SK	6	WTX	11
EMA	25	MAR	9	NH	16	PAC	7	SNJ	14	WV	15
ENY	22	MB	3	NL	3	PR	2	STX	49	WWA	48
								SV	20	WY	10

a lack of interest in 2003, but rather due to increased participation in 2002 following the events of September 11, 2001.

And when Field Day had started, How they talked and they talked.

How they talked and they talked and they talked and they talked

Some talked with CW. Some with single sideband

PSK and with RTTY they talked 'cross the land.

The total number of QSOs reported was off significantly during 2003—down to 1.12 from 1.42 million, or a decline of about 21%. This was in part due to generally very poor propagation, especially on two of the most popular bands—10 and 15 meters. There were declines in the number of QSOs on all three basic modes (see Table 2).

And if you looked up and you stared into space

The great ISS our earthly Field Day did grace.

For the third consecutive year, Field Day has been an "out of this world" experience, thanks to the participation of a licensed amateur on the International Space Station. This year the operator at the helm at NA1SS was Mission Specialist, ISS Flight Engineer Ed Lu, KC5WKJ.

The Ham in That Hat, he would know what to do.

How to use both the rigs—old Rig One and Rig Two.

Many groups they planned hard and included a GOTA

To make sure their group met its high QSO quota.

The "Get On The Air" Station—better known as GOTA—once again proved popular, as a total of 366 GOTA stations were reported. This means about one-third (33.2%) of GOTA-eligible entries took advantage of this unique way to kindle (or rekindle) interest in our hobby.

The Ham in The Hat met officials with glee.

If duty does call, you can always call We!

Keeping the focus on the fact that Field Day is the principal way we demonstrate and test our emergency communications capabilities led to an expansion of the 100 point bonus for having an invited governmental official attend your setup. This time a second 100 point bonus could be earned by having an official of one of the various served agencies attend your Field Day. The majority of the Class A stations cashed in on the expanded bonus, which helps broaden the visibility of ARES, RACES, and Amateur Radio communications in our various communities.

With appetite that sometimes was voracious

To the covered dish-cookers the Ham he was gracious.

No Field Day event is ever complete

Till the dishes are full of good things to eat.

Everyone knows that Field Day has also become "the social event" for many clubs. What better combination to bring people together—good food, great friendship, a learning experience and a challenge to master. Be sure you visit the ARRL Contest Soapbox On-line at **www.arrl.org/contests/soapbox**, where over 140 clubs, groups and individuals across the landscape share a small part of the Field Day story. And consider adding your photographs and memories to the site. It's a great way to share your experience and might serve to pique the interest of a potential new amateur or member for your club.

Members, make sure you visit the expanded Field Day results on-line at **www.arrl.org/contests/results**. There you will find an expanded write-up, some interesting tables and charts, and an interesting sidebar from that eloquent purveyor of propagation lore and knowledge, Carl, K9LA.

The Ham in The Hat, he spent the whole night.

To do something else, it just wouldn't be right.

'Mid thunder and lightning and a great 'puter crash

The Ham in The Hat—then the record did smash.

And what was this record he held so near and so dear?

Why, the record for fun he could have in a year.

And when the last QSO had finished its sound

And antennas were once flat again on the ground

A discovery of great importance was found…

Table 2
Entries By Full Class

Class	Entries	Class	Entries	Class	Entries
1A	184	51A	1	1E	139
2A	460	1B1	124	2E	16
3A	301	2B1	1	3E	5
4A	125	3B1	1	5E	2
5A	81	1B2	67	6E	1
6A	30	2B2	25	1F	55
7A	19	3B2	1	2F	62
8A	9	1C	48	3F	27
9A	3	2C	1	4F	15
10A	3	1D	192	5F	7
11A	3	2D	14	6F	1
12A	2	3D	5	7F	3
14A	1	4D	3	8F	1
15A	1	5D	2	9F	2
17A	1				

Table 3
High Claimed Scores

Call Sign	Score	Class
W3AO	27,834	51 A
W4IY	20,272	17 A
W2GD	15,678	3 A
W6YX	15,610	7 F
K1R	15,198	4 A
W6PT	14,336	2 A
K4BFT	13,960	5 A
W0CQC	12,750	2 A Battery
K7EAR	12,705	3 A Battery
K8ES	12,652	4 A

The all-bicycle mobile station of WD8AAU from Dayton, Ohio. Not a huge score, but Daniel had a great time.

BELLINGHAM HERALD

When you get past the magnificent view of the club's namesake, that's Doyle, KC7GX, mounting the 20 meter Yagi for the K7ZC Mount Baker ARC (WA) CW station.

A discovery discovered at each Field Day around...

The Ham in The Hat was not one ham or two.

It is every ham in the whole Field Day zoo.

Field Day has something that appeals to everyone. It may be the social aspect. It might be the contesting-type atmosphere. Perhaps you are drawn in to accept the challenge of testing your skills under less than optimum circumstances. Your computer skills may be what the group needs to keep them logging. Your old 10 kW generator may be just the thing to allow your group to add the extra station or keep the coffeepot brewing overnight.

Whatever your reason, there are thousands of hams across the bands that share your interests. The time to start planning is now. Field Day 2004 will be held, as always, the fourth full weekend in June—this time around June 26-27. Hope to see you on the bands!

When next summer comes calling do not be caught flat.

But jump in and play. Be the Ham in The Hat.

Scores

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

1A Battery

Chew's Ridge Gang					
K6MI	1080	5	7	11,725	SCV
Guano Reef BP					
N4BP	1032	5	3	11,020	SFL
Contest Quahogs of RI					
W1XX	811	5	4	8,810	RI
Buffalo Lighthouse Group					
K2ZR	632	5	4	6,920	WNY
W0CW Memorial Station					
W0GI	455	5	27	5,250	KS
Los Chupacabras					
WW5X	496	5	8	4,960	STX
Wyoming DX Contest Club					
W7SE	475	5	3	4,850	WY
Bear Mountain QRP Group					
WA5Y	402	5	14	4,405	NM
Neurosa's Gopher Munchers					
AE6C	348	5	3	3,580	SV
Calvary Chapel AR Fellowship					
WK6O	356	5	5	3,410	ORG
Anaconda ARC					
W7VNE	323	5	11	3,190	MT
AD4R	283	5	3	2,845	AL
WNY QRP Society					
K2WNY	254	5	3	2,570	WNY
HI QRP Club & Hilo ARC					
KH6IN	160	5	39	2,400	PAC
New Cuyama Quad Hoppers					
N6PC	236	5	4	1,995	SJV
The Farce					
AK2S	144	5	3	1,540	SNJ
Three Generations of Hams					
AC3V	159	5	4	1,535	EPA
US Department of State ARC					
W3DOS	105	5	3	1,445	MDC
Tidelands ARS					
K5BS	109	5	8	1,330	STX
Rodeo City RC					
N7AAW	44	5	22	620	EWA
ISS ARS					
NA1SS	41	5	1	405	MDC
Gopher ARC @ U of MN					
W0YC	14	5	10	295	MN

1A

The Motley Crew					
W9GG	1629	2	13	6,160	IL
Southern IL DX and Contest Club					
W9HUZ	1255	2	4	5,598	IL
Parma RC					
K8EE	1246	2	3	5,582	OH
Metro DX Club					
W9TY	1405	2	17	5,362	IL
Badger Mtn ARC					
W0CP	1167	2	3	4,768	CO
Big Hill ARC					
K0HP	983	2	5	4,730	SD
Central NC DX Chasers					
N4OL	1146	2	10	4,722	NC
In Memory of N8SM					
K1LT	1155	2	5	4,430	OH
Owensboro ARC					
K4HY	953	2	12	4,420	KY
Gunnison Valley ARC					
W0FD	1694	2	4	4,382	CO
Flying Beers International Broadcast					
K8FBI	1209	2	4	4,228	MI
Robert F. Heytow Memorial Radio					
K9YA	823	2	4	4,192	WI
Car Wash Gang					
W4ARM	968	2	3	3,558	SFL
The Four Hoarse Men					
K5PI	1061	2	4	3,550	STX
Clear Channel Communicators					
KB4VC	1115	2	5	3,508	WCF
Parma Radio Club II					
W8PRC	871	2	12	3,396	OH
Loop Group					
K0RK	1003	2	28	3,354	WCF
Case ARC					
W8EDU	806	2	3	3,316	OH
Comox Valley Friends					
VE7UF	791	2	5	3,232	BC
Hattiesburg ARC					
K5PN	1342	2	14	3,084	MS
Laurens ARS					
K4LSC	512	2	12	3,020	SC
Redmond Top Key Contest Club					
N7KE	655	2	19	3,002	WW
Thomson ARC					
W9RCA	1255	2	25	2,916	IN
Anti-Social FD Group					
N2NO	604	2	3	2,810	NNJ
Dinosaur Valley DX Society					
W5ZG	2104	1	7	2,753	NTX
Dr. Loomis Memorial Jr. Mechanics					
W3KDR	862	2	10	2,734	MDC
Stanly Cty ARC					
K4OGB	670	2	22	2,596	NC
SCAN / Red Ant Annihilators					
WA6P	1101	2	14	2,546	LAX
Butte ARC					
W7FO	722	2	15	2,482	MT
KI7RO	620	2	9	2,244	ID
Arkansas Radio Emergency Services					
N5AT	399	2	24	2,122	AR
Union Metropolitaine des Sans-filistes					
VE2UMS	460	2	43	2,044	QC
Blackstone Valley ARC					
W1DDD	748	2	23	2,030	RI
Hot Springs Village RC					
K5ID	392	2	12	1,982	AR
The Udder Club					
W1MOO	531	2	7	1,962	VT
look FD Assault					
W8ED	511	2	14	1,954	WV
Benson Cty ARC					
N0BG	647	2	7	1,896	ND
South Georgian Bay West Simcoe					
VE3SGB	450	2	20	1,876	ON
Valley Center ARC					
K0RH	673	2	6	1,846	KS
Azalea Coast ARC					
AC4RC	465	2	53	1,836	NC
Lanark-North Leeds ARES					
VE3REX	376	2	15	1,826	ON
Jasper RC					
K4BEH	458	2	12	1,802	GA
ARC of Univ of Arkansas					
K5GOE	421	2	15	1,788	AR
Halton ARC					
VE3OD	226	2	17	1,740	ON
Southern Oregon ARC					
K7LIX	559	2	14	1,736	OR
Mitchell ARC					
W0ZSJ	814	2	7	1,728	SD
WPPS RC					
W7POE	335	2	11	1,692	OR
N7WC	744	2	3	1,688	OR
W4DEX	780	2	10	1,680	NC
Cary ARC					
N4NC	357	2	22	1,656	NC
Edisto ARS					
AD4U	430	2	37	1,636	SC
Loudon County ARES					
KM4H	400	2	3	1,612	TN
Triode ARC					
N4WCO	471	2	15	1,598	NC
Sam Houston Amateur Radio Klub					
N5AK	428	2	18	1,568	STX
Benton ARS					
K5NE	325	2	11	1,534	AR
Austin ARC					
W5KA	310	2	64	1,510	STX
Bridgerland ARC					
W7IVM	401	2	30	1,510	UT
Woodchuck ARC					
KC8KLU	301	2	27	1,502	OH
MIT Radio Society					
W1MX	466	2	12	1,490	EMA
K7PZ	426	2	4	1,488	WW
USS Jurassic					
K8SSJ	81	2	10	1,468	OH
409th ASA Hogs on Amateur Radio					
N7ASA	359	2	3	1,458	AZ
W6RA	601	2	10	1,440	SF
W7BI	315	2	16	1,436	WW
Kamloops ARC					
VE7UT	258	2	5	1,430	BC
Endless Mountains ARC					
N3EP	561	2	5	1,422	EPA
Covey Hill ARC					
VE2CYH	323	2	22	1,396	QC
OSARG					
K1OS	483	2	5	1,366	RI
Fishing Party RC					
KD8CP	430	2	8	1,360	MI
Central WI Radio Amateurs					
K9UW	339	2	8	1,310	WI
Legion of Indianapolis DXers					
W9VW/5	492	2	3	1,288	NM
Juneau ARC					
KL7IG	292	2	22	1,286	AK
Three River ARC					
W0BRN	387	2	10	1,272	MO
West Island ARC					
VE2CWI	260	2	19	1,270	QC
Atchison Cty ARS / Jackson ARC					
K0HK	244	2	11	1,260	KS
Jackson Cty ARES					
NC4ES	277	2	12	1,254	NC
8 Rivers ARA					
N8RV	357	2	4	1,232	WV
Utica ARC					
K2IQ	360	2	10	1,220	WNY
WD0Q	388	2	3	1,202	IA
Reno Cty Kansas ARA					
W0WR	391	2	12	1,148	KS
Marshall Cty ARC					
W0GCJ	270	2	12	1,132	KS
Hiawatha / Falls City ARC					
AF0I	175	2	28	1,086	NE
Morris RC					
W2YD	242	2	13	1,074	NNJ
Williston Basic ARC					
K0WSN	422	2	6	1,044	ND
KQ5M	356	2	5	1,012	NM
Callaway ARL					
KS0B	178	2	15	964	MO
Englewood ARS					
K8ONV	270	2	23	964	WCF
Socorro ARA					
KC5OLJ	332	2	7	964	NM
HSB Hams					
KG5E	280	2	3	950	NTX
Middle Georgia RA					
WR4MG	271	2	20	942	GA
North Island ARC					
VE7ARK	230	2	6	906	BC
Brazosport ARC					
K3SMW	350	2	10	900	STX
Pathfinders ARC					
VE4PAR	395	2	10	890	MB
Saluda Baptist Assn					
N4SBA	133	2	5	884	SC
Flathead Valley ARC					
K7LYY	273	2	14	872	MT
Rejects & Derelicts					
KT2F	211	2	25	854	NNJ
Sons of the Beaches					
W6ME	287	2	10	832	SCV
Amherstburg RC					
VE3UDK	163	2	10	826	ON
Alii TenX Chapter					
AH6AW	313	2	6	826	PAC
KA2BEO	200	2	11	810	SNJ
Madawaska RC					
VE9CRM	128	2	4	804	MAR
London Bridge ARA					
AE6N	150	2	14	800	AZ
Picco Party Operators					
WA3RNB	262	2	9	788	MDC
Smoky Mountain Amateur Radio					
N4GSM	238	2	5	776	NC
Eastern Washington Contesters					
NE7WA	330	2	3	760	EWA
The Piqua ARC					
W8SWS	94	2	25	746	OH
Huron ARC, Inc					
W0NOZ	113	2	13	716	SD
KB8QGR	254	2	8	708	MI
AA3TL	250	1	3	706	EPA
Laguna Beach Emergency Com Team					
KE6GFI	101	2	55	702	ORG
Larkspur Field Day Club					
N0LP	201	2	7	702	CO
K3UW	169	2	3	702	EPA
Rowlett RACES					
W5R	98	2	6	696	NTX
Cullman ARC					
AK4B	246	2	14	656	AL
Hickory Amateur Radio Team					
N3EHY	172	2	3	642	EPA
Enterprise ARS					
WD4ROJ	165	2	18	630	AL
Parry Sound ARC					
VE3PSH	212	2	9	624	ON
Ogdensburg ARC					
K2RUK	133	2	20	614	NNY
Mountain Valley ARC					
K1PV	150	2	6	600	ME
North Brevard ARC					
WN3DHI	133	2	19	566	SFL
Sky High ARC					
W4IIR	82	2	3	564	NFL
Southern IL University ARC					
W9UIH	180	2	8	560	IL
Last Mountain Club					
VE5LM	138	2	6	548	SK
Colorado VHF Group					
K0YB	172	2	3	544	CO
Washington Area ARC					
W0AWL	16	2	10	532	IA
Wedixie ARC					
WB4MZO	105	2	4	530	GA
Dallas LDS Stake					
KJ5UY	59	2	8	518	NTX
AC7IB	106	2	4	512	OR
World Radio Staff Club					
WR6WR	203	2	10	506	SV
Rib Eaters					
N4MUB	146	2	5	502	NFL
N5HT	200	2	3	500	STX
South Hills Brass Pounders & Modulators					
KB3BUE	150	2	7	500	WPA
OEC Wireless Society					
WB6HII	150	2	4	500	SF
Univ of Tennessee ARC					
AA4UT	182	2	3	464	TN
Mission ARES					
VE7MIS	79	2	5	458	BC
KB0PBN	177	2	3	454	IA
Turkey and Bacon Club					
K6NN	338	1	4	438	SCV
West Seattle ARC					
W7AW	164	2	3	428	WW
Warren Cty ARES/RACES					
WC8EMA	100	2	14	400	OH
Central Idaho ARC					
KC7MCC	82	2	6	394	ID
Hatfield & McCoy ARA					
WV8KY	76	2	3	352	KY
NA7P	52	2	3	352	WW
Winchester ARS					
WA4RS	122	2	7	344	VA
Murphy's Match					
K0OJ	242	1	7	342	WY
Green City ARA					
N3GC	98	2	3	340	WPA
Bitterroot ARC					
W7FTX	117	2	15	334	MT
Oahu 80M DXers					
AH6RH	60	2	3	320	PAC
Hermiston ARC					
KC7KUG	107	2	9	314	OR
Watauga ARC					
WA4J	21	2	4	268	NC
Macon ARC					
W4BKM	82	2	20	264	GA
Operators of Portable Radio					
WA7VHF	73	2	7	246	AZ
Watertown ARC					
N9HR	32	2	7	214	WI
Gainesville Radio Gnats					
KK5CT	49	2	3	202	NTX
Pembina Cty ARC, Inc					
KC0QAL	12	2	10	124	ND
ARS of Nantucket					
N1NBQ	5	2	3	116	EMA

1A Commercial

Texas DX Society					
K5DX	1515	2	8	5,490	STX
ARCSG					
K3FT	886	2	3	4,044	MDC
CRA-Sirek-Tracy					
VE2CBS	303	2	15	1,212	QC
St Louis DX & Contest Assn					
AA0A	1133	1	3	1,133	MO
W8LBZ	508	2	3	1,016	OH
Elmira RC					
VE3ERC	122	2	12	244	ON
Outer Banks Radio Dudes					
W3AG	55	2	3	204	NC

2A Battery

Colorado QRP Club					
W0CQC	1363	5	6	12,750	CO
Minnesota QRP Society					
WQ0RP	955	5	12	9,330	MN
Motor City RC					
W8MRM (+KA8GRH)	609	5	50	5,885	MI
West Park Radiops					
W8VM	477	5	15	5,195	OH
Carbon ARC					
W3HA	415	5	11	4,595	EPA
Northrop Grumman ARC					
N9EW	405	5	18	4,470	IL
Western KY DX Assn					
K4EU (+WA0RWL)	428	5	11	4,055	VA
Walton RA					
W2LZ (+WA2IAX)	358	5	8	4,005	WNY
New Providence ARC					
N2XJ (+NF4X)	397	5	30	3,915	NNJ
Barstow ARC					
WA6TST (+KC6IIH)	313	5	39	3,760	ORG
NETQCF					
WW5R	340	5	4	3,275	NTX
Tri-County RA					
W2LI	246	5	19	3,105	NNJ

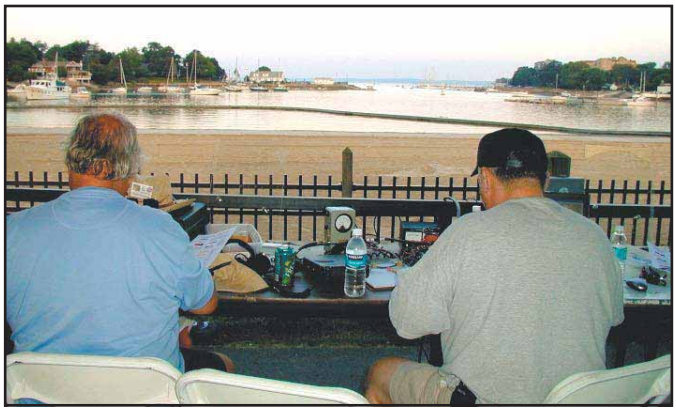
Early morning fog didn't deter the W6TJ Riverside County (CA) ARA from setting up their portable satellite station.

Independent RA, Inc					
K8KTY	319	5	16	3,080	OH
The A Team					
W4RRW	246	5	5	2,660	GA
El Jebel Shrine Radops					
KØFEZ	282	5	11	2,645	CO
Suburban Technical AR System					
W9SRC	219	5	5	2,610	IL
Open Repeater Group					
W6MW	300	5	35	2,425	LAX
Flying Pigs QRP Club SW WA					
WA7FP (+KD5PZO)	188	5	5	2,390	WW
Choctaw ARC					
K5CAR	197	5	18	2,375	OK
Lodi ARC					
N6SJV	240	5	12	2,225	SJV
Ontario DX Assn					
VE3ODX	219	5	3	1,905	ON
Johnson County ARES/RACES					
WN5T	223	5	16	1,745	AR
Cuero Gobblers					
W5NDS	153	5	5	1,625	STX
Hamilton Wireless Assn					
K6BW	141	5	5	1,520	SF
Photon Power					
W8HF	89	5	5	1,305	OH
VE3MB	184	5	3	1,220	ON
QRP Is Us					
W7TF	119	5	7	1,210	ID
Pioneers ARC					
W9DA	96	5	3	1,125	IL
BATC					
WVØH	72	5	3	895	CO

2A

San Diego DX / Pt Loma ARC					
W6PT (+W6RDF)	3931	2	14	14,336	SDG
Tampa ARC					
N4TP (+N4SEX)	4068	2	65	12,596	WCF
BARC/NCAARS/SCARC					
NG5M (+AB5ER)	3876	2	20	12,054	AR
Northwest ARS					
W5NC (+K5PTC)	3286	2	84	11,098	STX
Cortek Radio Assn					
W9CA	3044	2	20	10,748	IL
Raytown ARC					
KØGQ (+WØRDE)	3049	2	15	10,326	MO
Radio Amateurs of Northern Vermont					
W1NVT (+W1PU)	3368	2	30	10,250	VT
JPL ARC/Caltech ARC					
W6VIO (+W6UE)	2887	2	28	9,158	LAX
Twin State RC					
W1FN (+W1DXA)	2549	2	20	9,002	NH
The Four Hot Hams					
N4C (+N2PY)	2333	2	4	8,960	NC
Hoosier DX & Contest Club					
KJ9D (+WO9Z)	2429	2	21	8,630	IN
Shelby ARC					
AA4S (+NC4CQ)	2327	2	35	8,236	NC
Big Bend ARC					
K5FD (+W5ATO)	2463	2	29	8,180	WTX
Buckhead Contest Club					
W4TE (+W4KJ)	2424	2	11	8,178	GA
Smith Chart ARS					
K4OO (+K4ZMY)	2012	2	16	8,038	VA
Motorola ARC					
K9MOT (+KC9X)	2546	2	25	7,906	IL
Cantin ARC					
W8AL (+KIØDE)	2170	2	71	7,828	OH
Hughes ARC					
W6HA (+KG6NWJ)	1933	2	19	7,430	LAX
St Louis ARC					
KØLIR (+KGØKP)	2064	2	26	7,260	MO
Randallstown ARC					
N3IC (+K3MZ)	2245	2	15	7,238	MDC
Wayne ARC					
W8WOO (+N8IW)	2098	2	14	7,182	OH
Muskogee ARC					
N5KK (+KA5IIS)	1956	2	14	7,090	OK
Mother Lode DX & Contest Club					
K6AO (+K6TKD)	1728	2	11	6,936	SV
McMinn Cty ARC					
NA4K (+WA4PNI)	1874	2	35	6,914	TN
MN DX Assn					
NØFP (+WØRK)	1794	2	10	6,730	MN
Twin City FM Club					
WØEF (+WØAMT)	1889	2	40	6,712	MN
Montgomery ARC					
W4AP (+K8AJX)	1575	2	58	6,590	AL
Cape Fear ARS					
K4MN (+KG4YWF)	1879	2	31	6,374	NC
Fox River Radio League					
W9CEQ (+W9NE)	1754	2	35	6,272	IL
Oakland Cty ARS					
W8TNO	1857	2	15	6,246	MI
NC Contesters					
NR3X	2032	2	4	6,206	NC
Providence RA					
W1OP	1955	2	17	6,198	RI
Palos Verdes ARC					
K6PV	1789	2	19	6,192	LAX
Fidelity ARC					
WV1H (+WA1WM)	1915	2	24	6,138	RI
Middletown ARC					
W2MAR (+W2IMU)	1651	2	24	6,022	NNJ
Philips ARC					
W1HP	1593	2	9	6,020	EMA
Green River Valley ARS					
K9WM	1791	2	14	5,992	IL
Bossier Marshal Office					
K5BMO	1644	2	24	5,992	LA
Heart O' Texas ARC, Inc					
W5ZDN (+W5TSA)	1735	2	25	5,982	NTX
Burley ARC					
W7JQ (+W5QQQ)	1500	2	20	5,822	WW
Escondido ARS					
N6WB (+N8WP)	1965	2	68	5,820	SDG
Fayette AR Team					
N4KV	1829	2	10	5,792	KY
Pikes Peak ARA					
AFØS (+KØUSN)	1708	2	57	5,778	CO
Lafayette DX Assn					
W9LDX (+WR9A)	1555	2	21	5,698	IN
Fond du Lac ARC					
W9EBV	1560	2	25	5,694	WI
Schaumburg ARC					
N9RJV (+AB9GD)	1508	2	40	5,672	IL
Midland (WTX) ARC					
W5QGG	1334	2	22	5,624	WTX
Ocean-Monmouth ARC					
N2MO (+W1GD)	1467	2	25	5,516	NNJ
Madera Cty ARC					
K6IN (+W6WGZ)	1624	2	49	5,402	SJV
Candlewood ARA					
W1QI (+KD1YV)	1440	2	26	5,284	CT
North Florida ARS					
W4IZ	1719	2	25	5,272	NFL
West Jersey DX Group					
W2EN (+K2QDY)	1295	2	12	5,268	NNJ
Capeway RC					
W1AA (+W1AI)	1558	2	17	5,242	EMA
Souris Valley ARC					
KØAJW (+KØRHS)	1754	2	18	5,210	ND
Clinton Cty ARC					
W9PC (+W9AH)	1270	2	25	5,208	IN
Sonoma Cty RA					
W6SON (+W6LFJ)	1843	2	10	5,188	SF
Eastern MI ARC					
K8EPV	1143	2	9	5,166	MI
CARS					
W4S (+W4BWC)	1901	2	14	5,140	NC
Spokane DX Assn					
K7SDX (+W3AS)	1532	2	29	5,106	ID
Panama City ARC					
W4P (+W4RYZ)	1586	2	22	5,078	NFL
Mecklenburg ARS					
W4BFB	1225	2	25	5,064	NC
Northwest Mississippi Amateurs					
K5K (+W4FP)	1251	2	28	4,970	MS
Northeast Tarrant ARC					
N5EOC (+W5AP)	1213	2	35	4,952	NTX
Lynchburg ARC					
K4CQ (+KC1BH)	1374	2	50	4,932	VA
Tennessee Valley DX Assn					
W4FOA	1364	2	17	4,866	GA
Monroe Cty Radio Communications					
W8PI (+W8DWL)	1521	2	23	4,856	MI
Massillon ARC					
W8NP (+W8DEA)	1289	2	25	4,842	OH
District Seven Advisory Council					
W4W	1188	2	22	4,782	VA
Moontrose ARC					
KØSX (+KIØKY)	1324	2	26	4,778	CO
Northern Ohio DX Assn					
W8DXA	1613	2	22	4,756	OH
Forsyth ARC					
W4NC (+W4WS)	1430	2	44	4,752	NC
Sierra Blanca ARC					
KR5NM (+AB5JR)	957	2	10	4,688	NM
Delta ARC					
W4BS (+AG4KM)	1166	2	50	4,680	TN
550 DX Club					
K4TDP	1212	2	7	4,656	AL
Richmond ARC					
VE7RAR (+VE7YV)	1018	2	40	4,564	BC
Motorola ARC of Arizona					
W7MOT	1475	2	15	4,486	AZ
Gallatin Ham Radio Club					
W7ED	1130	2	13	4,480	MT
Arrow Club					
W8UM (+W8PGW)	1062	2	40	4,464	MI
Coconino ARC / North AZ DX Club					
W7TB (+AA7AC)	1363	2	8	4,438	AZ
Nashoba Valley ARC					
N1NC (+KB1HDO)	1424	2	21	4,396	EMA
Paso Robles ARC					
W6R (+W6PRB)	2239	1	16	4,318	SB
Canadian Police College ARC					
VE3CPC (+VE3XEM)	1085	2	11	4,310	ON
BSA Explorer Post 599					
WA2DFI (+W7BSA)	1063	2	10	4,274	AZ
Central Louisiana ARC					
K5MS (+KC5WWU)	1124	2	50	4,264	LA
Tupelo ARC					
KK5K (+KB5NSP)	1334	2	31	4,240	MS
Harrison ARS					
W5JJ	1232	2	6	4,228	AR
Antelope Valley ARC					
K6OX (+K6WTJ)	1147	2	50	4,196	LAX
3M ARC / St Paul RC / Metro Area					
WØJH (+KØAGF)	1037	2	38	4,184	MN
Sioux Empire ARC					
WØZWY	1267	2	20	4,138	SD
Oak Ridge ARC					
K4PI	993	2	36	4,130	TN
Hanover Area Hamming Assn					
KF3M	976	2	17	4,130	MDC
Virginia DX Century Club					
W4DZ	1068	2	14	4,096	VA
Trin Cty Repeater Club					
WØBU (+KCØJAF)	1156	2	48	4,086	MN
Kilocycle Club of Ft Worth					
W5SH	1135	2	12	4,076	NTX
Foothills ARS					
K6YA	995	2	25	4,024	SCV
Howell Cty ARC					
KØRWL	841	2	12	3,950	MO
Oklahoma City Autopatch Assn					
W5MEL (+AE5MH)	1071	2	37	3,942	OK
Radio Operadores Del Este					
KP3RE	1231	2	77	3,936	PR
Tippecanoe ARA					
W9REG	929	2	18	3,876	IN
Ski Country ARC					
KØRV	1214	2	15	3,834	CO
American Red Cross Emergency					
WB2QBP (+K2ARC)	1455	2	30	3,796	NLI
San Mateo RC					
W6UQ (+W6VJK)	976	2	16	3,792	SCV
Harris RF Communications ARC					
W2RFC (+KC2JPI)	1892	1	8	3,766	WNY
Ft Madison ARC					
WFØRT	912	2	15	3,756	IA
Eastern Washington DX Club					
W7LA	886	2	31	3,754	EWA
Stu Rockafellow ARS					
W8NJH (+KI8GA)	1022	2	19	3,744	MI
Cedar Valley ARC					
WØGQ	893	2	15	3,698	IA
Baltimore ARC					
W3FT	783	2	50	3,696	MDC
Guilford County ARES					
NA4GC	1182	2	25	3,688	NC
Johnson City ARA					
W4ABR	856	2	28	3,660	TN
Springhill ARC					
N5YE	1045	2	12	3,660	LA
Mifflin Cty ARC					
W3MCC	832	2	183,658		WPA
Johnson Cty Radio Amateurs Club					
WØERH	822	2	40	3,650	KS
Norwood ARC					
N1OP (+K1JMR)	821	2	22	3,612	EMA
Tri-County ARC					
W8YEK	1335	2	17	3,570	OH
Ottawa ARC					
VE3RC	836	2	25	3,510	ON
North Franklin ARS					
NF2AR (+N2RIP)	872	2	14	3,510	NNY
Green Mountain Wireless Society					
N1VT (+AB1CH)	983	2	25	3,484	VT
K7ZS	1036	2	3	3,450	OR
Bullitt ARS					
K4Y (+KY4KY)	815	2	25	3,440	KY
Goddard ARC					
WA3NAN	1064	2	13	3,394	MDC
QCWA - Chapter 17					
W3GS	919	2	7	3,390	EPA
Chaparral ARS					
W6MV (+AD6EZ)	1047	2	14	3,384	SB
Greer ARC					
W4IT	739	2	20	3,358	SC
East Bay Allbanders					
N6RX	904	2	8	3,346	EB
Pine State ARC					
N1ME (+K1CDA)	861	2	21	3,304	ME
The Cosumnes River BBQ & Mooing					
KN6OX	2167	1	12	3,296	SV
Historical Electronics Museum ARC					
W3GR (+KB3JUH)	654	2	21	3,292	MDC
Vintage Iron RC					
N3KR (+N3OD)	1079	2	7	3,286	NNJ
North Shore ARC					
VE7NSR (+VE7QQ)	813	2	40	3,266	BC
Ft Pierce ARC					
W4AKH	814	2	29	3,266	SFL
Blue Ridge (NC) ARC					
W4YK	910	2	27	3,190	NC
Fresno ARC					
W6TO	716	2	30	3,186	SJV
Police Amateur Radio Team of Westord, MA					
AG1I	777	2	15	3,172	EMA
Verde Valley ARA					
W7EI	1319	2	30	3,158	AZ
McHenry Cty Wireless Assn					
K9RN (+KC9AIE)	1129	2	20	3,158	IL
Nortel Networks ARC					
NT5NT	957	2	7	3,136	NTX
Lakeland ARC					
K4LKL (+WD4BEK)	630	2	43	3,120	WCF
Peninsula ARC					
W4MT	707	2	30	3,116	VA
Texas A&M ARC					
W5AC	825	2	10	3,116	STX
Iowa City ARC					
WØJV	617	2	18	3,114	IA
Trojan ARC					
WØWOB (+NSØO)	637	2	14	3,104	KS
KY-IN Contest Club					
W9UR	951	2	4	3,102	IN
Blossomland ARA					
W8MAI	721	2	22	3,100	MI
Harris/Intersil ARC					
K4HRS (+WA4AQV)	1249	2	14	3,098	SFL
Clairemont Repeater Assn/Boeing Employees ARS					
W6VLD (+N6RH)	982	2	55	3,062	ORG
Hiawatha ARA					
K8LOD (+N8RY)	743	2	30	3,046	MI
Milford ARC					
W8YDK (+K8AIR)	879	2	50	3,028	MI
Blackford Amateurs					
AA9Z (+WB9HLA)	773	2	10	2,934	IN
Valencia Cty ARA					
KC5OUR (+N5PR)	558	2	46	2,926	NM
Central Ohio ARES					
K8DDG	1048	2	35	2,922	OH
North Okaloosa ARC					
W4AAZ	918	2	16	2,904	NFL
Irvine Disaster Emergency					
N6IPD (+KW6B)	681	2	33	2,902	ORG
Mt. Baker ARC					
K7ZC (+K7SKW)	700	2	30	2,808	WW
West Virginia AR					
WV8AR	733	2	20	2,800	WV
Grand Rapids ARA					
W8DC (+W8IPN)	605	2	35	2,796	MI
South Town ARS					
WB2ELW	667	2	32	2,776	WNY
Thibodaux ARC					
W5YL	826	2	10	2,764	LA
Westside ARC					
WA6RC	714	2	32	2,758	LAX
Sevier Cty ARES					
AC4LS (+KV4EL)	697	2	11	2,756	TN
LEFROG					
W9BVQ	592	2	19	2,752	WI
Sterling Park ARC					
W4RW (+K4NVA)	715	2	16	2,748	VA
Victor Valley ARC					
K6QWR (+KD6YLT)	980	2	31	2,742	ORG
Parkersburg Amateur Radio Klub					
N8NBL (+K8OWL)	579	2	35	2,740	WV
Radio Central ARC					
W2RC (+K2LDC)	683	2	22	2,698	NLI
Arlington ARC					
K5SLD (+KB5PMX)	509	2	60	2,694	NTX
Lakes Region Repeater Assn					
W1BST	997	2	8	2,692	NH
Acadiana ARA					
W5DDL (+N5OA)	721	2	31	2,686	LA
Maury ARC					
W4GGM (+K4BX)	550	2	40	2,680	TN
West Allis Radio Amateur Club					
W9FK (+KB9TZB)	833	2	21	2,666	WI
Eastern Panhandle ARC					
WV8E (+KW8I)	1389	1	21	2,633	WV
Prarie Dog ARC					
WØOJY	612	2	46	2,632	SD
CRES ARC					
W8ZPF	863	2	18	2,628	OH
VE6US	646	2	3	2,620	AB
South Canadian ARS					
W5NOR	467	2	24	2,578	OK
Winona ARC					
WØNE (+KEØXI)	544	2	32	2,566	MN
Southwest MS ARC					
WB5ASP	809	2	18	2,560	MS
Lamar AR Committee					
WR8Y	541	2	23	2,560	GA
Northwest Ohio ARC					
W8EQ (+KB8LLL)	691	2	20	2,556	OH
Lancaster Cty ARC					
AK4N	539	2	20	2,538	SC
The Radio Farm					
NØMA	1167	2	5	2,534	IA
Charlotte ARC					
W4CQ	691	2	35	2,506	NC
Murray State University ARC					
K4MSU (+W4GZ)	749	2	32	2,500	KY
Eastern Shore ARC					
K4BW	525	2	32	2,488	VA
Santa Fe Trail ARC					
KSØKS	539	2	22	2,466	KS
Emergency Communications Assn					
WØECA (+NØPNP)	602	2	14	2,464	MO
Quinte ARC/Prince Edward RC					
VE3RL	694	2	12	2,452	ON
Imperial Valley ARC					
KC7EQW	414	2	14	2,450	SDG
Tamaqua ARA					
W3SX	573	2	5	2,446	EPA
Thomasville ARC					
W4UCJ (+KF4AON)	407	2	38	2,442	GA
Forx ARC					
NØGF (+KEØT)	675	2	13	2,424	ND
Cross Country Simplex Group					
NI9DX	606	2	10	2,414	IL
Blue Ridge ARS					
ND4N (+KG4GKG)	524	2	25	2,412	SC
K8RO	772	2	5	2,396	MI
Los Alamos ARC / Northern NM ARC					
W5PDO	523	2	15	2,382	NM
Tusco RC					
W8ZX	537	2	42	2,374	OH

Long Island Mobile ARC					
W2VL	490	2	87	2,360	NLI
Kawarth ARG					
VE3KRG	531	2	30	2,346	ON
Charlestown ARS					
WA4USN	500	2	36	2,338	SC
Peekskill/Cortlandt ARA					
W2NYW	733	2	11	2,328	ENY
Franklin Cty (NC) ARC					
WE4A	554	2	12	2,302	NC
Southwest Louisiana Amateur Repeater Club					
W5BII	598	2	45	2,296	LA
Carteret Cty ARS					
W4YMI (+W4ULD)	600	2	30	2,294	NC
Albemarle ARC					
WA4TFZ (+W4YRA)	672	2	45	2,288	VA
Humboldt ARC					
K6XG (+W6ZZK)	439	2	20	2,284	SF
St Clair Cty ARES					
K4SCC	1028	2	15	2,272	AL
Honeywell ARA					
WM7A (+KB7NKB)	766	2	11	2,256	AZ
Hurst ARC					
W5HRC (+N5QV)	560	2	48	2,244	NTX
HVARC					
NØDH	819	2	25	2,240	MN
BEARONS					
W7FLY	516	2	15	2,236	WW
Independence MO RACES					
NØAOM	500	2	12	2,236	MO
Simi Settlers ARC					
W6SVS	551	2	26	2,228	SB
Laurel ARC					
W5LAR (+N5PA)	528	2	19	2,222	MS
Grand Nelson Clan					
WB9GNC	904	2	10	2,208	MT
Palouse Hills ARC					
W7NGI	702	2	20	2,200	ID
San Angelo ARC					
W5QX (+KD5PIX)	640	2	41	2,180	WTX
Coastside ARC					
WA6TOW	612	2	9	2,168	SCV
St Peters ARC, Inc					
KBØSWK	487	2	15	2,156	MO
Moreno Valley ARA					
AB6PA (+KC6FJC)	506	2	31	2,154	ORG
Central Ohio Operators Klub Extra					
W8TNX (+WW8OH)	597	2	17	2,130	OH
Lewis & Clark RC					
K9HAM (+N9FTA)	376	2	22	2,126	IL
Gaston County ARS					
N4GAS	486	2	32	2,122	NC
Metuchen RC					
K2YNT	515	2	8	2,118	NNJ
Tri-County (WI) ARC					
W9MQB	410	2	9	2,114	WI
Newington ARL					
W1OKY	723	2	15	2,108	CT
Matagorda Cty ARC					
W5WTM	501	2	10	2,104	STX
Magazine ARC					
W5MAG (+KB5ZTU)	692	2	28	2,096	AR
VE7VCT	1418	1	10	2,084	BC
Douglas Cty ARC					
WØUK (+KØTOY)	362	2	40	2,082	KS
Fayette ARA					
N8EMZ	382	2	20	2,080	OH
Bloomington ARC					
W9INL (+N9NI)	397	2	38	2,076	IN
COBRA RC, Inc					
VA3XL	677	2	20	2,062	ON
Las Cruces Hots					
W3YK (+WK5C)	558	2	36	2,056	NM
Elko ARC					
W7V	453	2	8	2,046	NV
Victoria Haliburton ARA					
VE3LNZ (+VA3VHA)	721	2	37	2,042	ON
Heart of America ARC					
WØRR (+KAØFSP)	503	2	16	2,040	MO
Tri-County Repeater Assn					
AB9EJ	634	2	22	2,034	WI
GA Radio Engineers and Technicians					
WB4SQ	883	2	5	1,970	GA
DeForest ARC					
K8GE	302	2	21	1,958	OH
Jupiter Tequesta Repeater Group					
WY5I	687	2	20	1,938	SFL
Hellgate ARC					
W7PX	556	2	14	1,906	MT
Philips (OH) ARC					
W8NL	431	2	6	1,896	OH
Alhambra High School ARC					
K6R (+K6RSD)	379	2	5	1,896	SB
Pacific Cty ARC					
W7RDR	292	2	12	1,886	WW
Trident ARC					
N4EE	501	2	9	1,884	SC
West Tennessee ARS					
WF4Q	295	2	10	1,862	TN
Maryland Apple Dumpling ARS					
W3MAD	496	2	17	1,848	MDC
Huber Heights ARC					
NO8I	452	2	14	1,848	OH
W2VA	329	2	12	1,846	NLI
Genesis ARS					
N1ZIZ (+WB1FLA)	261	2	16	1,844	EMA
Lake County RACES					
W9QL	485	2	12	1,834	IL
Central Kansas ARC					
WØCY (+NØOBM)	410	2	30	1,824	KS
W3ZIC	636	2	7	1,800	WPA
Fox Cities ARC & Outagamie Cty					
W9ZL (+K6JDF)	359	2	42	1,800	WI
Garland ARC					
K5QHD	553	2	40	1,798	NTX
Western Washington DX Club					
W7DX	944	2	11	2,794	WW
Dixie Renegades					
WI7J (+W7WWB)	546	2	8	1,794	UT
Garden City ARC					
K8GC (+KK8GC)	258	2	35	1,786	MI
Northeast Georgia ARC					
K4LCP (+KT4Q)	558	2	8	1,780	GA
Miami Cty (IN) ARC					
K9ZEV	420	2	23	1,768	IN
ARC of Augusta					
W4DV	324	2	39	1,756	GA
San Antonio RC					
W5SC	439	2	37	1,754	STX
Playground ARC					
W4ZBB (+NF4DX)	408	2	23	1,742	NFL
Minden ARA					
N5RD	413	2	40	1,738	LA
Corona PD CSV Team					
W6CPD	407	2	14	1,726	ORG
Tri-Lakes (MO) ARC					
KCØM	291	2	11	1,712	MO
Okaw Valley ARC					
KK9N (+W9KXQ)	411	2	16	1,708	IL
Cass Cty ARC					
W9VMW	601	2	10	1,702	IN
Jackson Hole Area ARC					
K7JAC	542	2	6	1,700	WY
WD9GWH	403	2	3	1,698	WI
Athens Cty ARA					
NC8V	388	2	16	1,692	OH
Indiana Cty ARC					
W3BMD	379	2	24	1,684	WPA
Central Vermont ARC					
W1BD	342	2	30	1,684	VT
M & M ARC					
W8PIF	450	2	24	1,682	MI
AERO/BRATS					
W3PGA	258	2	20	1,678	MDC
North Country (NH) ARC					
K1NCR	476	2	13	1,654	NH
Foothills ARC					
KB4FWN	527	2	9	1,654	NC
Putnam Emergency Amateur Repeater League					
K2PUT (+W2NY)	459	2	18	1,652	ENY
Sand Hills ARC					
WØMI	467	2	15	1,634	KS
Newton ARC					
NØNK (+NØYO)	358	2	12	1,630	KS
Santa Clara ARA					
W6UW	431	2	18	1,622	SCV
Maui ARC					
KH6RS	419	2	14	1,590	PAC
Lakeway ARC					
W2IQ	387	2	29	1,588	TN
Shawnee ARA					
W9RNM	336	2	50	1,572	IL
RF Group					
AA6SD	476	2	6	1,570	ORG
UCSC IEEE Hams					
AC6P	380	2	50	1,568	SCV
Montgomery ARS					
NC4MC	286	2	18	1,568	NC
Reading Radio Club					
W3BN (+KB3EIS)	284	2	76	1,566	EPA
Northrop Grumman RC					
K6KH	383	2	13	1,560	LAX
Nomads					
NØTM	535	2	6	1,556	CO
Wichita ARS, Inc					
N5WF	275	2	38	1,552	NTX
Campbell River ARS					
VE7CRC	385	2	10	1,550	BC
Mountain ARC					
W6BW	286	2	24	1,524	SJV
Northland ARC					
W9BCY	1053	1	25	1,518	WI
Brockville ARC					
VA3BRC	262	2	15	1,518	ON
Athens ARC					
N4VHA (+N4ALE)	390	2	15	1,480	GA
Benzie AR Friends					
N8CG	399	2	38	1,462	MI
K7DPS	543	2	12	1,462	AZ
Manteca CA ARC					
KF6GDM	307	2	14	1,456	SJV
Kennebec Cty CERT					
W1PIG (+W1LEE)	198	2	28	1,450	ME
Lake Erie ARA					
WB8CQR	239	2	25	1,446	OH
CERTS					
VE3BPQ	390	2	16	1,426	ON
3 Rats					
NO4Q	208	2	10	1,402	TN
Spring Hill ARC					
K4SH	206	2	30	1,384	NFL
Control Chief Corp. Radio Team					
K3WL	392	2	3	1,384	WPA
Lake Bosworth ARC					
KY5G	380	2	3	1,382	WW
Baxter Cty ARES & Twin Lakes ARC					
K5BAX	218	2	20	1,372	AR
Burlington ARC					
W1KOO	295	2	9	1,370	VT
Vandalia Radio Group					
W8GUC	246	2	7	1,360	OH
Bellbrook ARC					
W8DGN	207	2	25	1,358	OH
Theodore Roosevelt ARC					
KØND	377	2	48	1,354	ND
Whitley Cty ARC					
W9SMQ	302	2	12	1,354	IN
TESARO					
W1IM	350	2	4	1,350	NH
Mississippi Valley ARA					
N9ETD	501	2	11	1,336	WI
Cochise ARA					
K7RDG	217	2	23	1,322	AZ
ARA of Bremerton					
W7VE	238	2	13	1,314	WW
Maple Valley ARC					
KC7KEY	197	2	50	1,294	WW
Athens ARC					
K5EPH	281	2	16	1,290	NTX
KVARC					
WØCET	253	2	15	1,288	KS
Harrisburg Radio Amateur Club					
W3UU (+KF3EH)	242	2	21	1,284	EPA
Cape Ann ARA					
W1GLO	240	2	20	1,268	EMA
Hospital Disaster Support					
K6EW	260	2	24	1,252	ORG
Boone Amateur Radio Klub					
KBØTLM (+WØFS)	245	2	17	1,242	IA
The IBM ARC					
W4IBM (+WD4MKV)	314	2	15	1,238	GA
Bourbon Cty KY RC					
AE4UK	412	2	12	1,224	KY



N2SF, the Westchester (NY) Emergency Communications Association "roughed it" at the Harbor Island Park.

PCARS					
KE4ZMZ	311	2	19	1,222	SFL
Oregon Tutalatin Valley ARC					
W7OTV	263	2	71	1,218	OR
Fred & Friends					
N9BSO (+KB8NTM)	334	2	10	1,206	OH
Hephzibah DX Club					
K4ADP	350	2	14	1,200	GA
Grayson Cty ARC					
K5GCC	199	2	20	1,198	NTX
3936 Group					
N1PP	302	2	12	1,198	NH
Club Radio Amateurs de Quebec					
CK2CQ	282	2	13	1,192	QC
SARES					
N6IH	140	2	41	1,180	SCV
Richmond Amateur					
W4RAT	356	2	20	1,170	VA
SSSS Amateur Radio Organization					
W6JAM	381	2	15	1,168	SDG
The Jersey Seven					
KK4VR (+KC4AUV)	311	2	5	1,166	VA
Rains ARA					
K5IJT	297	2	7	1,160	NTX
Juniata Valley ARC					
K3DNA	217	2	7	1,158	WPA
Fair Lawn ARC					
W2NPT	127	2	28	1,154	NNJ
River Cities ARA					
KA4OIL	200	2	17	1,152	KY
Kingsport ARC					
W4TRC	275	2	39	1,150	TN
AuSable Valley Emergency					
W8IIC	317	2	8	1,134	MI
St Cloud ARC					
WØSV (+KØARF)	245	2	15	1,128	MN
South Alabama RC					
WC4M	257	2	12	1,114	AL
Columbia ARS					
KE4BQI	98	2	19	1,112	NFL
Shuswap ARC					
VE7RAW	164	2	14	1,110	BC
Michigan City ARC					
W9LY	254	2	20	1,106	IN
Mills Cty Hams					
N5ZMO (+AA5QV)	244	2	18	1,088	NTX
DCS-22					
N6FDR	216	2	28	1,068	LAX
Heart of Texas DX Society					
W5DXS	225	2	12	1,056	NTX
Westside (LA) ARC					
W5ABD	252	2	20	1,050	LA
Pierre ARC					
WØPIR	275	2	14	1,042	SD
Pymatuning Amateur Radio Team					
WA3DX	260	2	4	1,036	OH
K2BRK	207	2	9	1,018	WNY
Westminster RACES					
WB6LBY	105	2	14	1,014	ORG
Discrete Components of 955					
AE3J	342	2	7	1,010	DE
North Shores ARC					
K6HAI (+AC5RD)	302	2	21	1,008	SDG
AA6R	352	2	4	1,004	SJV
Land of Lakes ARC					
K9HD	222	2	14	1,004	IN
Los Banos ARC					
AD6AA	245	2	9	990	SJV
Central Iowa RA Society					
KØMIW	254	2	11	988	IA
Albert Lea ARC					
NXØC	184	2	12	982	MN
Meridian ARC					
W5FQ	231	2	35	980	MS
Anoka Cty RC					
WØYFZ	130	2	8	974	MN
Kansas Nebraska RC					
KØKSN	82	2	25	970	KS
Association Radio Amateurs Portneuf					
VE2CSP	165	2	9	960	QC
Wilson's Wonders					
KC3M	349	2	12	958	EPA
Camp Ridge					
K9VSO	162	2	8	940	WI
ARA of the Southern Tier					
W2ZJ	160	2	15	936	WNY
Small Town Amateur Radio Service					
W5STR	214	2	31	928	AR
WF2V	214	2	5	912	WNY
CARLY					
K3KID	181	2	9	908	CT
Schenectady Museum ARA					
W2IR	202	2	9	904	ENY
Fort Wayne Assembly ARC					
KC9DRG	160	2	8	894	IN
Chisholm Trail ARC					
WD5IYF	45	2	11	890	OK
Long Island AR Simplex Club					
W2LIS	291	2	25	882	NLI
Limestone ARES Club					
N4SEV (+K4TRB)	134	2	18	868	AL
Northeast Iowa Radio Amateur Assn					
WØMG	45	2	7	866	IA
Circle M RC					
W5MOT	191	2	10	866	STX
North Arkansas ARS					
KM5PS (+KB5JXF)	178	2	35	864	AR
7-0 Kids Group					
N9OI	255	2	8	862	IN
Sooland ARA					
KØTFT	136	2	19	860	IA
Mile High RC					
K6GUN	77	2	44	854	ORG
Gulf Coast ARC					
WA4GDN	263	2	32	826	WCF
Disney Emergency Amateur Radio					
WD4WDW	205	2	18	820	NFL
Classic Bud Net					
W1PA	186	2	5	812	WMA
Univ of Arkansas @ Little Rock					
WA5LRU	141	2	7	808	AR
Aerospace Employees Assn ARC					
W6AGO (+AC6BP)	97	2	12	794	LAX
San Gogonia Pass ARC					
AK7R	73	2	28	754	ORG
Mine Creek ARC					
WAØPPN	159	2	12	754	KS
Ladies ARA					
N6FBT	124	2	21	748	ORG
Millbrae ARC					
WA6CTV	166	2	8	732	SCV
ARPSA					
K8SGV	208	2	8	716	MI
Thumb ARC					
W8AX	153	2	6	716	MI
Woodford Cty ARC					
KF4INN	107	2	6	714	KY
Bartlesville ARC					
W5NS	126	2	25	692	OK
Lawton Fort Sill ARC					
W5KS	141	2	13	684	OK
Clallam Cty ARC					
W7FEL	40	2	22	680	WW
Henry Cty ARC					
N9WB	86	2	10	672	IN
Suffolk Cty RC, Inc					
W2DQ	34	2	17	670	NLI
Rowan ARS					
W4EXU	131	2	11	662	NC
River City Amateur Radio Comm.					
N6NA	130	2	25	660	SV
Wolseley Repeater Group					
VE5WRG	110	2	5	658	SK
Virginia Appalachian Wireless Assn					
W4VAW	25	2	30	650	VA
Moose Jaw ARC					
VE5MA	174	2	18	648	SK
Koomer Ridge Kontesters					
W4K	124	2	4	646	KY
Indian Hill ARC					
K9GBT (+N9NL)	153	2	5	614	WI
Penn-Mar Radio Club					
W3MUM	117	2	12	610	EPA
Hualapai ARC					
WB6RER	101	2	10	602	AZ
Pike Cty ARC					
W9UL	99	2	10	598	IN
Great Basin Contest Group					
KV7V	179	2	11	582	UT
Detroit Metropolitan RC					
W8OHR	182	2	3	564	MI
Hart House ARC					
VE3UOT	80	2	4	560	ON
Dauberville DX Assn					
K3TI	156	2	20	512	EPA
Stanislaus Otters					
AD6IF	126	2	7	486	SJV
Arizona Amateurs on TV					
W7ATV	41	2	5	482	AZ
Internation Assn for Astronomical Studies					
KBØUAA	73	2	20	446	CO
ARAI					
VE2REG	101	2	5	402	QC
KF3CG	98	2	3	396	WPA

Central Maryland ARC
WC3MAR 31 2 5 364 MDC

2A Commercial

Order of Boiled Owls New York
KW2O 1203 2 10 4,224 NLI
Southwest Dallas Cty ARC
W5AUY 1099 2 38 4,018 NTX
Mountaineer ARA
W8SP 711 2 21 3,136 WV
Drake ARC
K8UU (+WE8N) 878 2 11 2,882 OH
Longmont ARC
W0ENO 503 2 20 1,680 CO
Spartanburg ARC
K4II 410 2 26 1,654 SC
Tri-Lakes ARC
W2TLR 192 2 20 908 NNY
Coon Valley ARC
WA0SPG 259 2 5 840 IA
Creston Valley ARC
VE7RCA 170 2 4 780 BC
Morgan Cty R-2 Schools
KC0LZD (+N0AYI) 70 2 25 674 MO
Georgian Bay ARC
VE3OSR 234 2 35 482 ON
Naturist New Hampshire
NU1DE 105 2 3 310 VT

3A Battery

Eastern Arizona ARS
K7EAR (+K7JEM)
1509 5 17 12,705 AZ
Franklin Cty ARC
AC1L 514 5 25 5,835 WMA
Paulding ARC
W4TIY (+WB4QOQJ)
518 5 19 4,795 GA
Knightlites QRP Club
WQ4RP 446 5 3 4,760 NC
Fannin Cty ARC
K5R (+K5FRC) 379 5 51 4,320 NTX
High Desert DX Assn
W6EFB 255 5 55 2,970 SJV
Cecil County DES
W3COU 157 5 5 2,290 MDC
Stamford ARA
W1EE 150 5 20 1,840 CT
Keno ARC
K7ENO 171 5 15 1,465 OR
KI7EL 92 5 3 995 WW

3A

Cherryville Repeater Assn II, Inc
W2GD (+W2CRA)
4903 2 30 15,678 NNJ
SERC/FCG
NJ4M (+NE4AA) 3830 2 41 12,268 WCF
Sussex County ARC
W2LV (+WV2V) 2927 2 27 10,620 NNJ
Rochester (NY) DX Assn
W2RDX (+W2AN)
2962 2 25 10,210 WNY
Pikes Peak DX Group
W0GG (+KC0MZL)
3031 2 12 10,092 CO
Santa Barbara ARC
K6TZ (+KF6DI) 2741 2 31 9,888 SB
Magnolia DX Assn
K5MDX (+N5OS) 2674 2 20 9,596 MS
Sturdy Memorial Hospital ARC
W1SMH (+N1IV) 2544 2 30 9,408 EMA
Mitre Bedford ARC/ Billerica ARS
W1ON (+NF1A) 2448 2 45 9,238 EMA
Massanutten ARA & Valley ARA
N4XU (+KZ1A) 2641 2 10 8,904 VA
ARC of Parker Cty, Texas
W5PC (+W5RON)
2505 2 24 8,744 NTX
North Shore RC/Metro ARC
K9OR (+AB9CQ) 2261 2 45 8,532 IL
Mid-Missouri ARC
N0SS 2042 2 25 7,856 MO
Old Barney ARC
N2OB (+N2CW) 2274 2 50 7,518 SNJ
McKinney ARC
W5MRC (+K5EEN)
1780 2 79 7,452 NTX
Castalia Island DX Assn
K4UP (+W4RMT) 2517 2 12 7,426 NC
Nittany ARC
W3YA (+W3GA) 4696 1 30 7,362 WPA
Mile High DX Association
K0AB 2086 2 12 7,278 CO
Columbus ARC
N4WV (+KO4RR) 1607 2 62 7,202 GA
Williamson Cty ARC
N5TT (+WC5T) 2027 2 54 7,084 STX
W/K ARC of Greater Milwaukee
N9AW 1622 2 13 6,964 WI
East Bay ARC
W6CUS 1642 2 20 6,790 EB
Greater Norwalk ARC
N1EV (+W1NLK) 1891 2 36 6,640 CT
Poughkeepsie ARC
N2YL 1760 2 16 6,550 ENY
Twin City Ham Club
W5EA 1837 2 35 6,426 LA
Vienna Wireless Society
K4HTA 1507 2 47 6,078 VA
South Orange ARA
K6SOA (+K6WO) 1573 2 47 6,026 ORG
North Shore RA
NS1RA 1478 2 55 5,738 EMA
Central OR DX Club
W7MT 1744 2 8 5,692 OR
Regina ARA
VE5NN 1611 2 19 5,570 SK
Baton Rouge ARC
W5GIX (+K5LSU) 1412 2 52 5,552 LA
Fauquier ARA
W4VA (+N3KTU) 1661 2 35 5,524 VA
Franklin Cty (VA) ARC
W4FCR (+K4BSF)
1224 2 24 5,402 VA
TARGA
K4SV 1326 2 14 5,370 NC
Redwood Empire DX Assn
W6KB 1849 2 24 5,334 SF
County Line ARA of Northwest NJ
K2AF 1396 2 15 5,182 NNJ
Golden Triangle ARC
W6GTR (+KN6DF)
1321 2 40 5,126 ORG
Elkhart Cty RA
K9WJU 1128 2 63 5,014 IN
K7DAV (+N7CN) 1217 2 13 4,896 UT
Amateur Radio for Youth
W0YH (+K0EMS)
1644 2 20 4,764 CO
Southern Vermont ARC
WT1B (+K2IIR) 1524 2 14 4,740 VT
Geezer/Natomas ARC
W6AW (+N6FR)
1353 2 16 4,736 SV
Kishwaukee ARC
WA9CJN 1069 2 25 4,676 IL
Hamfesters RC
W9AA (+KB9FQB)
1347 2 31 4,672 IL
Livermore Amateur Radio Klub
N6A (+N6FQQ) 1251 2 35 4,566 EB
Michiana ARC
W9AB 957 2 39 4,532 IN
Tar River ARC
W4DCG (+W4MY)
1307 2 20 4,518 NC
Bergen ARA
K2BAR 1309 2 26 4,494 NNJ
WIARC / HARC
W9AWE (+AB9DU)
1180 2 25 4,348 IL
Pottstown Area ARC
K3ZMC 1093 2 29 4,316 EPA
Utah ARC
W7SP (+AG7GR) 1074 2 10 4,310 UT
Nassau ARC
K2VN (+WA2AQQ)
1035 2 15 4,198 NLI
Xerox ARC
KE2T (+K2OID) 939 2 20 4,130 WNY
Paducha ARA
W4NJA 1000 2 18 4,066 KY
Eau Claire ARC
W9EAU (+KG9RA) 940 2 20 4,062 WI
Runestone RC
W0ALX (+KC0MNJ)
889 2 23 4,046 MN
Medina 2 Meter Group
K8FH 1045 2 25 4,004 OH
Dial Radio Club
K8PI (+W8BLV) 899 2 38 3,972 OH
South Texas ARC
N5CRP (+KY5V) 1105 2 20 3,970 STX
Sportsman Paradise ARC
KI4AYV 1054 2 44 3,880 NFL
Six Meter Club of Chicago
K9ONA 1057 2 15 3,780 IL
Larkfield ARC
W2LRC (+AB2NJ) 753 2 36 3,750 NLI
Tipton ARS
N4ZI 861 2 14 3,732 TN
Northwest Illinois ARC
W9RB (+KB9SEW)
942 2 15 3,684 IL
Chicago FM Club
N9PA 1079 2 18 3,664 IL
Randolph ARC
NC4ZO (+AG4ZH) 794 2 58 3,592 NC
Sudbury ARC
VE3ZI 939 2 11 3,552 ON
Kent Cty ARC
W3HZW (+AA3ZH)
860 2 15 3,406 DE
EFFECT
N8LH (+KI8BU) 990 2 16 3,394 MI
Boulder ARC Jr.
AB0XS (+AB0TD)
1076 2 53 3,378 CO
Yonkers ARC
W2YRC (+W2CZ) 810 2 60 3,374 ENY
L'Anse Creuse ARC
N8LC 1034 2 30 3,366 MI
North Georgia ARC
W4QQ (+W4SDR)
955 2 29 3,338 GA
Brightleaf ARC
W4AMC (+NC4PC)
654 2 28 3,302 NC
Milton ARC
W4VIY 889 2 18 3,274 NFL
Milford (OH) ARC
W8MRC 933 2 47 3,216 OH
SPARC
K3IR (+AA3C) 867 2 25 3,178 EPA
Fort Myers ARC
W4LX (+KG4TR) 711 2 75 3,164 SFL
The 440 Group
WU9Z (+N9WV) 777 2 35 3,106 IN
TTC-ARCH
K4TTC (+W4DUI) 813 2 29 3,070 TN
Des Moines RAA/ARCS
W0AK (+KC0AHQ)
760 2 40 3,060 IA
Broken Arrow ARC
W5BBS (+AE5ME)
714 2 10 3,028 OK
Central MO Radio Assn
K0SI 615 2 15 3,022 MO
Rochester ARC
W0MXW (+N0ADQ)
1201 1 50 2,997 MN
Boston ARC
W1BOS 625 2 45 2,996 EMA
Tri-State ARA
W8VA (+W8OI) 686 2 55 2,992 WV
Riverside Cty ARA
W6TJ 876 2 61 2,974 ORG
Cambridge ARA
W8VP 629 2 30 2,960 OH
San Fernando Valley ARC
W6SD 731 2 40 2,956 LAX
Bristol ARC
W4UD 868 2 50 2,938 TN
Fredericton ARC
VE9ND 785 2 22 2,934 MAR
North Ottawa ARC
W8CSO (+N8ARY)
662 2 40 2,928 MI
Chicago Suburban RA
N9BAT (+W9CHI) 789 2 7 2,898 IL
Foothills (SC) ARC
WT4F (+W5UGD) 673 2 28 2,868 SC
First State ARC
K3QBD 913 2 15 2,854 DE
Fall River ARC
W1ACT (+N1JOY) 468 2 17 2,810 EMA

K6Z, the Huntington Beach (CA) RACES group, was ready for anything along Radio Way—quakes, tornados, tsunamis…

Kennehoochee ARC
W4BTI (+AB0NG) 618 2 40 2,800 GA
Scorpian Ranch
WS4Y 723 2 5 2,790 KS
Shoreline ARC
W1BCG 598 2 33 2,784 CT
Evergreen Baptist Church ARC
K7EBC 538 2 10 2,776 WW
Hambuds
KA5E 629 2 20 2,756 STX
SPARK
W0MAC 606 2 10 2,754 STX
Big Thunder ARC
WA9GWM 627 2 20 2,714 IL
Ramapo Mtn. ARC
WA2SNA 744 2 10 2,684 NNJ
Plattsmouth ARC
KB0SMX 379 2 16 2,670 NE
Kings Cty RC
W2RAK (+WA3YRE)
834 2 15 2,648 NLI
Longview East Texas RC
N5REO 962 2 26 2,624 NTX
Bill Hoehl Memorial Contest Group
W4UOT (+N0EUU)
562 2 43 2,614 TN
Red Ryders
W8KX (+KW8G) 805 2 5 2,596 MI
Shenandoah Valley ARC
W4RKC (+N8GM)
614 2 29 2,592 VA
Rip Van Winkle ARS
K2RVW (+N2KN) 663 2 25 2,558 ENY
Base ARC
VE7RCN 816 2 12 2,552 BC
Central Washington ARC
W7TT (+W7FEO) 502 2 10 2,526 EWA
Piscataway ARC
K2VOA 645 2 20 2,512 NNJ
Nacogdoches ARC
W5NAC 664 2 29 2,498 NTX
Hocking Valley ARC
K8LGN 545 2 20 2,490 OH
Jefferson Cty (NNY) ARC
KC2ELX 728 2 20 2,484 NNY
Albuquerque ARC / AR Caravan Club
N5VA (+KD5RHR) 492 2 83 2,478 NM
Pecos Valley ARC
W5ZU 580 2 21 2,466 NM
Leowee Toxaway ARC
K4WD 579 2 28 2,432 SC
Alliance ARC
W8LKY 576 2 15 2,426 OH
K4HJ 642 2 15 2,404 KY
Rockwall ARC
K5RN 553 2 10 2,404 NTX
Jefferson Cty (STX) ARC
W5SSV 572 2 87 2,376 STX
Venango Vanguard
K3NE 713 2 6 2,352 WPA
Ramona Outback ARS
K6XT 454 2 30 2,306 SDG
Hernando Cty ARA
WB4NOD 281 2 16 2,296 NFL
Skyline ARC
K2IWR 638 2 25 2,282 WNY
AARC JR
KI3DS (+AA3RR) 581 2 81 2,262 MDC
Lincoln ARC
K0KKV 614 2 28 2,240 NE
York RC
W9PCS 624 2 16 2,240 IL
Cowichan Vally ARS
VE9CVA 894 2 9 2,206 BC
The Olympia ARS
NT7H 361 2 16 2,174 WW
Great Bay Radio Assn
W1FZ 457 2 18 2,174 NH
S Berkshires ARC
W1BAA/2 377 2 21 2,170 ENY
FARL / LARC
K8UUT 532 2 20 2,156 MI
Bloomfield ARC
W1CWA 439 2 20 2,130 CT
Lake Ozark ARC
N0ZS (+AB0WG) 456 2 16 2,086 MO
Radio Amateur Transmitting Society
W4PQP (+K4AAL) 473 2 56 2,062 TN
Neptune ARC
N2GT 370 2 42 2,062 NNJ
Royal Gorge ARC
NC0A 438 2 12 2,050 CO
Crawford ARS
W3MIE 438 2 28 2,038 WPA
Eastern Pennsylvania ARA
N3IS (+W9OKA) 549 2 20 2,024 EPA
Ashtabula Cty ARC
K8CY 519 2 19 2,024 OH
Lapeer Cty ARA
W8LAP 603 2 25 2,006 MI
Surrey ARC
VE7SAR (+VE7RSC)
367 2 7 1,996 BC
Jones Cty ARC
NN0L 479 2 28 1,992 IA
Irving ARC
K5I 320 2 29 1,988 NTX
Society of Newfoundland Radio
VO1AA 384 2 29 1,986 NL
Socorro & Tech ARA
KC5ORO 431 2 24 1,984 NM
Mystic Valley ARG
N1MV 332 2 25 1,966 EMA
Kootenia ARS
K7ID 431 2 4 1,964 ID
Aroostook ARA
K1FS 515 2 22 1,954 ME
Naval Research Lab ARC
W9NKF 384 2 10 1,944 MDC
Orchard City ARC
VE7OGO 425 2 25 1,928 BC
St Mary's Cty ARA
K3HKI 414 2 26 1,912 MDC
Clay Cty ARC
W0TE 697 2 10 1,894 MO
Saratoga Cty RACES
WA2UMX 570 2 21 1,890 ENY
Park Cty RC
AB0PC 243 2 7 1,880 CO
Stallion Springs ARC
KM6TB 449 2 4 1,868 SJV
Laurel Highlands VHF Society
WA3TVG 299 2 12 1,846 WPA
Lake Area Radio Klub
W0WTN 318 2 20 1,846 SD
Chenango Cty ARA
W2RME 307 2 14 1,844 WNY
Stillwater ARA
KB0SCE 327 2 49 1,814 MN
NASA Glenn ARC
NA8SA 447 2 12 1,812 OH
Mammoth Cave ARC
KY4X 319 2 20 1,810 KY
ManCoRad Club
W9DK (+KC9AAH) 442 2 23 1,796 WI
The Mt. Vernon ARC
K8EEN (+K4AWO) 477 2 13 1,792 OH
Oakland Radio Communications Assn
WW6OR 387 2 21 1,774 EB
Charles Cty ARC
K3SMD 318 2 27 1,772 MDC
Columbus ARC
N9LTT 315 2 30 1,754 IN
Lincoln Cty ARC
K7AM (+AB7QN) 377 2 45 1,734 OR
CQ RC
K1BCI 381 2 17 1,732 CT
Amateur Radio Transmitting Society
W4CN 368 2 38 1,722 KY
Key City ARC
K5QP 548 2 30 1,718 WTX
Dupage Cty OEM
KB9DRZ 258 2 20 1,716 IL
Radio Amateur Club Knoxville
W4BBB 354 2 32 1,710 TN
Cumberland Plateau ARC
W4CV (+W4XKE) 404 2 22 1,708 TN
Coshocton Cty ARA
W8CCA 384 2 27 1,706 OH
N9TTX 512 2 3 1,684 WI
W7HDI 1246 1 10 1,658 ID
Pilot Knob ARC
KS0LV 290 2 27 1,654 KS
Lee DeForest ARL
N7OD 441 2 20 1,616 ORG
Central IL RC
W9AML 296 2 32 1,594 IL
Lincoln Cty ARA
W4BV 185 2 10 1,586 TN

West Marin ARS #2
K6JOQ (+KG6JWK) 384 2 23 1,580 SF
Cedar Mountain ARC
KI7W 235 2 14 1,572 WY
Tri-County ARA
K6AGF 472 2 15 1,566 LAX
New ARC, Inc
W4EWN 238 2 15 1,556 NC
Mid Island RA
VE7MIR 366 2 15 1,556 BC
Monessen ARC
W3CSL 350 2 26 1,532 WPA
High Sierra FD Group
WB7ZQZ 455 2 10 1,510 SV
Radio Amateur of Corry
W3YXE 215 2 12 1,482 WPA
Tri Town Radio Amateur Club
W9VT (+N9WDG) 309 2 27 1,478 IL
Triangle East AEA
AG4WE 221 2 20 1,476 NC
Highland ARA
K8HO 394 2 20 1,476 OH
Sweetwater ARC
WY7U 337 2 24 1,460 WY
TBARC
K8PA (+N8YKG) 368 2 9 1,446 MI
Hancock Cty ARES
K5DMC 289 2 5 1,446 MS
Brownwood ARC
K5BWD 324 2 15 1,444 NTX
Hot Springs ARC
KØHS 238 2 15 1,430 SD
Cherokee Capital ARS
K4WOC 184 2 10 1,426 GA
South Brevard ARC
K4SBA 185 2 20 1,424 SFL
Sunparlor ARC
VE3SPR 446 2 12 1,422 ON
Maryland Mobileers ARC
W3CU 361 2 15 1,422 MDC
Fountain Valley RACES / WCARC
W6WC 310 2 11 1,420 ORG
Muncie Area ARC
N9RI 203 2 25 1,414 IN
Delta Cty ARA
K8ZAS 502 2 5 1,404 MI
Southern Counties ARA
K2BR 336 2 15 1,402 SNJ
Katy ARS
KT5TX 331 2 14 1,392 NTX
Titusville ARC
W4TAT 467 2 37 1,388 SFL
Richmond (VA) ARC
W4ZA (+K4RKO) 244 2 33 1,386 VA
Dubois Cty ARC
AA9SE 205 2 15 1,376 IN
Bluegrass ARS
K4KJQ 329 2 14 1,370 KY
Big Lake ARC
W4KPG 225 2 10 1,362 SFL
Ventura Cty ARC
K6MEP 170 2 7 1,340 SB
Mississippi Coast ARA
W5CR 257 2 36 1,334 MS
Umpqua Valley ARC
K7AZW (+KB7WDR) 328 2 28 1,296 OR
Seaway Valley ARC
VE3VSW 207 2 5 1,294 ON
Pasadena RC
W6KA 228 2 64 1,286 LAX
Sierra Intermountain Emergency RA
NV7YL 272 2 22 1,284 NV
Peninsula Radio Operator Society
W3PRO 188 2 27 1,284 MDC
Sunset Empire ARC
W7BU 182 2 13 1,282 OR
Alexander Cty ARES/RACES
W4ERT 320 2 11 1,270 NC
Southeast ATC
N8ZT 271 2 12 1,248 OH
AB8KP 240 2 10 1,248 MI
Miami Cty ARC
W8FW 286 2 21 1,248 OH
Scranton Pocono Radio Klub
K3CSG 371 2 25 1,242 EPA
Picorams
K9USA 190 2 26 1,242 IL
Motorola ARC - West
W6MOT (+KF6QED) 369 2 17 1,238 ORG
Grant Cty ARC
W9EBN 261 2 8 1,238 IN
Eastern Ontario ARC
VE3SAU 218 2 9 1,236 ON
Burlington Cty RC
K2TD (+K2M) 251 2 20 1,210 SNJ
Mercer Cty ARC
W3LIF 190 2 18 1,206 WPA
Fallbrook ARC
N6FQ 342 2 45 1,184 SDG
Ft Herkimer ARA, Inc
KB2UYI 173 2 22 1,180 WNY
RECWA
WA2GUG 139 2 3 1,178 ENY
Triangle ARC
K8BLP 218 2 16 1,136 WV
Saginaw Valley ARA
K8DAC 141 2 16 1,128 MI
Beaver Valley ARA
W3SGJ 285 2 38 1,068 WPA
Cumberland Valley ARC
W3ACH 260 2 13 1,054 WPA
Wexaukee ARC
K8CAD 325 2 15 1,048 MI
Clarksville Amateur Transmitting
KF4L 193 2 17 1,042 TN
Elgin ARS
VE3RSE 193 2 22 1,002 ON
Laurel ARS
K4XXX 246 2 20 996 KY
Union City ARES/RACES
KN6MA 185 2 15 994 EB
Cedar Lake ARG
KB9NSD 84 2 25 988 IN
Champaign Amateur Net
WB8UCD 269 2 16 980 OH
Hispanic American ARC
KF6JWT 290 2 14 980 LAX
Kentucky Colonels ARC
K4LOL 148 2 8 966 KY
Skywide ARC
VA3SKY 150 2 10 958 ON
Digital Prairie Dogs
AA9UF 158 2 3 942 IL
Wabash Cty ARC
KB9LDZ 150 2 4 902 IN
Thunderbolt ARA
KJØT 45 2 39 896 CO
Carl Hayden High School ARC
KC7KFF 240 2 10 880 AZ
Lehigh Valley ARC
W3OI 173 2 19 868 EPA
MARC
K9SAD 183 2 6 866 IL
Chesley Chipmunks
VE3ILJ 180 2 9 860 ON
East River ARC
W8MOP 156 2 20 844 VA
New Ipswich ARES Club
NI1NH 131 2 5 826 NH
Maple Ridge ARC
VE7CML 189 2 15 816 BC
Miamisburg Wireless
W8AJS 151 2 10 804 OH
Quality AR Klub
K7VIT (+N7UBS) 148 2 15 796 OR
Top of Michigan ARC
AA8PQ 97 2 10 794 MI
WW4M 177 2 10 776 NC
Barry ARA
KC8VTO 121 2 6 776 MI
The Maxim Club
N7QJ 186 2 3 772 OR
Radio Amateur Educational Society
VE6CWM 62 2 10 764 AB
Matanuska ARA
KL7JFU 44 2 9 732 AK
Area Amateur Radio Operators
W9YPS 165 2 12 730 IL
Calvert ARA
K3CAL 100 2 8 690 MDC
Metropolitan ARC
K8NOW 305 2 8 610 MI
Rural ARA
KC7WIR 88 2 3 590 NV
DCARC/BRRC
WØBXO 131 2 15 562 SD
Texas Instruments ARC
W5TI 87 2 11 554 STX
MA National Guard ARC
KB1IIF 62 2 9 530 EMA
Gateway ARC
W4KD 70 2 10 494 KY

3A Commercial

Russian Speaking RC of Toronto
VE3GKW 1216 2 9 4,356 ON
Splitrock ARA
K2RF (+K2EFK) 1224 2 41 3,396 NNJ
Zamora Shrine Radio Unit
W4ZHR (+K4HAL) 802 2 15 2,868 AL
Xavier Alumni RC
K8WBL 788 2 10 2,584 OH
Copper Country RAA
W8CDZ 560 2 11 2,082 MI
Adams County ARS
W3KGN 297 2 10 1,870 EPA
Gratiot Cty ARA
WA8AEG 503 2 14 1,726 MI
Macon County ARC
NØPR (+ABØC) 543 2 17 1,326 MO
W3SMR 549 2 20 1,186 MDC
Hillsdale Cty ARC
K8HRC 131 2 15 886 MI
Ehams
K9IQ 91 2 8 186 IN
Midway ARC
WØKY 82 2 15 164 NE
Yadkin Valley ARC
KE4YVF 64 2 6 130 NC

4A Battery

Summit ARA
K3ZZ 1159 5 8 9,040 MDC
Lockheed Martin ARC
W5IU 758 5 60 7,685 NTX
Portland ARC
W7LT (+W7PR) 704 5 26 6,285 OR
Montachusett ARA
W1GZ 476 5 12 4,765 WMA
DeKalb County ARC
W4GBR 476 5 25 4,195 AL
North Penn ARC
W3BTN 352 5 4 4,120 EPA
Boeing Employees ARS of Seattle
K7NWS 467 5 17 4,030 EWA
No Va QRP
WA4MM (+WB4JJJ) 139 5 7 2,010 VA
QCWA Chapter 162
K9AKG 100 5 11 1,835 WI

4A

Port City ARC
K1R (+W1WQM) 4956 2 30 15,198 NH
Delaware ARA
K8ES (+N8OB) 3537 2 63 12,652 OH
Western ARA
N6ME 3079 2 22 10,716 ORG
Falmouth ARA
K1RK 2389 2 62 8,806 EMA
Colorado Mountain Moguls
WØDZ (+WØHDD) 2742 2 20 8,206 CO
Boeing Employees ARS
WØMA 2097 2 20 8,166 MO
W4CUE (+WG4Y) 2271 2 74 7,760 AL
San Andreas Faultline Survivors
W6SW (+W6KC) 2648 2 19 7,558 SJV
Rappahannock Valley ARC
K4TS (+W4IM) 1850 2 26 7,324 VA
Roanoke Valley ARC
W4CA 2216 2 31 7,192 VA
Central Kentucky ARS
AA4NJ 1913 2 12 6,424 KY
Albany ARA
K2CT 1675 2 54 6,328 ENY
MicroHams / Icom
N7OS (+N7IH) 1530 2 35 6,134 WW
Kanawha ARC
W8GK (+KB8HNN) 1779 2 25 6,020 WV
Jefferson Cty ARC
W7JCR (+N7PL) 1435 2 32 5,988 WW
Scottsdale ARC
K7TR 1550 2 17 4,584 AZ
Peel ARC
VE3XR 1156 2 40 4,456 ON
TAARS
NO4Y 1053 2 32 4,374 NC
Fort Wayne RC
W9TE (+KB9WWM) 1133 2 48 4,340 IN
Grumman ARC
WA2LQO 1164 2 25 4,296 NLI
Sothwest Missouri ARC
NØEW 935 2 40 4,218 MO
Two Rovers ARC
W3OC 1028 2 36 4,210 WPA
Tuscaloosa ARC
W4MD (+NO4K) 1224 2 50 4,188 AL
Peconic ARC
W2AMC 993 2 41 4,120 NLI
Wabash Valley ARA
W9UUU 1028 2 48 4,102 IN
South Bay ARC
W6SBA (+W6ATT) 934 2 26 4,072 LAX
Alford Memorial RC
W4BOC (+KC4TOW) 910 2 60 3,998 GA
Wireless Association of South Hills
N3SH (+WA3SH) 887 2 21 3,924 WPA
Greater Vancouver Radio Group
VE7VRG 1317 2 38 3,908 BC
Central Michigan ARC
W8MAA (+KC8QZE) 801 2 20 3,726 MI
Hamilton ARC
VE3DC 1081 2 17 3,498 ON
RA of Erie
W3GV 1144 2 25 3,442 WPA
New Westminster, Burnaby & Coquitlam ARCs
VE7BAR 996 2 40 3,440 BC
Orange Cty ARC, Inc
W6ZE 946 2 40 3,350 ORG
Smoky Mountain ARC
W4OLB (+KC4PDQ) 898 2 20 3,338 TN
Nevada Cty ARC
W6DD 703 2 15 3,338 SV
Kent ARS
K3ARS (+N3WGC) 774 2 10 3,324 MDC
South Baldwin ARC
W4INU 749 2 32 3,322 AL
Mt. Vernon ARC
K4US 889 2 27 3,250 VA
Anthracite Repeater Assn
W3SJI 969 2 30 3,230 EPA
Kokomo ARC
W9GO 682 2 27 3,164 IN
Lanierland ARC
W4L 805 2 55 3,162 GA
Plano Amateur Radio Klub
K5PRK 1061 2 40 3,146 NTX
Mid-Atlantic ARC
W3NWA 603 2 49 3,120 EPA
Garlic Valley ARC
W6GGF 818 2 16 3,104 SCV
Four Lakes ARC
W9JZ (+N9OJN) 921 2 30 3,090 WI
North West Society of Amateur Radio
N7UO (+KD7WBP) 742 2 27 3,078 WW
Holland ARC
K8DAA (+KA8FQS) 768 2 75 3,016 MI
Troy Amateur RA
N2TY 1088 2 62 2,988 ENY
Rockford ARA
W9AXD 627 2 8 2,964 IL
Brownsburg Hawkesbury ARC
VE2CWB 997 2 10 2,946 QC
Lowndes/Magnolia ARC
AA5MT (+KD5LDT) 645 2 37 2,942 MS
Catalina RC
W7SA (+WB4RTP) 643 2 23 2,940 AZ
Island Cty ARC
W7AVM 831 2 20 2,920 WW
Starved Rock ARC
W9MKS (+KB9EZZ) 441 2 51 2,806 IL
IUA Squared
W5IUA 772 2 15 2,710 NTX
BARC & SACMARC
WØWYV 451 2 12 2,704 NE
Salem ARC
W7SAA (+W7RCK) 594 2 92 2,682 OR
ARCA/SCARS
NC6I 768 2 30 2,638 SV
Easton ARS
K3EMD 687 2 15 2,614 MDC
PVRA
N1XG 899 2 25 2,596 CT
Seneca Radio Club
W8ID (+K8ARL) 487 2 23 2,516 OH
Warrensburg Area ARC, Inc
WØAU (+KCØLNU) 688 2 18 2,378 MO
Yucaipa Valley ARC
KF6LLS 697 2 55 2,360 ORG
Golden Empire ARS
W6RHC 598 2 12 2,346 SV
Naval Postgraduate School ARC
K6LY 498 2 38 2,316 SCV
Nutley ARS
W2GLQ 367 2 18 2,180 NNJ
Thin Air RS
KØUE 557 2 5 2,164 CO
Ft Smith Area ARC
W5ANR 467 2 30 2,066 AR
Palisades ARC
W9BPT 601 2 30 2,006 IL
Orange Cty (NY) ARC, Inc
W2HO 410 2 35 1,992 ENY
Durham FM Assn
N4UBH 520 2 20 1,984 NC
Hot Spicy Mustard
K4HSM 706 2 19 1,914 TN
Portage ARC
KJ3O 437 2 30 1,914 OH
Central KY ARC
WA4UXJ 326 2 60 1,910 KY
Pearland ARC
K5PLD 422 2 13 1,854 STX
Tri County CW ARC
W3TCW 400 2 26 1,854 WPA
Waterville Area Wireless Assn
WA1WA 224 2 19 1,838 ME
Hall of Science ARC
WB2JSM 331 2 12 1,826 NLI
Lower Yakima Valley ARC
AC7XO 435 2 32 1,804 EWA
Crow River ARC
WØCRC 346 2 26 1,792 MN
Huntington Beach (CA) RACES
K6Z 278 2 30 1,768 ORG
TARS
W9OG (+N9QVQ) 478 2 20 1,756 IN
St Croix Valley ARC
VE1IE 211 2 14 1,738 MAR
Cascades ARS
W8JXN 214 2 30 1,648 MI
Keuka Lake ARA
AI2U 321 2 8 1,618 WNY
NBC ARC
N2EW 381 2 5 1,592 LAX
Hayward RC
K6EAG 236 2 16 1,496 EB
Yolo ARS
K6UO 332 2 17 1,472 SV
Deep East Texas ARC
W5IRP 307 2 21 1,460 STX
Sisters Repeater Group
W7GLG 289 2 17 1,420 OR
BARK / MRCN
VO1BRK 156 2 10 1,392 NL
Upper Valley ARC
K8FBN 142 2 21 1,384 OH
Tonto ARA
N7TAR 265 2 65 1,342 AZ
Cherry Hill OEM Group
NJ2CH 240 2 4 1,332 SNJ
SMARTS
NØEN 354 2 36 1,308 MN
Denver RC
WØTX (+KCØBGA) 247 2 5 1,284 CO
Kachina ARC
W7EH 284 2 28 1,234 AZ
Charles E Newton ARC
K4HYB 111 2 17 1,230 GA
Mt. Shasta ARC
W6BML 349 2 9 1,218 SV
Dirty Dawg CW Group
K9WJ 375 2 18 1,206 IN
Independent RC
WA6IRC 234 2 20 1,202 SB
Pioneer ARC
KØJFN 253 2 20 1,110 NE
Middlesex ARS
W1EDH 288 2 12 1,086 CT
Lamoine Emergency ARC
W9SSP 152 2 16 1,054 IL
TCARES
K6YV 171 2 34 1,042 SJV
Gladwin ARC
KB8ZML 161 2 25 1,022 MI
SCARE
KM7P 269 2 4 938 OR
Riverland ARC
WR9ARC 103 2 47 930 WI
Chaios Theory
WA8RFH 194 2 21 916 WI
Mid Ohio Valley ARC
AB8S 107 2 22 814 OH

4A Commercial

Lake Cty ARES Group
N4FLA 465 2 47 2,058 NFL
Somerset Cty ARC
K3SMT (+NN3A) 551 2 20 1,762 WPA
RA of Western New York
W2PE 340 2 13 1,338 WNY
Black Diamond ARC
W8HY 437 2 12 1,274 WV
Susquehanna Valley ARC
W3VPJ 176 2 22 820 EPA

5A Battery

Zuni Loop Mountain Expeditionary Force
N6GA 897 5 10 8,580 LAX
Durham Region QRP Club
VE3QDR 720 5 7 7,470 ON
Indian River ARC
W4NLX (+KF4FNZ) 523 5 50 5,720 SFL
David Sarnoff ARC
N2RE 459 5 45 4,775 SNJ

5A

Huntsville ARC
K4BFT (+WB4UEE) 4323 2 58 13,960 AL
Pina Colada Contest Club
COØUS (+T42FD) 3481 2 10 11,128 DX
Ozaukee RC
W9LO (+WI9M) 2403 2 29 9,146 WI
Gainesville Area Hams
K4EAC (+W4SH) 2620 2 56 9,004 NFL
LOUDOUN ARG
K4LRG 2168 2 36 8,796 VA
Murgas ARC
K3YTL 2283 2 33 7,894 EPA
Cuyahoga Falls ARC
W8VPV 2252 2 27 7,808 OH
AK-SAR-BEN ARC
KØUSA 1652 2 40 6,640 NE
Orlando ARC
W1SE 1812 2 52 6,392 NFL
DePage ARC
W9DUP (+KB9WVJ) 1807 2 18 6,028 IL
Brazos Valley RC
W5DPA 1156 2 40 5,416 STX
Eastern Connecticut ARA
K1MUJ 1367 2 31 5,248 CT
Boling Brook ARS
WG9L 1128 2 27 4,980 IL
Virginia Beach ARC
W4UG 1200 2 40 4,654 VA

Broward ARES/RACES
N4CU 1113 2 30 4,652 SFL
Clear Lake ARC
K5HOU 861 2 12 4,496 STX
Butler Cty ARA
W3UDX (+AA3YW) 1161 2 60 4,412 WPA
RF Hill ARC
W3AI 1340 2 15 4,280 EPA
Monongalia Wireless Assn
W8MWA 891 2 21 4,108 WV
Andrew Johnson ARC
W4WC 994 2 38 3,948 TN
Nortown ARC
VE3NAR 1043 2 15 3,800 ON
York Region ARC
VE3YRA (+VE3SLM) 962 2 41 3,732 ON
South Bay ARA
KU6S (+WS6S) 873 2 50 3,720 EB
Columbia-Montour ARC
WC3A (+N3KYZ) 645 2 15 3,630 EPA
Wilson ARC
WC4AR 763 2 54 3,578 TN
Hazel Park ARC
W8HP (+W8JVU) 961 2 48 3,530 MI
Canbridge ARC
VE3SWA 919 2 5 3,498 ON
London ARC
VE3LON 1055 2 20 3,408 ON
FARS & VRAC & NRAC
N7V (+N7UR) 762 2 84 3,398 NV
METRO/SPARC
W4BPH 693 2 10 3,368 WCF
Lancaster and Fairfield County ARC
K8QIK 728 2 30 3,296 OH
Mt. Diablo ARC
W6CX 887 2 75 3,182 EB
Flagler Palm Coast ARC
W4FPC 768 2 24 3,178 NFL
SLVARC & LPRC
AC6AD 766 2 15 3,020 SCV
Silvercreek ARA
AB8GO (+K8PQ) 756 2 11 2,974 OH
Rock River Club
W9TCH (+KB9NUM) 664 2 25 2,936 WI
Alamo Area Radio Organization
AA5RO (+KC5QIG) 583 2 60 2,864 STX
Kings Cty Repeater Assn
KC2RA 829 2 42 2,858 NLI
ARC of El Cajon
WS6F (+WA6BGS) 992 2 64 2,786 SDG
Southern Pennsylvania Comm. Group
K3AE 712 2 30 2,748 EPA
Midland ARC
W8KEA 513 2 17 2,724 MI
Coachella Valley ARC
NR6P 558 2 26 2,642 ORG
Kitchener Waterloo ARC
VE3IC (+VE3YKF) 618 2 24 2,570 ON
Great Plains ARA
KJ0Z 567 2 25 2,400 NE
NI9A 422 2 20 2,392 IN
Madison-Oneida ARC
W2MO 436 2 26 2,316 WNY
Marion ARC
W8GVB (+N8WOB) 568 2 20 2,258 OH
ARCS & CARS Joint Field Day
K4S 461 2 55 2,238 GA
HEATHENS
W5UW 613 2 6 2,228 OK
Chesapeake Amateur Radio Service
W4CAR 515 2 25 2,202 VA
Skyview RS
K3MJW 436 2 19 2,172 WPA
The Northern Ohio ARS
K8KRG 486 2 18 2,074 OH
Wisconsin Valley RA
W9SM 274 2 15 2,050 WI
Toothless Talkers
N8IVE (+KB8QDX) 716 2 16 2,038 OH
Boeing Employees (KS) ARS
KC0AHN 281 2 25 2,018 KS
Quanapowitt RA
W1EKT 391 2 12 1,998 EMA
Navarro ARC
N5DDC 440 2 47 1,822 NTX
Western Carolina ARS
W4MOE 228 2 60 1,758 NC
Marshall Cty ARES/RACES
W8CAL 356 2 17 1,732 WV
Arlington Communications League
KC9IL 326 2 10 1,656 IL
Whitman ARC
WA1NPO (+N1SOM) 325 2 22 1,640 EMA
Chehalis Valley ARS
WA7UHD 405 2 20 1,620 WW
Kamiak Butte ARA
KB7ARA 291 2 50 1,430 EWA
Russell Cty VA ARC
WR4RC 504 2 40 1,408 VA
Washington Amateur Communications
WA3COM 380 2 26 1,372 WPA
Conyers ARG
K1KC 320 2 50 1,352 GA
Sterling Rock Falls ARS
W9MEP 298 2 14 1,296 IL
Moultrie Amateur Radio Klub
W9BIL 266 2 14 1,270 IL
Schoharie Cty ARA
WA2ZWM 235 2 20 1,270 NNY
South Bay ARS
K6QM 338 2 12 1,162 SDG
20/9 ARC
K8TKA 362 2 26 1,152 OH

5A Commercial

Falls ARC, Inc
K9RHH 783 2 9 2,868 WI
Plateau ARA
WV8T 21 2 30 2,802 WV
Radio Operators of South Texas
W5ROS 741 2 9 2,274 STX
Milledgeville ARC
W4PCF 473 2 28 1,882 GA
Milwaukee Radio Amateurs Club
W9RH 341 2 18 1,180 WI
LaGrange ARC
AB4GA 353 2 20 1,120 GA
Roberson Kopernik RC
K2OQ 186 2 12 630 WNY

6A Battery

Orange Cty Radio Amateurs
W4EZ (+N4PRC) 465 5 21 4,925 NC
ARC of Alameda
KG6HM 235 5 15 3,315 EB

6A

South Jersey RA
K2AA (+W2EA) 3587 2 54 12,412 SNJ
Mike & Key Club
K7LED (+K7QV) 4026 2 82 11,516 WW
N4N (+KE4UW) 3309 2 25 11,074 GA
Santa Cruz Cty ARC
K6BJ 1865 2 47 6,562 SCV
Radio Club of Tacoma
W7DK (+W7OS) 1743 2 65 6,494 WW
Phil-Mont Mobile RC
W3EM (+W3PSH) 1247 2 30 5,202 EPA
Niagara Peninsula ARC
VE3VM (+VA3ROW) 1298 2 25 4,926 ON
Warminster ARC
K3DN (+WA3TQJ) 1085 2 36 3,934 EPA
Kendall ARS
KB5TX (+KC5OYQ) 863 2 46 3,540 STX
Satellite ARC
W6AB 738 2 26 3,250 SB
Scarborough ARC
VE3WE 665 2 18 2,996 ON
Westchester Emergency
N2SF 834 2 26 2,894 ENY
Sangamon Valley RC
W9DUA 716 2 30 2,880 IL
Central MA ARA
W1BIM 660 2 6 2,840 WMA
Southwest Iowa ARC
K0SWI 528 2 18 2,600 IA
Antietam RA
W3CWC 481 2 33 2,370 MDC
Big Bear ARC
K6BB 468 2 25 2,234 ORG
Beloit ARC
WD9BB 426 2 11 2,000 IL
Stanislaus ARA
W6ERE 280 2 37 1,960 SJV
Laughery Valley ARC
W9CIT 357 2 16 1,914 IN
Cleveland ARC
W4GZX 204 2 16 1,872 TN
Fayette Cty ARES
WX4KY 163 2 23 1,852 KY
North Hills Amateur Club
W3EXW 231 2 34 1,820 WPA
Chelsea ARC
WD8IEL 293 2 25 1,740 MI
Northern Kentucky ARC
K4CO 369 2 21 1,636 KY
Everglades ARC
W4SVI 345 2 40 1,526 SFL
Kimberling ARC
K0EI 141 2 15 1,526 MO
Triple A
AC3J 334 2 24 1,368 WPA

7A

Lake Cty ARA
N8BC 3209 2 37 11,154 OH
United Radio Amateur Club
K6AA (+W6TOI) 3621 2 40 10,430 LAX
Raleigh ARS
W4DW 3062 2 49 9,412 NC
Hampden Cty RA
W1NY 1865 2 55 7,072 WMA
Space-Park Employee Assn ARC
W6TRW (+WA6EIK) 1911 2 50 6,870 LAX
South Pickering ARC
VE3SPC 1235 2 40 5,042 ON
Central NH ARC
W1JY (+W1CNH) 1135 2 44 4,932 NH
SARS
W6CO (+KO6FR) 699 2 17 3,980 EB
Muskegon Area Amateur Radio
W8ZHO 864 2 58 3,790 MI
Alexandria RC
W4HFH 570 2 15 3,338 VA
Cherryland ARC
W8TCM 2094 1 33 3,216 MI
North Fulton ARL
NF4GA (+KB4KAY) 977 1 20 3,010 GA
Turlock ARC
W6BXN 684 2 8 2,744 SJV
Associated Radio Amateurs of Long Beach
W6RO 724 2 11 2,698 LAX
Mobile Sixers/Marple Newtown/Del
W3AWA 437 2 51 2,514 EPA
Poinsettia ARC
WA6BMH 394 2 11 2,300 SB
KE4RX 382 2 12 2,104 TN
Calaveras ARS
WA6YGA 243 2 34 1,662 SJV

7A Commercial

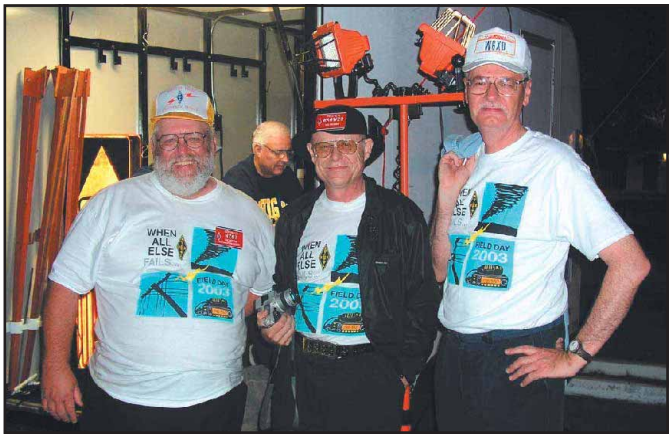
Ripley Cty Repeater Assn
NX9E 382 2 28 1,544 IN

8A Battery

Alameda Cty RC
N6DOD 553 5 30 5,015 EB
Delta ARS
VE7SUN 425 5 24 4,645 BC

8A

Kalamazoo ARC / SMART
W8VY (+K8KZO) 1398 2 50 5,888 MI
Cuyahoga ARS
NO8A 909 2 25 4,488 OH
Mississauga ARC
VE3MIS 1085 2 26 4,442 ON
Warren ARA
W8VTD (+W8SHR) 837 2 30 4,262 OH



ARRL Southwestern Division Vice Director NZ6T (left) and Director W6ZD (right) flank ARRL Vice President WA6ZWO while visiting sites around the division.

Gwinnett ARS
W4GR 893 2 30 3,888 GA
Mahoning Valley ARA
W8QLY (+KF8OG) 646 2 31 3,260 OH
Palmetto/Columbia ARC
W4MN 339 2 50 1,990 SC

9A

Wheaton Community Radio Amateurs
W9CCU (+N9HDW) 2126 2 66 7,606 IL
Gloucester Cty ARC
W2MMD 1763 2 26 7,588 SNJ
Utica Shelby Emergency Com Assn
K8UO (+KC8CPT) 1321 2 45 5,582 MI

10A

Ventura Cty ARS
N6R 771 2 74 3,894 SB
Crawford Cty ARC
W8BAE 1192 2 66 3,764 OH
Clark Cty ARC
W7AIA (+AC7NA) 375 2 51 2,766 WW

11A Battery

Conejo Valley ARC
AA6CV 987 5 35 9,300 SB

11A

Carroll Cty ARC
K3PZN (+AK3Z) 1854 2 47 7,752 MDC
Findlay RC
W8FT (+N8ET) 1087 2 28 5,110 OH

12A

West Valley ARA
W6PIY 1643 2 34 7,148 SCV
10-70 Repeater Assn
N2SE (+K2DBK) 1293 2 11 6,768 NNJ

14A

El Dorado Cty ARC
AG6AU 1227 2 37 4,956 SV

15A

Nashua Area RC
N1FD (+AK1K) 3030 2 50 10,606 NH

17A

Woodbridge Wireless
W4IY (+W4ZY) 5922 2 73 20,272 VA

51A

Potomac Valley RC & Columbia ARA
W3AO (+K3EF) 7754 2 60 27,834 MDC

1B-1 Op Battery

K0MF 577 5 1 6,070 CO
W7QC 545 5 1 5,850 ID
K5WNH 413 5 1 4,230 NTX
W3TS 389 5 1 4,190 EPA
K5AAR 397 5 1 4,070 OK
NZ5A 340 5 1 3,600 STX
KB4PPE 267 5 1 2,970 SC
K7EN 249 5 1 2,790 UT
AA5CK 254 5 1 2,740 OK
WB8RTJ 257 5 1 2,670 OH
WU0L 245 5 1 2,650 CO
N2EY 218 5 1 2,480 EPA
W3CB 175 5 1 2,450 MDC
W2AGN 217 5 1 2,360 SNJ
K7IA 189 5 1 2,290 NM
N6VZ 205 5 1 2,250 OR
KE0G 204 5 1 2,140 MN
AB2AN 180 5 1 2,100 NNJ
KD6RDO 178 5 1 2,080 SB
N7CEE 184 5 1 2,040 AZ
K5SI 190 5 1 2,000 STX
W7XT 189 5 1 1,875 MT
W2UX 170 5 1 1,800 SC
W8REI 157 5 1 1,770 MI
KI0II 156 5 1 1,760 NE
AA3S 149 5 1 1,590 MDC
W4DEP 167 5 1 1,535 KY
KD2HE 126 5 1 1,360 NLI
AA9DH 124 5 1 1,340 IL
K4JSI 118 5 1 1,280 MDC
VE3WZ 113 5 1 1,225 ON
W0CZ 100 5 1 1,200 ND
NK0E 100 5 1 1,100 CO
N0FPE 99 5 1 1,045 MO
NS1W 69 5 1 990 NH
K2KGJ 78 5 1 980 ENY
K5HPF 72 5 1 920 STX
VE3CG 71 5 1 910 ON
WB6QZK 57 5 1 885 LAX
N8KLX 78 5 1 880 MI
K3TW 52 5 1 815 MDC
WD6DX 80 5 1 785 SCV
WA6ARA 56 5 1 710 AZ
KE3HG 55 5 1 685 EPA
WA9STI 93 5 1 670 LAX
N6LZB 67 5 1 635 SB
KB9II 42 5 1 620 IL
N6NKO 20 5 1 610 WI
N4ECI 80 5 1 600 VA
N5PG 49 5 1 590 NTX
N7JI 39 5 1 590 OR
W1MVY 48 5 1 550 RI
AB4VF 45 5 1 550 NFL
WA7IRW 16 5 1 495 ORG
WD9EWK 51 5 1 455 AZ
N1VIC 68 5 1 440 ME
C6A/N5ZGT 30 5 1 400 DX
W1YX 20 5 1 400 WNY
KG4FXG 27 5 1 370 GA
N8XA 26 5 1 340 OH
N3EG 19 5 1 305 WW
W6GB 9 5 1 290 SJV
N8UW 14 5 1 240 OH
WU7E 27 5 1 235 AZ
W2RS 2 5 1 210 NNJ
N5YM 2 5 1 210 IL
W5ACM 13 5 1 165 ENY
N3JWJ 4 5 1 140 MI
WA7TPB 4 5 1 120 WW
N1GNV 1 5 1 105 CT
WD8AAU 15 5 1 75 OH
N0TYC 9 5 1 45 MN

1B-1 Op

N0AT 949 2 1 4,182 MN
WB9COY 1183 2 1 4,122 SDG
K3MD 726 2 1 3,310 EPA
W5ZO 607 2 1 2,418 WTX
K3ONW 550 2 1 2,300 EPA
K6WC 800 2 1 1,700 SF
KV2X 284 2 1 1,150 NNY
W2WC 260 2 1 1,140 ENY
AD6VB 395 2 1 1,090 LAX
K3YDX 205 2 1 934 MDC
W0DYD 227 2 1 932 MN
WS2N 189 2 1 866 NLI
KC8UR 160 2 1 854 OH
K8MR 214 2 1 784 OH
K5RCR 323 2 1 770 LA
WB6FDY 329 2 1 758 UT
W2EY 320 1 1 612 NH
KU7K 132 2 1 610 OR
WK3M 165 2 1 598 WPA
W0KIE 39 2 1 578 OK
WB2AXF 95 2 1 574 ENY
W0XR 170 2 1 554 CO
N4OLN 105 2 1 520 GA
W1MJ 79 2 1 510 EMA
WB6IC 101 2 1 480 LAX
K6PDQ 131 2 1 462 UT
KB2EBL 119 2 1 460 VT
N6CG 175 2 1 450 ORG
N6XT 160 2 1 420 ORG
WA3HRL 49 2 1 398 EPA
KD5EUM 37 2 1 374 STX
N7CFO 60 2 1 326 EWA
W9TQV 62 2 1 324 WI
WA6WPG 41 2 1 304 SJV
W3XG 50 2 1 300 MDC
WA6NGH 96 2 1 292 SDG
AB6S 91 2 1 282 SJV
N7EPD 71 2 1 278 WW
KE4QDM 71 2 1 274 MI
K9PLX 44 2 1 270 WI
N6RZR 83 2 1 266 SV
K6TBR 55 2 1 256 EB
K0VG 74 2 1 248 MN
AC1J 56 2 1 230 ME
W8KNO 4 2 1 208 OH
VA2DA 45 2 1 190 QC
N8WCR 23 2 1 146 WW

1B-1 Op

AC7LX/9 803 2 1 2,862 WI
N8IA 596 2 1 2,318 MI

W7MRG	290	2	1	968	WW
KG4TUL	130	2	1	340	GA
NØDLS	70	2	1	340	MN

2B-1 Op

KBØYTO	125	2	1	450	NE

3B-1 Op

KW8N	1346	2	1	5,556	OH

1B-2 Op Battery

W5YA (WD9FJL)	753	5	2	7,545	NM
NC7X	558	5	2	5,880	UT
KF9D	507	5	2	5,670	WI
K4WG (+W4EAE)	502	5	2	5,060	AL
W7EL	415	5	2	4,450	OR
KE4R	350	5	2	3,195	GA
VE3EQP	323	5	2	2,755	ON
K4RDU	252	5	2	2,720	VA
W3ANX (+W3APR)	245	5	2	2,650	WPA
K4MUT (+KB3FRX)	213	5	2	2,320	MDC
AC7A	207	5	2	2,160	AZ
WD3P	194	5	2	2,140	MDC
W1FYM (+N1JBH)	183	5	2	2,130	CT
N5ESE (+N2KTY)	189	5	2	1,990	STX
WØAZ	126	5	2	1,660	CO
K3SS/7 (+WF4U)	167	5	2	1,595	UT
K4UD	127	5	2	1,570	SC
NK6A (+WB6DWD)	99	5	2	1,190	LAX
KC5MM	55	5	2	1,075	AR
N1XT (+N1MGB)	114	5	2	870	ME
VA7MM	20	5	2	660	BC
WE7H (+KC7FNL)	85	5	2	625	AZ

1B-2 Op

N5RZ (+KT5E)	2136	2	2	7,524	STX
W8TK	1439	2	2	6,356	OH
K8RYU	1211	2	2	4,920	OH
K6SB/Ø (+W6GL)	903	2	2	3,476	SD
VE6KZ	701	2	2	3,204	AB
W7UG (+K7ZZ)	520	2	2	2,698	OR
K9ZA (+W9SKA)	533	2	2	2,452	IL
N7QT (+WA7NCL)	632	2	2	2,436	EWA
NE9U (+KB9TTO)	540	2	2	2,036	WI
K5DL (+W5TEN)	396	2	2	1,884	STX
N1JJ	969	1	2	1,675	MN
K9OM (+KI4BKL)	369	2	2	1,628	WI
K7GGG (+AAØP)	545	2	2	1,584	AZ
NRØT	315	2	2	1,438	MN
VE7CX (+VE7JRX)	114	2	2	1,422	BC
KØTY (+KØHPS)	302	2	2	1,354	SD
WR4F	466	2	2	1,284	KY
NØOND/VE5	286	2	2	1,108	SK
AB7QG	455	2	2	1,010	UT
NØSRF (+KEØPX)	424	2	2	948	CO
N8KZG	415	2	2	930	MI
KT6DM	280	2	2	860	SCV
WA7PRC (+N7MCG)	269	2	2	856	OR
WA6LVX (+KG6IWX)	228	2	2	756	SJV
N3EF	300	2	2	700	MDC
AA7L	130	2	2	678	EWA
W3C	75	2	2	550	EPA
N9EAX (+KC9DPT)	172	2	2	546	WI
W8JGC (+W8JGB)	116	2	2	532	MI
VE3LSC	109	2	2	478	ON
WB9NJS	134	2	2	468	SF
WD8MQN	132	2	2	464	VA
W3SW (+KB2ZWZ)	128	2	2	456	WNY
KD5CXF (+WA5TYJ)	25	2	2	450	NM
K5PA (+AD5HP)	73	2	2	446	STX
K4GSX	37	2	2	430	GA
K9JQE	140	2	2	380	WI
WB5PLJ (+NØEW)	97	2	2	294	MO
WA2YCJ	20	2	2	140	NNJ
N3KMZ (+N3QQK)	12	2	2	124	WPA

1B-2 Op

NN7S (+N7JKF)	910	2	2	3,858	MT
N1UR	769	2	2	2,520	VT
N4NTO (+KI4BFG)	257	2	2	1,210	NC
KAØZPP	115	2	2	430	ND
KB9VNO	74	2	2	296	IL

2B-2 Op Battery

K7RE (+N9NE)	587	5	2	6,325	WY
WUØH (+NØSXX)	407	5	2	3,920	SD
N8EFO	328	5	2	3,255	OH
W6UR	210	5	2	2,300	SJV
N2MN	209	5	2	2,135	NNJ
VE3FAL (+VE3AVS)	162	5	2	1,820	ON
N6MBY (+K6RHB)	193	5	2	1,765	SB
K5DI	135	5	2	1,285	NM
AA7IH (+WA7AXO)	96	5	2	1,060	OR
WT7X (+N7BCP)	99	5	2	775	WW
W6MPB	75	5	2	675	LAX

2B-2 Op

KQ8J (KB8LTF)	1482	2	2	4,828	MI
KK7UV	529	2	2	1,804	MT
W1SRG	448	2	2	1,718	ME
KFØTW	424	2	2	1,532	MO
WO9K (+KB9CTJ)	356	2	2	1,518	IL
K4CMD	473	2	2	1,460	VA
KØDAN (+K1LK)	559	2	2	1,418	MO
KC5JFO	301	2	2	1,154	NTX
K7GZB	524	2	2	1,154	MT
WØIVJ	423	2	2	852	CO
WA1USA	78	2	2	584	RI
W5RNF	180	2	2	562	NTX
W4RSK (+KD4KHG)	53	2	2	510	SC

2B-2 Op

WA9LKZ	11	2	2	28	IL

3B-2 Op

KØCO	168	2	2	918	CO

Mobile Stations

1C

AA6DP/MM	808	2	1	2,928	LAX
W3ET/MM	507	2	24	1,486	SNJ
W7HV/MM	143	5	3	1,430	EB
NF4U	187	2	1	748	GA
K9CG	141	2	3	564	IL
K4VIZ/MM	136	2	3	544	NFL
W8WEJ	110	2	1	440	WV
N7DLV	217	2	1	434	EWA
VE2/KØDI	106	2	2	420	QC
K8LT	112	2	2	408	OH
N3KLJ	130	2	2	408	EPA
AB4EJ	195	2	1	390	AL
W9DY	84	2	1	336	IL
K3SFP	81	2	1	324	VA
K5VHH	128	2	1	260	STX
W9BNO	123	2	1	258	CO
NØPI	120	2	1	240	WY
NØCQI	104	2	2	208	NE
KJ8I	101	2	1	202	OH
W8KL	72	2	1	194	OH
KI6CG	97	2	1	194	MT
W4ZPR	46	2	1	184	VA
NØPFS	64	2	1	182	SD
K7CN	43	2	1	172	OR
W7SAW/MM	81	2	1	162	WW
W7AQ	77	2	1	154	EWA
W7ON	64	2	4	140	AZ
N9JZ	66	2	1	132	IL
N1KAT	31	2	2	120	ME
AF5Q	53	2	1	106	OK
KA5FQA	47	2	1	98	OR
KD5RXT	45	2	1	90	NTX
KCØOCC	45	2	1	90	IA
NØWY	41	2	1	82	WTX
KFØQ	32	2	1	64	MN
WØIE	29	2	1	58	KS
KS9SSS	28	2	1	56	IL
K7UWR	26	2	1	52	WY
AA6DX	14	2	1	50	SF
VE4VID	24	2	1	48	MB
NP2DJ	21	2	1	46	VI
WØPTU	21	2	1	42	CO
N3HCN	10	2	1	40	MDC
WA8SSQ	20	2	1	40	OH
W5RZ	16	2	1	36	AR
NA3J	9	2	1	18	CO
N1NP	4	2	1	8	VA
WB9RDE	2	2	1	4	IL

2C

KA3KSP	10	2	2	20	WPA

Home Stations Commercial Power

1D

KH6ND	1299	2	1	4,620	PAC
KR4Z	1359	2	2	4,312	NFL
W1AQ	1425	2	7	4,118	RI
N2OW	873	2	1	3,492	WMA
K9WWT	780	2	1	3,120	IN
W6KFV	621	2	1	2,484	SB
NN2W	1454	1	3	2,233	NLI
W8MJ	466	2	1	1,864	MI
K5XR	718	1	1	1,436	STX
K9ZO	460	2	1	1,414	IL
K5ZD	382	2	1	1,410	WMA
W9TS	344	2	1	1,376	IL
KH6SH/K7	428	2	1	1,354	UT
KG1V	343	2	1	1,354	NH
VE2GB	334	2	3	1,336	QC
VE6AO	1315	1	3	1,315	AB
W1RM	324	2	1	1,296	CT
K5DR	858	1	4	1,255	LA
WA4NKL	300	2	4	1,200	GA
AE7EE	288	2	1	1,152	WW
WB2AA	283	2	1	1,132	NNJ
KBØSK	289	2	2	1,070	IA
W6NGC	513	2	6	1,026	LAX
W5RW	274	2	1	946	AR
WY4Y	941	1	1	941	GA
NG3K	227	2	1	908	MDC
W5GAI	313	2	1	882	STX
W6AKF	317	2	2	838	SV
W6VM	206	2	1	796	SB
N9MA	395	2	4	790	IL
AC8P	200	2	2	772	MI
AB5ZA	191	2	1	764	OK
K2UY	185	2	1	740	NLI
KØHW	329	2	1	736	SD
W6EEN	424	1	2	718	ORG
N5ASA	353	2	1	706	LA
K9UQN	182	2	1	676	IL
KCØFLP	338	2	1	676	MO
K6CSL	187	2	1	656	SJV
NE8J	218	2	1	650	NFL
WA6BOB	161	2	1	644	LAX
VE1GM	157	2	1	628	MAR
K8VOR	155	2	1	598	OH
K1YK	299	2	1	598	VT
W9OA	149	2	1	596	IL
KE9R	577	1	1	592	IN
VE5JZ	142	2	1	568	SK
N5UV	277	2	1	562	NTX
N7TOD	231	2	2	544	NV
NR9A	267	2	1	534	MO
N3AM	258	1	1	515	MDC
W7LZ	256	2	1	512	AZ
W2LRO	164	2	1	498	NNJ
WA2BCK	122	2	1	488	VA
W4HEW	122	2	1	486	SC
W6TK	297	1	1	479	SB
NS4DX	164	2	1	474	VA
W3PIE	161	2	15	472	WPA
KØVM	230	2	1	460	IA
KH6/W5WIA	226	2	3	452	PAC
KT4FD	224	2	2	448	GA
W8TWA	110	2	1	440	MI
KE6QR	136	2	1	420	EB
W8LJ	103	2	1	412	OH
N7QH	403	1	2	403	AZ
WW9R	180	2	1	360	WI
W1WIU	305	1	1	357	RI
KO6OP	177	2	2	354	SJV
K9GDF	88	2	1	352	WI
KØLWV	97	2	1	352	MO
W9ISC	84	2	1	336	WI
AJ6V	200	1	1	328	SCV
K6RXL	164	2	1	328	AZ
AA6EE	80	2	1	320	SDG
KU5S	157	2	1	314	WTX
W2VTV	143	2	1	310	NNJ
N2EZY	139	2	2	306	WNY
K2MK	76	2	1	304	SNJ
W7EK	91	2	2	294	WW
K8DDB	72	2	1	288	MI
K7LZJ	144	2	1	288	TN
W2CS	99	2	1	276	NC
AG4SV	68	2	1	272	GA
W4NTI	66	2	1	264	AL
W5KEC	66	2	1	264	AR
N3KN	159	1	1	254	EPA
K9DVB	127	2	1	254	WI
W1PDI	126	2	1	252	OH
VE3RCN	77	2	1	248	ON
AF4UL	123	2	4	246	GA
W6LPW	122	2	1	244	SCV
AA5EQ	120	2	1	240	NTX
WØDSA	113	2	1	226	CO
KA5PEA	107	2	1	214	MS
AA8IA	53	2	1	212	OH
WØOEP	53	2	1	212	MN
K9IM	102	2	3	204	IL
WA7YNU	85	2	1	200	MT
KE6LBX	65	2	1	196	SDG
W3DP	114	1	1	195	EPA
KE7UA	183	1	1	183	TN
WJ4E	45	2	1	180	SC
WD4CBZ	82	2	1	178	NFL
KB4XE	87	2	1	174	SFL
NØUGX	86	2	1	172	CO
WA9PYH	46	2	1	172	IN
N9KS	50	2	1	170	NFL
W4BWQ	84	2	1	168	NFL
AI9D	83	2	1	166	IN
W6CBA	82	2	1	164	LAX
VE3TAZ	41	2	1	164	ON
W7YVK	80	2	1	160	OR
KC8ELY	77	2	3	154	MI
WAØOTV	41	2	1	154	MO
WA8YVF	75	2	1	150	OH
W9WY	73	2	1	146	IN
KG4YWD	35	2	1	140	VA
VE3BKZ	51	2	2	138	ON
VE2XL	68	2	1	136	QC
NØNCL	66	2	1	132	IA
AA3II	33	2	1	132	WPA
KE4QOJ	66	2	1	132	VA
N4NDR	62	2	1	124	NFL
KAØITA	61	2	1	122	KS
WA6GFR	41	2	1	114	ORG
N4NVW	55	2	1	110	NNY
N8GX	108	1	1	108	MI
KE8TQ	50	2	1	106	OH
K8CPA	29	2	1	102	MI
KB9AFW	51	2	1	102	MI
KC8HWV	50	2	1	100	OH
W8CAH	25	2	1	100	IL
N6QZS	25	2	1	100	SV
VE3GNA	32	2	1	98	ON
K3VOA	42	2	1	98	MDC
NA4BW	48	2	1	96	GA
KG4USN	45	2	1	90	SFL
WA5YNE	88	1	1	88	OK
K8AN	30	2	1	88	OH
KIØMJ	43	2	1	86	MO
W6WXO	82	1	2	85	SV
N5PU	85	1	1	85	MS
K5BAT	41	1	1	82	AR
WB6KOE	40	2	1	80	SV
WB9MII	20	2	1	80	IL
W1JAB	38	2	1	76	NH
K3DG	18	2	1	72	SFL
WD4NIT	36	2	1	72	GA
AC5RI	19	2	1	72	NM
K1RFD	18	2	1	72	CT
WØXP	34	2	1	68	MO
WB2VBN	34	2	1	68	NNJ
N6PA	22	2	1	68	SB
WD4AJI	27	2	1	66	SFL
W3HF	16	2	1	64	EPA
K9ZBM	31	2	1	62	IN
N5GEJ	29	2	1	58	IN
KO4BB	28	2	1	56	NFL
WA2BKN	56	1	1	56	NNJ
ABØSD	26	2	1	52	IA
NEØP	17	2	1	48	OK
WN4M	12	2	1	48	TN
K3JHT	11	2	1	44	WPA
KØPJG	40	1	1	40	NC
KAØOGU	20	2	1	40	NFL
KD5HYF	20	2	1	40	STX
KK7CG	19	2	1	38	OR
KB9YXH	17	2	1	34	IL
WB6YZC	17	2	1	34	ORG
WA5LFD	17	2	1	34	NTX
KP4JRS	8	2	1	32	PR
NØADF	27	1	1	27	SFL
KG4OCJ	13	2	1	26	KY
KO6YG	12	2	1	24	SCV
KC4YOB	11	2	1	22	AL
KR4IZ	11	2	1	22	WCF
W4MDF	11	2	1	22	NC
N4UXA	17	1	1	21	VA
K6SKP	10	2	1	20	ORG
CJ2IC	10	2	1	20	QC
WA2JCP	10	2	1	20	EPA
N1KN	10	2	1	20	CT
ABØDX	6	2	1	18	MO
KK7GG	7	2	1	14	OR
KT3TV	7	2	1	14	WCF
LU5EVK	7	2	1	14	DX
WØRHW	9	1	1	9	IL
KA9RBI	2	2	1	8	IL
KC2CJI	3	2	1	6	NLI
N4XMX	6	1	2	6	GA
WA6HXF	3	2	1	6	LAX
AAØLM	2	2	1	4	MO

2D

N8GQ	1037	2	25	2,180	MI
N3XLS	582	2	2	1,754	EPA
K4CPO	429	2	15	1,348	TN
K4AAB	466	2	15	1,130	VA
N8CPA	247	2	1	988	OH
KW1AM	260	2	3	834	CT
W5DAR	213	2	22	674	NM
KB8UMD	284	1	1	552	MI
AF4HS	251	2	3	502	GA
KA5B	227	2	4	454	NM
K5EOK	153	2	32	436	OK
K3IEC	182	2	10	364	EPA
W5OMR	77	2	4	288	STX
W2EGB	61	2	6	122	ENY

3D

AF4NP	1528	2	10	3,056	AL
K2FA	647	2	3	2,196	WNY
W8BAP	375	2	30	1,010	OH
WN3M	275	2	10	976	WPA
W3PAH	226	2	4	578	WPA

4D

W1AW	627	2	12	1,694	CT
WR9N	215	2	8	440	IL
W9QYQ	187	2	23	440	IN

5D

KQ6AR	620	2	21	1,840	SJV
K9EAM	1335	1	27	1,570	WI

Home Stations Emergency Power

1E

W8DL	830	5	2	8,300	WV
W6JTI	703	5	1	7,030	SF
W2BC	1510	2	3	6,040	WNY
K9TP	2219	2	3	5,622	IL
WA7LNW	502	5	1	5,020	UT
K7SEL	363	5	3	3,410	ID
W8UE	331	5	1	3,310	MI
N7DZ	806	2	1	3,224	AZ
NØTT	768	2	1	3,072	MO
K5KDJ	300	5	1	3,000	STX
W3HGT	1252	2	5	2,848	NC
W4NI	289	5	2	2,845	TN
N6IIU	1398	2	1	2,796	SJV
K7NX	892	2	1	2,610	AZ
N6MI	1015	2	1	2,550	SJV
KMØRSE	267	5	3	2,490	IN
K1EEE	249	5	1	2,490	NH
K3WW	225	5	1	2,250	EPA
W4MJT	208	5	1	2,080	NC
KGØTW	205	5	1	2,050	MO
AA1O	205	5	1	2,050	EMA
WB2DVU	574	2	4	2,034	WNY
N7WS	977	2	1	1,954	AZ
K4PB	506	2	1	1,924	SFL
K8AB	191	5	1	1,875	OH
W5GZ	336	5	1	1,740	NM
KE6CC	206	5	1	1,715	ORG
K4WW	520	2	2	1,680	KY
AB4EL	168	5	1	1,680	NC
K4BKD	167	5	1	1,670	GA
K7HP	408	2	1	1,632	AZ
W6PRI	172	5	1	1,620	SCV
K9ES	626	2	3	1,608	SFL
KS4YX	156	5	1	1,555	SC
WX8J	147	5	1	1,470	OH
W1JAA	689	2	1	1,378	SC
K4FHI	133	5	1	1,330	NC
WR4I	117	5	1	1,170	VA
K7FD	1044	1	5	1,152	OR
K5EEE	575	2	1	1,150	SFL
KW3F	113	5	1	1,130	EPA
N7NB	112	5	1	1,120	WW
NT4P	111	5	1	1,100	NC
K8CV	256	2	1	1,024	MI
AG4V	500	2	1	1,000	TN
W3GN	245	2	1	980	MDC
K8ONT	259	2	4	942	MI
N5LFH	470	2	1	940	STX
KF6CNV	342	2	2	882	SJV
K6UF	265	2	1	856	SCV
WB8RFB	233	2	2	844	MI
N5EL	84	5	1	840	NTX
K9DCF	84	5	1	840	NM
NI7R	81	5	1	810	AZ
KØSUM	385	2	2	770	CO
N9XR	193	2	1	766	IL
KØYG	117	5	1	735	CO
W3LL	366	2	1	732	MDC
WA4FOM	75	5	1	680	NNJ
AC6TU	68	5	1	680	LAX
WM6J	167	2	1	668	ORG
N3FJP	323	2	2	660	MDC
W5ORM	163	2	1	652	NTX
K5NRK	308	2	1	616	MS
WN3C	152	2	1	608	MDC
K3SWJ	301	2	1	602	STX
WA1VKO	300	2	1	600	NH
K9UT	59	5	1	590	IN
KF7PG	147	2	1	588	WW
W3ZMN	58	5	1	580	EPA
WB5BNV	57	5	1	570	MS
K1RDD	53	5	1	530	WMA
K6TV	51	5	1	510	LAX
KA9TXE	47	5	1	470	IL
AAØPO	229	2	1	458	MO
KB3FJJ	45	5	1	450	EPA
W7RRC	152	2	1	440	OR
KR7SUB	122	2	4	438	WW
KT7AZ	210	2	1	422	AZ
AA7XA	41	5	1	410	OR
KU9RK	100	2	1	400	IN
K6OWL	111	2	1	398	SF
W2UXL	38	5	1	380	SFL
KB6CC	190	2	1	380	CO
W6ZH	38	5	1	380	LAX
WB2TVB	75	5	1	375	LAX
K6TY	134	2	1	374	LAX
KØXXX	181	2	4	362	AR
W9JOZ	170	2	9	340	IN
W3MGL	68	5	2	340	VA
N1XYF	165	2	1	330	VT
K6AWO	65	5	1	325	ORG
NN9X	84	2	2	288	IN
N2MTG	141	2	1	282	ENY
N4OZI	139	2	1	278	GA

NO6E	67	2	1	268	EB
W8MDV	120	2	1	264	MI
K2NPN	25	5	1	250	WNY
WA4JA	113	2	2	226	TN
VE7UBC	110	2	8	220	BC
AE6JB	43	5	1	215	SCV
KZ2G	21	5	1	210	NLI
KJ6JO	101	2	1	202	ORG
VE3OZ	100	2	1	200	ON
KF6IIU	48	2	1	192	EB
W7JBJ	37	5	1	190	WW
KC8PAR	19	5	1	190	WV
WB4QNG	37	5	1	185	KY
W5JJP	86	2	1	172	OK
AA5HY	81	2	1	162	LA
W6DMS	71	2	1	142	ORG
N0RQ	68	2	1	136	NTX
KG6CUK	25	5	1	125	LAX
KB0RQE	55	2	1	110	MO
VE3IJM	50	2	1	106	ON
WA5KQU	31	2	1	106	AR
KT6JS	51	2	2	102	SV
N1GF	50	2	1	100	EB
K2FEO	44	2	1	88	WNY
K7RQN	37	2	1	74	AZ
WA3WUL	30	2	1	70	DE
W7KI	33	2	1	66	WW
AH6NF	32	2	1	64	PAC
WA8LEQ	31	2	1	62	STX
N9QIL	8	5	1	60	IN
WA8MWA	15	2	1	60	OH
W7NRJ	29	2	1	58	EWA
V01XP	11	5	1	55	NL
WB8AEV	26	2	1	52	MI
W2TI	5	5	1	50	NNJ
KB9STQ	15	2	1	46	IN
KV4A	22	2	1	44	GA
N5IAC	40	1	1	40	NM
AE6EO	19	2	1	38	SCV
N3HQD	18	2	3	36	WPA
PV8IG	4	2	1	16	DX
KC4AAC	12	1	1	12	DX
N3AWS	3	2	1	6	NFL
WG1Z	3	2	1	6	EMA

2E

N2BJ	1979	2	2	5,080	IL
K9YHB	296	5	5	2,560	IL
K6SS	662	2	3	2,350	ORG
VE4ARM	805	2	13	2,012	MB
W1US	1590	1	4	1,979	VT
K4RRC	805	2	3	1,610	NC
W5ES	766	2	50	1,536	WTX
W8NI	472	2	5	1,520	MI
VE6FI	1036	1	8	1,036	AB
WW2DEM	246	2	4	950	ENY
VE1ARC	354	2	25	820	MAR
KU4MH	261	2	6	810	VA
VE3WRC	293	2	5	802	ON
N8KCL	330	2	2	774	OH
WA2AAZ	171	2	13	354	WNY
N4MBI	141	2	4	282	NC

3E

K5HLA	2325	2	36	8,108	STX
K5WPH	1226	2	35	2,906	WTX
NO8D	1520	1	3	2,380	OH
W8DYY	731	2	25	2,256	OH
W3KWH	554	2	22	1,368	WPA

5E

W6AQ	596	5	7	4,250	LAX
K4YNZ	234	2	7	676	AL

6E

W0NT	1677	2	15	4,784	CO

EOC Stations

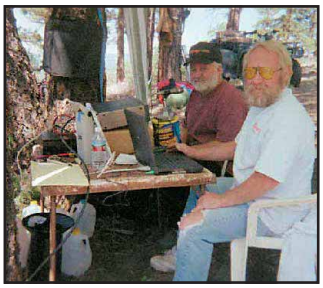
1F

ARVARF					
K5PXP	1127	2	15	3,374	AR
WC7BDS	544	2	17	2,674	ID
W7NWS	550	2	27	2,244	MT
West Essex ARC					
W2EF	457	2	8	2,126	NNJ
NPARC					
WK2I	345	2	22	1,660	NNJ
Great Falls Area ARC					
W7ECA	460	2	30	1,612	MT
W1LAS	389	2	18	1,552	CT
K3NDM	123	5	5	1,530	MDC
Nanaimo ARA					
VE7NA	274	2	19	1,266	BC
EOC					
VE1SE	531	2	3	1,262	MAR
N0GR	628	2	5	1,256	IA
Johnson Space Center ARC					
W5RRR	989	1	7	1,190	STX
N0ID	145	2	18	1,062	KS
St John ARC					
KP2SJ	157	2	15	988	VI
Clermont RACES/ARES					
K8JI	284	2	22	948	OH
Insurance City Repeater Club					
WA1ARC	148	2	9	886	CT
North Country ARC					
W2LCA	183	2	7	886	NNY
Elkhart Cty Emergency Management					
KC9ALY	77	2	12	824	IN
Big Bend ARC #2					
KA5NJA	211	2	4	822	WTX
Satern Metro-Detroit					
N8SE	9	2	13	818	MI
KY4HC	98	2	20	796	KY
Fundy ARC					
VE1HC	161	2	7	782	MAR
West Marin ARS					
W6RSI	15	2	25	630	SF
Clarke Cty ARES					
N4ZRA	64	2	16	628	GA
SATERN-Reno					
KK7IH	53	2	8	608	NV
W9EEH	3	2	19	606	WI
Lake County RACES # 2					
K9KRY	282	2	12	564	IL
N0APJ	25	2	5	552	KS
Volunteers in Prevention					
W6MUL	24	2	14	548	SCV
W0GC	143	2	2	490	SD
Cape May Cty ARC					
KA2CBC	93	2	9	486	SNJ
Macomb County ARPSC					
WA8MAC	145	2	4	440	MI
Com. Support Group, CO State EOC					
WC0AAX	129	1	4	429	CO
American Red Cross Central CT					
WB1ARC	43	2	3	416	CT
KC7OZU	402	1	5	402	WY
KC0EEC	144	2	17	388	IA
American Red Cross of NE NY RC					
KC2LQK	34	2	7	368	ENY
K4EOC	71	2	5	342	SFL
W7EOC/AC7AI	49	2	3	298	WW
KM5WB	92	2	10	284	WTX
N3IO	82	2	2	258	DE
W9KJ	55	2	2	250	IL
Terrace ARC					
VE7EOC	43	2	10	242	BC
Associated with Sturdy Memorial					
WC1PLV	15	2	2	230	EMA
Harrisburg Radio Amateur Club #2					
NK3E	14	2	2	228	EPA
N1SF RC					
WX9WX	200	1	8	206	IL
Pocono Amateur Radio Klub					
W3PRK	100	2	3	200	EPA
Gila ARS					
K5GAR	99	2	8	198	NM
Falukner Cty ARC					
W5AUU	40	2	9	180	AR
KL7FWX	20	2	2	178	AK
Sanibel Emergency Radio Unit					
W4SBL	89	2	9	178	SFL
K8SBI	30	2	2	80	OH
K7YCA	26	2	4	52	AZ
Harrison Cty ARES					
W4WLF	17	2	3	34	MS
Warren Cty (NY) RACES					
KT2M	9	2	4	18	ENY

2F

Albuquerque DX Assn					
W5UR (+K5HAB)	2621	2	18	8,494	NM
Platinum Coast ARS					
W4MLB (+K4QD)	1807	2	25	6,286	SFL
Halifax RAC					
VE1FO (+VE1YO)	1347	2	38	5,408	MAR
Truckee ARES					
K6ST	1494	2	10	5,056	SV
Oconee Cty ARS					
W4EEE	1061	2	15	4,512	GA
Meriden ARC/Wallingford EOC					
W1NRG (+KB1CIW)	920	2	42	4,314	CT
Eastern ARS					
K2EC	1363	2	18	4,144	NLI
Oakville ARC					
VE3HB	1057	2	33	3,060	ON
Quad Cty ARC, Inc					
N3QC	668	2	12	2,926	WPA
W6VOM	483	2	21	2,654	EB
VE7RAC (+VA7TRS)	375	2	35	2,320	BC

The K5WPH Sun City (TX) ARC was a hub of activity.



NØSRF and KEØPX take a moment to say "cheese" while operating in Colorado.

Great River ARC					
N0RWR (+N0YB)	603	2	32	2,120	IA
City of Peoria RACES					
N9SJ	363	2	7	2,018	IL
Madison Cty ARC					
W9VCF	541	2	11	1,820	IN
SCARES					
W5SCA	306	2	12	1,818	NM
W3EDU	611	2	7	1,814	EPA
Cabarrus ARS					
K4CEB (+KA4ATT)	295	2	18	1,590	NC
N9ZD	684	2	7	1,568	IL
Tippah ARA					
K5KIR	402	2	11	1,558	MS
Piscataquis ARC					
K1PQ	175	2	24	1,498	ME
W9UDU	316	2	12	1,492	WI
Bankhead ARC					
N4IDX	628	2	11	1,456	AL
Palatone IL EMA					
KI9R	427	2	14	1,454	IL
Reno Area Metro Simplex Club					
NV7RM	279	2	12	1,414	NV
Rhode Island Satern					
KB1IMA	33	2	5	1,266	RI
Tri County (NC) ARC					
NC4AR	276	2	8	1,252	NC
Otsego Cty ARA					
NC2C	321	2	19	1,246	WNY
Macon-Bibb EMA ARG					
WX4EMA	245	2	14	1,190	GA
Wild Horse Desert Hams					
KD5VWX	172	2	9	1,144	STX
Ellis County ARC					
WD5DDH	322	2	25	1,144	NTX
Davidson County ARES					
K4OHX	248	2	6	1,106	TN
Branch Cty ARC, Inc					
WD8KAF	237	2	9	1,098	MI
South Mountain Repeater Assn					
N3TWT (+W2ROQ)	109	2	15	1,098	EPA
Wells Cty ARC					
W9SR	218	2	16	1,080	IN
Red River Valley ARC					
WB5RDD	185	2	22	1,072	NTX
Union Cty (NC) ARES					
NC4UC	150	2	14	1,052	NC
HCARS					
KC8WIT	270	2	10	1,042	OH
San Juan Cty ARS					
K7KFM	76	2	10	1,020	WW
Enid ARC					
W5HTK	331	2	26	966	OK
Federal Way ARC / Federal Way					
WA7FW	155	2	20	922	WW
Mohawk Valley ARA					
KC2AUO (+N1YR)	189	2	4	908	NNY
Houston ECHO Society					
W5ECO	158	2	6	892	STX
RBRA - Manalapan (NJ) RACES					
K2GE	41	2	9	886	NNJ
St John Valley ARA					
N1FG	188	2	12	876	ME
Bonneville Cty ARES					
K7EFZ	249	2	8	870	ID
Preble ARA					
K8YR	50	2	12	856	OH
Walla Walla Valley ARES					
K7UH	157	2	14	832	EWA
Star Valley ARC					
KD7LVE	147	2	7	794	WY
WC8CLI	79	2	7	758	MI
Burlington Cty Joint ARES/RACES					
NJ2L	203	2	6	742	SNJ
Mason Cty RC					
K8DXF	104	2	28	734	MI
Wide Area Repeater Assn					
KA4MAP	211	2	17	722	KY
Convair/220 Club					
W6UUS	178	2	9	556	SDG
Peninsula AR Emergency Team					
KA7EOC	155	2	22	530	WW
Valley ARA					
N1RA	168	2	10	482	CT
Capital City ARC					
W7TCK	121	2	15	464	MT
W4LBT	171	2	3	446	NC
WA9RDF	33	2	5	266	IN
Somerset Cty ARC #2					
W3SRS	54	2	5	208	WPA
Oceano Sheriff's DEPT EOC - ECC15					
WB6MIA	52	2	5	104	SB
WC1MAA	31	2	3	62	EMA
Xerox Amateur Radio					
WD6CZH	21	2	14	42	LAX

3F

Valley RC					
W7PXL (+N7ICK)	864	2	23	4,344	OR
East Alabama ARC					
W4LEE (+K4LRW)	995	2	38	4,268	AL
KD4K (+KB4HQA)	1228	2	30	4,028	GA
Atchafalaya Amateur DX Assn					
WA5MC	572	2	7	2,880	LA
W1L	493	2	8	2,584	WMA
Cyclone ARC & Story County ARC					
W0ISU (+W0YL)	507	2	15	2,400	IA
KY Mountains ARC					
KN4M (+AF4YJ)	461	2	27	2,368	KY
Intercity ARC					
W8WE	466	2	32	2,274	OH
Scott Cty ARES Club					
N4CO	359	2	13	1,734	KY
KG4NLF	300	2	30	1,680	TN
Cross Cty ARC					
WA5CC (+N0HNQ)	169	2	26	1,640	AR
W7DG	452	2	18	1,516	WW
Oakland Cty ARPSC / Catalpa ARS					
W8OAK	95	2	20	1,490	MI
Tazewell Cty ARS					
W9TAZ (+W9UVI)	436	2	31	1,482	IL
Gwinnett Cty ARES					
KG4QDK	222	2	14	1,478	GA
A-G-S-T-W RACES					
KB1CDL	175	2	26	1,472	WMA
Roseland ARC					
K2GQ	487	2	38	1,438	NNJ
Mt Arlington RACES					
N2EON	209	2	4	1,318	NNJ
Shoreline Auxiliary Communications					
KB7RR	194	2	14	1,302	WW
Loyalist City ARC					
VE9LC	226	2	17	1,152	MAR
Chief Anderson ARC					
WA9EOC	109	2	16	1,118	IN
Plainfiend Radio League & EMA					
WW9AE	189	2	6	1,092	IL
Chipola ARC					
W4BKD	259	2	29	970	NFL
Metroplex ARC					
W2MPX	141	2	18	932	NNJ
WM7S	48	2	4	896	WW
Algonquin ARC					
N1EM	68	2	16	642	EMA
Tri City ARC					
WA1DD	146	2	16	292	CT
W6UCS	11	2	2	124	SCV

4F

Van Wert ARC					
W8FY	1739	2	18	5,660	OH
MCECG					
N7IZM	787	2	13	3,134	AZ
Texas Emergency Amateur					
W5SI	664	2	64	3,076	STX
Framingham ARA					
WC1MA (+W1FY)	708	2	40	2,766	WMA
Jackson ARC					
W5PFC (+W5JWX)	494	2	75	2,580	MS
Flagler Emergency Communications					
KG4TCC	360	2	20	2,540	NFL
Orange Cty FL ARES/RACES					
W4MCO	562	2	26	2,442	NFL
City of San Jose RACES					
W6IO	427	2	21	2,420	SCV
TCARA-TCARES/RACES					
KC8CNN	427	2	15	2,376	MI
Coastline ARA					
NC1D	583	2	10	2,194	CT
ARA of Southwest Florida					
K4YHB	890	1	25	1,876	SFL
Albany ARC					
W4MM	605	2	16	1,710	GA
Lancaster ARC and Lancaster OEM					
W2SO	326	2	30	1,252	WNY
WT9M	215	2	20	944	WI
Toronto EOC					
VA3EOT	37	2	4	174	ON

5F

Palomar ARC					
W6NWG (+NE6O)	2917	2	68	9,192	SDG
Great South Bay ARC					
W2GSB	674	2	52	3,490	NLI
Tyler ARC					
K5TYR	721	2	25	2,726	NTX
K4ORE	484	2	10	2,452	TN
Shelby Cty ARC					
W4SHL	569	2	55	2,108	AL
Grand Strand ARC					
W4GS (+AF4HL)	340	2	27	2,040	SC
WA7DEM	235	2	42	1,706	WW
National Trail ARC					
K9UXZ	303	2	17	1,108	IL

6F

W8VND	1461	2	26	4,586	OH

7F

Stanford University ARC					
W6YX (+WN6I)	4349	2	30	15,610	SCV
SEMARC					
W0CGM	314	2	8	2,198	MN
Silver Springs RC					
K4GSO	220	2	9	1,780	NFL

8F

Worcester Emergency					
WE1CT (+WB1ARZ)	1126	2	32	4,330	WMA

9F

Arlington (VA) ARC					
W4WVP	352	2	23	2,618	VA
TBCAR					
KE4FMN	370	2	11	1,402	NFL

ARRL Straight Key Night 2004 Announcement

Many people helped make us the operators we are today. And we all recall those special moments with our "Elmers"—the people who really taught us the ropes of operating. Most of us are fortunate to have had several along the way. When I first was getting started in the hobby, I was fortunate enough to have two that helped pave the way for me to "join the club."

By chance, they happened to be great friends and neighbors to each other. In fact, Everest, W4DYW, was also an Elmer to the other, Col Frank, WB4JMG. Between the two of them, they kept my interest sparked…and they taught me "the code." During all of the weeks I was studying the theory for my Novice test, you would usually find me either at Everest's or Frank's—rummaging through junk boxes or learning to solder. And most importantly (at least to me)—participating in Amateur Radio by "operating" their stations—tapping out CQs and making QSOs on the straight keys at their rigs.

They believed that the best way to learn the code was to use the code. By the time my own license arrived after several months of expert tutelage, I was ready to fly solo without a guiding hand to walk me through my the first contact—with Col Frank. By the time WN4YMV was QRV, they had already gotten me into the habit of checking into novice training nets and handling traffic—all through the magic of "pounding brass."

In this era of digital communication, keyboarding, FM and electronic keys, once a year many excellent operators bring the past to the present and participate in the annual ARRL Straight Key Night. The object of this friendly event is to enjoy some good, old-fashioned QSO fun, using straight keys. The emphasis is on rag-chewing rather than on fast contest-type exchanges. SKN 2004 begins at 7 PM EST December 31 and runs for 24 hours through 7 PM EST January 1 (0000-2400 UTC January 1, 2004).

When participating in SKN 2003, instead of sending RST before sending the signal report send the letters SKN, to indicate your participation and to clue in passersby who may be listening that SKN is going strong. Afterward, send the Contest Branch a list of stations worked, plus your vote for the best fist you heard (it doesn't have to be one you worked). Also, include your vote for the most interesting QSO you had or monitored.

Please post your comments and interesting photographs from your SKN adventure to the ARRL Contest Online Soapbox at **www.arrl.org/contests/soapbox**. You may also send in items for the Feedback section of the SKN 2004 writeup. Entries should be e-mailed to the Contest Branch at **StraightKey@arrl.org** or may be sent via regular mail to SKN, ARRL, 225 Main St, Newington, CT 06111.

Entries for SKN 2003 must be received by January 31, 2004. Votes for "Best Fist" and "Most Interesting QSO" will be tabulated and included in the April 2004 issue of *QST*. If you have questions about SKN, please visit the Contest Branch Web Page at **www.arrl.org/contests** or contact **contests@arrl.org**.

Last year we had 164 entries submitted for SKN—the most in many years. Why not dust off the key, clean the contacts and light up the ether with the beautiful melody of hand-created CW? If your Elmers were like mine, they will smile knowing that the true art of CW is not lost....—*N1ND* QST

2004 ARRL International DX Contest Announcement

Date: 0000 UTC February 21-2359 UTC February 22 (CW)

0000 UTC March 6-2359 UTC March 7 (Phone)

How to participate: W/VE amateurs work as many amateurs in as many DXCC countries as possible on 160, 80, 40, 20, 15 and 10 meters. Single Operators may participate as all-band High power, Low power or QRP, Single Band (with no power differentiation) or Assisted (with no power differentiation). Multioperator categories are Single, Two or Unlimited transmitters (with no power differentiation).

What to say: US and Canadian stations send a signal report and their state or province/territory. DX stations send a signal report and a number indicating their transmitter output power. If you use standard abbreviations and phonetics, you will find yourself being asked for fewer repeats.

Special interest: Operators will travel to many interesting DX locations—who wouldn't rather be on a warm Caribbean island in mid-February instead of the frozen tundra of the upper US Midwest? Many DX newsletters and mailing lists publish an extensive list of DXpeditions to look for the week before each mode of the contest. The weekly DX bulletin from W1AW also has a good list of reported stations. Be on the lookout for some great opportunities.

Quirks: Remember that the ARRL Multioperator Single Transmitter category does not allow a second transmitter that only works mults: it is a true Single Transmitter category. Multi Singles and Multi-Two stations must remember the six-band change per hour rule for each transmitter.

Rule changes this year: None.

Best reason to participate: It is possible to work enough countries to complete DXCC in a weekend. In fact, many stations may work enough stations to work DXCC on more than one band. Activity is always high with lot of stations to work. Any station that completes a minimum of 100 QSOs during either weekend is eligible to purchase an attractive 2004 DX Contest Pin commemorating their accomplishment.

Relative challenge: You don't have to have the fanciest equipment or the biggest station to make plenty of contacts in this contest. The exchange is simple, and there is always propagation to somewhere. Heading toward the bottom of the sunspot cycle will put more emphasis on the lower bands, so good operating practices and courtesy are even more important as some bands become more crowded.

Scoring: Each completed non-duplicate QSO counts 3 points. For W/VE stations, each DXCC entity worked counts as a multiplier once per band. For DX participants, each US state (except KH6 and KL7), the District of Columbia and Canadian province or territory counts as a multiplier once per band. Your final score is QSO points times total Multipliers worked.

How to report your score: For CW, you must send in your entry by March 24, 2004. For Phone, you must submit your entry by April 6, 2004. E-mail Cabrillo format log for CW to **dxcw@arrl.org** and Phone to **dxphone@arrl.org**. Send paper logs and complete summary sheet to DX CW Contest (or DX Phone Contest), ARRL, 225 Main St, Newington, CT 06111.

Complete rules: The complete rules may be found at **www.arrl.org/contests/forms** where you will also find links to the General Rules for all ARRL Contests, General Rules for ARRL Contests on bands below 30 MHz (HF) and other forms and operating aids, along with log sheets for submitting your entry. If you don't have Web access, you can obtain the complete rules and forms by sending an SASE with postage for 2 ounces to ARRL International DX Contest Rules, ARRL, 225 Main St, Newington, CT 06111.

For more information: E-mail **contests@arrl.org** or phone 860-594-0295. QST

DX Test Pins

Once again the ARRL is pleased to offer participation pins for the 2004 International DX Contest. Just make 100 contacts and you are eligible. The cost is $6 for US participants and $8 for non-US entries. If you use a paper log, simply attach a note ordering a pin along with the payment to your entry summary sheet. If you submit the entry electronically, simple send a copy of the first page of your Cabrillo log file (which shows your header information) along with payment. We can only guarantee orders postmarked by April 6, 2004. Orders may be sent to ARRL DX Contest Pins, 225 Main St, Newington, CT 06111. You may also phone 860-594-0295 with a credit card to place your order.

2004 ARRL RTTY Roundup Announcement

Date: 1800 UTC January 3-2400 UTC January 4

How to participate: Amateurs world-wide complete QSOs with each other on 80, 40, 20, 15 and 10 meter bands using Baudot RTTY, PSK31, Packet (attended operation only) and other digital modes. You may enter as either High or Low power in either a Single Operator or Multioperator Single transmitter category. Use of spotting assistance makes your entry Multioperator. You may work a station once per band (regardless of mode).

What to transmit: US and Canadian stations send a signal report and their State or Province. Other stations send a signal report and a consecutive serial number (starting with 001).

Special Interest: The ARRL RTTY Roundup is one of the premier worldwide digital contests. The highest score in each category in each ARRL Division or DXCC entity is eligible for a beautiful plaque. There are plenty of opportunities to sponsor plaques for the Roundup. Contact Kathy Allison, KA1RWY, at **kallison@arrl.org** or phone 860-594-0295.

Quirks: You may operate a total of 24 hours of the contest period. Your six hours of off-time must be taken in no more than two blocks (if you operate the full 24-hour period). Be sure to look for activity in the Novice/Technician subband of 28.1 to 28.3 MHz, with PSK31 activity at 28.120 MHz. Remember that total power output in the Novice sub-band may not exceed 200 W for US stations. On 40 meters, don't forget to look for European activity between 7.030-7.040 MHz.

Rule changes this year: For the first time, the ARRL RTTY Roundup is now an Affiliated Club Competition event. The minimum length of an off-time must be at least 30 minutes in length.

Best reason to participate: The RTTY Roundup brings out the premier digital operators across the US and around the world. It is a great way to either get started on a digital WAS or DXCC award, or to add to your existing totals. It is also a great chance to try out some of the newer digital modes, such as PSK31 or MFSK or some of the modes you may not have tried, such as Hellschreiber.

Relative challenge: Today's advances in computer interfaces, sound cards and software make it relatively easy for anyone with basic digital operation experience and skills to excel. The bands are almost always packed with stations to work during the Roundup.

Scoring: Count each completed non-duplicate QSO 1 point. Each US state (except KH6 and KL7), the District of Columbia, Canadian province or territory and each DXCC entity (other than W and VE) count as a multiplier. Multipliers count only once (not once per band). Your final score is QSO points times total Multipliers worked.

How to report your score: You must send in your entry by February 3, 2004. E-mail Cabrillo format log to **RTTYRU@arrl.org** or send paper logs and complete summary sheet to RTTY Roundup, ARRL, 225 Main St, Newington, CT 06111.

Complete rules: The complete rules may be found at **www.arrl.org/contests/forms**, where you will also find links to the General Rules for all ARRL Contests, General Rules for ARRL Contests on bands below 30 MHz (HF) and other forms and operating aids, log sheets for submitting your entry. If you don't have Web access, you can obtain the complete rules and forms by sending an SASE with postage for 2 ounces to ARRL RTTY Roundup Rules, ARRL, 225 Main St, Newington, CT 06111.

For more information: E-mail **contests@arrl.org** or phone 860-594-0295. QST

2004 ARRL January VHF Sweepstakes Contest Announcement

Date: 1900 UTC January 24-0400 UTC January 26

How to participate: Any amateur station on any band above 50 MHz may be worked. The entry classes for Single Operator are high power, low power or portable. A Limited Multioperator station may either use four bands or less. A Multioperator Unlimited uses more than four bands. A Rover is a 1 or 2 person station that operates from two or more grid squares. Any station may be worked once per band, regardless of the mode. You may re-work a rover station each time they move to a new grid square. Use of a spotting network makes your station a Multioperator entry. DX stations may only work W/VE stations for credit.

What to say: All stations give their callsign and 4 digit grid-square locator (such as W1AW FN31). Information on how to determine your grid-square is found on page 86 of the April 1994 *QST* or online at **www.arrl.org/locate/gridinfo.html**.

Special interest: If the solar flux index is high, be sure to check out activity on 50 MHz. Also, if you live in a coastal region, watch for some coastal tropospheric propagation. It won't be as prevalent as in the summer months, but if it occurs, you can get some great conditions for operating.

Quirks: Location and weather greatly impact this event. The higher the concentration of amateurs in a region the larger pool of potential QSOs. A severe winter storm in an area will keep Rovers at home and will reduce other activity. A Single Operator Portable station operates from a single location away from home and must use a portable power supply, portable station and a maximum of 10 W PEP output.

Rule changes this year: None.

Best reason to participate: This contest is a good way to build up totals for the ARRL VHF/UHF operating awards such as VUCC. A band opening on 50 MHz could also present the opportunities to find new states for an ARRL Worked All States award or add countries to a DXCC total.

Relative challenge: VHF/UHF/Microwave operation presents unique challenges that test the best equipped operators, but it is also possible for someone to participate in this event with modest stations. You will get better results utilizing SSB or CW instead of FM. The more bands you are able to utilize the better your results.

Scoring: QSOs count 1 point each on 50 and 144 MHz, 2 points on 222 and 432 MHz, 4 points on 902 and 1296 MHz, and 8 points each on 2.3 GHz and higher. On each band, every time you work a different grid square, you receive a multiplier. Your multiplier total is the sum of grids you worked per band. The final score is your QSO point total times your multiplier total.

How to report your score: You must send in your entry by February 25, 2004. E-mail Cabrillo format log to **JanuaryVHF@arrl.org** or send paper logs and complete summary sheet to January VHF SS, ARRL, 225 Main St, Newington, CT 06111.

Complete Rules: The complete rules may be found at **www.arrl.org/contests/forms** where you will also find links to the General Rules for all ARRL Contests, General Rules for ARRL Contests on bands above 50 MHz (VHF) and other forms and operating aids, log sheets for submitting your entry. If you don't have Web access, you can obtain the complete rules and forms by sending an SASE with postage for 2 ounces to January VHF SS Rules, ARRL, 225 Main St, Newington, CT 06111.

For more information: E-mail **contests@arrl.org** or phone 860-594-0232. QST

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*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

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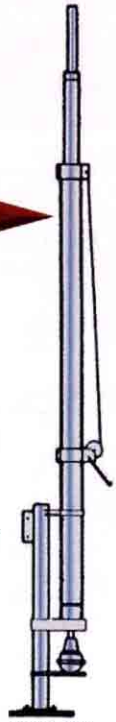

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- Water resistant case
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- Perfect for remote installation

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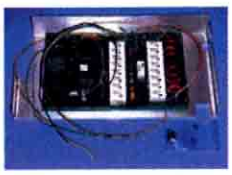

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- **Cold Hands.** Don't worry, the '703 comes with the TXCO, so your frequency will not drift when you touch the knob with cold hands. Ready for outdoors!
- **Optional Backpack.** A must have accessory! With room for batteries and other gear! *See below.*
- **No Assembly Required.** The '703 is ready to go when you are!

ACCESSORIES

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Model	Pin (W)	Pout (W)	Ic (A)	Gain/NF (dB)(dB)	(+13.8V) Type	$ Price
50 MHz						
0503G	1-5	10-50	6	15/0.7	LPA	208
0508G	1	170	28	15/0.7	Standard	367
◆0510G	10	170	25	15/0.7	Standard	319
144 MHz						
1403G	1-5	10-50	6	15/0.7	LPA	163
1405G	1-2	100	14	15/0.7	Standard	295
1406G	25	100	12	15/0.7	Standard	261
1409G	2	150	25	15/0.7	Standard	318
1410G	5-10	160-200	28	15/0.7	Standard	328
◆1412G	25-45	160-200	22	15/0.7	Standard	286
220 MHz						
2203G	1-5	8-35	5	14/0.8	LPA	168
2205G	1-2	70	12	14/0.8	Standard	309
2210G	5-10	130	20	14/0.8	Standard	346
◆2212G	25-45	130	16	14/0.8	Standard	316
440 MHz						
4405G	1-5	15-50	9	12/1.2	LPA	309
4410G	10	100	19	12/1.2	Standard	367
◆4412G	15-30	100	19	12/1.2	Standard	355
4414	35-45	100	14	-/-	Standard	316

Description	Size	Wt	Connectors
LPA=Low-power amp	3x6x5"	4lbs	UHF
Standard=Mobile/Base	3x6x11"	6lbs	UHF or N

HI-POWER AMPLIFIERS

Model	Pin (W)	Pout (W)	Ic (A)	Gain/NF (dB)(dB)	(+13.8V) Type	$ Price
50 MHz						
0548G	.1-.2	170	30	15/0.7	HPA	436
0550G	5-10	375	59	15/0.7	HPA	524
◆0552G	20-25	375	54	15/0.7	HPA	486
144 MHz						
1448G	.25-.5	160-200	29	15/0.7	HPA	471
1450G	5-10	350+	56	15/0.7	HPA	572
◆1452G	10-25	350+	52	15/0.7	HPA	525
1453G	25-60	280	43	15/0.7	HPA	468
1454	60-80	350	40	-/-	HPA	473
220 MHz						
2250G	5-10	225	40	14/0.8	HPA	579
◆2252G	10-25	225	36	14/0.8	HPA	537
2254	75	225	32	-/-	HPA	494
440MHz						
4448G	1-5	75-100	25	12/1.2	HPA	429
4450G	5-10	185	35	12/1.2	HPA	585
◆4452G	25	185	30	12/1.2	HPA	547
4454	60-80	185	26	-/-	HPA	508

HPA=High-power amplifier 3x10x11" 9lbs UHF or N
◆=Most popular models

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REPEATER AMPLIFIERS

Model	Pin (W)	Pout (W)	Ic (A)	Gain/NF (dB)(dB)	(+13.8V) Type	$ Price
50 MHz						
0508R	1	170	28	-/-	CD/cc	533
0510R	10	170	25	-/-	CD/cc	485
0550RA	2-6	375	59	-/-	CD/fn	759
0552RA	20-25	375	54	-/-	CD/fn	719
144 MHz						
1406RN	25	100	12	-/-	CD/cc	416
1410RA	4-10	200	27	-/-	CD/fan	579
1412R	25-50	200	22	-/-	CD/cc	455
1452RA	10-25	350	52	-/-	CD/fn	772
220 MHz						
2210R	5-10	130	20	-/-	CD/cc	503
2212R	25-45	130	16	-/-	CD/cc	474
2250RA	2-6	225	40	-/-	CD/fn	829
2252RA	10-25	225	36	-/-	CD/fn	787
440 MHz						
4410R	10	100	19	-/-	CD/cc	529
4412R	15-30	100	19	-/-	CD/cc	521
4450RA	2-6	185	35	-/-	CD/fn	836
4452RA	25	185	30	-/-	CD/fn	798

CD/cc=Cont-duty,convection-cooled -R =12x19x4"
CD/fn=Cont-duty,fan-cooled(dual fans) -RA =5x19x15"

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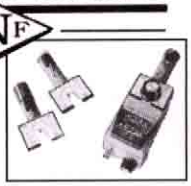
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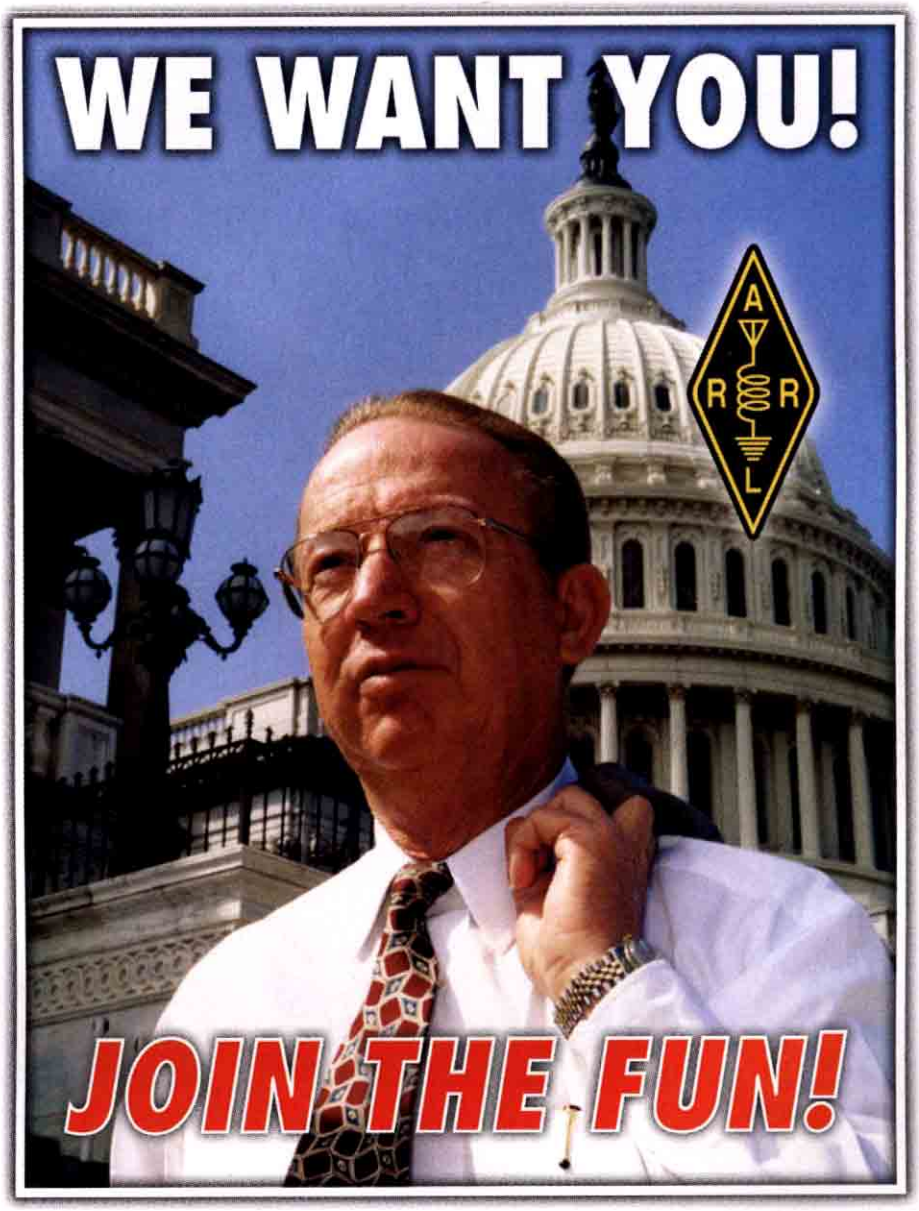

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IC-T2H SPORT More than enough power. (right) The 6W Sport meets MIL SPEC for shock and vibration and is more than enough for long distance communications. The 2M HT boasts tone squelch, customizable keys, DTMF encode, 40 memories and 10 weather channels. 2.3"w x 5.5"h x 1.3"d, 14.8 oz.....© **$89.99**

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-T90A Surprisingly compact, full featured. The T90A 50/144/440MHz HT offers 5W with wideband receive. It features 555 alphanumeric memories with Icom's DMS scanning technology. The T90A also provides DTCS/CTCSS, DTMF encode, PC programmability and weather resistance. 2.53"w x 3.44"h x 1.16"d, 8.47 oz.....© **$239.99**

IC-2100H-25N Durable 2M rig with superior RX IMD, performance. The 2100H25N offers 50W on transmit, extending its range. It also features CTCSS tone enc/decode, tone scan and 100 alphanumeric memories. It can be remote controlled using the new backlit mic. 5.5"w x 1.56"h x 7.09"d, 2 lbs, 10 oz© **$149.99**

IC-208H High power dualbander, wideband receiver. This 2M/70cm mobile provides a stable 55/50 Watts for long distance communications, plus reduced power for local. The 208H covers 118-173, 230-549 and 810-999MHz (cell blocked) receive as standard. With improved DMS, detachable front panel, 500 alphanumeric memories and user friendly design, mobile communications just got better. 5.56"w x 1.56"h x 7.31"d, 2.65 lbs.....© **$309.99**

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-718 Origin of the HF transceiver. With performance found in the HF all-band 718, such as wide dynamic range, high S/N ratio, and full duty operation, making distant contacts is easy. Experience its combo of the latest RF and digital technology. 9.44"w x 3.75"h x 9.41"d, 8 lbs, 6 oz ..... NOW! FREE UT106 included © **$499.99**

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 © **$779.99**

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**

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TH-G71A Sharp Distinction: 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 compatibility and 200 memories. 2.31"w x 4.44"h x 1.44"d, 11.6 oz **$229.99**

TH-F6A Unique features the competition is still scratching their heads over. The FM 144/220/440MHz F6A offers dual-channel RX capability, 16-key pad, multi-scroll key, 5W, and 435 memories. Other features include ferrite bar antenna for AM, lith-ion battery, and MIL-STD. 2.3"w x 3.44"h x 1.18"d, 8.8 oz **$329.99**

TH-K2AT A triumph of advanced engineering and design. (middle) This 2M 5W handheld is equipped with internal VOX, weather alert/RX, automatic simplex checker, auto repeater offset and multiple scanning functions. 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**

TM-271A All-terrain performance. On or off road, the 144MHz, 60W 271 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 **$399.99**

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 **$519.99**

TS-480HX New compact all-mode. This 200W HF/50MHz can operate on DC 13.8V and offers two power terminals. The 480HX 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..... **CALL**

TS-480SAT 100W version of above with auto antenna tuner. **CALL**

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TS-570D(G) Affordable DSP without compromise. High-end technology doesn't mean a high-end budget. With 16-bit DSP, untouchable digital filtering, heavy-duty transmitter design, and central frequency control, the 570D provides 160-10M operation. 10.63"w x 3.75"h x 11"d, 15 lbs. NOW! FREE Heil mic.After *Rebate **$989.99**

TS-570S(G) Same as the 570D(G) above, with the addition of 6M. NOW! FREE Heil mic.....After *Rebate **$1159.99**

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 **$1699.99**

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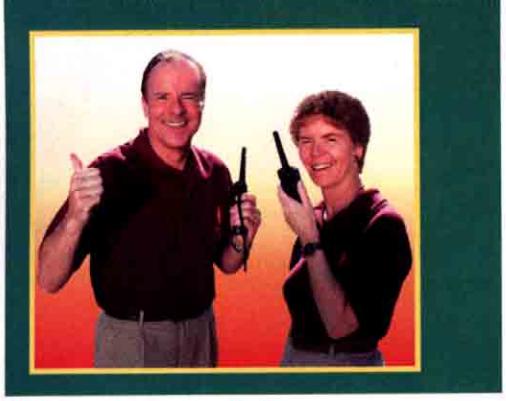

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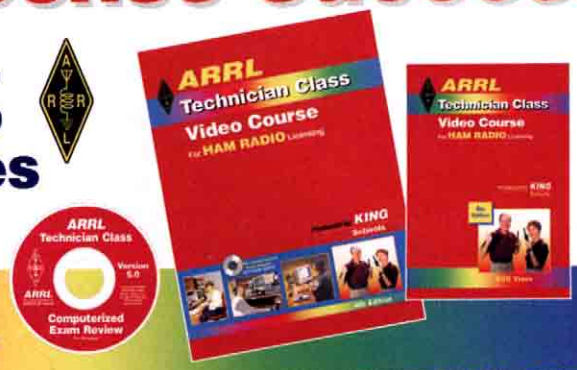

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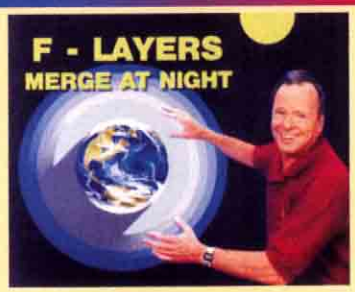

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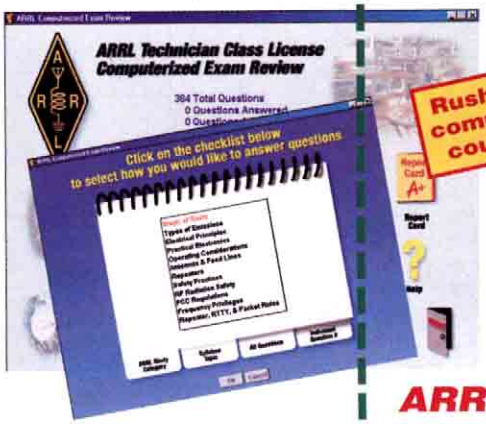

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VX-150 Designed for the most difficult conditions. (mid-left) This 2M 5W HT provides exceptional receiver performance with clean, clear transmit. Built to withstand outdoor use, the 16-key 150 is constructed to MIL-STD, with high-output, commercial-grade speaker and Omni-Glow™ keypad. 4.3"h x 2.3"w x 1"d, 11.5 oz .....© **$109.99**

VX-1R Power out of the pocket. (left) This 500mW, 144/430MHz HT provides wide receiver coverage in a small package. The 1R offers 291 memories, ARTS™, SmartSearch™, and dual watch. It also has one-touch emergency and built-in CTCSS/DCS while operating more than 11 hours per charge. 1.9"w x 3.2"h x 1"d, 4 oz.....Closeout © **$129.99**

VX-5R/VX-5RS Setting water resistance standards. (mid-right) Boasting 5W (4.5W on 430MHz), the 5R/5RS cover 50/144/430MHz while offering short to microwave reception. Perfect for outdoors with an optional barometric pressure unit. Black or silver. With alphanumerics and CTCSS/DCS. 2.3"w x 3.4"h x 1.1"d, 8.9 oz ....© **$229.99**

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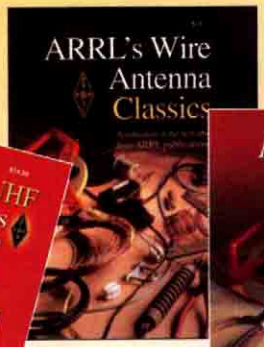

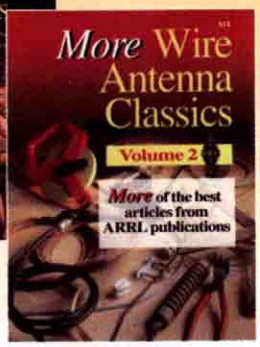

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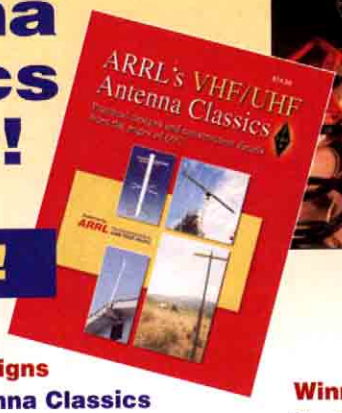

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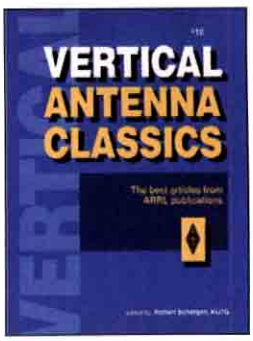

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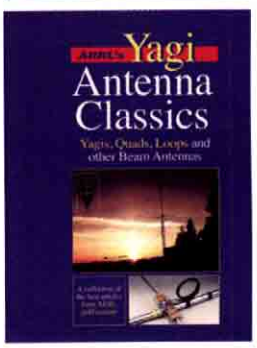

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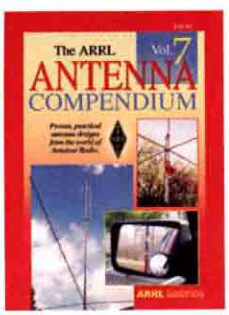

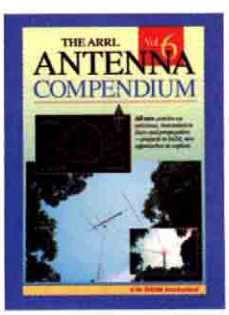

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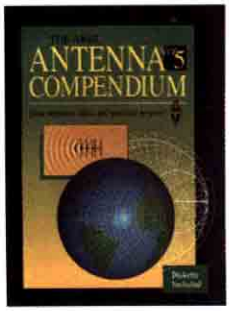

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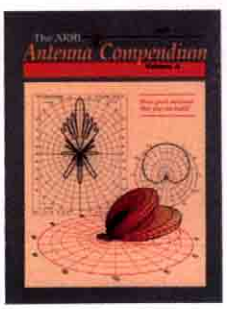

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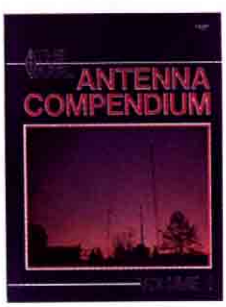

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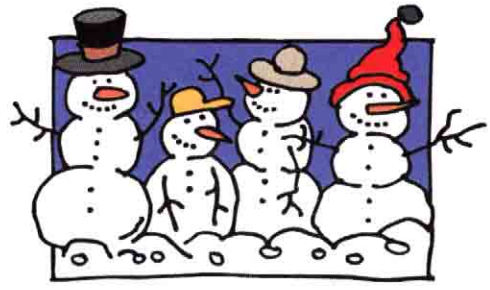

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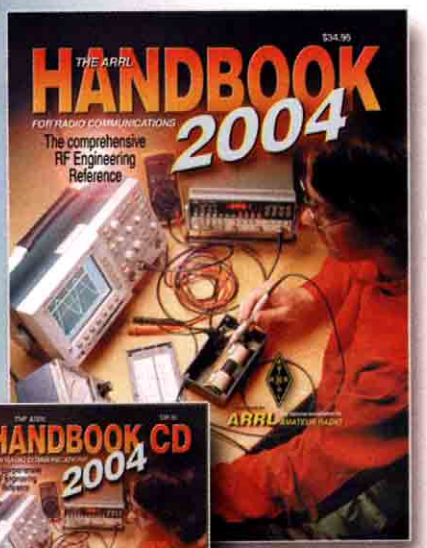

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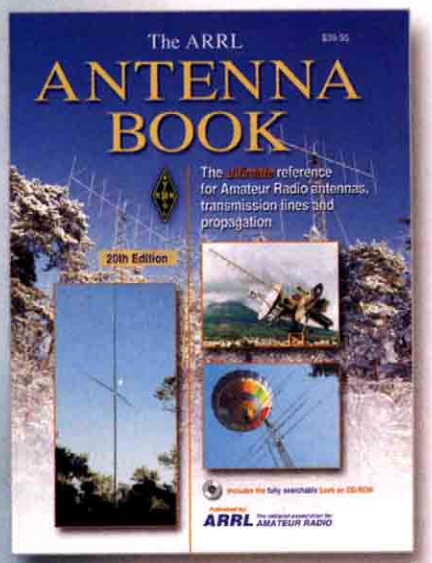

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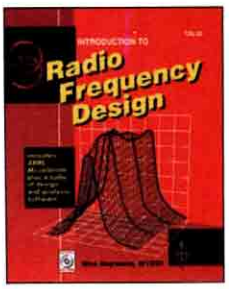

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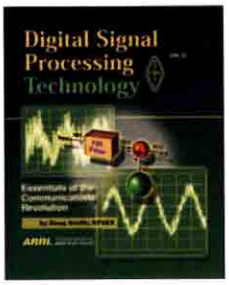

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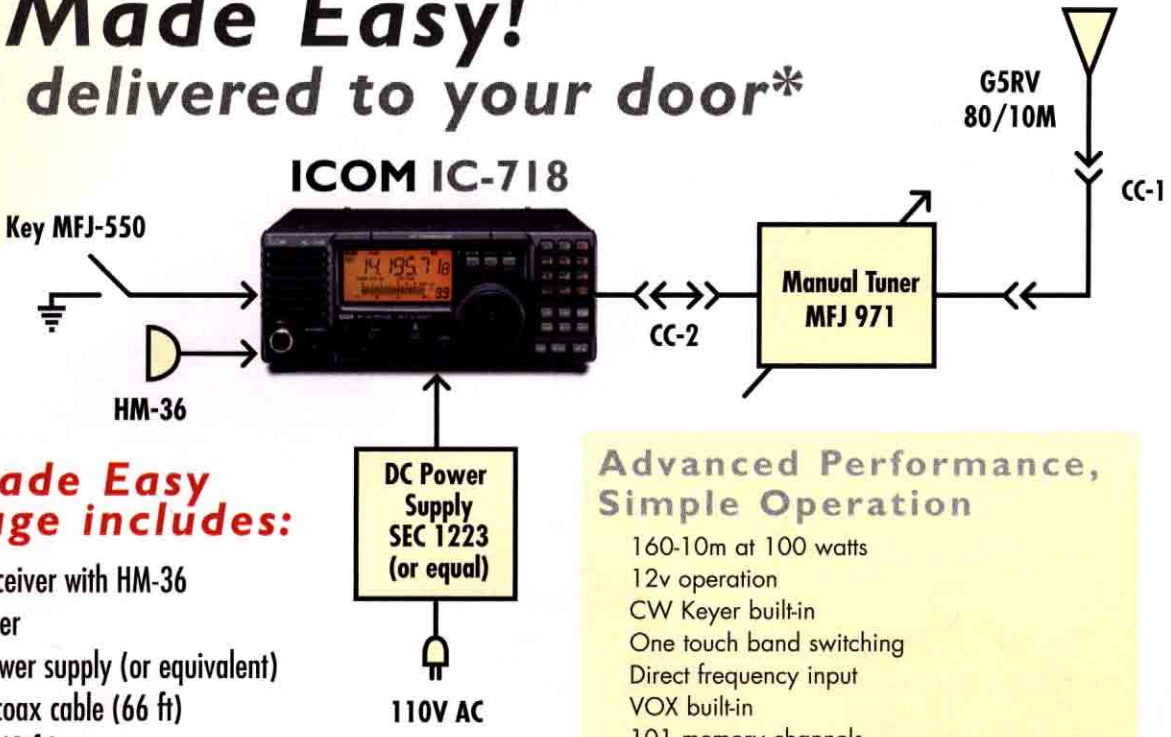

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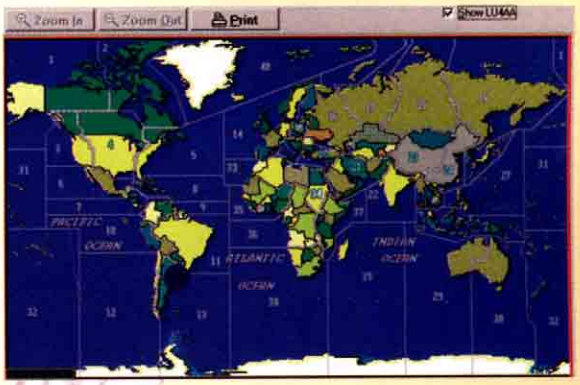

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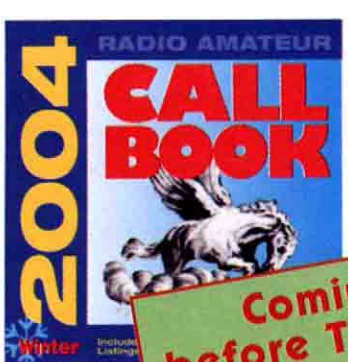

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B-2518-G
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Draws 17-22 Amps at 13.8 VDC. Measures a compact 12x3x5½ inches.

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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).

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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 4¾x1¾x7¾ 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
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***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. 3⅛x1¾x4¼ 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*.

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Commercial Amps ($159 to $429)

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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.*

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New!
MFJ-991,
$219.95

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MFJ-994,
$359.95
New!

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CANTON, CT: Enjoy the Fall and Winter Contest and DX season in a small town atmosphere west of Hartford, Connecticut. Great neighborhood. DXCC Honor Roll and 6M DXCC hilltop location. Four bedroom, 2 1/2 bath contemporary colonial in private setting at end of cul de sac. Fully zoned 60 ft Rohn 45 with KT-34XA and stacked VHF beams. Multiple 220V setups for high power amplifiers in place. Excellent schools. XYL friendly custom kitchen. Call Barbara Spelucin, Coldwell Banker, celll 860-212-7671.
E-mail: barbara.spelucin@CBMoves.com

COLORADO CHALET with ham gear, www.lostcreekcabin.com. WØLSD, Buena Vista, CO.

CURACAO - PJ2T Oceanfront 2BR house, 11 yagis, all watersports. ghoward@kent.edu http://www.pj2t.org

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(R) 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**

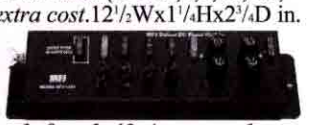
8 outlets. each fused, 40 Amps total. Factory installed fuses: two 1A, three 5A, two 10A, one 25A, one 40A. *Built-in 0-25 VDC Voltmeter.* Includes *extra* 6 pairs of *Anderson PowerPole®* contacts and *extra* 5 fuses (1, 5, 10, 25, 40A) -- *no extra cost.* 9Wx1¼Hx2¾ inches.

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.

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KH6SQ - http://www.seaqmaui.com

SANTA FE, NM 4BR 2BA HOME WITH 2390 SF ON 6-ACRE HILLTOP LOT, MANY FEATURES, $448,000. Property includes free-standing 50-foot tower with Sommer six-band array 10 - 30 meters, phased 40-meter loops and 80 - 160 meter capability. Eugene Colton, AF9O, Realtor with Town & Ranch. 505-946-2206 or 505-577-8039; epcolton@yahoo.com

SF BAY AREA 2BR 1BA HOME, $430K. EZ commutes. M2 log periodic+40M on 72 ft free-standing, motorized twr w/access (RV pad) for rental scissor lift for safe, easy maint. One BR wired 220, DSL, gnd bus, coax. Will consider leaving Icom 756 and kW. Move in, operate, good DX same day. w6ew@arrl.net; (510) 482-1755. If no answer send short message to w6ew@winlink.org

SUN CITY, AZ: Active retirement community where antennas are welcome. Beautifully remodeled home, 2 beds, 2 baths, 1496 sq. ft., family room, hobby room, double garage, large lot. $139,900. Info from 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: 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**

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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 **$99.95**

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.

Tiny Travel Tuner with Cross-Needle SWR/Wattmeter

MFJ-904 **$109.95**

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.

ALL-in-one Tiny Travel Tuner with 4:1 Balun and SWR/Wattmeter

MFJ-904H **$129.95**

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.

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

MFJ-1918 **$39.95**

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.

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.

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MFJ . . . the world leader in ham radio accessories!

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.

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General

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.

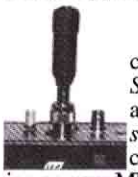
MFJ SWR Analyzer Accessories

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!*

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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 . . .

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MFJ's *MightyLites*™ are so light and small you can carry them in the palm of your hand! Take them with you anywhere.

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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!

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No RF Hash!

They are fully protected with Over Voltage and Over Current protection circuits.

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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.

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$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 . . .

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plus s&h

MFJ's heavy duty conventional power supply is excellent for powering HF or 2 Meter/440 MHz transceiver/accessories.

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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.

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MFJ-1112, $34.95. Similar to MFJ-1116. No on/off switch, LED, meter, fuse.

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Use sound card and rig for all digital modes!

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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.

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Select the ON digital mode -- all connections are made between your rig and computer for instant digital operation.

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Transmit mic audio at any time by pressing PTT to override digital modes -- great for SSTV and Contest Voice Keyer.

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Add "X" suffix for 220VAC.

New! *Basic* Digital Interface

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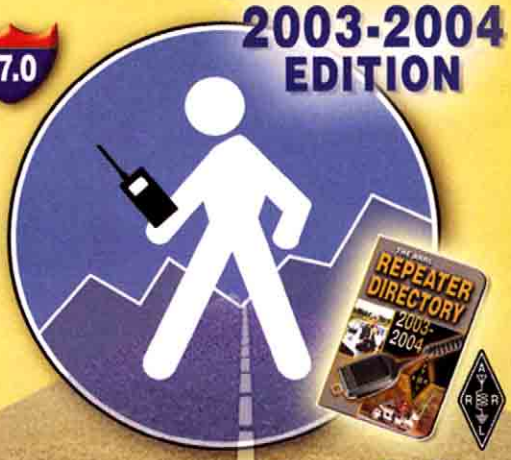

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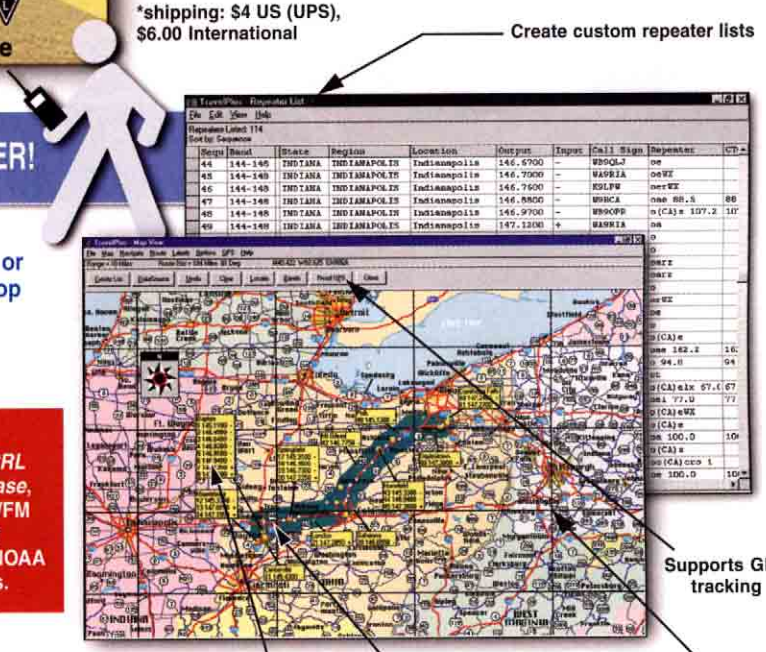

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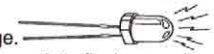

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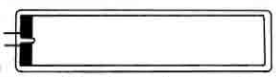

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SELF-SUPPORTING STEEL TOWERS

T200-64	64', 15 square feet	$1099
T200-72	72', 15 square feet	$1299
T200-80	80', 15 square feet	$1499
T200-88	88', 15 square feet	$1769
T200-96	96', 15 square feet	$2049
T300-88	88', 22 square feet	$1989
T400-80	80', 34 square feet	$1899
T500-72	72', 45 square feet	$1799
T600-64	64', 60 square feet	$1699

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	$849/1399
MA770/MA850	$2359/3649
TMM433SS/HD	$1139/1379
TMM541SS	$1499
TX438/TX455	$979/1579
TX472/TX489	$2459/4579
HDX538/HDX555	$1269/2269
HDX572MDPL	$5899

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	$179
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	$55
SBB7NMO, 2m/70cm Mobile	$75
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

PHILYSTRAN 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:
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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, built-in power supply, and more. With up/down hand mic 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-90R..... In Stock!
Ultra-compact 2m/70cm mobile XCVR.

FT-1500M..... New Lower Price!
Ultra-compact 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 mode 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!

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144/430 MHz FM DUAL BAND TRANSCEIVER

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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

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