Including Ham Radio Fun!

73® Amateur Radio Today

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International Edition

Marine Mobile Info

The Killer Beam

Reviews:

Agrelo DFjr

Sony New SW Rx

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Finally – A Professional-Quality Receiver to Monitor Weather Broadcasts!

NEW **Our new RWX is a very sensitive and selective Hamtronics® grade receiver to monitor critical NOAA weather broadcasts.**

Excellent 0.15µV sensitivity provides good reception even at distances of 70 miles or more with suitable antenna. No comparison with ordinary consumer radios!

Automatic mode provides storm watch, alerting you by unmuting receiver and providing an output to trip remote equipment when an alert tone is broadcast.

Essential for airports, police and fire departments, CAP, broadcast stations, state and local emergency managers, amateur repeaters – anyone needing a professional quality receiver. Because of its reasonable price, it is also handy for bikers, hikers, boaters, hunters, farmers – or anyone who needs up-to-date weather info and emergency warnings, even from distant stations.

Small enough for emergency or portable use, it can even be powered from a small 9-12V battery when needed. Crystal controlled for accuracy; **all 7 channels provided** (162.40 to 162.55).

You can buy just the receiver pcb module in kit form or buy the kit with an attractive metal cabinet, AC power adapter, and built-in speaker. It is also available factory wired and tested.

- RWX Rcvr kit, PCB only $79
- RWX Rcvr kit with cabinet, speaker, & AC adapter $99
- RWX Rcvr wired/tested in cabinet with speaker & adapter $139

WWV RECEIVER

NEW Get time and frequency checks without buying multiband hf rcvr. Hear solar activity reports affecting radio propagation. Very sensitive and selective crystal controlled superhet, dedicated to listening to WWV on 10.000 MHz. Performance rivals the most expensive receivers.

- **RWWV Rcvr** kit, PCB only $59
- **RWWV Rcvr** kit with cabt, spkr, & 12Vdc adapter $89
- **RWWV Rcvr** w/t in cabt with spkr & adapter $129

WEATHER FAX RECEIVER

Join the fun. Get striking images directly from the weather satellites! A very sensitive wideband fm receiver **optimized for reception of NOAA APT and Russian Meteor weather fax** images on the 137 MHz band.

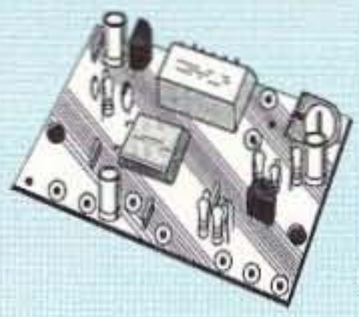
The R139 is lower cost and easier to maintain than synthesized units. And it is designed from the ground up for optimum satellite reception; not just an off-the-shelf scanner with a shorted-out IF filter!

Covers all five satellite channels. Scanner circuit and recorder control allow you to automatically search for and tape signals as satellites pass overhead, even while away from home.

- **R139 Receiver Kit** less case $159
- **R139 Receiver Kit** with case and AC power adapter $189
- **R139 Receiver w/t** in case with AC power adapter $239
- Internal PC Demodulator Board and Imaging Software $289
- Turnstile Antenna $119
- Weather Satellite Handbook $20

SUBAUDIBLE TONE ENCODER/DECODER

NEW **Access all your favorite closed repeaters with TD-5 CTCSS Encoder/Decoder**

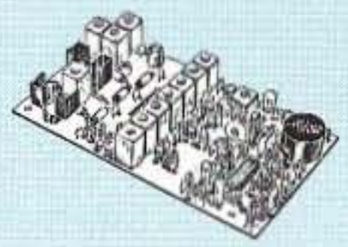


Encodes all standard subaudible tones with crystal accuracy and convenient DIP switch selection. Comprehensive manual also shows how you can set up a front panel switch to select between tones for several repeaters. Receiver **decoder** can be used to mute receive audio and is optimized for installation in repeaters to provide closed access. High pass filter gets rid of annoying buzz in receiver.

- **TD-5** CTCSS Encoder/Decoder Kit ..... only **$39**
- **TD-5** CTCSS Encoder/Decoder Wired/tested **$59**

HIGH QUALITY VHF & UHF FM XMTR AND RCVR MODULES

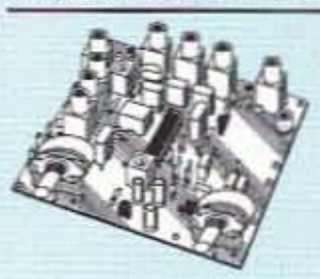
FM EXCITERS: 2W output, continuous duty.



- **TA51:** for 6M, 2M, 220 MHz .. **kit $99, w/t $169.**
- **TA451:** for 420-475 MHz. ..... **kit $99, w/t $169.**
- **TA901:** for 902-928 MHz, (0.5W **out**)..... **w/t $169.**

VHF & UHF POWER AMPLIFIERS.

Output levels from 10W to 100W **Starting at $99.**



FM RECEIVERS:

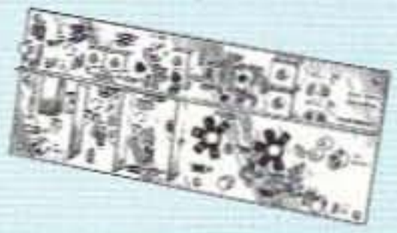
- **R100 VHF FM RECEIVERS** Very sensitive – 0.15µV. Superb selectivity – both crystal and ceramic IF filters, >100 dB down at ±12kHz, best available anywhere, flutter-proof squelch. For 46-54, 72-76, 140-175, or 216-225 MHz. ..... **kit $129, w/t $189**
- **R144/R220 RCVRS.** Like R100, for 2M or 220 MHz, with helical resonator in front end..... **kit $159, w/t $219**
- **R451 FM RCVR,** for 420-475 MHz. Similar to R100 above. ..... **kit $129, w/t $189**
- **R901 FM RCVR,** 902-928MHz ..... **$159, w/t $219**

TRANSMITTING AND RECEIVING CONVERTERS

Go on a ham satellite adventure! Add another band for the next contest. Thrill in the excitement of building your own gear, and save a bundle.

No need to spend thousands on new transceivers for each band!

- Convert vhf and uhf signals to/from 10M.
- Even if you don't have a 10M rig, you can pick up very good used xmtrs & rcvrs for next to nothing.
- Receiving converters (shown above) available for various segments of 6M, 2M, 220, and 432 MHz.
- Kits from $49, wired/tested units only $99.

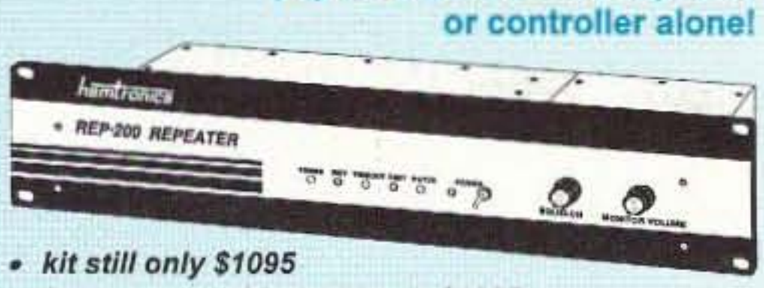


- Xmitting converters (at left) for 2M, 432 MHz.
- Kits only $89 vhf or $99 uhf.
- Power amplifiers up to 50W output.

Get more features for your dollar with our

REP-200 REPEATER

A microprocessor-controlled repeater with full autopatch and many versatile dtmf control features at less than you might pay for a bare-bones repeater or controller alone!



- ***kit still only $1095***
- ***factory assembled still only $1295***

50-54, 143-174, 213-233, 420-475 MHz. (902-928 MHz slightly higher.) **FCC type accepted** for commercial service in 150 & 450 MHz bands.

Digital Voice Recorder Option. Allows message up to 20 sec. to be remotely recorded off the air. Play back at user request by DTMF command, or as a periodical voice id, or both. **Great for making club announcements!** ..... only $100.

REP-200C Economy Repeater. **Real-voice ID**, no dtmf or autopatch. ..... Kit only $795, w&t $1195.

REP-200N Repeater. Without controller so you can use your own. ..... Kit only $695, w&t $995.

You'll KICK Yourself

If You Build a Repeater

Without Checking Out Our Catalog First!

Hamtronics has the world's most complete line of modules for making repeaters. In addition to exciters, pa's, and receivers, we offer the following controllers.

COR-3. Inexpensive, flexible COR module with timers, courtesy beep, audio mixer. ..... **only $49/kit, $79 w/t**

CWID. Traditional diode matrix ID'er. ..... **kit only $59**

CWID-2. Eprom-controlled ID'er. .. **only $54/kit, $79 w/t**

DVR-1. Record your own voice up to 20 sec. For voice id or playing club announcements. ..... **$59/kit, $99 w/t**

COR-4. Complete COR and CWID all on one board. ID in eprom. Low power CMOS. ..... **only $99/kit, $149 w/t**

COR-6. COR with real-voice id. Low power CMOS, non-volatile memory. ..... **kit only $99, w/t only $149**

COR-5. µP controller with autopatch, reverse ap, phone remote control, lots of DTMF control functions, all on one board, as used in REP-200 Repeater. ..... **$379 w/t**

AP-3. Repeater autopatch, reverse autopatch, phone line remote control. Use with TD-2. ..... **kit $89**

TD-2. Four-digit DTMF decoder/controller. Five latching on-off functions, toll call restrictor. ..... **kit $79**

TD-4. DTMF controller as above except one on-off function and no toll call restrictor. Can also use for selective calling; mute speaker until someone pages you. .. **kit $49**

LOW NOISE RECEIVER PREAMPS

LNG-( ) G_AA_S FET PREAMPS

STILL ONLY $59!

- Make your friends sick with envy! Work stations they don't even know are there.
- Install one at the antenna and overcome coax losses.
- *Available for 28-30, 46-56, 137-152, 152-172, 210-230, 400-470, and 800-960 MHz bands.*

LNW-( ) ECONOMY PREAMPS

ONLY $29 kit, $44 wired/tested

- Miniature MOSFET Preamp
- Solder terminals allow easy connection inside radios.
- *Available for 25-35, 35-55, 55-90, 90-120, 120-150, 150-200, 200-270, and 400-500 MHz bands.*

- **Buy at low, factory-direct net prices and save!**
- **For complete info, call or write for free catalog.**
- **Order by mail, fax, or phone** (9-12 AM, 1-5 PM eastern time).
- **Min. $5 S&H charge** for first pound plus add'l weight & insurance.
- **Use VISA, Mastercard, Discover, check, or UPS C.O.D.**

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e-mail: jv@hamtronics.com

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ASTRON CORPORATION
9 Autry
Irvine, CA 92718
(714) 458-7277 • FAX (714) 458-0826 www.astroncorp.com

SWITCHING POWER SUPPLIES

	CONT.	ICS	WT.(LBS)
SS-10	7	10	3.2
SS-12	10	12	3.4
SS-18	15	18	3.6
SS-25	20	25	4.2
SS-30	25	30	5.0

SS-25M With volt & amp meters
SS-30M With volt & amp meters

ASTRON POWER SUPPLIES

• HEAVY DUTY • HIGH QUALITY • RUGGED • RELIABLE •

SPECIAL FEATURES

- SOLID STATE ELECTRONICALLY REGULATED
- FOLD-BACK CURRENT LIMITING Protects Power Supply from excessive current & continuous shorted output
- CROWBAR OVER VOLTAGE PROTECTION on all Models except RS-3A, RS-4A, RS-5A, RS-4L, RS-5L
- MAINTAIN REGULATION & LOW RIPPLE at low line input Voltage
- HEAVY DUTY HEAT SINK • CHASSIS MOUNT FUSE
- THREE CONDUCTOR POWER CORD except for RS-3A
- ONE YEAR WARRANTY • MADE IN U.S.A.

PERFORMANCE SPECIFICATIONS

- INPUT VOLTAGE: 105-125 VAC
- OUTPUT VOLTAGE: 13.8 VDC ± 0.05 volts (Internally Adjustable: 11-15 VDC)
- RIPPLE Less than 5mv peak to peak (full load & low line)
- All units available in 220 VAC input voltage (except for SL-11A)

SL SERIES

• LOW PROFILE POWER SUPPLY

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
SL-11A	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R	•	•	7	11	2⅝ × 7 × 9¾	12
SL-11S	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

RS-L SERIES

• POWER SUPPLIES WITH BUILT IN CIGARETTE LIGHTER RECEPTACLE

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-4L	3	4	3½ × 6⅛ × 7¼	6
RS-5L	4	5	3½ × 6⅛ × 7¼	7

RM SERIES

MODEL RM-35M

• 19" RACK MOUNT POWER SUPPLIES

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46
RS-70A	•		57	70	6 × 13¾ × 12⅛	48

RS-M SERIES

MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46
RS-70M	57	70	6 × 13¾ × 12⅛	48

VS-M AND VRM-M SERIES

MODEL VS-35M

• Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
VS-70M	67	34	16	70	6 x 13¾ x 12⅛	48
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

• Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18
SL-11S	•	•	7	11	2¾ x 7⅝ x 9¾	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD

RAMSEY

Synthesized FM Stereo Transmitter

Microprocessor controlled for easy freq programming using DIP switches, no drift, your signal is rock solid all the time - just like the commercial stations. Audio quality is excellent, connect to the line output of any CD player, tape deck or mike mixer and you're on-the-air. Foreign buyers will appreciate the high power output capability of the FM-25; many Caribbean folks use a single FM-25 to cover the whole island! New, improved, clean and hum-free runs on either 12 VDC or 120 VAC. Kit comes complete with case set, whip antenna, 120 VAC power adapter - easy one evening assembly.

FM-25, Synthesized FM Stereo Transmitter Kit $129.95

Tunable FM Stereo Transmitter

A lower cost alternative to our high performance transmitters. Offers great value, tunable over the 88-108 MHz FM broadcast band, plenty of power and our manual goes into great detail outlining aspects of antennas, transmitting range and the FCC rules and regulations. Connects to any cassette deck, CD player or mixer and you're on-the-air, you'll be amazed at the exceptional audio quality! Runs on internal 9V battery or external power from 5 to 15 VDC, or optional 120 VAC adapter. Add our matching case and whip antenna set for a nice finished look.

FM-10A, Tunable FM Stereo Transmitter Kit $34.95
CFM, Matching Case and Antenna Set $14.95

RF Power Booster Amplifier

Add some serious muscle to your signal, boost power up to 1 watt over a frequency range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM Stereo transmitters, providing radio service through an entire town. Power required: 12 to 15 volts DC at 250mA, gain of 38dB at 10 MHz, 10 dB at 1000 MHz. For a neat, professionally finished look, add the optional matching case set.

LPA-1, Power Booster Amplifier Kit $39.95
CLPA, Matching Case Set for LPA-1 Kit $14.95
LPA-1WT, Fully Wired LPA-1 with Case $99.95

Micro FM Wireless Mike

World's smallest FM transmitter. Size of a sugar cube! Uses SMT (Surface Mount Technology) devices and mini electret condenser microphone, even the battery is included. We give you two complete sets of SMT parts to allow for any errors or mishaps-build it carefully and you've got extra SMT parts to build another! Audio quality and pick-up is unbelievable, transmission range up to 300 feet, tunable to anywhere in standard FM band 88 to108 MHz. 7/8"w x 3/8"h x 3/4"h.

FM-5 Micro FM Wireless Mike Kit $19.95

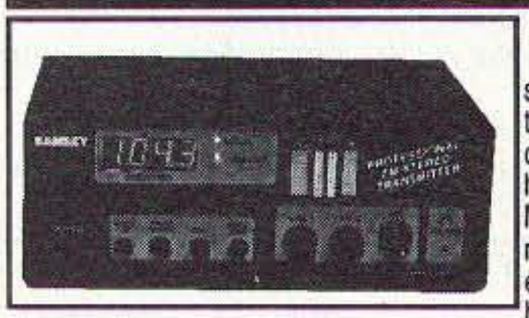
Crystal Controlled Wireless Mike

Super stable, drift free, not affected by temperature, metal or your body! Frequency is set by a crystal in the 2 meter Ham band of 146.535 MHz, easily picked up on any scanner radio or 2 meter rig. Changing the crystal to put frequency anywhere in the 140 to 160 MHz range-crystals cost only five or six dollars. Sensitive electret condensor mike picks up whispers anywhere in a room and transmit up to 1/4 mile. Powered by 3 volt Lithium or pair of watch batteries which are included. Uses the latest in SMT surface mount parts and we even include a few extras in case you sneeze and loose a part!

FM-6, Crystal Controlled FM Wireless Mike Kit $39.95
FM-6WT Fully Wired FM-6 ..... $69.95

Call for our Free Catalog !

Super Pro FM Stereo Radio Transmitter

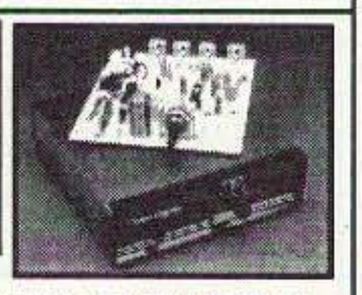


A truly professional frequency synthesized FM Stereo transmitter station in one easy to use, handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the FM-100. Set frequency easily with the Up/Down freq buttons and the big LED digital display. Plus there's input low pass filtering that gives great sound no matter what the source (no more squeals or swishing sounds from cheap CD player inputs!) Peak limiters for maximum 'punch' in your audio - without over modulation, LED bargraph meters for easy setting of audio levels and a built-in mixer with mike and line level inputs. Churches, drive-ins, schools and colleges find the FM-100 to be the answer to their transmitting needs, you will too. No one offers all these features at this price! Kit includes sharp looking metal cabinet, whip antenna and 120 volt AC adapter. Also runs on 12 volts DC.

We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.

FM-100, Professional FM Stereo Transmitter Kit $299.95
FM-100WT, Fully Wired High Power FM-100 ..... $429.95

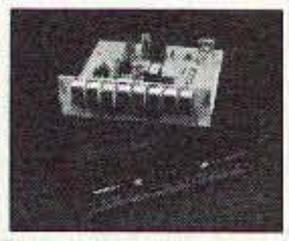
Speech Descrambler Scrambler



Decode all that gibberish! This is the popular descrambler / scrambler that you've read about in all the Scanner and Electronic magazines. The technology used is known as speech inversion which is compatible with most cordless phones and many police department systems, hook it up to scanner speaker terminals and you're in business. Easily configured for any use: mike, line level and speaker output/inputs are provided. Also communicate in total privacy over telephone or radio, full duplex operation - scramble and unscramble at the same time. Easy to build, all complex circuitry contained in new custom ASIC chip for clear, clean audio. Runs on 9 to 15VDC, RCA phono type jacks. Our matching case set adds a super nice professional look to your kit.

SS-70A, Speech Descrambler/Scrambler Kit $39.95
CSS, Custom Matching Case and Knob Set $14.95
SS-70AWT, Fully Wired SS-70A with Case $79.95
AC12-5, 12 Volt DC Wall Plug Adapter $9.95

Tone-Grabber Touch Tone Decoder / Reader



Dialed phone numbers, repeater codes, control codes, anywhere touch-tones are used, your TG-1 will decode and store any number it hears. A simple hook-up to any radio speaker or phone line is all that is required, and since the TG-1 uses a central office quality decoder and microprocessor, it will decode digits at virtually any speed! A 256 digit non-volatile memory stores numbers for 100 years - even with the power turned off, and an 8 digit LED display allows you to scroll through anywhere in memory. To make it easy to pick out numbers and codes, a dash is inserted between any group or set of numbers that were decoded more than 2 seconds apart. The TG-1 runs from any 7 to 15 volt DC power source and is both voltage regulated and crystal controlled for the ultimate in stability. For stand-alone use add our matching case set for a clean, professionally finished project. We have a TG-1 connected up here at the Ramsey factory on the FM radio. It's fun to see the phone numbers that are dialed on the morning radio show! Although the TG-1 requires less than an evening to assemble (and is fun to build, too!), we offer the TG-1 fully wired and tested in matching case for a special price.

TG-1, Tone Grabber Kit $99.95
CTG, Matching Case Set for TG-1 Kit $14.95
TG-1WT, Fully Wired Tone Grabber with Case $149.95
AC12-5, 12 Volt DC Wall Plug Adapter $9.95

Mini-Peeper Micro Video Camera

Super small, high quality fully assembled B & W CCD TV camera the size of an ice cube! Provides excellent pictures in low light (2 lux), or use our IR-1 Infra-Red light source to invisibly illuminate an entire room on a pitch black night! Imagine the possibilities... build it into a smoke detector, wall clock, lamp, book, radio. Exact same camera that's in big buck detective catalogues and stores. Kit includes: fully assembled CCD camera module, connectors, interface PC board kit with proper voltage regulation and filtering, hook-up details, even a mini microphone for sensitive sound! Two models available: Wide Angle Lens 3.6mm/f2, adjustable focus lens, 92 degree view; Pinhole Lens 5.5mm/f4.5, 60 degree view. The Pinhole Lens is physically much flatter and provides even greater depth of focus. The camera itself is 1.2" square. The Wide Angle Lens is about 1" long, Pinhole Lens about 1/2", interface PC board is 1" x 2" and uses RCA jacks for easy hook-up to VCRs, TVs or cable runs. Power required is 9 to 14 VDC @ 150 mA. Resolution: 380 x 350 lines. Instruction manual contains ideas on mounting and disguising the Mini-Peeper along with info on adding one of our TV Transmitter kits (such as the MTV-7 unit below) for wireless transmission!

MP-1, Wide Angle Lens CCD TV Camera Outfit $169.95
MP-1PH, Pin-Hole Lens CCD TV Camera Outfit $189.95

MicroStation Synthesized UHF TV Transmitter

Now you can be in the same league as James Bond. This transmitter is so small that it can fit into a pack of cigarettes - even including a CCD TV camera and battery! Model airplane enthusiasts put the MTV-7A into airplanes for a dynamite view from the cockpit, and the MTV-7A is the transmitter of choice for balloon launches. Transmitter features synthesized, crystal controlled operation for drift-free transmission of both audio and video on your choice of frequencies: Standard UHF TV Channel 52 (which should only be used outside of the USA to avoid violating FCC rules), and 439.25 MHz or 911.25 MHz which are in the amateur ham bands. The 439.25 MHz unit has the nifty advantage of being able to be received on a regular 'cable-ready' TV set tuned to Cable channel 68, or use our ATV-74 converter and receive it on regular TV channel 3. The 911.25 MHz unit is suited for applications where reception on a regular TV is not desired, an ATV-79 must be used for operation. The MTV-7A's output power is almost 100 mW, so transmitting range is pretty much 'line-of-sight' which can mean many miles! The MTV-7A accepts standard black and white or color video and has its own, on-board, sensitive electret micorphone. The MTV-7A is available in kit form or fully wired and tested. Since the latest in SMT (Surface Mount Technology) is used to provide for the smallest possible size, the kit version is recommended for experienced builders only. Runs on 12 VDC @ 150 mA and includes a regulated power source for a CCD camera.

MTV-7A, UHF TV Channel 52 Transmitter Kit $159.95
MTV-7AWT, Fully Wired Channel 52 Transmitter $249.95
MTV-7A4, 439.25 MHz TV Transmitter Kit $159.95
MTV-7A4WT, Fully Wired 439.25 MHz Transmitter $249.95
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73 Amateur Radio Today

Including Ham Radio Fun!

AUGUST 1997
ISSUE #443

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On the cover: Thanks to Ray Blowers N2ODA of Penn Yan NY for this shot of his repeater site at Bluff Point, in the heart of the Finger Lakes. The ten-foot dish is for NASA rebroadcast; Ray carries the missions from 6:00 a.m. to 11:00 p.m. for as long as they're up. The eight-foot solid dish (Ku) is for Saturday night's "This Week in Amateur Radio." Next month: your cover photo — if you remember to send it.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

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NEVER SAY DIE

Wayne Green W2NSD/1

Milestone

Or millstone, depending on how one looks at it. In a few weeks (September 3rd) I'll be 75. I've achieved this miracle by not falling off high buildings or towers when installing ham antennas, by my boat not getting sunk by the Japanese in World War II (not for any lack of diligence on their part), and by not getting caught by potentially irate husbands.

Then there were the two times on my first DXpedition to Navassa (KC4AF) back in 1958 when we darned near got killed. Come to think of it, all of the close calls I've had in life involved amateur radio. And that doesn't count getting a 2,000V jolt one night. Boy, did that knock me across the room! That was back in 1938, when I carelessly got across my 40m rig power supply.

One of the reasons I am such a persistent itch about your getting more involved with different aspects of the hobby instead of mindlessly rag-chewing what's left of your life away is the adventure that the hobby has provided me. I won't trot out my been-there-done-that list. Well, you'd just grumble that I was bragging. I've had a very adventurous life by most people's standards, thanks to ham radio. And imagine "working" at your major hobby for most of your life!

As Robert Frost said in "Two Tramps in Mud Time,"

My object in living is to unite
My avocation and my vocation

As my two eyes make one in sight.

Which explains two things—my own decision in 1955 to go into ham radio publishing, leaving an enormously successful career in manufacturing a high tech product—and my constant preaching that the shortest route to success in life is in marrying your personal interests with your career.

It also helps explain the extraordinary success of the Sudbury Valley-type schools, where the kids learn what they want when they want instead of being regimented, cookie-cutter style, into memorizing and then forgetting irrelevant baloney for 12 years. Or 16, if they've really been suckered by the system (like I was).

To Recap

Back in 1951, after having worked as a radio announcer and engineer, and then a television engineer as chief cameraman for WPIX (Channel 11) in New York and then as a producer-director at KBTV in Dallas, I tried working as a project managing engineer for Airborne Instrument Laboratories in Mineola, NY. This job confirmed for me that I really didn't want to be an engineer, so I spent much of my time sending out résumés to TV stations. It also taught me that the military is a grade-A sucker when it comes to R&D projects. Oh, the incredible wastes of money I saw there! Hundreds of millions of dollars.

John Karlson, an engineer on one of the projects I was managing, had invented a new kind of wideband omnidirectional microwave antenna. Hmm, I said, since microwaves and audio have the same wavelengths, this should work as a loudspeaker enclosure too. So, when a TV job clicked for me at WXEL in Cleveland as a producer-director, I loaded Karlson down with lab equipment from my ham shack so he could develop a prototype speaker system. I had a General Radio audio generator, a Dumont oscilloscope, an RCA-88 broadcast quality microphone, and so on.

A year later I was really fed up with my TV job. It combined low pay, high responsibility, and enormous stress. The station was mostly network, but I was producing and directing the local shows, with one, the Sohio News, being fed to TV stations all around Ohio. But producing news, news commentary, and sports roundups wasn't what they'd promised me. It was a real grind and not much fun, so I quit and went back to New York to see how Karlson was doing. He'd made almost no progress, so I spent a couple months with him in our anechoic chamber (an open field on Long Island) getting the speaker system into shape. It produced incredible sound! Nothing else on the market could even come close.

Neither of us had any money, so now what? We demonstrated it to Avery Fisher of Fisher Electronics, one of the big audio firms. Maybe you've heard of Avery Fisher Hall in New York? Avery listened and offered us a 4% royalty for him to market it.

I thought we ought to be able to do better than that, and besides, I liked the idea of building our own company instead of just doing R&D for someone else. So I went to the bank and borrowed $1,000 on my car, got a few enclosures made at a local wood shop, and took them to a few hi-fi stores to demonstrate. Oh yes, the size of the box was determined by the door of my car. I had to be able to get the box into the back seat to take it around.

The stores heard and ordered. But this was a slow growth system, so I next got an article on the enclosure published in *Radio News*. This brought in a big bunch of mail orders—money up front, which you don't get from stores. Working capital.

We demonstrated the system at hi-fi shows all around the country, wowing audio enthusiasts with the incredible sound we could produce from such a small box. Within two and a half years it was the largest-selling enclosure in the country, with four factories in the east and three in California busy turning them out for us. We went from a small bank loan to selling over $2 million a year, and that was in 1950 dollars. That would be about $20 million in today's dollarettes.

So why did I walk away from this in 1955 to become the editor of *CQ*? Because it was a grind. Factories to run, manufacturers' reps to manage, audio shows every few weeks somewhere, advertising deadlines, inventories, and so on. Building the company was fun and exciting, but just running it wasn't. I was having more fun with my ham teletype experimenting and with my little spare time *Amateur Radio Frontiers* magazine, which was about ham digital communications.

Karlson was anxious to quit his job with Airborne and come out of his R&D lab to run the company, so I changed careers to publishing. The company was out of business a few months later. It's a pity because I've listened to every speaker system on the market today and none comes close to the sound our old systems produced.

An article on Richard Wurman in *Fortune* (6/23/97 pp.106-116), who runs technology

seminars for the country's top business brains, says he advises in his 1989 book, *Information Anxiety*, "Your work should be an extended hobby." If the Sudbury School hadn't been invented I think Wurman would have invented it as the answer to "our rotten schools." His philosophy is to "indulge ideas."

I'm doing my best to take care of my body so I'll be around for another 25 years or so, so I can continue urging you to get out of the rat race, to stop sucking into commuting to work, build your own company, and to get your kids into a Sudbury-like school and forget college unless we can get the damned things reinvented to do the job that needs to be done and out of their 19th-Century mindset.

I've got a life and, I hope, a few years left to get you to have one too. There's tons of land open up here in New Hampshire for antenna farms, so why are you living in an apartment or a community that doesn't allow antennas? Wise up!

Sucker!

First, I doubt that you are going to believe me. Second, you're probably going to get angry—most likely with me. My message is simple: Sucker, you've been hoodwinked (a.k.a. brainwashed) into believing a bunch of baloney. Hey, I was a sucker too, so I know how it feels. As they say, "Ve get too soon old and too late schmart."

What's Wayne going to blast this time? The ARRL? The FCC? Congress? If you truly believe in any of those, yes. But basically, no—I'm going much deeper, into the very heart of your beliefs. Deep into your religiously held beliefs. Like your belief in the value of college, the work you do, your doctor, our political system, the food you've been eating, the water you drink, our school system, our currency, immunization, and so on.

College is for suckers. Going to the doctor is for suckers. Your job is probably a sucker's job. The food you've been buying is sucker's food. The so-called war on cancer? Smoke and mirrors. The war on drugs? More smoke. The Constitution? Not in *our* courts! Our legal system? Harde-har! It's been so prostituted by lawyers that it's a beyond being a joke. Lawyers become our judges and legislators, compounding the mischief, and mainly for the benefit of lawyers. And we're paying the bills—we suckers. You and I.

We all believe in the value of a college education, so how can I trash that? Because we've all been sold a bill of goods. Flimflammed. I wasted four perfectly good years of my life because I didn't know any better. Years when I could have been laying the groundwork for a real life instead of being another drone in a corporate or bureaucratic hive. I love the way our beloved government takes our tax dollars to provide a free college education for criminals, and how we encourage kids to go into hock, "investing" in years of useless memorizing and tests, which is grinding, fruitless work, little of which is ever going to be of the slightest use in their lives.

If you work for a large company, the government, or in education, you've been conned. If you are commuting more than 10 minutes a day each way to work, you've been suckered. If you don't own your own company by the time you're 25 you've been had by the system.

In a large company, working for the government, or in education, you'll never know freedom, no matter how high you climb the ladder. Practically speaking, the only way you'll ever make enough money to earn freedom is to be an entrepreneur and own your own business.

Yes, I know about the multimillion dollar salaries and benefits of some sports stars and megacorporation honchos. How much freedom do you think these people have, even with all their money? But I'm not interested in the success of a few exceptions; the nitty-gritty is in how any kid, family problems or background notwithstanding, can beat the system and be a winner.

Our public school system (and most private schools) is geared toward making sure you emerge as one of the hive, unable to question or think—barely able to read, unable to do even simple math or read a map—with almost zero motivation to change, and little perseverance when some sparks of motivation are struck. Aided by the media (newspapers, magazines, TV, radio), it hangs you up on total inconsequential amusements like watching sports, sitcoms, Oprah, and 98% of the other TV goulash aimed at the lowest common denominator (does that describe you?).

Yes, there are a few schools which have broken the mold (like the Sudbury Valley School), and yes, colleges could be re-engineered to provide a practical education which would help gear the graduates toward success as entrepreneurs. I tried my hand at edging Rensselaer Polytechnic Institute in that direction, but I didn't have a big enough lever to change tradition, even though I was on the Steering Committee, the RPI Council, a Rensselaer Patroon, and First Executive in Residence. Reason, I found, couldn't compete with tradition.

Well, it's probably too late to wean you from watching baseball and football, or from commuting to and from a job with little future, but perhaps I can get you to at least give your kids a break. Or grandkids.

Heck, you can turn over a new leaf at 70 and within five years be free. Of course, that's if you haven't ruined your body beyond repair with too little water, lousy food, and endless poisons.

So what's the alternative to having a job? To being a wage slave? How do you get from working at a job to owning a business? My booklet, *Making Money, A Beginner's Guide*, gives the details, but basically I recommend that youngsters decide what field will be the most fun for them, find an entrepreneur in that field with a small company and go to work as an apprentice. This approach actually will work for anyone from 17 to 70. Every small company has work that needs to be done and no one to do it. I'm not going to expand this into another booklet covering the same stuff, so get the book and then argue with me.

Entrepreneurs have to know a bunch of things, so get busy and educate yourself—with someone else paying for your education. Learn about sales, marketing, promotion, advertising, contracts, business law, purchasing, accounting, computers, communications systems, and so on.

For instance, if publishing looks like fun to you, you'll want to learn about advertising sales, circulation management, newsstand sales, list management, fulfillment services, desktop computer systems and printers, type readability, and so on. Learning spelling and grammar won't hurt either. That means reading every book you can find, subscribing to the key magazines, attending conferences and lectures, getting together with people in other publishing firms, and so on. Apply that same routine to any field that looks like fun. After all, why work when you can have fun and make money at the same time? Then it doesn't seem like work. Why do you think I started a ham magazine 37 years ago? And oh, the adventures and fun I've had as a result!

Once you're making plenty of money and have freedom, then you can get busy helping me solve our country's more serious problems. We don't have to have much crime. We don't have to have the country run by lawyers for their own benefit. Or controlled by the international megacorporations. We don't have to put up with a crooked Congress.

I know you haven't a clue about where our money supply comes from, else you'd have been writing to me, bitching about the incredible scam. Wow, have we all been suckered on that one!

So, are you going to continue on, fat, dumb and unhappy, or are you going to start wising up

Continued on page 40

Number 6 on your Feedback card

LETTERS

From the Ham Shack

Charlie Smith KE4OZN. Ask yourself a question. Why is the ARRL leadership so determined to destroy amateur radio? The League reports that in 1996, the organization lost about $700,000 in operations. The board gave two primary reasons. First, sluggish sales of amateur equipment, which translated into fewer advertising dollars being spent by manufacturers, retailers and distributors. Also, fewer orders of ARRL materials. Second, a decrease in new amateur licenses and upgrades. The ARRL board has responded in several ways. First, the administration and finance committee established a fund for the defense of amateur radio frequencies. The League reports in the March issue of *QST* that to date, more than 11,000 members have contributed more than $405,000 to the fund. Second, the board has chosen to increase League dues to $34 annually—an increase of roughly 10%. The problems with these decisions are, or should be, evident to everyone (except ARRL directors and at least 11,000 League members?). The ARRL doesn't seem to understand that these "problems" are easily solved. And nothing the League is doing is the answer. Instead of recommending an increase in dues, developing a defense fund and supporting a complete overhaul of amateur licensing requirements, including retaining the Morse code requirement, even if international code requirements are dropped, how about coming up with *real* solutions? How about making an effort to recruit new blood? New amateurs need equipment. Increased sales means greater advertising dollars being spent, increased ARRL publication sales, and possibly an increase of League membership. And how about lowering membership dues, at least for first time members? It makes more sense to make a little less per sale, but increase overall income by having more members if you can't sell 'em at $10 each. You probably won't (read: never in a million years) sell more by raising the price to $12. Try it sometime. More amateurs mean more usage of amateur frequencies. With a lot of people using the bands there is no need for a fund to defend our access to spectrum allotted to us. There is strength in numbers. Doesn't it make more sense to spend $405,000 to recruit than to defend? Not to ARRL directors and 11,000+ members. Why put so much energy into defending our hobby when all of our so-called problems will take care of themselves if we grow? How about stopping this nonsense about restructuring and renaming the different "classes" and simply scrap it all in favor of a one class system where those who pass a simple (roughly Technician class) test are welcomed into our ranks and simply known as "hams" or "amateur radio operators." Why continue a caste system? People will increase their knowledge and skill, or, if you feel this would be lowering "the standards," how about making everyone pass all requirements currently held by Extra class amateurs? That would improve the "purity" of our hobby greatly. Better yet, increase code requirements to 40 words per minute and eliminate all other modes of operation. It'd free up more spectrum for "real radio" (CW). And only allow home-brewed gear. I mean, don't "real" amateurs build their own stuff? Oh, how about an age requirement? How old is old enough? 40, 50, 70? And while you're at it, eliminate women from the ranks. And finally, limit the hobby to HF frequencies. Where will amateur radio be in 10 years? 20 years? If the ARRL continues down Stupid Ave., it'll all just be a memory. If it does survive another 20 years, radio stands a chance—as the bulk of ARRL's membership will be dead. Then, maybe those who remain will finally get a clue. Think about it.

Another troublemaker! The League has set aside funds for defending our frequencies for years. I remember when these funds were used for vacation visits to the Caribbean by a League president. And wow, did I see the membership money being thrown around recklessly at Geneva! But Charlie's right, we need new hams. Young new hams. Millions of young new hams. It would be good for amateur radio, good for the kids, and particularly good for our country. But since experience has shown that youngsters are interested in using computers instead of keys, they may not be welcomed by the League directors ... Wayne.

Mark McClure, Coral Gables FL. I just finished another Wayne Green editorial and I'd like to take a moment to say thanks for your booklet, "Making Money." I've taken your advice and become an expert in a field—courtroom technology—and I'm starting to reap the benefits. My wife and I just returned from a trip to India, Singapore and Malaysia. The company I contracted with paid all of my expenses and my wife flew on a frequent-flyer ticket, obtained primarily by running as much through our frequent-flyer Visa card as possible, as you have suggested. I'm not rich yet, but last year was my best year ever, and I owe a large part of it to your editorials, which exhort and cajole us to push ourselves. I really look forward to the late part of the month when your magazine arrives. I especially enjoy your non-radio topics. For me DXing and rag-chewing can't compete with the Internet, though I get on two meters from time to time and I'm on the board of directors of the local RACES team. In your editorials you often state that most of us don't take your advice and are too busy with ball games. Well, not all of us. I really appreciate being able to benefit from your knowledge and experience and I hope to continue to read your editorials for many years to come.

Thanks, Mark, that's really encouraging; now will someone please explain how I can get the rest of the readers to shape up? Anyone can add years of healthy living to their lives and make all the money they want, if I can just get them to start breaking their unhealthy loser habits. Sigh ... Wayne.

Harold Oroppe, Jr. K6QVD. I read with interest William Tilburg KG8AN's article on page 48 of the May issue #440 describing the half square DX antenna. However, I feel that credit should be given to Antennas West, Provo, Utah, and Jim Stevens KK7C, who has been advertising this antenna for many years, assembled or in kit form, in *73 Magazine*. Refer to page 31 of the May issue for his ad. I have personally used this antenna with phenomenal success for many years, even before our home was destroyed in the October, 1993, (Laguna Beach CA) firestorm along with almost 400 others. Antennas West is unique in that it offers many innovative antenna designs plus a ream of technical data that is straightforward and honest in an industry plagued with snake oil and exaggeration. For example, all of their antennas use custom-made Quiet Flex™ wire. This wire has more than 40 strands lightly twisted together under flexible insulation. It will not kink; snow and ice slip off before they can load it down; and acid rain and invisible pollution that corrodes the surface of ordinary antenna wire cannot penetrate the tough cover. This insulation withstands high heat and remains flexible at below-zero temperatures. Year after year it refuses to crack or harden under the bombardment of untraviolet rays. Quiet Flex is rated at 3,500 volts, which offers protection in unfamiliar locations. Most hams don't realize the corrosion that builds up on ordinary cheap bare stranded antenna wire acts like several hundred feet of tiny semiconductors. When wind sways the antenna, the strands rub together, and this generates noise. Noise generation starts within only a few weeks of the initial installation, before you can see the buildup of corrosion, and the noise increases relentlessly over months. Quiet Flex wire starts out quiet and stays quiet over the years ... and the price is right! I speak from experience, as I've lived a mile from the ocean for the past 31 years and have been a ham for 61 years. My original call was W6NHS in January 1936 in Hollywood, and ex-W2, W3, and W6/K6 after WWII.

Alan Plotnick NN1X. Can you tell me who makes an attaché case HF transceiver today? I know that suitcase transceivers were made during World War II, but it seems very strange that no radio company ever picked up on the idea and modernized it. With miniaturization, advanced rechargeable batteries and the need to compete with UHF HTs, this product seems to be just

begging to be introduced again. It would be great for Field Day as well as the home shack. And it wouldn't need to be another feeble 5 watt QRP rig. What about it?

Bummer, seems to me. Many rigs are small enough to throw into an attaché case, but since most of us just set a rig up on a desk and use it, the attaché case would be in the way. I don't remember any attaché case rigs in WWII, and I was there. I don't think attaché cases were even invented until the 1950s. We had book bags and briefcases before that. Certainly, nothing like that ever showed up on the surplus market after the war. And those were tube days, so rigs weren't all that small. Sure, you could have squeezed a BC-456-sized rig into a briefcase, but the power supply would have made it a real bear to carry ... Wayne.

Dorothy AA2VL. I would like to nominate Frank WB2IJZ (Wet Bottom) for a "Good Apple" certificate.

Frank has had a license since 1963. He keeps saying he knows he could pass to upgrade. I believe he could, but he doesn't do it.

Frank has been Net Manager of the Early Birds, Western New York area, for about 15 years. He is right on the job 5:25 a.m. Monday through Friday. He doesn't have to worry about losing his manager job; no one is waiting in line to assume the responsibility. He does a very good job and deserves a Good Apple Certificate for being a dedicated ham.

Richard Harrison KB5WZI. Our ARRL Section Manager addressed our club recently. He strongly promoted the League's ability to protect and preserve ham frequency bands. As cost-cutting and deregulation eliminate spectrum policing, technology, commerce and influence take away ham frequencies. The ARRL would like us to believe that it mitigates this erosion. Other than electing hams to Congress, only a sizable pro-ham population or a sizable influence purchase can improve our status. Some hams deny a problem exists. Others believe the ARRL will cope, and still others hope the problems will go away. Influence comes from people and money. Yet, many hams say more is not better. As Vince Lombardi would say, "It's not the best thing, it's the only thing." It takes numbers. Influence will result from a sizable segment of society perceiving significant self-interest in ham radio. We need more hams, and we need to convince the public that ham radio is a good source of able technicians for the information revolution. The occasional cell phone logjam can produce pro-ham publicity for a while, but non-ham wireless growth will shrink these stories. The ambassadorial role of ham radio is not too persuasive. The worst conflicts seem to occur between those who know each other best.

Ham radio stimulates interest and progress in electronics. Hams are self-motivated to investigate and experiment. This education is the real value of ham radio. Young people are likely to benefit most from this experience and benefit their communities in turn. The success of small activist groups comes from persuasion of outsiders to share their causes. Hams also need others to back ham causes. It is unlikely that any ham lobby could successfully compete with commercial interests now. Interested hams are a tiny fraction of the population. The public doesn't show much support for hams. Hams mess up telephones, radios, televisions, stereos, and other stuff too, don't they? How about money? How many millions were given in the name of ham radio to various election campaigns? How about access to the regulators? Do you think ARRL buys better lunches than AT&T? Commissioners are political appointees. In turn, bureau chiefs get the nod from commissioners. These guys usually are seeking a steppingstone to better places. They find them, too, through the commercial interests they regulate. In their new positions, they can return to influence their former colleagues. In opposing this entrenched system, ARRL can only skirmish. Any pretension otherwise is less than candid. To save ham radio, you have to grow it, and make allies.

Another troublemaker trying to use reason to penetrate closed minds. It won't work ... Wayne. 73

QRX . . .

Remember the Glory Days—and the Good Manners—of Ham Radio?

In talking with another old-timer, I was reminded that in the old days we were all scared of the FCC. His logbook, like mine, was filled with line after line of unanswered CQ calls. The rules said to record all transmissions, so that's what we did. Contacts that we made or unanswered CQs all were dutifully recorded. We were convinced that if we accidentally violated the edge of a band or let a profanity slip out, that there would soon be a knock at the door or a "pink slip" in the mail. To this day I still go no closer than 5 kHz to the end of a band.

Courtesy and proper radio etiquette were commonplace. Phone transmissions were always preceded by, "Is this frequency in use?" We all felt that we were privileged to be on the cutting edge of an exciting new field. We had worked hard for our licenses and were proud of our role. We relayed messages from servicemen overseas to their loved ones at home. Sometimes we were even privileged to be able to set up a phone patch and share in the joy of a reunion. In times of disasters and national emergencies we were a vital link that often helped save lives or bring comfort to worried family and friends.

There were glorious adventures to share. I remember how thrilling it was to talk to the crew of "Kon-Tiki" as they sailed their raft across the Pacific. I remember listening to hams aboard our spacecrafts as they circled the globe. I remember talking to my daughter aboard a research vessel exploring the mid-Atlantic rift. All this, and much more, with equipment that we had put together with our own hands.

Today it's FAX-modem this, Internet that. I've got more money, so I bought a fancier station with more power and a bigger antenna. And, what's worse, it's no longer a group of proud people sharing the fraternity of radio communications. When I tune across the bands today, I hear people giving religious sermons, people spreading messages of hate, and people cursing each other in the most vile and obscene language. Then there are those who seem to take delight in jamming contacts and those who deliberately interfere with various nets. They have the lamebrained idea that they are defending liberty and that no group of people has the right to use any particular frequency for longer than they feel is appropriate.

As a retired psychologist, I can describe the jammers and the interferers as remarkably similar groups of people. For the most part, they all suffer from poor self-image and weak egos. They are busy overcompensating for inferiority complexes.

The question is, what do we do about these immature individuals who are ruining amateur radio for the rest of us? Unfortunately, there is little likelihood of any of them growing up without seeking professional help. Yelling at them only feeds their egos, making them feel important. It's best to treat them the way you would any group of little kids calling names. Ignore them and most of them will get bored and go away. These misfits typically have little ability to delay gratification. If they find they can't bother you they'll get frustrated and find someone else to annoy.

The other solution is to have the FCC act as "Big Brother." When emotional development is arrested or regresses to such an infantile level they either do not have any self-discipline or have lost whatever self-discipline they may once have had. They only function, and even then poorly, when they are subject to constant external discipline that reacts strictly and rapidly. The FCC would have to constantly monitor the bands and confiscate equipment, fine, and even imprison these individuals. I am not sure that any ham in the land of the free wants to be subjected to that kind of scrutiny. So let's not get angry and fight with these immature, mentally disturbed people. They deserve our sympathy, not our scorn. Try to not let them bother you.

However, there is one area where we should take an active interest. Stop and think for a moment. What person, in his right minds, would spend so much time and effort on destructive behavior, devoted to destroying other people's enjoyment? If you know one of these people, you owe it to him to get him some help. This destructive behavior can only get worse and eventually end up in self-destructive actions. You are your brother's keeper. Get him into therapy before it's too late.

In the meantime, we old-timers can remember back to the glory days of ham radio and all the joy and excitement it gave us. We can shed a tear for the youngsters who were born too late to share it with us. But, maybe there is still hope for them in areas of amateur communication that are still evolving.

By Hal "Doc" Goodman W3UWH, 7 Perkins Road, Eastport ME 04631.

Ode to Volunteers

Many will be shocked to find
When the day of judgment nears,
That there's a special place in Heaven
Set aside for volunteers,
Furnished with big recliners,
Satin couches and footstools.
Where there's no committee chairman,
No group leader or car pools;
No eager team that needs a coach,
No bazaar and no bake sale.
There will be nothing to staple,
Not one thing to fold or mail.
Telephone lists will be outlawed,
But one finger snap will bring
Cool drinks and gourmet dinners,
Rare treats, fit for a king!
You ask, who'll serve
The privileged few, and work
For all they're worth?
Why, all those who reaped
The benefits, and not once
Volunteered on Earth!

Author unknown, submitted by Jack Kirkpatrick K8BWX to the *SMARS Feedback* newsletter, August 1996, and reprinted in *RF-Carrier*, Dayton (OH) ARA, March 1997.

Ham Radio Volunteer Services Bill Introduced

Good news for ham radio volunteers: the Amateur Radio Volunteer Services Act of 1997 (HR 1013) has been introduced by US Rep. Anna Eshoo of California. If enacted, the bill would place volunteers in the Volunteer Examination Program and the Amateur Auxiliary under the protections of the Federal Tort Claims Act by affording them the same legal protections as employees of the federal government while they're carrying out such volunteer duties. "This bill would help protect the personal liability of volunteer Amateur Radio operators while performing duties on behalf of the federal government," Eshoo said in introducing the measure. As she explained it on the House floor, it's simply a question of fairness for volunteers, who risk damaging lawsuits while saving the government time and money. The bill was introduced with 21 co-sponsors hailing from both parties.

HR 1013 is nearly identical to a bill introduced last year but not enacted and similar to a unanimously accepted amendment to the FCC reauthorization bill that Eshoo herself offered last year in the Commerce Committee.

On the House floor, Eshoo outlined the rationale behind the Amateur Radio Volunteer Services Act of 1997 in these words, and urged her colleagues to support the bill:

"Amateur Radio operators are self-regulated, with volunteer operators monitoring the airwaves for violations and administering licensing exams. This volunteer corps saves countless hours of staff time and resources for the Federal Communications Commission; however, because they are not federal employees, they put their personal assets at risk in the event of actions taken against them as a result of their volunteer service to the government. It is simply unfair that these volunteers who are saving the government time and resources should have to risk their personal assets in carrying out their service. The Amateur Radio Volunteer Services Act would classify those individuals donating their time and expertise to maintaining the quality of the Amateur Radio airwaves as federal employees only for the purpose of actions taken against them in the performance of their duties as self-regulators. This action will ensure the continued viability of the Amateur Radio community and continue to save the FCC and the federal government time and money that would otherwise need to be expended."—ARRL.

From the *Tuned Circuit*, monthly bulletin of the L'Anse Creuse ARC (MI), April 1997.

More Vanity Callsign Follies

The FCC has granted another 420 or so vanity callsigns, representing vanity applications received between February 6 and March 4. Some 330 of the applications ended up in the work in process or WIPS stack, many because the FCC was unable to issue any of the applicants' callsign choices. The vanity callsign program remains popular: During February and March, the FCC received 1768 vanity callsign applications, the majority of them filed electronically.

A reminder: Vanity applicants who did not get one of their callsign choices will have to apply in writing for a refund of the $30 filing fee. The FCC will mail to all unsuccessful applicants a copy of the application (including FCC processing numbers) and a copy of their check. To request a refund, applicants then must send a letter to the FCC, 1270 Fairfield Rd., Gettysburg PA 17325-7245, along with their taxpayer ID number (Social Security number). The FCC still has not said when it plans to open Gate 3 for Advanced class vanity applicants.

From *Harmonics*, official publication of the South Jersey Radio Association, April 1997.

CQC Top Ten Uses for a Computer in the Ham Shack

10. You can use it as a really big paperweight.
9. It keeps your coffee warm.
8. It makes a great door stop.
7. You can check your E-mail while your keyer sends CQ.
6. You get to say "Sorry, Old Man, you're not in the computer."
5. It keeps dust from settling on the surface it covers.
4. If lightning strikes, the computer might absorb it and thereby protect your radio equipment.
3. You can check the packet net to see who's on air—much easier than actually turning on your receiver.
2. You can justify your new rig as a "computer upgrade."

And the Number One Use for a computer in the ham shack:

1. Three words: Random signal generator.

From Low *Down*, official journal of the Colorado QRP Club (cqc@aol.com).

Ham Radio Excluded from CB Enforcement Bill

At the request of the ARRL, Amateur Radio has been specifically exempted from a bill submitted April 17 by US Senator Russell Feingold (D-Wisconsin) that would give states and municipalities authority to enforce the FCC's CB regulations. Feingold's bill, designated Senate Bill 608, originated with efforts by the Beloit WI City Council—responding to long-standing CB interference complaints—to pass an ordinance allowing local authorities to enforce FCC regulations. The bill is aimed at reducing radio frequency interference stemming from the use of unauthorized equipment or frequencies by CBers.

In presenting his bill, Feingold told his Senate colleagues that he has received RFI complaints over the past several years from numerous Wisconsin communities "in which whole neighborhoods are experiencing persistent radio frequency interference."

If approved by Congress, Feingold's bill would amend the Communications Act to allow state or local governments to enforce regulations that prohibit the use of CB equipment not authorized by the FCC (such as high-power linear amplifiers). As it now stands, no license is required to operate on the 11-meter Citizens Band, but the FCC does have strict requirements on the type of equipment that CBers can legally use. Feingold called his bill "a common-sense solution to a very frustrating and real problem which cannot be addressed under existing law."

TNX *Tuned Circuit*, monthly bulletin of the L'Anse Creuse (MI) ARC, May 1997. 73

Free Repeater, Free HTs and Some Good Ol' PR

Would your *employer pitch in?*

Jim Kocsis WA9PYH
2217 Hidden Oaks Court
South Bend IN 46628

I had received an E-mail message at work from our Emergency Preparedness Coordinator (EPC). He had broadcast an E-mail message to all the people at our facility asking for all ham radio operators to attend a meeting to discuss hams' providing emergency communications. I replied with the names and business phone numbers of the hams I knew at work.

First contact

At our first meeting we talked about communications over and above what is provided by our five security guards. (Like most other companies, we've downsized and as a result have a much smaller security force than we used to have.) The idea of hams helping in an emergency came from the company where our EPC used to work, Rockwell International in southern California. Rockwell had around 8,000 employees in a 208-acre workplace, approximately 140 of whom were hams. We have 1,200 people spread over 105 acres and only 10 hams.

Why us?

During an emergency our five security guards cannot provide effective communications over all areas since there are so few of them. Hiring additional security guards just to be able to cover any emergency is expensive. How often would additional security people be needed? How much would it cost to buy hams some HTs and a repeater instead of hiring an equivalent number of security guards? We hams are at work every day and know the layout of our work areas—probably better than the security guards do. Although most of us aren't at work during second and third shift we could be called in to help during off hours.

The advantages of hams providing emergency communications are many:

- We're adept at using the radio to transfer information;
- Once the equipment is paid for the system is nearly free (except for maintenance, equipment upgrades and small amounts of time for meetings, practice, etc.);
- It builds camaraderie among hams at work (we found out that there were two employees most of us didn't know were hams);
- We received free HTs to wear on our belts full-time (what ham doesn't like to wear an HT?);
- Our EPC is planning to get his ham license so he can participate too—the more, the merrier;
- If the emergency is widespread (both inside and outside company property) cellular phones will be jammed, making them useless for emergency communications, so hams will be the only link from the company to the outside;
- The biggest plus is fulfillment of our obligation as amateurs to provide communications as a public service. Your EPC has what appears to be a very simple job—until an emergency occurs. Then you can really understand the responsibility of the position. Anything that you can do to help him/her during an emergency will be valuable and appreciated.

What are the potential dangers where you work and live? Some are weather-related, others are common to any facility with production/test laboratory areas. Here in South Bend, Indiana, at the extreme northern tip of the state, we have more than you might think.

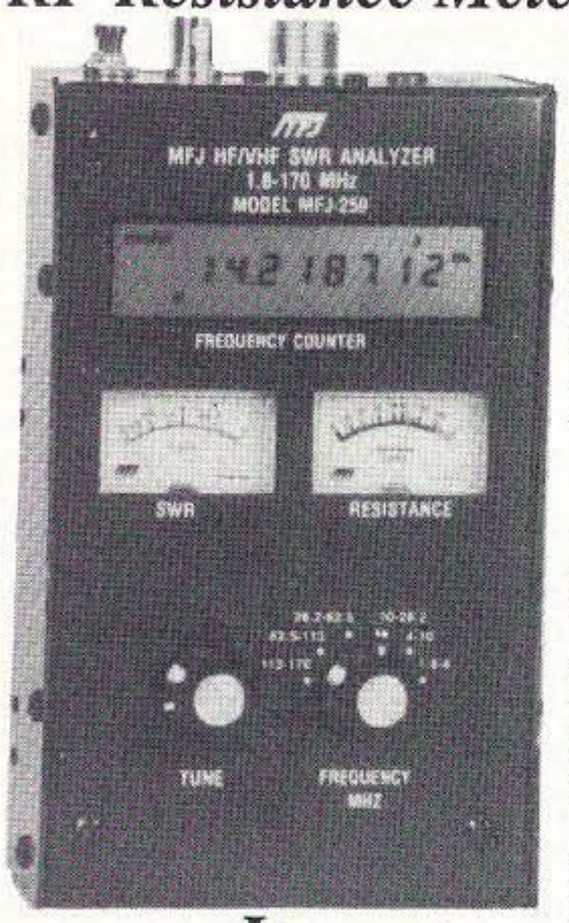
How's the weather?

Every spring, summer and early fall we have severe lightning storms. What would happen if lightning struck a building, possibly setting it on fire? There would be a need to evacuate the building (in the rain).

Every winter we have one or two blizzards with accompanying "lake effect" snow. Being at the southeast edge of Lake Michigan, we get "dumped on" whenever winds come across the lake

MFJ *HF/VHF* SWR Analyzer™ with RF Resistance Meter

Read your antenna SWR from 1.8-170 MHz . . . 10-digit LCD frequency counter . . . RF Resistance Meter™ . . . smooth reduction-drive tuning . . . simple-to-use . . .



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Find your antenna's true resonant frequency from the shack.

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Free Manual

MFJ comprehensive 18 page instruction manual is packed with useful applications -- all explained in simple language you can understand! **For** free manual write or call MFJ.

Take It Anywhere

The MFJ-259 is fully portable, powered internally by 8 AA batteries or 110 VAC with MFJ-1312B, $12.95. It's in a rugged all metal cabinet that's a compact 4x2½x6¾ inches. Take it to remote sites, up towers, on DX-peditions -- anywhere your antennas are located.

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1.8-170 MHz *SWR Analyzers*™

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440 MHz *SWR Analyzer*™

MFJ-219 **$99.95** **Read** SWR of any antenna 420 to 450 MHz -- just plug coax of your antenna into SO-239 connector, set frequency and read SWR. Uses microwave integrated circuits and microstrip technology. Jack for external frequency counter. 7½x2½x2¼ in.

MFJ-219N, $99.95, sames as MFJ-219 but with "N" connector.

MFJ-219 uses 9 volt battery or 110 VAC with MFJ-1312B, $12.95.

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Measure signal strength over 60dB range - Check and set FM deviation - Measure antenna gain, beamwidth, front-to-back ratio, sidelobes, feedline loss in dB - Analyze audio quality with scope

NEW! MFJ-224 **$159.95**

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from the northwest. One inch per hour isn't uncommon. A quick buildup of snow could collapse roofs, trapping people inside. We would need to know how many people were trapped as well as keep others out of the hazardous area.

On April 12, 1996, we had a hailstorm that did millions of dollars' damage to cars, homes and crops. What damage could have occurred to our facility? We don't know since the hailstorm hit approximately 10 miles away. We only got a few grape-sized hailstones at our facility while the worst-hit areas received nearly baseball-sized hail.

In September 1985, a tornado touched down about two miles north of our facility at 4 p.m., when most people were leaving to go home. The tornado ripped the roofs off a few homes and then went back into the clouds. (The strange part is that the weather bureau, less than a mile from the point of touchdown, never saw it—nor was a tornado warning/watch issued!) In April 1965 over 200 tornadoes hit the midwest—some of them hit only 20 miles southeast of our city. If you've ever seen what a tornado does to anything in its path, then you know how dangerous they can be to humans.

We have a saying in town: "If you don't like the weather, just wait a few minutes ... " [By the way, northern Indiana really is a very nice place to live. We have beautiful spring, summer and fall seasons—and winter, if you like it. One thing we *haven't* had (yet) is an earthquake.]

Where's the fire?

Any building can catch fire. Getting all the people out can be a real problem. Who might still be inside? Are there winds that might spread the fire to other buildings? We have production and test laboratory areas at our facility. Chemicals could get spilled and catch fire. Smoke from the chemicals could injure someone. We would not only need to get people out of certain areas but keep others from entering those areas.

Man-made hazards

Like many large facilities we have overhead power lines coming into our facility. Our power lines pass over an internal driveway/walkway. Every winter and spring we have at least one or two ice storms. Will the lines stay up if they get coated with ice and the wind picks up? If the lines come down you will need to spread word to all people to stay clear of this area. The affected area will need to be barricaded.

We have railroad tracks less than 200 feet from one of our buildings. In 1992 a tank car on a passing train began leaking ammonia gas. They stopped the train near the building I work in. Luckily, it happened before most people came to work for first shift. Only the security guards and a skeleton third shift were at work. The local radio and TV stations spread the word on the news that morning that all employees were not to report to work until after the area was cleared. What would have happened if the leak had occurred a few hours later when everyone was at work?

In one of our buildings we use jet fuel for testing. If a fire should occur, automatic detectors set off an automatic fire extinguishing system. Sirens sound for 20 seconds and then the area is filled with CO_2 to starve the fire of oxygen. The CO_2 will also asphyxiate humans.

These are examples of the many things that could happen at your facility. These disasters could happen anywhere. Ask your EPC what could happen at your facility and what the communications needs would be for each situation.

Procedures

What kind of information will you transfer from one site to another? You could be letting the command center know any one of the following pieces of information:

- How many people are at your rally point during an evacuation
- How many people are injured, what types of injuries, etc.
- Extent of the damage
- How many people are or might still be trapped inside a building

We were each issued a green construction-type hard hat to wear during both practice drills and real emergencies. The color green stands out so that the emergency coordinators (who wear blue hats) for each area will be able to pick out the communications person (ham) in a crowd of people. We have also put the word "COMMUNICATIONS" on the front of each hard hat. Inside our hats we've each stuffed a copy of a map showing each of our rally point locations. (A rally area is where people go if a building must be evacuated. Although your EPC should pick the rally points, command center, shelter locations, and evacuation routes, your group can certainly help find the best locations. You probably know your building as well as anyone else, so help make the selections if you can.)

Our rally point locations are referred to as A, B, C (Alpha, Bravo, Charlie), etc. Since we only have 10 hams we didn't have any problem with running out of one-letter designators. We purposely did not use our callsigns or names when referring to a rally point. During an emergency you want a very simple way of specifying a location. You don't want to have to determine a location by having to associate a person's call or name with it. Each ham knows approximately how many people to expect at his rally point during an evacuation. We have one ham and one to seven Emergency Coordinators assigned to each rally area. There is also one ham located at in the command center who funnels all the information to our EPC. The command center has a radio on the security department's frequency.

Our command post is the location where our EPC will be during an emergency. It is mobile—two situations that would require the command post to be moved are shifting winds during a chemical leak or fire; and fire department trucks, ambulances, etc., needing access to a given location.

Hopefully your company's management will be as willing as ours to allow you time to spend organizing and practicing your procedures, having meetings, etc. Our company was very generous and allowed us time to get the process organized and in place. We use charge numbers to track the amount of time spent on any given work-related project, this one included. If your company is like ours, get an account (charge number for us) set up so that you can track how much time you really spend putting a system like this in place.

Most of the hams in our group have pagers. Since we may be just about anywhere in one of several buildings we make good use of them for business purposes. They could also be used to spread the warning to all the hams in your group, since we may not always have our HTs with us, but we'll always have

our pagers. You could also have a specific code to send out for each emergency situation—or keep it simple and just have one numeric code, that tells you to check in on the repeater.

You should also consider how you will need to interface with the local police, fire and HAZMAT departments, if and when they come to your facility for an emergency such as a fire, chemical spill, explosion, etc.

Plan what nearby repeater or simplex frequency you will use if your repeater doesn't work (for whatever reason—the antenna gets taken out by wind or lightning, the repeater is being jammed and times out, the power goes out and the battery fails, etc.). Check out coverage using both the alternate repeater and the simplex frequencies. Are there any dead spots?

The first thing we did was to perform a site survey to see if there were any dead spots in our facility. There are several areas that have either lots of metal piping, metal walls or rebar-reinforced concrete walls. While the repeater transmitter can be made as powerful as needed to saturate all areas, the HTs cannot since they have 5W maximum output and the typical "rubber ducky" antenna—a known poor performer!

For the site survey we used 2W HTs, a 1/4-wave vertical mounted atop a three-story building at the center of our facility, and a 10W transceiver with an S-meter. (The S-meter was needed so we could make accurate comparisons of signal levels at all locations.) We walked through all areas while talking to the base station. Levels from all 28 areas checked were very good (nearly full scale: 9) to excellent (full scale: 10) with the exception of one area. A chart was made listing signal level vs. location (see **Table 1**). The received signal at all locations was full quieting. At this point we knew a 10W repeater and 2W HTs would provide the required coverage. When using a repeater, cavities and a better antenna, received signals will be even stronger. (The repeater has more tuned circuits and better sensitivity than the transceiver, the cavities provide additional noise and interference rejection and the antenna has 9dB gain over the simple 1/4-wave antenna used during the site survey.)

When the radios came in, we checked them out and then logged them in a book

10W base with ground plane on top of Plant 26
All portables approximately 1.5 – 2.5W
Signal Levels: 1 = none, 3 = poor, 5 = good, 10 = excellent

Location	Signal Level
Plant 14 cell 1	9
Plant 14 cell 2	9
Plant 14 2nd floor east	10
Plant 14 2nd floor west	10
Plant 14 cell 32	7
Plant 14 cell 35	9
Plant 14 cell 7	10
Plant 14 cell 3	9
Plant 14 cell 43	10
Plant 13 south	10
Plant 13 center	10
Plant 2 Gate 6	10
Plant 2 Gate 5	10
Plant 3A	9
Plant 3 Gate 8	10
Plant 3 center	10
Plant 4	9
Plant 5	8
Plant 25	8
Gate 9A	9
MIS	9
HSE	10
Dock 10	10
Plant 23	9
Parking Lots (all)	10
Plant 19 isle	10
Plant 19 west	9
Guard Shack	10

Table 1. *Signal levels on 147.42MHz. Note that Plant 14 cell 32 had the lowest signal level. It was the closest to the base station (only 100 feet away!), while the farthest point (Plant 2 Gate 6, 1,000 feet away) registered very strong signals.*

showing which unit belonged to whom by serial number. Then we each put our callsign on the backs of the HTs. Knowing you are responsible for a particular unit makes you take better care of it.

Our EPC initially asked all of us if we could supply our own radios. About half of us had HTs, several of which did not work reliably. Some were older models and thus were considerably larger and heavier than HTs that are popular now. We need the equipment to be in good working order and most importantly, reliable. We were offered new HTs and our own new repeater system based on the following justifications:

•All hams should have the same radio. If we had to borrow one from another ham in our group, the borrower would already be familiar with the operation of the radio.

•The radio will always be at work. There won't be any problems with having to remember to bring your radio to work each day. There is always the risk of dropping your own HT or banging it into something while going in and out the entrance, carrying it in your car, etc. Keeping it at work will eliminate this possibility.

•The radios are new and should be trouble-free for at least a few years. The part that will probably need replacing first is the battery pack since the heat from the drop-in charger will shorten its life. (A tip: cycle your battery periodically to keep it healthy and do a check on it so it gets replaced b*efore* it fails during an emergency.)

You will need to coordinate with your state's repeater frequency coordinator to get your frequency assignment. Your antenna pattern should provide good coverage throughout the entire facility. The best location for our antenna was not in the center of our facility but rather far off center. With the antenna being much closer to some locations than others we focused most of the power to the farthest areas. This has the extra benefit of keeping our signal out of the coverage area of other repeaters, and keeping their signal out of our repeater. Try to put the antenna's major lobe and null where they will do the most good.

Problems and solutions

We have 10 hams to cover approximately 105 acres and 1,200 people. The

ratio of 10.5 acres and 120 people per ham results in much more responsibility for each ham at our facility. (Compare our ratio with the 58 people and 1.5 acres per ham at Rockwell.) What's the solution? Get more people at our facility to get their ham licenses! We already have our EPC interested in getting his ham license.

The HTs we selected have a rather small speaker that produces very little audio. Will we be able to hear them in a noisy location? Perhaps a speaker-mike would help. I've heard the amount of audio from a Motorola commercial HT and our little TH-22s are no match for the Motorolas! Granted, they cost about five times as much as ours and we probably won't be going into noisy areas with our HTs, but will they be able to produce enough audio for all our needs?

There are a lot of PCs and other electronic equipment throughout our facility. Walking through many areas we get squelch openings caused by the machinery and PCs emitting signals on our repeater frequency. (My own PC at work opens the squelch on my HT, located 10 feet away.) We don't want these squelch openings to occur while we walk through office areas or while in a meeting. The solution is to install PL decoders so that the receiver doesn't open until it hears the PL frequency. However, not thinking far enough ahead, we didn't order our HTs with this option. Going back to request more money is always more difficult than asking for the full amount the first time. Make sure you cover *all* known expenses the first time. Our EPC is not the one reluctant to request more money, but he said it would have been easier to buy all that we needed the first time.

When trying to reach another ham about work-related issues it can be very tempting to use your HT rather than calling him on the phone, paging him on the PA system or calling his pager. Remember that ham radio is *not* to be used for business purposes. If you use the HT to call another ham to discuss ham radio issues, that's fine, but don't use the HT/repeater for anything to do with business matters. Remember, too, that amateur transmissions are *not* private and anyone could be listening. By using phones, pagers or PA systems you are assured privacy. If there is any doubt, don't use the HT.

Our EPC wants our guards to have receivers nearby so they can monitor our transmissions during an emergency. With this receiver on all the time they will hear any casual (ham-related) transmissions, too. Will they turn it down if they consider it annoying and forget to turn it on during an emergency? No solution has been thought of yet.

What happens if your HT is damaged? Our EPC anticipated this situation and has offered to replace/repair our HTs if they're damaged while "on duty." If we take them home overnight or over the weekend and they get damaged, the repair comes out of the ham's pocket. Don't abuse the system. Be honest—if you damage the HT away from work, pay for it.

Don't put autopatch on your repeater! We didn't and will never miss it. We

Photo A. *Mario Meribela N9ABN, David Scott WD8CZM, Brian Dickey KB8QEC, Tony Kostreba KB9AFW, Stephen Elek, Jr. KB9GP, Bob Herendeen N9NRW, Harold Miller N9PEN, Roger Tinti WA9OKC, Jim Kocsis WA9PYH. Not available for photo: Mark Thompson WB8OWQ. Photo by Ben Jagla.*

have telephones all over the facility if you ever need to make a phone call. An autopatch would be more of a problem than it's worth.

If you want to find some more "holes" in your system, try having a practice evacuation. We scheduled one, but the time it would occur was only specified as "sometime during the month of October." Our EPC picked a clear day when it was 70 degrees.

Problems we encountered were significant:

- Several people did not know the location of their department's rally point;
- Only a few of the Emergency Coordinators showed up at their rally points;
- Many of the ECs had never made it to the training sessions they were supposed to attend, so they didn't know what to do during the evacuation;
- Many employees did not know who their EC was.

Keep in mind that you are stopping production to test the system—management doesn't want to have to practice very often (not at all, if possible), so make sure you get most, or all, of the faults identified with one practice evacuation.

The repeater caused us some problems too. It turned out that the repeater we bought is available in two models. One covers 134 to 146MHz, the other 146 to 160MHz. The dealer didn't tell us that the units cover either the upper or lower 2MHz of the 2m band, but not both. It turned out that we ordered the right model, but what if we had received a frequency allocation in the opposite 2MHz? Back to the dealer goes the repeater; add a few weeks' delay. (The repeater we chose is synthesized and can be set up on any frequency in its range. However, the unit has capacitors and coils in the front end that are different for the two different frequency ranges. The parts that need to be changed are surface-mount parts, something that we didn't want to change, since they are rather difficult to solder. Also, the warranty would be voided if we modified the unit.)

The equipment

We chose Kenwood's TH-22ATH for the HT, a Yaesu VXR-5000 25W repeater, Cushcraft AFM-4DA bay antenna, Communications Specialists model ID-8 CW identifier, Wacomm model WP639 VHF-FM cavities, a temperature compensate battery charger, Xenotrix model 8110F12100CN/P, a Yuasa/Exide 65Ah battery, Belden 9913 coax and a few type-N coax connectors. The total cost for all this equipment was $5000. Call around for quotes for the brands you choose. We had problems interfacing the identifier to the repeater. See if you can get a repeater that offers either a built-in identifier or one that plugs right in. Several of our guys spent a whole afternoon getting the repeater and IDer to work together properly.

Credits for a job well done!

Here are the guys who did the bulk of the work getting our system in place:

Mario N9ABN used a PC to program the repeater transmit/receive, timeout time, PL on, PL frequency; compiled the site survey data.

Roger WA9OKC aligned the repeater receiver for maximum sensitivity, assembled the antenna, loaned us his spare cavities until ours came in and provided/operated the transceiver/antenna for the site survey.

Bob N9NRW gathered the quotes for the equipment, coordinated with the purchasing department to get the equipment ordered, programmed and interfaced the IDer, and took the role of repeater licensee.

Tony KB9AFW checked out all the HTs upon arrival, tracked all HTs by serial number and assigned them, figured out how to program the HTs and the options (group paging, etc.) that we might use in the future.

Others provided moral support.

Consider approaching your EPC to see if he thinks you could provide help with a system like this. You will probably want to meet among yourselves before you approach your EPC since you may not get the support of enough hams or might have some big stumbling block that will prevent you from succeeding in implementing a system like ours. If you think you have enough hams to be of some help, go to the safety people and lay out your plans. Keep in mind that companies exist to make money and their first question will probably be "How much will it cost?" Do your homework and have an approximate dollar amount ready (hopefully a little on the high side) for that first meeting.

Also consider getting in touch with your local newspaper to see if they will carry an article showing the services your group is providing to the community—additional PR in your community never hurts. Good luck! 73

Figuring RF Exposure

New standards can help avoid potential hazards.

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Volts per meter, amperes per meter, milliwatts per square centimeter: if these terms are not familiar now, they probably will be by the end of the year. At that time, you will be required to conduct an RF safety evaluation for your station.

The experts have been arguing for 30 years about whether there are or are not nonthermal effects from exposure to RF. They still don't agree. One thing they do agree on is that fairly high exposure to RF can cook eyeballs and do other bad things. For this reason, the RF exposure standards are based on the heating effect of RF. If you spend a sunny day at the beach, a certain amount of the sun's power will fall on each exposed square centimeter of your skin. Hence the terms microwatts per square centimeter and milliwatts per square centimeter.

Measuring the heating effect of RF directly can be done with a temperature-sensitive resistor called a bolometer. This technique is practical only at microwave frequencies, however. At lower frequencies, the best we can do is to measure the voltage that the electric field will induce in a dipole or that the magnetic field will induce in a loop. The units of measurement are volts per meter for the electric field and amperes per meter for the magnetic field. If you could measure one volt between two points one meter apart in space, the electric field strength would be one volt per meter.

Since heating is due to power density, we must convert volts per meter to milliwatts per square centimeter. Ohm's law to the rescue. $P = E^2/R$. If E is 27.5 volts per meter in space, it will be 0.275 volts per centimeter because there are 100 centimeters in a meter. So what about R? It is 376.7 ohms, which is the resistance of free space. So let's solve the equation:

$$P = \frac{E^2}{R} = \frac{(0.275)^2}{376.7} = \frac{0.00020W}{cm^2} = \frac{0.20\,mW}{cm^2}$$

This is the 30 to 300 megahertz limit for uncontrolled environments as specified in the new standard. The standard has been written for both volts per meter and milliwatts per square centimeter so that you won't have to make this conversion. Thanks, FCC. The 1982 standard didn't do this.

If you are fortunate enough to have access to a spectrum analyzer and calibrated antennas, you can measure the field intensity at your station. This is a simple but somewhat time consuming process involving adding a bunch of factors expressed in dB. There is one catch, however. The spectrum analyzer is calibrated in dBm. This means dB relative to one milliwatt in 50 ohms. The antenna, on the other hand, is calibrated in dB relative to one microvolt (dBµV). Again, Ohm to the rescue.

$$P = \frac{E^2}{R} \text{ or } E = \sqrt{PR} \text{ where } P = 1mW \text{ and } R = 50\Omega$$

So let's solve the equation:

$$E = \sqrt{PR} = \sqrt{0.001 \times 50} = \sqrt{0.05} = 0.2236V = 223600\mu V = 2.236 \times 10^5\mu V$$

Now 10^5 = 5x20dB =100dB and 2.236 = 7dB.

So we can convert dBm into dBµV by simply adding 107dB.

We now know what dBm and dBµV mean. What about dBc, dBd, and dBi? Harmonics and other spurious signals are measured in dBc, which means dB below the carrier. But how do we know whether this means volts or watts? The answer is neither. It means dB. The decibel is the logarithm of a dimensionless ratio.

As you know:

$$dB = 10 \log \frac{P1}{P2} \text{ or } dB = 20 \log \frac{E1}{E2}$$

Note that the units (watts or volts) cancel out because they appear in both the numerator and denominator. So dB means dB. We can, however, convert dB into a power ratio or a voltage ratio by using one or the other of the above formulas.

Antenna gain is measured in dBd. This means dB relative to a half-wave dipole. The term dBi refers to gain relative to a theoretical but non-existent point source radiator. It is useful for computing predicted antenna gain, but it should never be used to indicate the gain of a practical working antenna. A half-wave dipole has a gain of 2.14 dBi. Antenna manufacturers sometimes list their antenna gains in dBi because it makes them look 2.14 dB better than they really are.

I hope that I have helped make the commonly used units of RF measurement more understandable. It is not my intention to comment on the new RF safety standards except to say that in my opinion they are both reasonable and enforceable. I leave the experts to continue their arguments for another 30 years. In the meantime I'll continue to carry my 2m HT on my belt and use a speaker-mike to avoid exposing my eyes. 73

Antennas for Amateur Television, Part 2

See Part 1 in July's 73.

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The corner reflector, invented by John Krauss, is probably one of easiest antennas (next to the cantenna) that a ham can build in a few minutes to get from 10 to 13dB of gain. It is an extremely simple design (**Fig. 1**) in which a reflector, bent into the form of a corner, is used to reflect the radiation from a dipole radiator in the front of the antenna. With proper spacing of the radiator from the corner, the reflected wave adds to the forward wave to increase the gain in the forward direction.

The gain of the corner antenna depends on the angle of the corner, the position of the radiator with respect to the apex of the corner, and the size of the reflector. The gain will vary from 10 to 15dB, depending on the angle of the corner. A gain of 10dB is easily attained for a corner with a 90° angle and 12dB for the 60° corner. Higher gains are attained by using the 45° corner antenna. In **Fig. 2**, the gains of a 90° and 60° corner antenna are shown as a function of the spacing of the radiator from the apex. As can be seen in this graph, the gain of the antenna as a function of the spacing of the radiator within the corner reflector is not that critical for the 60° and 90° corner reflectors, and provides a great means for matching the feedpoint impedance to 50 or 75Ω coax for low SWR. The feedpoint impedance will change as a function of the spacing of the radiator from the corner, as shown in **Fig. 3**. It is easy to see that moving the radiator in and out slightly can improve impedance matching.

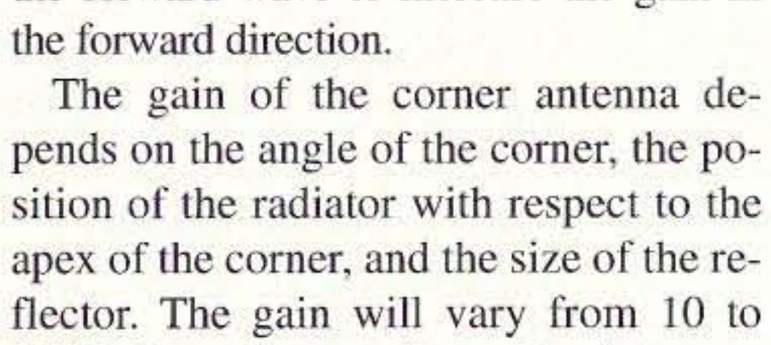


Fig. 1. *The corner reflector (Ref. 2, p. 551).*

The size of the reflector will determine the overall gain of the antenna. The width of the reflector should be a minimum of 0.6 wavelengths long. Width-of-one-wavelength reflectors will improve the gain slightly in the forward direction and minimize radiation from the sides. The length of the corner is also not supercritical, but shorter than one-wavelength-long corners have a tendency to broaden the radiation pattern and reduce the gain. Therefore, a minimum of one-wavelength-long corner is recommended for the 90° angle corner; longer for the 60° and 45° corners. The reflector material can be made out of wire elements, mesh, or sheet metal. If wire elements are used, the separation between these elements should not be greater than 0.1 wavelength. Shorter spacing, such as 0.05 wavelength, is more desirable. Mesh size should be approximately 0.05 wavelength on square.

A set of dimensions that have been worked out for the corner reflectors for the VHF and the UHF range is shown in **Table 1**. Several different options have been presented in this table, and you can refer to **Fig. 4** for an explanation of different dimensions in the corner antenna. Broadband operation of the corner reflector can be achieved by using a bow-tie dipole radiator instead of the single-element dipole.

The corner reflector has some great advantages, in that it is probably one of the simplest to build, is simple to feed, and can be used for multiple bands. It is possible to add a second radiator for the higher bands within the corner reflector and drive the two radiators with separate coax. This way, a dual-band operation can

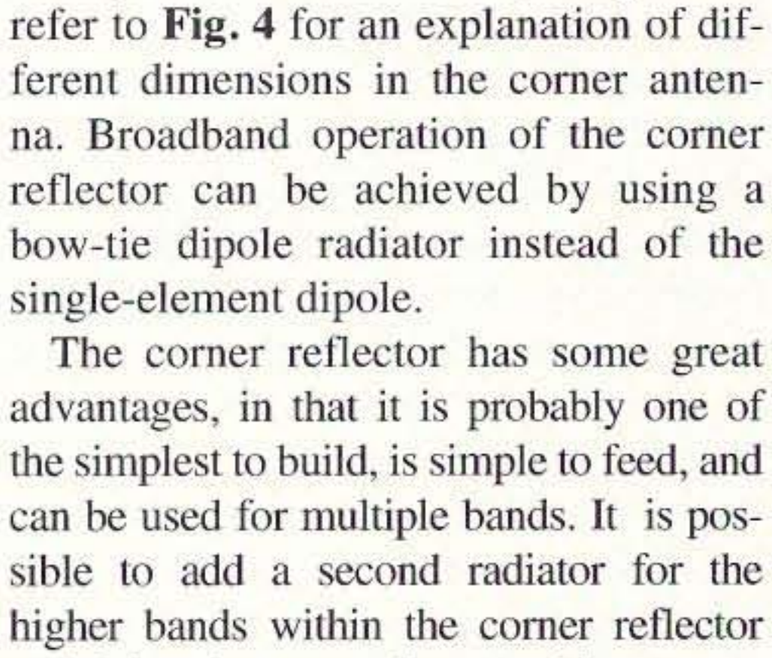


Fig. 2. *Gain of a corner reflector antenna as a function of the spacing of the dipole from the reflector (Ref. 2, p. 554).*

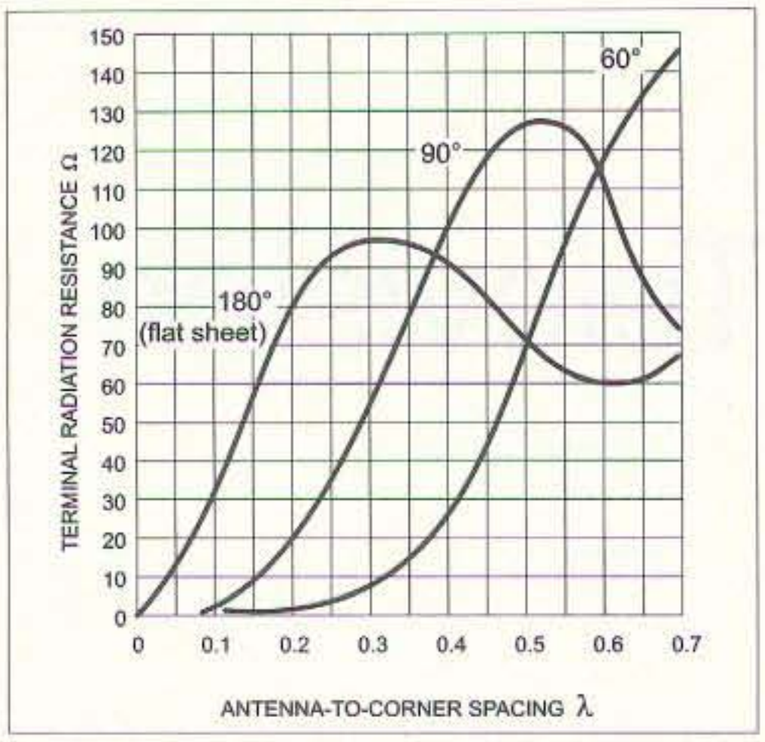


Fig. 3. *Feedpoint impedance of the radiating dipole in a corner reflector antenna as a function of the spacing between it and the reflector (Ref. 2, p. 556).*

be achieved within the same reflector. The disadvantage of the corner reflector is that its physical size becomes large, especially at the lower frequencies.

The trough reflector antenna

The gain from the corner reflector is typically limited to approximately 13dB or so with the size of the reflectors applicable for ATV. Additional gain can be obtained by making the reflector larger, and one design which achieves this without making an unwieldy corner reflector is the trough reflector. In this design, the apex of the corner is truncated so that the reflector becomes flat immediately behind the radiator, with sides that are angled at the original corner angle. The shape of this reflector is like a feed trough for cattle, so it's called the trough reflector.

The design of the trough reflector is shown in **Fig. 5**. The dimensions of this antenna become quite large at the 400MHz frequency but are manageable from 900MHz and up. Typical gains of 15 to 17dB can be obtained with this antenna. It is similar to the corner reflector, in that it is easy to build and feed, and also offers the possibility of multiband operation. The disadvantage of the trough reflector is that its size becomes quite large at the lower UHF frequencies. An additional disadvantage is that as the gain is increased, the beamwidth is decreased in one direction. Therefore, a very narrow beam is obtained in one direction while a broad beam is obtained in the other direction.

Dimensions for Corner Reflector Arrays (VHF and UHF)

Frequency (MHz)	Side Length S (inches)	Dipole to Vertex D (inches)	Reflector Length (inches)	Reflector Spacing G (inches)	Corner Angle (V°)	Radiation Resistance (Ohms)
144*	65	27 1/2	48	7 3/4	90	70
144	80	40	48	4	90	150
222*	42	18	30	5	90	70
222	52	25	30	3	90	150
222	100	25	30	Screen	60	70
420	27	8 3/4	16 1/4	2 5/8	90	70
420	54	13 1/2	16 1/4	Screen	60	70
915	20	6 1/2	25 3/4	0.65	90	70
915	51	16 3/4	25 3/4	Screen	60	65
915	78	25 3/4	25 3/4	Screen	45	70
1296	18	4 1/2	27 1/2	1/2	90	70
1296	48	11 3/4	27 1/2	Screen	60	65
1296	72	18 1/4	27 1/2	Screen	45	70
2304	15 1/2	2 1/2	20 1/2	1/4	90	70
2304	40	6 3/4	20 1/2	Screen	60	65
2304	61	10 1/4	20 1/2	Screen	45	70

*Side length and number of reflector elements somewhat below optimum; slight reduction in gain.

Table 1. *Dimensions of corner reflector arrays for VHF and UHF (Ref. 1, p. 18-10).*

The reflex antenna

An antenna that has high gain, is easy to build and operate, but is not very well known, is the reflex antenna. Basically, this is a shallow sheet metal box, approximately two wavelengths long on each side and one-half wavelength deep. A dipole radiator is placed in the center of the box at a distance of approximately one-quarter wavelength from the back of the sheet reflector. A set of wire elements spaced about one-half wavelength apart are placed at the front of the box reflector, and help to reflect back the radiation at high angles. This design is shown in **Fig. 6** with dimensions for 440MHz and 1250MHz antennas. Gain of approximately 12dB is easily attained and higher gains can be achieved with larger-sized boxes. The advantage of the reflex antenna is that it is simple to build and easy to feed. The disadvantage is the large size of the reflector—which makes it difficult to mount on a tower.

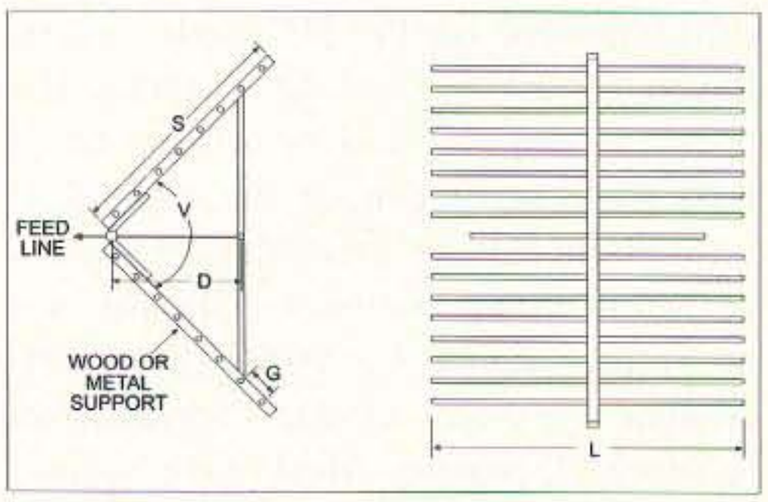
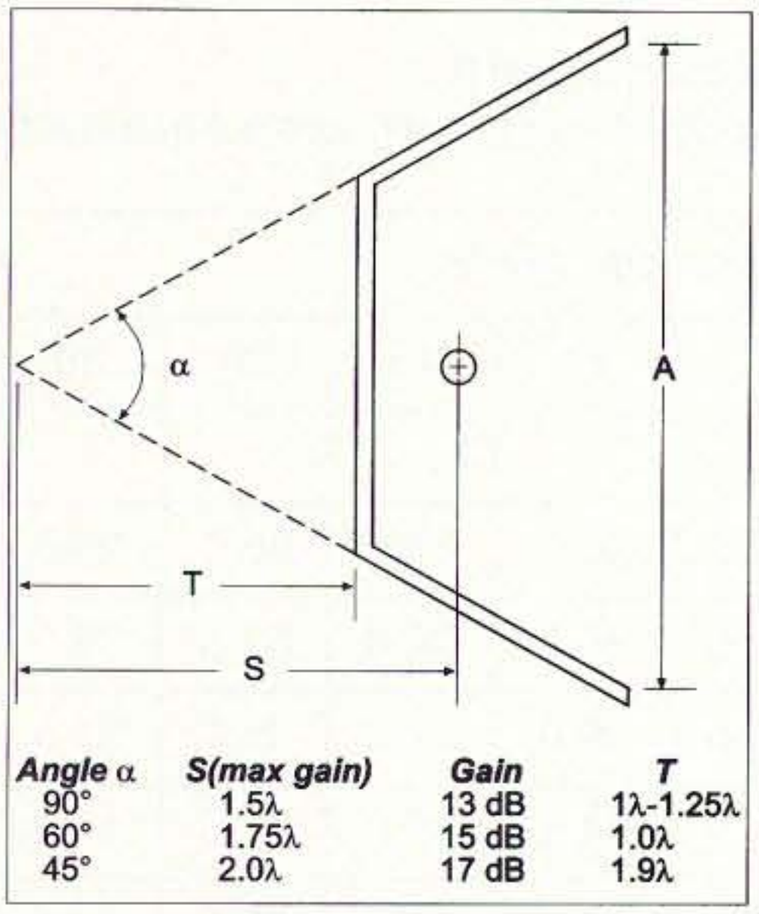


Fig. 4. *Design of the corner reflector and the parameters used in* ***Table 1*** *(Ref. 1, p. 18-10).*

The parabolic reflector

The parabolic reflector is probably one of the most powerful reflecting antennas used in microwaves. It is used extensively in optics as a high-efficiency reflector for narrow-beam projection of light, such as in a flashlight. Its principle



Angle α	S(max gain)	Gain	T
90°	1.5λ	13 dB	1λ-1.25λ
60°	1.75λ	15 dB	1.0λ
45°	2.0λ	17 dB	1.9λ

Fig. 5. The trough antenna and some of the general parameters for its design (Ref. 1, p. 18-11).

of operation is quite simple: For a radiator at the focus of the reflector, the reflected radiation from the radiator travels the same distance to the front of the antenna regardless of which location it reflects from in the antenna reflector. This means that all of the radiation reflected from the parabolic reflector is in phase at the surface of the reflector, and becomes additive to produce the gain in a forward direction. The shape of the reflector that achieves this is paraboloid, as shown in **Fig. 7**.

The radiator is usually placed at the focus of the ray paths of the signal. The design of the radiator is quite critical in the proper operation of the parabolic reflector and proper illumination of the reflector is critical to achieving high gain. Isotropic radiators send only part of the radiation back toward the reflector while radiating some to the front. Radiators with reflectors in the front, such as a dipole with a reflector, reflect the signal back toward the parabolic reflector to illuminate the reflector better.

Very effective for the parabolic reflector is the cantenna design, with a shorter can length, so as to illuminate the surface appropriately. The beamwidth of the radiator is critical so that the maximum energy is delivered to the full surface of the reflector. A very narrow beamwidth will only concentrate the energy in a certain part of the reflector and not the full surface. Similarly, a very broad radiator will tend to put the radiation outside of the reflector and decrease the gain. A rule of thumb used by several designers of parabolic reflectors is to reduce the signal level at the edge of the parabola by 10dB from the center. Feeding the parabolic reflector with other than horizontal or vertical polarized radiation is easily achieved with a short helical winding radiator for circular polarization.

The gain of the parabola is a function of its diameter. **Table 2** shows a typical range of gains for the diameter of the dish antenna and the frequencies. As the frequencies increase, the variations on the surface of the dish antenna and the deviation from parabolic surfaces become critical. This makes it difficult for the average amateur radio operator to construct his own parabolic reflector, but parabolic reflectors are abundant in the surplus market, so an antenna can be easily built for the ham frequencies.

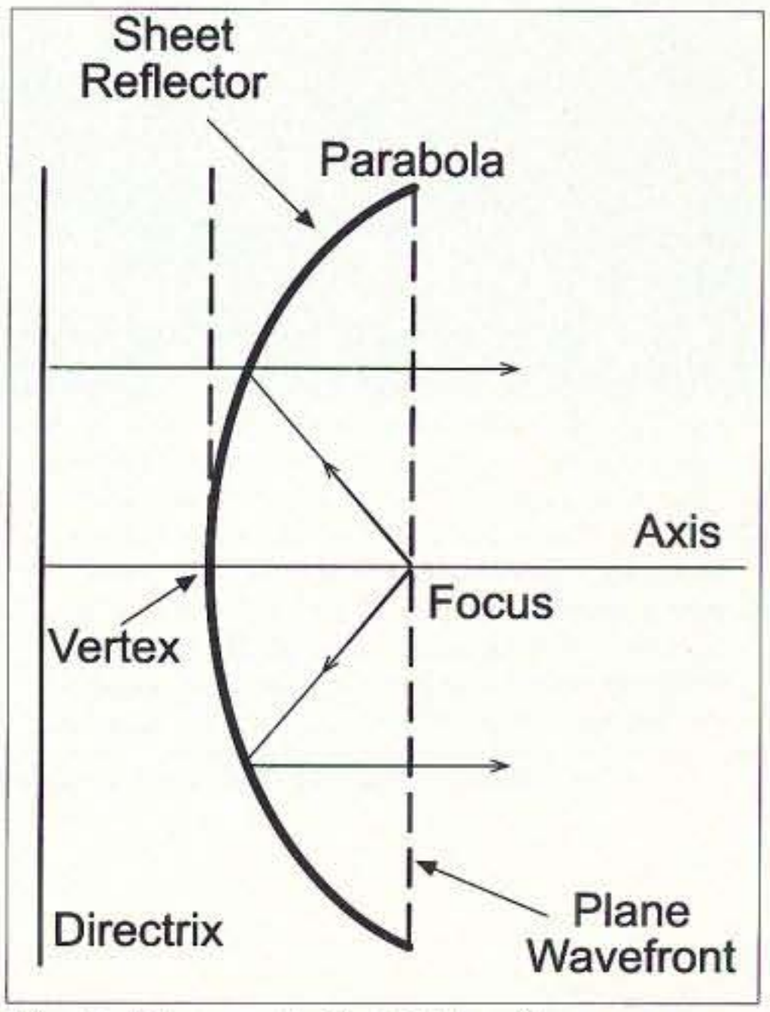


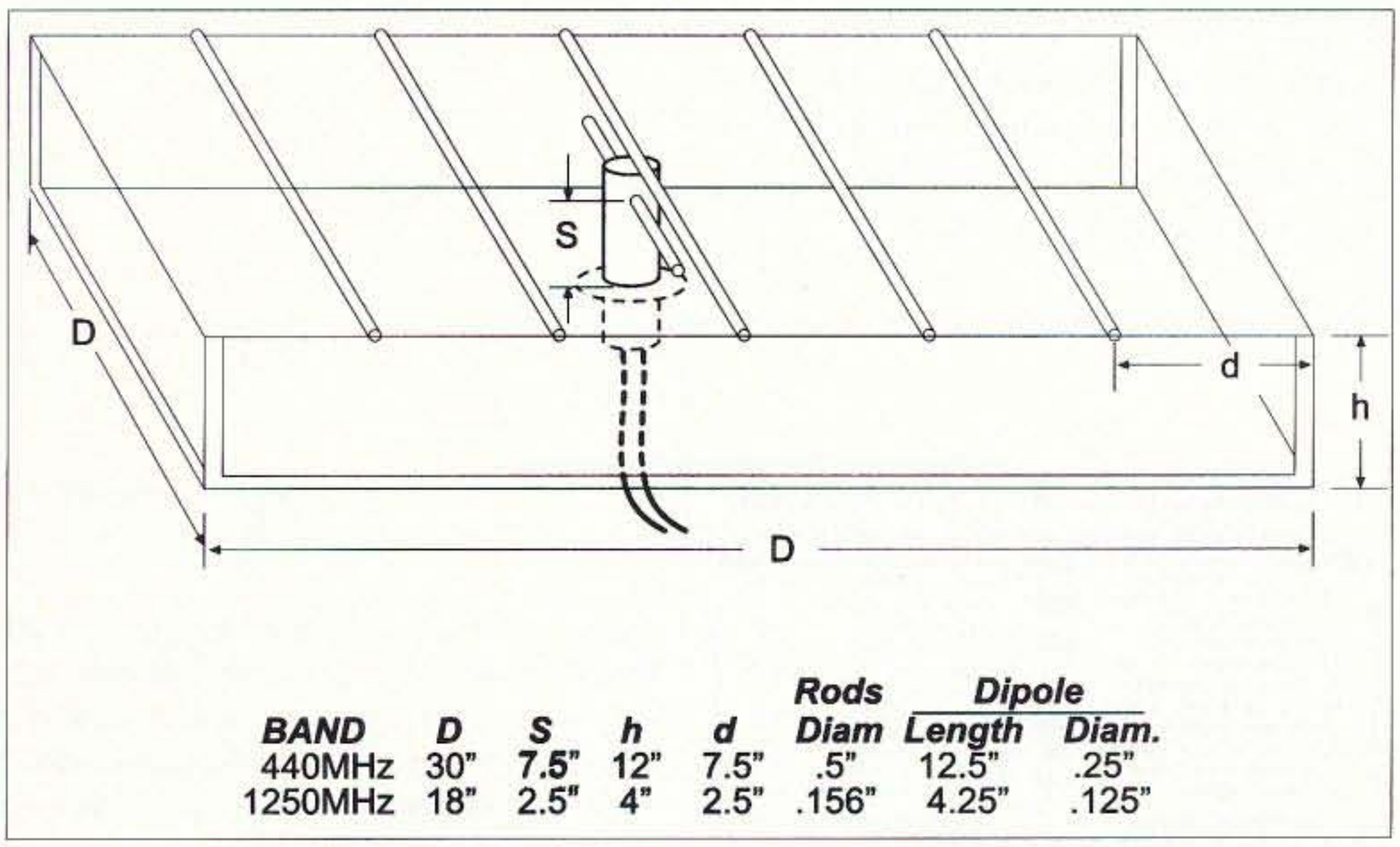
Fig. 7. The parabolic (dish) reflector antenna and the ray path of the reflected waves showing the in-phase reflected wave (Ref. 2, p. 562).

The advantage of the parabolic reflector is its extremely high gain. Gains of approximately 20 to 30dB can be easily achieved with a properly designed dish antenna. The disadvantages of the parabolic reflector are: the difficulty in making a precision reflector; illuminating it properly with the proper radiator; and its large size for the lower bands.

The horn

The horn antenna is a waveguide that is flared out into a horn with a wide opening. The angle of the horn, its size, and its aspect ratio will determine the gain and polarization of the radiation. Horn antennas have one very important characteristic: They are essentially high-pass devices, which means that they can work at frequencies that are higher than the design frequency. A horn designed for 400MHz will work all the way up to 10GHz and its gain will increase as the frequency is increased.

The horn, adapted for single polarization, is shown in **Fig. 8**. Instead of a full metal pyramidal structure, only two sides are used and the polarization is horizontal. The feedpoint impedance is approximately 400Ω and open-wire transmission lines can be used to reduce the line losses. Alternatively, a step-down transformer can be used to match into 50 or 72Ω coax. This antenna will work from 400MHz to 2.4GHz, will



BAND	D	S	h	d	Rods Diam	Dipole Length	Dipole Diam.
440MHz	30"	7.5"	12"	7.5"	.5"	12.5"	.25"
1250MHz	18"	2.5"	4"	2.5"	.156"	4.25"	.125"

Fig. 6. The reflex antenna and design parameters for the two useful frequencies for ATV. Gains of 10 to 12dB are easily achieved with this design (Ref. 3, p. 404).

Parabolic Antenna Gain
(over isotropic antenna; subtract 2.1 dB for gain over dipole antenna)

	Dish Diameter (feet)						
	2	**4**	**6**	**10**	**15**	**20**	**30**
Frequency							
420 MHz	6.0	12.0	15.5	20.0	23.5	26.0	29.5
902	12.5	18.5	22.0	26.5	30.0	32.5	36.0
1215	15.0	21.0	24.5	29.0	32.5	35.0	38.5
2300	20.5	26.5	30.0	34.5	38.0	40.5	44.0
3300	24.0	30.0	33.5	37.5	41.5	43.5	47.5
5650	28.5	34.5	38.0	42.5	46.0	48.5	52.0
10 GHz	33.5	39.5	43.0	47.5	51.0	53.5	57.0

***Table 2.** Gain of parabolic antennas. Reflector efficiency of 55% is assumed (Ref. 1, p. 18-12).*

have significant gain at the higher frequencies, and is an excellent antenna for reception of several ATV transmissions on different frequencies.

With the exception of the parabolic reflector antennas, most of the antennas referred to in this article can be built within a couple of hours, and gains between 10 and 13dB can be easily achieved. The yagi is a proven antenna which can deliver high gains when designed and constructed properly. The cantenna, the corner reflectors, and the reflex antennas are noncritical designs, very forgiving in their construction. They are probably the easiest high-gain antennas that can be built for ATV by the average amateur. The parabola remains the ultimate high-gain antenna, unmatched in performance at the higher frequencies, with gains exceeding 20dB.

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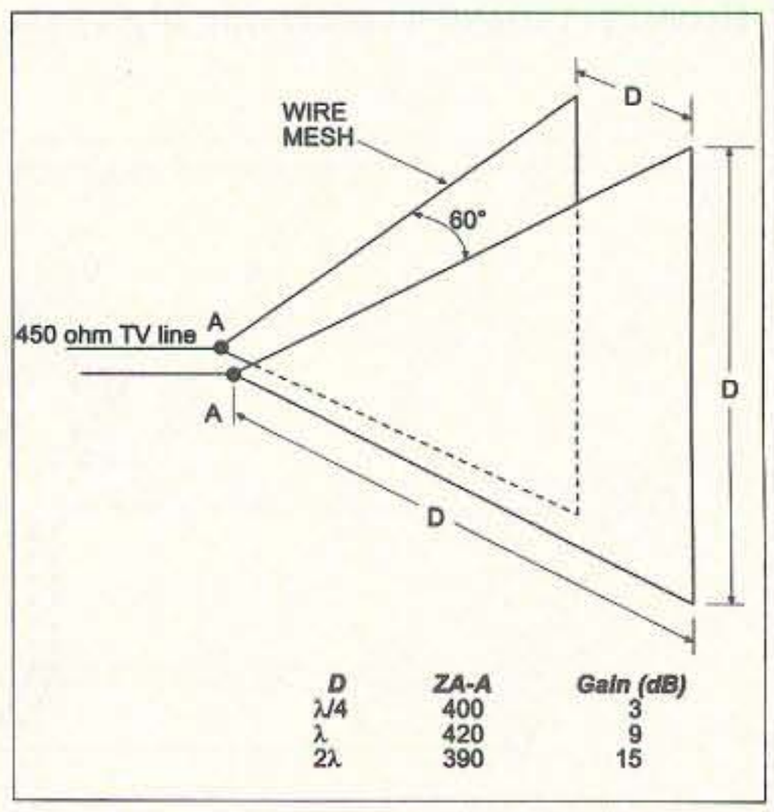

***Fig. 8.** A 60° horn antenna design for horizontal polarization of signal. The two sides are made of wire mesh or sheet metal and placed at an angle of 60°. Feedpoint impedance is approximately 400Ω and the antenna will operate at higher frequencies than the design frequency (Ref.4, p. 543).*

Negative Resistance RF Preselector

An easy way to soup up that old superhet.

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Interference, from whatever source, is the bane of the radio receiver user. Some interference is on the same frequency as the desired signal, and there's not much that can be done about that. But there's hope for eliminating or at least reducing off-frequency interference with RF selectivity.

Off-frequency interference falls into two general categories: strong signals that drive the receiver into nonlinear operation and produce intermodulation distortion or cross-modulation, and spurious receiver responses. RF selectivity can reduce the amplitude of the interfering signal to tolerable levels. The rub comes in the selectivity that can be achieved with practical and economical tunable tuned circuits. Narrow bandwidths require high-Q tuned circuits, and the Q tops out at about 100 for practical inductors suitable for HF receivers.

All is not lost, though. The circuit described in the following paragraphs can increase the Qs of a tuned circuit to more than 1,000 if need be. The theory and design equations are given to allow changes to be made to accommodate a particular situation or the parts at hand.

Receivers fall into two general classes: tuned radio frequency (TRF) and superheterodyne. The TRF is conceptually simple and free of spurious responses. Unfortunately, it is not very selective. A crystal set is a TRF without RF amplifier(s), although it may have post-detection audio amplifiers.

The superhet receiver converts the input RF signal to a frequency that permits greater selectivity. It offers many advantages, but at a price: it has spurious responses. The process of converting the desired signal to the IF produces two signals that can be received equally well. One is the IF above the local oscillator, and a second one is the IF below the local oscillator. These two responses are separated by twice the IF; one is the desired signal and the other is the image.

Rejecting the image response is a primary concern in superhet receiver design. When the IF is low, the image and the desired frequency are close together and it is more difficult to suppress the image. There have been two primary solutions to rejecting the image. One is to use one or more RF amplifiers in front of the first mixer for improved RF selectivity; the other is to use two (or more) IFs. In the dual conversion receiver, the first IF is made high enough to ease image rejection, and the second made low enough to make selectivity manageable. The multiple conversion receiver is more complex, but enjoys greater popularity today than the single conversion types.

The single conversion receiver usually has an IF in the range of 455kHz, with the local oscillator operating above the desired frequency. This arrangement puts the image 910kHz above the tuned frequency. Tuning to 550kHz in the broadcast band puts the image at 1460kHz, which is also within the broadcast band and makes image suppression critical.

The five-tube AC/DC receivers of the '40s and '50s had only one tuned circuit between the antenna and the first mixer. In inexpensive receivers, a single conversion is used and image response is often sacrificed on the altar of cost. Some inexpensive shortwave receivers also used the same design concept. Needless to say, they received lots of signals, but half of them were images.

Using RF amplifier stages between the antenna and the converter is effective in suppressing the image. Each RF stage increases off-frequency suppression by 6dB. The number of sections in the tuning capacitor indicates how many RF stages there are: one section (the smallest) for the oscillator; one section for the antenna; and one for each of the RF stages. A three-section capacitor indicates one RF stage.

An image response down 30dB from the tuned frequency is pretty good, but nothing to brag about. A receiver with a single RF amplifier can provide fair image suppression for tuned frequencies up to 7MHz. Above 40m, the performance falls noticeably. A shortwave receiver without an RF amplifier will have serious image responses at 40m and can be questionable even in the broadcast band. If only reliable, high-Q RF circuits were available ...

The response of one single-tuned stage falls 6dB for every doubling of the

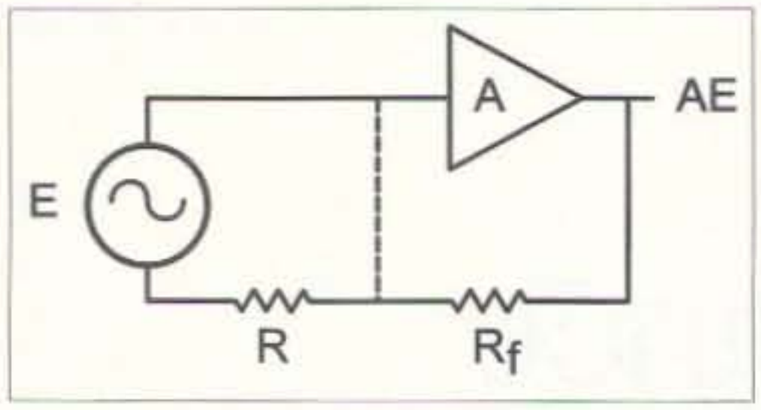

Fig. 1. A conceptual negative resistance generator.

bandwidth. Therefore, when the response is down 30dB, the bandwidth is 32 (2^5) times the 3dB bandwidth. To have a frequency (the image) 910kHz off-frequency be down 30dB requires the 3dB bandwidth to be about 28.5kHz. A tuned circuit with a Q of 60 at 7MHz has an equivalent parallel resistance of about 69k and a bandwidth of about 117kHz. A bandwidth of 28.5kHz requires a Q of about 246.

The bandwidth of a parallel-tuned circuit is related to the circuit Q as follows:

$$BW_3 = \frac{f_o}{Q} = \frac{1}{2\pi C R_p}$$

where

BW_3 = the 3dB bandwidth in Hz

f_o = the center frequency in Hz

$$Q = \frac{R_p}{X_L} = 2\pi f_o C R_p$$

C = the circuit's resonating capacitance in pF

R = the equivalent parallel resistance in Ω

When the tuning capacitance is 20pF, a bandwidth of 28.5kHz requires a parallel resistance of about 280kΩ. This parallel resistance is much higher than that of any practical inductor. But, adding a negative resistance across the resonant circuit increases the effective resistance as well as the Q.

A negative resistance is not a component you can buy from your local electronics supplier, but it is something you can generate with a simple circuit. A conceptual negative resistance generator is shown in **Fig. 1**. R is the total resistance appearing at the input of the amplifier, the effective parallel resistance of the source and the input resistance of the amplifier. The gain of the amplifier is A and the output is in phase with the input. R_f provides feedback from the output of the amplifier back to R.

When the junction of R and R_f is removed from the amplifier in **Fig. 1**, the open circuit voltage of the source E appears at the input of the amplifier and its output is AE. Since the same current flows in R and R_f, when the voltage across R is E, the voltage across R_f must be AE-E or E(A-1). When the value of R_f is chosen so that the voltage across R is E, R_f/R = A-1. When the voltage across R is E and the junction of the resistors is reconnected to the input, no current flows from the source into the resistors. The resistance looking into the junction of the resistors is infinite, and the conductance looking into R_f is exactly equal to the negative conductance of R.

$$R_n = \frac{R_f}{(A - 1)}$$

A practical noninverting RF amplifier is shown in **Fig. 2**. The gain of the amplifier is determined by the transconductance of the pair of transistors, G_m, R_s, and the ratio of R_c to R_s. The gain may be expressed as:

$$A = VG_{sf}\left(\frac{1 + R_c}{R_s}\right)$$

VG_{sf} is the voltage gain of the source follower. The gain of a source follower is often assumed to be unity when, in fact, it is always somewhat less than that.

The gain of a source follower is:

$$VG_{sf} = \frac{G_m R_s}{(G_m R_s + 1)}$$

The gain is near unity only when the product $G_m R_s$ is much greater than one. G_m is the change in the current in R_s for a change in gate voltage. The current in R_s is essentially I_c. Since $I_d = I_b$, and $I_c = I_b h_{fe}$, G_m can be expressed as:

$$G_m = g_{fs} h_{fe}$$

The N-channel JFET, Q1, is a 2N5457. It is similar to the MPF102, but has some typical values given in the data sheet whereas only maximum and minimums are given for the MPF102. Typical values for the 2N5457 are: I_d = 0.1mA for V_{gs} = 2.5V; I_{dss} = 3.0mA for V_{gs} = 0V. V_{off}, the gate to source voltage that reduces I_d to zero, is given in the data sheet as 0.5V minimum to 6V

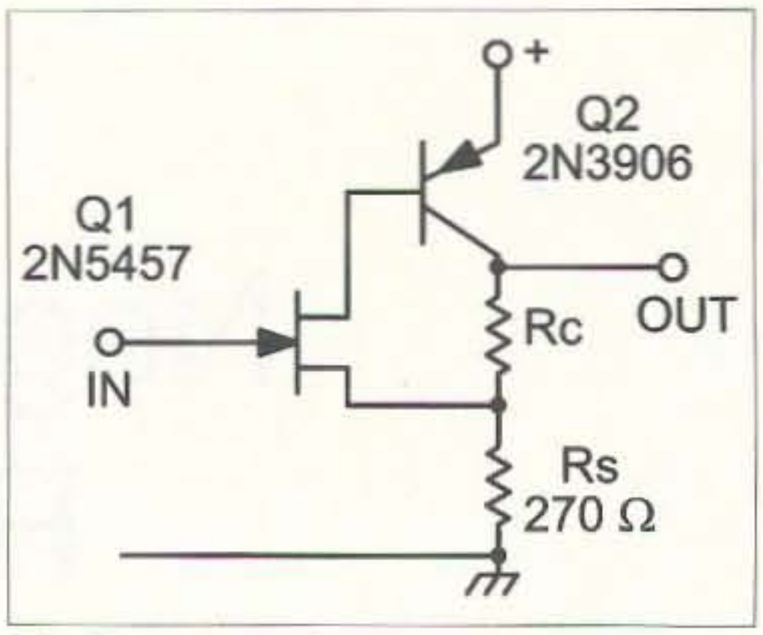

Fig. 2. A practical noninverting amplifier.

maximum. V_{off} must be either measured or calculated for use in calculating I_d and g_{fs}. The relationship of I_d to I_{dss}, V_{gs}, and V_{off} is:

$$I_d = I_{dss}\left(\frac{1 - V_{gs}}{V_{off}}\right)^2$$

This may be rewritten to solve for V_{gs}/V_{off}:

$$\frac{V_{gs}}{V_{off}} = 1 - \sqrt{\frac{I_d}{I_{dss}}}$$

which can be rewritten to solve for V_{off} or V_{gs} for the typical values of V_{gs}, I_d, I_{dss}:

$$V_{off} = V_{gs}/[\,1 - \sqrt{\left(\frac{I_d}{I_{dss}}\right)}\,] = 3.06V$$

$$V_{gs} = V_{off}\,[\,1 - \sqrt{\left(\frac{I_d}{I_{dss}}\right)}\,] =$$

2.66V (for I_d = 0.05mA)

The forward transconductance of Q1, gfs, can be calculated with the expression:

$$g_{fs} = \frac{2I_d}{(V_{off} - V_{gs})} =$$

2.5×10^{-4} (I_d = 0.05mA)

The ratio of collector current to base current, h_{fe}, of Q2 (2N3906) is assumed to be 200 (specified as 100 minimum, 300 maximum at I_c = 10mA). Since I_c is very much greater than I_d, the current in R_s is essentially I_c. To produce V_{gs} = 2.66V (I_d = 0.05mA, I_c = 10mA), R_s must be 266Ω. 270Ω, the nearest standard 5% value, is used for R_s. The effective transconductance G_m is:

$G_m = g_{fs} h_{fe} = 0.25 \times 10^{-4} \times 200 =$ 0.05mhos

The voltage gain of a source follower is calculated with equation 5 to be 0.93:

$$VG_{sf} = \frac{G_m R_S}{(G_m R_S + 1)} = 0.93$$

The gain of the amplifier can now be calculated with the equation

$$A = VG_{sf}\left(\frac{1 - R_C}{R_S}\right)$$

for the values of VG_{sf} and R_S established. Rearranging the equation to solve for R_C yields:

$$R_C = R_S\left(\frac{A}{VG_{gs} - 1}\right)$$

The negative resistance is controlled by A and R_f. If the resistance across a tuned circuit is 69k and the resistance needs to be 280k for the desired bandwidth, the negative resistance needed can be determined as follows:

$$\frac{1}{R_{desired}} = \frac{1}{R_{tank}} + \frac{1}{R_n}$$

$$\frac{1}{280k} = \frac{1}{69k} + \frac{1}{R_n}$$

$$\frac{1}{R_n} = \frac{1}{69k} - \frac{1}{280k} = \frac{1}{91k}$$

The equation

$$R_n = \frac{R_f}{(A - 1)}$$

shows that a 91k negative resistance can be generated with R_f of 91k and an amplifier gain of 2.0, or when R_f is 150k an amplifier gain of 2.6 is required. Given the uncertainty of the Q of the tuned circuit, it seems prudent to make the gain variable by varying R_C. Changing R_C does not change the operating point of the amplifier as long as Q23 does not saturate. That is, as long as V_{ce} is greater than 1V.

The DC operating point of the amplifier is determined as $R_S I_C$. Since I_C is independent of collector voltage while V_{ce} is greater than V_{cesat} and I_d is independent of V_{ds} while V_{ds} is above pinch-off, the operating point is independent of the supply voltage. The operating point is determined by R_S and I_C. The high negative feedback leads to a very stable amplifier. If I_C tried to rise, V_{gs} would rise, I_d would decrease and I_C would decrease.

The amplifier shown in **Fig. 3** has R_C composed of 300Ω fixed and 500Ω variable. The gain varies from 2.0 to 3.8. When R_f is 91k, R_n will be variable from 91k to 33k. While the negative resistance can be controlled with either A or R_f, it is preferable to have the gain low because a lower R_C results in greater bandwidth of the amplifier and smaller DC voltage drop across R_C, which will reduce the DC power supply voltage requirements.

The power supply for the negative resistance generator is not critical; the only requirement is that the voltage be high enough to keep the 2N3906 out of saturation when R_C is maximum. The DC voltage, collector to ground, can be as high as 14.4V with worst case component values, which translates into a supply voltage of about 15.2V. The maximum VDG (drain to gate) of the 2N5457 is given as 25V. Therefore, the supply voltage can be anything from 15.2V to 25V. The current drawn is about 10mA (12mA worst case) which can probably be stolen from the receiver's supply without ill effects.

The negative resistance generator can be built on a one-inch-square perfboard that fits nicely on the RF (antenna) section of the tuning capacitor. Band-switching usually entails switching coils, and the Qs may vary from band to band and with frequency over a band. Therefore, the selectivity control R_C should be convenient to adjust when tuning. For maximum bandwidth, the leads from R_C should run directly to the circuit board and not be dressed into a harness or against the chassis.

It is worth noting that if the total resistance across the tank is negative, the circuit will have infinite Q and will oscillate. Heathkit employed this technique in one of their shortwave receivers years ago. They used it in the IF to act as a combined selectivity control and BFO. Needless to say, it was not a very satisfactory arrangement.

Variable RF selectivity can be useful even in a receiver with an RF stage. The only caution is to use the high selectivity in the antenna section. If the high-Q tuned circuit is the plate or collector load, the gain of the RF amplifier will increase as the Q increases. The

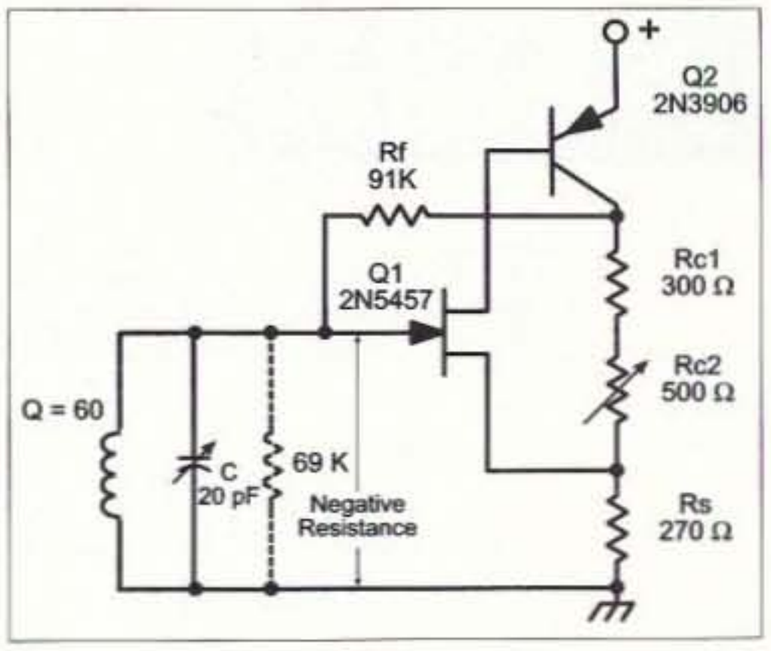

Fig. 3. *A negative resistance can increase RF selectivity.*

increased gain could exceed the maximum stable gain of the RF amplifier. This caution is appropriate for both transistor- and tube-type amplifiers. When the RF selectivity is used in the antenna section before the signal experiences any amplification, strong off-frequency signals can be suppressed before they can drive a stage into its nonlinear regions and generate crossmodulation or intermodulation products. **Fig. 4** shows the simplified antenna section of a receiver. The "negative resistance" block is the circuit shown in **Fig. 3**.

The negative resistance generator can bring the old single conversion receivers back to service for just a few dollars and a couple of hours with a soldering iron. Yard sales often have old shortwave radios that can yield the basic stuff for turning a sow's ear into a silk purse. If push comes to shove, you could use an old shortwave receiver that otherwise might not be worth reviving because it doesn't have tubes in the sockets (tubes are expensive these days, if you can find them). If it has the RF section reasonably intact, coils, band-switching, and tuning capacitor, it can be used to build an offboard preselector. True, the tracking of the preselector and receiver is a problem, but the improvement in interference rejection can be worthwhile—especially in the 40m band, where the high-powered broadcast signals raise Cain. 73

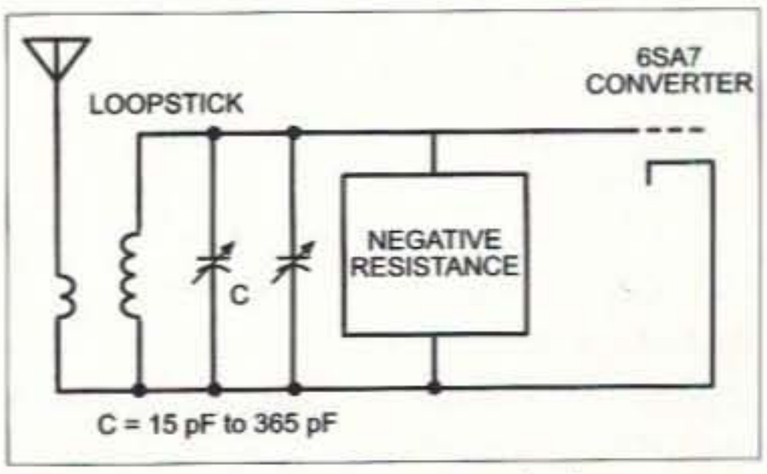

Fig. 4. *Partial schematic of the antenna section of a simple receiver.*

Number 24 on your Feedback card

The Agrelo Engineering DFjr Doppler Direction Finder

A fast track into T-hunting!

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Doppler radio direction finding (RDF) installations are easily identified by their array of three to eight vertical whip antennas. A switching circuit connects the whips to your receiver one at a time in rapid sequence to simulate a single whip moving in a circular pattern. Due to a property of physics called the Doppler Effect, this apparent antenna motion applies periodic frequency modulation to incoming signals. The display unit detects the phase of this FM with respect to the antenna switching sequence. This tells the direction of the signal relative to your vehicle heading.

If your RDF need involves the DX bands (below 50MHz), very weak signals or signals with no carrier such as single-sideband voice, forget about using a Doppler. It is also not the best choice if you will be doing your tracking on foot, if you want to do RDF remotely from a mountaintop radio site, or if the target signal is horizontally polarized. But if you want to go mobile to find a strong VHF-FM or UHF-FM hidden transmitter, spurious signal or jamming station, a Doppler may be just the right tool for you.

Because the simulated rotation rate is about 30,000 rpm, Dopplers can capture bearings on signals lasting only a fraction of a second. They attach to ordinary mobile or hand-held FM transceivers and require no rotating parts or holes to be drilled. That means you can join the hunt in minutes, even in a rental car.

Until recently, you had the choice of spending at least $600 for a commercial wired/tested Doppler set or building your Doppler at home for about $150 plus hours of parts gathering and construction. Now there is an attractive third option, the DFjr by Agrelo Engineering. It is not a kit, but a complete plug-and-play RDF add-on for 120 to 550MHz, made in the USA and selling for about $350. Your only assembly tasks are mounting whips and magnets onto the antenna unit frame and installing the system on your vehicle.

Honey, I shrank the Doppler!

The DFjr display box (**Photo A**) measures only 2-3/4 x 4-1/2 x 7/8 inches. It's so small that I misplaced it a couple of times before I got it installed in the van. There are no protruding switches or knobs, so it fits nicely in a shirt pocket. You might think that it could be mounted anywhere in a vehicle, but there are practical limitations. You can't just place it atop the dashboard, because all connectors are on the bottom edge. You need to find a shaded spot that is easy to view by driver and assistants. Provide a solid backing so you can depress the three buttons firmly. For me, the best solution was making a pair of aluminum strip brackets to span between the heater duct and the instrument cluster. Velcro® strips hold the DFjr to the brackets.

Any function operation requires pressing sequences of one or more of the three membrane buttons on the panel. The manufacturer says that these switches require only 100 grams of force, equal to the weight of three parakeets. But in my tests, the center button required 500 grams and the two edge buttons needed almost a kilogram to actuate. Some users report that they miss the positive tactile feel of ordinary push-buttons. I agree, and I would also prefer a digital readout or auditory feedback to indicate what modes have been selected.

Photo A. *The DFjr display box is about the size of a cigarette pack. Here it is next to one whip of the original version antenna set. All photos by author.*

The display box has no room for a speaker. Most users plug the DFjr into the receiver's external speaker jack and plug an external speaker into a jack on the DFjr. The alternative is rewiring your radio's external audio output jack so it doesn't cut off the radio's speaker. Agrelo provides the audio cable from radio to DFjr, but not an external speaker or its cable. Audio plugs and jacks are 1/8-inch connectors, not the more widely used 1/4-inch types. There is no power on/off switch. I got tired of pulling out the 12VDC connector sandwiched between two audio cables, so I bought an in-line switch from a hardware store and installed it in the cable.

The DFjr has a circular directional display of 16 light-emitting diodes (LEDs). There is an LED in the center of

the circle, making it easier to interpret the readings in a dark car at night. Red HI and LOW LEDs help you set the audio level from your receiver. The LED indicating low level must be off for the unit to process bearings. Occasional flashing of the HI level LED is OK, but too much audio will make it come on continuously and performance may suffer. When Doppler tone falls below threshold level, the display automatically holds the last bearing.

As with other Dopplers, you should recalibrate the display each time you change receivers, vehicles, or ham bands. There is no rotary calibration control; you press all three buttons simultaneously when the target signal is known to be dead ahead. A parenthetical note to readers who wonder why not calibrate by having someone stand directly in front of the car with a keyed hand-held: You probably will not get a highly accurate calibration on any VHF Doppler set that way, due to near-field multipath and a non-planar wavefront. It is much better to be driving toward a known-location signal such as a repeater or NOAA weather station. Better yet, have a fellow ham transmit while driving several car lengths ahead of you as you move along with your Doppler setup.

An evolving antenna

To go with its novel display unit, the DFjr includes a complete easy-to-install mobile antenna system. Its aluminum crossarm frame has twelve holes so that whips can be quickly and accurately positioned for the 2m, 125cm and 70cm bands. The switcher consists of four monolithic RF preamplifiers and switching transistors in a weatherproof enclosure at the center of the array (**Photo B**).

The original antenna set, partially shown in **Photo A**, had one large magnet directly under the switcher box. Early users quickly discovered that this design was unacceptable. The lack of a counterpoise for each whip severely degraded RDF performance. When four magnets on "pigtails" were added to RF-couple the coax shields to the car roof at the base of each whip (antenna Version 2), performance improved markedly.

Agrelo's staff redesigned the array to have four fixed magnets, one under each whip (**Photo C**). Many of these Version

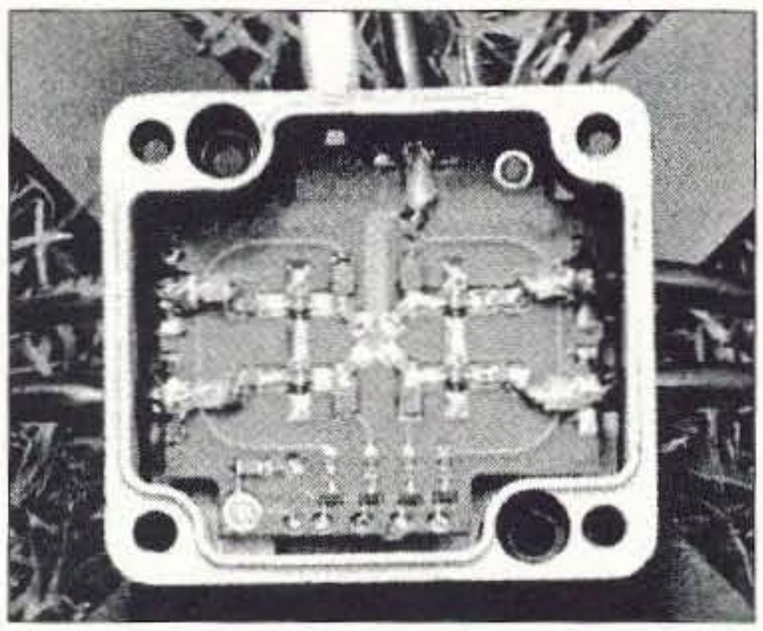

Photo B. *The antenna switch enclosure measures 2-1/2 x 2-1/4 x 1-3/8 inches. A waterproof cover and gasket (removed for the photo) keep rain and dust out.*

3 sets worked well, but some developed shorts at the whip bases. In my case, shrink-sleeve tubing covering the crimp portion of a solder lug cold-flowed to create a low-resistance condition that made the display "wander" randomly. The problem was not detectable with an ohmmeter, but I could observe differences in pulse waveforms on the whips with an oscilloscope. That antenna version has chrome-plated hex upper nuts and black whip-holding caps with hex-head setscrews. If you have one, I recommend that you add tape or other insulation at the crimp ends of the lugs at the whip bases to avoid shorts.

Shorting problems have been solved in the latest antenna set (Version 4) being shipped to new buyers (**Photo D**). It has a plastic coax termination at each whip and conical upper nuts with slot-head setscrews. An instruction sheet with eight color photos shows you how to put it together. The four mag-mounts are high quality with rubber padding to

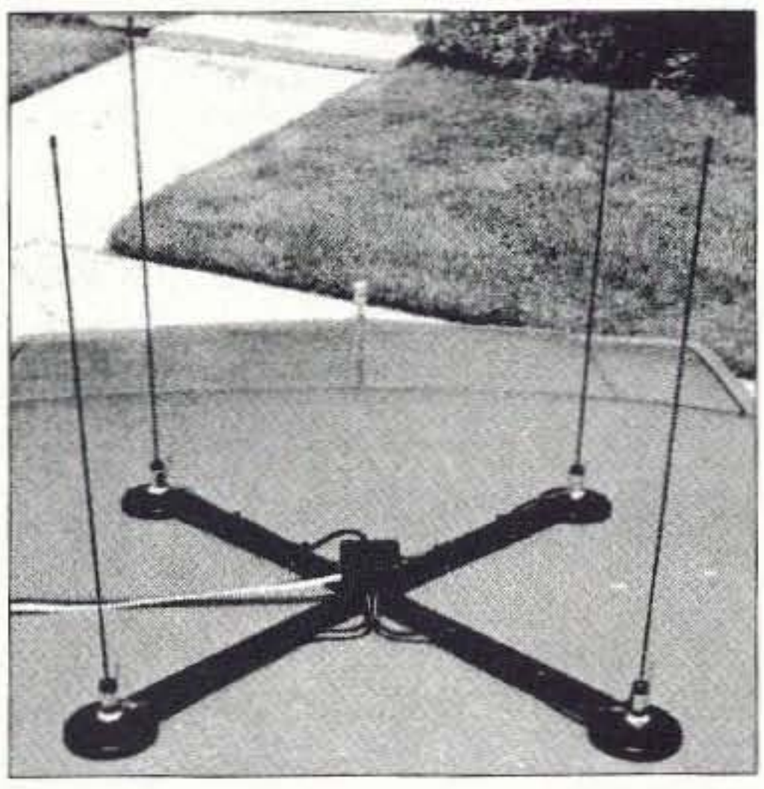

Photo C. *The four-magnet antenna assembly quickly mounts on almost any vehicle. This is the third version.*

protect your vehicle's finish. Unless you have a nonmetallic or deeply corrugated rooftop, installation will be a snap. (Four snaps, actually.)

The Version 4 antenna set has a 12-foot data (RJ-25C) and RF (RG-58) cable, enough for sedans and trucks. I prefer to mount the antenna set at the rear of my minivan's roof; the cables are about three feet too short for that. Extension cables are available from Agrelo Electronics, or you can make your own.

While any Doppler RDF set can be modified for computer interface by adding a serial communications board, the DFjr is computer-ready right out of the box. Its RS-232 serial port feeds relative bearing information at one of five selectable baud rates. You can program it so bearings come out of this port only when their quality is above a desired threshold. With Agrelo's optional multi-port adapter (MPA) accessory, a laptop computer, packet terminal node controller (TNC) and separate VHF-FM transceiver, you can transmit your position and RDF bearings via Automatic Packet Reporting System (APRS). You can also display the bearings of other similarly-equipped T-hunters in the APRS network on your laptop.

The MPA combines RDF and global positioning system (GPS) data onto one computer port. The rate at which your position and RDF bearings are transmitted on packet can be selected from five-second to 16-minute intervals, or entered manually by pushing two buttons on the DFjr. While your setup transmits packets, the DFjr automatically halts RDF processing, avoiding bearing errors due to QRM from your packet transmitter.

How smart is it?

Besides the DFjr's miniaturization and plug-and-play attributes, Agrelo Engineering touts its "smart" processing. The manual states, "Although no unit can eliminate multipath and signal dropout, the DFjr simply ignores the effects." In point of fact, no VHF RDF set, Doppler or not, can ignore multipath.

Let's say you are parked along a road through a canyon and the target station is over a hill to your left. Direct signal is greatly attenuated by knife-edging over a ridge. At the same time, this signal is being reflected toward you from a hilltop in another direction. This condition—signals from the same source arriving via more than one route—is the definition of multipath.

If the reflected signal is stronger than the direct signal, your Doppler will either indicate that the signal is coming from the hilltop (an erroneous bearing) or it will show a "wild" bearing between the two signal sources. If you and your Doppler begin moving under these conditions, the relative strengths and phases of the direct and reflected signal components will change continuously at your antenna, making a traditional Doppler display flicker, jump and "dash around the ring."

By narrowing the bandwidth of the tone filter in a traditional Doppler processor, jumps and flickers are reduced substantially, but there are practical limits to this technique. Doppler users "eyeball average" the dancing display to deduce their best estimate of the true direction of the signal source. That works for experienced T-hunters in most situations, but if there is insufficient direct signal relative to one or more very strong reflections, no amount of "brain processing" will turn bad bearings into good ones.

The DFjr has two operating modes. In the Raw Mode, bearings are displayed in real time with moderate tone filtering, just as in traditional Dopplers. In the Statistical Mode, the DFjr accumulates samples for approximately two seconds, digitally processes them with a proprietary algorithm and then displays the resulting estimated bearing.

The garbage-in/garbage-out principle applies to the Statistical Mode. If your vehicle and the target emitter are stationary, and if there are no moving reflecting objects in the signal path, all sample data points will be alike and there will be no difference between Raw Mode and Statistical Mode indications. If you are moving in a straight line and enough good data can be captured in the sampling period, a good processed bearing will result. But when you are in an area where most or all of the incoming signal is reflected, no amount of statistical analysis will turn two seconds' worth of bad data points into a good bearing. Furthermore, if your vehicle turns sharply or if there is more than one signal received in the sample period, the calculated bearing for that period is meaningless.

I have used the DFjr for several months, taking lots of test bearings on stations in known locations and going on competitive T-hunts hidden by very clever hams. I frequently change from Raw to Statistical mode and back again, just to get a "feel" for the RF environment where I am at the moment. In the Statistical Mode, a new bearing appears about every two seconds, sometimes 180 degrees from the last. It makes me wonder, "Did I pass the hidden T or am I being deceived by multipath?"

With lots of tall buildings, canyon freeways and mountain peaks within our southern California T-hunt boundaries, severe multipath is a way of life. Some T-hunters claim there is no place in the US where it is worse. It takes time to learn to use any Doppler in this environment. If you are like me, you won't win your first strong-signal T-hunt with your DFjr, but you will eventually find the transmitter or at least get as close as you can by road. Your skill will improve as you gain experience, just as it does with any other RDF method.

Is it accurate?

When describing measurements, it is common for the terms "accuracy" and "resolution" to be confused. DFjr's advertising is a case in point. The Agrelo Web site states that the DFjr has ±1.40625-degree accuracy in the Statistical Mode. Don't take this to mean that your bearings will always be within a couple of degrees. That number is not the RDF accuracy, it is the resolution of the digital output from the RS-232 data port.

In the data output, the 360-degree azimuth range is described by 256 bits, each bit representing about 1.4 degrees. But even if you could perfectly calibrate a Doppler and even if there were no such thing as multipath, ±1.4-degree bearing accuracy over the 360-degree range is not a reasonable expectation, due to factors such as mutual coupling among whips in the antenna system. Tests by a maker of Doppler sets for the military have shown that sophisticated 4-whip Dopplers are capable of only about ±5-degree accuracy under ideal conditions, no matter how good their resolution.

Steve Hall KK4PM performed accuracy tests of his DFjr on known-location repeaters last summer and reported his results to the APRS Internet mailing list. His computer program automatically

compared his field bearings from the DFjr data port to GPS-computed headings from his field locations to the repeaters. Sure enough, Steve found that computed accuracy was about ±5 degrees when he was driving in the clear and worse in areas of high signal reflections.

If your DFjr is not connected to a computer, your bearing indicator is the 16-LED Doppler readout, which provides only ±11.25-degree resolution. While not good enough for precision triangulation, it's fine for homing in on a hidden transmitter in a mobile T-hunt. Just let the display lead you down the roads.

Sure would be great if ...

Agrelo Engineering is the first company to bring a microprocessor-enhanced Doppler set to the amateur radio market. Digital Doppler technology has plenty of room for innovation and there are many features that could be added. Since there is already a microprocessor in the unit, I wish it had a "smarter" user interface. How about including memory to store multiple calibration factors for various bands and receivers?

It would be useful to have the ability to select the sample period time over a 0.25- to five-second range, to adapt to a variety of multipath conditions and transmission lengths. Maybe the LED in the center of the display could be made to flash at a rate corresponding to the amount of multipath, as evidenced by variation in data points during the sample period. Rapid flashing would indicate high multipath, whereas consistent data would result in a steady glow.

The DFjr is not sold in ham stores. It is available only from Agrelo Engineering, P.O. Box 231, Pattersonville NY 12137; phone (518) 864-7551. A new detailed operator's manual has just been issued to replace the rather sketchy one originally supplied. For more information, contact the company or visit its Web site. Since that site is presently in the process of changing servers, I suggest you use the link from the Homing In site [http://members.aol.com/homingin/]. 73

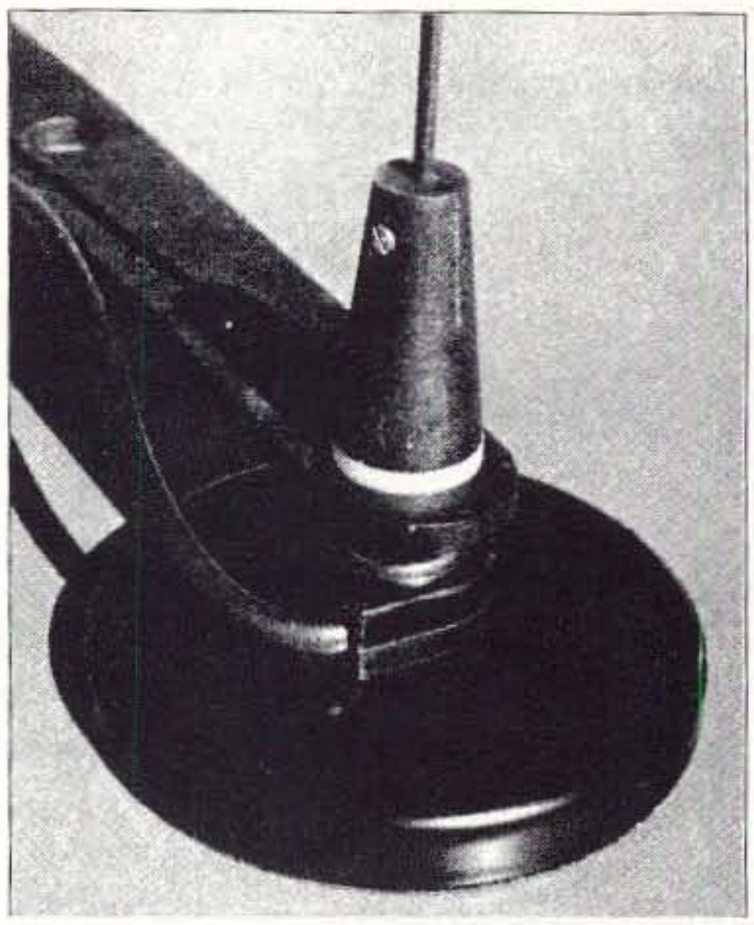

***Photo D.** The latest antenna set (fourth version) has a molded coax termination block to prevent shorts at the whip bases.*

73 Review

Sony's ICF-SW100S

A micro-sized shortwave communications receiver with full-sized features.

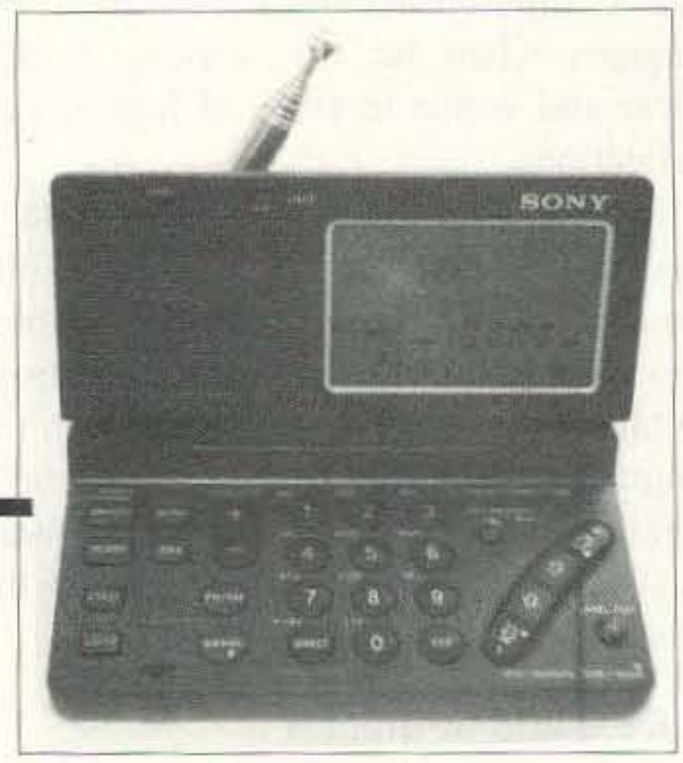

***Photo A.** Close-up front view of the ICF-SW100S.*

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Rowlett TX 75088

What weighs seven ounces, is only a little bigger than a pack of playing cards, and can take you to distant lands without the need for you to leave your easy chair? No, it isn't a portable transporter beam. It's the ICF-SW100S pocket shortwave receiver, available at your local consumer electronics or amateur radio store for only $349!

Finding a pocket-sized, high-quality, dual-conversion communications receiver may at first sound like science fiction, especially one that contains a digital readout, memory "channel" capabilities, and the ability to demodulate upper and lower sideband shortwave radio signals. The receiver also incorporates a circuit capable of AM synchronous detection—more about that later.

"The synchronous detection in this receiver works superbly on fluttering/fading shortwave AM broadcast bands."

Let's take a closer look at this minuscule receiver. Measuring 4-3/8 inches by 15/16 inch by 2-7/8 inches, this receiver is about as small as they come. It's powered by two AA batteries; you can expect to get about 24 hours continuous use from alkalines, and about 60 hours use from lithium batteries.

Also supplied with the receiver is a hefty (overkill, here) AC power adapter, a pair of headphones, and as an added bonus a preamplified active antenna module with a convenient built-in transmission line reel, which allows for the option of collapsing the built-in receiver antenna and placing the active antenna module on a windowsill.

The on-board amplifier exhibits about 10dB gain (measured at 10MHz) and climbs to nearly 15dB at 25MHz. Also, a switch is used on the module to broaden or narrow the amplifier bandwidth for four selectable band segments. Weak, barely audible CW signals on the amateur bands were quite copyable when the active antenna was utilized. Surprisingly, it is unnecessary in most cases to employ the preamplified antenna module, as the sensitivity of this tiny receiver is impressive. Measured sensitivity for this receiver is 0.25 microvolts for 10dB S + N/N (measured on 10MHz).

Another bonus is selectivity. Listening to the crowded 80m and 20m amateur bands on a Thanksgiving morning was a good test for the receiver's ability to separate crowded amateur radio signals. This is where this little receiver excelled. The sensitivity and selectivity also really help when DXing AM broadcast radio signals. In spite of the receiver's obviously small built-in loopstick antenna, it has proven to be an equally good broadcast-band DX receiver.

How does it sound? The tiny 1-5/8-inch, eight-ohm speaker has plenty of volume and a very crisp communications-quality sound that favors the high end. The absence of bass makes music sound a little tinny; however, the sound quality while listening to FM stereo broadcast signals using a set of good headphones is unusually good. A tone switch on the side of the receiver alters the audio frequency response and optimizes the built-in speaker for "voice" or music.

Tuning

The tuning range is 150kHz to 30MHz and includes 76 to 108MHz FM. Audio stability while listening to SSB amateur radio signals and CW signals is excellent. Moving the receiver around or bumping it causes only a slight change in tone while listening to SSB or CW signals. The "bump" test on some other receivers sometimes causes unacceptable change in frequency. The slight change noted on this receiver is not objectionable nor does it interfere with intelligibility.

Because the receiver is really too small to utilize a vernier knob, tuning is accomplished by four buttons that allow for "coarse" and "fine" tuning up and down frequency or direct keypad entry. While in upper or lower sideband, the "coarse" tuning buttons allow the listener to step through the frequency at 1kHz increments. By keeping the button down (in upper or lower sideband mode), a scan function takes over, moving at a rate of about 100kHz in 15 seconds. The fine-tuning buttons move the

received frequency at 100Hz steps while in sideband mode for each press of the button. The "coarse" tuning automatically changes step rates while in the "AM" mode. It will step at a rate of 100kHz in three seconds, or 5kHz increments for every single push of the button.

Explaining the tuning rates in writing makes it far more complicated than it really is, as it only takes a few minutes to get used to the button tuning rates. Direct keyboard entry is the way to get to a particular frequency quickly, and a total

"Weak, barely audible CW signals on the amateur bands were quite copyable when the active antenna was utilized."

of 50 available memory channels will store your favorite frequencies for quick access. In the AM mode, the easy-to-read liquid crystal display resolves the received frequency down to 1kHz. Although "tenths of a kHz" (100Hz) is not displayed, in SSB it takes ten clicks of the fine-tuning button to move up or down frequency a single kHz. By keeping track of the number of times you have pressed the fine-tuning button, you can resolve the received frequency down to 100Hz, e.g., 14,103.1kHz.

In addition to frequency storage, a label edit function is convenient to label the stored frequencies' contents—such as "WWV" on 10.000MHz, shortwave broadcast call letters, or country designations. Optically, the LCD readout exhibits excellent off-axis performance. Alphanumerics stay sharp and distinct on the screen when it's viewed from any angle.

Synchronous detection

A beautiful feature Sony has designed into this receiver is the capability to store the mode (upper or lower sideband, AM, or FM broadcast), including the ability to recall whether synchronous detection is desired while in the AM mode. This is the smallest shortwave receiver made that employs this circuit.

What is synchronous detection? There are two big problems listeners have when DXing AM medium- and shortwave broadcast stations. When a carrier component drops out of a portion of the received signal, fading occurs, and it is usually most dramatic on the shortwave frequencies, due to propagation changes.

The synchronous detection injects a pure carrier frequency with the signal's original carrier. This artificial carrier is mixed with the received signal to compensate for the lost or greatly attenuated carrier component. Does this system work? I was naturally skeptical of this analog signal processing technique, and was really surprised to discover that the synchronous detection in this receiver works superbly on fluttering/fading shortwave AM broadcast bands. The synchronous detection circuit can also be energized on the AM mediumwave broadcast bands, a real "plus" for AM DXers.

Another common problem shortwave listeners encounter involves closely stacked broadcast stations using a double sideband transmission. They usually will interfere with each other as one of the sidebands is affected from the adjacent signal, causing a "beat" or heterodyne. Synchronous detection also helps in this situation, as the other unaffected sideband can be selectively received, and will null out the sideband that is being interfered with by the adjacent signal.

Other functions include the capability to receive FM stereo broadcast stations, a world clock, and the ability to use the clock as a wake-up timer, an important traveling necessity. The ICF-SW100S has proven to be an extremely versatile receiver, and is certainly one of the smallest available. Don't let size fool you, because the "large radio" features on this flea-sized receiver make carry-along shortwave radio listening a lot of fun.

Also, the clamshell design is very practical. This configuration allows the user to listen while the receiver display is closed. I have found this receiver excellent for listening to amateur radio QSOs while away from the shack. With this rig in its shut configuration and the antenna swiveled to the side, "shirt-pocket" monitoring is a reality. Try doing *that* with your TS-950S! 73

Emergency Communications

The only salvation for ham radio?

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Have you seen the current price paid for frequencies? The FCC, our friendly federal supervisory agency, has discovered the value of the radio frequency spectrum. The past few years have seen several frequency auctions. The government is garnering billions of dollars for frequency bands no larger than some of our ham bands. Every company with geographical dispersion and either service or delivery people roaming the countryside wants to know exactly where those people are. They also want to tell those people where they should be or should go next. The best way to accomplish this is radio. When you add in automatic location reporting, the company managers think they're close to heaven.

Almost everyone wants a portable/mobile telephone. Some want more than one. Some occupations nearly force people to own a portable phone. Does anyone remember the good old days when a beeper was regarded as either a status symbol or major annoyance? Now, look at the billions in profits the better-run cell-phone companies are reporting. No wonder the bureaucrats in the FCC feel they're missing something.

Two years ago a group of companies bid for, and received, a band of frequencies near 2GHz. This band was roughly the size of the 70cm band. The accepted bid was over 2.5 billion dollars.

We have perhaps a half million active hams in the US. How many would we have if the entry fee for use of just one band was $5,000? Perhaps we could work out some way to *rent* a frequency on days we wanted to use it. That certainly would kill some activities, such as calling CQ, nets where people check in with no traffic, etc. Would you rent use of one (160-10m) frequency on the off chance someone might answer your CQ? You can try to figure the chances that person who has bought the corresponding share of "your" frequency might have something interesting to say. A better use of your money might be investing in lottery tickets. Would you pay an annual fee for use of your favorite 2m repeater? OK, when did you last pay your repeater association dues? If we had to pay for use of our ham bands, there would be no ham radio.

There may be just one area where we can justify our continued unrestricted usage of the valuable limited natural resource, the radio frequency spectrum. Remember from your Novice exam questions there was something about ham radio providing a pool of trained operators, promoting international goodwill, technical innovations, and emergency communications? Can one of these official benefits of ham radio actually *save* ham radio?

US vs. them

First, the pool of trained operators was a blatant effort by the military to sidestep training CW operators in case of war. They no longer use CW. The typical military radio has become foolproof. The only thing that keeps hams above average in understanding technology is that each year, our public schools present us with new and improved fools. There are few things for the operator to adjust other than the received volume. Mostly, what we can expect from the military is that they like us to keep some frequencies (we think of them as ours) available for military use during emergencies. The government can issue one statement and we are gone. The military then moves into the recently vacated (our) frequencies.

Is the promotion of international goodwill the salvation of ham radio? Look at the list of countries allowing ham radio. Most are countries where the people like the ideas the US promotes. Does ham radio enter into shaping their public opinion? The countries that do not like US views on things do not have many hams. We are not going to influence public opinion nor foster feelings of international goodwill in such countries. The countries that oppose US views do not allow conversations on certain political subjects. Again, we cannot affect international goodwill in such situations. The authorities in such countries do not care what the people think. The Cold War ended several years ago, so our own government sees little need to cultivate goodwill among other nations. The government view is that the Cold War ended because of the efforts of the government. The opinions of the people were never a factor, in the authorities' view.

Technical innovations? Get real!

How much brainpower does it take to take a hand-held out of the foam packing? When was the last time you built something? Did you actually think it was as good, if not better than, something you could buy? When was the last time you thought of something you wanted to use your radio to do, and couldn't do, because of the equipment's limitations?

Ham operators have developed several great technical innovations: the use of high frequencies, such as everything higher than the AM broadcast band; single sideband; and others. What technology has ham radio developed during the past ten years? During the past 20, 30 or 50 years the answers would be the same. Spread spectrum transmission, one of the current technological innovation darlings, was invented and patented 55 years ago. This "new" technology was invented by a movie star, using piano player rolls. Crude, but it worked. Now the technology has caught up and spread spectrum is the coming technique. Does anyone want to bet there is at least one ham in your club who cannot set the clock on his VCR? We are expected to be the technical innovators of the future!

(If you don't remember, the star was Hedy Lamarr; she was granted the patent for a Secret Communications System on August 11, 1942. The original plan was to guide torpedoes via radio control. The frequency changing was to prevent enemy jamming of the signals. It did work, but the US Navy thought Hedy could do more for the war effort by selling bonds.

This torpedo guidance could have been a major development—if it had been implemented. During the first half of World War II the German and British torpedoes were much more accurate than ours and the Japanese had torpedoes with both greater range and better accuracy than the American Navy's.)

That leaves emergency communications on our list of justifications for ham radio. With the exceptions of tornadoes, floods, or hurricanes, weather is almost never a cause of telephone problems. When you consider the redundancy provided by ten or more long-distance network companies and the cell-phone companies, when are we hams needed for communications?

Sit down, Elmer, and take one of your pills

I didn't say hams wouldn't be needed. I asked *when* will we be needed? The need for true emergency communications over long distances will hold for isolated areas such as islands and Third World areas. While inside the US, our long distance capabilities are useful in two types of major emergency situations: initial reports, and health and welfare messages. For smaller-scale emergencies in the US we can expect years of opportunities, if, and only if, we can show our capabilities and get the recognition we need from the proper (local and state) officials. Floods, tornadoes, and hurricanes are capable of destroying communications towers and buildings—and recently the US has joined the rest of the world in experiencing terrorist bombings. Floods will cover houses, cables and equipment housings. Hams must be ready for smaller localized emergencies.

The development of fiber optics means there is more telephone company equipment scattered over the countryside. Very few people have fiber optic service direct to the house—the conversion from fiber to copper circuits takes place in manholes, huts, and cabinets here and there, usually near residential neighborhoods. What effect on normal communications the combined effects of the incorporation of fiber optics and a flood or major storm will have is anyone's guess. The equipment performing the change from fiber to copper circuits will work while the equipment has power and is dry. It will continue after loss of commercial power while the battery holds, or if the repair people can get a standby generator to the site.

During a flood or storm, often the area power lines are shut down because of the risk to rescue workers. There are limits (read "costs") as to how much reserve battery the communications companies can afford to put into each remote terminal site.

Cell-phone-type technology will be less affected, as the tendency is to put cells on hilltops for better propagation. Floods don't get them, but power loss can. One cell company is building sites on a grid pattern eight to 10 miles apart, across the country. There are not enough portable generators in the world to cover them if they lost power! This can become one situation where older is better. During a major wide-area power outage, older all-copper circuits from a telephone office should continue to function. The newer circuits such as fiber and cell technology types will only work where the remote sites have backup power sources. Telephone offices usually have batteries sufficient to last hours, then standby generators sufficient to run all the equipment, lights and air conditioning.

If we hams are to be respected as emergency communication providers, we need to prepare for the actual-type emergencies we will face. While Field Day is great fun, are we going to need long distance communications from some city park during our most likely emergency event in our community? Field Day is a tradition, and the experience received in setting up temporary stations and the activity will serve well when we need emergency communications on whatever band. I have a question for all Field Day participants—are you learning anything, or are you simply repeating the same mistakes each year?

I know of a club that spends up to six months preparing for Field Day. The site is selected. The area is mapped and scale drawings prepared. Antennas and supports (using existing trees wherever possible) are selected. Additional supports are pre-built for locations where no tree exists. After all this planning one helpful old-timer arrives early and puts all the antennas up the same as they were the last time this location was used. This old-timer never operates Field Day; he is the hospitality committee. He never remembers the reason they did so poorly last time. The big reason for the poor results last time was mutual interference between the various stations. (The planning committee suspects that the old-timer's requiring all antennas to use a common center support is a factor.) This is excusable one time, not *every* time for 25 years.

What new technology should your emergency preparedness group look into before the next emergency? Until you have worked with positioning via GPS location and packet reporting, you cannot appreciate how great an idea this combination can be. I recommend the article "Automatic Position Reporting System" published in the December

1996 edition of *73 Magazine* for more information about this system. Then be creative and find ways to use this equipment during your next emergency drill or real situation.

What happened to the sign?

How well do you know your county or city? Imagine attempting to tell someone your location when every street sign and landmark building has gone with the wind of that hurricane or tornado. I know that in my county, the firefighters and police dispatchers relay directions to the emergency responding units. There are many new and changed streets—the only people really up on the latest streets and developments are the utility engineers and construction workers. They learn the areas before the street signs are installed. Any street sign listing something the local Neanderthals find interesting (or offensive) will result in that sign being AWOL just when it is needed for emergency response.

I just finished an emergency exercise where the problem preparation team drove the target area three days before the exercise, using a map. During the exercise, the initial survey and assessment teams (using street signs for reference) reported their location as being the intersection of two parallel streets; if the preparation group had *also* looked at the signs, they'd have noticed that the street signs were incorrect! Why no one else noticed (or complained) is a mystery.

Picture it: Your emergency assessment team starts out towards a suspected disaster area. They soon need to report injuries or damage and request assistance. They need not take time to find a street sign or landmark—headquarters already has their location and the locations of all other teams displayed on the computer screens at the emergency coordinator's office. The support team with the required skills and least travel distance can be dispatched. If all emergency response teams have this APRS capability, only the coordinates need be sent. The GPS equipment can direct even a newcomer to the correct spot. If you want to win over a hesitant emergency coordinator or other official just demonstrate this real-time location reporting capability. It works!

How much practice do you need?

If you or your organization are to provide effective support during emergencies, then there must be several qualified net control operators and *everyone* must be familiar with net procedures. Simulated emergencies are not the best answer. There just is not the adrenaline needed and you get too few volunteers. Get the practice you need with as many real situations as possible.

These need not be emergencies—just look at the activities in your community. There are parades, running events, bicycling events; anything that brings people together is an opportunity. Look for events where there is some physical activity; a little activity in today's couch-potato society will guarantee at least an occasional call for medical transport. I suggest distance running and bicycling events for practice. The geographical spread makes the need for communications real. The exertion and need for water, food and medical support can give you real problems for your net. Also, you can have perhaps a year to prepare for these events.

Look for events outside the boundaries of your immediate neighborhood, too. During an emergency you will need familiarity with adjoining counties and perhaps even adjoining states. You will certainly need to know the communications problems within your area. If all your practice is from hilltops with a clear view of the horizon and the handheld range is 75 miles, what will you do when a real emergency occurs at the bottom of some canyon where the radio horizon is less than two miles away? To develop the knowledge and skills needed to overcome such problems, you should work as many different events as possible.

Learn to use ham TV; there is no better way to impress people than with live pictures, shown at the emergency response headquarters, and with your ability to tell the camera operator to zoom in on the object just left of center screen. If there isn't an ATV group in your area, start one. The same goes for portable packet and satellite communications groups. During an emergency you may need communications beyond 2m simplex range, but not the worldwide capabilities of the low bands. Get a GPS receiver with the capabilities to interface with your portable packet station. Package the equipment in a compact bundle so you can transfer to another vehicle when needed. This could be a good use for an under-utilized computer.

When you set up a portable station at an emergency site, does your group demonstrate professionalism and efficiency? Why not package a convenient length of coax, an omnidirectional antenna and a support structure in one package. I suggest a J-pole antenna. They are easy to construct and compact. My favorite support structure is a Fiberglas™ telescoping pole made for electrical and telephone industries to measure the height of high-voltage lines. They consist of several concentric tubes about five feet long. To use, you pull the smallest tube out until a snap-locking pin locks to the next larger tube. You repeat this process until you either have sufficient height or run out of tubes. Commercial suppliers provide similar steel poles for ham and TV antennas. These supports need added stability from guy wires. You need to include guy material, and don't forget the appropriate anchor devices, in your prepackaged emergency kit. An alternative support is a base plate with a vertical post. You place the mast over the post and park a car or truck wheel on the base plate. After you park the vehicle, keep the keys. Otherwise, you may abruptly (and involuntarily) leave the net.

Communicate effectively

To forward a message to another site, check first to see that it is understandable. If the message will go through several relay people ask yourself, is it concise? During an emergency you may be routing messages through people who have never handled a message, even in a non-emergency situation. Humor the newcomer, and keep the messages short and understandable.

If you are given a message that doesn't make sense, ask the people originating the message to rewrite it. A few minutes taken to rewrite the message, preventing a series of calls for clarification, is much more efficient than any alternative.

Practice, practice, practice

You need to develop your skills before the emergency occurs. The best practice

is to have real situations, then figure how to overcome the problems that occur. The type of practice depends on what is available in your area. Here in the Midwest we can practice net operations with tornado spotting nets. We also have cave rescue and lost person operations. Then there are the usual parades, large gatherings of people at civic events, and amateur sporting (running, walking and bicycling) events. If you feel these events lack the challenge of a true emergency, a few years ago someone forgot to secure access to a drinking water source for a fireworks display that attracted 35,000 people. The panic when they ran out of popcorn the year before had been bad enough. These were evening events in town. If the problems had occurred twenty miles from town in dreadful weather, the problem could have become a crisis.

Each event should be viewed as an opportunity for you and your ham group to learn more about your communication capabilities and deficiencies. You want to learn both the good and the bad. Then use the good to promote your abilities to other groups. Learn from the deficiencies to prevent disorganization the next time you set out to provide communications support.

Each event, be it a real emergency or a practice session, should be followed by an after-action review, with the participation of the event officials; they know what they need to run the event. Ask them how your portion could have been done better. Please encourage hams and other event volunteers to participate in this activity. A good critique of the recently-completed event support is not to criticize anyone; its purpose is to prepare for a better job next time.

Sample information sheet for post-event critique

Date:
Location:
Time:

- Number of medical emergencies: Problems?
- Number of lost people retrieved: Problems?
- Other priority activity:
- Communication problems discovered:
- Suggested solutions for communications problems:
- Other operational problems observed:
- Ham operator skills needing improvement:
- Could we/should we use these items next time or next year:

Ham TV of area activity relayed to HQ?

An eye-in-the-sky—ham TV from an airplane or balloon?

Digital (GPS) reporting of vehicle locations?

Computer-to-computer data transfer via ham radio (packet)?

Alternate modes or frequency bands such as 222MHz for more confidentiality in communications?

Portable repeaters?

Dual-band mobile radios as portable repeaters?

- Any other items that could be of benefit next time:

What is your part? Have you signed up with your local emergency coordinator? Was this recent enough that your data is both on file and current? Have you participated in a drill or communications support activity for a large event during the past three months so you could consider your radio communications skills current? I know you can talk—can you communicate? When was the last time your group investigated your area's needs for emergency communications? How quickly could your group have a dozen portable packet stations set up and operating at remote sites? Would anyone in your group know where to place digipeaters to relay information to the outside world? What leads you to believe that your existing repeaters and digital repeaters will survive the events that take out the commercial communications systems?

Do you have the ability to store packet data directly into a central database? Any time people are sent to shelters, there are many inquiries as to who is in and who is not in the shelters. Then when there is more than one shelter, or some people visit a hospital, there is the problem of uniting families and friends. If someone could format a packet message to record where victims are, we could reduce the time spent looking for people. All this would take is an identifier to tell the computer to record the following fields. Then the message originators could simply enter data in the prescribed format and presto! The computer could locate people quickly. Even if you never need to locate people in shelters, this can beat looking through 40 pages of log sheets looking for a message from someone who needs the truckload of supplies that is now blocking your route home.

Can't your group field several portable packet stations? Join the twentieth century. Take a small cabinet, install a small 2m rig, a TNC, a power supply and backup battery. Then, when an emergency occurs, plug in a portable computer and attach an antenna. (You do know how to operate your packet station using just the garden variety communications software you might find on any computer, don't you?) You now have an instant packet station. There is another approach. Take an under-utilized 386 computer, and build the TNC and radio into the case. You may learn more about RF noise suppression than you ever wanted to know, but you can have an impressive portable packet station. If you can add a four- or eight-line (or larger) liquid crystal display and a keyboard, you have a true one-piece packet station. Innovative use of technology and readiness to serve can keep the future bright for ham radio. 73

At Sea About Marine Mobile Operation?

Weekend boater or dedicated sailor, you need your radio!

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Since the days of Guglielmo Marconi, the value of being able to communicate from vessels at sea has been a major influence on the development of two-way radio technology. Probably the only Morse code that the non-radio communicator knows is the "dit dit dit dah dah dah dit dit dit" of the marine emergency "SOS" signal.

Today, many military and commercial vessels use sophisticated satellite two-way systems with auto-aiming, gyro-stabilized antennas that cost a small fortune; however, the mainstays of marine communication are still VHF and HF radio circuits.

Belt and suspenders

For many recreational boaters, the installation of ham radio equipment has become an additional safety feature for their boats as well as a way of combining two of their hobbies. A word of caution, however: Many modern radios, both VHF and HF, can be easily modified to transmit on marine frequencies. To use a modified radio in this mode is illegal and can result in serious penalties. In a life-threatening emergency, however, the radio may be used without problems.

In such a case, it is also permissible for a non-licensed individual to use the radio on any frequency where help may be found, including marine, military, and ham. Even if you have a regular marine radio on board, it is still worthwhile to have a modified radio installed as a backup. Anytime on the ocean or even lake that you can use a "belt and suspenders" policy, it is smart to do so.

VHF issues

The ham general coverage receiver is also perfect for picking up weather charts and satellite pictures in conjunction with a very simple interface and inexpensive software available from many sources on bulletin boards, Web sites, and commercial vendors.

Let's take a look at some of the practical issues of installing and using ham radio gear on your boat. We'll deal with the easiest first—VHF. The marine VHF band is a group of internationally agreed-upon frequencies between 156 and 162MHz. As you can see, that is pretty close to the ham 2m allocation, and unless you are a purist, it is really not worth the trouble of installing a separate 2m antenna on your boat. The usual half-wave or vertical collinear gain antenna used on recreational and many commercial vessels will function very well on 2m. The ham frequencies are only 8% off the resonance of the marine antenna; you will not have a perfect SWR, but your radio will easily handle the small mismatch. If you are operating on a sailboat, you will be amazed at the over-water range that comes from having the antenna mounted at the top of the mast. It really highlights how close to a dummy load the "rubber ducky" HT antenna is!

Although the marine radios use channel numbers and not frequencies in their displays—by law, they had to be made "sailorproof"—their instruction book usually has a conversion table of channel to frequency. If your radio will transmit on the marine band, you should program in channel 16 at 156.800MHz. This is channel 16, the international emergency frequency monitored by coast guards worldwide, all military and commercial vessels, and most conscientious pleasure boaters. USE IT ONLY FOR LIFE-THREATENING EMERGENCIES.

A word of caution about trying these marine antennas on frequencies other than 2m. Most of these antennas present a DC ground. This is not a problem at or close to the design frequency; but at 220MHz or 440MHz, the antenna is so far off resonance that it will be a short across your radio output with probably expensive and smoky consequences!

Incidentally, most marine antennas are designed for a maximum power of 35W; marine radios are limited by the FCC to 25W output.

HF challenges

Running HF from a boat presents different challenges, as most pleasure boats do not have an HF antenna as standard equipment. There are on the market dozens of mobile antennas sold for use on land vehicles that will perform even better in the marine environment. Some manufacturers (e.g., Spider) offer stainless steel versions for use in a saltwater environment.

The key to operating any mobile antenna and having a good signal is a very

low-resistance RF ground. The boat offers the opportunity to provide a superb ground against which the antenna can work if you know how to take advantage of it.

We are talking about an RF ground here. The negative battery lead of the radio will not provide this, nor will a 10- or 15-foot run of 12-gauge wire connected to the engine block. At HF frequencies, wire over a few feet long represents a significant impedance, and on the higher HF bands it may just as well not be there!

Copper foil

Some brands of mobile antenna claim that they will work using the stainless steel handrail of the boat as a "counterpoise." They may "work," but there is no substitute for a solid RF ground, and the way to achieve this is with copper foil. A continuous run of 3"- or 4"-wide, 5-mil or better foil should be run from the base of the antenna to the engine ground on a power boat or to the keel bolts on a sailboat.

If the boat's anti-electrolysis bonding measures are correct, the engine block should be connected to all metal through hull fittings and with a rubbing brush to the propeller shaft. A second length of foil should be run from the operating position to the same point and connected to the radios' grounding lug. The foil should be laid flat to the hull and can be secured with contact cement. Corners can be turned by folding the foil rather like a mitered corner. Try to run a continuous length. After installation, it can be painted if required.

Connections

The base mounting of the antenna should be connected to the radio using a good-quality 50-ohm coax, and all connectors should be sealed on the outside with silicone sealant or proprietary coaxial sealing tape. It is not a good idea to use foam-cored coax in marine installations, as it is far more prone to "wicking" moisture than solid-core is. For all but the shortest runs, RG-8 or better should be used.

The above installation uses the common land mobile antenna that is brought to resonance by the use of loading coils for the band needed. This is the most convenient way on most powerboats and some sailboats.

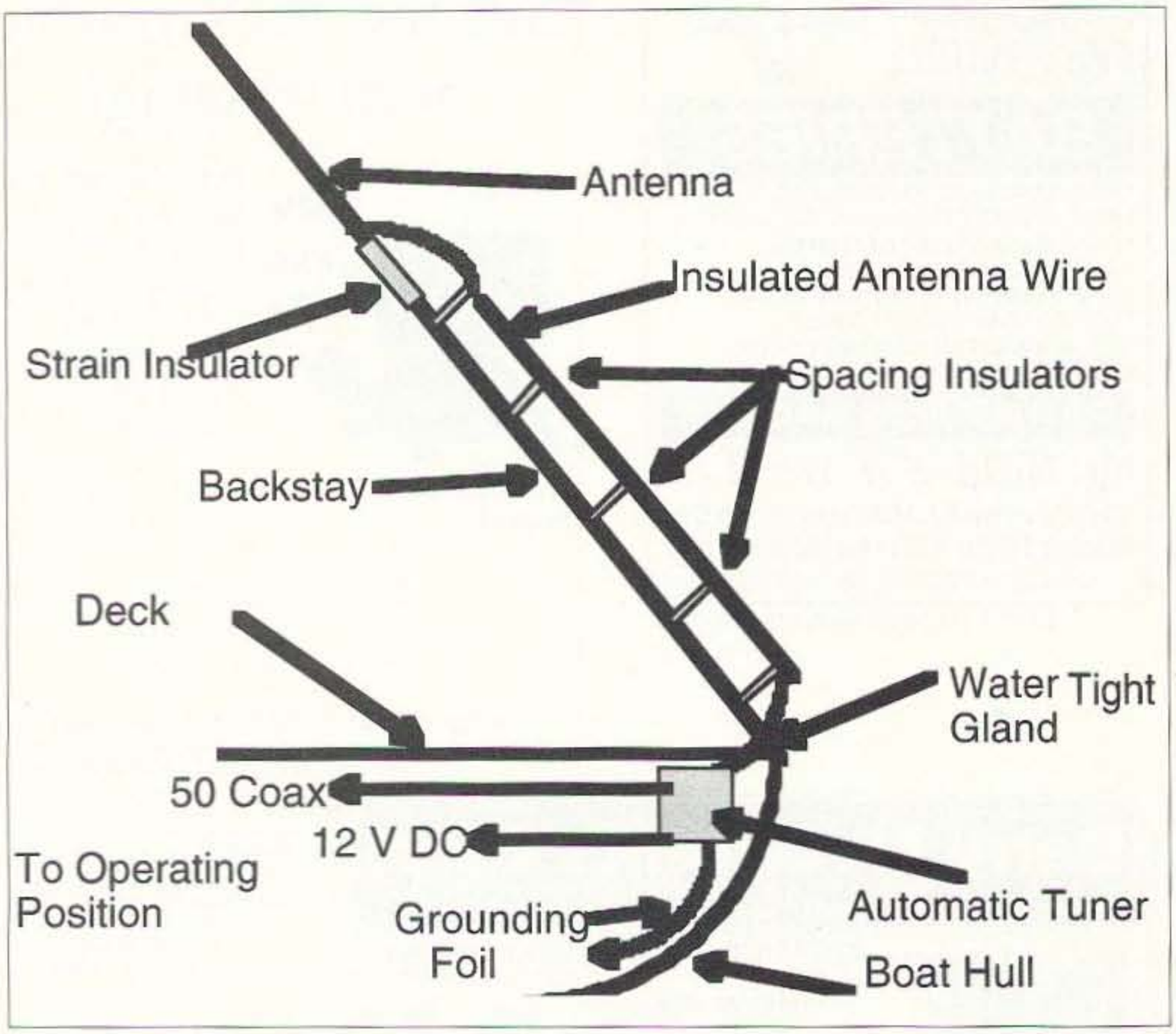

Fig. 1. Tuner at base of antenna.

Using the rigging

An option that has proven very popular and effective on sailboats is to make use of a piece of the boat's existing rigging. Although the stainless steel rigging wire does not have the conductivity of copper, the diameter and length of the stays make them very usable radiators. The most practical stay to use is the one that runs from the head of the mast to the stern of the vessel and is called, logically enough, the backstay. Even on a moderately-sized family sailboat, this stay is over 30 feet long. To use the stay as an antenna, a modification has to be made to its construction, as it must be insulated from the masthead and the rest of the rigging.

The most elegant way to do this is to install special in-line rigging insulators in the stay, the uppermost of which should be three to four feet from the mast attachment point. The lower one should be sufficiently above the deck to ensure that the antenna portion of the stay cannot be grabbed accidentally when it may be in use!

These fittings are the preferred way of sectioning the stay, as they are designed to withstand greater strain than the wire that they insulate. Unfortunately, they are expensive and usually require professional installation. A less elegant (and less expensive) solution is to insert, in the same locations, ceramic egg strain insulators, as used by the power company on poles and guys. If you take the second approach, be quite sure that they will handle the mechanical loads imposed on the stay.

The exact length between the insulators is not critical, since the antenna will need a tuner and be operated as an almost vertical random wire. As a rule of thumb, the longer the better that avoids multiples of one-half wavelength on any of the frequencies that you intend to operate on. The advantage of the random wire approach is that with a tuner it can be made to operate on all ham and marine frequencies.

Tuners

The way this type of antenna is connected to the tuner depends on the type of tuner you plan to use. If your purse runs to it, there are now on the market several tuners (often called "couplers" in the marine electronics industry, made by SGS, Icom, Hull, etc.) designed for matching the 50-ohm transmitter output to a random length of wire. These should not be confused with the automatic tuners built into many modern rigs. The built-in tuners are really designed to "touch up" the match of a near-resonance antenna that is being used slightly off its resonant frequency. They do not have the required range to be used in this application. The suitable automatic tuners are contained in a semi-waterproof housing that will allow them to be mounted in a fairly sheltered location right at the base of the antenna. They are connected to the radio by standard coax

FREQUENCY (MHz)	TIME (UTC)	NET NAME	AREA COVERED
21.402	2200	Pacific Maritime	East & South Pacific
21.350	1630	Pitcairn	Central & South Pacific
14.106	0300	Travelers	Australia & Indian Ocean
14.283	1100	Caribus	East Coast & Caribbean
14.300	1600-2200	MM Service	World Wide
14.313	24 hours/day		
14.340	1830	Manana	Mexico & Pacific
7230	1100	Caribbean	Caribbean
7238.5	1600	Baja	West Coast & Mexico
7294	1445	Chubasco	West Coast & Mexico

***Table 1.** Some maritime mobile SSB net frequencies. There are many other MM nets around the world that come and go depending upon season and propagation. Some nets change time by one hour when Daylight Savings Time is in force.*

and usually a 12VDC cable. This type of installation is shown in **Fig. 1.**

The wire running from the tuner to the antenna side of the insulator should be at least 8-gauge, with high-voltage insulation suitable for exterior use. The wire used to supply the high voltage to neon advertising signs is often used. If the cable passes through the deck, a correctly-sized waterproof gland should be used. These are a standard marine electrical item. If you are on a tight budget, slip a couple of pieces of shrink tubing over the wire where it will pass through the deck, shrink them, and seal the area liberally with marine silicone caulking compound. In this installation, the copper grounding foils should be attached to the lug on the tuner.

A much less costly, but less convenient and efficient, method uses an off-the-shelf or home-brew tuner at the operating position, connected to the antenna feedpoint with a good grade of RG-8 or better coax. In this configuration, there will be, at times, quite a high standing wave ratio on the coax; but at the usually short runs involved, the losses will not be significant, nor at the normal 100W power range in use will heating be a problem. Because of installation difficulties, ladderline cannot be used in this application. This installation is shown in **Fig. 2**.

The feedpoint

The attachment of both the single wire feed and the coax to the antenna feedpoint needs some careful consideration, because it must be a very good electrical and mechanical connection as well as prevent water ingress into the cable. Electrolytic action of dissimilar metals must also be minimized. There are no doubt special mil spec fittings available for this, but the vast majority of installations make use of either bronze split bolt and nut combinations available from electrical supply houses, or small all-stainless-steel hose clamps. Be sure to check the bolt on the supposedly "all-stainless" clamps sold in discount hardware stores, as these are often *not* stainless.

To attach the wire to the stay, use two, or preferably three, clamps or nuts spaced a couple of inches apart on each leg of the stripped coax, or just three on the single wire. The clamps and joint area should be carefully and liberally coated with marine-grade silicone sealant, taking care not to leave any pinholes or gaps where water could be trapped and cause a "noisy" joint. The end of the insulation of the wire must also be carefully sealed, especially the coax, as water "wicking" along the braid will render it useless. In the case of the coax, the insulated section below the feedpoint can be fastened to the lower part of the backstay with cable ties about a foot apart. If available, ultraviolet-resistant ties, usually black in color, should be used.

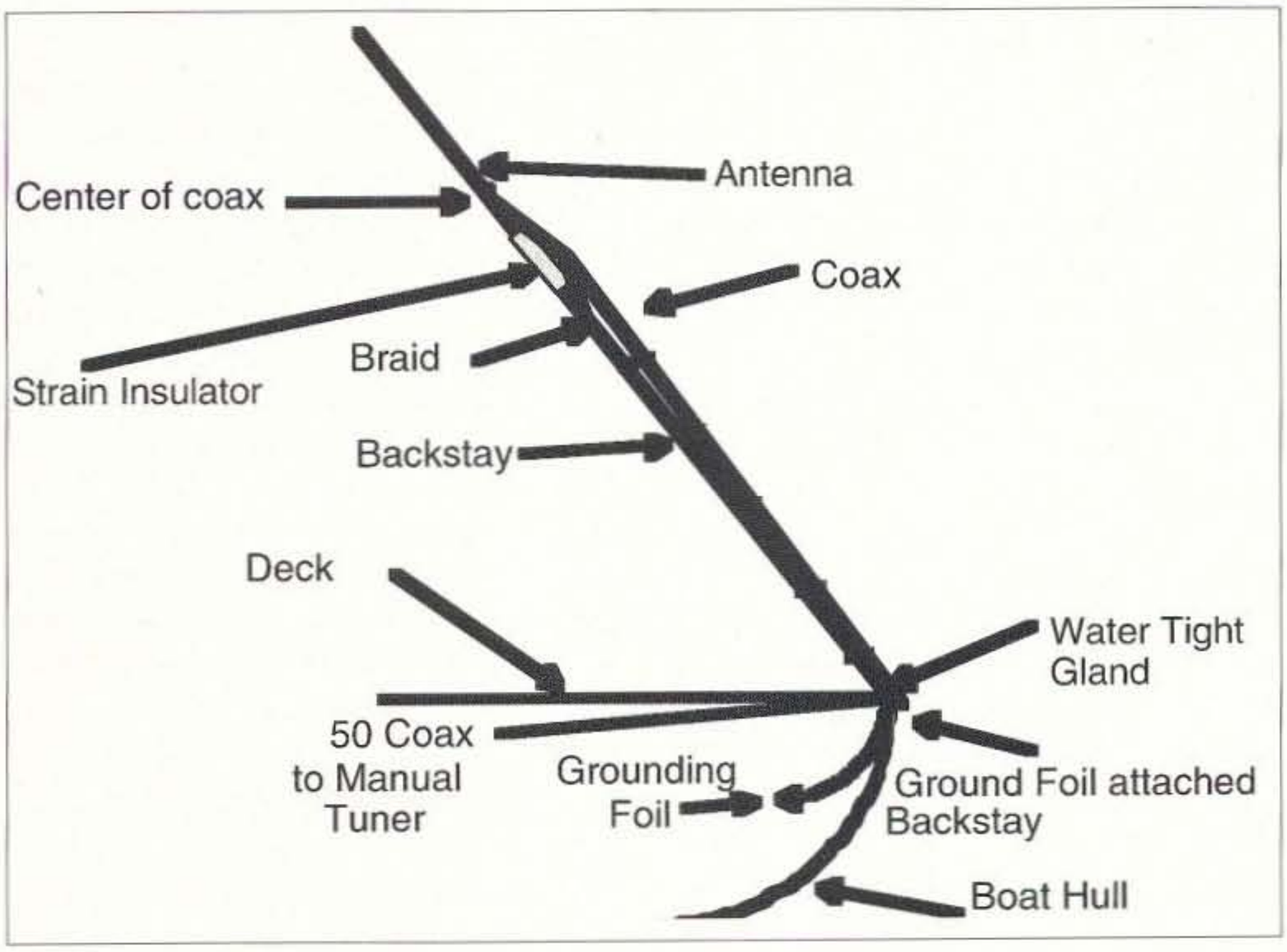

Fig. 2. *Tuner at operating position.*

The single-wire feed should not be taped along the backstay, as the wire forms part of the radiating system. It should be supported two to three inches away from the stay by insulating spacers that can be easily fabricated from Lucite™ rod or half-inch PVC water piping. The spacer should be attached about every 12 inches along the stay.

The "random wire" principle can also be used on powerboats where a marine-grade Fiberglas™ whip can be matched with the tuner and the same grounding requirements used. These whips are in the range of 23 to 35 feet long, require sturdy mounting flanges, and can put a significant dent in your pocketbook.

Backstay antenna here to stay

The backstay antenna is standard on almost all long-distance cruising sailboats; and given good grounding, thanks to the excellent conductivity of the saltwater, it has enabled boats with standard 100W transceivers to maintain contact with hams ashore from the farthest reaches of the oceans.

There are, in fact, regular nets in many countries around the world that listen for just such traffic 24 hours a day. When they are not occupied by lunatics, 14.313MHz or 14.300MHz are good frequencies to check for this activity. A short list of some of the more active net frequencies is given in **Table 1**. Check them out. You may be surprised how well this type of mobile whip or backstay antenna can do when surrounded by hundreds or thousands of miles of highly conductive sea water!

You may wonder why you cannot use a dipole on board and avoid all this ground foil and installation. Well, of course you can if you have the clear space in which to hang it and are interested in one band only. Multiband dipoles of the trapped variety are really not a good idea in a marine environment and would almost certainly not perform any better than the backstay. Some boating hams do carry a 15m and 20m dipole on board as an emergency backup in case of dismasting or shipwreck; but these would probably be the same ones who would carry climbing irons and a safety belt to shinny up the palm trees to hang their skywires! 73

Board Creation Tips

Seven steps to beautiful PC boards.

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If you've never created your own printed circuit board, here's the first thing you need to do: Find someone comfortable with etching boards and coerce him into mentoring you. It helps if your victim is also a ham—and people with darkrooms, safelights, and developing lights are good candidates. Also, look for orange-yellow fingers—the sign of a ferric chloride user. Once you've done your arm-twisting, proceed to:

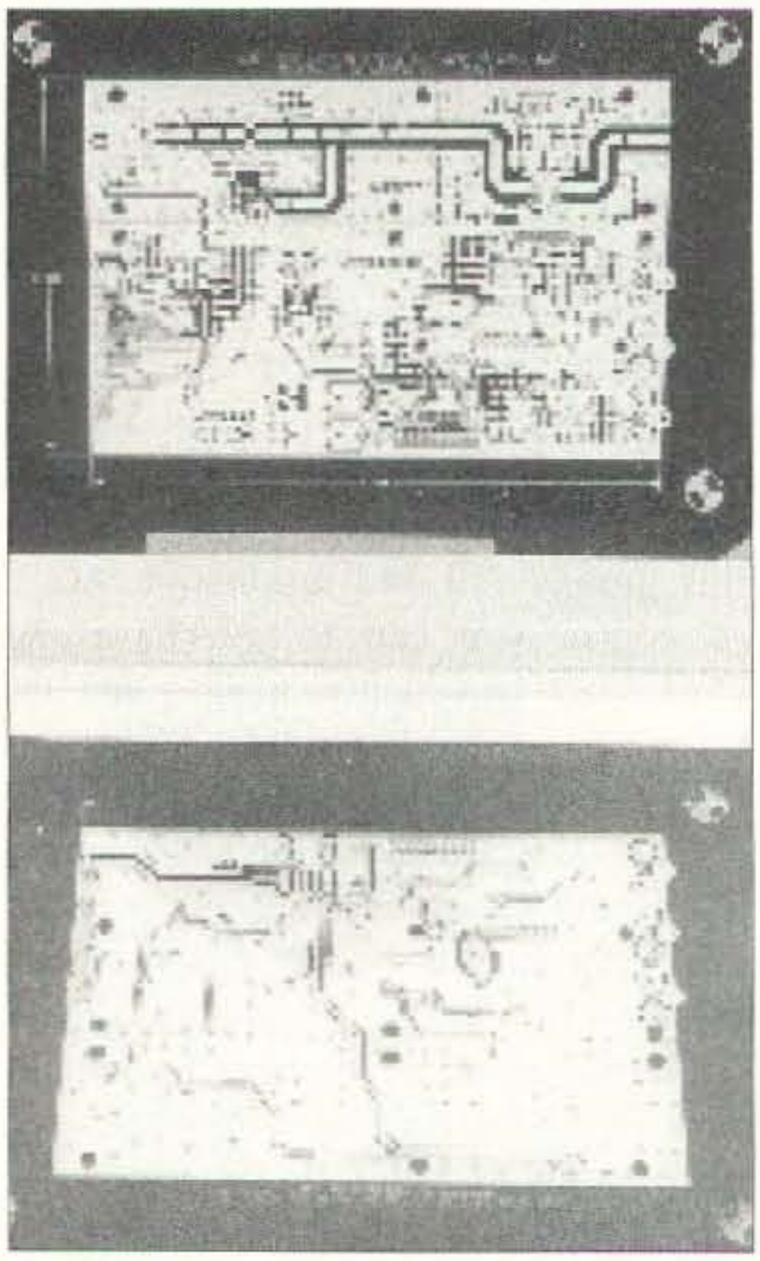

Photo A. *Glass "sandwich" with artwork positioned and taped.*

• Step 1. Have negative images of *both* sides of your artwork made by a commercial graphics company (about $6 per 8- x 10-inch image). It is very important that these negatives be made to scale. Things don't work very well if the artwork is the wrong size. These images should also be made on the bottom side of the film—so that the image will be against the pre-sensitized copperclad rather than 5 to 8 thousandths of an inch above the copper.

• Step 2. Gather supplies. Pre-sensitized negative-resist copperclad board, 4 x 6 inches, with 1-oz. copper foil on both sides, sensitized on both sides. I usually buy a board kit that includes the board and developer for that board (KeproClad™). One pint of ferric chloride (can be used till it doesn't work—CAUTION! *Don't* dispose of it in a septic tank system) should be adequate. Nickel, silver, or tin plating solutions are optional. You'll need a glass or plastic flat-bottomed container, large enough to hold the board flat in the various solutions. A double-boiler or a microwave can be used to heat the solutions to optimum temperatures (do not boil solutions; *warm* them to a maximum of 110°F). A safelight (a yellow bug light works), used to align the artwork to the board, and a developing light—used to expose the resist, are recommended items. I also have two 8- x 10-inch sheets of clear glass to "sandwich" the two pieces of film and the board together (**Photo A**), masking tape, transparent tape, and scissors.

• Step 3. Read the labels. Remove children and pets from the work area and the chemicals. I do my board etching in the garage with the light switch taped over and all the doors shut. Pre-sensitized board is not extremely sensitive to normal house lighting but direct sunlight MUST be avoided. Thirty seconds of direct sunlight is equal to four to six minutes of exposure under a developing light (i.e., completely exposed). Sunlight can be used to expose resist, but I prefer a more controlled environment.

• Step 4. Set up your work area. Turn off normal lights and use a safelight or bug light to prepare the artwork "sandwich." Target mark decals outside of the board area are used to align the two sides of the artwork with each other. They are not symmetrical, to ensure that the artwork is not backwards. Expose the "sandwich" for the time recommended by the board manufacturer for the developing light you are using, once on each side. Working under the safelight, separate the sandwich, remove the protective film from both sides of the board (hold the board by the edges) and place it in the developer solution. A small sponge is usually provided, to gently scrub the board while it is in the developer solution. Remove the board from the solution when all the artwork becomes visible. Save the used developer. At this

point, normal lighting can be used. Rinse thoroughly and dry the board. The next step is to "pickle" the board in etchant. Developer and etchant chemicals will react if mixed together. Place the board into the etchant bath for 15 to 30 seconds. Remove and rinse it. The copper areas will be a dull pink if the resist has been fully developed. Rinse and dry the board. Return the board to the developer bath for 15 to 30 seconds if there are any shiny copper areas. Rinse and dry the board. Etch the board in ferric chloride solution—agitate thoroughly, keeping everything in the container where it belongs—till all the copper areas are gone and the traces look like the positive-image artwork. Rinse thoroughly. NOTE: Ferric chloride permanently stains clothing. Forever. It will *eventually* wash off your skin. I try to be neat, but I always wind up with at least one spot somewhere. Wear your grubbies and work on a surface that can tolerate chemical spills.

• Step 5. Drill the holes. Most of the holes look like donuts. Drill the "hole" out. The majority of the holes can be drilled using a .031-inch to .035-inch drill bit. Vias can be drilled using a .040-inch bit. The larger holes are .050-inch (voltage regulator leads and power wires), .067-inch (RCA connector center pins), .078-inch (fuse holders), and .125-inch (mounting holes and RCA ground leads).

• Step 6. After all the holes have been drilled, the board trimmed to size, edges sanded, etc., remove the etch resist covering the copper. Resist stripper (Kepro DFS-12G for dry film) can be used, or the developer saved from Step 4 will work, with a little extra effort. Place the board in heated developer solution for 5-10 minutes to soften the resist. Gently scrub the board using a nonmetallic scrubbing pad (mine's a Scrunge™), using the solution to rinse and lubricate the board. Continue until all resist is removed. Rinse with clean water and dry.

• Step 7. Additional plating can now be done, or use the board "as is." Tin and silver cold plating solutions are available. Solderability can be improved by additional plating, but most hobbyists overcome poor solderability by using a more aggressive RA (rosin, activated) flux—an option not as available to commercial board assembly houses due to cleaning equipment requirements and hazardous waste disposal. 73

NEVER SAY DIE

Continued from page 5

and beating the game? It means making changes in your food, water, work, and TV watching, so maybe it's better just to get angry with me for bringing it up and forget the whole thing.

Why doesn't that crazy Wayne stick to writing about ham radio? This is supposed to be a ham magazine, isn't it? Alas, ham radio, like all of the other amusements offered to keep us quiet, is far too seldom used as a way to have fun while learning and just as a way to have fun. Far too small a percentage of hams are busy pioneering and learning about new modes or bands. Otherwise I'd have more articles for *73* trying to get you involved.

We're awash in amusements, for the mind and body. It helps keep us from learning about and then challenging the system. For the body we have a long list of destructive foods which taste good—like most fast foods, snacks, and desserts. We have mind-numbing drugs such as alcohol (a.k.a. beer), tobacco, and the harder stuff. We have endless entertainments to keep us busy—watching sports, soaps, movies, and sitcoms, listening to the radio, bowling, golf, and so on.

Our daily lives are full, between our sucker work (and that includes commuting), our family (which we are almost all seriously screwing up), our sucker meals (you really should know better than to ingest the crap you've been eating and the poisoned water you've been drinking), and large screen home theater entertainment, complete with a PrimeStar™ dish. And the Internet (I almost forgot *that* incredible time-waster).

When I got the job as editor of *CQ* in 1955 I was amazed and dismayed when I got to know more and more of the ARRL directors to find out in what deep contempt they held the members who had elected them. "Dumb as stumps," they explained. They laughed about the League's façade of democracy.

But it's the same in Washington, where our "leaders" have the same contempt for the public (you). In this case it's more of a mutual contempt because we know Congress and our political leaders are on the take. We *know* they're taking lobbyist bribery money to run TV ads which will guarantee their reelection. We *know* they're using media consultants, ad agencies, pollsters, and spin doctors to manipulate us, and we, like sheep, oblige by being manipulated and reelecting them. Our politicians know how easily we can be manipulated by things like prayer in the schools, abortion, flag burning, and environmentalism, where emotions rule over reason.

Sucker. Hmm, now where did you put those golf clubs?

So, are you mad at me? Well, am I right, or am I exaggerating?

Heck, you don't even own your home or the land it sits on. The state owns those and rents 'em to you with what is called property taxes. How about your car? Do you even own that? Try not paying your taxes on it and see. Or the license tag "registration" tax.

So what can you do about all this? Right now your politicians are semi-listening to you via opinion polls or, if you are a member of a vociferous organization like AARP, NRA, etc., they hear that one-sided view. Other than that you have no connection with them, despite the marvels of modern communications. Mail, faxes, phone messages and E-mail are either totally or completely ignored—unless you back them up with a bribe (a.k.a. reelection campaign donation), in which case you'll at least get an evasive answer. Joining a militia group isn't a good answer either.

The best bet is to understand what's going on so you can beat the system, then perhaps you can help me teach others to do the same. The upside is a longer, healthier, happier, wealthier life. The downside is you have to change almost everything you believe. It's easier to just get mad at me. Shoot the messenger.

Books

Even though I provide a good list of sources for buying the books I review in my guide to "Books you're crazy if you don't read," and I explain in bold type that I am *not* selling these books ("Oh, Wayne's just trying to sell books"), I still have readers trying to order them from me or Radio Bookshop. Tut.

I started the Radio Bookshop back in 1958 when I was the editor of *CQ*. That's a contest-oriented ham rag, in case you're not familiar with it. When I took on editing the magazine in January 1955 at a marginal salary it was with the understanding with publisher Sandy Cowan (not a ham) that if I got it into the black that I would have a share in its success. It was losing around $20,000 a month at the time. By the October issue I had it making money and running 128 pages instead of 64.

By 1958, with the money rolling in, I asked Cowan about the sharing he'd agreed to. He pleaded poverty. Maybe next year. So I asked for a half page of free advertising in the magazine so I could sell books to hams to make some extra money. No problem. I think the poverty plea was honest because I found out later that he was taking the profits from the magazine to buy a 60-foot yacht.

Over the last almost 40 years the Bookshop has done well when I was running it personally, but whenever I've turned it over to an employee to run it's managed to lose money. I never was able to find anyone who would take enough interest to see that we stocked good new books and kept the better sellers in stock.

Cowan and I split when, in January 1960, with him owing me a year's pay and owing my columnists and authors over a year for unpaid articles and columns, my assistant editor made a copy of the company's 1959 financial statement which showed that *CQ* had made over $1 million in profits that year. The capper came at Christmas when Cowan gave me a $5 Christmas bonus, saying it was all he could afford.

I tried working for an advertising agency, but didn't enjoy it. So I sold everything I could and got together just barely enough money to put out the first issue of *73*.

Now, back to the Bookshop. Unless books are advertised and promoted, like anything else, they don't sell. Book stores are not libraries, so if a book doesn't sell fairly quickly it's sent back to the publisher for credit. That's why Barnes & Noble are able to sell remaindered books so cheaply. Publishers print, say, 50,000 of a new title. Around 20,000 of them may be actually sold, which pays for the project. The 30,000 remainders are sold at $1 or less each to B&N, Crown, and other such outlets, just to get rid of them. Well, it beats selling them as waste paper.

Oh, the publisher saves a few copies for any possible later demand, so for a while Barnes and Noble can order a title from the publisher for you—until it's out of print.

Which brings me to libraries. They're limited by their shelf space, so if a book isn't active it eventually gets sold. I keep an eye open for library sales, picking up some excellent books for around 10¢ to 25¢ each that way. A few years ago I wanted to help out the Peterborough Town Library (the first free public library in the country), so I went through my book collection and picked out a few hundred titles I didn't need any more and donated them. You guessed it—I was able to buy most of them back for 10¢ each a couple years later at their book sale.

Yes, I could make money selling many of the books in my review guide. I could, if I could find someone to run the business. I sure don't have the time, and at this time of my life I'm not going to do *anything* just in order to make money. Of course, thinking back, there have been very few businesses that I've gotten into just as a way to make money. Like almost all entrepreneurs, it's the challenge of doing something, not the money involved, which has always excited me.

Viva CW!

A nice article on how to get involved with CW came in from W6BNB. Bob was explaining how much fun it is to communicate via a key. Hmm, let's see: Novices are plugging along at five words per minute. Generals and Advanced licensees are up to around 12 wpm. Yes, this almost got me to thinking.

The article ran almost five typewritten pages. At 12 wpm it would take someone three and a half hours (with no errors and with remarkable bladder control) to transmit it, and three and a half to copy it on the receiving end. Unless someone is reading-challenged they should be able to read the story in about two minutes. Slow readers might take up to eight minutes. Tsk.

Voice ambles along at around 150-200 words per minute, or around 16 times faster than a 12 wpm CW contact. Twelve minutes to read the story aloud.

My editorial each month, which runs around 7,000 words, would take ten hours to transmit (and receive), not counting meals and pit stops. I'd rather scan it into my computer and send it automatically.

My thought is that at 12 wpm, this sure is a painfully slo-o-ow way to c-o-m-m-u-n-i-c-a-t-e. Yes, it's faster than smoke signals and the snail, but just barely. No wonder voice communications has grown to be so popular, with CW pretty much relegated to the small minority who enjoy it. No wonder we're the only ones using CW any more. It's slow, error-prone, and limited in throughput by the skills of the sender and the receiver.

So how come the ARRL has so religiously fought every effort to eliminate the code from the license exams? Take a look at the organization's name for a hint. Radio relay. This harks back to the old spark days when distances were limited, so it was necessary to relay messages for them to cover much territory. This evolved into the ARRL's traffic system, where hundreds of ops acted like Western Union stations, soliciting messages from friends and sending them gratis. They happily originated, relayed, and delivered messages by the tens of thousands.

When RTTY came along in 1949 it was restricted to the VHF bands and the 11m ham band. A group of us petitioned the FCC to allow RTTY on the HF bands, but the ARRL fought it, worried that RTTY might replace CW for traffic handling. Indeed, in 1954 I set up a message center just off Times Square in New York so the public could send Christmas messages to their servicemen overseas. There was a *CQ* magazine cover photo of me with Skitch Henderson, Faye Emerson and Bill Halligan at the message center. We took thousands of messages from the public and relayed them on 2m from midtown Manhattan out to Long Island, where they were sent via the HF traffic nets to Antarctica, Europe, and Africa.

Eventually, despite the League's every effort to prevent it, we got the FCC to okay low-band RTTY, but it never caught on with the League's traffic nets, despite a throughput (at that time) of 60 wpm with zero errors as compared to the usual CW net 15 wpm.

Instead of remaining frozen in the 1930s we should be pushing for higher and higher throughput on both the HF and VHF bands. With the Internet rumbling along at 28 and 56kbps, that's 1,000 words per second or 60,000 words per minute. Well, that's over telephone lines, so we should be able to do at least that well via amateur radio. Instead it's taking us about three and a half days, day and night with no pit or hamburger stops, to put through 60,000 words via CW instead of one minute. Snore.

At that throughput we wouldn't have to transmit very long to communicate the average ham message. A half second blast would keep the receiving op busy reading for at least a couple of minutes, and then another couple to type out a return message. That would enable a hundred or more QSOs to be handled just on one frequency.

And I don't remember where I put my key. Darn!

Cancer!

The cellular phone industry, like the tobacco industry, is still doing its best to bury research reports showing a connection between cancer and their product. My thanks to Dr. Kelly VK4AOK for a clipping from an Australian paper reporting on research done with 200 mice, half of which were exposed to cell-phone radiation for two half-hour periods a day. Over a nine-to-18 month period, the exposed mice had 2.4 times as many tumors as the unexposed mice.

A significant increase in a form of B-cell lymphoma was evident early in the experiment, and the incidence continued to rise over 18 months, which suggests that the effects are cumulative and time-related. B-cells in the immune system are the key factor in over 85% of all cancers and infections. Mice are not men, but cells are cells.

All this merely confirms again the extensive research by Dr. Ross Adey K6UI, the pioneer in researching the effects of microwaves on human cells and the brain.

When powerful interests are threatened by research, as they have been with tobacco, EMFs, dental amalgam, root canals, aspartame, and so on, the lawyers and PR spin doctors get into the act, backed by an easily-bribed Congress and Administration, and

***Photo A.** W2NSD petting a friendly critter. Nope, you can't feed the animals ... but taking pictures is great fun.*

it's the public that suffers. We're more expendable than the money.

Vanity, Vanity

I see where the FCC is planning to increase the vanity callsign fee from $30 for ten years to $50. It started out as $70. Big deal. At any of those prices it's a bargain.

Back in 1948, when I moved to Southern Pines, North Carolina, to take a job as an announcer at WEEB, the station owner explained after I'd gotten there that I'd have to get a First Phone ticket. So I took the train to Washington that night, arrived the next morning, took the test, and got my ticket. While I was there I asked 'em what callsign they were up to in the amateur division for the W4 area. "Oh, we're issuing W4NSA right now." "Stop the presses!" I yelled. The result was that I got W4NSD. Back then there was no problem with keeping one's suffix, if it was available. When I moved back to New York to work at WPIX as a cameraman I changed back to W2NSD.

In those days it was easier to change call prefixes than to do the paperwork required for portable operation.

When I moved to Cleveland to work for WXEL as a TV director I changed it to W8NSD. I remember the ARRL's Sweepstakes contest that year. For the first weekend I operated from Cleveland as W2NSD/8. On the second weekend I was back in New York operating as W8NSD/2, since my call change had arrived during the week. I had kW stations at both locations, so the only piece of equipment I used in common for the two contest weekends was my D-104 mike.

In 1962, when I moved to New Hampshire, I called the FCC to see if W1NSD was available. Well, it wasn't in use, but the FCC had stopped the practice of swapping call prefixes. However, if I'd hold on for a few months they expected their policies to change and I could get the W1NSD call. So I operated temporarily as W2NSD/1. And here we are 35 years later and I've gotten sorta used to being "portable 1." I see that W1NSD is still open, but what's the benefit in changing? The only call I'd pay $50 (or $500) for would be "W." I might settle for W1, remembering the fun I had operating JY1 for a couple of weeks from the palace in Jordan.

Hmm, I haven't had any real ham adventures for a while—I've got to get on the stick. No, I don't want to operate from Navassa again—twice was enough. Once we've got some sun spots going again and the DX is up, I'll have to look around.

Six Flags

Sherry, suffering somewhat from cabin fever, suggested we celebrate her birthday by making a trip down to New Jersey to visit the Six Flags™ amusement and game park. And while we're in the area, visit the Statue of Liberty. Well, heck, I'm so far behind in my work that another two or three days won't make much difference.

The only problem we had on the way down was getting to the Statue of Liberty ferry at Battery Park on Manhattan just in time to see the last ferry of the day (3:30 p.m.) leave without us. Oh well, we'll catch the old gal on the way back.

Our first event the next morning was the game park, where we drove through, being careful not to hit too many animals. That was fun, despite their having the more dangerous animals behind fences. It was fun having a great big deer come up and stick his nose in my car window so I could reach up and scratch his ears. The giraffes, too, were right out there in the road begging for handouts from every passing car. Ditto the ostriches.

The last section of the Safari park had the baboons and they were busy swarming over the cars, looking for food. The car ahead of us, despite endless signs asking visitors not to feed the animals, handed out at least a dozen bananas to the baboons. It's fun having a baby baboon sitting on your rear-view mirror looking curiously in at you.

Next we headed for the amusement park. $7 parking fee in addition to the $35 park entry charge. Hmm. The weather couldn't have been better—sunny, but cool enough to need a light jacket. Alas, the park was a serious disappointment. It was dirty and seedy. I guess we've been spoiled by the Disney parks—we've visited 'em in Anaheim, Orlando, Paris, and Tokyo. The Disney rides are fun, the food outstanding, and everything is kept spotlessly clean. We found the food at Six Flags expensive, made more frustrating by long, slow lines (did they train their staff in Russia?), and not very good. We tried watching some of the free entertainments. Ugh! Most of the rides were $5, but they didn't look interesting enough to bother. We left, grumbling in disappointment.

The next morning we made two more trips through the game park, enjoying every minute of it. It takes over an hour to get through the place and, ignoring the endless warning signs to keep our windows closed, we didn't, so we got a ton of great animal pictures. One of the baboons capped the experience by sitting on the van roof and peeing down our front window.

On the return trip we caught the Liberty Island ferry from Liberty Park in New Jersey, thus avoiding the dangers of New York City. There was a very long, very slow line of people climbing the 384 steps to the crown, so we settled for an elevator ride to the top of the old lady's pedestal, where I took the required pictures of lower Manhattan. The ferry and the island were packed with kids. Thousands of kids, brought in by the bus loads.

We got back to the farm around midnight. The game park sure made the whole trip worthwhile. For Six Flags, if it was across the street, and free, I wouldn't bother going.

When I was a kid we lived across the street from the Washington Zoo, so I spent a lot of time getting to know the animals

and birds during the year we lived there, zooming around on my bicycle. Imagine being able to go to the zoo every day, if you want!

Avoiding Shots

Unless you've been so totally suckered into believing in the importance of immunization shots that you haven't read the Walene James book, *Immunization, The Reality Behind the Myth*, which I've both reviewed in my editorial and included in my guide to "Books you're crazy if you don't read," your next step is to ask what you have to do to avoid having your children (or grandchildren) given shots which do little good at best and can do serious permanent damage or kill them at the worst.

Before you decide that Wayne's off his rocker again, which is the usual explanation when what I report is in disagreement with what you've been taught to believe by our school system and the media, do me the courtesy of doing your homework. My goal is to learn what I can in order to help you live a better life. Unfortunately, much of what I've learned is against commonly held beliefs.

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NEVER SAY DIE

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You don't *have* to have your children inoculated. You don't *have* to be inoculated yourself. And you don't have to become a member of Green's Religious Cult to avoid shots. Yes, I know all about the school rules that require all kids to have shots. But what I know that you don't is that you don't have to obey those rules. You don't even have to accept shots in the military or for foreign travel.

For schools, all you have to do is supply a release form which requests an exemption from medical vaccines for your child because it violates the free exercise of your sincerely and consciously held beliefs—and that you assume full responsibility for your child's health, thus releasing the school from same.

There's a booklet that covers the subject thoroughly, explaining what to do (and what *not* to do—like try to explain, argue or reason with school or other public officials). It's *Immunization Exemptions* from Dorrance Publishing, 643 Smithfield St., Pittsburgh PA 15222. The 34-pager is $11, including s/h. ISBN 0-8059-3319-0.

Remember Miss America a couple years ago? She was made stone deaf by immunization shots. Other children are killed (a regrettable, but acceptable loss to the trillion and a half dollar medical industry), or come down with polio. I know that the major health problems of my life started soon after getting my childhood shots.

No, I'm not selling the book. I probably should, just to make it easier for you, but then I'd get the usual "Wayne's just interested in making money" crapola from people who have been too dumbed down by the system to think for themselves.

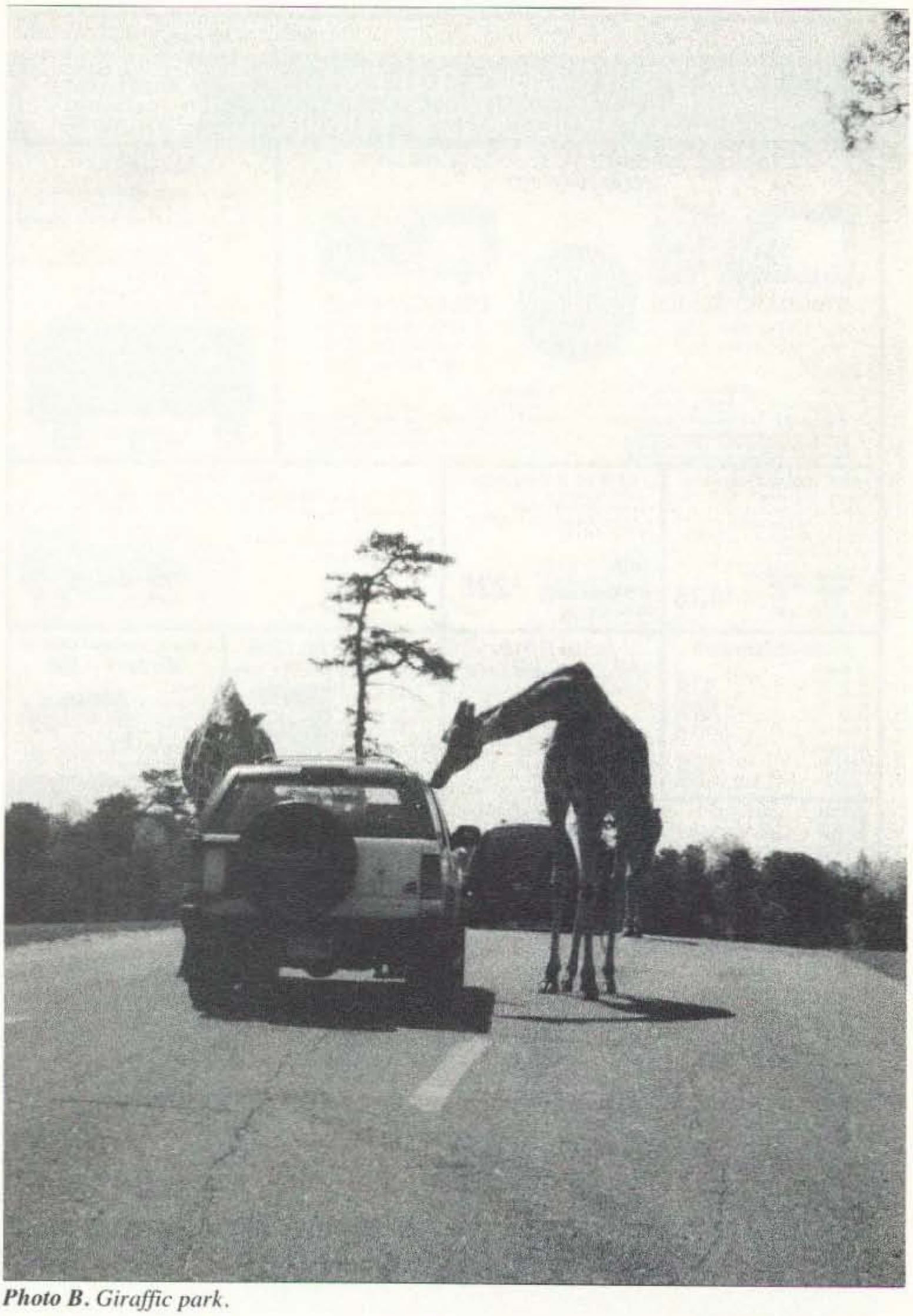


Photo B. *Giraffic park.*

Water

Are you and your family still drinking tap water in spite of my editorials? A recent newspaper article sent in by a reader pointed out that the sodium fluoride our government is putting in our water supplies and which we also get in some toothpastes can damage the central nervous system. "This damage can cause motor dysfunction, IQ deficits and learning disabilities. Harvard Medical School claims the poison can accumulate in the brain tissues. Researchers have claimed for years that fluoride is linked to bone cancer, hip fractures in the elderly, and in tooth decay."

Are you distilling the water you drink yet? I sure am! It's not a big deal to purify the relatively small amount of water you drink—a gallon or two a day per person. My latest Damark catalog lists the Genesis distiller at $180 (800-827-6767).

And what do you think the long-term effects of the chlorine they're using to kill germs in your water are doing to your body and mind? Chlorine is a poison. Are you really still drinking that stuff? Do you have some kind of a death wish? Hey, there are easier ways to get out of a lousy job than slowly poisoning yourself (and your family).

Then there's the copper from your pipes and lead from the solder joining the pipes, and so on. No wonder you're getting sick, feel so tired and can't think as well as you used to.

FCC News

There's a move afoot to make it easier for traveling hams to operate in the countries they're visiting, and for foreigners to operate here. Right now we have to apply for operating permits for every country we visit, which takes time and money. Having operated from over 60 countries so far, I can attest to the frustrations involved—the paperwork, the weeks it often takes, and the license fees.

When the agreements are all signed I'll let you know so you can take an HT and maybe an HF portable the next time you're traveling. I'll also let you know what countries are parties to the agreements, but it does look as if it's going to include most of Europe and the Americas.

While on the topic of traveling, I've been amazed at how few people are using credit cards to pay for my booklets and for subscriptions to *73* and *Cold Fusion*. If you have a business you've got to be really dumb not to get an airline credit card and rack up free flying miles as you pay for as many business expenses as you can with the card. Plus your groceries, gas, and so on. Sherry and I have had Continental Airlines cards for years now and we've been able to fly first class to Europe once or twice a year just on the free miles. Who says it's expensive to travel? Only if you're not taking advantage of the opportunities.

We both like Continental Airlines. Yeah, they had some problems when they got started, but they go almost anywhere we want, and have given us no hassles. When we were doing more traveling we used to buy yearly (senior) passes on Continental (and Eastern before that) which allowed us to travel once a week anywhere in the country. That brought down my traveling cost to around $50 a flight! In the last year or so I've been so busy that I haven't had enough time to travel, so we've skipped getting the yearly passes.

Continental has done a nice job for us, with on-time departures and arrivals, no lost luggage, and decent meals.

Liar Liar

When I see a senator or congressman on TV telling us that campaign contributions don't in any way influence his actions or votes, why am I reminded of the lineup of tobacco executives swearing in that congressional hearing that tobacco is not addictive and does not cause sickness and death?

This is what came to mind as I read Article II, Section 4 of our Constitution. "The President, Vice President and all civil Officers of the United States, shall be removed from Office on Impeachment for, and Conviction of, Treason, Bribery, or other High Crimes and Misdemeanors." Bribery?

If it isn't for the purpose of bribery, what is the purpose of individuals and corporations "donating" millions of dollars for reelection campaigns? Corporations are not known for throwing away money. They invest it.

I plead guilty myself. In the past I've donated $100 or so to election campaigns and I've recommended you do the same thing. And what did I expect in return? Quid pro quo? I expected to be able to get my senator or representative on the phone when I had a concern. I wasn't donating my money to be a good guy and help another good guy get elected—I had the expectation of my

Continued on page 56

Number 46 on your Feedback card

On the Go

Mobile, Portable and Emergency Operation

Steve Nowak KE8YN/5
15475 Summerwood Avenue
Baton Rouge LA 70817

Ultra-basic mobile operations

I do a lot of traveling in my job, and getting in a little radio time helps pass the time and make the miles go faster. A five-hour drive on the interstate will pass much easier if I can talk with a few folks on the way. Since I often end up using rental cars, a handie-talkie is the radio of choice much of the time.

What do you need to operate comfortably on 2m or 440MHz when on the go? Obviously you need a radio, but like many aspects of this hobby, it's the peripherals which make the system work better and much more fun.

The first and most important item is a reasonable antenna. For an antenna, there are several choices. The rubber ducky type of antenna may be fine for use at the hamfest, but is pretty impractical for use in the car. Not only is the short flexible antenna marginal to begin with, but the auto body acts as a pretty effective radio frequency shield. Some people like the clips which allow you to mount the rubber ducky antenna so that it is outside the window. While this does eliminate much of the shielding, it is still only a rubber ducky. For use in the car, I prefer a magnetic-mount quarter-wave antenna. If you remove the antenna from the base, it can easily fit in most suitcases. There are a number of these units which can operate on both 2m and 440MHz, although those that claim to be "gain" antennas tend to be a few inches too long to fit my suitcase. In any case, check the antenna out before you pack it for the trip. I usually do a quick continuity check to make sure that the center conductor and braid are not shorted, and that there is continuity from one end of the antenna to the other.

Make certain that the threads of the antenna are clean. I once bought a dual-band magnetic-mount antenna while on a trip and set it on the roof. It operated extremely poorly, and when I packed it into my suitcase I realized that the threads had been painted and were effectively insulated from the base. Set the SWR using your own car; this should be close enough for most other vehicles. In any case, it will beat the alternatives. Installation only takes a moment once you get to the car, and it can be tucked back inside the car when you park. A couple of suggestions might make this choice easier.

First, when transporting the antenna in your suitcase, keep the magnet away from computer disks or audio tapes.

Second, use a piece of metal as a "keeper" to contain the magnetic field. A round cover plate from an electrical junction box can be obtained at any hardware store and costs less than a dollar. This not only helps contain the magnetic field, but also helps the magnet retain its strength. Don't forget to remove the metal plate before putting the antenna on the car.

Third, try to attach the antenna to the center of the roof and try to minimize dirt, moisture or snow from the location where the antenna will be mounted.

Finally, I usually bring the coax in through the right rear door so that it is not kinked sharply. A center conductor which is braided will be less likely to break than a single conductor. When bringing the wire into the vehicle, do not coil the excess as this will form a coil which the antenna designer did not include in his or her calculations.

For use outside the vehicle, I like to take either a flexible quarter-wave, which mounts on the handie-talkie, or else a telescoping five-eighths wave. Sometimes the nearest repeater is located quite a distance from the hotel where I plan to stay, and the rubber ducky isn't enough. A J-pole made from a section of television twinlead is also useful, especially if you're going to be at one location for a while. The J-pole can be hung from the curtain rod in the hotel room with a small hook or string. It also has the advantage of being able to be rolled up into a very small package.

Power is always a consideration, of course. When traveling, I tend to use the HT's battery packs, and recharge them in the evening. A spare battery pack is important, as is the charger. Although I have a rapid charger, when I travel I only take the trickle charger. Most of these are the "wall wart" variety, which incorporates a plastic box containing the transformer that plugs directly into the wall. If you're traveling and don't use hard-sided luggage, there is always the risk of the plug getting bent during baggage handling. One way to prevent this is to use the type of receptacle found on extension cords as a plug cover. Cut the wire flush with the receptacle, then plug the charger into the receptacle.

I have also had handie-talkies which had drop-in power units that could fit over the glove compartment door. These not only powered the rig, but also could trickle-charge the battery pack. They usually plug into the cigarette lighter and some even have a small light to illuminate the face of the handie-talkie. Obviously, a hand-held microphone is important if using this type of power supply.

In the car, unless you're using a drop-in charger, it's easy to use the HT as a microphone, but small units have incredibly small speakers. At highway speeds, the sound is terrible. A small external speaker can often be found for less than $10 and will make operating much easier. While I sometimes use headphones with an attached microphone for portable operation, I prefer using the external speaker in the car. In some states, wearing headphones while driving is illegal. In any case, if an emergency vehicle is using its siren, I want to be able to hear it—or any other traffic hazard for that matter.

Finally, for VHF and UHF operations, you will need to know which frequencies are available at different locations. The repeater directories have come a long way in the past few years, and each type has its advantages and disadvantages. The atlas type of directory is easier to use, particularly if you're not familiar with the area. On the other hand, I've run across areas where some repeaters were omitted. The pocket-sized directory is more complete and has additional information about the repeater capabilities.

"If an emergency vehicle is using its siren, I want to be able to hear it!"

I tend to write repeater frequencies on the map I plan to use. If it's an area I pass through frequently, I may highlight my favorite, but I leave the others listed. You never know when you may need directions or assistance, and the preferred repeater isn't working, or no one responds. My favorite maps for these purposes are the ones the auto club uses, which are bound into a small booklet for a specific route. Naturally, I tend to program appropriate frequencies into my HT's memory, but if I want to make a contact in a hurry, the map helps me decide which frequencies I want.

Some of the ideas in this month's column may be useful, not only to the traveler, but also to those who are new to the hobby and are getting started on 2m or 440MHz. For many of us, the handie-talkie was our first rig, and finances (or spouses) may tolerate the purchase of one radio, but balk at purchasing two or three. Hopefully there may be an idea or two here which will help you get a successful start. 73

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the November issue, we should receive it by August 31. Provide a clear, concise summary of the essential details about your Special Event.

AUG 2

CARLINVILLE, IL Computer Fair/ Hamfest '97 will be held by the Macoupin County ARC, Inc., at the Moose Lodge in Carlinville. New location: take I-55 exit 60, follow signs 5 blocks west of the square on Rt. 108, turn left on Alton Rd. and watch for signs. Gate time is 7 a.m.–noon. Setup is at 6 a.m. Adm. $3. For general and vendor inquiries, call *Tim Jones, (217) 627-2355.* There will be VE exams for all classes; pre-registration is required. Call *Bill Ogle NØAP, (217) 854-8261.* Talk-in on 146.82/.22.

COLUMBUS, OH The Voice of Aladdin ARC will host the 7th Annual Columbus Hamfest from 8 a.m.–3 p.m. at the Aladdin Shrine Facility, 3850 Stelzer Rd. From I-270, exit WB onto Morse Rd., go 1/4 mi. to Stelzer Rd., turn south. Vendor setup from 6:30–8 a.m. Free parking. Commercial exhibits, flea market, refreshments, door prizes, free seminars. VE exams, register at 9:30. Adm. $5 adults, children under 12 free. Indoor 6-ft. tables, $8; outdoor spaces, $3. Talk-in on 147.84(-). For further info, contact *Jim Morton KB8KPJ, 6070 Northgap Dr., Columbus OH 43229-1945; tel. (614) 846-7790 eves only.*

HOUGHTON, MI The 1997 Upper Peninsula Amateur Radio Convention, better known as the U.P. Hamfest, will be held at the City of Houghton's Dee Stadium facility, located on the downtown waterfront. Doors open to the public at 9 a.m. EDT. Vendors and persons selling equipment will have main floor access beginning at 7 a.m. EDT. Friday eve. access will also be available, although overnight storage will be at owner's risk. AC power by previous arrangement only. Tables are $6/full table, $4/half table. Contact *Roland Burgan KB8XI, (906) 482-2403; E-mail: [rburgan@up.net], Packet: [KB8XI @W8YY.#UPMI.MI.US.NA]. For lodging/camping/boating info, contact Keweenaw Chamber of Commerce at 1-800-338-7982, or on the Web at [http://www.portup .com/ mainstr/chamber/home.html].*

AUG 2 & 3

JACKSONVILLE, FL The 1997 ARRL National Convention will be held at the Osborn Convention Center in Jacksonville. Open to the public Sat., 9 a.m.–5 p.m.; Sun., 9 a.m.–3 p.m. The Greater Jacksonville Amateur Radio & Computer Show will host the event. Free parking in the main convention center parking lot. Setup 1 p.m.–6 p.m. Fri., Aug. 1st. Upgrade VE exams will be offered at 9 a.m. on Sun. at the convention site. A wide variety of programs and forums will be presented by ARRL staff and noted authorities of national stature. Banquet at 7 p.m. Sat. at the HQ hotel, the Jacksonville OMNI. A special rate of $69 per night is available to those mentioning the convention. Phone *(904) 355-6664 or 1-800-843-6664* for reservations. Reg. for the entire weekend is only $8, which includes parking in the main lot. For more info, visit the *Web site at [http://users.southeast.net/ ~jrmoore/hamfest.html],* or write *Greater Jacksonville Hamfest Assn., P.O. Box 27033, Jacksonville FL 32205.* For swap table reservations, contact *Karl Hassler N4DHG, 2767 Scott Circle, Jacksonville FL 32223,* or phone *(904) 268-2302.* Tables are $25 ea. for the weekend. For commercial exhibitor space, contact *Vern Ferris KB4VPU, 356 Aries Dr., Orange Park FL 32073, tel. (904) 272-7250.*

AUG 3

BERRYVILLE, VA The 47th Annual Winchester Hamfest and Computer Show will be presented by the Shenandoah Valley ARC, starting at 6 a.m. at the Clarke County Ruritan Fairgrounds in Berryville. General adm. $5, children under 16 admitted free. Tailgaters, additional $7 per space. Commercial and indoor tables by reservation; contact *Irv Barb W4DHU, Rt. 3 Box 5385, Berryville VA 22611. Tel. (540) 955-1745; E-mail: [ibarb@visuallink .com].* A flyer and vendor's table form can be downloaded from *[http:/ /www.w3ic.com/inet/svarc/hamfest].* VE exams will be given by the Mountain ARC Teams at Cooley School, across from the Hamfest. Walk-ins are welcome. Register 7:30 a.m.–8:30 a.m. No exam fees. For more info on exams, contact *Leo Patterson KQ8E, (304) 289-3576; E-mail: [6815484@mcimail.com];* or call *Gay Rembold W3DFW at (301) 724-0674.* Talk-in on 146.22/.82 W4RKC.

MARSHFIELD, WI The Marshfield Area ARS will host their 6th annual Potluck Picnic and Swapfest at Wildwood Park, Marshfield WI, starting around 11 a.m. All are welcome. Talk-in on 147.180. Contact *Guy A. Boucher KF9XX, 107 West Third St., Marshfield WI 54449. Tel. (715) 384-4323. Packet: [KF9XX@W9IHW.WI.USA.NA]. E-mail: [guyboucher@tznet.com].*

PEOTONE, IL The 63rd Annual Hamfesters Hamfest will be held 6 a.m.–3 p.m. at Will County Fairgrounds (I-57 exit 327 East) in Peotone. Sat. setup 3 p.m.–11 p.m. Free overnight parking. Secured building. Main exhibition hall opens at 8 a.m. Flea Market electric hookup fee is $10. Electricity will cost $10 for 4 tables or less; electricity is free for more than 4 tables. One free ticket per vendor; all others, $4 in advance, $5 at the gate. For reservations, etc., contact *Dave Brasel NF9N, 6933 W. 110th St., Worth IL 60482.*

PORT HURON, MI VE sessions will be held 8 a.m.–1 p.m. by the Eastern Michigan ARC at St. Clair County Community College, in conjunction with their annual Swap Meet. QRP and DX forums and a QRP demo will also be featured. Adm. $3 in advance, $4 at the door. Talk-in on 147.3 and 146.52. Contact *Bob Hebert KB8WMW* or *Frank Forsyth W8XI* at *P.O. Box 611230, Port Huron MI 48061-1230; or E-mail to [kb8wmw@juno.com].*

RANDOLPH, OH The Portage ARC Amateur Radio and Computer Hamfair '97 will be held 8 a.m.–4 p.m. at Portage County Fairgrounds, in Randolph (State Rt. 44, 4 miles south of I-76). Unlimited free parking. Admission is $4 in advance, $5 at the gate. Indoor tables $10 ea., flea market spaces $3 ea. For reservations, tickets, or info, contact Joanne Solak KJ3O at (330) 274-8240. WAS-DXCC card checking will be featured, and ARRL officials will be available. Mobile check-in and info on 145.39(-)MHz and 28.390MHz. Deadline for advance tickets is July 15th. Make checks/ MO payable to *Portage ARC* and mail to them at *9971 Diagonal Rd., Mantua OH 44255.*

AUG 9

BARABOO, WI The 1st annual Circus City Swapfest will be held at the Sauk County Fairgrounds 7 a.m.–noon, rain or shine. Tailgate sales. Free parking. Admission $5 at the gate, $4 in advance. Tables $5 for 8 ft. (includes one admission). Electr. available. For advance tickets and tables, contact *Yellow Thunder ARC, 1120 City View Rd., Baraboo WI 53913.* Check the Web site at *[http://www.thelorax.com/ ~sschulze/hamfest.htm].*

TACOMA, WA The Radio Club of Tacoma flea market will be held at the Charles Wright Academy, 7723 Chambers Creek Road West, starting at 9 a.m. Adm. is $4 with 12-year-olds and under free. Overnight RVs $2 for self-contained, Friday night only. Commercial vendors contact *Alan at (206) 840-4947.* For general info, contact *Bill at (206) 584-1086; E-mail: [BShimmin@CompuServe.com].* Power is limited; first-come, first-served. Talk-in on 147.28(+). Mail reservation payments to *Radio Club of Tacoma, Box 11188, Tacoma WA 98411.*

AUG 9 & 10

ST. CLOUD, MN Hamfest '97 will celebrate the 75th Anniversary of the St. Cloud ARC, beginning with a banquet on Aug. 9th at 7 p.m. Call (320) 251-8008 for reservations and information. Sun. morning at Whitney Senior Center, there will be VE testing at 10 a.m. A swap meet will be held 8 a.m.–2 p.m. Call the number given above for table reservations. Talk-in on 147.015 or 146.94.

AUG 10

STICKNEY, IL The DuPage ARC's Hamfest Computer Show will be held 8 a.m.–2 p.m. at Hawthorne Race Course, 3500 South Cicero Ave., Stickney IL. All dealers will be in one air-conditioned exhibit hall. Commercial setup is Sat., 3 p.m.–6 p.m.; Sun., commercial and flea market setup at 6 a.m. Outdoor flea market spaces are free. All indoor space must be reserved. Advance tickets $4, $5 at the gate. Children under 12 admitted free. Handicap accessible. Talk-in on 145.250MHz.

For advance tickets, send check payable to *DARC*, and send with a business-size SASE to *DARC Hamfest '97, 7511 Walnut Ave., Woodridge IL 60517.*

AUG 14 & 28

FT. WORTH, TX VE Exams by the Lockheed ARC and the Kilocycle Club of Ft. Worth will be held for all classes at the Lockheed Rec. Area Facility, 2400 Bryant Irvin Rd., Ft. Worth, at 7 p.m. For details call *Ted Richard AB5QU at (817) 293-6745.* G.R.O.L. testing by appointment only.

AUG 16

BURFORD, ONTARIO, CANADA The Brantford ARC Flea Market will be held at Burford Fairgrounds on Hwy 53, 15 km west of Brantford, 9 a.m. to ? Adm. $5, children under 12 free. Vendor setup 7:30 a.m., $8 per table. Tailgaters $4. Free parking. Talk-in on VE3TCR 147.150(+). For table reservations contact *Richard La Rose VE3RLX, 153 Dunsdon St., Brantford Ont. N3R 6N3; (519) 752-2437. Packet: VE3RLX@VA3SME; E-mail: [rlarose@bfree.on.ca].* Or write to *Brantford ARC, P.O. Box 25036, Brantford, Ont., Canada N3T 6K5.*

LONGVIEW, WA The Lower Columbia Radio Assn. (W7DG) will sponsor its 6th Annual Ham Radio, Computer & Electronic Equip. Swap meet, 9 a.m.–3 p.m. at the Cowlitz County Fairgrounds in Longview. Adm. $3. Swap tables are $12 before Aug. 2nd, $15 after. Commercial tables $15. Free parking, overnight RV parking on the fairgrounds for $10, electrical hookup available. Vendor setup Fri., 5 p.m.–9 p.m.; Sat., 6 a.m.–8:45 a.m. Talk-in on 147.26(+), pl 114.8. Take exit 36 or 39 off Interstate 5 and follow the signs west for the county fairgrounds. Mt. St. Helens and the Oregon coast are nearby. For more info, write to *LCARA Swap Meet, P.O. Box 906, Longview WA 98632;* or call *Bob KB7ADO, evenings, at (360) 425-6076.* Or E-mail to *[KB7ADO@aol.com].*

ROANOKE, VA A Hamfest/Computer Show will be held by the Roanoke Valley ARC, Sat., Aug. 16th, 9 a.m.–5 p.m. at the Exhibit Hall, Roanoke Civic Center, Roanoke VA. Setup at 6 a.m. with help available. Features include equip. dealers, free forums, two walk-in VEC exam sessions, and an indoor/outdoor flea market. Adm. is $5 at the door or in advance, outdoor tailgating $5, Indoor flea market tables $10 per table, dealer tables $20 ea. (plus $20 for electr.). Make checks payable to, and mail an SASE to *RVARC, P.O. Box 2002, Roanoke VA 24009.* Dealers and inside flea market contact *Claude KE4UVO, (540) 774-8971, or [ke4uvo@intrlink.com].* All others contact *Terry AE4EW, (540) 890-6782 or [ae4ew@ix.netcom.com].* Talk-in on 146.985(-).

AUG 17

CAMBRIDGE, MA A tailgate electronics, computer and amateur radio Flea Market will be held Sunday, Aug. 17th, 9 a.m.–2 p.m. at Albany and Main Sts., Cambridge MA. Adm. $4. Free off-street parking. Tailgate room for 600 sellers; $9 per space in advance, $10 per space at the gate. Includes admission. Setup at 7 a.m. For space reservations and further info, call (617) 253-3776. Mail advance reservations before the 5th to *W1GSL, P.O. Box 397082 MIT BR., Cambridge MA 02139-7082.* Talk-in on 146.52 and 449.725/444.725 - pl 2A W1XM rptr. Sponsored by the MIT Radio Society and the Harvard Wireless Club.

PAULDING, OH The Paulding County AR Group, Inc. will hold their 7th Annual Hamfest at the Paulding County Fairgrounds on Fairgrounds Road. Free camping. Young hams under 12 admitted free with one adult. Setup at 6 a.m. Inside table $8, includes one gate; outside spaces, $5, includes one gate. General Adm. $3. Additional tables $5. Contact *Hamfest Chairperson, Jerry KB8MAF, PCARG Inc., 10392 SR 500, Paulding OH 45879. Tel. (419) 399-4507 or E-mail: [jlrhod @Bright.net].* Talk-in on 146.46/.46 simplex or 146.865/.285 rptr.

AUG 23

BRIDGEWATER, NJ The Somerset County ARS Inc. Annual Hamfest will be held at the Somerset County 4H Center on Milltown Rd., just off Route 202, 8 a.m.–1 p.m. Setup is at 6 a.m. Talk-in on 448.175 (-5) pl 141.3, 147.135(+.6) pl 151.4. Call *Pat N2CQM, (908) 873-3394,* or write to *SCARS, P.O. Box 742, Manville NJ 08835.*

AUG 23–24

WOODLAND PARK, CO The Mountain ARC will hold its 16th Annual Campfest at the Colorado Lions campgrounds (4.5 miles north of Woodland Park, on Hwy. 67 North). Follow the signs. This is a family event with picnic, camping, and fishing. Gates open for campers Fri. at 2 p.m. Camping and/or selling fee is $10 per night (no double fees). Advance, paid reservations are required for camping. Bring your own tables or tailgate. Talk-in on the 146.82 rptr. The Colorado Lions Camp is in charge of refreshments and no other food sales are permitted. Pot luck dinner around the campfire Sat. night at 5 p.m. Contact *MARC, P.O. Box 1012, Woodland Park CO 80866-1012;* or call *Don AAØNW at (719) 687-3692.* Remember, this event is being held in Colorado High Country, so come prepared for the weather.

AUG 24

ADAMS, MA The Northern Berkshire ARC will hold their Annual Flea Market at Adams Agricultural Fair Grounds, beginning at 8 a.m. Setup for vendors is at 7 a.m. Vendor contact is *Joel Miller N1WCF, (413) 442-2653.* Talk-in will be on 146.910, the Mt. Greylock rptr. Prices are $6 for vendors, including one adm.; $3 for shoppers with adm. for the first person; and $1 for each additional person. Pre-reg. for vendors secures a table, if needed. Tables will be available on a first-come, first-served basis the day of the event.

YONKERS, NY A Hamfest/Computerfest will be sponsored by the Yonkers ARC at the Yonkers Municipal Parking Garage on Main St. in Yonkers. Buyers: 9 a.m.–3 p.m., sellers: 7:30 a.m. No VE exams. Pre-reg. $10 per space, AC power available with pre-reg. $14 at the door. Buyers: $5; XYL, YL, and kids under 12 free. Make checks payable to the Yonkers Amateur Radio Club, and mail to *Y.A.R.C., P.O. Box 378, Centuck Sta., Yonkers NY 10710-0378.*

AUG 31

DUBUQUE, IA The Great River ARC, Iowa Antique RC and Historical Society, and the Tri-State Computer Users Group will sponsor a Hamfest/Radiofest/Computer Expo August 31st, 8 a.m.–2 p.m. at the Dubuque County Fairgrounds on Old Highway Rd., west of Dubuque. Features include free parking, dealers, flea market, tailgating, and VE exams at 10 a.m. Adm. is $3 in advance, $5 at the door; 12 and under admitted free. 8 ft. tables are $8. Talk-in on 147.84/.24. Contact *Loren Heber NØYHZ at (319) 556-5755; Jerry Lange KBØVIK at (319) 556-3050; or Jerry Ehlers NØNLU at (319) 583-1016.* Write to *G.R.A.R.C., P.O. Box 546, Dubuque IA 52004-0546.*

SEP 6–7

AUSTIN, MANITOBA, CANADA The Manitoba Amateur Radio Museum will host its 3rd Annual Ham Fest on the grounds of the Manitoba Agricultural Museum in Austin. For details write to *Manitoba Amateur Radio Museum Inc., 25 Queens Crescent, Brandon, Manitoba, Canada R7B 1G1.*

LOUISVILLE, KY The Greater Louisville Hamfest/ARRL KY State Convention will be held at the Kentucky Fair & Exposition Center, all indoors. Tickets $6 for both days, Sunday $5 at the door. Send advanced ticket registration with an SASE. Mail requests for tickets and info to *P.O. Box 34444-Q, Louisville KY 40232-4444.* Commercial vendors call *(812) 948-0037 or (812) 282-7007.* For flea market spaces call *(812) 282-4898 or (502) 935-7197.* Check the Web page at *[http://www.thepoint.net/~GLHA/].*

SPECIAL EVENT STATIONS

AUG 1, 2 & 3

OSHKOSH, WI Members of the Fox Cities ARC will operate W9ZL from the Experimental Aircraft Assn. Fly-In and Convention in Oshkosh. Operations will be on the General phone portions of the HF bands, as well as RTTY and CW, as conditions and operators permit. The club will also be giving "on grounds" convention information (no QSLs please) on 146.520 simplex. Proper QSL and SASE only, to *Wayne Pennings WD9FLJ, 913 N. Mason St., Appleton WI 54914 USA* for a special 8" x 10" picture certificate.

AUG 16

TAMA, IA The Tama ARS will operate WDØGAT 1500Z–2300Z Aug. 16th, to celebrate the 100th Anniversary of Lennox Manufacturing. Operation will be in the General 80–15 meter phone, Novice 10 meter phone, and 2 meters. For a certificate, send your QSL and a 9" x 12" SASE to *TARS/WDØGAT, P.O. Box 94, Montour IA 50173 USA.*

AUG 16, 17 & 18

ENGLEWOOD, NJ The Englewood ARA, Inc., invites all amateurs the

world over to take part in the 38th Annual New Jersey QSO Party, 2000 UTC Sat, Aug. 16th–0700 UTC Sun., Aug. 17th, and from 1300 UTC Sun., Aug. 17th–0200 UTC Mon., Aug. 18th. Phone and CW are considered the same contest. General call is "CQ New Jersey" or "CQ NJ." NJ stations identify by signing "De NJ" on CW and "New Jersey calling" on phone. Frequencies: 1810, 3535, 3950, 7035, 7135, 7235, 14035, 14285, 21100, 21355, 28100, 28400, 50–50.5, and 144–146. Phone on even hours; 15/10m on odd hours (1500 UTC–2100 UTC); 160m at 0500 UTC. Exchange QSO number, RST and QTH (state/province, or country). NJ stations' QTH is their county. For more information, write to *Englewood ARA, Inc., P.O. Box 528, Englewood NJ 07631-0528 USA.* Include a #10-size SASE. Stations planning active participation in New Jersey are requested to advise EARA by Aug. 1st. Portable and mobile operation is encouraged.

AUG 30–31

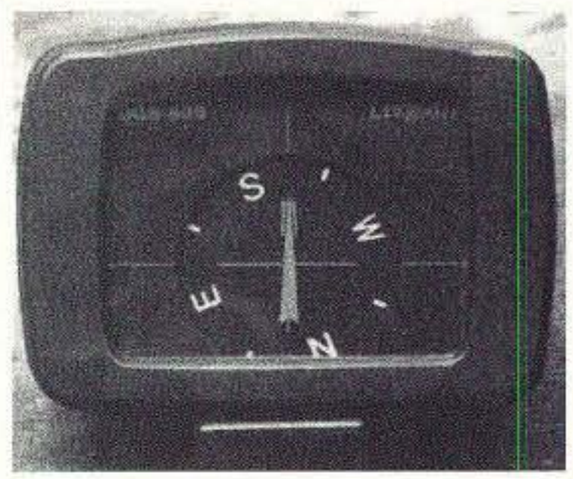
BOWLING GREEN, KY Station N4HID will be operated by the Western Kentucky DX Assn., 0100 UTC Aug. 30th–2400 UTC Aug. 31st, in recognition of the contributions made by animals to science, and for their companionship with mankind. Operation will be on 7330, 14280, 21380 and 28580MHz. Certificates will be available. Send name and address to QSL to *Ed Gann N4HID, 445 Elrod Rd., Bowling Green KY 42104 USA.*

AUG 31

THOMSON, IL The Palisades ARC and 90 West DX Assn. will operate Station W9BPT, Aug. 31st, 1700Z–2100Z, to celebrate Thomson Melon Days. Operation will be on the lower portion of the General 40 and 20 meter bands. For a certificate, send QSL and 9" x 12" SASE to *Bob Plumley K9IEG, 1123 West Main St., Thomson IL 61285 USA.* 73

Number 49 on your Feedback card

Updates



No, *this* way ...

Readers of Joe Moell's "Homing In" column in July may have noticed an anomaly. Here is **Photo A**.

Wanna talk to a real person?

At the end of "Build the Mag-Glass," on page 23 of June's *73*, the telephone number for ordering Neodymium iron-boron magnets from Marlin P. Jones and Associates is actually their FAX/automated ordering number. If you want to interface with a human face, call: (800) 652-6733. 73

Number 88 on your Feedback card

Barter 'n' Buy

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it, rather than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The *73* Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial!) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the November 1997 classified ad section is September 12th, 1997.

RF TRANSISTORS TUBES 2SC2879, 2SC1971, 2SC1972, MRF247, MRF455, MB8719, 2SC1307, 2SC2029, MRF454, 2SC3133, 4CX250B, 12DQ6, 6KG6A, etc. **WESTGATE**, 1-800-213-4563. BNB6000

CUSTOM DIAL COVERS/CLOCK LENSES (HAMMARLUND, ETC.) $10.00 PPD. Send bezel, OLD or dimensions, make, model. **Bill Turner WAØABI**, 1117 Pike, Saint Charles MO 63301. BNB499

The Communicators HandBook A Reference guide for the professional engineer or Radio DX'er with A list of **FREE** catalogs and Much, Much, More!!.. To Order send $9.98 U.S. Check/M.O., Canada $13.50 int'l postal M.O. TO: **S. Crawford**, P.O.B. 83, Riverdale NY 10463. Fast FREE Shipping. BNB799

Audio Equipment wanted. 1930's - 1960's. Tube-type amplifiers, large or small speakers, mixers, microphones, tubes, parts, etc. Especially Western Electric, Jensen, Marantz, McIntosh, J.B.L., etc. **1-800-251-5454.** BNB202

BREAK THE CODE BARRIER: A self-hypnosis tape that allows you to learn or increase code speed easily and quickly. To order send $14.95 + $3.00 S&H to **Dr. Hal Goodman**, P.O. Box 184, Eastport ME 04631. For more info. send SASE or [http://www.nemaine.com/w3uwh/morse.htm]. BNB2031

HEATH COMPANY is selling photocopies of most Heathkit manuals. Only authorized source for copyright manuals. **Phone**: (616) 925- 5899, 8-4 ET. BNB964

CLASSIC RADIOS. RadioFinder web list revised weekly: [www.radiofinder.com] TEL/FAX **(313) 454-1890**; [finder@radio finder.com]. BNB700

ASTRON power supply, brand-new w/ warranty, RS20M $99, RS35M $145, RS50M $209, RS70M $249. Call for other models. **(818) 286-0118.** BNB411

TIRED OF IRONING? PCB service. No $ setup, free scanning available. **FIRST PROTO,** 4201 University Drive. #102, Durham NC 27707. (919) 403-8243. BNB5005

HEATHKITS WANTED: Premium Prices paid for unassembled Heathkits. Rob W3DX, **(804) 971-6812** evenings or [Robcap@aol.com]. BNB206

METHOD TO LEARN MORSE CODE FAST AND WITHOUT HANGUPS Johan-N3RF. Send $1.00 & SASE. **SVANHOLM RESEARCH LABORATORIES**, P.O. Box 81, Washington DC, 20044 U.S.A. BNB421

FM MICRO/LOW POWER BROADCASTING 88-108MHz. PLL Transmitters/R.F. Amplifiers/Antennas. Mono/Stereo, 50 mW's to 100 Watts. Free *Catalog*/Info Call (250) 642-2859 or E-Mail: kscott@pinc.com. **R. Scott Communications Ltd. We Ship World Wide From Canada!** BNB102

MAHLON LOOMIS, INVENTOR OF RADIO; by Thomas Appleby (copyright 1967). Second printing available from **JOHAN K.V. SVANHOLM N3RF**, SVANHOLM RESEARCH LABORATORIES, P.O. Box 81, Washington DC 20044. Please send $25.00 donation with $5.00 for S&H. BNB420

Number 50 on your Feedback card

CARR'S CORNER

Joseph J. Carr K4IPV
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[carrjj@aol.com]

Let's do a few things this month. We will continue (briefly!) the discussion on ham software, we will look at radio astronomy and related topics, and then we'll mention a nationwide QSO party for those who like contests.

Software

Golly day, it's interesting reading E-mail after publishing a "controversial" (?) article like my software rant. For those who came in late, I have bemoaned the lack of professionalism in a lot of ham software. I also bemoaned the fact that so much of it is in the obsolete MS-DOS format, rather than Windows®. Wow! What an interesting time reading E-mail after that article appeared.

One guy wrote: "Right on, OM! I bought (remain nameless) from (so-and-so), and it was a DOS program ... Like you said, it wouldn't run on my Windows 3.1 machine." The very next E-mail, immediately beneath it, came from the guy who wrote and distributed the offending software: "You are totally ignorant! I will continue to write DOS software ... My (remain nameless) program is well regarded and very popular ... it continues to sell." I should have forwarded the first guy's E-mail to him—one of his own customers was congratulating me.

I was also struck by the tone and shrill illogic of some E-mailers. One fellow made the absurd accusation that anyone with a Pentium™ computer and Windows 95 has to be rich, and only uses it to download pornography off the World Wide Web. Not me, thank you. My religious convictions and respect for my wife and kids say, "Don't go there."

Several people ranted against Bill Gates. I can't say that he's my favorite person, and I very much wish he had some old-fashioned competition. But does that mean I want to stay with an obsolete (Bill Gates) product? And then again, I could spite my face by cutting off my nose.

One fellow verged on abusive, but after we exchanged a few E-mails seemed to calm down. Others ... well, others did not respond so well. One chap made so many illogical, untrue, and just plain phony claims that I had to laugh. My response to him: "Sir, your opinion is yours to have by right, but recognizing your constitutional right to hold dear any opinion you wish does not mean that I have to overlook the fact that said opinion stands on the edge of a logical precipice that is simply too broad for the healthy mind to leap."

Radio astronomy

Hams are ideally situated to do some radio astronomy observation. Regular readers of this column know that one of my passions is getting new blood interested in amateur radio ... and if that new blood happens to be high-school- or college-aged youngsters, then all the better. Learning a bit about radio astronomy would serve to ease people into our hobby as well. Radio astronomy will, after all, fit nicely into the science curriculum of high schools, community colleges, and four-year colleges ... and might be of interest to their ham clubs.

The equipment and antennas of radio astronomy are very reminiscent of ham radio stuff (at least the receivers). If you would like to explore this topic, then here are some sources (some on the World Wide Web and E-mail):

Radio-Sky Publishing
P.O. Box 3552
Louisville KY 40201-3552
E-mail: [radiosky@radiosky.win.net]
Web site: [http://www.win.net/~radiosky]

Radio-Sky publishes several books, including a really good teacher's guide to radio astronomy. It's mistitled, however, because it is useful to nearly everyone interested in the subject. Also, the author of *Radio Astronomy Projects* (a Radio-Sky title), Dr. William Lonc, can be reached at:

E-mail: [lonc@husky1.stmarys.ca]
Web site: [http://apwww.stmarys.ca/~lonc/lonc.html]

One thing on Dr. Lonc's Web site is information on the 2m ham band beacon set up on Sable Island in the Atlantic by St. Mary's College in Nova Scotia.

Jeff Lichtmann has a catalog of supplies and books for aspiring radio astronomers:

Jeff Lichtmann
Radio Astronomy Supplies
190 Jade Cove Drive
Roswell GA 30075

Finally, the Society of Amateur Radio Astronomers (SARA) can be reached at:

Society of Amateur Radio Astronomers
Membership Services
247 North Linden Street
Massapequa NY 11758

If you are interested in the Search for Extraterrestrial Intelligence (SETI), then an amateur group might be of interest:

Dr. Paul Shuch N6TX
SETI League
P.O. Box 555
433 Liberty Street
Little Ferry NJ 07643
E-mail: [n6tx@setileague.org]
Web site: [http://www.setileague.org/]

You can also find a lot of material on the World Wide Web by typing in "radio astronomy" on your Web browser. Be sure to limit the search to sites that meet both words (some browsers like to see something like "radio AND astronomy", others have a check box).

Radio astronomy isn't the only activity that might possibly interest newcomers. I have coined the term "radioscience observing" to cover the entire range of activities involving the amateur science applications of radio: astronomy, SID/solar flare hunting (HF and VLF), Jupiter DXing, moonbounce, terrestrial propagation studies, and others. In fact, I am working on a book on this subject for Howard W. Sams (look for it late this year or early 1998). Radio astronomy and radioscience observing might be the "hook" to get some people interested in amateur radio.

U.S. Air Force 50th Anniversary QSO Party

In celebration of the creation of the United States Air Force on September 17th, 1947, the Headquarters, U.S. Air Force Directorate of Communications and Information, is sponsoring a QSO party for all interested radio amateurs from 0001 UTC 20 Sept 97 to 2359 UTC 21 Sept 97. All bands and modes.

Score contacts by "point identifier."

Stations with licensees with no Air Force affiliation have a point identifier of 1, are worth one point, and would identify with the suffix "Air Force One" on phone or "/AF1" on CW or digital modes.

If the licensee is a U.S. Air Force veteran, member, or retiree (of any component, active, Air National Guard, or AF Reserve), the point identifier is determined by subtracting the year the licensee entered the Air Force from 1997. For example, if he or she entered the Air Force in 1947, their point identifier is 50 (1997 - 1947 = 50), and they would ID "/AF50." If he or she entered in 1963, their point identifier is 34 (1997 - 1963 = 34), and they would identify "/AF34." Note that the duration of Air Force service is insignificant; the point identifier value is determined solely by the year the member entered the Air Force.

Obviously, the most sought after stations will be those brave men and women who entered the Air Force in 1947, whose point identifiers will be "50" and whose contacts are worth 50 points!

Scoring: Add total point identifiers for all qualifying contacts.

Multiple contacts: Stations may be worked multiple times on

QRP

Low Power Operation

Michael Bryce WB8VGE
P.O. Box 508
Massillon OH 44646
[73357.222@compuserve.com]

The 1997 Dayton HamVention® is history. With excellent weather, although it was a bit cold on Friday, the crowds were out in full force. As usual, QRP operators from around the globe found their way to the Days Inn South.

FDIM

It was standing room only for this year's Five Days In May QRP sessions. Starting Thursday morning, the sessions covered just about every aspect of operating QRP. No matter what you may be interested in, from antenna design to designing your own Web page, it was covered during the FDIM sessions.

Plans are already in the works for next year's event. If you have never made it to the Dayton HamVention, you must clear the calendar for next year's FDIM.

Of course, even if you could not make the FDIM sessions held at the Days Inn, there were also QRP forums being held at the Hara Arena. They were hosted by the QRP-NE club, with Jim W1FMR as the moderator. So, if you wanted to learn more about QRPing, Dayton was the place.

Friday night, the QRP ARCI held its annual banquet. Our guest speaker this year was Martin Jue, president of MFJ Industries.

The QRP ARCI is pleased to announce that the following were inducted into the QRP Hall of Fame in 1997 for outstanding contributions to the QRP community:

Doug Hendricks KI6DS
Dick Pascoe GØBPS
Mike Czuhajewski WA8MCQ

All were present at the QRP banquet at Dayton to accept their awards. Previous HOF inductees were: 1992—W1FB, G3RJV, AA2U, W7EL; 1996—K8IF, W9SCH, W9PNE, WØRSP, W7ZOI, K1BQT, GM3OXX.

And from the president of the QRP ARCI, Mike Czuhajewski WA8MCQ:

"The QRP ARCI also presented plaques of appreciation to Mike Bryce WB8VGE, for his long work for the QRP ARCI in the thankless but difficult and critically important jobs of membership chairman and publicity manager, and to Myron Koyle N8DHT, for his years of work in running the rooms reservations which contributed greatly to the success of QRP Dayton."

I was happy to accept the plaque for N8DHT, who was unable to attend the banquet. A quick head count by me tallied up over 150 people in attendance—needless to say, it was sold out. Seems we are making some noise, because this year it took Pete over 30 minutes to give away the door prizes!

QRP operators not only like to play radio, they like to build radios as well. So Friday night, after the banquet, the QRP ARCI held its vendor night. Here vendors from around the world showed off their latest and greatest to the crowds.

New goodies to play with

While I can't possibility list all the vendors with all their new gadgets, here are a few that stuck out Friday night:

Wilderness Radio had their Sierra and Cascade rigs. And how about a noise blanker for your NorCal QRP rig? They also had their new BuzzNot noise blanker. It really works!

On hand, too, was the Wilderness KC2 LCD counter/keyer/S(C)meter/wattmeter. This widget does everything I just said and only draws 7mA doing it. You can add the KC2 to the Sierra or any other QRP rig.

S&S Engineering was showing off their new DDS VFO. If you've been planning on a analog VFO for a project, you should take a look at this microprocessor-based digital VFO.

Dave Benson also had on display his new "White Mountain" SSB transceiver. Right now, he has models for either 75 or 20 meters. Its small size—4.4 by 5.25 inches—makes the White Mountain one of the smallest SSB rigs I know of in kit form.

Dave also informed me that the popular Green Mountain series of superhet CW transceivers is now available on all the ham bands from 80 to 10 meters. This includes 30, 17, and 12 meters.

Kanga US was showing off a new multiband rig, but Bill did not have enough information about the new kit to share details. So, contact Bill at Kanga US to learn more.

There sure were a lot of "38 specials" running around at Dayton. Most could be seen Friday and Saturday night at the Days Inn. Although I can't say it with 100 percent certainty, I was told that as of Friday night, NorCal had sold over 1,700 "38 specials."

On hand were Atomic keyer kits, Rainbow antenna tuners, keyers, keyer paddles and microprocessor-based goodies of all types. Why, I even had a selection of QRP-sized solar panels.

One of the slickest projects I saw was a Wilderness Radio Sierra with an LDG microprocessor-controlled automatic antenna tuner. I'm sorry I did not make a note of the name or the call of the operator who did all the work. If you know, please drop me a note. It's the only Sierra "AT" I've ever seen!

One interesting comment my wife made to me was the name selection used by the various vendors for their products. She noted that rigs from W6 land were named after guns (the 38 special and the 45 automatic), while the stuff out of the east coast had names like the "White Mountain" rigs. What surprised *me* was that she noticed in the first place.

QRP ARCI news

Myron N8DHT has stepped down as secretary/treasurer of the QRP Amateur Radio Club International. Ken Evans WD4U of Lilburn GA is the new secretary/treasurer.

To renew your membership in the QRP ARCI, contact me at the address at top. *Do not* send renewal monies to Ken. If you would like to join the QRP ARCI, again, send your check to *me*. The current price of renewal is $15. New member with membership certificate is $17. Membership in the QRP ARCI is for life. The yearly dues are for *The QRP Quarterly*.

If you have a problem with your membership, I'm the guy to contact. If you have E-mail, that's the best and fastest way to let me know about your problem. My E-mail address is also at top. Don't contact Ken WD4U or anyone

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the same band if the contacts are on different modes, but only once on each band if on the same mode. Stations may be worked and scored on multiple bands.

Send logs by 15 October 1997 to: K5HOG, Razorback Radio Club, 604 Julian Avenue, Honolulu HI 96818, USA.

Logs must have station worked, date, time, mode, band, and point identifiers for each contact. *Points must be totaled on each page to be accepted.* Neither accepted nor rejected log sheets will be returned unless accompanied by a suitable SASE.

Prizes: Trophy (plaque) with Air Force 50th Anniversary logo signed by the Headquarters, United States Air Force Director of Communications and Information (Lt. General William Donahue) to the overall winner. Certificates (signed and with AF 50th logo) to top three finishers in each state and country.

Questions to: Bernie Skoch K5XS, Colonel, USAF, Director of Communications and Information, Headquarters Pacific Air Forces, 604 Julian Avenue, Hickam Air Force Base, Honolulu HI 96818; E-mail: [75376.12@compuserve.com].

While this is not a Contests column by any means, I thought this one looked especially interesting. So, Go Air Force, Happy 50th Anniversary (which is a lot to say from a guy who works with Navy aviators)!

That's it for now. Please keep that snail mail and E-mail coming in, and no "DOS spams," please! To each his own (opinion, that is)! 73

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
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[dmiller14@juno.com]

You're invited to send me your tips, suggestions, ideas and shortcuts, as always, to the addresses shown above. I'm always in the market for new and interesting contributions like this first item.

The mysterious capacitor

From Ken Guge K9KPM: "I recently encountered what at first seemed a strange problem with my broadband VHF/UHF discone antenna. One of the beauties of the discone design is its very wideband frequency capabilities; this one (a commercially-made unit) is specified as usable on transmit from 2m on up through the 23cm ham band and with an even greater range of potential usability as a receive-only antenna.

"Over the winter, however, my discone's SWR rose dramatically (to over 3:1 at 2m). It reached the point where the antenna became virtually unusable for either receiving or transmitting. I first checked the indoor end of the feedline with an ohmmeter, and found that there was some measurable shunt resistance; this in an antenna that should have displayed a completely open circuit to DC. Going a little further, I also found that it was acting very much like a fairly high value capacitor ... about 3,000pF in fact! At 2m, that 3,000pF (.003µF) would be enough to effectively bypass all but the strongest of 2m signals to ground, working out to about an ohm of capacitive reactance at 144MHz.

"My first thought was that perhaps water had somehow worked its way into the coaxial (RG-8X) cable feeding the antenna, but disconnecting the coax at the far end, and repeating the measurements, proved conclusively that the coax itself was perfectly all right ... the problem had to be in the antenna. But what could go wrong with a nicely-machined, well-sealed antenna's main connection block? There was virtually no open gap for water to enter the connecting block from the sides or from above, yet disassembling the entire machined piece showed a considerable amount of internal corrosion and even a small amount of water itself. **Fig. 1** shows a side view of the basic construction of the antenna—not particularly complicated nor subject to this type of problem. What might possibly have caused this seemingly inexplicable condition to develop? The antenna's coaxial connector is facing downward—it was unlikely that water might have worked its way in via this route. Ditto for the rest of the discone's construction. There just wasn't any obvious way for moisture to enter in a liquid form—only via humidity in the air. Here's what I feel happened:

"The interior of the connection block has a small, hollow cavity, which, though not penetrable by rain, is subject to infiltration by moist, humid air (not being hermetically sealed). We have our fair share of moist, humid days in the Chicago area, often followed by quickly changing temperatures that can drop amazingly rapidly (sometimes 60 or 70 degrees in just a few hours). If moist air gets into the connector block's cavity, and then is subjected to a dramatic cool-down, the moisture in the trapped air will condense out in the form of liquid water. Several episodes of such a natural occurrence can cause a significant buildup of water inside a tight (but not perfectly air-tight) container. I feel that the discone's connecting block cavity was such a container. Over time, of course, the water worked on the surrounding metal pieces, causing severe corrosion and changing the pure water into something more like an electrolyte. That electrolyte, and the otherwise insulated metal pieces inside the block, resulted in a .003µF electrolytic capacitor being developed right inside my VHF/UHF antenna—isn't nature wonderful?

"Now here's the moral. If you live in a climate such as that found near Chicago, it might be best to consider either sealing relatively air-tight connections entirely, or, if that's not practical, leaving enough free-air circulation space so that air exchange can take place more rapidly when climatic conditions shift quickly. In that way, humid air has a chance to be flushed out before it can condense

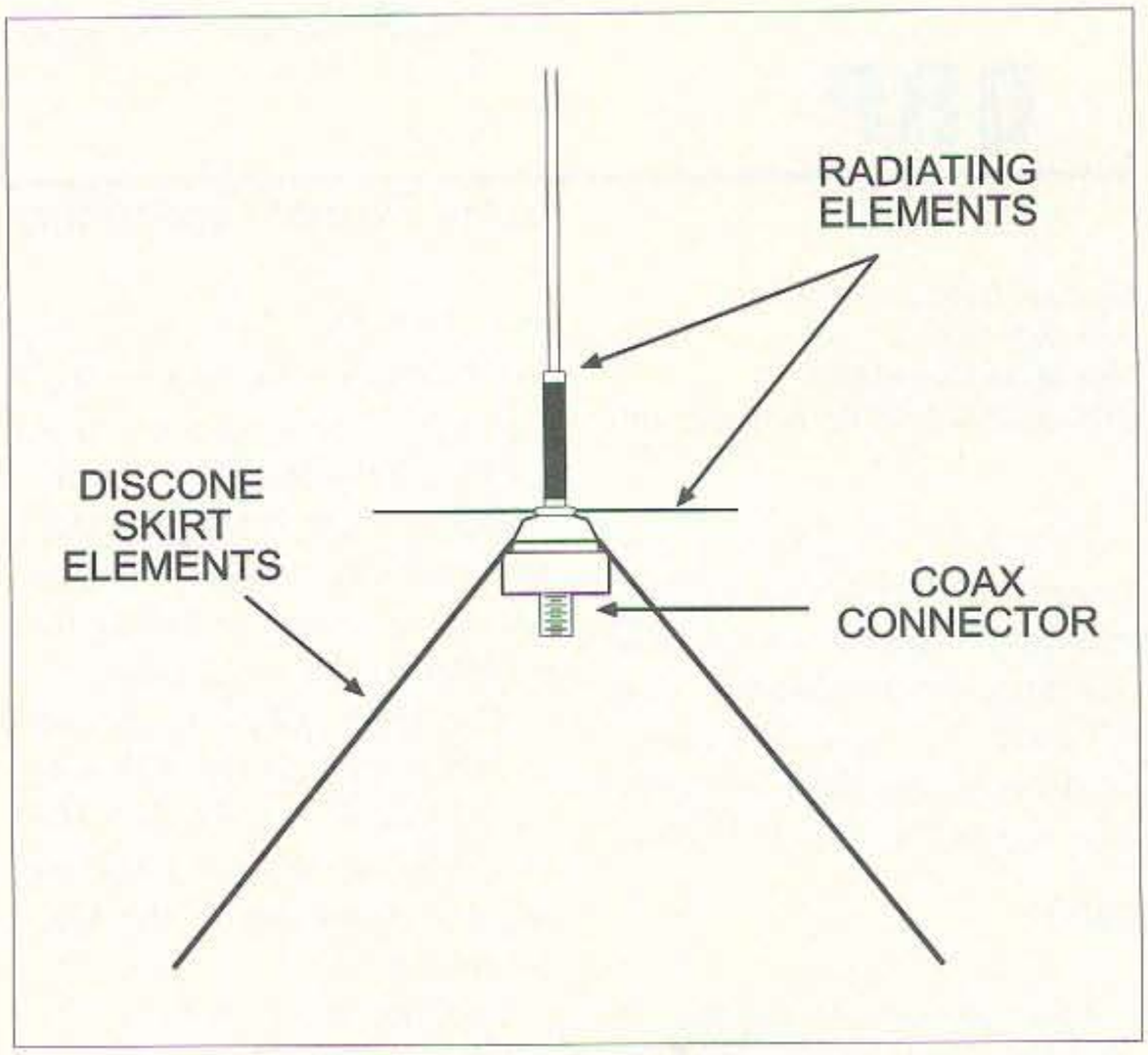

Fig. 1. *K9KPM's discone antenna. The connector block is very weather-resistant, but not totally airtight. The coax cable connector is attached to the bottom of the block.*

else. I'm the only person who can modify the computer database holding the club's records.

FD photos

By the time you read this, those mosquito bites should have healed over. How about sending some FD photos to me? I'm sure the rest of the QRP world would like to see what the other guy's station looked like!

New QRP award

The 30 Meter QRP Millennium Challenge. In a nutshell, here's the basic idea:

The first person to work 200 countries (confirmed by QSL) using 2W RF (output) on the 30m band by the year 2000 will win a very (very!) nice trophy. This is not going to be as easy as it sounds. Working the required 200 countries is not that hard, but getting all the QSL cards is another matter. The deadline is January 1, 2000. Yes, I know there was no "zero" year, but the deadline remains January 1, 2000.

This is something I've been wanting to do for a very long time. Although many of the finer details have yet to be worked out, this should be enough to get everyone started. As they say, "the clock's ticking."

- To give everyone a head start, only contacts made after July 1, 1997, count toward the award.
- RF power output shall be no more than 2W.
- Contacts must be confirmed by QSL. QSL cards should indicate the QSOs were at QRP levels.
- Only contacts made on the 30m band count towards the award.
- Multi-mode contacts are fine, e.g., CW or any digital mode that does not use repeaters.
- The award is open to all licensed ham radio operators worldwide.

I'll be getting all my ducks in a row, and by the time this article hits your mailbox, all the details will be down. I also will send the rules to all the various clubs and magazines. Now, I wonder who will be the winner? ... 73

and deposit its water into the open cavity. In the case of my discone antenna, I chose to fill that open cavity above the bottom connector with Stuf™. It's a Teflon™-based grease that's compatible with electrical connections, and is made by Cross Devices of Cutchogue, NY. It's described as a dielectric waterproofing filler for coax connectors. I bought my tube of Stuf in Milwaukee, but it's probably available elsewhere as well. I packed the grease into the cavity of the connection block so that some of it actually oozed out when everything was reassembled and a new connector was installed, assuring me that the cavity would now be virtually airtight (or at least tight enough to prevent a similar occurrence in the future). We'll see.

"After reassembly, the antenna showed perfect continuity through the connection points and no shunt impedance whatsoever, so I'm reasonably confident that the job will hold. I hope that my experience may have some value to other readers who've encountered similar problems with outdoor connections. Remember to stick with it—there's an explanation for everything!"

Moderator's note: Ken is absolutely right when you stop to think about it. Any enclosure that's capable of trapping moist, humid air is a potential water reservoir, just waiting to happen, when a quick change in temperature takes place. Filling that reservoir with an RF compatible grease (such as he did), is probably the best insurance against an event like K9KPM experienced. Good tip, Ken!

Circular memory

From Frank Brumbaugh W4LJD: Here's an easy-to-implement tip that won't void a single manufacturer's warranty. "If you ever have difficulty remembering what band your antenna tuner might actually be tuned to, then here's the gadget for you! It's never a good idea to key your transceiver into an unknown load, as can easily happen if you've forgotten on what band (or band segment) you last used your tuner (antenna transmission line matching network). Many tuners are not marked with regard to actual band or frequency range, so it's often difficult to see where the tuner is set just by glancing at it ... but no more!

"Take a look at **Fig. 2** and make up something similar for yourself, either out of cardboard or artist's drawing board. What's shown in **Fig. 2** is somewhat reminiscent of the old circular slide rules used by engineering students before the advent of electronic calculators and now palmtop computers. It's just a circular cardboard cutout that mounts onto another piece of square or rectangularly shaped cardboard, with a single screw through its center and a nut placed on from behind. All of your normal ham band haunts can be shown around the perimeter of the movable circle, and when you've tuned everything up correctly, move the cardboard circle to the proper position to indicate what band or band segment you're tuned to. That's it—nothing elaborate, just an always-close-at-hand reminder for those of us who need it. Don't laugh—if you don't need it now, you will!"

Reach for the stars

From Thomas Hart AD1B: Here's a tip for making it easier to operate through the RS-12 satellite. "Since becoming 'seriously' involved in hamming through the RS-12 satellite, I've been seeking out ways to make the experience even more fun. Using the satellite involves transmitting on the low end of the 15m phone band and listening on the satellite portion of the 10m band. Using only a Kenwood TS-430S, I've been able to put the transceiver's built-in split-VFO to work as the means of generating the 15m up/10m down frequency offset needed. As time went on, I thought that it might be interesting to hear my downlink signal in real time, too, so I tried using another 10m-only transceiver that I owned for that purpose. The results were disappointing, perhaps partly due to the transceiver itself not being sensitive enough, perhaps partly due to desensing caused by my own 15m transmit signal. I heard myself on the downlink, but it wasn't nearly what I had hoped for in terms of signal strength and reliability.

"My next step was to try listening for myself on RS-12's 2m downlink instead. I purchased a reasonably priced 2m to 10m converter from Hamtronics, used the 10m-only transceiver as the tunable IF for the converter, and ended up very satisfied with the overall results. The use of a sensitive receiving converter ahead of a mediocre 10m transceiver seems to be an economical answer for a better downlink monitor. Since the noise level and sensitivity are determined in the 2m converter, even a converted CB SSB transceiver may work well enough as the IF, demodulator and audio stages of a setup like this. Why not give it a try if you happen to be strapped for cash, but would still like a few bells and whistles in your satellite station?"

Cable shrinker

From Phil Salas AD5X: "In my mobile VHF ham installation, I like to use RG-8X (or RG-8M from Radio Shack™) to bring the RF from the radio at the dashboard out to the hatchback antenna mount in the rear. To then exit the vehicle, I've rigged up a short (one foot) section of RG-174/U to get through the car's hatchback gasket, and then to the outside antenna mount.

"RG-174/U 50Ω coax is the perfect size to use, being just a tenth of an inch in diameter. It easily feeds through my car's hatchback weather-stripping without spoiling the purpose behind the weather-stripping gasket. Splicing the RG-8X to the RG-174U takes place via a pair of BNC connectors and a BNC feedthrough barrel. Rigging a BNC connector for the RG-174/U can be a bit tricky, but I've had good results using a crimp-on type of BNC plug (intended for RG-58 coax) but soldering it instead to the miniature RG-174/U coax.

"Here's how I've done it: First, I tin the lip of the BNC's collar, then strip off about 1/2" of the RG-174/U's outer black jacket. I unbraid the exposed shield and fold it back along the remaining jacket. Next, I strip off all but 1/8" of the center conductor's insulation, cut the center conductor to 1/4" length, tin it, and slip the BNC center pin over the tinned end, carefully soldering it in place

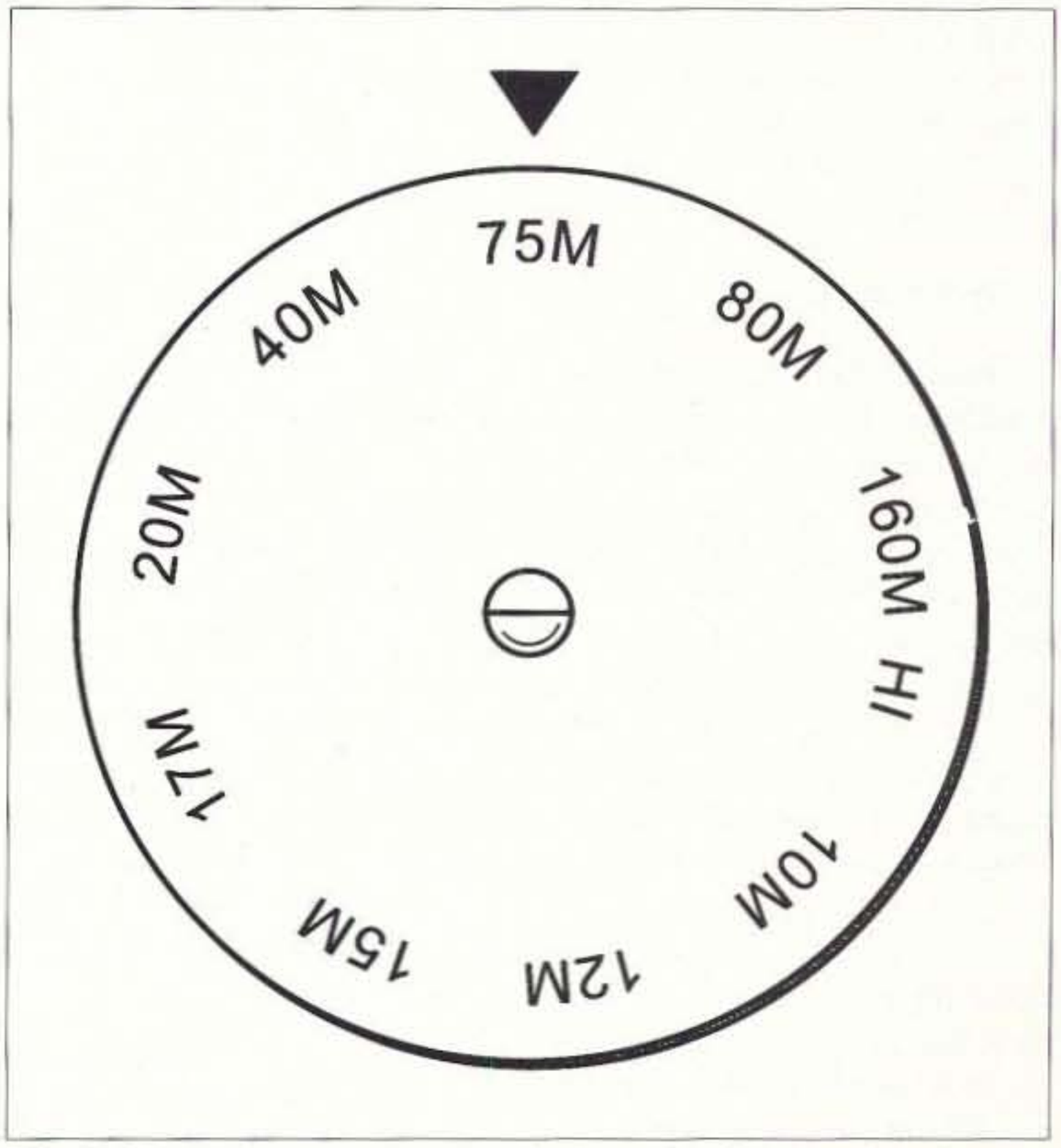

***Fig. 2.** W4LJD's tuner memory wheel, made of artist's board, to remind the operator of the last band or band segment for which the tuner was optimized. See text.*

with minimum heat and very little additional solder. If too much solder is used, the center conductor pin may not fit back into the BNC's shell properly. If done correctly, you should now be able to insert the RG-174 finished cable and pin into the BNC's shell far enough so that the center pin is seated firmly and the tip protruding just shy of the end of the BNC shell. The final step is to solder the RG-174/U's braid to the previously tinned collar of the BNC plug assembly, again using the absolute minimum amount of heat to do the job. Allow plenty of cooling time and don't move the assembly during the cool-down period; these tiny cables can't withstand much heat, so it's best to practice on a scrap piece first.

"Last, but not least, I put a short length of heat-shrink tubing over the BNC's collar and part of the cable, and shrink it in place. The addition of the shrink tubing gives a protective, professional-looking touch to the job. Finally, connect the open end of the RG-174/U to the antenna mount that you're using, again finishing up with a short piece of heat-shrink tubing for stress resistance and weather tightness. The entire cable assembly should hold up well if reasonable care is taken to make sure that it doesn't get pinched at any time in the hatchback door-to-frame interface. It's also one that you'll be proud to show off to your ham buddies."

Battery tap tip

From Jerry Lagersbrom AAØMO: "Here's a tip to keep in mind if you need to make a high-current connection directly to your automobile's 12V battery, such as for that new mobile ham rig you just bought. Instead of splicing into the existing battery connections at or near the battery's terminals, simply use the 'spare' set of terminals that already exist on many of the current line of auto batteries. Since some automobile makers use the side-mounted terminals for their main connections, and some use the top terminal scheme, battery makers will often provide two sets of terminals on new and replacement batteries. It helps to keep down the inventory that dealers have to keep on hand. It also makes it very easy for the ham radio mobile operator who wants to tap into the battery right at the source itself, which is the recommended way of doing the job. Simply purchase the correct terminal kit (either top or side) opposite from what your car's manufacturer has chosen, and use those terminals for your mobile rig. When it comes time to sell the car, it's an easy matter to remove the radio's cabling, since you didn't have to splice into the original factory wiring for your installation. It also makes it easy to disconnect your added wiring should it become necessary to isolate a future power drain problem ... at least you can easily exonerate your ham gear from blame."

Murphy's Corollary: Any rechargeable-tool battery will run down just moments before the last of the important tasks is completed.

Many thanks to the contributors who make this column worthwhile each month. Without their continued input, I'd run down pretty quickly. They include:

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Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of 73 Magazine, *and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or* 73 Magazine *for any equipment damage or malfunction resulting from information supplied in this column.*

Please send all correspondence relating to this column to Dave Miller NZ9E at the address at top. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73 Magazine*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to *73 Magazine*. 73

Number 54 on your Feedback card

HAMSATS

Amateur Radio Via Satellites

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Since the early days of AMSAT-OSCAR-6 nearly a quarter century ago, satellite chasers have devised ways to set up and operate mobile and portable stations. This has allowed them to take their favorite ham-radio pursuit on the road. High power and large directional antennas are not needed to make quality contacts through many low-earth-orbit amateur satellites, and operating a portable or mobile satellite station can be a lot of fun.

Enlightenment

My first serious satellite home station included some rather antique tube-type HF gear in conjunction with solid-state receive and transmit converters. Getting everything wired together was challenging, but operation through AMSAT-OSCAR-7's mode "B" transponder (70cm up and 2m down) was easy. I was familiar with the HF gear, and it was a simple matter to calculate the transmit and receive frequencies.

To listen on 145.950MHz with my 2m-to-10m receive converter, the HF receiver was set to 29.950MHz. Transmission on 435.150 was as simple as setting the HF transmitter to 29.150MHz. The transmit converter and the power amplifier took care of the rest. Reasonably good circularly-polarized, crossed-yagi antennas provided some great contacts, and even the occasional European DX from my south Texas station.

During a demonstration for a Houston ham group, the amplifier died due to a power problem. For about a month, I had only about 750mW of output from the 70cm transmit system. To my surprise and delight, this was sufficient to make contacts through A-O-7. Voice contacts were difficult, but the CW contacts were effortless. The effective radiated power (ERP) was calculated as 7.5W when the antenna gain and cable loss were considered. A 70cm, quarter-wave-whip, mag-mount antenna and a 10W transmitter would have done as well.

Experiments with various omnidirectional antennas were performed after the amplifier was repaired. As expected, the results were acceptable. With some extra attention to the feedline, preamplifier, and power output, superb contacts became the rule and not the exception. Similar results were obtained via AMSAT-OSCAR-8's mode "A" transponder (2m up and 10m down) using an outdoor ground-plane antenna on 2m and an indoor dipole on 10m.

Going mobile

My first attempt at mobile satellite work provided a few surprises and led to some important changes. While the results of the home station were promising, the radio configuration, power system, and antennas for the car required some modifications.

The older HF rigs were too large for the vehicle and required

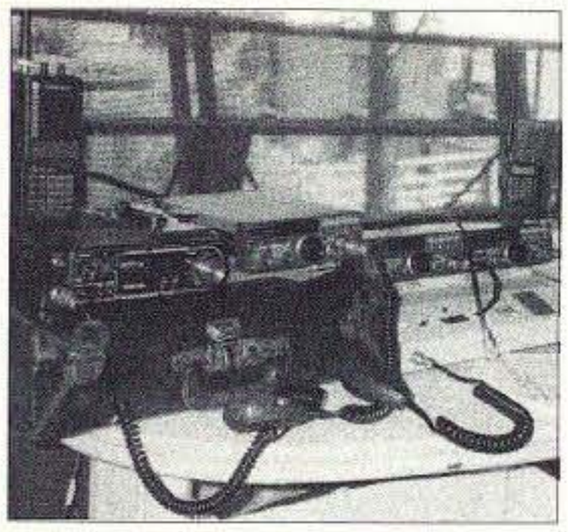

Photo A. *A collection of multi-mode rigs covering all the satellite frequencies from 15m through 70cm.*

special power inverters to get the high-voltage DC for the tubes. The receive and transmit converters were difficult to mount, connect, and power. The car's ignition generated unexpected noise and, due to the close proximity of the transmit and receive gear and antennas, there was excessive receiver desense.

Choosing the right equipment

I decided to start over with a simple configuration only for mode "A" activity. A borrowed Kenwood TR-9000 multi-mode, 2m transceiver was used for the uplink. The antenna cable was routed away from the receive gear and the power line was connected via RG-8 coax cable directly to the car battery. The antenna was a Larsen 5/8-wave mag-mount.

A Yaesu FRG-7700 general-coverage receiver provided a usable downlink signal with some help from a home-brew MOSFET preamplifier and a cut-down CB whip antenna. Power was routed from the battery through a filter board. While some ignition noise was still present, the desense problem was gone. Several hundred contacts were made with this setup from Texas, New Mexico, Colorado, and Wyoming via A-O-8 and some of the early Soviet RS hamsats.

Park it

Did you know that you can get a ticket in Texas for inattentive driving? It's not a good idea to operate complex equipment while driving, and the state troopers will be glad to explain it to you. Don't chase satellites while in motion if you are in the driver's seat. Weak signals, changing conditions, Doppler shift and the complexity of controlling two radios simultaneously are enough without trying to keep on the road at the same time. Listening for the beginning of a pass while tuning the receiver is plenty.

Moving on

After banging up some of the radios in my mobile system, I saw that using my primary (home) rigs on the road would never be appropriate. In addition to being somewhat old, delicate, and hard to power, they are all too large and heavy. Even many of today's popular satellite radios fit into this category. I just can't see trying to mount a Yaesu FT-736R under the dash or trying to pack it into a briefcase. Even the smaller new ones like the Icom IC-821H are rather expensive to be hauling up and down the freeways.

Over the years, I have collected a number of secondhand, small, multi-mode, single-band transceivers that are employed almost exclusively for satellite work on Field Day, vacations, camping trips and mobile excursions. They all operate from 12V, can be packed easily, cost between $80 and $250 each, and are old enough to repair without a microscope and a super-fine-point soldering iron. A few scratches and dents won't bother me as long as they provide good service.

For the 15m uplink to RS-12, I use an NCG 15m SSB/CW transceiver. It was $80 at a local swapfest, is very simple, puts out about 15W, is a bit large at 9 x 9 x 2.5 inches high, but has a nice three-digit LED frequency display. It is a bit rare, but there have been a few similar 15m solid-state monobanders produced by other companies over the years. With a simple dipole antenna, most of my RS-12 contacts have been made with this radio while away from home.

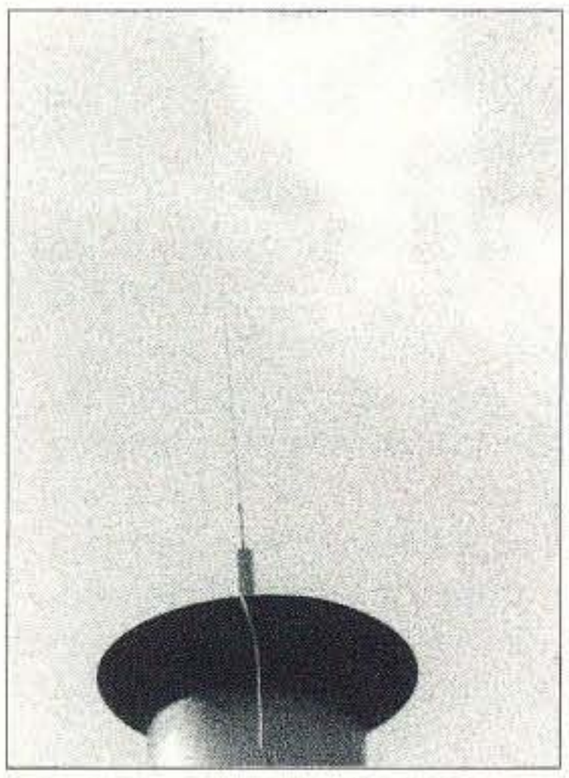

Photo B. *A modified "CB" mag-mount saw portable use as an RS-12 uplink antenna while perched on a chimney pipe.*

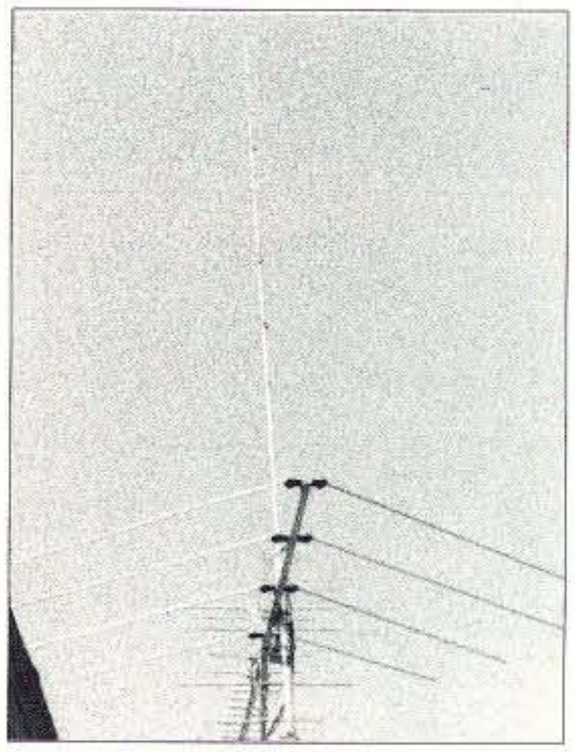

Photo C. *A CushCraft Ringo Ranger easily mounts above the TV antenna for hamsat operation.*

A Uniden HR2510 10m all-mode transceiver has provided good service for mode "A" downlink work. While there have been several modifications to boost its power output, that has been unnecessary for my receive requirements. Its sensitivity is good. While it lacks selectivity, congestion on the satellites is usually not a factor, and this radio does its job well. The Radio Shack HTX-100 and Uniden HR2600 are almost identical, with the exception of fewer modes in the Radio Shack transceiver and a few more features in the HR2600 version. Prices on these radios range from $100 to $180, depending on the condition.

My Yaesu FT-480R, multi-mode, 2m transceiver has been the central unit of my portable and mobile configuration for a number of years. It was purchased from a local ham for $250 and does a great job for both mode "A" and "J" (2m up and 70cm down) uplinking with 10W output, and mode "B" receive, sometimes with a preamp. The central microprocessor went out soon after purchase, but Yaesu was very helpful with a reasonably-priced replacement. There are excellent multi-mode 2m rigs available from all the major ham manufacturers. Price and availability are the determining factors.

Finishing out my monobander collection is the Yaesu FT-780R for multi-mode 70cm mode "B" uplink activity and mode "J" reception. It was originally purchased in Panama. After a few years, it found its way to my shack in Houston after an exchange of $225. The 70cm satellite band is from 435 to 438MHz. The FT-780R operates between 430 and 440MHz, thus covering my needs. For those requiring a radio that will work terrestrial 440 repeaters, this rig is not appropriate. There are other transceivers that tune 420-450 or 430-450MHz.

The only new radio in my collection of mobile/portable satellite rigs is an Alinco DJ580T dual-band (2m and 70cm) HT. It has provided many excellent FM contacts with *Mir,* the Shuttle, and AMRAD-OSCAR-27 using the large battery pack and 15-inch dual-band whip antenna.

Antennas and amplifiers

While ground planes and other omnidirectional antennas have worked well for the LEO hamsats from the car, I have tried a few yagis, quads, and helix antennas while out fishing or camping. The extra gain has always helped, but without rotators, I feel a bit silly running back and forth to the antenna array every few minutes to re-aim. Experimenting in the back yard before an outing to a remote location usually provides

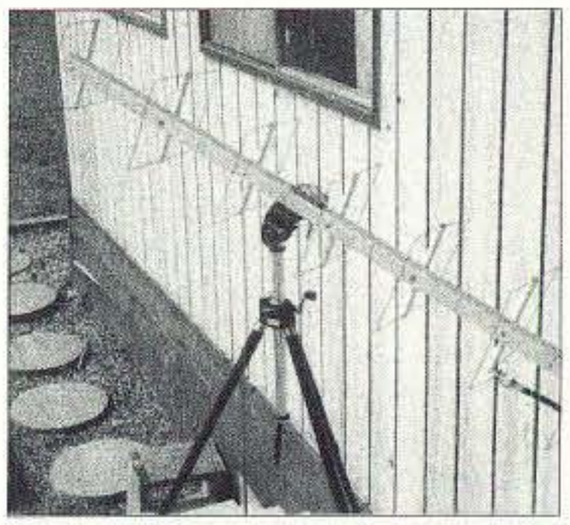

Photo D. *An old camera tripod provided support for a seven-element 70cm quad during a fishing trip.*

an opportunity to determine the best configuration beforehand.

Occasionally I have needed an amplifier to get a good signal up to a target satellite. If the power is available and the transmit signal doesn't cause desense in the receiver, an amplifier has made the difference between a few difficult QSOs and many easy contacts, but there's a catch. The key to good satellite operation is to focus on the receive system before increasing the output power. There are already too many stations on the amateur satellites that overload the transponders just because they have inadequate reception and keep raising their uplink signal until they can hear themselves. Good preamps and downlink antennas come first.

What's next?

If you haven't undertaken mobile or portable hamsat chasing, give it a try. It's not easy, but the results are certainly satisfying. Check out the used gear at the conventions and swap meets. It's best to keep the big rigs at home and the small inexpensive ones on the road.

There are some out-of-production HTs that do CW and SSB, including the AEA DX Handy for 10m and the Santec LS-202A for 2m. There are also a number of new CW/SSB HTs made in Japan that are not marketed in the United States and cover the bands from 40m up through 70cm. They occasionally show up for sale on the used market and might provide even more fun for satellite backpacking and low-power (QRP) satellite work. 73

NEVER SAY DIE

Continued from page 45

"donation" buying some influence. And, indeed, I found that the system worked as I expected. Donors usually get through to the man, non-donors don't. And that's bribery.

So we're reading about the High Crimes of the Clinton White House and both of the political parties, plus the time that congressmen have to spend building their re-election campaign funds.

When the money is a bit short a senator can threaten an industry with a hearing. Since almost (?) every industry is crooked, that loosens the purse strings in a hurry. I remember when Senator Dodd of Connecticut was charged with that by a Senate Committee.

Fortunately we have the fox guarding the hen house, so we're not seeing any indictments or impeachment proceedings, despite the patent illegality of the whole campaign funding process.

The solution? The only one I can think of is my Never Reelect Anyone (NRA) approach. That would at least make reelection campaigns unnecessary, since all incumbents would be eliminated in the primaries. It would help, but it wouldn't totally discourage the swarms of lobbyists waving suitcases full of cash at our representatives.

I've also proposed that state legislatures pass laws making it illegal for any congressman to speak or vote on any bill which might affect the business of any donor. That might help dry up bribery. Further, to initiate such an actions I've proposed that every ham club select a club member and run the member for the state legislature. We need to start having some political clout anyway.

Boiled Silver

I see where Bob Beck is recommending that you silver merchants use less salt to make colloidal silver by making it while boiling your distilled water. He says this makes a finer grade of colloid which will keep longer and act faster. I'm building quite a file on colloidal silver, but I'm not sure how much of it is fact and how much exaggeration. In the meantime, I've got Dr. Douglass of *Second Opinion* saying not to drink the stuff, while on the other hand there's a ton of testimonials telling about the wonders of drinking it.

Well, I don't think you can go far wrong if you use it to prevent salmonella on chicken and

Continued on page 77

Number 57 on your Feedback card

HOMING IN

Radio Direction Finding

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Build the NorthScope

Sometimes hidden transmitter hunting (T-hunting) is easy. I get sharp, unambiguous bearings, drive directly to the hidden T on good streets through light traffic, and my passengers ask, "What's so hard about this?"

Or was I just daydreaming? Actually, it seems as if every time I take ride-alongs to demonstrate the fun of radio direction finding (RDF) contests, the hunt is extra difficult and I don't do as well as I would like. Of course, it wouldn't be fair to blame the passengers for upsetting my concentration. The fact is that there are wide variations in difficulty of T-hunts due to variations in signal level, polarization, terrain, and the surroundings of both the hidden T and the hunters. I'm always seeking out new ways to get the best bearings in the worst circumstances.

Most two-meter T-hunters in southern California use a yagi or quad of three to six elements on a mast extending vertically from the vehicle window or roof hole. They depend on the radio's S-meter to tell the direction of strongest signal as they rotate the mast by hand. An RF attenuator keeps the meter on scale when closing in. In urban areas where signals are constantly reflected from hills and buildings (multipath), the beam's sharp forward lobe can pick out each direct and reflected signal component. That's a major advantage of the beam method over a Doppler or dual-switched-dipole setup.

The down side is that interpreting your beam's indications can be tricky and time consuming, slowing you down when speed is of the essence. Sometimes multipath, airplane flutter, and path blockage make the S-meter reading fluctuate constantly as you roll along. Getting an accurate bearing on the direct signal while ruling out reflected signal peaks under these circumstances is not an exact science. A few experienced T-hunters have improved their performance with polar-plot bearing displays of signal strength versus direction on a cathode-ray tube (CRT) or computer.

CRT bearing readouts featured in past "Homing In" columns include those of KK6CU (October and November 1992), NØMKJ (March 1994), and AB6OS/KA6SOX (November 1993). The screen shows signal strength versus direction from multiple sweeps of the antenna so the operator can "eyeball average" fluctuations resulting from motion. It is much easier to discern the most likely direct signal direction in a multipath environment with a polar display than it is with just an S-meter.

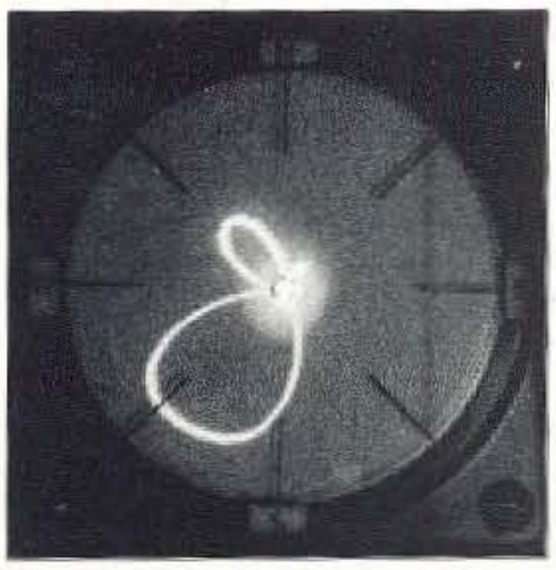

Photo A. *A local repeater produces this pattern on the mobile quad and NorthScope. The main forward lobe at 220 degrees true is the direct signal. The second lobe at 320 degrees is reflected signal from nearby foothills.*

North-up is better

All of the above polar displays show signal directions relative to the vehicle's heading. That's fine when you're driving in a straight path and you know exactly which way you're going. But what about T-hunts that take you on winding roads in new housing developments or along desert washes in the middle of nowhere? How can you interpret the display accurately when it rotates as the vehicle turns?

Last month's "Homing In" showed how a fluxgate compass sensor on your mobile beam detects the mast's orientation with respect to true north. Why not combine the fluxgate sensor and CRT readout to produce a polar display of signal strength that is always relative to north, no matter which way you turn? In aviation terms, this is called a "north-up" display. I call mine the NorthScope.

For good "eyeball averaging," the CRT must display several rotations or sweeps of the RDF antenna at a time. An ordinary oscilloscope won't do—you need a storage-type oscilloscope or a high-persistence CRT like those in radar sets of the pre-computer era. The NorthScope trace of **Photo A** is typical for a strong signal with a small amount of multipath. The higher the beam's gain, the sharper and narrower the major lobe will be. Note that this pattern is consistent for every rotation of the antenna because the vehicle and source are stationary and there are no moving objects such as aircraft in the path.

The NorthScope is at its best in a difficult RF environment such as in **Photo B**. The large repeatable lobe identifies the most likely direct bearing to the T. Reflections and noise in other directions show up as a jumble of non-correlated traces after several rotations of the mast. If there are two or more keyed-down transmitters in different directions on the frequency simultaneously, the NorthScope can resolve bearings for each of them. Try that with a Doppler!

Sometimes the signal level flutters, making it hard to find a peak on the S-meter. Worse yet, imagine the S-meter bounce if the signal switches on and off every second or so. (It's legal on some hunts!) Under these conditions, turn the antenna slowly several times, find the peak on the polar display, then read the direction.

A CRT readout need not be a budget-breaker. Used storage scopes show up regularly at electronics surplus sales and swap meets. They aren't cheap, but if you're an experimenter, you will find other uses for one around the shack. Medical monitors such as the Tektronix Model 603 include waveform storage and are available on the surplus market at lower prices. Look for scopes and monitors that accept two analog inputs and have an X-Y mode, plus gain and position controls for each channel.

Laboratory scopes and medical monitors are designed to operate from household outlets. You will need a DC-to-AC step-up converter to adapt them to mobile use. PowerVerters™ by TrippLite are suitable and available in several wattage ratings. Be advised that the current drain of a storage scope or monitor can be substantial; a heavy-duty car battery is a good idea.

A simple interface

To connect the scope to the sin/cos fluxgate outputs (described last month) and draw a polar plot as the mast goes around, we need a circuit that varies the sine and cosine amplitudes in proportion to the incoming signal level. The analog multiplier, a little-known function block, is perfect for this task. Not to be confused with the more common analog multiplexer (which switches signals), the analog multiplier produces an output signal that is the exact product of two input signals. For instance, if one input is +2 volts and the other is +3 volts, the multiplier output is +6 volts.

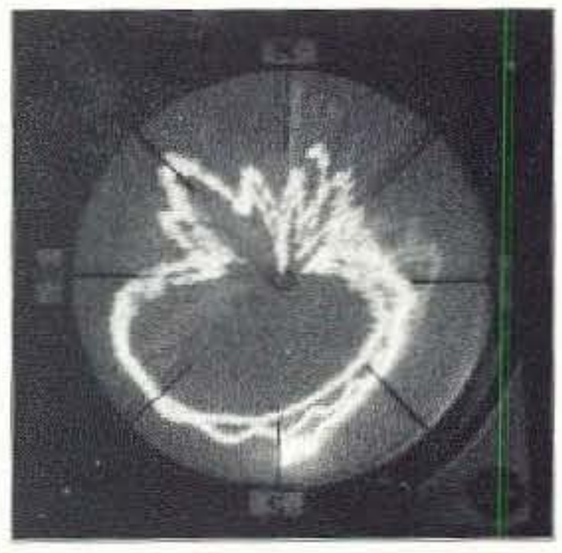

Photo B. *This distant simplex signal is on the other side of a hill, so it has lots of multipath and airplane flutter. By viewing several overlaid sweeps with the NorthScope, it is clear that the most likely bearing is 235 degrees.*

A four-quadrant multiplier takes into account the polarity of input signals. If A input is -2 volts and B input is +2 volts, output is -4 volts. Put in -1.5 volts and -2.0 volts to get +3.0 volts, and so forth. Typically, the product voltage is internally divided by a factor of 10. This makes sense when you consider that the result of 5 volts times 5 volts is too great for a circuit powered by a 15-volt source if the output is not scaled down.

Analog multiplier integrated circuits are inexpensive and ideal for modulators, wattmeters, voltage-controlled amplifiers, and automatic gain control stages. The major suppliers of these ICs are Analog Devices, Harris Semiconductors, and Motorola Semiconductors. Sin/cos signals swing positive and negative, while S-meter signals are positive. Therefore, the multiplier must operate in two of the four quadrants.

I chose the Motorola MC1495, available from nationwide distributors such as Newark Electronics. The dual-inline package (P suffix) is easiest for home builders to use, but it may be harder to find than the surface-mount (D suffix) package.

Fig. 1 is the fluxgate-to-monitor interface circuit schematic. There are separate analog multiplier ICs and operational amplifiers for the X and Y axes. All parts except the multipliers are available at local parts stores. They fit onto a few square inches of perforated board space (**Photo C**). Construction is simple, even without an etched circuit board. No ground plane is needed, but be sure to put the supply bypass capacitors close to the ICs. Mount S1 and R1 in convenient locations for adjustment during T-hunts.

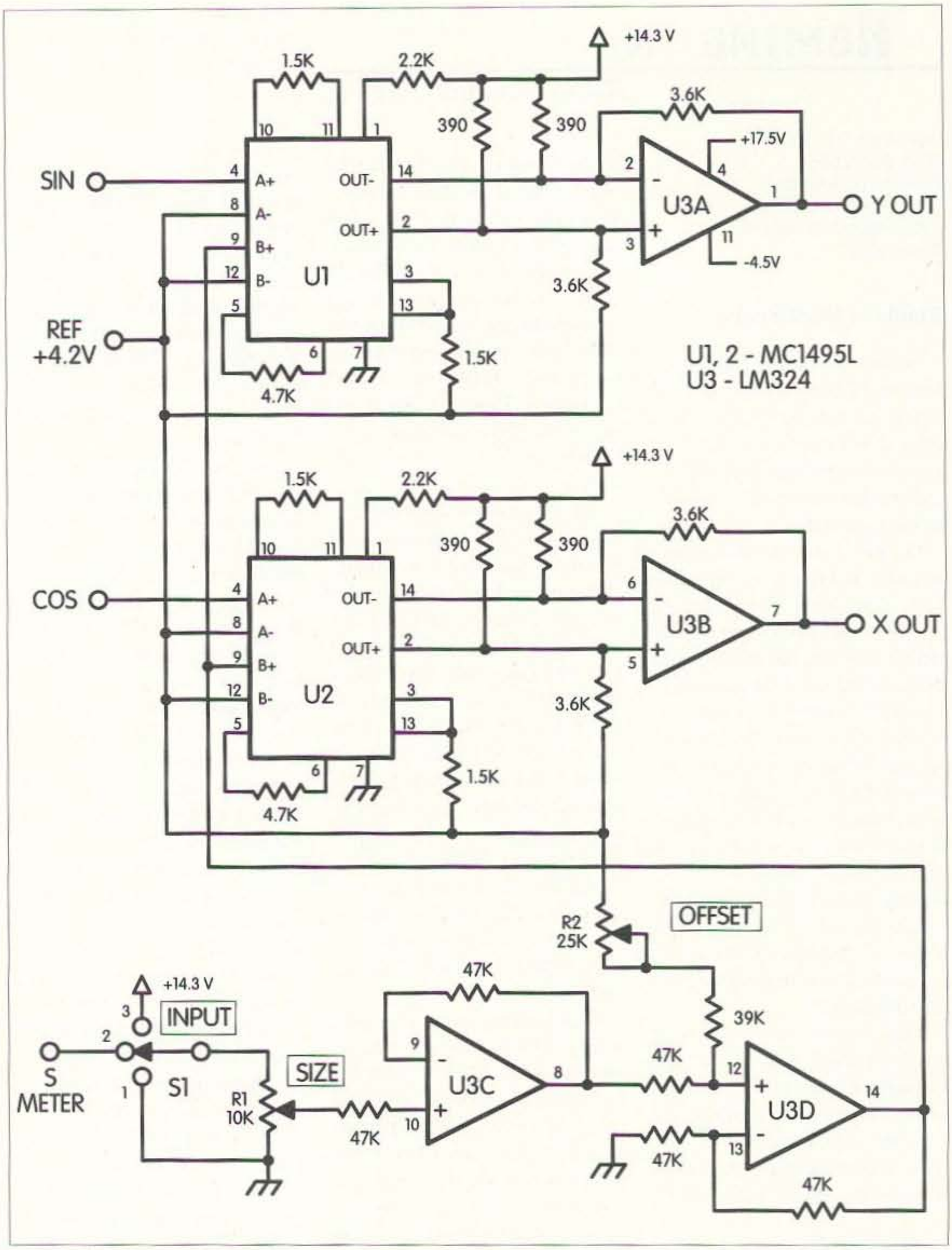

Fig. 1. Schematic of the interface circuit that combines fluxgate compass and S-meter signals to drive a north-up CRT display. Resistors are in ohms and capacitances are in microfarads unless otherwise noted.

Inputs of the multiplier ICs are differential amplifier stages. That's ideal for this application because the sin/cos outputs from the fluxgate compass vary positive and negative with respect to a +4.2-volt analog reference. By connecting multiplier inverting input pins to the analog reference, that relationship is preserved through the interface circuit and there is no need for a regulated negative voltage supply. U3A and U3B convert the differential outputs of the multiplier ICs to single-ended.

My receiver's S-meter tapoff circuit is described in Chapter 5 of the book *TRANSMITTER HUNTING—Radio Direction Finding Simplified* (available from *73*'s Radio Bookshop). It includes an operational amplifier to drive an analog panel meter atop the dashboard. The op-amp output in that circuit goes from zero to +10 volts full scale and connects to the point marked S-METER in **Fig. 1**. U3A is a voltage follower stage with unity gain; U3B adds 4.2 volts to the S-meter voltage as required by the differential analog multiplier inputs.

To ensure sufficient headroom in the multiplier and avoid waveform clipping under all input conditions, use care in choosing supply voltages for the interface circuit. The positive supply to the MC1495 ICs should be regulated. Supplies for the LM324 quad op-amp can be unregulated. The LM324 positive supply (pin 4) range is +15.8 to +20 volts; negative supply (pin 11) can be -1.5 to -12 volts. Look for places to tap off these supply voltages within your monitor.

Tune-up is easy

A few simple alignment steps are required to set up the NorthScope for the first time. Connect all the assemblies and install the fluxgate sensor on your antenna mast. Set the focus control on your monitor for a minimum-size spot. Keep the

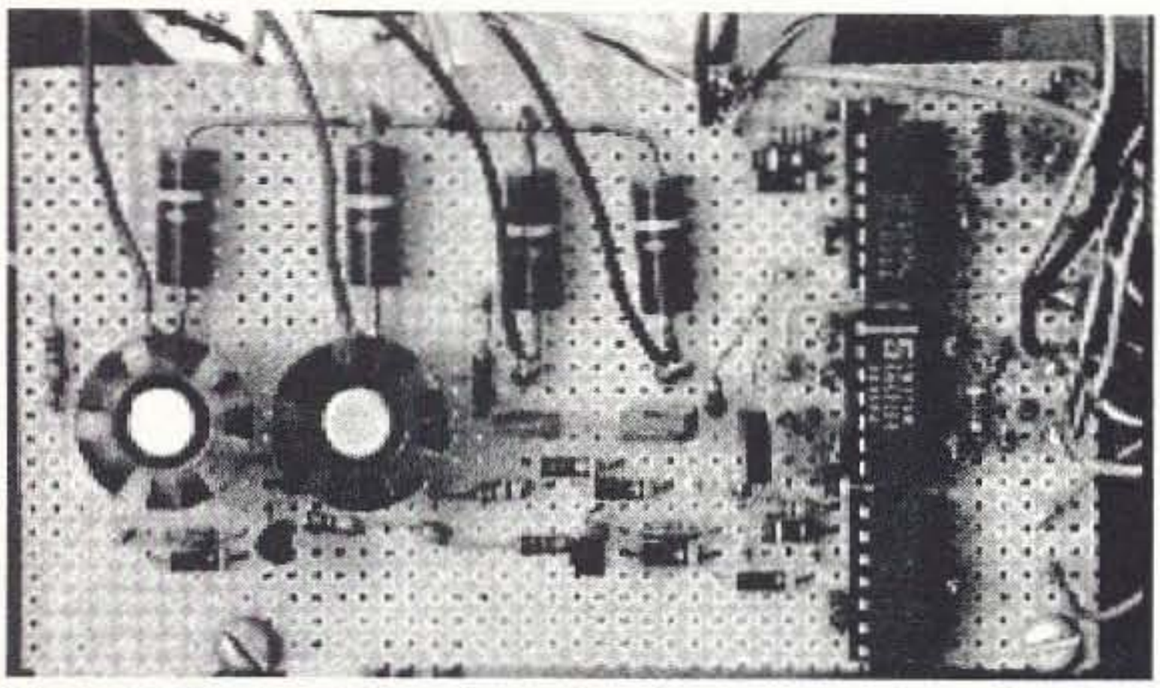

***Photo C.** The three ICs and associated resistors on the right side of this perforated board are the fluxgate/S-meter interface components. The rest of the board holds CRT deflection amplifiers for the home-built monitor.*

brightness control as low as practical to avoid burning the phosphor screen of the scope. X and Y channel sensitivity settings should be about one volt per division, depending on your screen size.

Turn SIZE control R1 on the interface to zero. Set input switch S1 to SPOT (position1). Set the X and Y position controls on your scope to center the spot on the screen. Turn the mast and sensor around 360 degrees; the spot should not move. If it does, adjust OFFSET control R2 until the spot does not move as the mast turns. Now re-center the spot, if necessary, with the position controls.

Set S1 to CIRCLE (position 3). Adjust the SIZE control to move the spot about an inch toward the edge of the screen. Rotate the mast/sensor and adjust the X and Y gain controls and the two screwdriver-adjusted potentiometers on the left side of the fluxgate compass display for a perfect circular pattern around the center spot position. The E-W and N-S pots on the fluxgate equalize the left-right and top-bottom voltage swings such that positive excursions equal negative excursions for each axis. This makes the circle trace exactly over the spot (see **Fig. 2**). If the circle is elliptical instead of round, adjust the X and Y channel gains as appropriate.

Set S1 to TRACE (position 2). With your receiver tuned to an active repeater and enough RF attenuation that the S-meter does not peg, swing the beam around and adjust the SIZE control for a trace similar to **Photo A**. There is plenty of gain in the S-meter channel, so you can get a full-size trace even if the incoming signal only moves the S-meter to quarter-scale.

Notice that the reflection lobe in **Photo A** is quite sharp but the major lobe is broad at the outside. This is caused by nonlinearity in my receiver's S-meter circuits. Normally this is not a problem, but I can get a sharper lobe if needed by adding RF attenuation to the receiver and turning up the SIZE control to compensate. It should also be possible to add nonlinear devices such as diodes to the feedback path of U1A to make that stage an antilog amplifier; I have not tried this yet.

While the north-up display could be used with a motorized mast like the displays of KK6CU and others, I prefer turning the mast by hand. Not only does it simplify the project (no slip rings for the coax and sin/cos signals), it also makes it easier to find the exact direction of signal peaks as displayed on the scope. I can rock the beam back and forth until I'm satisfied that I have found the optimum bearing. This is particularly helpful when there is airplane flutter or rapid amplitude changes due to keying or high modulation levels.

I have enjoyed building several oscilloscopes over the years so I decided to make my own monitor/display for the NorthScope. By modifying a commonly available "boat anchor" scope and raiding the junk box, the cost was under $100. The monitor draws about as much as a typical mobile receiver, so I don't worry about draining the car battery. Next month's "Homing In" will have all the monitor details and some thoughts on computerizing the NorthScope. Meanwhile, keep sending your T-hunting news and column suggestions via E-mail or my post office box. Thank you! 73

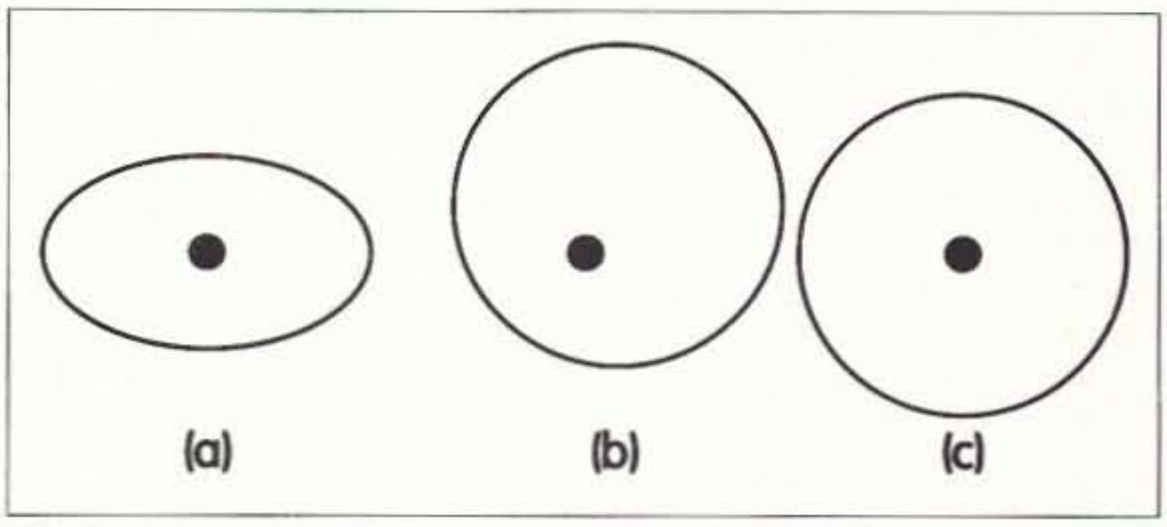

***Fig. 2.** At (a), unequal horizontal and vertical gain. At (b), offset due to misadjusted E-W and N-S controls. At (c), a perfect circle in proper position.*

Number 60 on your Feedback card

Ask Kaboom

Your Tech Answer Man

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It's heeeere!

As I sit down to write this column describing the arrival of the first home VCR and the impact it had on our world (which goes far beyond television), I realize I have a little celebration of my own to consider: This is my 100th column. Can you believe it? It's been more than eight years now! I feel privileged to have been able to serve you all these years, and I hope it will continue as time and technology march on.

For the past few months, we've been exploring video and video recording. Last time, we were examining the obstacles that kept this technology out of the home for so long. Let's look at the first of the two biggies and how it was solved. (Hint: They both involve radio-related techniques.)

Hurry up and slow down

The biggest obstacle to the home VCR was the rate of tape consumption. Even at the seven and a half inches per second (IPS) of the EIAJ standard, too much expensive tape went through the machine per hour. And I do mean expensive: Videotape, which had to be made to very precise tolerances, required a higher level of manufacturing precision than was generally available for consumer products at the time, so costs were high.

The audio tape world had clearly shown that people hated threading tapes and would avoid buying recorders if they had to do it; home audio recording only took off when the cassette became widely available, even though much superior-sounding reel-to-reel recorders had been available at reasonable prices for many years. So, any successful home video recorder had to use a cassette. Also, it was anticipated early on that home users would want to time-shift recordings for later viewing, and that meant at least an hour of recording on a tape, preferably much more. The size of the cassette would be daunting to most people.

The race was on to reduce tape usage. The answer proved to be fairly straightforward, although making it work in color was not. Here's a little background that'll help with understanding how they did it:

In any tape recorder, signals are recorded as regions of magnetism, like little bar magnets, next to each other on the tape as it goes by. (OK, there are other ways, such as through the tape, but they are problematic and never caught on.) The narrower the magnets, the more you can fit into a given tape length. As we discussed before, though, there are practical limits as to how narrow you can make them before you can't read them anymore. The solution to recording the large quantities of information required for video was to use rapidly rotating heads that traced out long, thin tracks diagonally. A servo mechanism would then position the heads during playback so they'd scan the tracks and not the space between them.

Space? What space? Well, in theory, you didn't need any, because each head would hit only its own track. In practice, though, it didn't really work out that way. Due to mechanical tolerances, notably wow and flutter in the tape drive, some of the signal from adjacent head sweeps would get picked up by the head as the tape's precise position wandered a little bit. That resulted in interference and unacceptable playback, so the tape speed was increased to make some space between each track. They called that the "guard band." It worked, but it upped the tape speed considerably, since a significant percentage of the tape wound up being wasted to allow for all that unrecorded space. In fact, the guard band was a primary cause of high tape consumption—but how to get rid of it?

History to the rescue

Developers of audio recorders had long known that head alignment was crucial for maximizing the amount of information—high frequency response in the audio world—a tape could hold. Specifically, the head gap, which both creates and reads the bar magnets, should be at a right angle to the direction of tape travel. (That setting is called the "azimuth" adjustment.) If you draw two parallel vertical lines close to each other to represent the head gap, you can see why. As the tape moves past the lines, it will take a linear distance equivalent to the width of the gap for one magnet to move out of the way completely, so another one can be written.

Now, draw some vertical magnets, and try tilting the head gap in relation to them. What happens? The *effective* gap width, which is from the left to the right of the entire gap, is much bigger, because at one end the gap sticks way to the right, and at the other, way to the left. Much of the energy the magnets would create as they move by is lost within one gap-width when the magnets are not very wide, because more than one magnet can fit in at a time. The result is seriously reduced high-frequency response, just as if the gap were much bigger than it really is. In an audio recorder, that's bad.

Crooked isn't always wrong

As you may recall, I mentioned that video is recorded using FM. As hams, we know something about that mode. The important thing here is the capture effect: A stronger signal can completely obliterate a weaker one, as long as they're more than a few dB apart. The key to Sony's Betamax™, which ushered in the low-tape-speed home VCR, depended on that effect. They eliminated the guard band by slowing the tape down so much that adjacent tracks not only had no space between them, they actually cut into each other—the result being tracks narrower than the heads that created them!

"But what about the interference?" I hear you say. Yes, it would be massive if that's all they did. With tracks thinner than the heads, each head sweep would pick up signals from three sources—the desired track, and the adjacent ones on each side. What a mess!

The real cleverness of their scheme lay in deliberate misalignment of the head azimuth. By tilting one video head about 17 degrees left and the other the same amount right, they created more than 30 degrees of misalignment between tracks. So what?

Well, let's call one head the A head and the other the B head. When the A head is reading its track, it's picking up its intended signal, along with signals from the adjacent B tracks, but those tracks are seriously out of azimuth alignment with the A head (which is aligned opposite to the one that created them), so they will be much weaker. Combined with the FM capture effect, the adjacent tracks' signals simply disappear! And that, gentle readers, was the key to the home video recorder, the grail sought for twenty years. (Well, almost. There's still that pesky color problem to deal with.)

The first Betamax recorded one hour on a cassette. While we might laugh at that today, it was, at the time of its introduction, the highest recorded information density ever achieved on magnetic tape, bar none. Not even the military had anything which could store that much material on so little tape. It was also the most complex consumer product ever made; it was so far beyond the radios and TVs of the time that there was no comparison. People were eagerly buying tape recorders more complex than their *cars*.

The implications of that feat of information storage were little recognized at the time, but the availability of consumer-priced, megahertz-rate recording ushered in much of what we have today. I'm not suggesting that gigabyte-sized hard drives work the same way (they don't), but the VCR created a consumer demand for the manipulation and recording of large amounts of information. A six-transistor radio just wasn't an exciting product anymore. Suddenly, that old audio cassette

recorder didn't seem like much, either.

Even more than that, the huge success of the VCR ushered in the era of cheap high-precision manufacturing that has brought us the home computer, CD players, camcorders, pocket-sized dual-band HTs, you name it. VCRs required all kinds of specialized ICs, which drove the chip makers to new levels of expertise. The machines also required mass production of extremely precise mechanical assemblies, something never before done on such a scale. In the mid-1970s, it cost more—much more—to put a pair of new heads on a black-and-white reel-to-reel video recorder than it does to buy an entire new color VCR today. Whereas the process used to have to be done by hand, under a microscope, we now have entire head drums, with heads mounted, completely made by machine in factories that input raw materials and output fully aligned, ready-to-use assemblies with tolerances in the micron range. Yes, the VCR was a tremendous instrument for technological progress, even if people do use it mostly for catching up on mindless sitcoms.

Next time, we'll explore that other big obstacle: the recording of color. Until then, 73 de KB1UM. 73

Number 61 on your Feedback card

The Digital Port

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All those TNC commands ... and how we solved the "too many retries" dilemma

This column is about solving problems. After all, isn't it great when you find a solution? If anybody needs solutions, it is this digitally-obsessed ham, so as quickly as I get them, I pass them on. Hopefully, they are of value to my readers.

This month's conundrum concerns a perfectly good direct packet connection that quit working a few months ago—and it was from *my* shack to the local PBBS just across town. That's serious, especially when I am writing this column. If I am looked upon to answer questions, I'd better answer my own.

To begin, there were several failures. You may recall from last month's column how my computer had ceased to converse with the terminal node controller (TNC). That was a problem of the first order and I assumed, once it was in working order, this packet connection would start cooperating.

General Rule #1: Assumptions generally make my life uncomfortable.

So ... yes, the problem is located. Contact with the PBBS has been reestablished. I'm easy to please—just make my radio work. When I test problems like this, I use as much logic as possible, but logic was playing a few wild cards ... again.

Part of the dilemma with logic is that we like to bypass the steps we "already know the answers to." Last month, after installing XPWare, it appeared that the PK232-MBX was in business on all modes, except for the local packet connection. Difficulty in making and maintaining solid connections has given me fits in this corner of the valley for as many years as I have worked packet.

There are definite signs of multipath. When a signal is transmitted, it bounces around the valley and wreaks havoc at this receiving antenna; too many signals out of phase and therefore unreadable. This was solved a few years back when Martin N7NPB installed the CCBBS just a couple miles away, but still there is a sizable hill along the path. Martin has gone to great lengths to defeat the multipath monster, but at times, he has resorted to transferring files to and from the next node via landline.

When my latest problem arose, it seemed normal to assume something had changed in the geological structure of the valley and the multipath demon had returned; after all, construction never ceases. Just about every test proved this (when I know the answer, it is easy to plug in the correct circumstances). I was so comfortable with the diagnosis that Martin was ready to invest in more equipment to fix the problem. That is the way with hams—the good guys feel there is nothing too good nor too expensive if it will make life better for a fellow ham.

Deceptive screen messages

Some of the strange symptoms of the disease were manifested when KB7NO sent a connect request to CCBBS; the perfectly readable response would show up on my screen and seemingly indicate the connection was made. However, this wasn't so. I had Martin watch from his end and he could see the connect request frame come across his screen, which would trigger his system to send out the welcoming frames that included the instruction for me to tell CCBBS what I wanted (read mail, bulletins, etc.).

The missing ingredient was that the "connect" LED was not lit, on the front of my PK232 panel. This was followed by a lot of unacknowledged signals transmitted back and forth, until my screen would display the message "retry count exceeded—Disconnected." Once in a great while a fragile connection would be made—always immediately after I had changed something (never the same thing).

So ... this led me to think there is something valuable to put into this month's discussion while I tell about the angst I was suffering and the steps, though logical, that wound very slowly around to a realization of the true nature of the problem. Incidentally, I took a quick look into the on-line dictionary for angst. The words anxiety and depression certainly are descriptive of the mood that prevailed for a few days.

Changing the TNC commands from default

One of the areas I experimented with was the commands that you can define in your TNC, and this is something you need to be at least cognizant of. There are approximately 100 definable commands in most TNCs. For instance, one that is required before you can make a packet connection is MYcall. It simply states your callsign so the station you are connecting to can identify you.

Modern software installs your call automatically when you are setting up the program, so you don't want to attempt to bypass this part of the setup. In primitive programs, you are instructed to go to the *cmd>* prompt and type *MY [space] [your callsign]*. MY is short for MYcall. It is okay to type the command in its entirety, but nearly all commands have an abbreviation.

You will find that the defaults are usually set in the memory of the TNC and you will be able to operate just fine without changing much other than entering your call. Some of the commands affect what you see on the monitor; some alter the packet to be sent; others are for automatic messages you may send; and there are those for mailbox functions.

The ones I felt were most worth tweaking were the ones having to do with timing the sent packets, in respect to the incoming packets. See **Chart 1** for a list of the commands I worked with the most. You will notice that all these function to cause a "wait" interval to avoid having two signals collide.

In **Chart 2** you will see other commands I changed for various reasons described. It's good to know as much as you can about these commands. They are not all the same with all brands of TNC. However, they are described in the operator's manual for each TNC.

There is considerable latitude in the settings, and every now and then, it appeared that there was progress—that I must have repaired a nerve in the system—and the two systems would magically connect. However, the connection was poor and seldom did any subsequent commands perform their functions.

The impression that I was doing battle with multipath signals was further solidified as I finally

COMMAND	FUNCTION
TXdelay n	Specifies the wait in 10ms intervals that the TNC is to wait after keying up the transmitter before sending data.
AXhang n	Another wait parameter that specifies the time in 100ms intervals that the transmitter will wait after the repeater keys up before sending data.
AXdelay n	Specifies the wait time in 10ms intervals to perform the same function and in addition to AXhang.
DWait n	Specifies the time in 10ms intervals that the TNC will wait after the last heard signal on a channel before keying up.
RESptime n	Specifies the time in 100ms intervals that the receiving TNC will wait before sending an acknowledgment of a received packet.
FRack n	Specifies the time in seconds the transmitter will wait for acknowledgment after sending a packet before sending the frame (packet) again.

Chart 1. *These commands are specifically used to help avoid collisions between packets by preventing simultaneous sending and receiving between stations on the same frequency.*

found a station connected to CCBBS whose transmissions I could copy on my monitor. Most other stations were from another side of the hills and their signals could not be copied on my monitor, only those signals from CCBBS.

Digipeat looks like the answer

I entered a connect path to CCBBS via the other station and got an instant connection. Some of this was pure luck—this TNC user had the digipeat option "on," plus his connection continued long enough to get my desired result. Elated, I sent Martin the news.

I started making plans to set up a digipeater in another part of the valley. [Short explanation: Digipeating is a handy function of the TNC. It allows stations to connect through one another and each will pass along (repeat) digital messages that would otherwise be difficult or impossible due to distance and/or terrain.]

In preparation to setting up a digipeater, I dug out an MFJ-1274 and started getting cables ready. Martin, in the meantime, was making his own plans, on a grander scale, to put up a node on a nearby peak. I felt it might be a good idea to first try the 1274 in the shack to be sure it still worked.

After a few false starts, I got the 1274 in place of the PK232 and, after a little configuring, got the screen to speak a language I understand. I tried a connect to CCBBS just to be sure everything responded and, lo and behold, the connection worked—first try!

I spent at least ten minutes connected, to see that this wasn't just another coincidence, and sent Martin a personal message. Then I disconnected and connected and read a few bulletins. Definitely, the source of the problem was found. This should prove, until next time, though many things are improbable, nothing is impossible.

The next thing was to contact the new owners of the AEA line, Timewave. I checked their Web page and did not see a phone number, so I sent them E-mail describing my dilemma. At this writing, they have not had time to respond. By the time this is published, the actual problem will have been resolved.

If you have questions or comments about this column, E-mail me at [jheller@sierra.net] and/or CompuServe [72130.1352]. I will gladly share what I know or find a resource for you. On packet, when you get a chance, drop me a line [KB7NO@N7NPB.#NONEV.NV.USA.NOAM]. For now, 73.

COMMAND	FUNCTION
PASSAll	This will turn error correction on or off. Therefore, if there are packets being received, they can be viewed.
FUlldup	Normally off, but with it on, I was able to view all the commands as they were being sent. However, it encourages collisions.
WHYNOT	This shows up in some AEA packages and is meant as a diagnostic tool. My screen filled with a form of "weak signal" messages.
PErsist	This is also AEA-specific. This is meant for use with multiple connects to avoid collisions by monitoring carrier detection (DCD).

Chart 2. *These commands were experimented with to explore the possibilities offered. Each manufacturer/programmer offers ideas that are worth exploring when the solution becomes difficult.*

Number 63 on your Feedback card

New Products

Wipe Out!

Wipe out that interference and noise before it gets into your receiver, that is. When you plug your station antenna into the MFJ-1026, your antenna system turns into a directional receiving array! You can place a null up to 60dB deep on any type of noise and interference arriving from any direction and wave angle. Lightning crashes from distant thunderstorms, severe power line noise from arcing transformers and insulators, lamp dimmers, touch-controlled lamps, electric drills, industrial processes, TV birdies and more can be eliminated with the MFJ-1026 Deluxe Noise Canceling Active Antenna.

Is a strong local ham overloading your sensitive receiver? Cast a deep null on him and literally take him out—you won't even know he's there. Null out your local AM broadcast station, and underneath you might find a faraway station in an exotic place you've never heard of!

The MFJ-1026 simply plugs in between your transmitting antenna and transceiver. To null, adjust amplitude and phase controls for minimum S-meter reading or lowest noise. To peak, push reverse button. Use the built-in active antenna or an external one; it's better than a phased antenna—you can electrically "rotate the array" while the antennas remain stationary.

The MFJ-1026 is priced at $139.95, and has a little brother without the built-in active antenna; the MFJ-1025 is only $119.95. For your nearest dealer or to order, call (800) 647-1800; FAX (601) 323-6551; or write MFJ Enterprises, Inc., 300 Industrial Park Road, Starkville MS 39759.

Just Like Magic

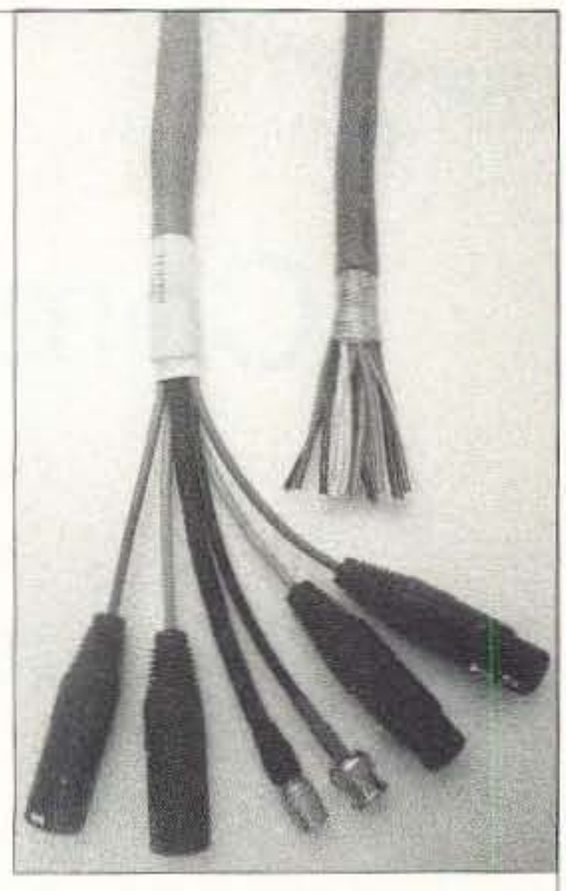
MFJ proudly announces the MFJ-281 ClearTone™ Communications Speaker for SSB, FM, AM, and CW. Plug it in and MFJ promises speech fidelity that you never knew existed. The MFJ-281 will restore the smooth sound of sine waves that CW naturally generates and make it far easier to copy. Small built-in speakers just can't deliver this kind of tonal quality. The ClearTone was carefully designed to improve the intelligibility of speech in the frequency range of 600 to 4,000Hz while reducing undesirable noise, static and hum.

The MFJ-281 is less than four inches square and will handle 8W, 8Ω. It comes with a six-foot cord and 3.5mm mono plug, and a versatile swivel mounting bracket lets you direct the sound where you want it—and all this for only $9.95! And, of course, it's covered by the MFJ *NO MATTER WHAT* one-year unconditional warranty. For your nearest dealer or to order, call (800) 647-1800; FAX (610) 323-6551; or write to MFJ Enterprises, Inc., 300 Industrial Park Road, Starkville MS 39759.

New Camera Cables from Nemal

Nemal Electronics International has introduced a new line of multicore camera cables for use with Sony, JVC, Toshiba, and other equipment. The cables feature precision coaxial members, various control wires, and a flexible outer jacket, which offers protection from temperature extremes, abrasion, oil, gas and ozone.

Nemal has also introduced a new remote control composite cable for use with Sony paintbox remotes, making it easier to use the Sony remotes in field applications, and providing all the required interconnections under a single flexible jacket—Nemal's high-performance flex jacket. Standard terminations include XLR for audio, BNC for video, and a 10-pin plug for the remote cable.



For more information, contact Nemal Electronics at (305) 899-0900; FAX (305) 895-8178 or E-mail: [info@nemal.com].

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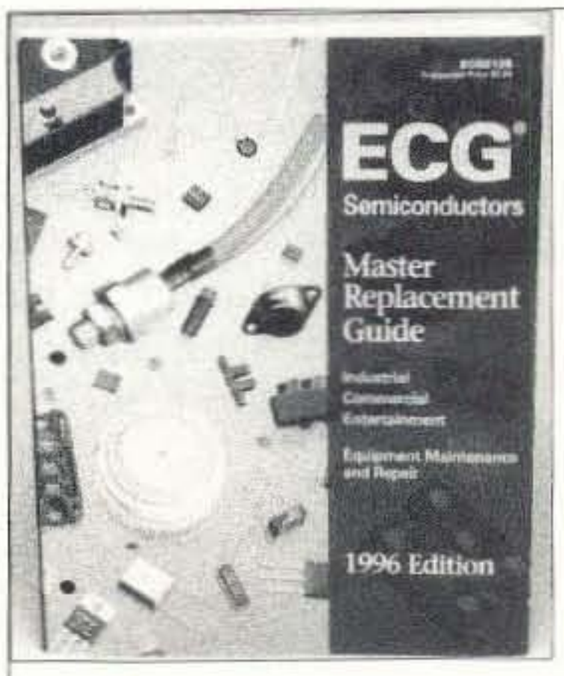

MCM Adds Philips ECG Semiconductors

MCM Electronics proudly announces that Philips ECG is the newest in their line of top quality products. MCM stocks over 1,000 ECG items with access to their entire line—over 4,500 SKUs.

MCM has just released its newest catalog, #38, with 6,500 new items. New categories of Data Comm, Computer Software, Gaming, Printer Parts, Office Supplies, and Safety offer you new service opportunities. All MCM's trained sales representatives are professionals, available on toll-free lines to provide immediate service Monday through Friday, 7:00 a.m. to 9:00 p.m. EST, and Saturday 9:00 a.m. to 6:00 p.m. EST. FAXed orders are accepted 24 hours a day, every day. For complete information and a free catalog, call MCM Electronics at (800) 543-4330; FAX (937) 434-6959.

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Number 64 on your Feedback card

Communications Simplified, Part 20

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If you examine **Fig. 1** carefully, you will note that the sampled signal at the bottom of the figure consists of pulses, and that their amplitude is proportional to the amplitude of the analog wave at that point. You will also see that the tops of these pulses are sloped the same as the analog waveform was at that point. In most cases, this slope is entirely unnecessary, since the circuit which does the reconstructing of the pulses will supply its own slope; hence the pulses in most systems will generally have flat tops. Furthermore, since the slopes of the tops are unimportant, only the height (amplitude) of these pulses is important; the pulses can therefore be very narrow. This makes it possible to squeeze many other pulses between them, thus allowing more different channels to be multiplexed together (but note that this rapidly increases the required bandwidth).

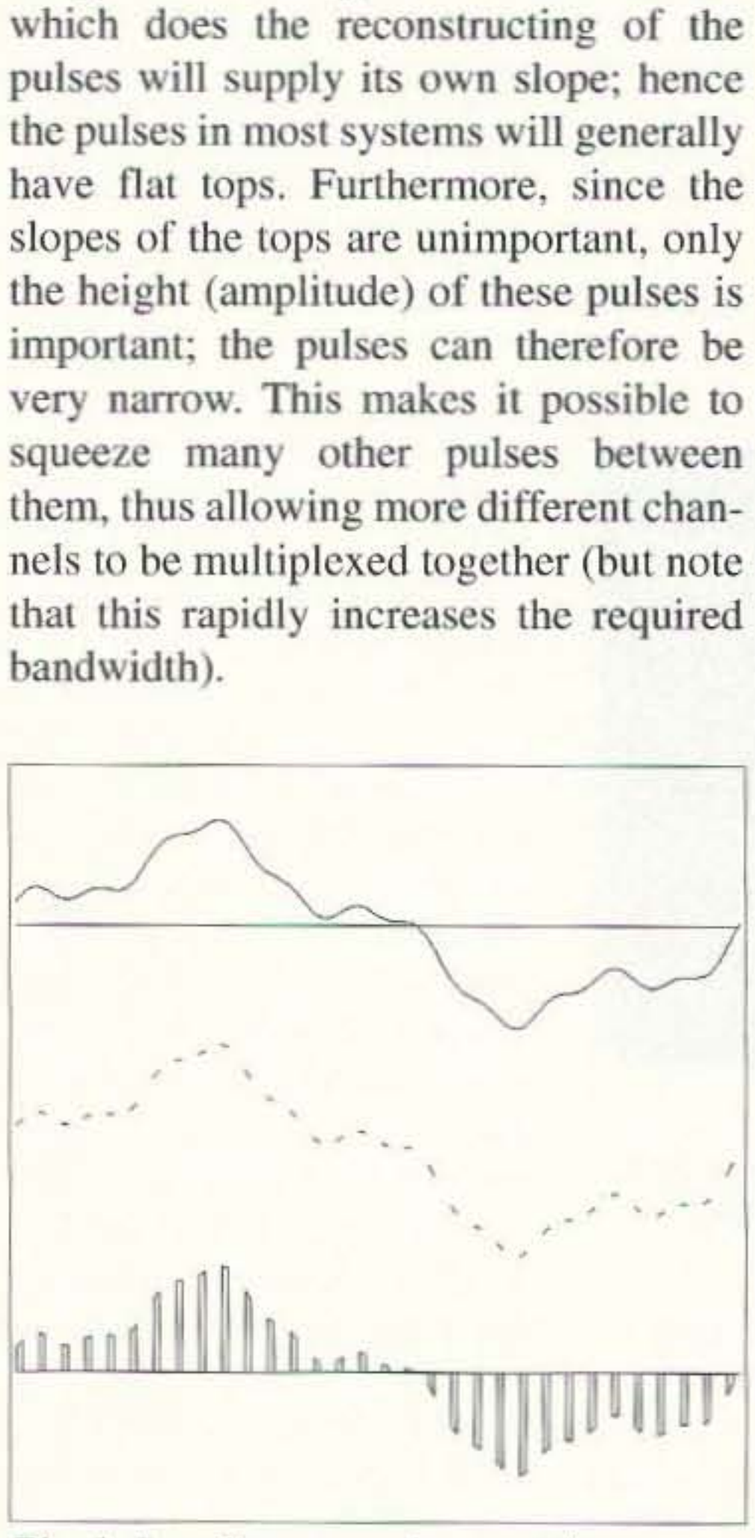

Fig. 1. Sampling an analog waveform.

The pulses in **Fig. 1** actually have another fault—some are positive and some are negative, which makes them difficult to send through some circuits. It is better to make all the pulses the same polarity, as shown at the bottom of **Fig. 2**, by adding a fixed DC voltage to the original analog signal; this changes it from pure AC to pulsating DC.

PAM: Pulse amplitude modulation

The result is then called PAM or pulse amplitude modulation, since it is the amplitude of the pulses that tells us what the voltage should be. PAM is a sort of electronic mongrel—it is partly digital and partly analog. The timing and the fact that it consists of pulses makes it look digital, but the amplitudes which preserve the voltage levels are purely analog. So PAM permits us to do time division multiplexing, but is still subject to many of the same problems as analog transmission would be, including noise, distortion, etc., because the heights of the pulses can become distorted as the signal is sent through different circuits and communications media.

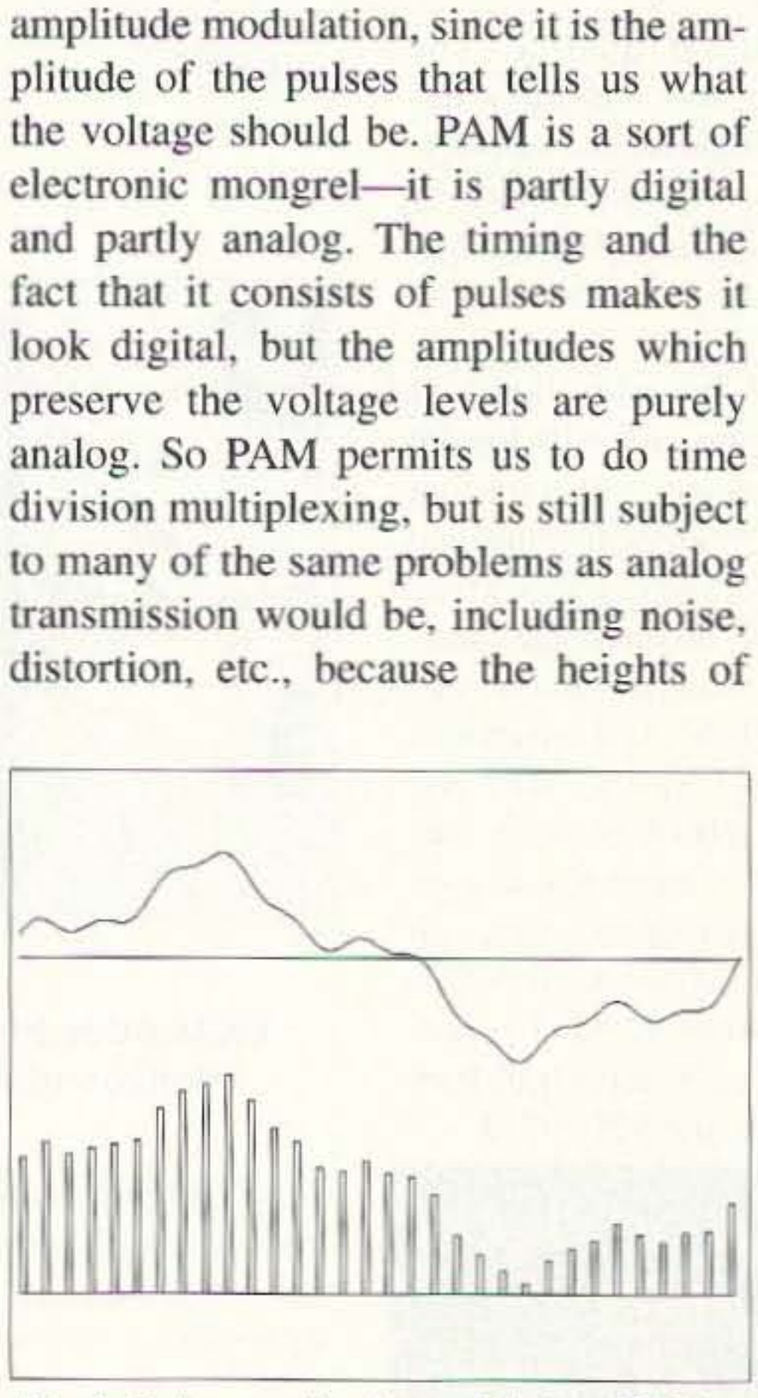

Fig. 2. Pulse amplitude modulation (PAM).

PWM: Pulse width modulation

Rather than modulate the amplitude of each pulse, we can change the width of the pulses; this results in pulse width modulation or PWM, which is shown in **Fig. 3**. A pulse is wide when the amplitude of the original signal is high, and narrow when the amplitude is low. (Note, by the way, that the sampling rate in **Fig. 3** is much too low. The Nyquist sampling theorem states that there should be more than two samples taken during the fastest cycle of the waveform. We have circled what looks like a fairly small/fast cycle, and there are not two complete samples in that small interval.)

As you can see from the small "tick" marks under the pulses, the leading edges of the pulses are evenly spaced; it is the trailing edges that move back and forth to vary the width of each pulse in our example. There are variations of PWM which move only the leading edge, or which move both edges to vary the width.

PWM has some advantages over PAM. Since all the pulses are the same height, PWM can be sent through digital circuits which would otherwise ignore or alter pulse heights. A PWM signal can be fairly easily converted back to an analog signal by passing it through an "integrator" circuit, that is, a circuit which measures the area under each pulse and converts that area to a fixed

voltage. It can also be easily analyzed by digital circuitry, which can measure the width of a pulse fairly accurately by measuring its timing.

Nevertheless, PWM is still only an analog-digital hybrid. Any kind of distortion which slightly changes the width of a pulse will distort the signal. PWM therefore has fairly limited uses in communications. One fairly common use is in high-power amplifiers or power supplies. Since the voltage in a PWM signal is either at zero or at full height, there are no in-between states. When such a signal is amplified by a transistor, the transistor is either fully off (when the current through it is zero) or fully on (when the voltage across it is very close to zero). The power lost in a transistor is the product of current times voltage; if one or the other of those two is zero or close to zero at all times, their product is small, and the power dissipated in the transistor will be small. This allows the amplifier to provide a high power output signal without itself losing much power in the process.

PFM: Pulse frequency modulation

Pulse frequency modulation is another analog-digital hybrid; here the frequency of the pulses depends on the analog signal's voltage, as shown in **Fig. 4**.

PFM is very similar to FM, where the frequency of a carrier also depends on the analog signal being transmitted, but instead of a sinusoidal carrier, we have rectangular pulses. PFM is sometimes used in instrumentation and measurements, but its use in communications is usually associated with FM. For example, there are some FM detector circuits which convert FM to PFM, and then use digital circuits to measure the frequency and convert it to an analog signal.

All-digital methods

All of the methods we've looked at so far—PAM, PWM, and PFM—have been mixtures of analog and digital techniques. The value of an analog signal affected either the amplitude, width, or frequency of pulses, in a continuous or analog fashion. By this we mean that the amplitude, width, frequency, or whatever, could take on a continuous set of values; there could be an infinite variety of amplitudes, widths, or frequencies. The problem with these approaches is that small circuit errors, which might produce slight changes in the amplitude or width or frequency of a pulse, cause errors in the signal.

Now it is time to look at the purely digital methods. In a digital system, there is a limited number of possible amplitudes, widths, frequencies, or whatever, in a signal. For example, in most computer circuits, there are only two voltage levels: one that we call a low, and another one we call a high. The low is usually close to zero volts, while the high is usually somewhere between +2 and +5V. The beauty of this scheme is that the precise voltage of a high or low is not important, so that slight imperfections in a circuit which might change, for instance, +5V into +3V make no difference because a high is a high is a high. But changing a high into a low, or vice versa, is catastrophic, so if the change is large enough to change +5 to 0V, then all Hades breaks loose. Fortunately, with careful design, we can avoid most such huge errors.

We have already discussed binary numbers, so let's just add that these highs and lows generally represent the ones and zeroes of binary numbers. (The high is usually a 1, while the low is usually a 0, but beware: there are many, many places where the high is the 0 and the low is the 1.)

PCM: Pulse code modulation

We can now see how PCM or pulse code modulation works. We sample an analog signal (using the Nyquist sampling theorem to tell us how often to sample) just as before. But instead of using each sample to control some analog characteristic of a pulse, such as its amplitude or width, we convert that sample into a code—usually a binary number. Although there can be some errors in the conversion process itself, once the conversion to a digital code is done, that code can then be stored or transmitted with absolutely no additional errors (as long as we are careful).

The modern telephone network is a prime example. Before the 1970s, transmission over the long-distance telephone network was analog. Cross-country connections were noticeably noisier and more distorted than speaking with someone across town. Today, your voice

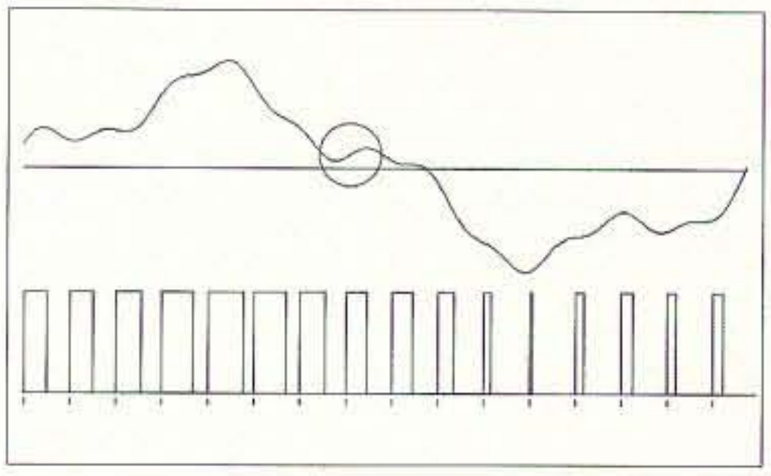

Fig. 3. *Pulse width modulation (PWM).*

is digitized as soon as it enters your local telephone company central office (and sometimes even sooner!). It is then carried as a digital signal almost all the way to its destination. The distance it travels is unimportant, because the data arrives at its destination exactly as it left your town. You can no longer tell the difference between a local call and a long-distance call just by the quality of the connection (and, despite what some telephone carriers will tell you, it has nothing to do with whether the connection is through a fiber cable).

Fig. 5 shows how it's done in a CD recorder and CD player. As the analog music signal comes in, a sample-and-hold circuit grabs samples of the input signal's voltage at the sampling rate. It then holds that voltage constant (even while the signal itself is changing) long enough for an analog-to-digital converter (also called an A-to-D converter, or just ADC) to measure the voltage and convert it to a binary number. This process is called quantizing. The resulting binary number is sent through a communications channel (or, in the case of a CD, recorded on the disc). Eventually, it goes back into a digital-to-analog converter (also called a D-to-A converter or DAC), which converts it back into an analog signal. But this signal has jagged edges because it has been quantized. Fortunately, the jagged edges represent frequencies above one-half of the sampling frequency (and therefore above

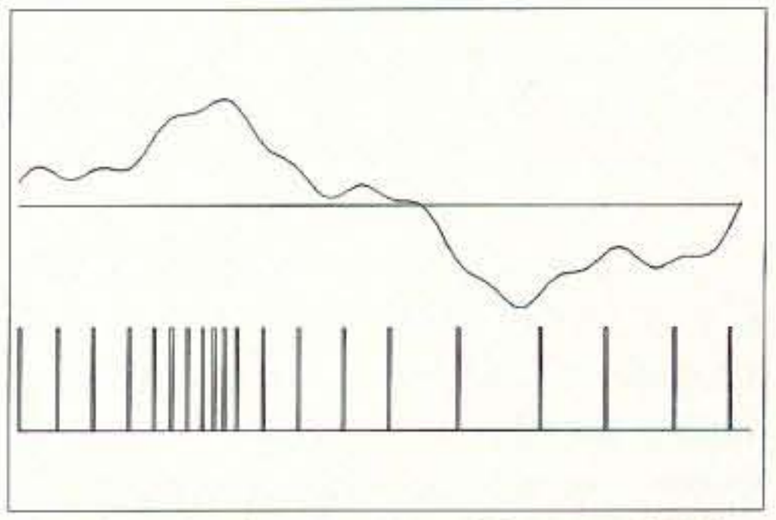

Fig. 4. *Pulse frequency modulation (PFM).*

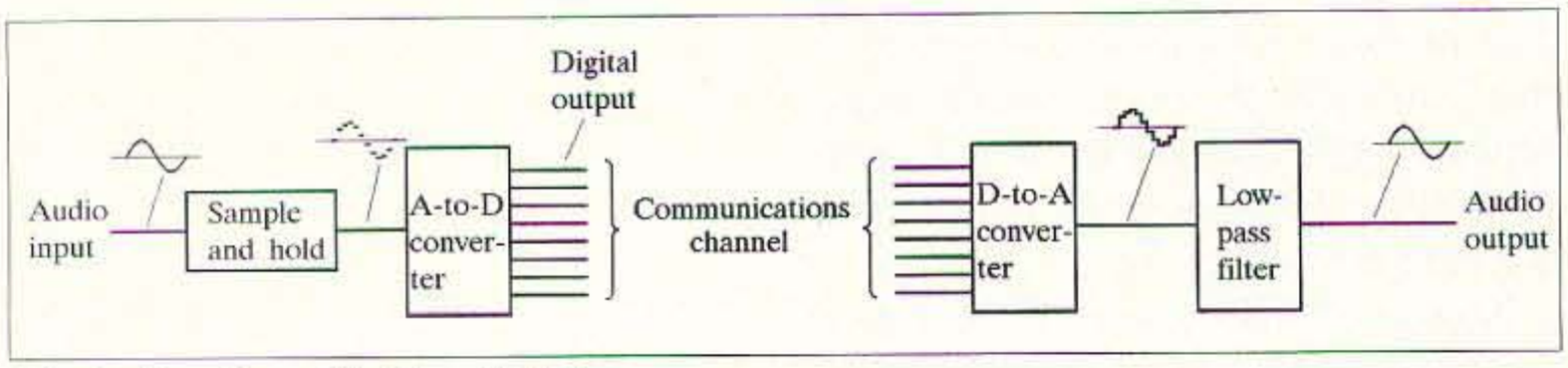

Fig. 5. Sample-and-hold and ADC.

even the highest frequency of the desired signal), so they can safely be filtered out without removing any desired signal. The result is then the original audio.

The ADC cannot, however, capture the exact value. When it quantizes the voltage, it can only express it to the nearest allowable digital number, and so it generates a quantization error.

To understand quantization error, think of shoe sizes. My foot is bigger than a size 11 shoe, but smaller than a size 12. If I wanted to order a pair of new custom-made Bruno-Magli shoes from the manufacturer, I could trace the outline of my foot on a piece of paper and send that as a measurement. This would be an analog measurement which, if only I could perform it exactly, would be an exact representation of my foot size. The problem is that temperature or humidity (or the vagaries of the post office) could slightly change the size of that paper, so that the manufacturer might send me the wrong size.

So I choose to measure my foot instead, and send just the measurement. Unless my letter is grossly mangled by the post office, that measurement will get to the manufacturer and still be readable. But the problem is this—how good is the ruler I use to measure my foot size, and how much space do I have to write down that size?

If I had a perfect ruler, I might find that I have a size 11.627295779532214 59 ... foot, where the periods (called an ellipsis) denote that there are more digits than I have written down. In fact, my measurement might require an infinite number of digits, but the manufacturer obviously doesn't need all of them (nor do I have the room for them in this chapter).

But suppose I only have a ruler calibrated to the nearest inch. I must now decide whether my foot measures 11 inches or 12 inches. Whichever one I choose, there is a slight error and the shoe will not quite fit. This slight error is called quantization error. I can reduce the error somewhat by using a better (more expensive) ruler which has marks smaller than one inch, but I will now also need more room to write the measurement down.

The analog-to-digital converter works the same way. Whatever the input voltage is, it can only measure the voltage to the nearest step size. Moreover, the number of possible measurement values depends on the number of bits it outputs. If the converter had only a one-bit output, which could therefore be either a 0 or a 1, there would only be two possible "sizes." With just one output bit, the converter could only specify two possible voltage levels; in-between voltages would have to be assigned to one of those two allowed levels.

With a two-bit output, on the other hand, the ADC could measure four different analog voltages: for example, the bits 00 could mean "very small," 01 could mean "medium," 10 could mean "big" and 11 could mean "very big." But in-between voltages must still be assigned to one of those four allowed levels.

Just as using n bits allows us to specify 2^n different binary numbers, so using n bits allows the ADC to specify 2^n different values of voltage (for instance, two bits can specify 2^2 or four different voltage levels).

To see what this means, let's suppose that we have a converter which has a three-bit output; it can therefore detect eight (2^3) different voltage levels. Look at **Fig. 6** to see what this would mean.

At the top of the figure, we have the same analog waveform we have seen in previous figures. The tick marks show us when the sample-and-hold circuit and the A-to-D converter sample the input signal. At each tick mark, the ADC looks at the analog signal, and assigns it (quantizes it) to the nearest of the eight voltages it can distinguish. (Most converters actually use the next lower value, rather than the nearest value.) These eight levels are labeled with their binary equivalents, from 000 for the lowest to 111 for the highest. The output from the ADC would therefore be the series of numbers 100, 101, 100, 101, 101, ... as shown at the top of **Fig. 6**.

In other words, the gradual changes in the input voltage that occur between samples are ignored; the ADC only sees the signal as it exists at the instant it is sampled. As far as the ADC is concerned, the signal might as well be the squared-up wave that is shown superimposed over the analog signal in **Fig. 6**. When the digital signal is eventually converted back to analog, we will get this squared-up signal, but the filter circuit in the output will round off the sharp corners.

The problem, of course, is that the squared-up wave (even after it is rounded off again at the end) is not quite the same as the original analog signal, and this introduces an error. You can think of this error either as distortion, or as noise, that is, a signal which simply shouldn't be there.

The bottom curve in **Fig. 6** plots the difference between the original analog signal, and the squared-off quantized signal that the ADC thinks it sees—this is the noise or distortion. Let's try to compute its size in terms of the voltage steps that the ADC can detect.

The maximum peak-to-peak amplitude of the original analog signal is eight divisions. The error signal at the bottom of **Fig. 6** has a maximum peak-to-peak amplitude of two divisions. But notice that this signal has very sharp tips at its maximum and minimum points; after the filtering that occurs at the end, those peaks will be rounded off, and the peak-to-peak amplitude of the error will be less than one division peak-to-peak.

We now have a peak-to-peak desired signal level of eight divisions, and a peak-to-peak noise level of roughly one

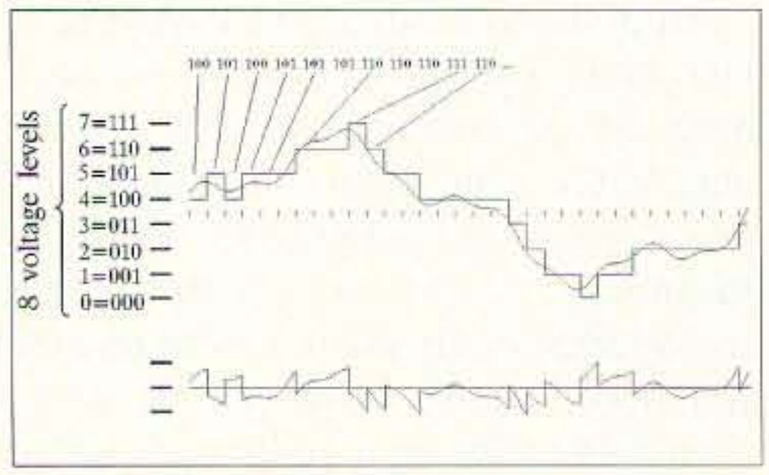

Fig. 6. Calculation of error and signal-to-noise.

division (or less). The signal-to-noise ratio is then about 8-to-1; which works out to

$$20 \log \frac{8}{1} = 20 \times 0.9 = 18\text{dB}$$

In this case, we had three-bit numbers giving us 18dB signal-to-noise ratio. If we repeated this calculation for different numbers of bits, we would note that, as a general rule, each bit in the binary number will give about 6dB of signal-to-noise ratio.

Let's now return to the compact disc. In the CD recorder, the analog-to-digital converter generates a 16-bit number, and is accurate enough to quantize 65,536 different voltage levels (since 2^{16} is 65,536), which gives us a signal-to-noise ratio of about 16 x 6, or 96dB.

To achieve a frequency response to 20,000Hz, the audio is sampled at 44,100 times per second. But since the CD is stereo, all of this happens for both the left and right channels. We now have 44,100 samples per second, times two channels, times 16 bits per sample, or a total of 1,411,200 bits per second. This is about 85 million bits per minute, or about 6 billion bits for the complete disk (slightly over 70 minutes).

This large number of bits would not be needed if we were willing to accept lower quality sound. For example, since the telephone network does not need hi-fi quality to 20kHz, or a 96dB signal-to-noise ratio, it uses many fewer bits. For a frequency response to slightly under 4000Hz, the telephone companies sample 8000 times per second. Seven bits are quite adequate for voice quality sound, so telephone company A-to-D converters only recognize 128 different levels, and output seven-bit binary numbers. Over one second, we then have 8000 samples, times seven bits per sample, or 56,000 bits per second—much less than the CD.

With 128 levels, the resulting signal-to-noise ratio is about

$$20 \log \frac{128}{1} = 20 \times 2.1 = 42\text{dB}$$

(or again about 6dB per bit). This isn't anywhere as good as a CD, but still perfectly adequate for voice communications.

Compression and expansion

Compression involves changing a signal or data in some way so as to use less space to store or transmit it. At the receiving end the process is usually reversed to uncompress (expand) the signal or data to bring it back to its original state. This compression/expansion process can fall into two categories: lossy and loss-less.

• In loss-less compression, the expansion exactly reverses the compression, so that the final result is exactly the same as the original. Loss-less compression is generally used for computer data, where changing even just one bit can completely ruin a program or data file.

• With lossy compression, the expanded data may be slightly different from the original. Lossy compression is generally used for data intended for humans, who can usually tolerate slight differences in sound or pictures.

Compression/expansion can be done on both analog signals and digital data.

Radio stations provide a good example of analog compression. The signal-to-noise ratio of a typical AM broadcast station is usually much less than that of a CD recording (especially one of classical music). If they turn up the volume so that the very weak portions of music are above the radio signal's noise level, the very loud portions of the same recording will overmodulate and distort. If, on the other hand, they turn down the volume so that the loud parts produce 100% modulation, then the soft passages will be below the noise level and become inaudible. Radio stations therefore often use a compressor to reduce the dynamic range (the difference between very loud and very soft sounds) of a recording. The compressor automatically turns up the volume on soft sounds, and turns it down on loud sounds. Since there is no expander in your receiver, no expansion is ever used.

In the digital world, most compression methods look for repetitive patterns in the data. For example, certain combinations of letters, such as *th* and *ing*, appear fairly often in the English language. We could save space by simply replacing each such string by some special character, such as perhaps ¶ or §. Like other extended ASCII characters, these special characters take eight bits each; even better compression could be achieved by replacing very common strings with even shorter bit patterns, perhaps using just a few bits. As long as the expansion process then replaces each special code by the original string, we can reconstruct the original without loss. It is entirely possible to compress plain text by a factor of 2-to-1 or 4-to-1 (meaning that a compressed file takes only 1/2 to 1/4 as much space as the uncompressed file). Some files (especially if they contain long strings of spaces or blanks) can be compressed even more. If you're into computers, then you may know about "zipping" files (using the PKZIP program to compress, and PKUNZIP to later expand) as an example of a loss-less compression. It compresses computer files so they take up less room on a disk.

But loss-less compression does not work if there are no repetitive patterns in the original data, because then it is not possible to come up with short codes for often-used patterns. Loss-less compression also seldom achieves more than a 5-to-1 compression (though greater compression is possible on certain types of files).

This is where lossy compression comes in. Lossy compression does all of the above, but it also examines the data to see whether there are details in it which are not needed and which could be eliminated. This is a matter of judgment, though—a compression method which might work for sound files might be disastrous on a picture file.

There are several common lossy compression methods in use. For example, Sony developed an audio MiniDisc—a compact disk which is about half the size of a normal compact disc, and stores just 1/5 as many bits, but can hold the same 74 minutes of music. It uses a compression method called ATRAC, which splits the 20kHz bandwidth audio signal into 512 smaller frequency bands, analyzes which bands have either no signal, or a soft enough signal that it would be masked by some louder sound elsewhere, and then eliminates those judged unhearable. The resulting signal is different from the original, but in ways that only a careful side-by-side comparison can detect. And even then, many listeners can tell the difference between the original and the ATRAC-modified sound, but cannot always tell which sounds better.

Another example is the JPEG system for compressing still computer pictures

(or MPEG compression for motion pictures). Because the eye is not particularly sensitive to certain kinds of picture distortions which affect color or sharpness, JPEG and MPEG achieve much greater compression than most other methods—compressions of 50-to-1 or 100-to-1 are not unusual. After JPEG or MPEG compression and expansion, the picture is not quite as sharp or detailed as it started, but the changes are usually small enough that most people are not bothered very much by it (although certain kinds of pictures are very badly affected).

Zipping, JPEG, and MPEG compression are not usually performed "real-time." That is, they are not performed as the data is being generated or used. First you generate digital data in its original form, and then, at some later time, you go back and compress it. Part of the reason for this is that these compressions take time, and today's hardware isn't fast enough to do the compression while the original data is being generated. That will undoubtedly change.

Other methods, though, can be performed real-time. Sony's ATRAC, for example, works in real time. A MiniDisc recorder can compress the sound signal while it is being recorded, and expand it while it is being played.

A-law and μ-law compression

In telephone applications, A-law and μ-law compression are specially designed for digitized voice to reduce the apparent distortion without increasing the number of bits.

With even spacing between the quantization steps, as in the top curve in **Fig. 7** (which shows only sixteen steps, though normal telephone audio uses 128 steps), loud sounds (those having a large peak-to-peak value, and shown at the left) are quantized with far more steps (and therefore much less distortion) than weak sounds (shown at the right). This is the opposite of what we normally get with analog methods, where softer sounds tend to be clearer and less distorted than loud sounds, and it sounds unnatural.

The solution is to change the spacing between quantization steps so that the steps in the middle are closer together. A small waveform will now be quantized with finer steps, and its shape better preserved than before. The bottom curve in

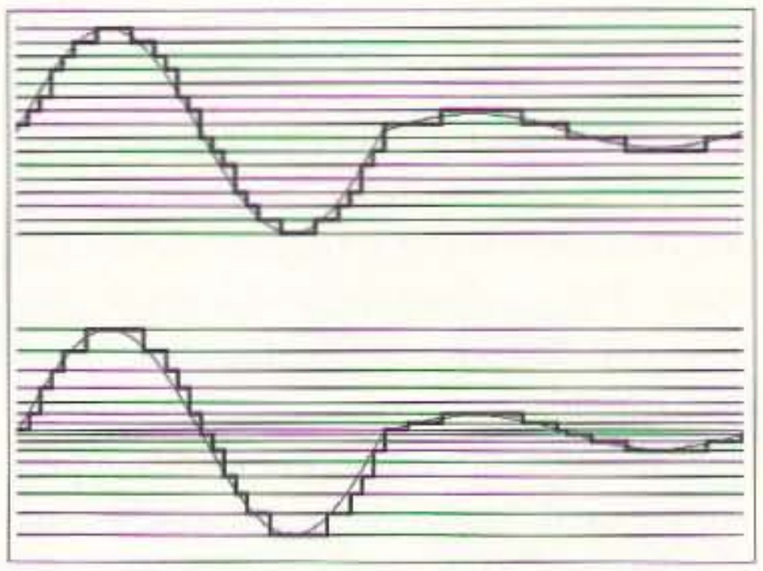

Fig. 7. *Use of unequal steps in quantizing.*

Fig. 7 shows the effect. There is a bit more error in the large wave at the left, but this is outweighed by the better accuracy for the smaller wave at the right.

Obviously, both the compressor in the sender, and the expander in the receiver, must know what the step sizes are, so that the expander can properly rebuild the waveform from the digitized samples. This process of compressing an audio signal at the transmitter end, and then expanding it at the receiver end, is called companding.

A-law and μ-law companding both work the same way, but their step sizes are slightly different. A-law companding is primarily used in Europe, whereas μ-law companding is the US standard.

Fig. 8 shows another way to look at this process. Rather than design the A-to-D and D-to-A converters to use variable size steps, let's imagine that the input audio signal (just before a normal A-to-D converter) is passed through a nonlinear circuit which slightly boosts small voltages, and slightly reduces large ones.

Fig. 8 shows the transfer function (that is, the relation which tells what the output voltage will be for any particular input) of such a circuit. The horizontal axis shows the input voltage (zero is in the middle, while negative input voltages are to the left and positive voltages to the right). The vertical axis plots the output voltage, with plus at the top, minus at the right, and zero in the center.

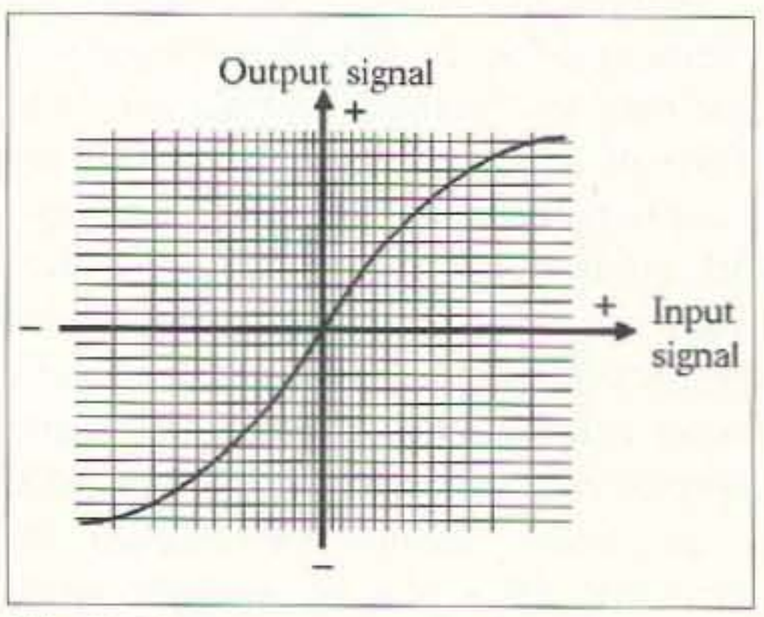

Fig. 8. *Compressor transfer function.*

The result is that small signals, which only move slightly to the left or right of the zero (the center of the figure) are stretched out so they take up more steps of the A-to-D converter's input. In other words, instead of shrinking the step size for small signals, this nonlinear circuit stretches small signals to fit the equal step sizes of the converter.

At the receiver, an opposite circuit would treat the audio signal coming out of the D-to-A converter, doing the exact opposite—reducing small voltages and increasing large ones. This circuit restores the audio signal to its original shape.

This method of companding works quite well for telephone-quality voice signals, and makes a noticeable difference in audio quality.

DPCM: Differential PCM

Differential Pulse Code Modulation or DPCM is basically PCM but with digital compression to reduce the number of bits required to carry the information without actually changing the accuracy.

The idea hinges on the fact that, for most analog waveforms, any two successive samples are usually fairly similar. In other words, the difference between any two successive samples is fairly small—and definitely smaller than the overall size of the waveform. Hence the number of bits needed to specify the difference between two samples is smaller than the number of bits needed to give the entire value of each sample.

For example, in **Fig. 6**, we saw that the first few quantized steps in binary were 100, 101, 100, 101, 101, 101, 110, 110, 110, 111, 110, etc., each of which required three bits. In decimal, these are the numbers 4, 5, 4, 5, 5, 5, 6, 6, 6, 7, 6, etc. Once we know the first value (4), we can specify the others by giving only the differences from the previous number. For example, the second number is 101 or 5, which is the previous number (4) plus 1, so we would write +1. The sequence would then be +1, -1, +1, 0, 0, +1, 0, 0, +1, -1, which would require fewer bits than expressing

the entire sequence 100, 101, 100, etc.

As we've already seen, the system only works if successive samples are fairly similar—since there aren't big jumps from one sample to another, only a few bits are needed to specify the difference. The system breaks down if there are many sudden jumps between samples, but this doesn't generally happen with speech or with most audio.

MPEG compression for motion pictures uses a similar concept. In most film or TV action, there is little difference between one frame and the next. Rather than fully describe each of the 30 or so (depending on the method) frames per second, MPEG compression compares each frame with the one before it, and describes only the differences. Occasionally, when a scene changes, the MPEG data must provide a much greater amount of data to describe an entirely new picture, but this is relatively rare.

Delta modulation

Delta modulation is an extreme case of differential PCM. In delta modulation, the sampling rate is much higher than required by the Nyquist theorem. We use the term oversampling to describe it—for example, a system where the sampling rate is 16 times higher than the minimum required would be called "sixteen times oversampling."

At first glance, this sounds bad: taking more samples than necessary implies more bits than necessary. The difference, however, comes in the number of bits needed per sample. If you sample fast enough, the difference between successive samples becomes so small that there is at most a one-step difference between any two successive samples. Then you need only one bit to express that difference.

The previous paragraph is not entirely correct; it's a bit over-simplified. Actually, we need slightly more than one bit to express the difference between two successive samples. The reason is this: A given sample measurement could be either (1) larger than the previous sample, (2) smaller than the previous sample, or (3) the same as the previous sample. One bit can only express two possible conditions, not three, so you need more than one bit.

Delta modulation, however, ignores the third possibility—the case where one sample is the same as the previous one. When there are several samples of the same value, instead of coding them as "same, same, same, same," delta modulation introduces a slight wiggle into the waveform by coding them as "bigger, smaller, bigger, smaller." By using a 1 to mean "bigger" and a 0 to mean "smaller," delta modulation gets by with just one bit per sample.

Fig. 9 shows an example, illustrating two kinds of possible errors. At A, we see that the analog signal is rising faster than the digital approximation can follow. This can happen if the system does not sufficiently oversample. This error could be reduced by increasing the sample rate (which, unfortunately, requires more bits) or increasing the step size (which, unfortunately, would reduce the signal-to-noise ratio).

At B, we see that the analog signal is almost constant. Ideally, the digitized signal should also remain constant. But because the bit coding in delta modulation requires that the digitized waveform cannot stay constant—it must go either up or down—this introduces a slight "wiggle" which adds a slight amount of noise into the signal. Fortunately, with oversampling the sampling frequency is much higher than the highest signal frequency (for example, with 16 times oversampling, the sampling frequency would be over 32 times higher than the highest signal frequency). The frequency of this "wiggle" is therefore way above the signal range, and so it can easily be filtered out with a low-pass filter.

Delta modulation has one major advantage: It greatly simplifies the design of the A-to-D and D-to-A converters, and this drops the price. A moderately fast microprocessor can easily convert back and forth between plain PCM and either DPCM or delta modulation, making it possible to use delta modulation even when data is coded with PCM. That's why you often see CD players advertised as using oversampling—they use an inexpensive microprocessor to convert the PCM on the CD into delta modulation, and then convert that to audio with a simple one-bit D-to-A converter. This can give somewhat better results than a 16-bit D-to-A converter costing the same.

Vocoders

In wireless applications, bandwidth is becoming so scarce that the US government has been auctioning off RF frequencies to the highest bidder. We have already discussed how high-definition television (HDTV) will use digital methods to compress a high-resolution picture into the same 6MHz bandwidth currently used for normal TV.

Another bandwidth crunch exists in voice communications, such as in the mobile radios used by trucks, taxis, and police, and in cellular radios and PCS—the Personal Communications Service which is being developed in parallel with normal cellular phones. This has led to the development and use of vocoders.

Normal speech can be broken down into several dozen basic sounds called phonemes; words are then put together out of these phonemes. The vocoder or voice encoder is a device which produces phoneme sounds like those which might be produced by a speaker's mouth. It does not try to duplicate a particular waveshape, but rather is told by a digital data stream what sounds to make. (There is obviously another side to the vocoder, and that is the part that can analyze an actual voice and break it down into its components.)

Whereas normal telephone company digitized voice signals require 56k bits per second, vocoders using just 13kbps are fairly common, and substantial progress has been made at units which can work with just 8kbps of data. Current vocoders produce speech that sounds slightly unnatural, but that is close enough that most users can recognize not just the words, but also the voice of the original speaker. The ultimate goal is to reduce the bit-per-second rate even further, so that mobile communications bandwidths can be reduced from their current 15kHz down to 7.5 or even less.

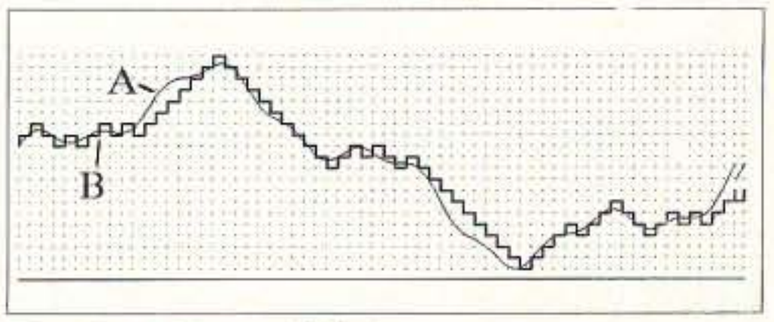

Fig. 9. Delta modulation.

Oscillator Basics, Part 1

Some things every ham should know.

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Oscillators are magical little circuits that generate the signal we transmit via radio; without the oscillator there would be no signal to transmit or receive. Actually, the oscillator is an amplifier that has its output coupled back to its input (**Fig. 1**). Though the circuit will oscillate, the frequency of oscillation is uncontrolled—it will be at the highest frequency the amplifier can support.

Selected components in the feedback circuit will provide control of the frequency. In the case of a crystal oscillator, the crystal operates as a resonant circuit, placed in the feedback path of the amplifier to control the frequency and stability of the oscillation.

Fig. 2 shows how a crystal is used; there are two resonant modes from which to select. **Fig. 2a** shows an anti-resonant (parallel) crystal; it exhibits a 180-degree phase shift across its terminals (high impedance). **Fig. 2b** shows a resonant (series) crystal, which exhibits a zero degrees phase shift across its terminals (low impedance). In either case, the amplifier must provide a like amount of phase shift, canceling out the circuit losses, to sustain oscillation.

Because of circuit variables and differences between crystals, some oscillator applications require adjustment or "netting" of the operating frequency. The method most often used is placing a capacitor or inductor in the crystal circuit to "pull" the crystal frequency to that desired.

Fig. 3 shows some of the methods used. A capacitor or inductor is placed in series with a resonant (series) crystal (**Fig. 3a**), and is placed in parallel with an anti-resonant (parallel) crystal (**Fig. 3b**). The capacitor or inductor, when added to the crystal circuit, will shift the crystal frequency predominantly in one direction from nominal.

Note that a resistor is placed in parallel with the series-resonant crystal, particularly when used with a series-connected capacitor, to maintain a conductive path for bleeding off trapped electrons. The crystal is a non-conductor, and when in use, electrons will build up on the isolated circuit conductor between the crystal and capacitor, and the number of electrons (voltage) will increase with continued use and apply a DC bias to the crystal.

Eventually, the excessive bias may apply sufficient pressure to fracture the quartz, but in the meantime, the crystal frequency will shift uncontrollably. A shunting resistor (any value between 100 and 2000 ohms, 680 ohms being typical) provides a conductive path, relieving the voltage strain on the crystal.

Some circuit designers use a small RF inductor across the crystal to accomplish the same purpose as the resistor. Again, the value is not critical, but the inductor's impedance value must be at least ten times the crystal's operating impedance. 73

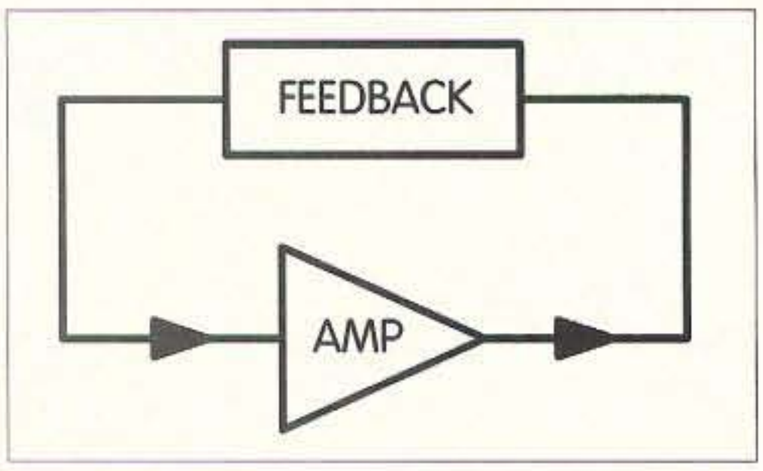

Fig. 1. *Oscillation (feedback) is amplifying the same signal over and over.*

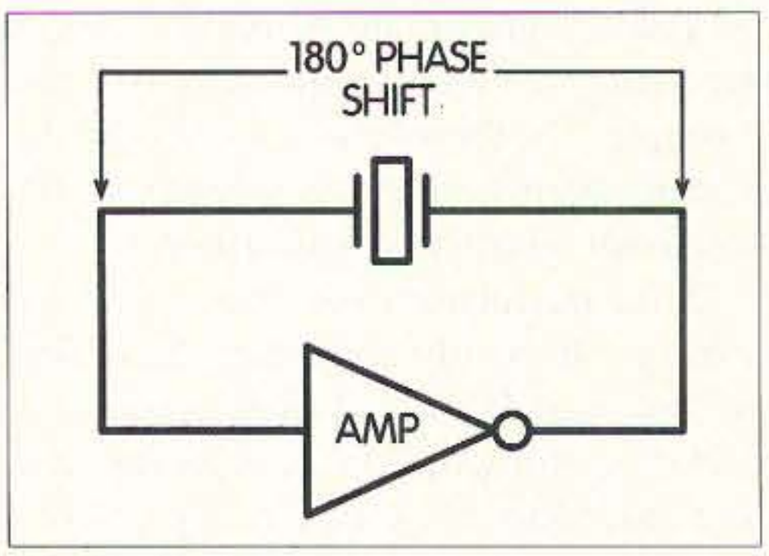

Fig. 2a. *Anti-resonant crystal.*

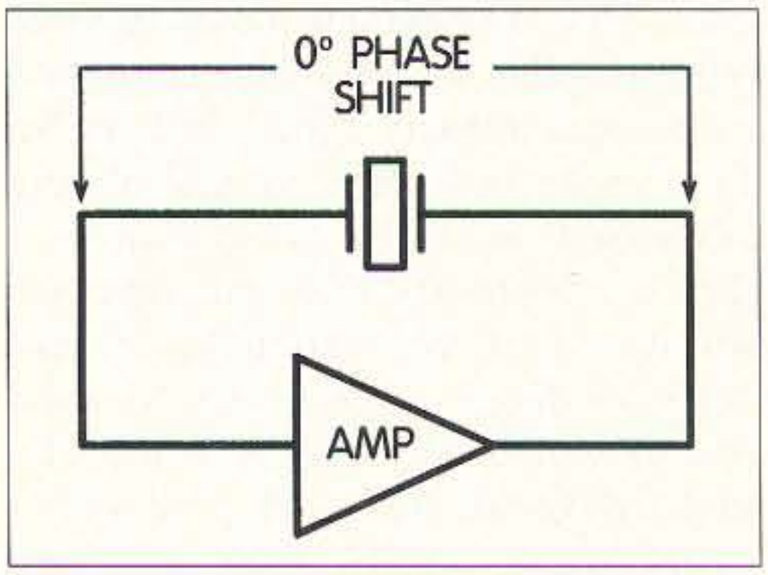

Fig. 2b. *Resonant crystal.*

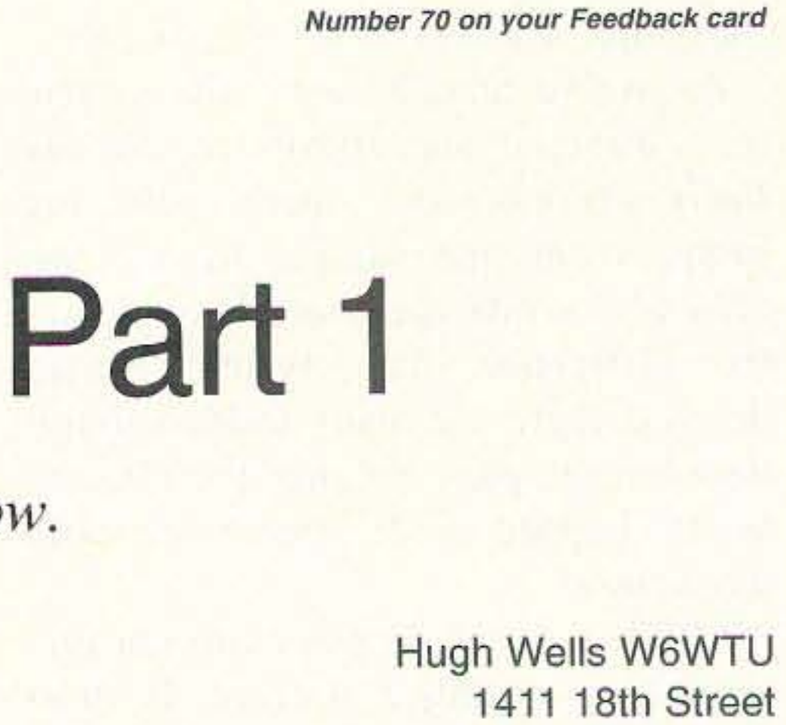

Fig. 3a. *Resonant.*

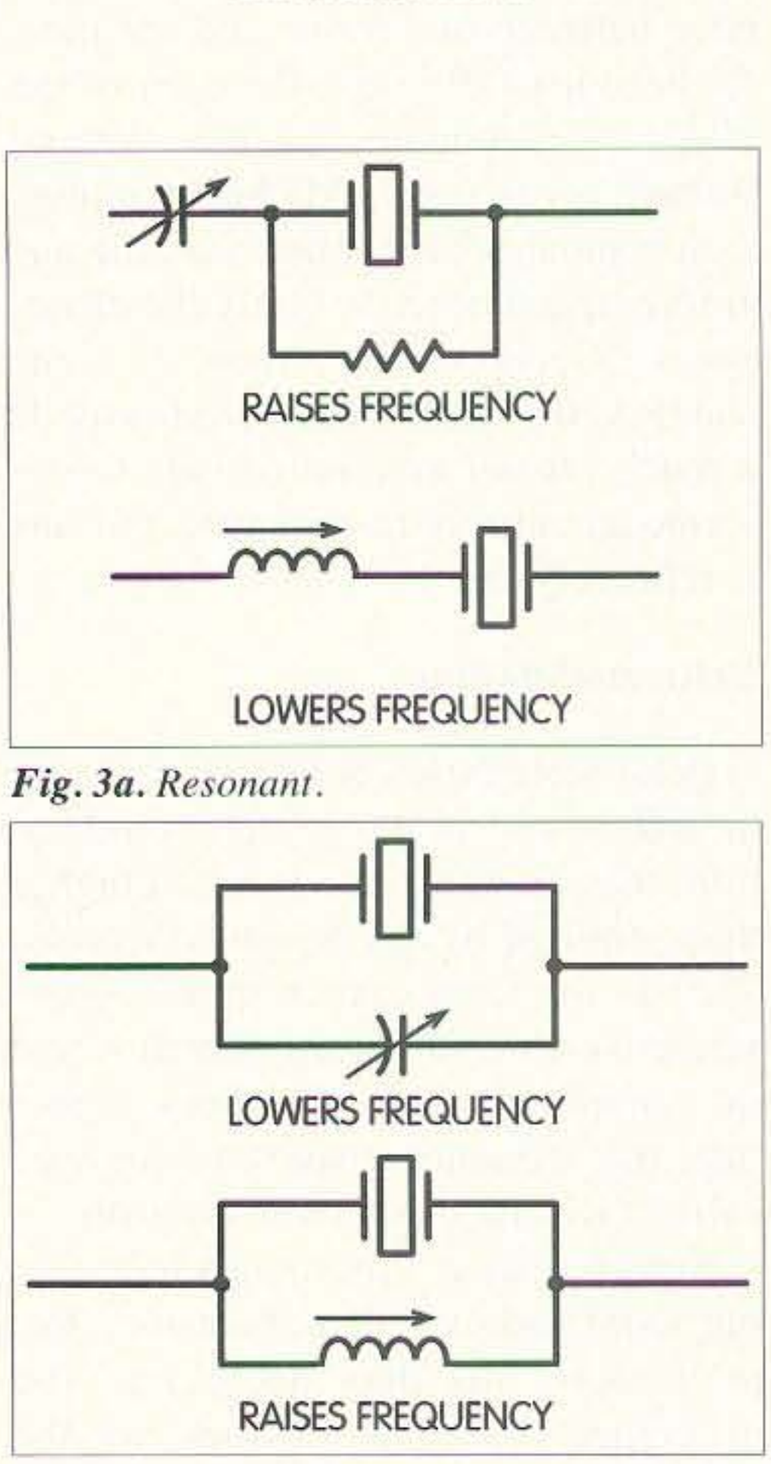

Fig. 3b. *Anti-resonant.*

Frequency and CW CQs

How to zero-beat your transmitter.

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Back in the early days of radio, before World War I, and for some years after it, the transmitters most hams used were called "spark sets." In many cases, they used power-line AC with no special power supplies other than a high-voltage step-up transformer.

When each half cycle of the power line AC cycle built up to a high enough voltage, the transmitter's spark gap would spark across. For a few milliseconds a damped (decaying) radio-frequency (RF) AC oscillation would be produced in the transmitter/antenna coil and capacitor network, pretty close to the frequency of resonance of the transmitter's antenna inductances (L) and capacitances (C).

Because of the weird damped waveform of the RF-AC oscillations, both a "carrier wave" and "sidebands" (RF-AC waves above and below the carrier frequency) could be heard perhaps 100kHz (or more for nearby receivers) from the LC circuit's fundamental frequency. It was a terribly broad buzzing sound emission.

We have improved greatly on our transmitting equipment today. A modern CW transmitter is capable of operating, key down, on a single frequency, producing no sidebands at all. However, if it is keyed, it does develop a few sidebands. The old spark transmitters produced damped waves and for this reason their radiotelegraphic code transmissions could not be called CW because "CW" stands for Continuous (non-varying) Wave signals.

You probably know that today's AM broadcast band is from 550 to 1,600kHz. But let's turn the clock back and think for a while like the hams did back in the old days of radio. In those days, the frequency 550kHz was expressed as, "550 kilocycles-per-second," or simply, "550kc." Similarly, 1,600kHz was "1,600kc," or "1.6 megacycles-per-second," or simply, "1.6mc." Today, we would say it was "1.6MHz."

As a result, receivers accepted a very wide band of frequencies. If a spark station opened up on 600kc, any listeners within perhaps 50 miles would be able to hear him (few, if any, "hers" in those days) if their receivers were tuned anywhere between perhaps 400 and 1,000kc. So, the frequency on which a CQ was called was not too important. If a spark rig was operating, just about everyone anywhere around with a radio receiver would hear it. Answers could be expected to come from stations using a carrier frequency several hundred kilocycles away.

"If a spark rig was operating, just about everyone anywhere would hear it ..."

And what we know as 60Hz AC today was called 60 cycles-per-second, or 60cps then. Note that we now capitalize the M in mega (million), whereas in the early days they would use a lower-case m. The abbreviation for kilo (thousand) is still indicated by a lower-case k. The term "hertz," meaning cycles-per-second when used as a unit of measurement, is abbreviated "Hz." Of course, old Heinrich Hertz's name is capitalized as "Hertz."

No assigned frequencies

In the very early days of radio, there were no assigned frequencies. Operators used any frequency on which they could get a rig working. In order to pick up signals strong enough to operate earphones satisfactorily, the insensitive early crystal and other detector circuits had to be closely coupled to the antenna.

Because of unknown degrees of coupling from antenna to receiver or transmitter, the values given here can only be approximations. But what a wide swath two hams could cut in the radio spectrum—perhaps a whole megacycle! That's more than three times the width of our present 40m band.

It wasn't long before all of the amateur stations, plus a rapidly increasing number of broadcast stations, plus commercial radiotelegraph stations, plus all of the military services, began interfering with each other. Bands of frequencies had to be assigned for the different services. Commercial radiotelegraph and the military were assigned bands of frequencies below the assigned AM broadcast band (in those days, it was

stated as higher in "wavelength") than the BC band, which was roughly where it is today. Believing that the frequencies higher than the BC band were more or less useless, they assigned all of these to the amateurs.

In the second decade of the 20th century, the invention and use of the vacuum tube (VT) allowed this device to be coupled to LC circuits to produce RF-AC oscillations of a very pure sine-wave type. This resulted in the generation of radio frequency transmitter carriers with zero bandwidth.

Locally, the old spark sets, even with loosely coupled antenna circuits, had very broad carrier bandwidths. At some distance they may have only appeared to be perhaps 40kc on receivers, but that is still very wide by today's standards. If ships operated a high power spark transmitter on the international watch and distress frequency of 600m (500kc) when entering or leaving a port, they would wipe out some or all of the local BC station signals. Ships were required to lower their transmitter power when near ports.

A VT oscillator operating on a frequency, let's say 7mc, has zero bandwidth. However, when it is keyed, meaning it is turned on and off to produce dots and dashes, it goes from zero amplitude to maximum and back to zero. This is a half-cycle of square-wave RF-AC.

True, sine-wave-shaped radio waves from VT oscillators have no sidebands. But square-type RF-AC waves developed by CW keying do produce sideband RF-AC signals. Keying with a straight key may produce 6 square waves per second, or a 6cps square-wave AC. Such square waves are rich in harmonics of the keying frequency (unless a keying filter is used). If the 6cps square-wave RF-AC is limited by filtering to only 5 significant sidebands on both sides of the carrier, the bandwidth of the emission would be 6 x 5, or 30cps on each side of the carrier, for an overall bandwidth of 60cps. If the sending speed is doubled, the bandwidth of the signal doubles, but this is not much in comparison with an old-time spark transmission.

It wasn't long before hams found that they could generate pure RF-AC carriers on the frequencies they were allotted from the BC band to 10mc and above. (The L and C built into early-day tubes made operation above 10mc difficult, limiting higher frequency uses considerably.) Hams realized that high-frequency signals from their transmitters traveled up into the ionosphere and were either reflected or refracted (bent) back down to Earth many hundreds or thousands of miles away, providing distant (DX) communications without thousands of watts of RF power.

Not only did amateurs generate narrowband transmitted signals, but with the amplification provided by vacuum tubes, they could also use loosely-coupled and therefore more sensitive and narrower bandwidth receivers. These might be made to tune over a wide band of frequencies, perhaps from 2 to 7mc with one coil and one variable "condenser" (capacitor). The amateur frequencies from 2 to more than 10mc were about 8 times the width of the BC band, and 15 times the width of all of the frequencies allotted to the commercial and military radiotelegraph services.

"Let's not be band hogs! Make sure you are zero-beat!"

Wide allotment

At first, with their wide allotment of frequencies, if one ham called CQ on 3mc and was answered by another using a 4mc transmitter, it took a long time for the 3mc ham to tune around and find the 4mc answering frequency. So CQs were sent for long periods of time and much time was spent trying to find an answering call. They soon learned how important it was to adjust the frequency of their transmitters as close as possible to the CQing station's frequency. (We are still talking about times before and shortly after WWI.)

Since the amateurs were able to communicate over long distances using high frequencies, it wasn't long before the commercial and military services decided they wanted to operate on these frequencies, too. So, other frequency allocations had to be made. This time the higher frequencies were divided into amateur bands and separate bands of frequencies for each of the other services.

The amateur frequencies started at 1.75-2mc and were known as the 160m band. The other bands, all harmonically related, were the 80, 40, 20, 10, 5, and 2.5m bands. They were also known as the 1.75, 3.5, 7, 14, 28, 56, and 112mc bands. If an amateur decided to operate on a good daytime and nighttime band, such as the 40m (7mc) band, he would only have to tune over a couple of hundred kilocycles looking for a response to his CQ.

Later, when the amateur CW bands were sectioned off with parts in which radiotelephone could also be used, a CW CQ on 7.05mc might only require searching from 7 to perhaps 7.1mc with a receiver. That is still quite a wide band of frequencies to have to search for answering calls.

In the 1930s, '40s, and '50s, a great many amateur transmitters were "crystal controlled," meaning that they put out RF-AC only at the frequency (or harmonics of that frequency) to which the crystal was "ground" (manufactured to oscillate). With no crystal near the frequency of a CQing station, an answering operator would be lucky if the CQing operator tuned that far to find the answer to his or her CQ (more girls were now getting into ham radio).

Mr. Hertz arrives

After WWII, the old cps, kc, and mc abbreviations were changed to our modern hertz, kHz (kilohertz), and MHz (megahertz) abbreviations. You may still hear old-time hams using the kc and mc designations, which sounds normal enough to them—although it may not to later generations. The OMs say, if "kc" stands for kilocycles-per-second, why add another letter, making it "kHz" to say the same thing? But languages other than English may use other terms for "cycles," so the "c" in "kc" would be meaningless to them.

With the complexity of amateur radio equipment steadily increasing over the years, almost all modern "transceivers" can now transmit and receive on any desired frequency in one or all high-frequency amateur bands. Most transceiver receiving sections will track with their transmitting sections. If you transmit on 7.05MHz, your receiver should receive CW signals that are also on 7.05MHz, and produce a pleasing 700 to 800Hz audio output from them.

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Unfortunately, some transceiver receivers are not detuned, or "offset" 700 to 800Hz from their transmitters. If an incoming signal is tuned to a pleasing tone, the transmitting section may turn out to be 700 to 800Hz above or below the CQing station's frequency. This may be far enough off with today's narrow passband receivers, some as narrow as ±250Hz, that the CQing station will not hear the answering station unless his or her receiver is tuned back and forth a kilohertz or so across the frequency on which the CQ was sent.

So, as in the old days, it may still be necessary to tune around after calling CQ to find an answering call. Some home-brew amateur transmitters still use crystal oscillators and may not be able to answer anywhere near the CQing station's frequency. If a variety of crystals of different frequencies are available, one may be close enough to the CQing station's frequency to hope that the answering call will be heard.

Many of today's transceivers have a built-in "Receiver Incremental Tuning" (RIT) control. RIT controls tune only the receiver, leaving the transmitting frequency unchanged. The RIT is a really handy circuit for both CW and SSB communicating. If your transceiver has an RIT control, after you call CQ on CW and hear no answering calls, turn on the RIT and move its control knob perhaps 1,000Hz each side of its zero or off position. That way you can tune in amateurs who are calling you, but unknowingly are not on your frequency.

They've got the (zero) beat

The subject of zero-beating is an interesting one. If two different RF-AC frequencies are mixed together at the input of the right kind of an electronic circuit, both of these signals will appear in the output circuit. But besides the original two frequencies there will be two other "beat frequencies" in the output. One will be the sum of the two original frequencies, and a second will be the difference between the originals.

Suppose a 7,001,000Hz signal is received and mixed with the output of an oscillator you can control. If you set your oscillator to a frequency of 7,001,700Hz, the audible beat frequency signal in the output of the electronic circuit, besides the original two frequencies, will be a pleasant-sounding 700Hz tone. The second output beat signal will be a "sum frequency" of 14,002,700Hz. This is far beyond the limits of our hearing (which is about 20kHz for young people, perhaps 8kHz for the elderly) and may be of no use to us in this particular case.

When you tune your transmitter to the same frequency as an incoming signal you are said to be zero-beating the two signals because no beat signals are developed. When your transmitter is zero-beat with another station's carrier you will be using the least amount of band space possible, usually something less than 100Hz when keying CW.

If one CW station is off another CW station's frequency by 800Hz, the two stations will be using about 900Hz of the band when communicating. They are using about nine times as much band space as two CW stations who were zero-beat. Let's not be band hogs! Make sure you are as close to zero-beat as possible with any station you are working.

Tricky business

Getting your transmitter to zero-beat with another station's carrier can be tricky. If you use a separate transmitter and receiver, when you tune in a CQing signal, first adjust your transmitter to very low power (or turn off the final amplifier if possible). Then tune it across the frequency of the signal being received. As you tune, you will hear a whistle that starts as a high audible tone, goes down to zero and then goes back up to so high a frequency that it is no longer audible. Retune to the zero signal condition and your transmitter will be very close to zero-beat with the other transmitter. It may not be exactly zero-beat because neither our receivers nor ears will respond to frequencies below perhaps 20Hz, leaving a dial spread of about 40Hz that we cannot hear.

Transceivers with receivers having a built-in offset of 700 to 800Hz from their transmitter's frequency, when tuned to a pleasing 700 to 800Hz beat tone, should be relatively close to zero-beat with that signal when transmitting. This is an excellent type of CW rig.

A problem arises when a transceiver's receiver is not offset from its transmitter's frequency, which may be the case in transceivers built for SSB operation with CW as more or less of an afterthought. When the listening operator tunes to a pleasant-sounding tone, the transmitter will probably be 700 to 800Hz above or below the CQing station's frequency. If the transceiver has an RIT control, there should be some RIT setting at which a pleasant-sounding CW signal will put the transmitter at zero-beat with the incoming signal. Always use this RIT setting when working CW. If there is no RIT control, as with some of the QRP kits, things become more difficult. With a little experimenting, it may be found that by readjusting the frequency control 700 to 800Hz between sending and receiving, two stations can operate on the same frequency. This does require retuning your rig each time you shift from transmit to receive, which is undesirable. Another possibility is to add a RIT control and switch, which takes a bit of doing. With so many different types of CW rigs in use it is impossible to explain how to zero-beat them all correctly. If you are not sure how to do it, experiment with another amateur on the air until you know how to adjust your transmitter to zero-beat the other station's frequency. Experimenting is the name of the game of amateur radio. Zero-beating is the only way to work CW properly.

As mentioned above, when operating SSB with a transceiver, as long as you have your RIT off, or not detuned, when you adjust the main tuning dial so that the received voice sounds most natural to you, your transmitter should be zero-beat with the other station's suppressed carrier frequency. The only time to use your RIT with SSB is when one of the stations in a net is not operating exactly on the net frequency and you have to tune until he sounds normal to you. This is where the RIT's on-off switch comes in handy: RIT off to listen to the net frequency—RIT on to hear the off-frequency station (whose RIT is probably on and detuned!).

Calling CQ

There is a basically proper method of calling CQ on CW. First, patrol for a minute or so a part of the band in which you want to work. Find a stretch of 2 or 3kHz that appears to be clear. If necessary, tune up there, send "test," and sign your call. If you hear "QRL," which means "This frequency is in use," move

your transmitter to some other apparently clear frequencies. Listen for about five seconds, then send "QRL?"—meaning, "Is this frequency being used?" If you hear "QRL" or "yes," move again. In many cases, you may not hear stations because they may be in your skip zone. If you hear no QRL, or "yes" answer, listen for about five seconds and then repeat the QRL? call. If there is still no answer, call "CQ CQ de" and send your callsign twice, slowly and distinctly, followed by a "K," meaning "go ahead." If there is still no answer, there is probably no one else monitoring that frequency and wanting to communicate.

Now send a full CQ call: CQ four or five times followed by "de" and your callsign once. Repeat the CQ calls and signing two or three times, ending with your call letters sent at least twice, very distinctly and well spaced, followed by K. Do not run your callsign characters together. With some of the weird callsigns we have today, it is easy to confuse someone if a callsign is repeated but not spaced properly. Be sure to space adequately between your callsigns! You may know your callsign, but the operator at the other end has to learn what it is!

Patience

Don't always expect to get a response on a first CQ call. After tuning back and forth across the frequency a few times to see if someone is answering but is not zero-beat with you, repeat the CQ call again. In general, don't make a CQ call last for more than 60 seconds. On a dead band, you may have to make the full CQ calls many times before you get a response.

Even kilowatt-transmitter operators may not get an answer after half a dozen calls, so don't give up easily if you are using lower power. You have to keep calling until someone happens to tune across your frequency while you are sending the letters "CQ." This is the reason why you only sign your call once in between CQ calls—it is so you will be sending CQ most of the time with minimal signing time. Don't send a long string of CQs with only a couple of signings at the end. Others may get tired of listening and tune off.

After two or three CQ call sessions, wait about 10 seconds, then patrol the band to see if there is someone calling CQ somewhere else. After half a dozen CQs, try moving your frequency a kilohertz or so to possibly pick up someone who is sitting on this new frequency.

Sometimes there may be a QSO in progress on the frequency on which you have been calling CQ, but you do not hear them because they are in your skip zone. Other operators may be in the position where they can hear both you and the other QSO in progress at the same time, but they will not answer you on that frequency for fear of interfering with the QSO. That same operator might answer if you were a kilohertz removed.

At the end of a QSO, some operators send "QRZ?" when they mean CQ. When you send QRZ? you are indicating that you have heard a station calling you but that you were unable to copy the call and you are requesting him to repeat his call. Other stations should not call you if some other station is already calling. If you want to have another contact after you sign clear of a station, merely send CQ twice and sign your call twice. If someone is listening who wants to contact you, this is the correct go-ahead indication.

It may be more desirable to answer CQs than to call CQ on a busy band. You can be more selective about who you will be working. Generally, if you want to rag-chew, stay out of the lower-frequency DX portions of the CW bands. Most DX stations only want a contact and may not be looking for a rag-chew. In years gone by, amateurs wanting to rag-chew would send, "CQ RCC," meaning CQ to the rag-chew club members, but we don't hear this any more.

Slow down

Always make sure that you send your CQs at a speed a little slower than you can copy comfortably. When in a QSO, make sure you send at a speed that the other operator can copy. If you ask questions but get no answers, slow down—you are probably sending too fast (or too poorly?) for that operator! If the other operator is making a lot of mistakes, he or she is perhaps trying to send too fast. Slow your sending and hope that the other operator does the same, or use the Q signal "QRS," which means, "Send slower." That will usually improve the sending of an operator who is told to slow down. Always use slower sending when you know the receiving operator is having QRN troubles.

A long way

We have come a long way since the early days of spark transmitters and those insensitive crystal detector receivers. Today, it is rare to find another station answering our CQ who, if not zero-beat, is more than one or two kilohertz from our frequency. But we should not forget that there are still some, usually home-brew, crystal-controlled transmitters in use, so it may be a good idea to search further away from your calling frequency sometimes to pick them up.

In the early days of radio, if there were 10 spark transmitting stations working at the same time in the two megahertz of frequencies that were in general use at that time, it probably would have been considered crowded conditions. Today, in the 150 kilohertz that we think of as being the 7MHz CW band, with our modern equipment we could probably squeeze in 150 separate QSOs at one time, involving 300 amateurs. This is not considering all of the other stations either in our skip zones or which are out of range.

While CW can be used legally on all parts of all amateur bands, many operators resent hearing CW being used on phone frequencies, or on frequencies used by other modes of communication. Let's use our amateur frequencies in such a way as to keep everybody at least reasonably happy. 73

Keys to Days Gone By

Enthusiasm for the code keeps this ham's nostalgic collection working.

Charles M. Seay, Sr.
106 South Main Street
Dickson TN 37055

People have their own reasons for becoming hams. It may have been the excitement of witnessing a DX contact, the prospect of owning and appearing on your own television station, the desire to rag-chew, or a love of code and the satisfaction that only a code contact can bring.

After a while, the best part of the amateur world is the nostalgia that goes with the hobby. Whether it's remembering that special contact, the construction of that first piece of equipment, or the collection of special segments of equipment, you can't be around two or more hams for fifteen minutes and not hear the phrase, "I remember when."

Nostalgia is a great part of the satisfaction that comes to those who collect and use different types of telegraph keys. They are always wondering who owned the key before it came into their possession, and what important message it may have sent. This is especially true of keys that were made and used during the great historical periods, such as the great world wars or some natural or man-made disaster.

One of those collectors of antique keys is Shelby Rye AD4WQ. While he doesn't have a huge collection of keys, his is unique in that he uses each key in his collection on a rotation basis. He loves the code. He now has 80 keys and six sounders, but he is especially proud of his collection of Martin Rotoplex and McElroy keys. One of his Martin Rotoplex keys carries a serial number 13, and his McElroy Deluxe Bug was manufactured in the late 1930s.

No key collection would be complete without a broad spectrum of straight keys. In this area, Shelby has a J-12 key with a history back to World War I, a J-38 straight key and a J-45 leg key from World War II, and seven Western Union legless keys of different vintages. Most of the keys were found at hamfests or through contact with families of silent keys.

A Bunnell KOB key with sounder sporting a pre-1900 manufacture date occupies a special place in collection of sounders. Many of his sounders were obtained through contact with retired railroad operators or their families.

Shelby was introduced to the wonderful world of amateur radio in February of 1994, took and passed his Novice test in April of that year, and was first licensed as KE4NFP. Before he received his first license, he had already passed the twenty-words-per-minute code test and all written exams for his current Extra Class call AD4WQ.

Shelby is known to other hams in middle Tennessee as Coach Rye. He is the men's basketball coach at the local high school. Coach Rye said, "Like basketball, learning the code requires the discipline to practice. I love to make at least five code contacts each day, with a yearly goal of 2,000 contacts." Before his introduction to amateur radio, Coach Rye collected knives and pocket watches. When I asked Coach Rye what he thought of amateur radio, he replied, "Without a doubt, it's the most captivating hobby I've ever been involved with."

Shelby operates a Ten-Tec Omni Six with all filters into a dipole 55 feet per side through a MFJ 949E Tuner. "I never run over 60 watts and I usually hang out on 40 meters between 7.030 and 7.040," said Shelby. He is a check-in most nights with the Tennessee CW Traffic Net on 3.635 at 7:00 p.m. CST.

***Photo A.** Shelby Rye AD4WQ, at the operating position of his amateur radio station with a selection of keys on rotation.*

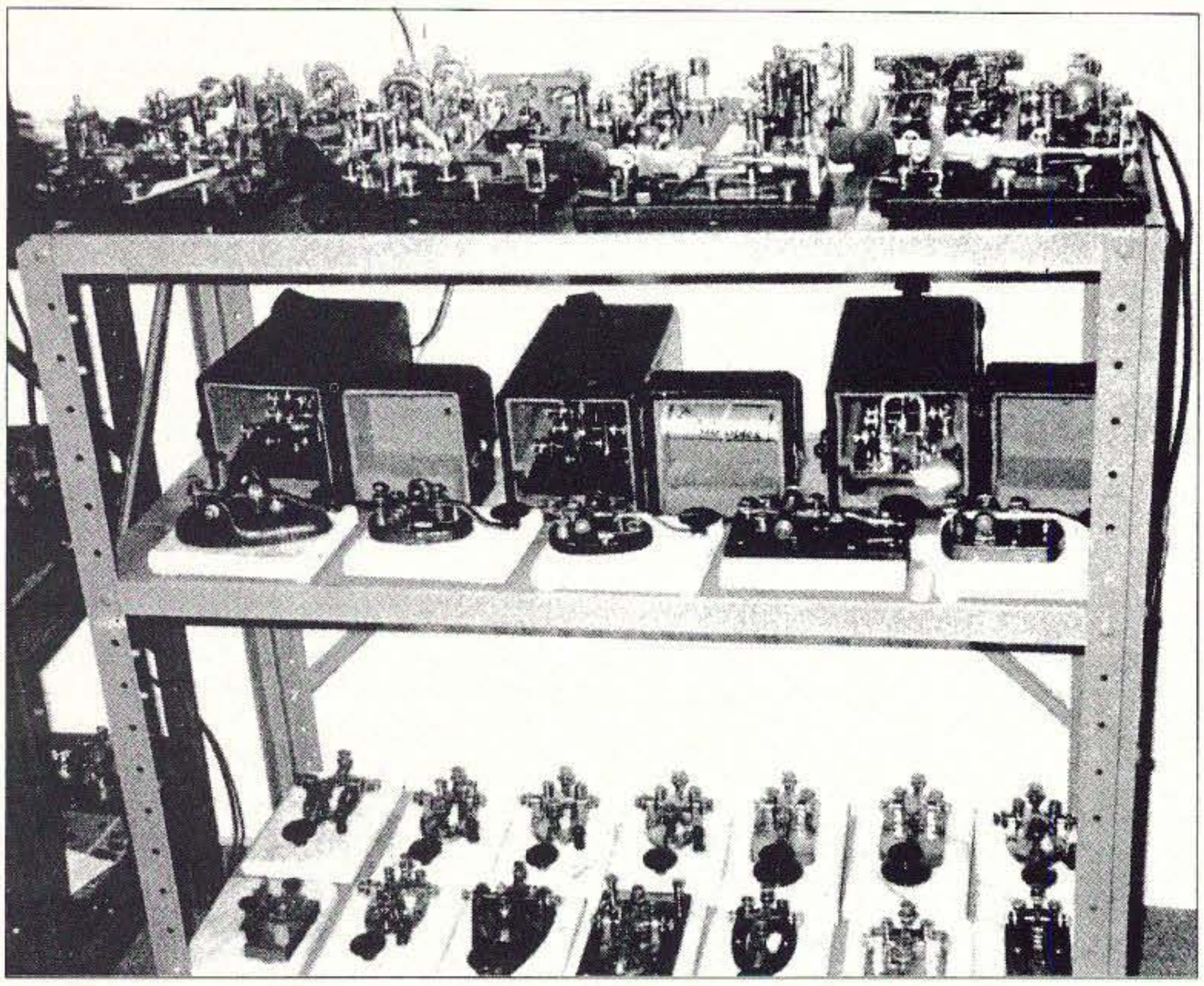

***Photo B.** Just one rack, showing some of the keys in Shelby Rye's collection. All keys are in working order and are used on a rotation basis.*

Whether you collect keys, QSL cards, awards, or other equipment, nostalgia now plays or will play an important part in your amateur career. You can't operate an amateur radio station without encountering reminders of the past, whether it's the electronic theory, or equipment, or an old-time operator. Each person and each piece of equipment in the amateur radio service is unique. Who would have it any other way? 73

NEVER SAY DIE

Continued from page 56

fish, or anything that may come riding along with your strawberries or raspberries, both of which have been making people sick recently.

Dr. Farber sent me an updated edition of his *Silver Micro Bullet*, a book which is included in my guide to books you should read. Silver may be the best answer to the coming plagues brought on by escalating microbial resistance to antibiotics. I see that *The Plague Makers*, which I have reviewed, is now on the front page of the Barnes & Noble flyers at a discount price.

When am I going to hear from you about your adventures with silver? The April issue had a simple gadget for making the stuff.

DVD

I hope it's no news flash to you that we're going to be seeing an increasing flurry of digital video discs. They're the same size as CDs, but they hold over nine times more data, which has made it possible to put a whole movie on a single disc. They crammed the additional data on the discs by making the pits nine different depths instead of just one. With movies this will enable them to add different endings, sound tracks in several languages, comments on the production, and other trivia.

The discs will be lower priced than video tape, so as players come down in price we may see the movie renting public buying the new players. The pictures will be much better than on tape, and you don't have to fast forward or rewind to find something. No, you can't yet record your own.

Judging from the ubiquity of video rental stores, I'm one of the few people who doesn't rent movies. Or buy them, either. I go to the movies every week or so, and catch a few of those I miss in PrimeStar. I haven't missed very many good movies, but I *have* watched a bunch of turkeys.

I can't think of any good reason for me to get a DVD player yet. Heck, Sherry bought a video disc player and we've never used it. I do keep my VCRs busy. I rarely watch any shows live, preferring to time-shift them for my convenience and so

Continued on page 88

Number 78 on your Feedback card

Above & Beyond

VHF and Above Operation

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Shakedown tests of portable microwave systems

August is the month for the start of the ARRL 10GHz Contest. It is open to all participants who have access to or have constructed transceivers for making contacts on 10GHz. The rules are quite simple—communicate with one another and promote activity and experimentation on our microwave bands. Well, there are a few more rules to follow, but the main spirit of the contest is to encourage communications among amateurs and to promote 10GHz microwave communication.

Most amateurs participating in this contest operate either wideband FM or single sideband. Most of the old-timers on this band have migrated to narrowband operation for its superior performance with single sideband operation. Even so, many still take their wideband rigs along just to keep the simple rigs in operation and to make contacts with ever-present new amateurs.

I am sure that in the future (if not in this contest, then in another) there will be amateurs who might attempt high-speed data communications. Some others may use standard video for communications. Art WA6YQH and Ray N6RE could be ready to use their 10GHz facilities for making several contacts using full-scan NTSC video. They have been the video pioneers in our group, making some very important contributions on how to set up systems and methods for video operation on 10GHz.

The beauty of operating on 10GHz is that there is space for all of us to improve our own skills and construction practices. On 10GHz, there are sufficient frequency allocations allowing all these modes of operation.

In our very first years (early 1980s), I operated on wideband FM, as this was the only equipment that was (1) inexpensive and (2) available (inexpensive) at that time. Now, I utilize an improved system that is fully linear in operation. It will pass FM as well as SSB signals equally well. We even tried video operation briefly. My main mode of operation is SSB—distance and weak signal work make this mode of operation the best choice.

When signals are moderate to very strong, we usually switch to narrowband FM. The 5kHz bandpass with FM allows for very crystal clear communications without retuning, as is the case when you work many different stations using SSB. Operation on FM is not unlike using a standard 2m HT, as quality is quite the same.

The ARRL 10GHz Contest is my cup of tea—one that lets us commiserate while participating in something we all enjoy. The annual contest is usually held on the third weekends of August and September. Get a copy of *QST* for contest rules.

Sometimes preparation for the contest is put off till the last moment, and that's what this column is all about. First, to get you thinking about getting in on the fun on 10GHz after you have put together a 10GHz transverter, I want to provide a list of functional tests to ensure that it will work after you transport it to a remote hilltop.

Most things we purchase are expected to operate in almost every environment, whether fixed station or portable/mobile. However, things we home-brew tend to need a little more care, depending on the packaging and construction methods. In this arena, I cast myself into the caldron as I have failed to do, several times, what I am about to tell *you* to do. This is the voice of experience and near failure speaking: If you do not test prior to going to a remote location, you just might not have a functional rig, or at least a very sensitive one, to use. I have found out on more than one occasion that a moment of preparation prior to going to the hilltop will be well-spent time.

What you need to do is to check out your transverter and make sure that all is well. Here the best test is to get several of your buddies together and test all the rigs in your group. You might not have the latest in noise figure or frequency test equipment—this is not needed but nice to have. What you want to find out is how you fare compared to the group of fellow amateurs with whom you expect to communicate.

Is your antenna properly focused, and are your signals being received in similar strength, as well as transmitter power? You're not after an absolute value, but a simple comparison of systems, noting the top performers and finding out what is out of adjustment or not sensitive enough. In general, a full system shakedown performance/repair/adjustment/evaluation on home grounds.

Checking out your rig sounds simple even for a well-equipped home shack, as far as test equipment goes. Remember, even if all seems well, just making the trip to some remote spot with your equipment is the same as placing it on a "shake table." For me, this shake table is the back of my pickup truck. Even though the equipment was carried in boxes, it was still not transported in a "hardened" or shock-resistant state for an arduous trip to a microwave hilltop site.

My transceiver for many years has been a home-constructed system fabricated on the top plate of a 10GHz, 10W TWT amplifier. There are two different DC-to-DC power supplies providing -24 volts, +12 volts, -5 volts, and +24 volts. All are isolated switch mode power supplies allowing a single common ground for all components between input and output of the supplies. There are a microwave brick-type Frequency West oscillator, a mixer, and two 10GHz amplifiers, all connected to a bank of four SPDT microwave relays. In addition, there is a circuit that will detect RF on the IF cable between the transverter and 2m driving radio.

Whatever your system, place it in an environmentally suitable antenna test range in competition with others for some friendly tests. See who has the most sensitive receiver and best power-to-antenna performance. All things are equal when you factor in power output antenna gains expected. By observing

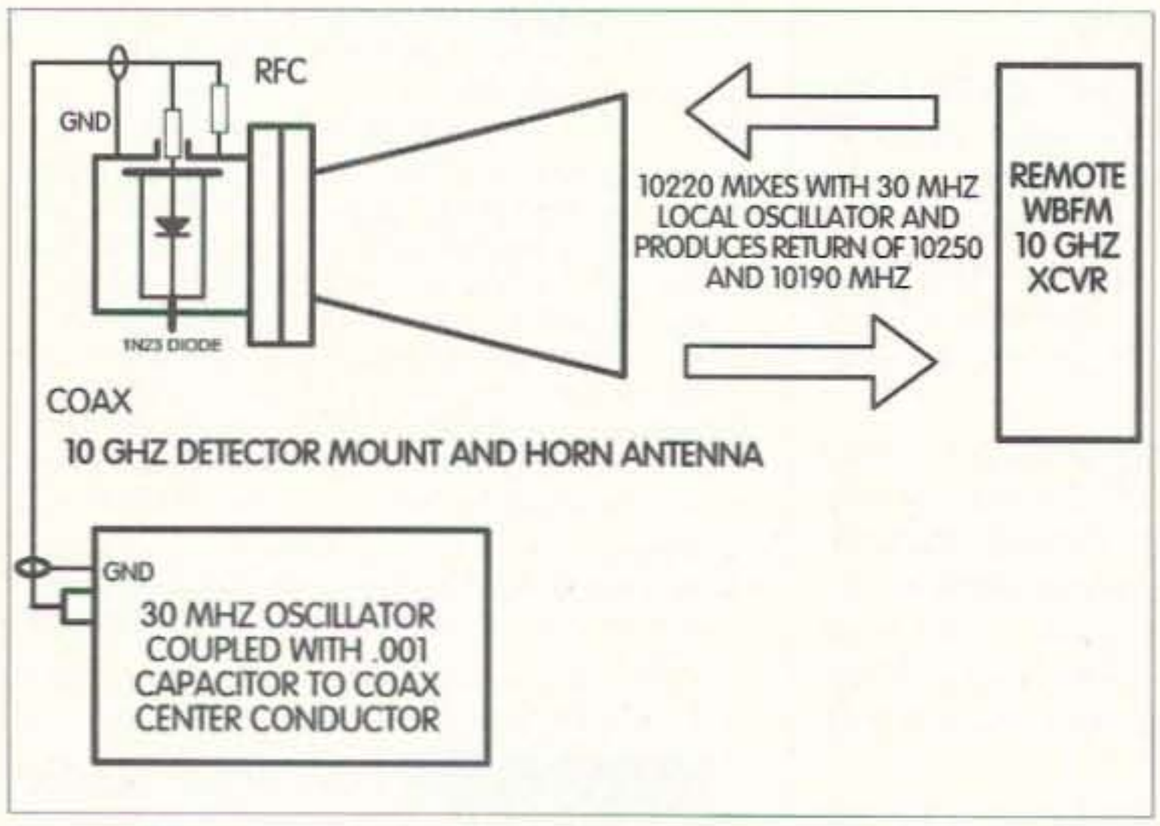

Fig. 1. *Basic microwave "boomerang." This device will provide a return signal for a selected band of operation. It is the simplest one that can be constructed for test purposes using wideband FM-type Gunn-diode oscillator receivers/transmitters. Uses local oscillator running at IF frequency of 30MHz injected into waveguide transition and small horn antenna.*

the remote system signal (IF) sensitivity returned in either S-units or so much power as observed on a sensitive RF power meter, you will get some very quick ballpark figures of some really smoking signals and some other performers that should be as good. This test points to a system performance level and may show that some part of the system is not functioning as well as it should be.

The problem could be as simple as changing the feed position on a dish antenna to illuminate it better than what you are getting from where the geometry says the feed should be. Small adjustments can be best made in this type of setting—this is how the pros do it and certify their equipment. Why not take advantage of their antenna range adjustments and apply it ourselves? True, the backyard antenna range is simple, but it's still effective in determining just how well your rig stacks up against others. See **Figs. 2** and **3** for information on how we set up our test range.

The remote transceiver is the most basic unit that can be constructed for the frequency band in question. In our case, the transceiver is constructed for 10GHz operation. It is built with a Frequency West microwave brick-type oscillator operating at 10,224MHz injecting into the LO (local oscillator) port of a microwave coaxial mixer. The mixer output (RF) port is coupled directly to a small waveguide horn antenna that has about 10 to 15dB gain. The horn gain is not important and should be kept low, as we want a weak signal to detect at the far end of the test path.

If signals are too strong, a waveguide or coaxial attenuator can be placed in the connection between the mixer and the antenna. The IF port of the mixer is connected to a long run of coax back to the point of test. In our case, a 300-foot length of RG-59 was used to allow insertion of amplifier pads, power meters, and signal generators to make performance evaluations.

By using a signal generator for the transmitting source, output power can be controlled by the quality attenuator on the generator, sending a measured amount of signal to the remote transverter and seeing how much is required to detect a minimum discernible signal on the test receiver system. The main reason we do not want to use a 2m transceiver for these tests is that the S-meter is limiter-controlled and can give bad information when the signal is in saturation. Using the signal generator with variable power output, it can be set to a calibrated point and referenced to detected sensitivity. These tests are not absolute, but in a practical sense are very good.

It doesn't matter what you choose to use in your system, be it expensive signal generators and power meters or a 2m handie-talkie. Just be ready to adjust your system, and at minimum with the 2m HT have a variable attenuator or series of coaxial pads (fixed attenuators) to reduce its power output as well as sensitivity on receive.

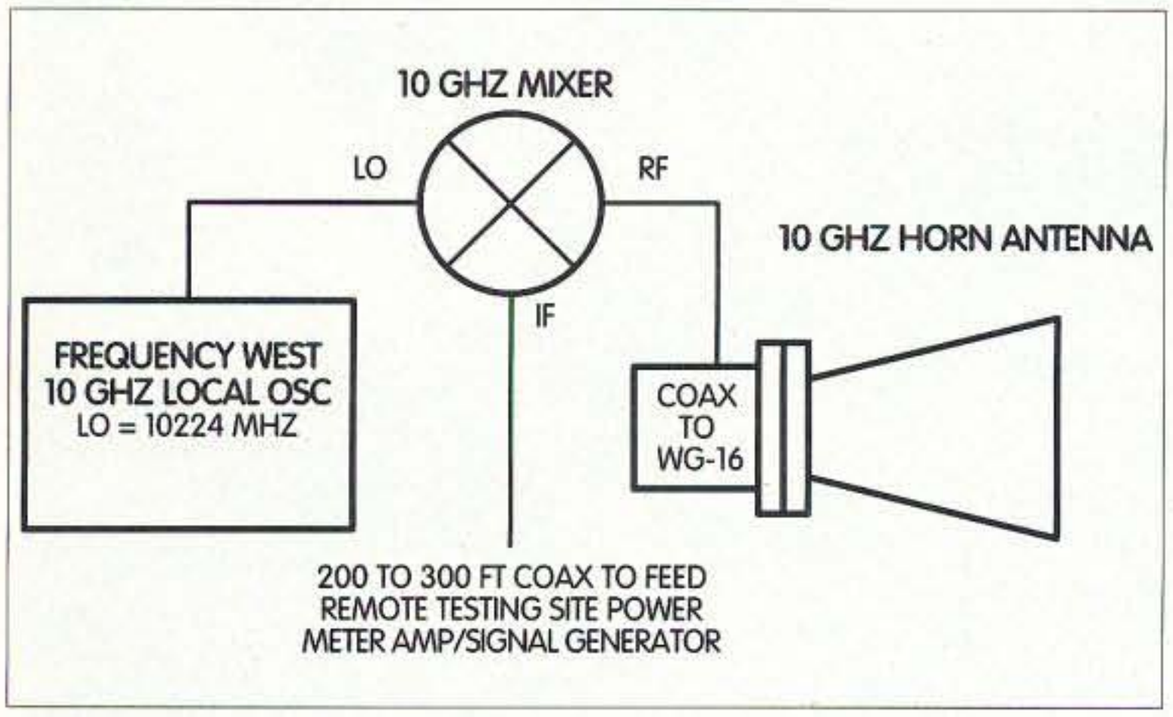

Fig. 2. *Sensitive simple transceiver consisting of local oscillator and mixer fixed to small horn antenna. Operation is linear, so FM, SSB, and video can be run on system. The transceiver is mounted in metal housing to protect it from the elements and provide orientation, horizontal and vertical adjustment for the remote end of the antenna test range. In operation it's a very low power test receiver/transmitter.*

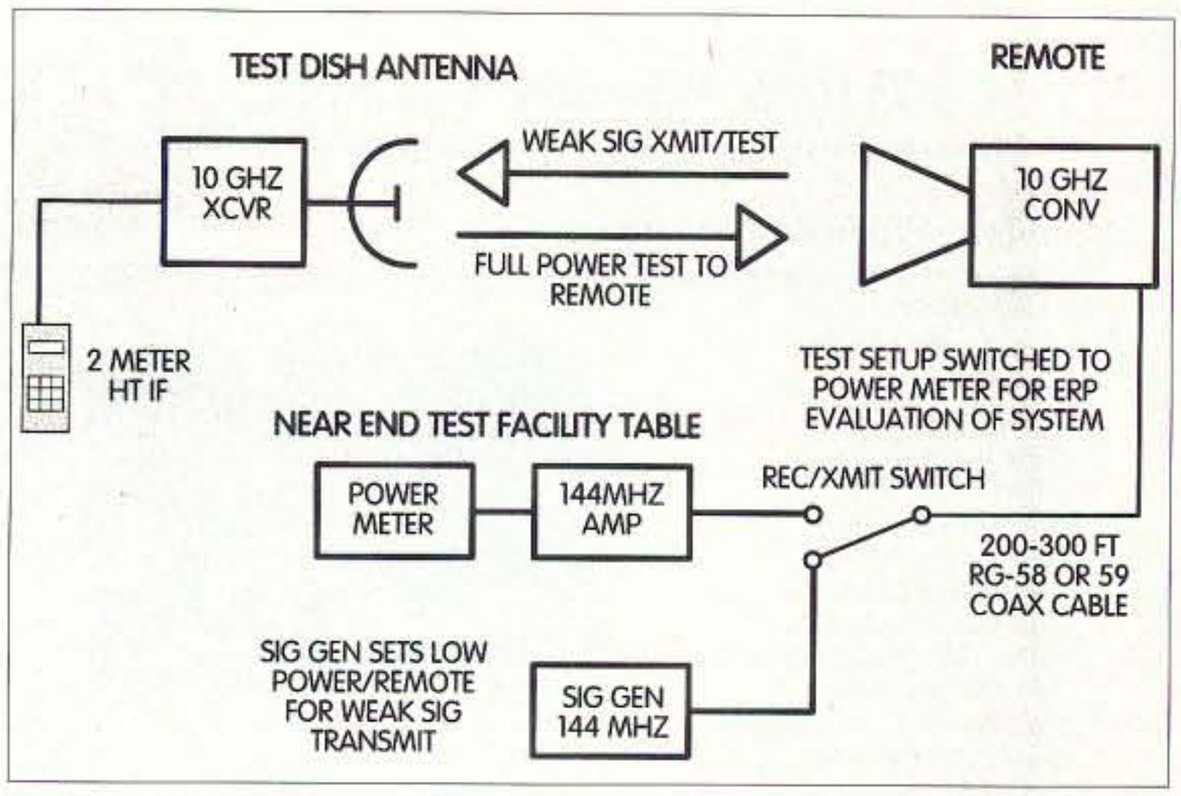

Fig. 3. *Test-range setup using a testing path constructed in Kerry N6IZW's backyard, with a remote flea power transceiver as shown in* ***Fig. 2****. The unit is placed at the far end of the backyard—about 200 feet away. The coax at IF frequency of the remote unit (144MHz) is returned to near end of antenna test range for system evaluation. This provides a relative evaluation of system sensitivity and transmitter output power, including evaluation of antenna performance.*

Run the 2m HT on its lowest power setting. I am assuming 1/4W or so (that's 250 milliwatts), or +24dBm. Remember here that the mixer only needs a maximum of +10dBm for full function.

Adjust your 2m power to conform to these limits at a maximum or else you will just "let the smoke out of" the mixer—and it can't be put back. The loss of a microwave mixer is indeed a sad occurrence. Just be careful and keep power to the mixer in transmit to a low level. When setting up the test range, measure the loss of your long run of coax and include it in the formula you develop for your situation.

Did anyone catch that I stated I used RG-59? Yes, it's not 50Ω coax but 75Ω, and the SWR will not be a large factor in the tests because the coax is so long the effect is quite minimal. Why did I use RG-59? Well, primarily because it was the only coax around that was 300 feet long and in one piece. I did not want to put together a nightmare of splices. Due to the length used, it was not found to be a problem because we needed all the additional loss we could find to make reasonably meaningful sensitivity tests.

How did my rig fare in these test evaluations? Well, I don't expect to take the cake in the receiver sensitivity tests as I still use a pair of MGF-1402 GaAsFET front-end preamplifiers whose noise figure is in the 2 to 3dB range. There will be more sensitive receivers in the test pool. I just haven't had time to take my own advice and improve my receiver noise figure by replacing the MGF preamps with a better GaAsFET at 10GHz. Nonetheless, a transmit power output of 10W and my 30-inch dish should perform on a par with the other systems being evaluated.

Now off to the trials to find out if what I expect to see will be true. Our test is scheduled for an evening meeting of our microwave group, so I hope we get going while I can still take some photos!

And the winner is ...

Well, we had the test-range evaluation, and as I suspected the receiver sensitivity of my 10GHz front end was able to detect a signal as transmitted at -80dB into the test system. The better systems with lower noise figures were able to make minimum

***Photo A.** Photo of N6IZW's backyard, showing rigs to be tested. Left, Ed W6OYJ; at table, Kerry N6IZW; John WB6BKR; author's rig; and Jay KD6PBH. Test-range test performed by Kerry N6IZW at test table.*

discernible signal detections to -85dB.

My system was working well but not top-notch here. The receive results show that I need to improve the signal-to-noise ratio by replacing the first preamp with one of a lower noise figure. As far as transmit goes, we calculated that my system (looking at dish diameter gain and power output of the TWT amplifier at 10W) gave an ERP of 73dB. This compared favorably with Kerry N6IZW's system. Both of our systems use the same type and power TWT amplifier and dish antenna so they should be quite identical in operation.

Next month: the world of coaxial switches. I plan to get into specifics so that you can recognize what makes a good VHF or HF switch and what the differences are. Of course, these switches can be found in surplus as we try to hold down costs. The main thrust will be to show the different types that are available in surplus and what frequencies they are suited for. If you have any questions on this or other topics, please write. *73*, Chuck WB6IGP. 73

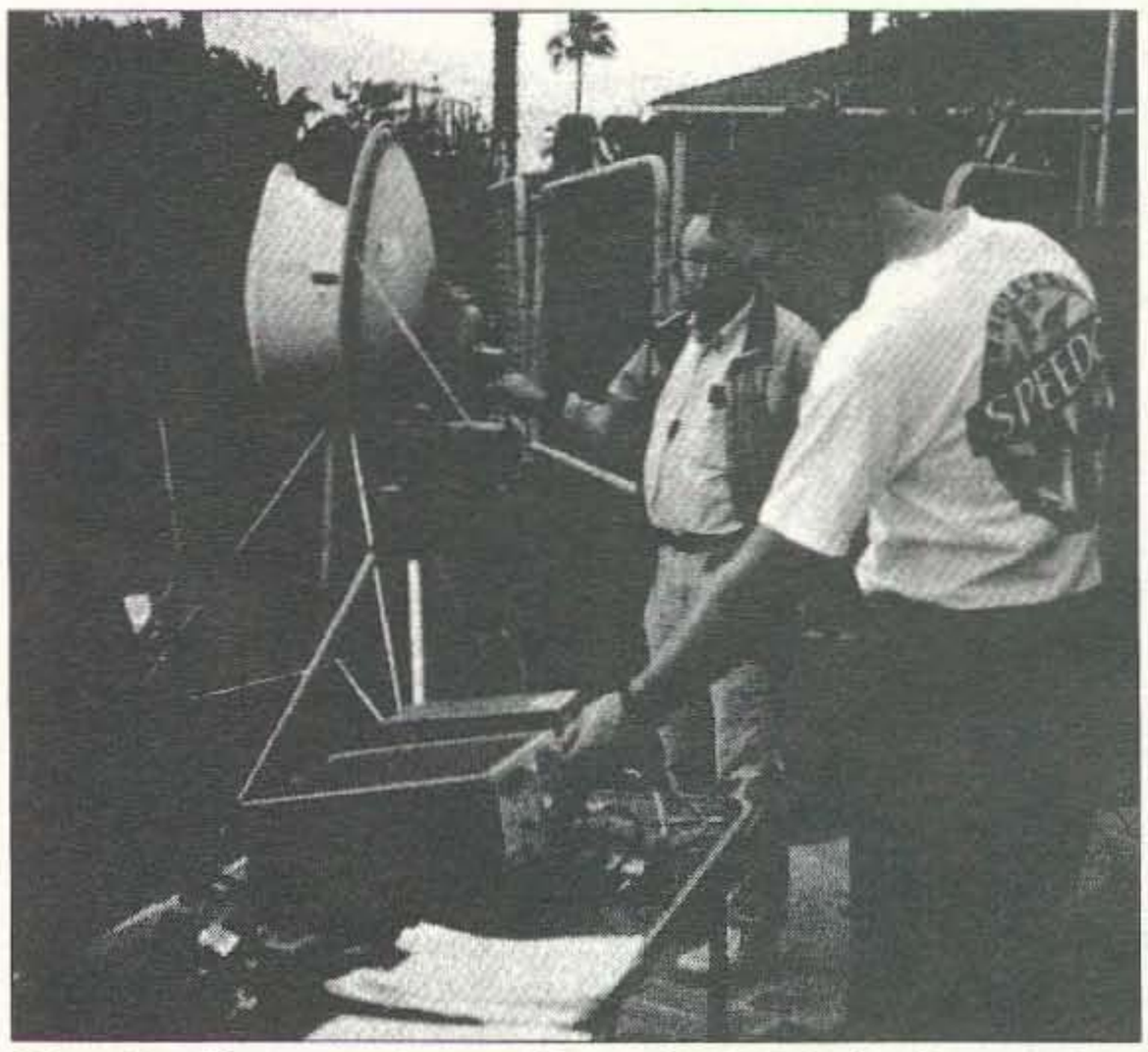

***Photo B.** Close-up of test table and N6IZW checking receiver sensitivity of Ed W6OYJ's 10GHz receiver. What looks like one odd-shaped dish is really two dish setups brought for test (see **Photo A**).*

The Killer Beam

Just how much is "some" assembly?

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I recently came into a small windfall of money. This was the opportunity to finally upgrade my radio station. Using the Internet, I was able to locate an old Heathkit SB200 for a reasonable amount. It arrived, and even though I still have not been able to figure out how to hook up the transceiver to the linear so that they work together, I am able to use it with a manual which turns it from standby to operate. It's clumsy, but it works, and for the time being it will do.

I was also able to locate a 30-foot tower at a reasonable price. Now that we have cable and satellite systems on the island, many people who put up TV towers found that they no longer needed one (even with the best of towers and antennas you were lucky to get more than two or three stations and those erratically—more of the joys of living in rural Maine). A local contractor put the tower up for a very reasonable price. In three yards of cement and bolted to the house in two places. We really do get strong winds out here in the North Atlantic. Again, this being rural Maine, he did a very good job, but it was eight months from the time we agreed on the transaction until he finally did get around to putting it up.

My antenna system, on the other hand, was a semi-disaster. It consisted of an 80m dipole and a 20m dipole hanging from one tree. See the previous section regarding winds.

"All my neighbors were complaining about interference, and there was talk of tar and feathers."

Here, I was determined to do things the "right way." After looking through several amateur radio supply catalogs, I picked up the phone and called one on their 800 number. To protect the guilty, I won't say who I called. Told them what I wanted. "A nice tribander, not too big, with a good strong rotor, new coax, with an SWR/wattmeter to monitor my newly powerful station, and an antenna switch that would ground the antenna when not in use." I added that I did not know much about modern antennas, and asked for recommendations.

After much discussion, I settled on a four-element tribander (here again, no name, to protect the guilty). This being settled, I gave them my credit card number; the card itself melted under the four-figure price. So much for my windfall—but I'm retired, and, unlike the demands of my other hobbies, such as flying airplanes, this was a one-shot investment. It should last me a lifetime—or at least that's how I rationalized it.

Within a week, everything except the actual antenna arrived. A call to the store revealed that this antenna was so wonderful that it was out of stock. The factory was filling back orders and it would take another two or three months till they could ship mine.

Two and a half months later

As you may have guessed, this project has been going on for almost a year. I was getting quite anxious to get my new "super station" on the air. Aside from that, with my old antenna I could only operate late at night. The SWR was so high that all my neighbors on the island were complaining about TV and telephone interference, and there was talk about reviving the old custom of tar and feathers.

The big day finally arrived. As background, let me tell you that the only other beam I'd ever had was an old three-element tribander I'd bought back in the late '50s. It consisted of several

poles and traps that all screwed together very easily and took about two hours from unpacking to up-on-the-roof-and-working. *This* was a horse of a different color. I should have been suspicious when I noticed that the antenna, which measures 16 feet by 32 feet, arrived in a box that measured one foot by one foot by eight feet.

"Try as hard as I could, I couldn't figure out which way was up!"

Some assembly required

This was not an antenna. It was a 300-piece metal jigsaw puzzle that required a small machine shop and an empty aircraft hangar to assemble. There were poles within poles within tubing within tubing, metal strips, and on and on. When spread out it covered my entire living room, dining room, part of the kitchen and part of the entranceway. For about three months I found myself eating out, having had to relinquish the first floor of my house to this project. There were four large plastic bags full of assorted nuts, bolts, screws, and washers; two large plastic bags full of assorted clamps; a large plastic bag full of assorted plastic caps, slides, plugs and other extraterrestrial-looking pieces; a pot of special goop to put on every nut, bolt, and part that was metal; and a bag full of something as yet still unidentified. There was also a 40-page instruction manual.

Help!

I called the radio supply store to remind them that I'd told them that I am a retired senior citizen with arthritis and they could have at least warned me about what to expect, or even better, have suggested an antenna that didn't require a team of engineers, or that was already partly assembled. Using their best bedside manner, they told me that any idiot should know that all modern antennas are that way and that I was being a crybaby. They did at least agree to take back and give me credit for the expensive balun they'd sold me, seeing as the antenna came with its own built-in one, and they did replace the antenna coax switch with one that actually worked. I didn't even mention that the expensive length of new coax I'd ordered with connectors already assembled arrived as a coil of coax with two new shiny coax connectors in a small plastic bag taped to the wire.

A month later, putting in two or three hours a day, despite the battle between my arthritic fingers and the slippery goop needed on every fitting and connection, I'd managed to assemble almost half of the antenna. I figured that in another month I'd be ready to move outdoors to put the large pieces together, mount the rotor and thrust bearing, and put up the antenna. Lots of fun in a typical Maine winter.

Hello, is the technician in?

In the meantime, despite reading the manual many times, I finally had to admit defeat and call the manufacturer, who of course does not have an 800 number. The manual emphasized, several times, that the vacuum holes inside the capacitor sleeves had to be facing up, but try as hard as I could, I couldn't figure out which way was up! The manufacturer's representative was more sympathetic than the store had been, and did admit that there really was no way to tell, using the manual, which way was up. She explained that "up" was off the horizontal axis, with each opposite element end being the mirror image of the other, and each separate element end being the obverse of the preceding one. I asked, "If the antenna were lying on the ground, would the element ends be lying flat or up and down?" She said, "Flat." Amen.

Persistence pays off!

It took me about two months to get all the parts put together into nine large components. The weather forecast called for several days of good weather, so I took the nine components out into the back yard and, using two large wooden picnic tables, completed the final assembly. The measuring and final assembly went much more quickly and easily than I had anticipated.

With the help of a large "cherry picker" and two agile young men, the completed antenna was lifted up and mounted atop the 30-foot tower. I must say that I was really looking forward with great anticipation to that weekend of ham operating.

Running low power and then high power, I found that I had a flat 1 to 1 SWR on 20m, a 1.1 to 1 on 10m (1.3 to 1 above 29.5), and a 1.3 to 1 on 15m. In addition, rotating the antenna made a very significant difference in signal strength when both transmitting and receiving. I was hearing stations that I had never heard before.

Over the next three days, on 20m I worked six Japanese, two New Zealanders, an Australian, literally dozens of Europeans, four Israelis, a Kuwaiti, several Russians (including a Siberian station), the South Pole, Hawaii, Alaska, etc., etc. And in almost every case, they reported that I was the loudest signal on the band!

Well, let me tell you, after almost 50 years of being one of the many stations in the pileup, just getting more and more frustrated, it felt really great to be the "800-pound gorilla." The very worst I did was to be the second or third station recognized in huge pileups—and this was from stations that before the new antenna I could not even hear at all.

With my almost ideal location, overlooking the Atlantic Ocean, it has only gotten better since then. So I would say to my fellow hams who are also old enough to remember the smell of ozone from their rotary spark gaps, there really is something to this new technology of trapless beams. Despite all the effort and frustrations involved in getting the antenna up, I would do it again. If you could have been in the room with me when I got reports from stateside and South American stations telling me I was pinning their S-meters, or from some rare DX telling me I was 40 over nine, you'd have thought from the look on my face that I was a five-year-old getting a pony for Christmas.

My new antenna has renewed the excitement and brought back the joy I first experienced so many years ago. If ham radio is getting old or boring, I recommend that you, too, consider modernizing or upgrading your station, despite all the effort involved—or perhaps *because* of it. 73

Music from the Past

A distinctive fist brings back memories of a revered silent key.

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Crown Point IN 46307

I heard him on the low end of 20 the other night, more than a decade after his death, and it made me wonder whether other people ever hear silent keys they've known and loved.

Mine was named John Miller. His call was W9PBS. He was a sightless ham who inspired a lot of other hams and non-hams, sightless and sighted, to do whatever it was they had to do with pride and with dedication, in ham radio as in life, and to do it *better*.

"Don't ask a good op how to operate or a good man how to live," he would say. "Listen. Pay attention. Then emulate!"

What I heard the other night was his fist—different, personalized, unmistakable—his! He'd patterned it early on, he once told me, after that of a Merchant Marine amateur aboard a banana boat somewhere in the Caribbean whom he'd worked as a brand-new ham in the 1930s.

"That op's CW cadence," John said, "was distinctive enough so you could copy him through fourteen other guys, all zero beat."

I can't vouch for the accuracy of that comment, but I can swear the description fitted John. He held his venerable Vibroplex's dashes a heartbeat too long for its dotting rhythm at any setting of its speed-weights. Once heard, you'd recognize him anywhere, rag-chewing or in a pileup, by those slightly heavy dahs interspersing the perfectly timed dits. Inexplicably, his dah-accenting fist didn't change at all when, in later years, he switched to a paddle and a keyer.

On AM and then on sideband, John's phonetic moniker for his suffix, "Peanut Butter Sandwich," was heard only rarely, during infrequent lapses from his beloved CW into what he disdained as "mouth mode."

Before I was licensed myself, I found this curious. Surely, I thought, talking with other people across the void must be more fun than just exchanging signals with them in some primitive dot-dash jargon. But John preached otherwise.

"Talk," he would inform me, "is chatter. Morse is music." It took me years to learn that he was right.

As a neighbor, friend, and electronics aficionado, I was for half a lifetime privileged to be among those called on by John for help in some of the small things he couldn't manage himself: finding and fixing equipment bugs; erecting antennas (wire dipoles and slopers in trees early on; beams and rotators atop towers in later years); programming 2m gear for local repeaters; keeping the HF rig properly dipped in his favorite bailiwick, the low end of 20.

"That's where the DX lurks," he explained to me the first time he asked me to check his final for resonance at 14,030, adding the admonition, "Be quick and be careful." His transmitter then was a home-brewed rack-and-panel affair with a personality of its own. Its power transformer hummed the basso background for "Old Man River," while its 866s flashed their intense blue glow in the staccato cadence of the rig's keying. Its final was a heavy-duty triode famous for its unforgiving ways: Operate it very far off resonance for more than a very few milliseconds and you'd be shopping for a replacement.

"Short key-downs and long key-ups," John would exhort me. "And dip it at fourteen oh thirty so I can zip from fourteen oh one to fourteen oh fifty without blowing the final. That's where the DX pops up."

And when it did, so did he. Nights and weekends, from the late 1930s to the late 1980s, the war years excepted, few DX stations could bounce a rare prefix into northwest Indiana anywhere between 14 and 14.050 megacycles (then; it's become megahertz only relatively recently) without encountering calls from and QSOs with a blind ham whose dash lengths characterized a distinctive fist and whose attitude characterized a noble person.

Days, John worked as a proud entrepreneur, operating the concession stand in the county-seat courthouse. He made the coffee, sold the goodies and the cigarettes, maintained the inventory, kept the books. He greeted hundreds of patrons and friends daily, recognizing most by their voices and many by their footsteps. He kept track of his money by stowing ten-dollar bills in one pocket; singles, fives, and twenties in others.

Afternoons, when the courthouse closed, he and the then-current version of perhaps the dozen or so beloved and devoted guide dogs he went through in his adult lifetime would hike the ten blocks home to XYL Fran and harmonic Paul Albert in all but the most inclement weather. He took a cab only when snow

or ice made walking hazardous. On rare occasions he might accept a ride from a friend, but, "Only if you're headed my way!"

Evenings, John would "pay my dues to the community," attending Lions Club meetings, playing Elmer to potential hams, encouraging new ones to "emulate," welcoming a steady stream of visitors to his kitchen and/or ham shack with steaming mugs of the muscular black coffee he called "sludge."

Until the last decade of his lifetime, it bothered John mightily—though he'd deny it if you mentioned it—that he needed tune-up assistance from friends. The only tip-off was the regularity with which he'd mumble, "Looks like somebody'd invent a talking milliammeter," while one of us was dipping and tweaking his rig. Then he'd ask, "What's she read at resonance?"

"One forty," he'd be told.

"Load her up another sixty. I want two hundred mils on the nose. Looks like somebody'd invent a talking milliammeter."

Finally, somebody did. From an article in this magazine, I built for John a solid-state audio oscillator whose tone varied with the amount of plate current drawn by the finals of a rig coupled to it. Once it was hooked up and he was "shown" it (given ten minutes to inspect it with his fingers), it took roughly thirteen seconds of instruction for John to master its use. It may not have been the very best day of his whole life, that first-time tune-up of his rig, alone, unaided, all by himself. But it came close!

With the advent of TV and its accompanying TVI, John reluctantly junked his home-brewed, open-frame, rack-and-panel transmitter, and graduated to commercial TVI-shielded transceiver usage. His first was a Yaesu with a pair of the then brand-new-and-wondrous TV horizontal-oscillator tubes in the final. He loved it. He worked the world with it (and so did I, visiting him, by then long-since licensed myself) until it died and none of us local "experts" could revive it.

Then he swapped it in on a Kenwood 520 with extra-tight IF filters (the kind that are common today), which remained the joy of his life for his remaining years. The last I knew, that rig still was in use by a former neighbor of John's, then respectably known as W9PUB, who moved it from warm-and-sunny Indiana to the cold-and-snowy regions of Wyoming, where he's been hiding out ever since behind a new and strange two-letter 7th District call I never can remember. But the transfer of ownership came only after John Miller became a silent key.

For a long while I grieved, mourning him and the disappearance from the low end of 20 of the distinctive fist of W9PBS, the old Peanut Butter Sandwich, the man to whom "Emulate!" was advice and Morse was music. So did many others. We took comfort from the words of the preacher delivering his funeral eulogy, "Now John can see!" We consoled ourselves that he was working better DX across wider voids from a better QTH with a cosmic-state rig feeding a Universal antenna. Thus, gradually, the passage of time worked its inexorable magic of healing and of forgetting.

But then, the other night, I heard him on the low end of 20!

I was reading the mail, tuning idly across the band, catching a word here, a phrase there, absently noting which call areas were coming in, as a fellow will do on a dull evening. And suddenly, there it was! This weak signal, almost into the mud yet readable through stronger ones because of its distinctive cadence, was wrapping up a QSO.

I didn't catch the call, but there was no mistaking the fist. The way the dahs were a mite too long for the dits fingerprinted the op for me. There could be no doubt. Whatever the signature, it was—it had to be—John, the late W9PBS, the old Peanut Butter Sandwich. And then a final bar of music from that distinctive, unmistakable fist, singing "gl es sk es cl," left me listening to static crashes, cosmic noise, the pounding of my own pulse.

That's when I found myself wondering whether other people sometimes hear their own dear-departed buddies making distinctive and unmistakable Morse music in a favored section of a favorite band.

I'm pretty sure they do ... 73

RTTY LOOP

Amateur Radio Teletype

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Well, this month I find I have been soundly blasted by the readership. Why? Because there are apparently several programs out there that use a Soundblaster™ card, or compatible, to decode radioteletype. This month, we will have a look at two of them, along with one other, non-Soundblaster, program for good measure.

Brent Stuart ZL4TX dropped me a note tipping me off about an application called FTV, written by Brian E. Cauchi 9H1JS, in Malta. This program decodes quite a variety of digital modes. It is available via Brian's home page: [http://www.geocities.com/SiliconValley/2504]. FTV is currently in Release 0.98g, and handles RTTY, FAX, SSTV, and CW using a Soundblaster interface card. As the author says, FTV brings innovative digital signal processing and analysis techniques to your multimedia PC. It can be used to receive images from weather satellites and terrestrial facsimile stations, text transmissions from radio telex services, as well as amateur radio FAX, SSTV and RTTY signals. It can also transmit amateur radio FAX and SSTV (slow scan television). No external hardware, other than a radio, is required, as all the necessary signal processing is implemented in the software.

The main strength of FTV lies in the approach used for processing the incoming signal. During reception, the demodulator waveform is stored in memory, which allows recovery of incorrectly set parameters, such as FAX lpm, SSTV modes, and RTTY baud rates, on the fly. Watch jumbled pictures take form, while the incoming signal is processed and displayed in real time. Automatic mode recognition is provided for FAX, SSTV, RTTY and CW modes. And again, no additional hardware is required.

Minimum system requirements include an 80386 CPU, Soundblaster-compatible sound card, 256K of expanded memory (preferably 1024K or more), and SuperVGA graphics card with VESA support (at least 640 x 480, 256 colors).

An unregistered trial version of the software is available at the above Web site. I will be adding it to the RTTY Loop Software Collection as well for those without Web access. See below for details on this assortment of RTTY software.

Another program Brent mentioned is RADIORAFT by Francois Guillot F6FLT. This program listens to the incoming signal and scans it, similarly to the PK-232, to decide for itself just what you are listening to, displaying the data accordingly. It is available on the author's page at: [http://ourworld.compuserve.com/homepages/F6FLT]. RADIORAFT is advertised as decoding modes including ARQ-E, RUM-FEC, Baudot, ASCII 7,8, Sitor-A and B (Tor-arq/fec), ARQ-6, SI-ARQ, SWED-ARQ, ARQ-M (2 and 4), ARQ-E3, ARQ-N, POL-ARQ, FEC-A, HNG-FEC, CIS11, SI-FEC, Autospec, Spread, Packet, and Morse. With automatic detection of modes, speeds and shift, an included frequency meter/baud meter, and signal frequency tracking, this program is a powerful addition to the RTTY amateur library.

Requirements for this program are a PC with a simple interface, such as a plain terminal unit, or Hamcomm or Baycom type interface. This is *not* a Soundblaster-type program.

Once again, this program can be downloaded from the above Web site. Since CompuServe sites can be slow, though, the author provides several worldwide mirrors on the site to enhance access, a nice touch. Of course, this program will be in the collection, as well.

Yet another program surfaced by way of Bob Lewis AA4PB, who told me about Brian Beezley K6STI, writing a program called RITTY which also runs on a Soundblaster card. The program is described in some detail at: [http://www.ping.be/ON9CNC/FEB97.HTM].

By the way, notice the uppercase letters on this address. Be aware that Unix systems are case sensitive, and that if you type this address in lowercase letters you probably won't connect! I know I didn't until I found the site via a search.

Anyway, Brian tells me that RITTY 2.0 is a DSP data-communications system that now includes PACTOR. RITTY provides state-of-the-art RTTY and PACTOR transmission and reception using digital signal processing. RITTY is software that runs in your PC and uses your sound card for analog I/O. No specialized hardware is required.

RITTY's RTTY demodulator uses a limiterless front end and optimal channel filters with the SIN(x)/x matched-filter response that maximizes receive sensitivity. The filters automatically tune to the incoming mark and space tone frequencies for effortless copy. A sophisticated automatic threshold correction algorithm maximizes text recovery during selective fades. A special wideband detector minimizes polar flutter, while a narrow input bandpass filter fights QRM. An effective squelch suppresses noise print. Special data-presentation modes allow text recovery and signal analysis under difficult conditions. RITTY can act as a modem for the RTTY by WF1B contest-logging program. RITTY's licensed PACTOR implementation features a sharp input BPF, concurrent 100- and 200-baud optimal SIN(x)/x channel filters, gated, synchronous ATC for selective fading, 21-bit memory-ARQ with optimal combinatorial weighting coefficient, single-bit error correction without ARQ, recognition of noisy control signals, fast callsign detection for quick linking, and tolerance for partially compatible, unlicensed PACTOR implementations. RITTY provides remarkably fast and robust text throughput under difficult conditions.

RITTY has an FFT-based spectral tuning indicator that's easier to use than a scope and more informative. A demodulated-waveform display provides detailed signal and propagation analysis. RITTY features both AFSK and FSK transmit output, adjustable mark/space frequencies, selectable Baudot punctuation, and fine control of protocol timing and detail. RITTY automatically records all received text to a file and can transmit text files.

The program requires a 486DX/33 minimum, math coprocessor, and VGA display. Implementation of RTTY modes is with most eight-bit sound cards, while PACTOR requires a 16-bit Creative Labs Soundblaster card.

This is a commercial program, but a trial version is available at the Web site, [http://www.megalink.net/~n1rct/], which is maintained by Dick Stevens N1RCT and has a wealth of RTTY software information available on this and other programs.

The RITTY Program, version 2.06, is $150, and is available from Brian Beezley. Of course, the download version is in the collection, as well!

My sincere thanks to both these gentlemen for bringing these programs to my attention. Any others out there in the wings?

Now, above I mentioned the RTTY Loop Software Collection. This is a collection of some seventeen disks of software of interest to RTTYers, including both RTTY and non-RTTY programs, as well as some computer utilities. You can see a full list of the programs, as well as have the opportunity to download some of them, on the RTTY Loop home page at: [http://www2.ari.net/ajr/rtty/]. Or, if you cannot connect to the Web online, you can send me a request via E-mail at [ajr@ari.net] and I'll E-mail you back the list. Or, if you can't even do that, send a self-addressed stamped envelope to me at the address above and I'll return the list to you on paper! The information supplied will fill you in on all the details of obtaining copies of the programs for your own use.

I still have some other items you have sent me to use, but I always can use more! You can

HAMS WITH CLASS

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Staten Island NY 10313-0006

Multi-cultural projects

Several weeks into the spring semester with my new ham radio classes, many of the students seemed to be especially fascinated with the idea of being able to speak with people from different countries. I usually get about 400 students in my 13 radio classes; each term there is a different "chemistry" to the classes. There have been times when most of the children gravitated to VHF and UHF exclusively, and other times when they only wanted to get involved with ATV, packet or CW.

This term the 6th, 7th, and 8th graders were eager to get started with different DX projects. Several of my former students who were still in the school brought in QSL cards from contacts they had made on their own 10m rigs at home. My students always enjoy listening to their peers speak about what fun they're having in the hobby. The licensed students enjoy sharing their expertise with the other kids.

I often invite local hams who are active DXers to visit my classes. I encourage them to bring QSL cards from interesting places to display for the children. They always bring lots of great stories to relate about exciting contacts they've made.

Through the years several of our unusual contacts have been videotaped by children in the class. I've learned the value of showing footage of other kids having fun and doing exciting things in my classroom. It's kind of like showing "coming attractions" of all the good stuff that's yet to come.

One afternoon when we had several boxes of QSL cards to go through, we decided to organize them by country and to assign teams to each country who would report back to us with more information about the culture and geography of that country. Before long we were involved with the ESL (English as a second language) teacher and with the foreign language department fair. Parents were sending in dishes of foods from their native countries along with samples of clothing and other articles indigenous to those areas of the world.

"... remember that children who are busy chasing DX aren't being chased by the police!"

One of the best projects the children came up with was a multi-cultural quilt made of construction paper. Every time a radio contact was made with a different region of the United States or with a foreign country, a child would make a square patch with tempera paints to include a scene or symbol of that area. When the patchwork "quilt" was completed, we were all so delighted with it that we had it hung up in the school auditorium for visitors to see as well.

A fun toy that one of the teams made when they presented their reports on Mexico was the *bolero* toy. Several of my students received personal family photos from the hams they had spoken to. This personal touch led them to research things of interest to young people in that country. The bolero toy was a big hit in class. The game itself requires simple hand-eye coordination. The materials needed to make it are: a toilet tissue cardboard or paper towel tube cut in half, an 18-inch-long piece of yarn, an empty thread spool, tempera paints and brush, and a hole puncher.

First, the children painted the tube in bright colors and designs, and let it dry. Next the wooden spools were painted and left to dry. A hole was punched in the paper tube near the top. The student then ties one end of the yarn to the tube and the other end through the spool. The object of the game is to get the spool into the tube while holding the tube in one hand. Needless to say, we all had a good time with this one. Later on, the toys were packaged and brought over to a local community center where they were distributed to appropriate children's organizations.

When my students speak with other children or any other ham anywhere outside of our area they like to find out the things that are different about them. They are also starting to appreciate the fact that all people have lots in common with each other—especially things that appeal to children. Most students, wherever they are from, are concerned about report cards, grades and tests. It's an enlightening experience listening to children talking to youngsters from other places and sharing so many of the same concerns and fears about the world today. As adults, maybe we should be listening more to what the young people are saying.

Any teacher with the capabilities for DXing in a classroom will have a myriad of activities they can do with their students, encompassing all areas of the school's curricula: social studies, science, math, language arts, geography, foreign language, and even crafts. Have fun; and remember that children who are busy chasing DX aren't being chased by the police! 73

Photo B. *An international cultural hall was set up outside our room as a continuation of the project so more people could share in the DX fun.*

Photo A. *Exchanging cultural objects is a favorite spin-off project after a DX contact.*

RTTY LOOP *from page 85*

E-mail me [ajr@ari.net], or AOL users can use [Marc WA3AJR], while CompuServe users can send mail to [Leavey] on the CompuServe system. If push comes to shove, scribble your comments or questions down and send them to the P.O. Box address above. See you next month here at RTTY Loop! 73

PROPAGATION

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As this forecast is being prepared (early May), solar flux values continue in the low 70s with little likelihood of an immediate improvement. The usual high July-August HF signal absorption levels will combine with low flux values to depress HF propagation this month. Poorest days (P) are likely to surround the 1st, 9th, 10th, and 20th when an upset-to-active magnetic field and accompanying ionospheric disturbances are most likely. You can also expect other geological upsets and violence near these days. The best (G) days to search for DX are likely to be the 5th, 13th, 17th, 23rd and 27th–30th, while the remainder will be only Fair (F) or trending, as shown on the calendar. The onset of Cycle 23 appears to be sluggish at best, with only a few signs of improved propagation conditions. The only advice we can offer is to practice patience, listen a lot, and hope for improvement this fall or next spring.

AUGUST 1997

SUN	MON	TUE	WED	THU	FRI	SAT
					1 P	2 P-F
3 F	4 F-G	5 G	6 G-F	7 F	8 F-P	9 P
10 P	11 P-F	12 F-G	13 G	14 G-F	15 F	16 F-G
17 G	18 G-F	19 F-P	20 P	21 P-F	22 F-G	23 G
24 G-F	25 F	26 F-G	27 G	28 G	29 G	30 G-F
31 F						

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA						20	20					
ARGENTINA	20	20	20	40			20	20	15	15	15	15
AUSTRALIA		20	20	20	40	40	20					
CANAL ZONE	15	40	40	40	40	40		15	15	15	10	10
ENGLAND			40	40			20	20	20	20	20	20
HAWAII			20		40		20					
INDIA												
JAPAN						20	20					
MEXICO	15	40	40	40	40	40		15	15	15	10	10
PHILIPPINES							20					
PUERTO RICO	15	40	40	40	40	40		15	15	15	10	10
RUSSIA (C.I.S.)							20	20		20		
SOUTH AFRICA			40	40		20	20				20	
WEST COAST	20	40	40	40	40	40						20

CENTRAL UNITED STATES TO:

ALASKA		20	20					20	20			
ARGENTINA	15	20	20	40			20	20		15	15	15
AUSTRALIA	15	20	20	20	40	40		20			20	
CANAL ZONE	15	20	20	20	40	40	20	20	15	15	15	10
ENGLAND	20	40					20	20		20	20	20
HAWAII	15	15	20	20	20	40	20	20				
INDIA												
JAPAN		20	20					20	20			
MEXICO	15	20	20	20	40	40	20	20	15	15	15	10
PHILIPPINES		20	20				20	20				
PUERTO RICO	15	20	20	20	40	40	20	20	15	15	15	10
RUSSIA (C.I.S.)								20			20	
SOUTH AFRICA							20				20	20

WESTERN UNITED STATES TO:

ALASKA		20	20						20			
ARGENTINA	15	20	20	40	40			20	20		15	15
AUSTRALIA		20	20	20	20	40	40		20		15	15
CANAL ZONE	15	15	20	20	40	40		20	20	15	15	15
ENGLAND	20							20	20			20
HAWAII	20	15	15	20	20	20	40	40	20		20	20
INDIA				20					20			
JAPAN		20	20						20			
MEXICO	15	15	20	20	40	40		20	20	15	15	15
PHILIPPINES				20					20			
PUERTO RICO	15	15	20	20	40	40		20	20	15	15	15
RUSSIA (C.I.S.)									20			
SOUTH AFRICA			40						20			
EAST COAST	20	40	40	40	40	40						20

Band-by-band propagation this month:

10–12 meters

Occasional intense sporadic-E propagation may provide openings to 2,000 miles or more, while frequent short-skip openings out to 1,000 miles or so can occur on Good (G) days.

15–17 meters

Frequent short-skip openings to 1,500 miles and occasional long-skip openings on north-south paths across the equator are expected on Good (G) days.

20 meters

DX to all parts of the world can be expected on this band from sunrise to sunset on Good (G) days, with peak conditions usually occurring a few hours after sunrise, and again in the late afternoon. Short skip to 2,000 miles or so may be expected as well.

30–40 meters

Consistent nighttime DX to all parts of the world is expected from sunset to sunrise, with the possible exception of poor reception due to high static levels during thunderstorm activity. Short-skip openings averaging 500 miles during the daytime and 1,500 miles at night are anticipated.

80–160 meters

Nighttime DX on 80 and 160 can be fair this month, with the exception of high noise levels on both bands from thunderstorms. Daytime short skip of a few hundred miles is possible on 80 but not on 160. Short-skip propagation is expected at night on each band, and ought to be fair out to perhaps 1,400 miles or so, but limited by QRN. 73

NEVER SAY DIE

Continued from page 77

I can skip through the commercials.

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Has amateur radio brought you any adventures? It has me, and I write about 'em so others can share in the fun I've had. If you haven't had any adventures, get yourself in gear! Our hobby has a world of adventure open for you. I'll never forget my Oscar contact with Moscow during a 20-second window. Or working 2m aurora. Or working six states on 10 GHz from a local mountain. Or working a bunch of ZS ops while in a balloon while cruising over the South African veldt. Or diving for dropped antenna elements in the shark-infested water at Navassa.

Now get busy and share the fun you've had with the rest of us. 73

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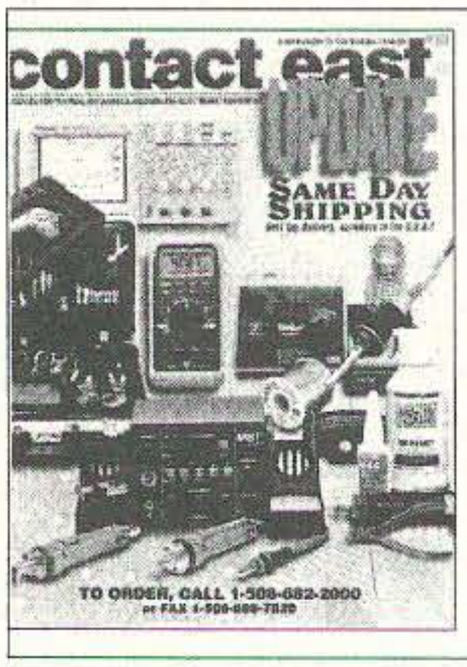

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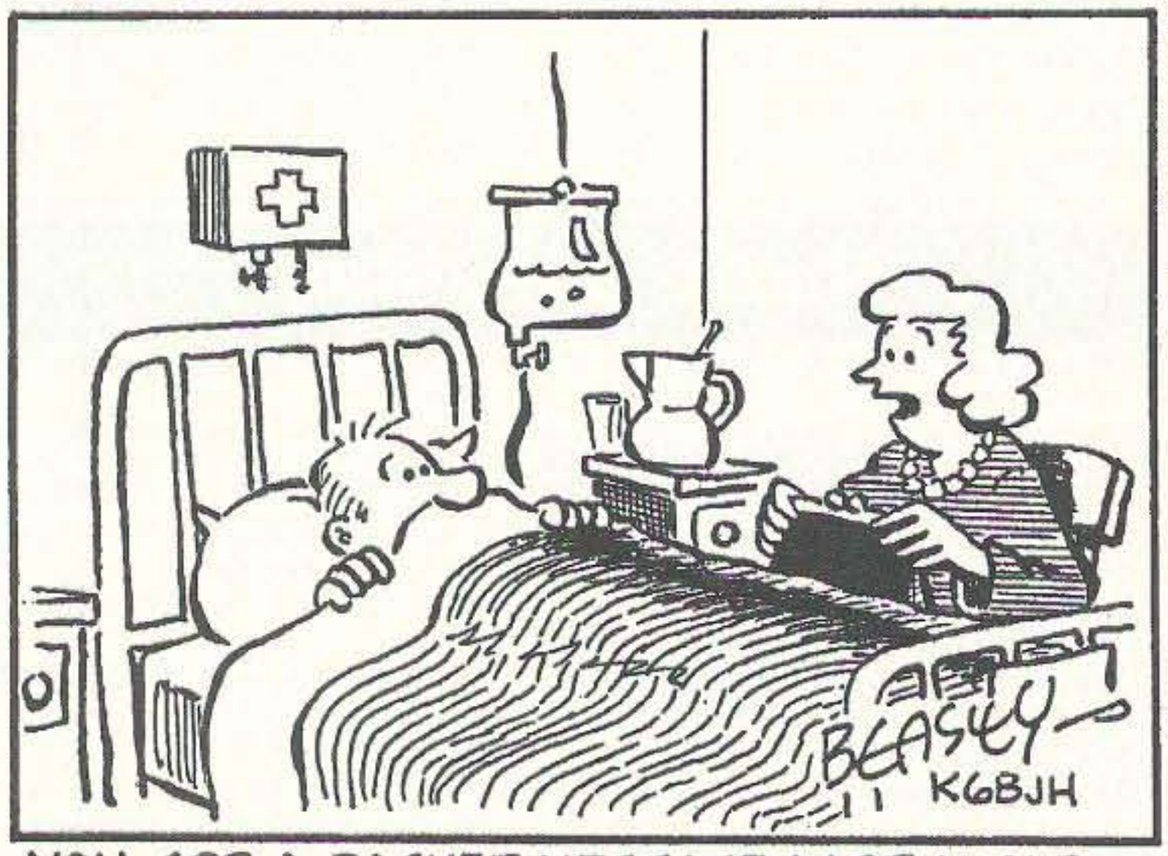

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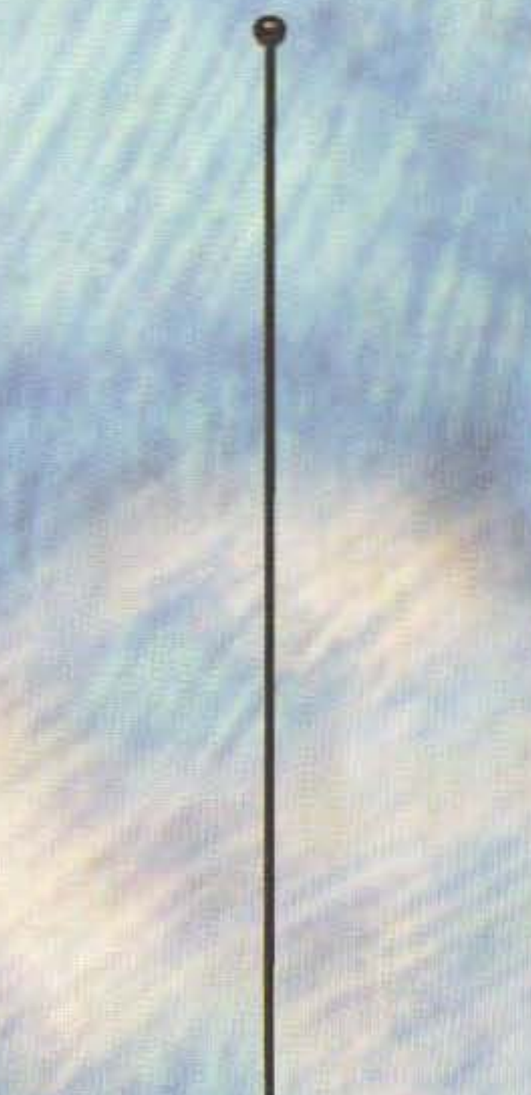

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