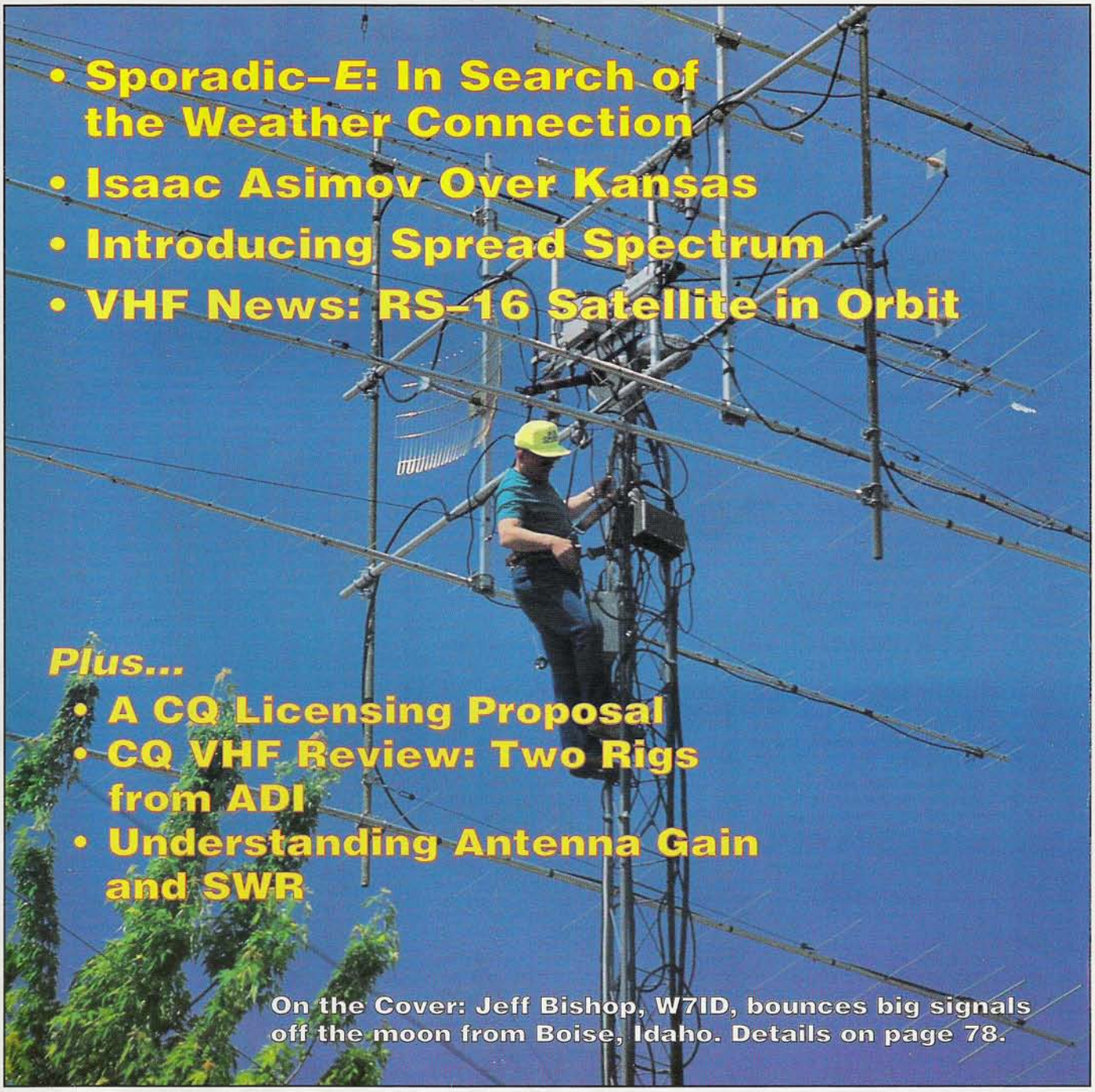
ICD 08237

CQ VHF Ham Radio Above 50 MHz

May 1997



- Sporadic-*E*: In Search of the Weather Connection
- Isaac Asimov Over Kansas
- Introducing Spread Spectrum
- VHF News: RS-16 Satellite in Orbit

Plus...

- A CQ Licensing Proposal
- CQ VHF Review: Two Rigs from ADI
- Understanding Antenna Gain and SWR

On the Cover: Jeff Bishop, W7ID, bounces big signals off the moon from Boise, Idaho. Details on page 78.

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C228A

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- 40 memories (20 + 20 "limited" memories)
- 130-174 and 200-244MHz extended receive
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- CTCSS Encode/Decode
- DTMF squelch with Paging
- Scanning-busy, pause or hold

C188A
C288A

C188A 2 Meters The Slim-Line HT

- Fits in your shirt pocket!
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- 40+ memories (or optional 200+memories with snap-in chip)
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- CTCSS Encode/Decode
- DTMF squelch with Paging
- Scanning-busy, pause or hold

C288A 220 MHz Slim-Line HT

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- 115-249 MHz extended receive
- TX 220 MHz band

C468A
C168A

C168A 440MHz The Deluxe small HT

- 2 Meters
- The Deluxe small HT 5 watts at 12VDC
- 40+ memories (or optional 200+ memories with plug-in chip)
- 115 to 174MHz extended receive (including AM aircraft band)
- CTCSS Encode/Decode
- DTMF squelch with Paging
- Scanning-busy, pause or hold

C468A 440MHz The Deluxe small HT

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- 40+ memories (or optional 200+ memories with plug-in chip)
- 400-474MHz extended receive
- CTCSS Encode/Decode
- DTMF squelch with Paging
- Scanning-busy, pause or hold

C528A 2M & 440MHz Deluxe Twin-Band HT

- 5W (2M and 440) at 12VDC
- 40 memories (20 + 20 "limited" memories)
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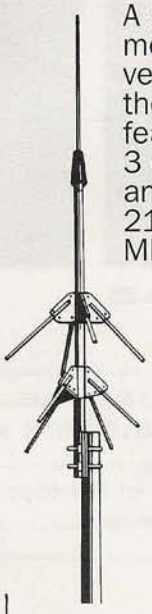
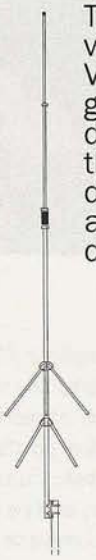


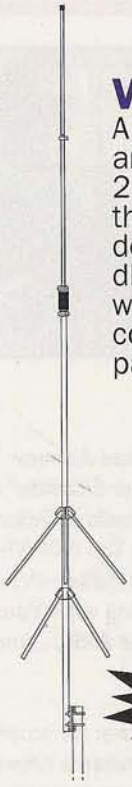
V3R

A 1 1/4 meter vertical, the V3R features a 3 dBd gain and covers 216-225 MHz.



V4R

The 70 cm vertical V4R's 3 dBd gain is derived from the extended double zepp antenna design.



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A rugged antenna for 2 meters, the V2R delivers 3 dBd gain with a wide coverage pattern.

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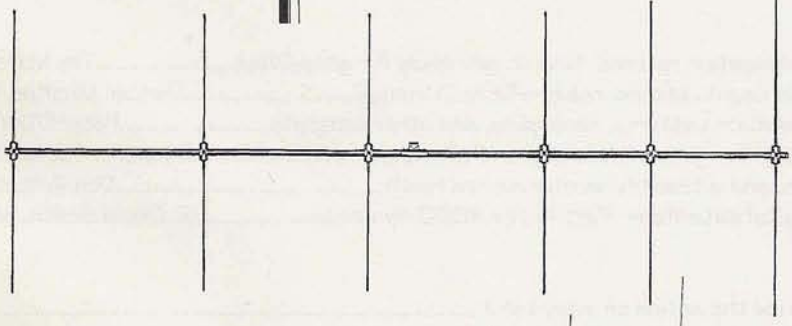
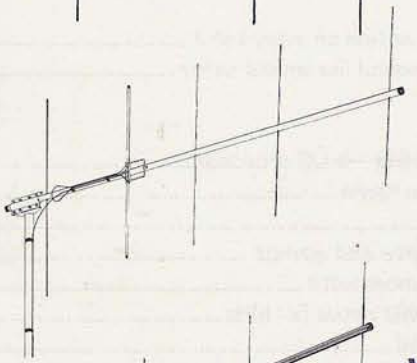


64DX, 66DX

The 4-element 64DX generates an impressive 8.2 dBd gain and the 6-element 66DX, an unprecedented 10.3 dBd.



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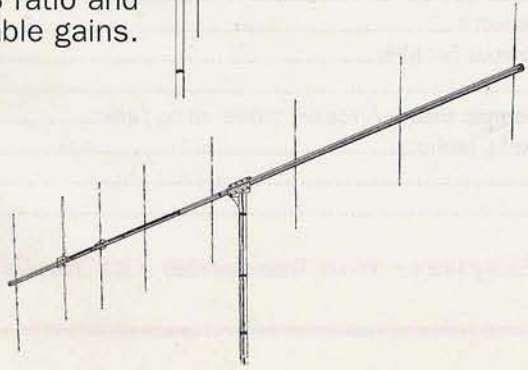
A 9.1 dBd gain antenna for 2 meters featuring Hy-Gain's exclusive Beta Match for exceptional F/B ratio and maximum obtainable gains.



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CIRCLE 115 ON READER SERVICE CARD

CQ VHF Ham Radio Above 50 MHz

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- 50 memories plus "Call" channel, each memory capable of "odd splits" and alphanumeric designations
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CIRCLE 117 ON READER SERVICE CARD

License Restructuring— A CQ Proposal

Some suggestions from CQ Communications to go along with the amateur licensing proposal put forth by an ARRL committee.

A key ARRL committee has proposed a major restructuring of the "lower half" of the amateur licensing system. It involves reducing the General class code speed requirement from 13 to 10 words per minute, doing away with the Novice license, carving up the HF Novice subbands for expanded phone and CW use, and greatly expanding the HF privileges of today's Tech-Plus licensees.

Another part of the proposal calls for toughening up code exams by reinstituting a sending test and requiring one minute of perfect copy (out of five) in order to pass the receive test.

These changes to the code test procedures are the only parts of the proposal to which we objected (see "Line of Sight" April, 1997 *CQ VHF*), and we heartily support the rest of the plan. But we'd also like to contribute to the discussion by adding some proposals of our own into the mix—ideas we've been discussing here at CQ for months, before we even knew what the League committee was thinking about.

First, Back to the Code Test

I'm going to bring up my objections to the proposed code test changes one more time, but only because it relates directly to our first proposal. Last month, I related my own experience with failing the "old-style" test by two letters and finding the comprehension exam much more meaningful. I recently spoke with an ARRL director who told me about his experience with *passing* an old-style test.

"It was just a bunch of letters on a page," he told me. "I had no idea what any of it meant, and was amazed when the examiner told me I'd passed." How is this a better exam than the current "multiple guess"? My two cents is, it isn't.

I also spent some time on the phone—after last month's column went to press—with a high-ranking member of the ARRL committee. He explained to me that the reason for the code-test proposals (they weren't explained in the committee's report) was persistent reports of widespread cheating on the current exams. Going back to the old way, he assured me, would make sure candidates *really* know their code.

A Symptom of a Bigger Problem

If there is, indeed, widespread cheating on code exams, I seriously doubt that going back to "the old ways" will solve the problem. This is because 1) cheaters will cheat, and a harder exam will only slow them down until they can find new and better ways to pass without learning the material; and 2) cheating on code exams really isn't a problem in itself so much as it's a symptom of a much bigger problem affecting amateur radio today: we're successfully creating new *amateurs*, but we're failing at creating new *hams*. What's the difference?

Amateur radio is a hobby and a service, licensed and regulated by governments and international treaties. *Ham radio* is a community and a culture. We have our own language, customs and internal rules. This is why a ham, traveling anywhere in the world, can meet another ham and instantly feel he or she is among friends. This is why hams help each other out, say by putting up antennas or by freely sharing information that in a commercial setting would be very expensive. This has nothing to do with the license and rules of amateur radio; it has *everything* to do with the worldwide ham radio culture.

"Changes to the code test procedures are the only parts of the proposal to which we objected...and we heartily support the rest of the plan."

What are the tools by which this culture communicates and educates itself? The answer is not "amateur radio," but amateur radio clubs, organizations, and publications. Too few new amateurs in recent years have been joining the culture, becoming *hams*, by joining clubs, joining the ARRL, and subscribing to magazines. We, as established members of the community, are failing to bring new recruits into the culture, into the community. Chances are, if they felt they were full members of the community, they'd be far less likely to cheat at anything.

Proposal #1: The Pilots' Model

Instead of making the code tests harder to pass and discouraging people from upgrading, we propose that the rules require some effort at becoming part of the

(Continued on page 82)

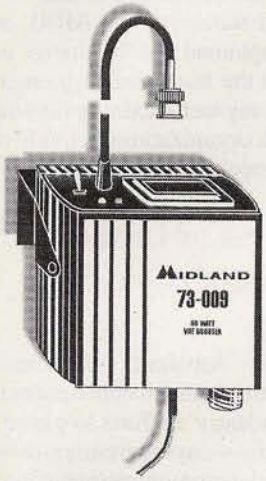
By Rich Moseson, W2VU, Editor

MIDLAND EQUIPMENT

MODEL 73-030

Micro Miniature 2 meter VHF transceiver.

Covers 144-148 transmit and 138-174MHz receive. Palm size...only 4 1/2 x 2 1/4 x 1" with battery, yet loaded with features. Two watts output with battery supplied but 5 watts is available with an optional 9.6V battery. Features included several battery save modes, 72 user programmable memories, scanning, built in DTMF with auto dial memories. Full LCD panel with frequency and function, channel steps from 5 to 50kHz, keyboard entry, repeater splits, three power ranges, priority channel scan and more. Supplied with 6V-600MA rechargeable battery, flexible antenna. Wall battery charger, belt clip and instructions. Jacks for speaker/microphone, antenna and power.



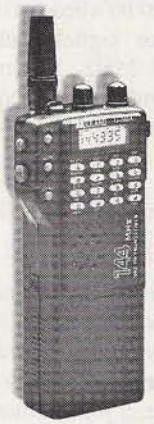
MODEL 73-009

Car adapter plus linear amplifier 135-170MHz The 73-009 is a wide band linear amplifier allowing you to convert handheld transceiver into mobile units. The installation of the 73-009 on the vehicle's driver side window makes the unit even more handy, in a place which is not usually used for other accessories but very close to the driver's side. Adding a speaker microphone and an external antenna, completes the mobile station. Voltage 13.8VDC. Current drain 5A. Frequency range 135-170MHz. Max output power 30W. Impedance 50 Ohm. In/Out Connector BNC/SO239. Size (4 3/4 x 4 3/8 x 1 3/4"). European craftsmanship.

MODEL 73-007

Miniature 70 CM (440MHz) UHF Transceiver

Same as the 73-005a but covers 430-450 transmit and 420-470MHz receive.



MODEL 73-005A

Miniature 2 Meter VHF Transceiver

Covers 144-148 transmit and 130-170MHz receive. Backlighted keyboard. Two watts of power output expandable to 5 watts. Miniature 9 cubic inch size, 18 function LCD multi-function readout. Three power levels. Keyboard or rotary frequency entry. Multi-function scan. 20 independent memory channels. Frequency steps of 5-10-12.5-20-25 or 50kHz. Built-in DTMF and paging. Optional tone squelch. Multifunction dial lamp. Dual watch. Battery save feature. Auto power off. Repeater offset and reverse. Monitor switch. Frequency/function lockout. Jacks for external antenna, speaker, microphone. Supplied with 7.2V 700mA rechargeable battery, flexible antenna, wall style battery charger and belt clip.

MODEL 75-510

14 Channel PLL Family Radio

The 75-510 offers maximum channels, power and control. All 14 channels are included in this PLL handheld. Maximum allowable power output. Full FM. 39 frequency CTCSS tone code included for ultra privacy. LCD control panel. Other features include fully automatic squelch control, LCD ON/OFF light, scan, busy channel bypass and delete, channel up-down controls, mode function, battery low indicator, keylock system, transmitter time out timer for safety and memory retention. Jacks are provided for an earphone or speaker/microphone. The unit is supplied with a flexible antenna and belt clip. Size: 2 1/4W x 4 3/4H x 1 1/4D. Weighs 1 lb.

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VHF News

RS-16 in Orbit

A brand new ham satellite is in orbit. Russia's Radio-Sputnik-16, or RS-16, was launched on March 4, 1997, as a transponder on a Russian "Zeya" military satellite. According to the newsletter, "SpaceNews," it was the first launch from the new Svobodnyi cosmodrome in Amur Oblast. The satellite was launched aboard a Start-1 booster rocket, a modified SS-25 ballistic missile.

Hams around the world have reported hearing strong signals from RS-16's 10-meter CW beacon, on 29.408 MHz, according to ARRL and AMSAT reports. The satellite is expected to operate with a 2-meter uplink and 10-meter downlink, although it also has a 70-centimeter beacon (the first Russian satellite that's so equipped). At press time, only the beacon was operating and the transponder had not yet been turned on. That may have changed by the time you read this. If you hear RS-16's beacon on 29.405 or 29.451, tune for signals between 29.415 and 29.448 MHz, the expected downlink passband. Uplink frequencies are expected to be 145.915 to 145.948 MHz.

Phase 3D Systems Pass Initial Tests

An international team of amateurs has successfully installed and tested all of the major systems aboard the new Phase 3D satellite. According to the AMSAT News Service, a joint American/German team installed and tested the satellite's main power and computer systems, three of its transmitters, the 70-centimeter receiver, the IF switching matrix that will allow the satellite to use virtually any combination of uplink/downlink bands, the Japanese SCOPE camera experiment, and the LEILA strong-signal attenuation experiment. All were reported working well.

Team members were particularly impressed with the operation of LEILA, which is designed to conserve the satellite's power by automatically reducing the strength of overpowered uplink signals. After first superimposing a warning tone on the "offender's" downlink signal, LEILA reduced the power of the downlink signal from approximately 140 watts to about 2 watts!

Final assembly and testing of the satellite continues in preparation for its scheduled launch this July from the European Space Agency's launch site in Kourou, French Guiana.

AMSAT Seeks Additional Phase 3D Donations

AMSAT officials say the Phase 3D satellite project has so far cost some $3 million, with those costs being split nearly evenly between AMSAT-NA (the North American amateur satellite organization) and AMSAT-DL (its German counterpart). However, officials say they anticipate another $800,000 will be needed to finish construction, ship the satellite to its South American launch site and get it into orbit. Fund-raising efforts so far have brought pledges and donations of about $600,000 (including a recent $50,000 donation from JAMSAT, the Japanese AMSAT group), but they're still short nearly $200,000. Donations of any amount are welcome, and may be sent to AMSAT-NA, 850 Sligo Ave., Silver Spring, MD 20910; or, outside the U.S. and Canada, to your national AMSAT group. Be sure to designate your donation as being for the Phase 3D satellite.

"Little LEOs" Go After 220, Too

Faced with large-scale amateur opposition to proposals for "sharing" the 2-meter and 70-centimeter bands with hams, the "Little LEO" industry has gone on the offensive, adding the 219- to 225-MHz band to its "wish list," according to reports from the ARRL and AMSAT.

Little LEOs are small low-earth-orbit satellites (commercial versions of the amateur radio "pacsats," OSCARs 16 through 19) using various forms of data communication, including spread spectrum. Currently operating on limited areas of spectrum, the Little LEO industry has been asking the FCC and State Department to propose at this year's World Radiocommunication Conference (WRC-97) a long list of frequencies for "sharing studies" between Little LEOs and current users. The WRC will determine international frequency allocations.

The Little LEO list first submitted last summer included 144 to 148 MHz and 420 to 450 MHz, setting off a firestorm of protest among hams. At the February meeting of the joint government/industry group reviewing these and other proposals, the Little LEO group submitted a new proposal, which added 219 to 225 to its list. In a joint statement, the ARRL and AMSAT complained that the change was submitted "at the last possible moment" and "without any technical support whatsoever." Both organizations actively oppose these proposals.

RAC Warns of Little LEO "Divide and Conquer" Strategy

The Radio Amateurs of Canada (RAC)—another staunch opponent of the Little LEO industry's efforts to use amateur frequencies—says representatives of some large telecommunications companies are approaching ham clubs and asking for a forum to explain their side of the controversy. In an advisory to Canadian radio clubs, RAC warns that

> ...the approach of the Little LEO interests may be a 'divide and conquer' strategy to lull amateurs into agreement with their rationale for band sharing... Your hospitality and broad-minded reception of their speakers could be turned against you. Don't let them do it!

The ARRL Letter says officials of one Ontario radio club defended their invitation as an "open-minded effort to get all the facts." The *Letter* goes on to quote one club official as saying that, while he opposes any sharing of the 2-meter or 70-centimeter bands, "I do support an open dialogue...to discuss joint experimental sharing at 220 MHz."

FCC Proposes New Spread Spectrum Rules

The FCC is proposing to relax some restrictions on amateur spread spectrum (S/S) communications, but not to the full extent requested by the ARRL in its

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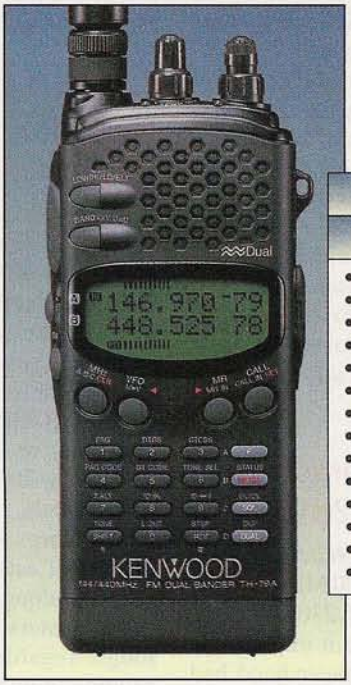
FM Mono Band Mobile

- 144 MHz operation
- 62 memory channels
- 6 character alpha-numerics
- DTMF memory for autopatch
- 50 watts output power
- Multi-scan capability
- Backlit microphone
- MIL-STD 810C and 810D
- Dual menu system
- Repeater reverse switch
- DTSS selective calling
- Built-in CTCSS encoder
- Wireless cloning

"Super! I can use alphanumeric memories to store names, call signs, and repeaters on my TM-261A."

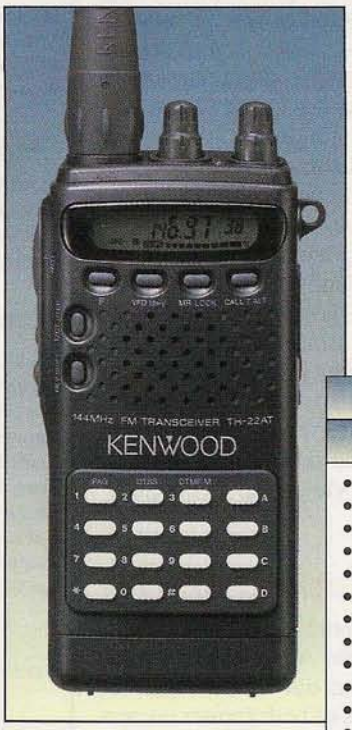


TH-79A(D)

FM Dual Bander

- 144 MHz / 440 MHz operation
- Dual receive on 2 bands
- Dot-Matrix LCD display
- 7 character alpha-numerics
- 82 memory channels
- Operator's Guide function
- DTMF memory for autopatch
- Wireless cloning
- PC programmable
- MOS FET power module
- High performance antenna
- CTCSS encode/decode
- Remote control feature
- Airband receive

"Great! My TH-79A(D) receives on 2 bands at the same time. Comes in a 5W version too."



TH-22AT

FM Mono Bander

- 144 MHz operation
- User friendly operation
- 40 memory channels
- Compact rugged design
- DTMF memory for autopatch
- MOS FET power module
- Direct DC input
- Luminescent DTMF keypad
- Multiple scan modes
- Auto battery saver circuit
- Built-in CTCSS encoder
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December, 1995, petition for rulemaking. In a notice of proposed rulemaking (NPRM) issued in early March, the FCC proposed dropping current rules that limit amateur spreading techniques, and adding new rules to allow international S/S contacts, and to require S/S transmitters to use automatic power control. This will automatically reduce transmitter power to the minimum necessary for communication. The NPRM did not include any new S/S frequencies. S/S is now allowed on amateur frequencies above 225 MHz. Comments on the proposal, WT Docket 97-12, are due by May 5, with reply comments due June 5. (*This month's "Digital Data Link" column, prepared before this NPRM was announced, covers the topic of amateur S/S communications in some detail.—ed.*)

Hams Keep Secondary Use of 2305 to 2310 MHz

The creation of a new Wireless Communication Service at 2300 MHz will *not* cost amateurs the use of 2305 to 2310 MHz, as some had feared it might. This segment of the 13-centimeter band had been among the frequencies that Congress ordered the FCC to auction last year. In a lengthy report and order establishing the WCS, the Commission decided to retain the secondary amateur allocation on a non-interference basis (hams may not cause interference to WCS stations) and clarified the status of other amateur allocations on the band.

Here is the current list of 13-centimeter amateur allocations:

2300 to 2305 MHz: Co-secondary (no primary service; an ARRL petition for primary status on this band segment is still pending)
2305 to 2310 MHz: Secondary to fixed, mobile and radiolocation services
2390 to 2400 MHz: Primary
2400 to 2402 MHz: Co-secondary (no primary service)
2402 to 2417 MHz: Primary
2417 to 2450 MHz: Co-secondary with government radiolocation (industrial, scientific & medical are primary)

(Tnx WA8DZP/K6WR/N7STU)

New FCC 800-Number

The FCC has established a new toll-free number for amateur radio license inquiries; it is (800) 225-5322. According to *The ARRL Letter,* this will connect you to the FCC National Call Center, operated by the Commission's Consumer Information Bureau. The old 800-number, which went directly to the FCC licensing facility in Gettysburg, Pennsylvania, will be disconnected. Callers will get a message referring them to the new number.

Hams Asked to Participate in Federal GPS Study

Amateurs using APRS (Automatic Position Reporting System) in conjunction with GPS (Global Positioning System) satellite receivers are being asked to take part in a federal study of the potential benefits of establishing a national "differential global positioning system" (DGPS) radio beacon service, according to *The ARRL Letter.* These beacons will increase the accuracy of GPS signals, and the Coast Guard and Army Corps of Engineers are in the process of establishing a DGPS beacon network along the coast and near navigable waterways. Amateur input is sought regarding the possibility of expanding to an inland DGPS network. In a letter to the ARRL, a member of the federal study group asked for comments on any potential benefits of such a network, "especially as it may relate to public safety or public betterment applications." Responses may be sent to PB Farradyne Inc.'s Ted Pugh via e-mail at <pught@farradyne.com>.

C3I Buys Rutland Arrays

C3I, Inc. has purchased the assets of the former Rutland Array antenna company, which went out of business following the deaths of both former owners (Tom Rutland and Bill Gamble). C3I's Owen Wormser, K6LEW, and Terry Price, WD8ISK, say they have a limited stock on hand of Rutland's K1FO-designed antennas and are busily working to get the manufacturing facility back into operation. For updates and information, visit C3I's Web page at <http://www.C3IUSA.com> or call C3I at (800) 224-5137. (Tnx K6LEW)

Mir News

A fire aboard the Mir space station didn't stop students from making ham radio contact with the crew...we've re-

(Continued on page 81)

CQ VHF Ham Radio Above 50 MHz

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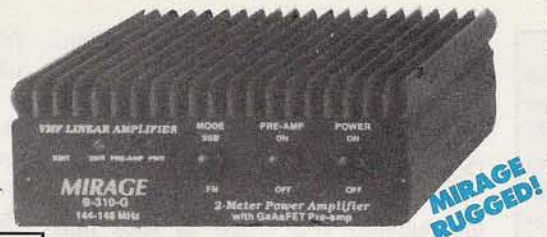

MIRAGE RUGGED!

Power Curve -- typical B-310-G output power							
Watts Out	*25*	*50*	*75*	*95*	*100*	*100+*	*100+*
Watts In	*¼*	*½*	*1*	*2*	*4*	*6*	*8*

For an incredibly low $199, you can boost your 2 Meter handheld to a super powerful 100 watt mobile or base!

Turn "You're breaking up . . . Can't copy" into "Solid Copy . . . Go ahead."

Talk further . . . Reach distant repeaters . . . Log onto faraway packet bulletin boards.

This rugged Mirage B-310-G amplifier operates *all modes*: FM, SSB and CW. It's perfect for *all* handhelds up to 8 watts *and* multi-mode SSB/CW/FM 2 Meter rigs.

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Free 3 foot handheld to B-310-G coax cable -- just plug and play! ***Free*** mobile bracket! ***Free*** rubber mounting feet for home use!

Plus more . . .

Automatic RF sense Transmit/Receive switch. Remote keying jack. LEDs monitor "On Air", high SWR, pre-amp, power. Push buttons select SSB/FM, pre-amp, power. Draws 15 amps at 12-15 VDC.

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With Mirage's legendary ruggedness, you may never need our superb warranty.

Dual Band 144/440 MHz Amp

$159.95 BD-35 Suggested Retail

Power Curve -- typical BD-35 output power							
Watts Out (2Meters)	*30*	*40*	*45*	*45+*	*45+*	*45+*	*45+*
Watts Out (440 MHz)	*16*	*26*	*32*	*35+*	*35+*	*35+*	*35+*
Watts In	*1*	*2*	*3*	*4*	*5*	*6*	*7*

***Add** this Mirage dual band amp and boost your handheld to 45 watts on 2 Meters or 35 watts on 440 MHz!*

Works with all FM handhelds up to 7 watts. Power Curve chart shows typical output power.

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35 Watts for 2 Meter HTs

B-34-G

$89.95

Suggested Retail

Power Curve -- typical B-34-G output power								
Watts Out	*18*	*30*	*33*	*35+*	*35+*	*35+*	*35+*	*35+*
Watts In	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*

- ***35 Watts Output on 2 Meters***
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- ***18 dB GaAsFET preamp***
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- ***Works with handhelds up to 8 watts***
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B-34, $69.95. 35 watts out for 2 watts in. Like B-34-G, FM only, less preamp, mobile bracket. 3⅛x1¾x4¼ inches.

160 Watts on 2 Meters!

B-5016-G

$299

Suggested Retail

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Hear weak signals -- low noise GaAsFET preamp gives you excellent 0.6 dB noise figure. Select 15 or 20 dB gain.

B-5016-G has legendary ruggedness. *We know of one that has been in constant use since 1979!*

Heavy-duty heatsink spans entire length of cabinet -- prevents overheating. Power transistors protected by MIRAGE's *Therm-O-Guard™*.

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RC-1, $45, Remote Control. On/Off, pre-amp On/Off, selects SSB/FM. With 18-ft cable.

Draws 17-22 amps at 13.8 VDC. 12x3x5½ in.

Power Curve -- typical B-5016-G output power								
Watts Out	*130*	*135*	*140*	*145*	*150*	*155*	*160*	*165*
Watts In	*20*	*25*	*30*	*35*	*40*	*45*	*50*	*55*

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B-2516-G, $299. For 10 to 35 watt mobile or base stations. 160 watts out for 25 watts in.

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Letters

Your Spot to Speak Out

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Dear *CQ VHF*:

I had to read your November, 1996, editorial twice just to make sure of what I had read. First of all, thank you, not only for an opinion that I personally agree with, but also for your courage in expressing it in public.

Even though I'm a new amateur, I've heard plenty about the code/no- code controversy. I don't profess to be an expert, but I'm not dumb, either. I could almost see one of the points made by "keepers": that the code requirement keeps out the "CB-types" who don't follow accepted practice on the air or use obscene language...except that it doesn't. For example, on a recent trip through New York City, I heard a man on the radio cursing out another amateur (he was using the other ham's call in his tirade.) And this was on a repeater that my directory says is sponsored by the NYPD amateur club!

Really, I'm sorry if your opinion or mine offends anyone. Having teenagers myself, I can understand how people feel when a new person comes along with a different way of doing things—"they haven't been around long enough to tell me anything," or some variation. But this is different. There are people out there who could make a true contribution to amateur radio, whether through technology advancement or just by participating, by making the hobby grow in numbers. They don't get in, though, because code keeps them out. That's a real shame.

It's like NØYHH said in his letter in the same issue: "...the 21st century is rapidly approaching. Let us think about the next generation of hams." Well put, Steve. 73,

Gerry Santomassimo, KBØVOF

Dear *CQ VHF*:

In your recent survey about ARRL membership you failed to take into account that you must be a member to be an EC (Emergency Coordinator). That in and of itself has been why I was a member. Even though I never was an EC, I still had that intention until recently.

With the current stand of both ARRL and its membership regarding WARC-99 and the requirement for CW to use the HF bands, I will not continue my membership, even if I don't manage to upgrade.

During the past year I served as club president. I was the first No-Code to hold that position and the first one that didn't upgrade during that term. While I continue to try, I still can't copy five wpm of code. I can play a game on the computer at 18 wpm, but that doesn't translate to five wpm of copy during a testing session.

I wish that you and others could take the stand of the Canadians that CW is just another mode and not the solution to problems on HF. If there weren't any problems on HF, that would tell me that the requirement works.

I have always tried to consider myself a professional, whether when piloting a private plane, doing search and rescue, or being a radio operator, I just wish others could do the same and have fun doing it. My only reason for being involved in amateur radio is to be of service during any emergency. If not me, who? If not now, when?

Sincerely,
Jim, N8SVI
Smiths Creek, Michigan

Jim—You are correct that ARRL membership is a requirement for holding an Emergency Coordinator (EC) position, or any other appointment within the ARRL Field Organization. And you're also correct that we didn't include "holding a Field Organization appointment" as a major reason for joining the League.

Personally, I see nothing wrong with a requirement that people holding leadership appointments in an organization must be members of that organization. It's hard to represent an organization to which you don't belong.

As to your wish that we "could take the stand of the Canadians" on CW, I refer you to my November, 1996, editorial, in which we did just that—strongly support the Canadian position opposing CW as an international licensing requirement and urge the ARRL to do the same.

Finally, I'm in full agreement with the sentiment expressed at the end of your letter ("If not me, who? If now, when?"). Many of our fellow hams who are constantly bickering over petty matters would be well-advised to consider the full and original quotation, from the Hebrew scholar Hillel: "If I am not for myself, who will be for me? If I am only for myself, what am I? And if not now, when?"

Dear *CQ VHF*:

There appears to be a paradox within the ham community: The more experienced hams seem to view the no-coders as the "red-headed stepchildren" (no offense meant to either of those groups), yet the FCC seems bound and determined to take our frequencies away from all of us. If the ham community would unify and take aim at retaining those frequencies, we would all be better off. I think Peter Coffee's response to "The HT Ham" hits the nail right on the head. The higher class hams should not feel as though the lesser classes are infringing on their territory but should act as mentors in order to advance the science as a whole.

Don Sykes
Phoenix, Arizona

Dear *CQ VHF*:

I've thought of a plan to end this code problem. When the time comes for renewal of the license, let the requirement be to show you can still copy the code that your license requires. Maybe this would stop some of these problems.

M. Albaugh, KBØNJU

Dear *CQ VHF*:

The ARRL recently asked for comments on its proposed restructuring of amateur licensing requirements—a proposal that appears to be nothing more than small bits of tinkering. Sifting through the chaff, you discover that the suggested changes are not significant—mostly window-dressing that continues to promote

segregation. However, the restructuring strategy implies that steps need to be taken to contain "perceived" abuses of the handicapped waiver provision—does the League mean to challenge the judgment of the medical profession? The proposal also suggests that there are too many amateurs to allow full participation by all operators. Is that comment—considering remarks of media pundits that: "the ARRL represents the majority of operating amateurs"—an admission that the majority of operators are incapable of self-controlling their band occupancy?

Amateur clubs throughout the country are lamenting the failure of new operators to upgrade and to join their organizations. The argument they hear, from young and old, against either upgrading or joining any organization is: "the benefits are not worth it." The future of the hobby is at risk unless a way is found to attract new blood and stimulate participation in HF communications. The future of HF the bands lies with spectrum use by all amateurs—perhaps a period of training using all the bands, with an experienced operator, prior to being issued a license would stimulate interest. If a creative solution is not found to energize interest in HF operations then, as the aging old-timers fade away, so will those bands and most of amateur radio.

When any autocratic organization initiates legislation that creates preferential benefits, society becomes divided and, sooner or later, those being dominated by special interests will realize that they are being oppressed by manipulated regulations and collaborating bureaucrats—they will seek relief from that discrimination—usually to the detriment of all concerned. This nation was built on the values and principles of individual responsibility and self determination, not by people who believe they have the right to control others. Tomorrow's technology must be accommodated—standing pat and limiting participation will almost certainly mean a slow death for the hobby.

Guy A. Matzinger, KB7PNQ
Cheney, Washington

Guy—If you read the League's restructuring proposal carefully, you'll see that it includes significant increases in HF privileges for holders of the current Tech-Plus license. This should help spark new interest in HF operating, as will (more than anything we can do) the upward climb of the sunspot cycle.

The idea of requiring a training period with an experienced operator is one with which we agree (see this month's "Line of Sight").

Finally, I think you'll find that many readers of this magazine will strongly disagree with your contention that the future of ham radio depends primarily on HF interest and activity.

Not Ready for Prime Time

Dear *CQ VHF:*

The article in the "Futurescope" section (January, 1997, *CQ VHF*) entitled "WearStation: A Ready-to-Wear Ham Station," may be a perfect example of why the FCC has instituted an RF standard. He must look like the 4th of July fireworks in the dark.

Chuck VanVleck, KB8WHQ
Plymouth, Michigan

Dear *CQ VHF*:

Regarding N1NLF's "WearStation"... this guy has too much time on his hands. Give me a backpack shack any day for mobility, flexibility, and utility.

Cheyenne Foxtear
Palmdale, California

(Continued on page 81)

Product Update

New FM Handheld from Kenwood

Kenwood's new TH-235A handheld transceiver was designed to be user-friendly while providing hams with an abundance of features in a compact rig (approx. 6" x 2-1/4" x 1-1/4", HWD). It offers an easy-to-use menu system, 60 memory channels, and built-in keypad to put control at the user's fingertips. Programmable squelch and DTMF memory also enhance convenience.

The TH-235A offers 60 non-volatile memory channels for rapid access. All memory channels can independently store essential data—transmit and receive frequencies, frequency step, tone frequency, etc.—in non-volatile EEPROM, eliminating the need for battery backup. There is a built-in CTCSS tone encoder, and an optional decoder (TSU-8) enables the setting of different tones for receive. Also built in is DTSS (Dual-Tone Squelch System), which allows DTMF access. The squelch is opened only when a specific three-digit code has been received. Group calling is also possible.

The user can choose from several scan modes: full band scan, programmable band scan, and memory scan with programmable memory channel lock-out. There are also two scan stop modes: TO (time-operated) and CO (carrier-operated). Up to ten 16-digit DTMF codes with ID can be stored for automatic dial use when making telephone calls through an autopatch system. Telephone number redial is also provided.

Other features include wireless cloning; menu system, channel number display, programmable squelch, function key lock, high and low power output, LCD with two backlighting modes, auto repeater offset, repeater reverse switch, time-out timer, auto power-off and auto battery-saver circuit.

Suggested retail price for the TH-235A is $199. For more information, contact your dealer or Kenwood Communications Corp., P.O. Box 22745, Long Beach, CA 90801-5745, or call (310) 639-5300; World Wide Web: <http://www.kenwood.net>.

Circle 100 on reader service card

(Editors Note: Be watching for CQ VHF's *"First Look" at this radio in next month's issue.)*

ICOM IC-W32A Dualband Handheld

ICOM's newest dualband handheld, the IC-W32A, fits comfortably in your hand and is designed for both experienced and novice operators.

A total of 200 memories may be displayed by either frequency or name (up to eight alphanumeric characters can be programmed for each memory channel). Each band has 100 memory channels and four DTMF (touch-tone®) memories with up to 16-digit capability. Memory management allows you to easily transfer memory contents to either VFO or to other memories, while an EEPROM prevents memory loss if the battery runs low.

The IC-W32A has separate tuning and volume controls for each band on the top panel to allow independent adjustment of each band. ICOM's versatile VHF/UHF exchange function lets you assign VHF/UHF tuning and volume to either knob.

You can receive both VHF and UHF bands simultaneously (both frequencies can be viewed on the display) or use the V/V or U/U functions to receive two frequencies on the same band. You can transmit on either operating band. Frequency coverage is 144 to 148 MHz and 440 to 450 MHz transmit and 118 to 174 MHz and 400 to 470 MHz receive. Three levels of power output are available, along with multiple power-saver functions and a battery voltage readout, which allows you to monitor the battery condition. The IC-W32A accepts 4.5 to 16 volts external power supply.

Additional features include full cross-band duplex operation, programmed, full, and memory skip scanning functions, built-in tone encoder and decoder (tone squelch), plus transmit and receive CTCSS tones can be different.

Memory channels, memory names, and other information can be easily transferred from one IC-W32A to another using ICOM's optional OPC-474 cloning cable, plus the optional computer software enables you to clone and edit contents using a computer.

Suggested retail price for the IC-W32A is $479.00. For additional information, contact your dealer or ICOM America, Inc., 2380-116th Avenue NE, Bellevue, WA 98004, or call (206) 454-8155.

Circle 101 on reader service card

Cutting Edge Enterprise's Powerport 149

Cutting Edge Enterprises has improved upon its line of rechargeable, portable power supplies by adding the Powerport 149, a device with more muscle and endurance.

The Powerport 149 is compact at 4" x 4.5" x 6" and lightweight at nine pounds. This unit provides 140 watts of 115 Vac (surges to 200 W), and up to 20 amps of 12-Vdc power. (For example, a handheld radio will run for up to 80 hours, or a portable fluorescent light for 25 hours.) The optional padded bag, with detachable accessory pouches, protects the unit from impact and makes it easy to transport.

At the heart of this rechargeable power supply is a sturdy 12-volt, 9 amp-hour, gel-cell battery. It can be charged in your vehicle through the cigarette lighter without requiring the engine to be running. It is also equipped with a fully automatic wall charger which can be left plugged in without fear of overcharging your battery. Flexible solar panels are also available as a charging option.

Powerport will run and charge many devices in the field, such as handheld radios, test equipment, soldering irons, emergency lighting, laptop computers, handheld GPS receivers, electric hand tools, video cameras, or fax machines.

Prices are $159.95 (140-watt, 9-amp model); $136.95 (140-watt, 7-amp model); and $114.95 (50-watt model); all prices plus shipping. For more information, contact Roger Hall at Cutting Edge (800) 206-0115 or 1803 Mission St., Ste. #546, Santa Cruz, CA 95060.

Learn Morse Code with VHF FM Equipment

Advanced Amateur Radio Products, Inc. is offering a new product for learning, teaching, and practicing Morse code on the air with VHF FM equipment.

The compact FM Morse connects between the FM transceiver and code key. When transmitting, the user depresses the code key and a tone is heard by receiving stations. When the code key is not depressed, the microphone operates normally. With FM Morse, amateurs proficient in Morse code can set up practice sessions with one or more students, and students can also practice their Morse code with each other on-the-air.

FM Morse is available in three models: the "Original" (RJ-45 microphone connectors only) sells for $14.95; the "Universal," which offers automatic keying of radio with keyer, sells for $24.95 (RJ-45 model) or $29.95 (8-pin round model); and the "Practice Plus," which offers the "Universal" features plus a code oscillator that produces a sidetone while transmitting, and may also be used by itself for personal practice, sells for $39.95 (RJ-45 model) or $44.95 (8-pin round model). Prices for all models are plus shipping/handling.

For additional information, contact Advanced Amateur Radio Products, Inc. at 5010 Delta Rd., Delta, PA 17314, or call (717) 456-6479 or (800) 459-6707; e-mail: <AARadio@aol.com> or <www.advancedamateur.com>.

Circle 102 on reader service card.

Updated "Repeater Information Directory"

Looking up repeaters by location only helps you if you know the names of the towns where you'll be. Travelers in the central and western U.S. can get repeater information in a variety of ways from regional editions of the *Repeater Information Directory*, compiled and updated annually by Joel Harris, W5RID.

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Flight of the Isaac Asimov

It was a balloon flight that proved Murphy's Law—nearly everything that could go wrong did. And KD4STH can't wait for the next one!

By Lloyd Verhage, KD4STH*

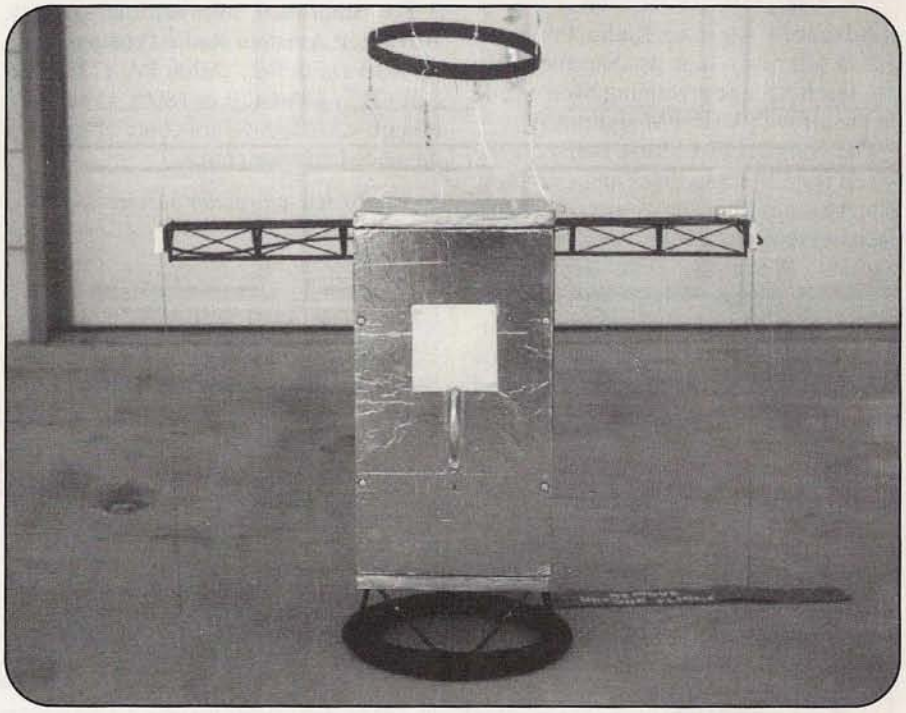
We launched Isaac Asimov on a balloon flight last November... and he landed in a tree 160 miles away! No, it wasn't the *real* Isaac Asimov. It was a "near-space" capsule named after the famous science fiction writer. But this flight was an educational adventure worthy of the capsule's namesake.

I'm the Project Manager and Chief Engineer of Kansas Near Space Project (NSP), which unites both the study of near space sciences with the practice of amateur radio. Together, they function as a tool to promote the study of science in high school.

Building the Isaac Asimov

Our near-space capsules are named after spokespersons for science. The Isaac Asimov's case, or "bus," was built from blue polystyrene foam, the kind used to insulate homes. We chose this because it's lightweight, insulative, and reasonably strong. The capsule had five decks: two for power, controls, and radios, and three for experiments. The capsule's exterior was covered with gold monocote (the plastic covering used in many radio-controlled, or R/C, airplanes), primarily for looks and for additional heat control.

After loading the electronics and experiments, the remaining interior space was filled with Styrofoam peanuts. The peanuts provided additional insulation and cushioning. The capsule hatch was then bolted shut (no explosive bolts here!). The capsule's "booster" was a helium-filled latex weather balloon, the kind used by the National Weather Service.



An early photograph of the Isaac Asimov. This is the bus before the addition of the sensors. (Photos courtesy of the author)

The capsule was weighed and the balloon was filled to lift the capsule's weight plus one extra pound (the balloon is said to have *one pound positive lift*).

Data was relayed to the ground via packet radio transmissions on 144.95 MHz simplex (using a Kantronics KPC-3 and Yaesu HT running about 2 watts). The antenna was a 2-meter dipole suspended on the end of a fiberglass boom. A secondary beacon was attached to the capsule as an aid in recovery should the telemetry fail (which it did). Capsule position was determined by an onboard Motorola OnCore® GPS (Global Positioning System) receiver. A "Basic Stamp 2" microcontroller provided control of the capsule and all experiments. Recovery team stations on the ground recorded the packets in a data log for future processing (accomplished with a spreadsheet).

The telemetry was generated by the onboard controller (Basic Stamp 2), which was programmed to collect data from sensors and the GPS receiver. After minimal processing, the data was sent to the TNC as serial data. The TNC transmitted the data as packets. To do this, the KPC-3 was placed in transparent mode, in which the TNC transmits anything it hears. Nothing could be simpler...assuming, of course, that it all worked!

What Goes Up

Equipment for the experiments we wanted to conduct for this flight included a Geiger counter and a film packet to

Lloyd Verhage, KD4STH, is the Project Manager and Chief Engineer of the Kansas Near Space Project (NSP). He plans to teach high school science and to use ham radio ballooning in his classes.

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A photograph taken by the Isaac Asimov's on-board camera. We were inside the shed getting ready to carry the capsule outside. The parachute is in the center of the photo and the balloon is to the right. Crew members are from MAARS, the Manhattan Area Amateur Radio Society.

record cosmic rays, temperature sensors (inside and outside the capsule) to track temperature changes as the balloon rose and fell, a high-altitude dust collector, and Styrofoam gliders to be released at 50,000 feet. The capsule also carried two cameras, one looking straight down (vertically), and the other aimed out, horizontally. The cameras had autoadvance and autofocus features and were controlled by the capsule's on-board computer.

Ham radio was a major "player" in nearly every aspect of the flight, as we used a packet transmitter to relay position information as well as telemetry from the experiments. In addition, trackers on the ground used ham radio to keep in touch with each other.

It took us an hour to fill the balloon, load the capsule, and power it up. Many people helped carry the assembled near-space craft outside the shed. Slowly, hand over hand, the balloon was eased up (we didn't want the balloon to jerk the capsule or parachute upwards). It was an amazing feeling when I raised the capsule over my head. It gently rose out of my open hands and into the heavens. I strongly recommend that everyone build a capsule like this if only for the experience of having your "child" leave the nest.

The Problems Begin

Shortly after launch, we noticed that the backup beacon was not transmitting. However, we weren't too worried about the beacon because the telemetry was working perfectly (cue ominous background music). Then, about a half hour into the flight, we realized that the TNC wasn't sending new packets. At this point, no radio transmissions could be detected from the capsule.

This was major bad news. The balloon was predicted to reach an altitude of 90,000 feet over...and Kansas is a big place. With neither telemetry nor beacon transmissions, the Isaac Asimov was lost in near space. After about 45 minutes of borderline panic, we discovered we could use the ground stations to connect to the capsule. Once connected, the TNC would transmit telemetry for about 20 seconds before timing out and going silent. As long as we maintained the connection, we'd receive telemetry. Believe me, it's

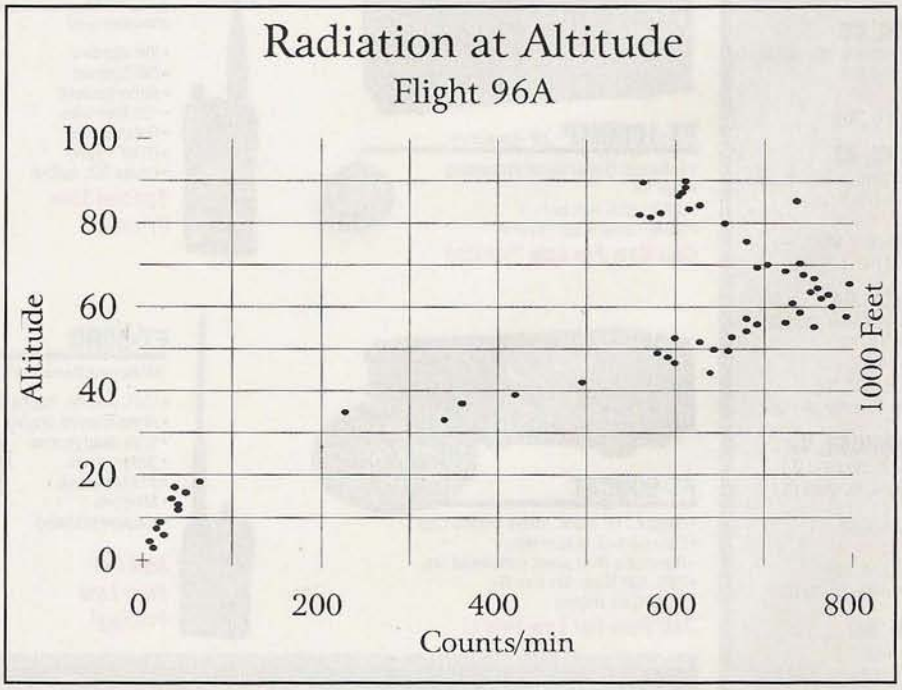


Figure 1. Cosmic radiation recorded by the Geiger counter on the Isaac Asimov during its flight. Note the peak at around 60,000 feet, and the steady decline above 62,000 feet.

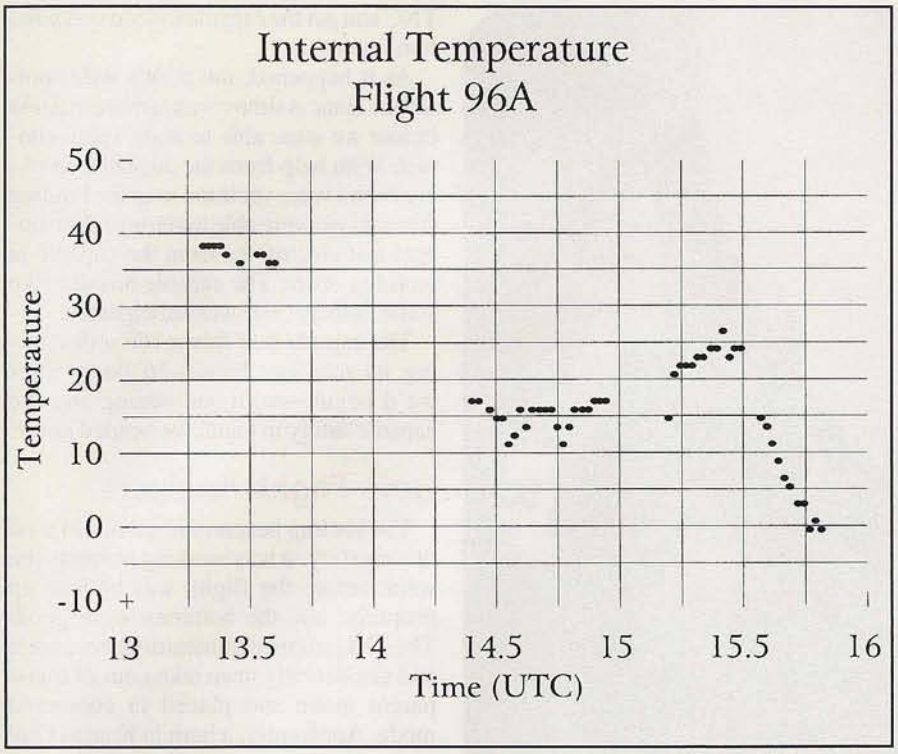


Figure 2. Graph of internal temperature aboard the Isaac Asimov. Starting at around 38° F on the ground, the temperature fell as expected until the intensity of the sun's radiation made the temperature rise again. Once the balloon burst (1530 UTC), the internal temperature plunged as the balloon free-fell toward Earth.

pretty boring to press the enter key every 15 seconds for an entire flight.

The capsule reached a maximum altitude of 90,226 feet before the balloon burst. Once it passed 30,000 feet on the way down, the capsule was too low and too far away for us to maintain contact, so the TNC timed out and stopped transmitting. And this time, we couldn't re-establish contact with the capsule.

Recovery Efforts Begin

Three recovery vehicles with a half dozen strangers equipped with radios, antennas, and laptops descended upon the small town of Girard, Kansas. We disembarked, talked on radios, watched laptops, scanned the sky, and contacted the sheriff about a "capsule" which had just landed in the county. We must have looked like something out of *The X-Files*.

We finally found the capsule by going airborne. As we searched, we ended up at the municipal airport in Pittsburg, Kansas, where we found a pilot who was happy to fly one of our team members in his airplane. At 1,000 feet up, the radio horizon increases tremendously so we hoped we'd be able to connect with the

The ground crew takes the balloon outside in preparation for launch. The parachute and capsule are attached and follow behind. The balloon is launched hand-over-hand to keep everything moving smoothly.

TNC and get the capsule to send us a position report.

As it happened, the pilot's wife spotted the Isaac Asimov's parachute in a tree before we were able to make radio contact. With help from the airplane, recovery crews were vectored in to the landing site, and we were able to retrieve the cameras and electronics from the capsule in working order. The capsule bus did take some damage, but was salvageable.

The capsule had flown 166 miles during its mission. Now—16 hours after we'd begun—with sun setting and the capsule safely in hand, we headed home.

Post-Flight Analysis

The backup beacon failure is still a bit of a mystery. It was working properly the week before the flight, was hooked up properly, and the batteries were good. The TNC stopped transmitting because it had accidentally been taken out of transparent mode and placed in command mode. Apparently, a ham in Kansas City had connected with the capsule, not knowing what it was. Since it didn't reply back to him as a normal packet station would, he disconnected. This disconnect changed the TNC's mode. Instead of

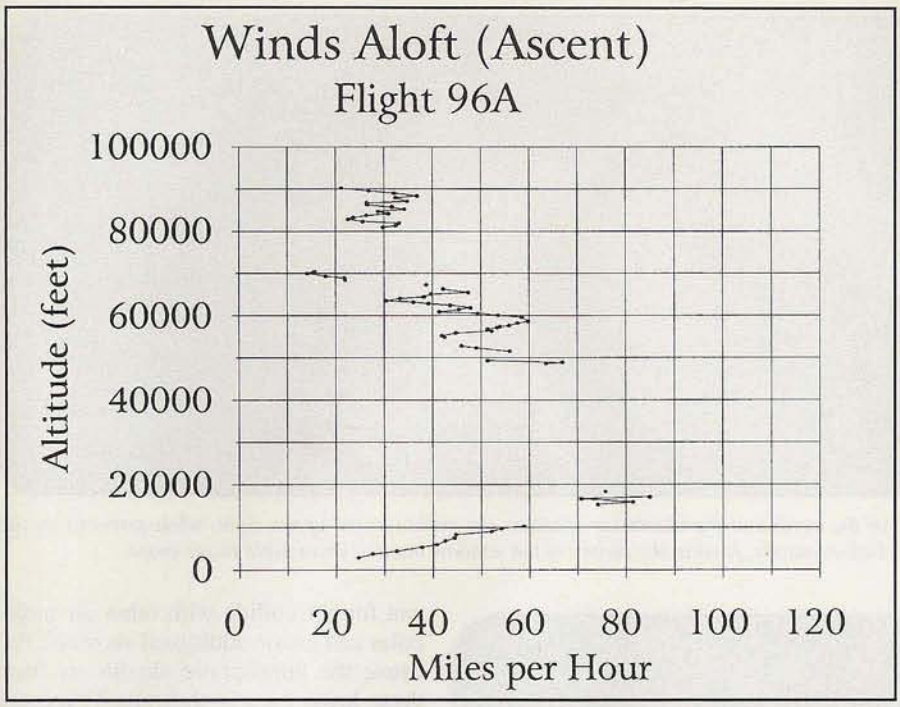


Figure 3a. During the balloon's ascent, wind speeds were clocked between 15 and 85 miles per hour. There are more measurement points on this graph than on the descent graph (Figure 3b.) because the ascent took longer and more readings were taken.

transmitting the data it heard, the TNC was waiting for instructions on what to do next. Had I known this could happen, I would have either disconnected the earphone jack or programmed the Basic Stamp to regularly tell the TNC to go back into transparent mode.

I also discovered that my routine for

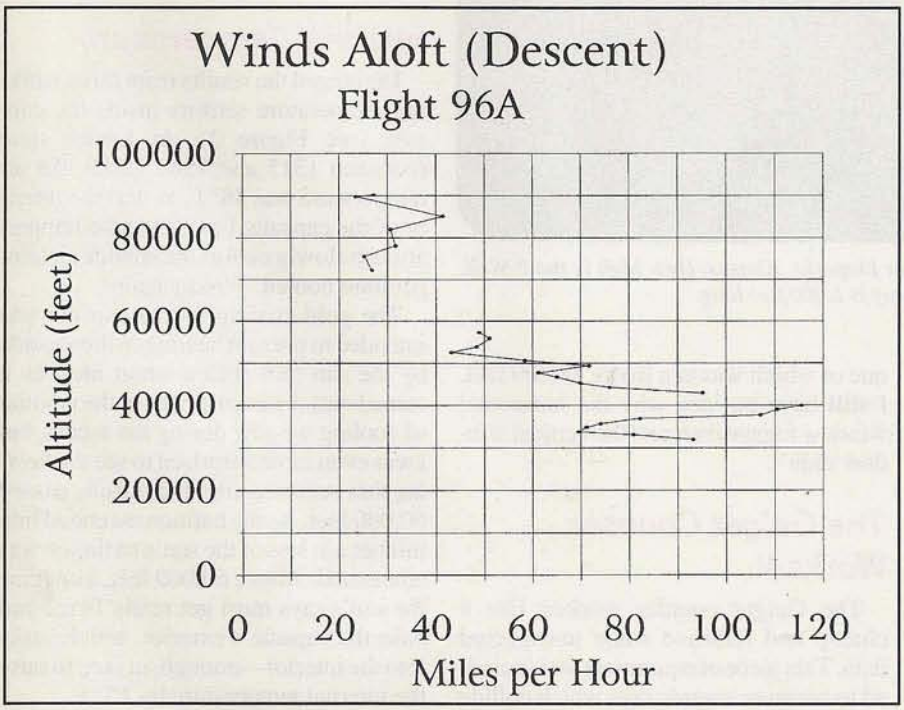
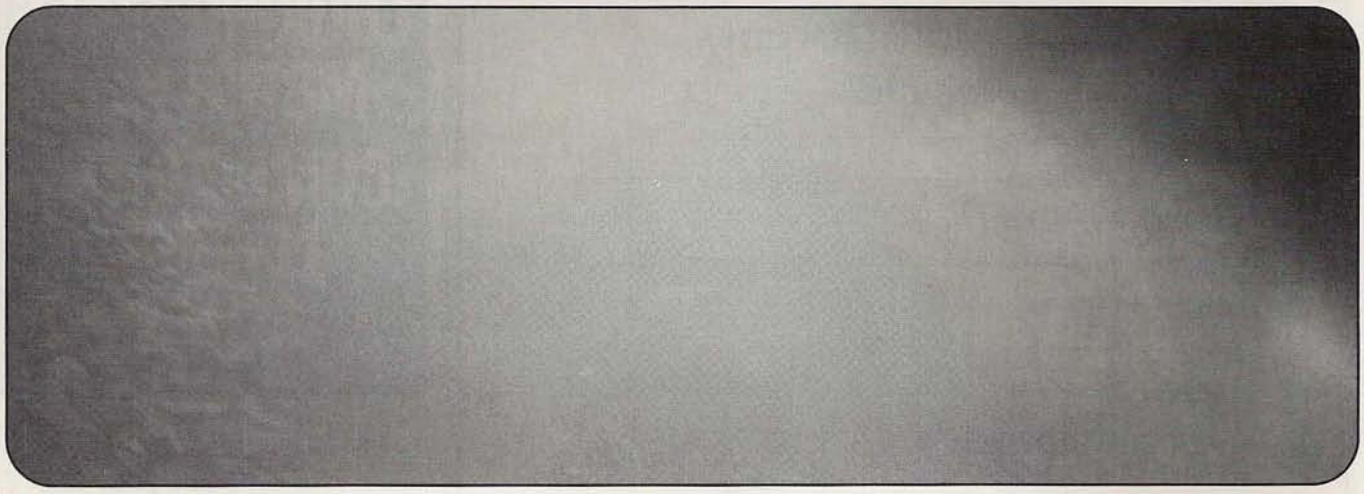


Figure 3b. There were fewer measurements taken on the way down, but this graph clearly shows the influence of hitting the jet stream at about 40,000 feet. The influence of the jet stream is missing from the ascent graph because of gaps in telemetry transmissions.



From an altitude of 88,000 feet, the curvature of the earth and the blackness of space are visible at the upper right, while patterns on the ground can be seen at the far left. Unfortunately, frost in the center of the window made it impossible to see more.

The view from 33,000 feet above the airport in Emporia, Kansas. How high is that? Well, consider this: The runway is 5,000 feet long.

converting the altitude data from ASCII to binary format failed, so the Basic Stamp controller was never aware of the capsule's altitude. Consequently, the gliders were not dropped and the dust sampler did not open as had been scheduled to happen at specific altitudes. In addition, the external temperature sensor and pressure transducer failed, but we were able to get interesting temperature data from inside the capsule.

For the most part, the cameras worked well. The window over the horizontal camera fogged over during the flight, so only four pictures really came out well, one of which was at a frosty 88,000 feet. I still have no idea why the horizontal window fogged over and the vertical window didn't.

The Geiger Counter Worked!

The Geiger counter worked like a champ and returned some unexpected data. This piece of equipment was included to measure cosmic rays which collide with air molecules high in the atmosphere, creating showers of lower energy particles. These secondary cosmic rays can further collide with other air molecules and create additional showers. Because the atmosphere shields us from these lower energy showers, I expected the Geiger counter count to climb as the capsule ascended, but I didn't expect the drop we saw at about 62,000 feet (see Figure 1). I believe that at that altitude, we were entering a region of *primary cosmic rays* and leaving the secondaries below. These higher-energy rays can be so energetic that they can go right through the Geiger tube without causing a discharge (detection).

Internal Temperature

I averaged the results from three working temperature sensors inside the capsule (see Figure 2). At launch time (between 1315 and 1345 UTC), the air temperature was 38° F, as was the interior of the capsule. I expected the temperature to slowly cool as the outside air temperature cooled. Wrong again!

The gold coating on the capsule was intended to prevent heating of the capsule by the sun (not such a smart idea, as it turned out). I was surprised at the amount of cooling we saw during the ascent, but I was even more surprised to see the *heating* that occurred after the capsule passed 60,000 feet. As the balloon ascended into thinner air, less of the sun's radiation was attenuated. Above 60,000 feet, I imagine the sun's rays must get really fierce and bake the capsule's exterior, which soaks into the interior—enough, in fact, to raise the internal temperature by 15° F.

After the balloon burst, the capsule descended at better than 6,000 feet per minute until the parachute deployed. The

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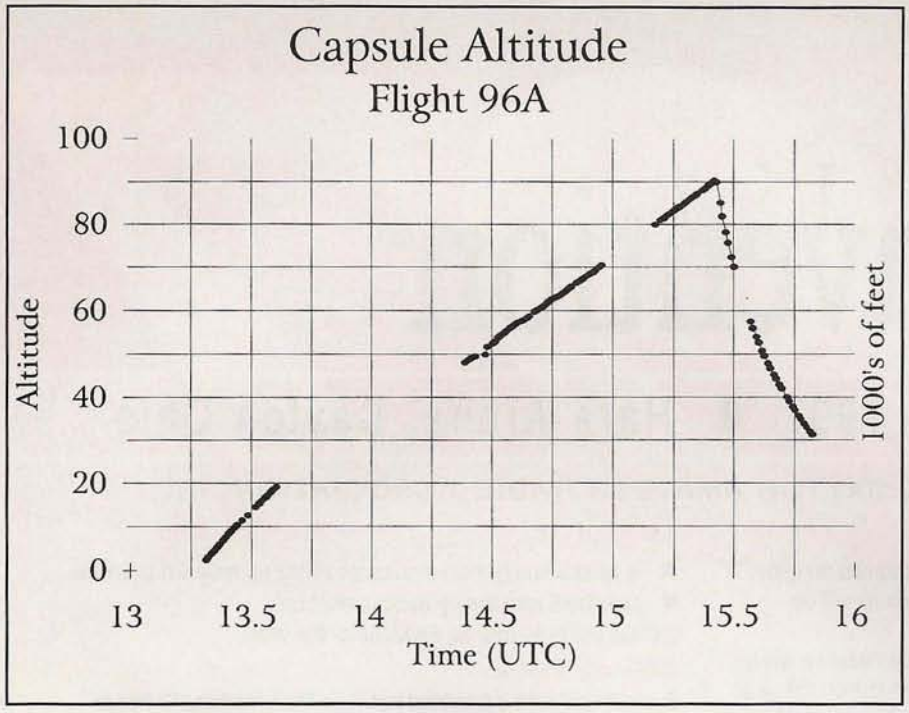


Figure 4. This graph of capsule altitude shows a steady rate of climb (the one-hour gap early on was due to telemetry failure), followed by a sharp, fast descent after the balloon burst at about 90,000 feet.

associated wind chill must have rapidly cooled the capsule, decreasing its interior temperature by at least 30° F.

Winds Aloft

The GPS receiver calculated positions (latitude, longitude, and altitude) every five seconds. From this data and the time of day I was able to calculate the speed of the balloon. Here in Kansas, one degree of latitude equals about 69 miles and one degree of longitude equals about 60 miles. Assuming the balloon moved exactly like the wind, I was able to plot wind speeds at different altitudes.

I plotted the winds aloft separately for the ascent (Figure 3A) and the descent (Figure 3B). Since the balloon ascended at a slower rate than it descended, the resolution is better during the ascent portion of the flight. But on the descent chart, you can easily see that, at 40,000 feet, the capsule passed through the jet stream with winds of 120 mph. It's no wonder the capsule got so far ahead of us.

Capsule Altitude

I also plotted the capsule's altitude throughout the flight (Figure 4). You can see that it ascended at a near constant rate (706 feet per minute). The descent was fastest at the highest altitudes were the air was too thin to effectively operate the parachute. As air density increased, the parachute became more effective at slowing the capsule down.

Lessons Learned

So the flight was basically a disaster, right? Wrong. It was truly a learning experience. And here are some of the main lessons we learned:

1. Checklists—Always have a checklist and check it for completeness.

2. Foolproof Designs—I burned out three voltage regulators and a servo by being careless with my wiring. We're designing the next capsule with polarized power connectors. There should only be one way to connect wires.

3. Backup Procedures—Don't rely on a single method to operate an experiment. My ASCII to binary altitude conversion routine failed and that doomed two of the experiments. Next time, we'll use both altitude and time information in our experiments; that way whichever occurs first (height reached or time elapsed) will trigger the experiment.

4. Get Ahead of the Capsule—We let everyone chase the balloon after it was launched. We'd have been more productive if we'd sent a team out ahead of the balloon. The balloon didn't have to follow roads or speed limits.

5. Get the Word Out—If I had done a better job of notifying the surrounding ham community, hams to our southeast could have been listening and keeping the connection active.

Onward and Upward

Near-space projects are too much fun to do only once, so we planned another launch for the middle of March (after this article was submitted). I believe near space projects are one of the best ways to get the public, especially younger people, interested in amateur radio. Where else can an average person get involved in designing and flying experiments in near space conditions? And amateur radio will be one of the tools they'll need to participate. ■

Resources

One of the greatest sources of help for getting ham radio balloon projects off the ground is the balloon "listserv" on the Internet. You can e-mail a message to all members of the list at <balloons@Pixar. com>. In addition, Dave Mullenix's Balloon FAQ (Frequently Asked Questions list) can be reached on the World Wide Web at <http://www.usa.net/~ rickvg/pubs/faqloon.htm>. There's a list of ballooning-oriented ham groups on the *CQ VHF* FTP site at <ftp:// members. aol.com/cqvhf/96issues>. The site may also be accessed via the *CQ VHF* Web page at <http://members.aol.com/ cqvhf/>. Finally, feel free to contact me, or check out my Web page. My e-mail address is <verhage@humec.ksu.edu>, and my Web page is at <http://www.ksu. edu/humec/knsp/kns.htm>.

Balloon launches are regulated by the Federal Aviation Administration (FAA). Don't launch without calling your local FAA center first! See "Flight #9: Ballooning on a Budget," in the September, 1996, issue of CQ VHF *for specifics.—ed.*

Hamfest Calendar

The following hamfests are scheduled for May, 1997:

May 2–3, Annual Fresno Hamfest, Riverland RV Park, Town of Kingsburg, Fresno, CA. For information, contact Bob Weaver, KD6SYP, (209) 436-8830. (exams)

May 3, Annual Hamfest, Kansas City Market Center, Kansas City, MO. For information, contact Bob Roske, (816) 436-0069 or write to: Box 28954, Kansas City, MO 64188-8954; e-mail to: <wa0clr@juno.com>,

May 3, 2nd Annual Hamfest/Computer Show, Tyler County Fairgrounds, Middlebourne, WV. Talk-in: 147.360+ PL 110.9. For information, contact Ray Gorrell, KA8GOH, Rt 1 Box 60, Middlebourne, WV 26149 or call (304) 758-2832.

May 3, Hamfest, Assembly of God Church, Klamath Falls, OR. Talk-in: 147.32/92. For information, contact Keno Amateur Radio Club, P.O. Box 653, Keno, OR 97627. (exams)

May 3, Annual Hamfest, Cadillac Middle School, Cadillac, MI. Talk-in: 146.98 repeater. For information, contact Dan, KE8KU, Wexaukee, A.R.C., PO Box 163, Cadillac, MI 46901 or call (616) 775-0998. (exams)

May 3–4, ARRL West Texas Section Convention and Key City Amateur Radio Club Hamfest, Abilene Civic Center, Abilene, TX. Talk-in: 146.160/760. For information, contact Peg Richard, KA4UPA, 1442 Lakeside Dr., Abilene, TX 79602 or call (915) 972-8889. (exams)

May 4, 23rd Annual Hamfest, Middletown Grange fairgrounds, Wrightstown, PA. Talk-in: 147.09/.69 repeater and 146.52 simplex. For information, contact George Brechman, N3HBT (215)443-5656. (exams)

May 4, Giant Electronic Fleamarket, Lincoln High School, Yonkers, NY. Talk-in: 449.425 MHz PL 156.7, 223.760 MHz PL 67.0, 146.910 HZ, 443.350 MHz PL 156.7. For information, contact Otto Supliski, WB2SLQ, (914) 969-1053. (exams)

May 4, 3rd Annual AA9HI Hamfest, Monroe County Fairgrounds, Bloomington, IN. Talk-in: on K9TC repeater, 146.895- MHz. For information, contact AA9HI, John Anderson, (812) 332-3734 after 5:00 PM or KF9NA, Randy Kinser, (812) 332-3588 after 7:30 PM. (exams)

May 4, Kishwaukee Amateur Radio Club Hamfest, Sandwich Fairgrounds, Sandwich, IL. Talk-in: KARC repeater 146.730 minus o/s or 146.52 simplex. For information, contact Bob Yurs, N9ZNA, KARC Pres. at (815) 895-3219 or e-mail to: <N9ZNA@AOL.com>.

May 4, Great Hagerstown Hamfest & Computer Show, Hagerstown Junior College Athletic, Recreation & Community Center, Hagerstown, MD. Talk-in: 146.940-, 146.520 simplex. For information, contact the ARA at (301)791-3010 (phone/fax). (exams)

May 10, 14th Annual Hamfest, Will County Fairgrounds, Peotone, IL. Talk-in: 146.94. For information, contact Will Bowser, K9IFO, 1210 N. Riverside Drive, Momence, IL 60954 or call (815)472-2079.

May 10, 1997 Hamfest and Computer Swapfest, Manitowoc County Expo Ctr., Manitowoc, WI. Talk-in: 146.61- or 147.03+. For information, contact Glenn, (414) 684-7096. (exams)

May 10, Amateur Electronics Swapfest, National Guard Armory, SD State Fairgrounds, Huron, SD. Talk-in: 147.08(+). For information, contact Lloyd Timperley, WBØULX, PO Box 205, Huron, SD 57350 or call (605) 352-7896 (eves). (exams)

May 10, Annual Hamfest, Anderson County Fairgrounds, Greenville, SC. Talk-in: 146.01/.61. For information, contact Gene, WB4ZBZ, or David, KE4QQQ, (864)476-2609 or e-mail to: <ke4qqq@innova.net>.

May 10, Hamfest, Fleamarket and Computer Show, Central Canyon Elementary School, Caldwell, ID. Talk-in: 147.200 (+600) N7NTY rpt.; 146.520 simplex; or 28.400 10 meter remote base to 147.200. For information, call Paul, KK7DG (208) 467-6340 or write SRARDC, PO Box 122, Caldwell, ID 83606 or e-mail to: <Dgardner@micron.net>. (exams)

May 15–17, 4th Annual Hamfest, Costersan Lake, Bakersfield, CA. For information, contact George, KC6KGH, (805) 323-3691 or visit our webpage: <http://members.aol.com/robertj966/bara.html>. (exams)

May 17, Annual Hamfest, Ephrata High School, Ephrata, PA. Talk-in: 144.85/145.450. For information, Contact William R. Kirkner, PO Box 308, Adamstown, PA 19501. (exams)

May 17, Annual 76 Auction and Fleamarket, VFW Post 6342, Forestdale, RI. Talk-in: 146.76. For information, contact Rick Fairweather, K1KYI, 144 Parkview Drive, Pawtucket, RI 02861 or call (401) 725-7595 between 7 and 8 PM.

May 16–18, 1997 Dayton Hamvention, Hara Arena, Dayton, OH. For information, call (937) 276-6930; fax: (937) 274-8369 or e-mail to: < info@hamvention.org>.

May 18, HamSwap '97, Carmichael Elk's Lodge Parking lot and hall, Carmichael, CA. Talk-in: K6IS repeater on 145.190+ (pl 162.2) and 224.400+. For information, contact Bob AC6HF, (916)966-3654 or e-mail to: <NHRC@ns.net>.

May 23–24, Third Annual Hamfest, Civic Center on Jackson County Fairgrounds, Pascagoula, MS. Talk-in:145.110- (W5WA, repeater). For information, contact Charles F. Kimmerly, (KIM) N5XGI, 19000 Busby Rd., Vancleave, MS 39565 or call (601) 826-5811. (exams)

May 25, MFMA Memorial Day Hamfest, Howard County Fairgrounds, W. Friendship, MD. For info, contact Craig RockenBaugh, 429 Severnside Dr., Severna Park, MD 21146 or call (410) 987-6042.

May 25, Annual Hamfest, DeVry Institute of Technology, Chicago, IL. Talk-in: 147.255+, 444.825+. For info call (773) 545-3622 or (773) 486-6823 or write to CARC, 5631 W. Irving Park Rd., Chicago, IL 60634.

May 31, Hamfest Nashville '97, Tennessee State Fairgrounds, Nashville, TN. Talk-in: 145.470. For information, contact Bill Pingley, KTØC, (615) 889-7376.

May 30-June 1, Rochester Hamfest & Computer Show, Monroe County Fairgrounds, Rochester, NY. For information contact Hamfest Office during business hours at (716) 424-7184 or write to Rochester Hamfest, 300 White Spruce Blvd., Rochester, NY 14623 or Fax: (716) 424-7130.

Operating Notes

For May 1997:

May	
5	Eta Aquarids Meteor Shower peak
10	ARRL Spring Sprints, 902/1296/2304 MHz (see rules, April, 1997, *CQ VHF*, p. 55)
17–18	ARRL Spring Sprint, 50 MHz
29	Moon Perigee (closest to Earth)

Turn Your "Power Station" into a Work Horse

Gordo shows you some simple "mods" to make this versatile power unit more useful than ever.

By Gordon West, WB6NOA*

If the charge on your HT's battery never seems to last long enough, you've probably considered one of several external power packs now on the market. Among the most popular is the "Power Station," a gel cell battery system selling nearly everywhere, from consumer electronic mail order catalogs to swap meets and flea markets. In the ham radio marketplace, you'll find the Power Station available from The Ham Contact in California and, more recently, from Premier (ADI) dealers nationwide.

The centerpiece of the Power Station is a massive 7-amp-hour gel cell battery capable of operating mobile and portable equipment running as much as 100 watts, with or without recharging power. But even this sort of power has its limits.

The portable Power Station can be a valuable station accessory, but some easy "mods" are needed to bring out its full potential.

Absolute Power?

If you plan to run just a small handheld off of your power station, you can get by nicely without making any modifications. You simply plug your handheld's 12-volt DC power adapter into the 12-volt socket on the Power Station labeled "output." And, if you're planning on running a small amplifier, you need to run it off of the *back* two output stud terminals. Although the front receptacle is fused with a 10-amp fuse, the internal wires feeding that output are relatively small and would probably contribute to a fairly large voltage drop.

The 12-volt input receptacle allows you to "float" the internal battery when running your handheld in the car from the 12-volt output socket. This lets you buffer your automobile battery to minimize ignition whine.

But that 12-volt input receptacle won't allow much charging current to feed the internal battery. You might charge a couple hundred milliamps at best due to the relatively small wires and a low-capacity voltage regulator circuit. But if all you are running is a handheld, your input charge capability should keep the battery topped off.

Your power station can also be charged from an AC power source with the included wall adapter. Plug one end of the adapter into 110 volts AC, and the other end into the Power Station jack marked "charger input." This is for trickle-charging your battery; and if you run your handheld mainly on receive, your charger will generally keep ahead of the small amount of current that you might be pulling. However, if you do a lot of transmitting while running off of the built-in battery, you may notice that you're pulling your voltage down faster than it can be replenished by the wall adapter.

There's a third output on the Power Station, rated at 3 volts, 6 volts, and 9 volts, with the center pin positive. Unfortunately, this output is designed for extremely low-current devices, such as a pocket tape recorder. You can't substitute the 6- or 9-volt power station output for your handheld battery pack. If you draw

Gordon West, WB6NOA, is Senior Contributing Editor of CQ VHF.

The meter that comes with the Power Station is very hard to read in the 12- to 15-volt range. Replace it if you can (see text for details).

too much current from this 3-, 6-, or 9-volt output, you could blow the regulator and unleash damaging current into your handheld, toasting it for life. Your best bet is to buy a 12-volt power adapter specifically designed for your HT and run it off of the 12-volt output socket.

Rewiring for Higher Power

If you plan to run a mobile VHF/UHF transceiver on high power (45 to 50 watts) from the portable power station, you're going to need to do some internal rewiring. While the battery is suited for this type of use, the small wires on the inside aren't! Unscrew the six Phillips-head screws on the back of the plastic case, lift off the case, and you'll see what I mean. Big battery, tiny wires, and a voltage regulation circuit not designed for more than a couple hundred milliamps.

I rewired the 12-volt input and the 12-volt output sockets through the fuse on the back of the set directly to the battery push-on leads—completely bypassing the input and output voltage regulator and the tiny wires. I used a short length of red and black, 14-gauge wires which can easily handle 10 amps. My voltage regular input is now that 10-amp fuse. The natural equalization of the internal 7-amp-hour battery to my 12-volt voltage input source typically keeps charging levels below 3 amps on the internal battery when it's almost dead, 2 amps as it comes up in charge, and less than 1 amp when the internal battery is reaching a full charge.

On the output side, I can now run my single- or dualband mobile transceiver and not worry about it toasting anything on the inside of the power station. I still have that 10-amp fuse for protection.

Avoiding "Traps"

I have also run 100-watt HF transceivers from the external 12-volt studs on the back of the unit inside the trap door. Again, the battery can handle this load just fine, but the trap door usually falls apart after a few openings and closings, so you want to make sure that you don't accidentally short out the exposed studs. To guard against this, I rewired both the positive and negative studs with an internal set of red lead and black lead fuse holders, putting 20-amp fuses in each line. A direct fuse connection to the internal battery allows you to run a 100-watt HF transceiver at full tilt for up to 20 minutes of talk-and-listen time before you need to recharge your Power Station.

In addition, the 20-amp fuses are more than enough to protect that 7-amp-hour gel cell from running down if it's plugged in when you try to start your car with a dead car battery. Plus the current is sucked backward through your cigarette lighter plug and out of your Power Station.

A Battery Buffer

If you tried to run your HF transceiver directly off of your vehicle's cigarette lighter receptacle, chances are you'd ex-

"If you plan to run a mobile VHF/UHF transceiver on high power (45 to 50 watts) from the portable power station, you're going to need to do some internal rewiring."

perience a major voltage drop, your SSB signal would sound terrible, and you'd probably blow the cigarette lighter fuse... if you didn't melt down the wiring in the lighter receptacle.

Most lighter receptacles can handle up to 15 amps, which is what's needed to heat up the lighter element. But a 100-watt SSB transmitter can pull as much as 20 amps on voice peaks. Your rewired Power Station can serve as a buffer, though, if it's plugged in between the cigarette lighter receptacle and your transceiver. In this setup, the Power Station's internal battery delivers power for most of your intermittent 20-amp requirements, while the 12-volt input port is recharging at 3 or 4 amps through the cigarette lighter receptacle. The 10-amp fuse on the input side ensures that your vehicle's wiring won't be overloaded.

The Meter and the Battery

Most models of the Power Station also have a very small voltmeter, calibrated from zero to 20 volts, to read out the condition of the internal battery. The range from zero to 11 volts is calibrated in white, with anything above that in such dark print that you can't easily see what your running voltage is. If you can find a 0 to15-volt replacement meter that fits in its place, I'd recommend that you make the swap, both to make it easier to see and to better show you the all-important 12- to 15-volt excursion during charging and discharging cycles.

I suspect that all of these devices, regardless of brand name, are made in one major factory in the Far East, and almost all of the inside wiring is identical. But I've found many different types of 7-amp-hour gel batteries on the inside. If you can read the battery name as Yuasa, then you've got a good one. However, if you open up your unit and the battery looks scuffed up or doesn't have a recognizable name on it, go to your local radio parts store and get a 7-amp-hour Yuasa alarm battery to put in its place. It's a standard size 7-volt, "no spill," lead acid-type battery and the terminals simply push in without soldering.

The Power Station's strong plastic construction and massive carrying handle makes it a great accessory for going portable with your two-way radio equipment. It's much too heavy to wear on your belt, however; so, if that's what you're looking for, go with some of the other excellent battery packs from your local ham radio dealer (see "Resources").

But if you're looking for a good emergency battery system—one that you can rapidly recharge from an automobile battery after you modify the internal circuitry—the Power Station is a good investment at around $49.95 and only 30 minutes of your time to beef up its power-handling capabilities ■

Resources

For more information on the Power Station, contact one of the following:

The Ham Contact, P.O. Box 3624, Long Beach, California; Phone: (800) 933-HAM4

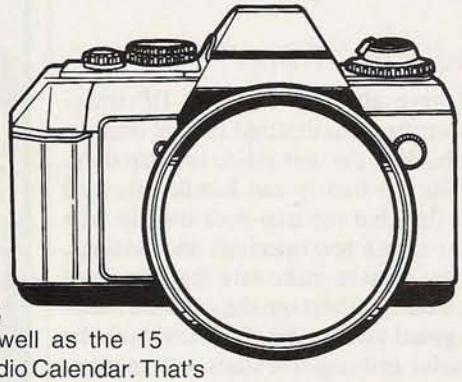
Premier Communications (Model #SB-752), 20277 Valley Blvd., #J, Walnut, California 91789; Phone: (800) 666-2654

Additional sources of long-lasting, rechargeable power (these have less capacity than the Power Station, but are meant to be worn) include:

Comet "belt pack," from Comet/NCG, 1275 N. Grove St., Anaheim, California 92806; Phone: (714) 630-4541

Quantum "Ham Battery," from Quantum Instruments, Inc., 1075 Stewart Ave., Garden City, New York 11530; Phone: (800) 989-0505

PHOTOS WANTED!



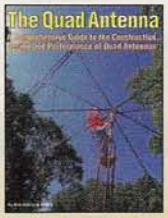
We're planning the travel itinerary for 1997 for *CQ* Staff Photographer Larry Mulvehill, WB2ZPI, and could use some input from our readers. As you know, Larry shoots all the covers for our publications *CQ, CQ VHF,* and *Popular Communications,* as well as the 15 photos for the annual *CQ* Amateur Radio Calendar. That's 51 shots used each year. Since a major part of the expense of generating these photos is travel, we like Larry to put together a few large "swings" each year to various parts of North America to visit specific locations we've been tipped-off about by readers. That's where you come in.

If you know of a particularly photogenic setting that you feel might lend itself to a good cover or a calendar shot, why not let us know about it! It might be a great antenna installation, or a neat mobile setup, an interesting shack, or even a busy electronic workbench with work in progress. How about an interesting Police, Fire Department, Public Service, Scanning, Shortwave Listening, Military Communication, or Broadcasting setting? Don't be shy about recommending your own setup, either! If you think you've got a suggestion that can lend itself to a great amateur radio photo, let us know. If you can provide a snapshot or two for reference, great. If a snapshot isn't available, a short verbal description will help.

Send your ideas and snapshots to Larry Mulvehill, WB2ZPI, at 32 Comanche Drive, Oceanport, NJ 07757. Larry will decide if your suggestion fits in with our needs and his schedule. If you'd like your snapshots returned, please include an SASE. The sole reward for your help will be the gratitude of your fellow readers, and of Larry, who will have the opportunity to make about a hundred new radio friends again this year. Be sure to include information about how Larry can get in touch with you.

CQ Books, Calendars, Videos

The Quad Antenna



by Bob Haviland, W4MB

Second Printing

An authoritative book on the design, construction, characteristics and applications of quad antennas.

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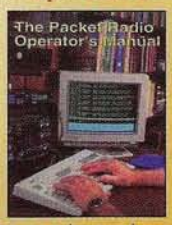
The Packet Radio Operator's Manual



by Buck Rogers, K4ABT

CQ has published an excellent introduction and guide to packet operation. It's the perfect single source, whether you're an advanced user or just starting out.

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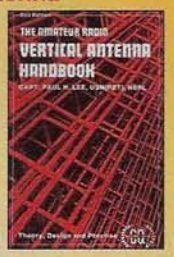
The Vertical Antenna Handbook



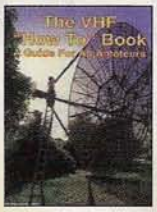
by Paul Lee, N6PL

Learn basic theory and practice of the vertical antenna. Discover easy-to-build construction projects for anyone!

Order No. VAH... **$9.95**

The VHF "How-To" Book

by Joe Lynch, N6CL



This book is the perfect operating guide for the new and experienced VHF enthusiast.

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The NEW Shortwave Propagation Handbook

by W3ASK, N4XX & K6GKU

The most comprehensive source of information on HF propagation is available from CQ! Read about propagation principles, sunspots, ionospheric predictions, with photography, charts and tables galore—it's all in this unique reference volume!

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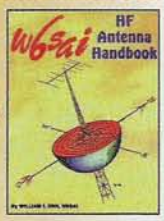
W6SAI HF Antenna Handbook

by Bill Orr, W6SAI



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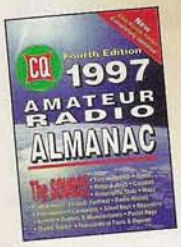

1997 Amateur Radio Almanac 4th Edition

NEW!

by Doug Grant, K1DG

This volume is filled with over 500 pages of ham radio facts, figures and information. CQ's almanac is a resource you'll refer to over and over again. If it's ham radio, it's in The Source!

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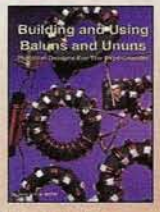
by Jerry Sevick, W2FMI



This volume is the source for the latest information and designs on transmission line transformer theory. Discover new applications for dipoles, yagis, log periodics, beverages, antenna tuners, and countless other examples.

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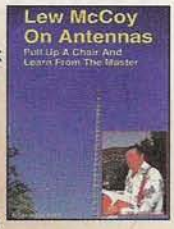
by Lew McCoy, W1ICP



This is truly a unique antenna book that's a must for every amateur. Unlike many technical publications, Lew presents his invaluable information in a casual, non-intimidating way for anyone!

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The Great Sporadic-E Debate—Part 2: In Search of the Weather Connection

Last month, WB2AMU explored the apparent link between solar activity and sporadic-E. Now, we look at phenomena that are closer to home—and more controversial.

By Rita Williamson, KB5KYN, and Owen Williamson, KI5JD

As this summer ushers in the 1997 sporadic-*E* season, VHF operators around the northern hemisphere are ready to take advantage of bell-clear openings into areas 600, 900, or even 1,200 miles away, on bands up to 2 meters. Certainly, no other "exotic" propagation mode requires so little special equipment or knowledge, while providing so much fun for so many VHF operators.

Unfortunately, no technical question in VHF radio is quite as controversial as sporadic-*E* propagation. Forecasting sporadic-*E* openings rivals tea-leaf reading for reliability. Still, many hams have an almost faith-like belief in their "method" of predicting openings. Some scorn others' findings as hoary amateur lore from the days of the spark gap, or as technical fairy tales. The biggest question of all is the alleged link between *E*-skip and weather. Is there really a meteorological connection with sporadic-*E* phenomena? With the arrival of this year's sporadic-*E* season, the question is sure to come up again, on the air and wherever VHF operators compare notes.

Long-standing ham legend has connected sporadic-*E* with stormy weather However, many hams still roundly deny the possibility of an *E*-skip/weather connection. An article by Ken Neubeck, WB2AMU, in the July, 1996 *CQ VHF* (p. 16) sought to "debunk" and "derail" any link between storms and *E*-skip. Meanwhile, the ARRL's *Advanced Class License Manual* states flatly that "*E*-skip is directly associated with terrestrial meteorological phenomena..." (p. 3-2).

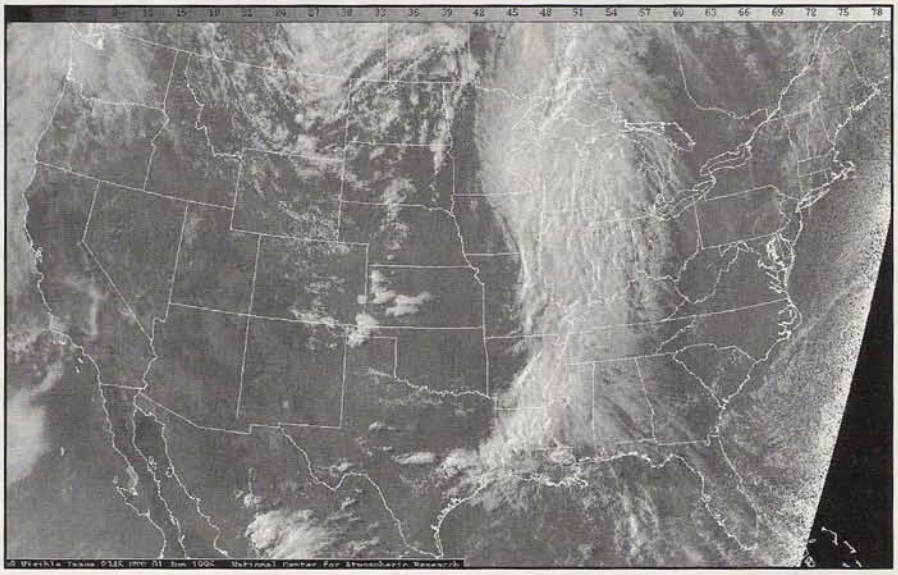


Figure 1. Weather satellite photo for June 1, 1996, showing supercell storm activity and grayscale (unretouched).

What Do Scientists Say?

Outside the ham community, the link between *E*-skip phenomena and meteorology is still an open, and very much debated, scientific point. Here is a sampling of the discussions:

An eminent scientist who is working with the National Oceanic and Atmospheric Administration (NOAA) HF Over the Horizon Radar project advised the authors of this article that: "There is credible evidence that these...precede tornado touchdowns. However, I know of no credible papers connecting sporadic-*E* with thunderstorms." (Dr. T. M. Georges, private communication)

Another ionospheric physicist disagreed vehemently and wrote that there is no evidence of a sporadic-*E*/meteorological connection whatsoever. (Dr. Ernest Smith, University of Colorado, private communication)

A third simply advised us: "That's a fairly complex topic you are researching...and I'm afraid one that isn't well understood yet." (Dr. Cary Oler, University of Alberta, private communication)

Much of the published research in the

*Rita (KB5KYN) and Owen (KI5JD) Williamson are a daughter/father research team in El Paso, Texas. Rita is a high school sophomore and has been a licensed ham operator for eight years. She's won numerous local and regional awards in VHF/UHF-related radio science. Owen, a social worker, has been a ham for 35 years and has been interested in sporadic-*E *for most of that time.*

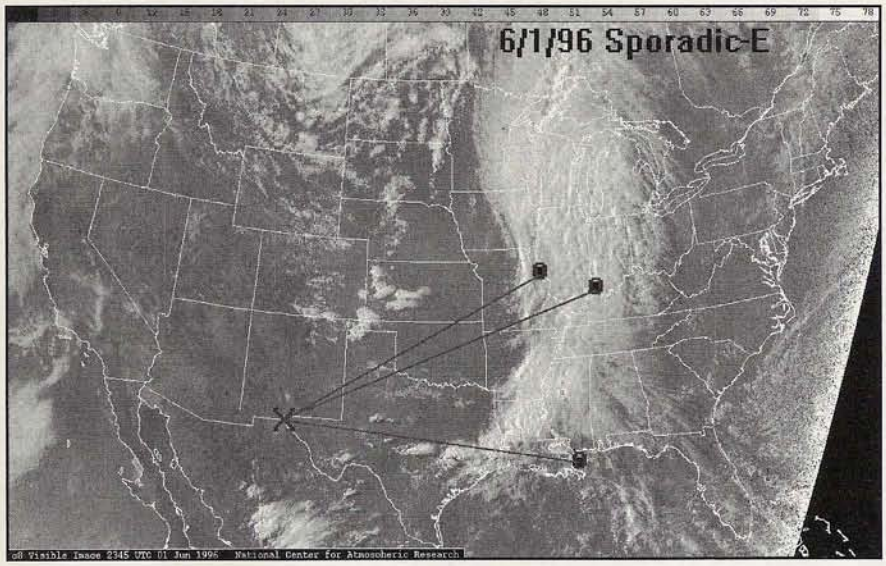


Figure 2. Weather satellite photo for June 1, 1996, showing the sporadic-E opening that day into the storm area.

field was done in the pre-Space Age years. However, more recent investigations of sporadic-*E* by scientists seem to back a weather connection, as follows:

Quite different from the normal thick layers due to cosmic radiation influences, *Es* seems to be a 'meteorological' phenomenon, the only one well known in the ionosphere except for winds. Therefore, the behavior of this layer is completely different from the normal layers. As to energy, it is probable that existing molecular excitation or ionization is concentrated in a small height range by vertical exchange trapped by some discontinuity which is eventually formed by strong windshears...."[1]

Also, according to Kato: "Some sporadic-*E* can be produced by gravity waves through their wind shear...."

The theoretical "missing link" between weather (which takes place in the bottom 10 to 15 kilometers of the atmosphere) and sporadic-*E* (occurring approximately 100 kilometers up in the ionosphere) seems to be a virtually unknown phenomenon known as *gravity waves*. Not to be confused with cosmic gravity waves, which can theoretically come from collapsars, black holes, and other astrophysical exotica, atmospheric gravity waves are really a form of pressure-wave, with wavelengths ranging from a few meters to continent-size, and frequencies from 0.01 Hz on downward.

According to T.L. Killeen and R.M. Johnsson (*Upper Atmospheric Waves, Turbulence, And Winds: Importance For Mesospheric And Thermospheric Studies*, Space Physics Research Laboratory, Department of Atmospheric, Oceanic and Space Sciences, University of Michigan, Ann Arbor, via Internet):

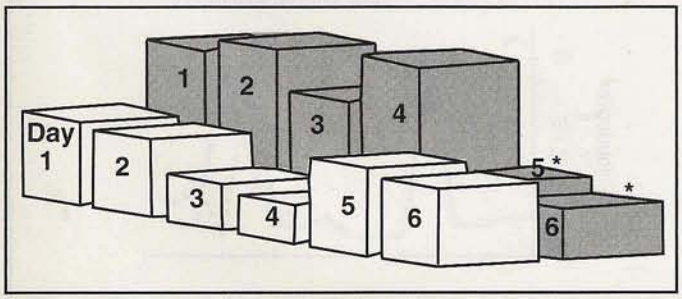
Recognition of the importance of gravity waves for upper atmosphere structures has led to numerous experimental and theoretical efforts....Signatures of 'breaking' gravity waves at mesopause altitudes >90 km [i.e., the *E*-layer of the ionosphere!] are of particular interest. These waves are generated at lower altitudes due to tropospheric effects, such as the passage of weather fronts and intense pressure regions. The waves propagate upwards and grow in amplitude, until they reach a critical level near the mesopause where they 'break,' depositing energy and momentum....The smallest scale waves (meters to kilometers) are thought to be the most important for forcing the mesosphere/lower thermosphere.

The Experiment

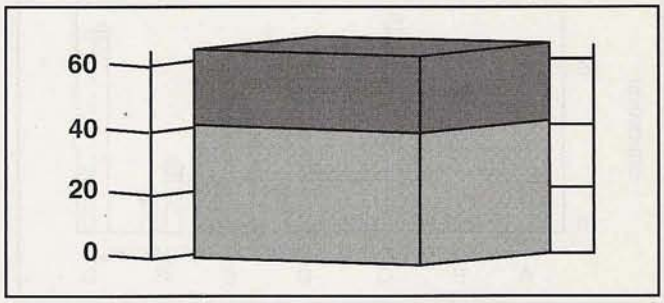
Based on this evidence for a material link between meteorology and sporadic-*E*, we designed a research mini-project from our home QTH in El Paso, Texas. We sought to track any empirical evidence linking strong sporadic-*E* openings with inclement weather in other areas of the country, while searching for clues about the mysterious gravity wave connection. El Paso is rarely subject to severe weather during the early to mid-summer *E*-skip season, making it a good location from which to make this study.

During six randomly chosen days at the peak of the June, 1996, sporadic-*E* season, we used a low-powered rig and an omnidirectional vertical antenna to work FM repeaters around the country via-*E*-skip on both 6 and 10 meters.[3] This deliberately ensured that only the strongest-*E*-skip openings would be logged and analyzed, and it avoided the chance-factor involved in simplex contacts (individual hams may or may not be on the air during an opening, but a repeater will always respond if you can "hit" it).

We logged all contacts and repeaters "hit" and then downloaded NOAA weather reports and satellite cloud cover photos from the Internet, covering the periods of the sporadic-*E* openings and the areas contacted (see Figures 1 and 2). We analyzed the satellite photos for cloud cover levels, both at the areas contacted



*Graph 1: Cloud cover at repeater sites hit vs. control group (repeaters within E-skip range not hit) by day. Back row = repeaters hit; Front row = repeaters not hit; * = openings into the mountain west only, on days 5 and 6.*



Graph 2: Average Cloud cover grayscale at sites of repeaters hit vs. sites not hit over the course of the entire experiment. Lower block indicates cloud cover at repeaters not hit; lower and upper blocks combined indicate cloud cover at repeaters hit.

954 [9 JUNE 1996]
WFUS1 KPAH 09123
TORPAH
INC 163-092200-

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TORNADO WARNING
NATIONAL WEATHER SERVICE PADUCAH KY
FOR PEOPLE IN THE FOLLOWING LOCATION...

IN SOUTHWEST INDIANA

...VANDERBURG COUNTY

A TORNADO IS EXPECTED TO MOVE JUST NORTH OF EVANSVILLE THROUGH 435 PM CDT. DOPPLER RADAR INDICATED A POSSIBLE TORNADO AND STORM SPOTTERS REPORTED A FUNNEL CLOUD NEAR THE EVANSVILLE AIRPORT AROUND 420PM. STORM MOVEMENT WAS NORTHWEST AT 15 MPH.

IF YOU ARE IN THE PATH OF A TORNADO ...THE SAFEST PLACE IS A BASEMENT. GET UNDER A WORKBENCH OR A PIECE OF STURDY FURNITURE. IF NO BASEMENT IS AVAILABLE...SEEK SHELTER IN AND INTERIOR ROOM SUCH AS A CLOSET ON THE LOWEST FLOOR. USE BLANKETS... PILLOWS... OR CUSHIONS TO COVER YOUR BODY. AVOID WINDOWS.

SHANKLIN*

Figure 3. The NOAA National Weather Service tornado warning for Evansville, Indiana, June 9, 1996.

and at midpath along the direction of propagation. We compared the weather conditions at repeater sites "hit" and repeater sites not contacted during each opening. As a "control," we also included weather at three randomly selected cities within *E*-skip range (1,000 to 2,000 kilometers) which have active VHF-FM repeaters but which we were never able to contact during the experiment.

Finally, in search of the elusive "gravity waves," we monitored received signal levels during a day-long strong sporadic-*E* opening into southern Indiana on June 9, 1996, and simultaneously followed weather reports and satellite photos of

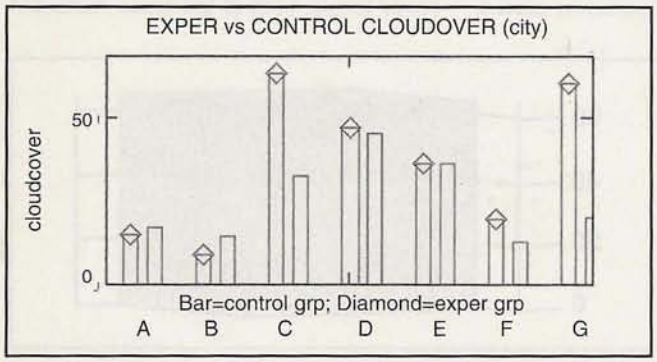
"During six randomly chosen days at the peak of the June, 1996, sporadic-E season, we used a low-powered rig and an omnidirectional vertical antenna to work FM repeaters around the country via E-skip on both 6 and 10 meters."

that area. Signal-strength data was logged automatically every minute by computer, and the results were number-crunched afterwards with a Fast Fourier Transform (an advanced mathematical algorithm used to detect patterns of periodicity in data).

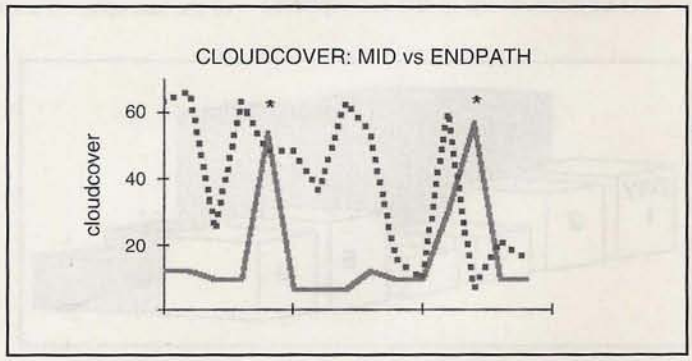
Astounding Results

Perhaps the most astounding result to emerge from this mini-experiment was that every one of the repeaters we "hit" via-*E*-skip, on six random days, was in an area experiencing or expecting thunderstorms within about a 20-kilometer radius, according to NOAA weather reports. Thunderstorms are not unusual in June, especially in the plains states and along the Gulf coast. But we found one every day, everywhere from California to Minnesota to New Orleans. And based on the published thunderstorm probability maps, we figured the odds of this being a random result at well over a trillion-to-one (scientific results are usually considered significant if the probability of a chance result is less than 20-to-1).

We then considered the level of cloud cover, both at repeater locations contacted and at "control" sites where repeaters



*Graph 3: Experimental vs. control group cloud cover by city over entire experiment. Bar = control group/not hit; Diamond = experimental group/repeaters hit; * = Cities A and B were located in the mountain west.*



Graph 4: Cloud cover levels: midpath vs. endpath. The dotted line indicates the cloud cover grayscale at repeater sites hit, while the solid line indicates the cloud cover grayscale at midpath for each repeater hit (= contacts into the mountain west).*

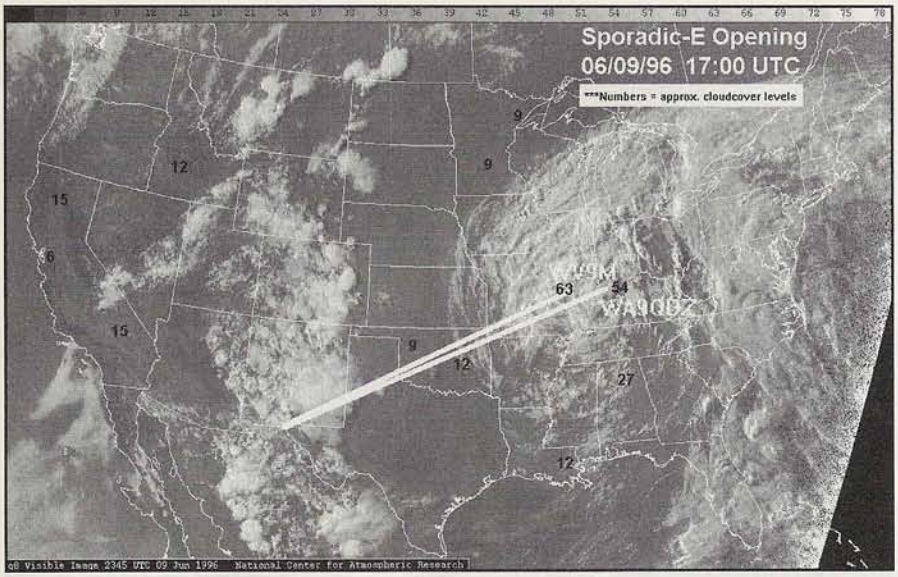


Figure 4. Weather satellite photo for June 9, 1996, with the sporadic-E opening that day (only into the storm area).

are on the air but no contact was made. As shown in Graph 1, average cloud cover for repeater "hits" was 74% greater than for the control group on dates/locations without *E*-skip contacts. This correlation held true for each of the days of the experiment (Graph 2) and at five of the seven repeater locations included in the experiment (Graph 3). Interestingly enough, the only two sites where the correlation did not hold true were in the Mountain West.

Finally, the most mysterious result appeared when we correlated the average cloud cover for each repeater site actually "hit," versus cloud cover midway along the propagation path. HF operators are familiar with the technique of tracing midpath propagation conditions to determine maximum usable frequencies for communication between two points. Yet, our data clearly showed that the determining factor for *E*-skip was weather conditions *at the repeater site*, not along the path of propagation (Graph 4)!

What Is Sporadic-E, Anyhow?

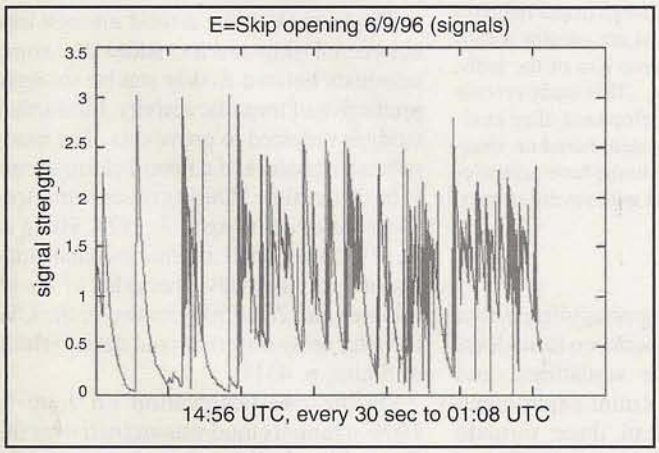
Scientists have complained that we know more about the atmosphere of Mars or Venus than we do about the conditions in our own upper atmosphere. Too high for planes and balloons and too low for satellites, the *E*-layer, 100 kilometers above our heads, is still explored only by sounding rockets and surface-based radio. This lack of data leaves sporadic-*E* as one of Earth's great remaining geophysical mysteries.

The well-known small "size" of sporadic-*E* openings (which can provide contacts into Minneapolis but not St. Paul, or link Milan to London but nowhere in between) means the phenomenon must be itself relatively tiny. Observations of near-perfect *E*-skip reception on lower TV channels lead scientists to believe that sporadic-*E* may be "a mirror-like pancake" (Smith, p. 74), as small as 90 meters in size, which effectively reflects, rather than refracts, VHF signals. This phenomenon is capable of hovering stationary (within a few meters), 100 kilometers above a fixed point on the Earth's surface for 90 minutes or more, or can sometimes stay coherent and travel across land or ocean at 500 kilometers per hour or faster.

(In case a mirrored, hovering 90-meter pancake suggests other images, several scientists have indeed suggested extraterrestrial origins for sporadic-*E*, but they are thinking of ions from meteors, and not "cloaked" UFO's.)

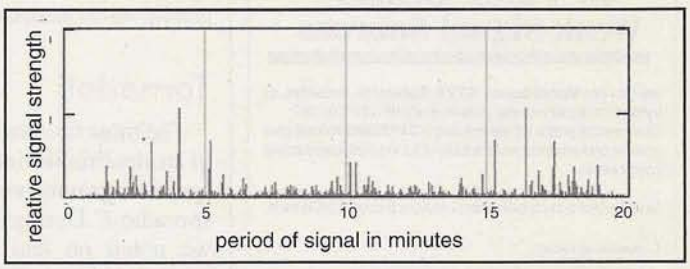
The Gravity Wave Connection

Even though the precise nature of the sporadic-*E* mechanism remains unclear,



Graph 5: Relative signal strength from Evansville, Indiana, repeater during all-day E-skip opening 6/9/96 into El Paso, TX. (Measured every 30 seconds from 14:56 UTC to 01:08 UTC.) Note: Repeater was not on the air continuously, but was constantly being brought up by hams, plus QRN from nearby storms, providing a near-continuous signal source.

"...every one of the repeaters we 'hit' via E-skip, on six random days, was in an area experiencing or expecting thunderstorms within about a 20-kilometer radius...."



Graph 6: Partial Fast Fourier Transform of Graph 5. This shows a strong periodicity at 16.4 minutes and 4.07 minutes (about the fourth harmonic of the first signal.) Hung and Smith report wave periods of three to five minutes in the ionosphere in the presence of severe thunderstorms, and 11 to 15 minutes before and during tornado outbreaks.

Co-author Rita Williamson, KB5KYN, operates during the sporadic-E experiment from the station of the Sun City Amateur Radio Club in El Paso, Texas.

the connecting factor that physically links-*E*-phenomena with stormy weather seems to be *gravity waves*.

According to Hung and Smith (p. 431):

> In recent years, experimental observations of CW Doppler soundings of the upper atmosphere showed that there are ionospheric disturbances apparently associated with severe weather and thunderstorms. These studies reveal that quasi-sinusoidal oscillations with two harmonics of wave periods, 3 to 5 minutes and 6 to 9 minutes, are observed when thunderstorms with cloud tops (radar heights) in excess of about 12 Km are present within a radius of several hundred Km of the ionospheric reflection points....This study reveals the possibility of the development of an environmental forecasting system based on ionosphere observations of atmosphere acoustic-gravity waves associated with severe storms.

Tornado!

The most fascinating possibility is that of an identifiable link between tornadoes, specific gravity-wave signatures, and sporadic-*E*. During our mini-experiment, we noted no less than three tornado reports within a 100-kilometer radius of a repeater site we "hit," in a total of 10 midwestern U.S. contacts. Research shows that the probability of a tornado averages $^1/_{5000}$ per year per square mile area of the U.S., or one in 1,825,000) for any given square mile in any given day. (Church, et. al., p. 329)

Random probability would be a one in 143 chance of detecting a tornado within 100 kilometers of one of the experimental sites on one day, times 10 midwestern repeater contacts (tornado data was available only for the midwest) = 1:14 chance of detecting one tornado. The fact that *three* tornadoes were detected means that the probability of this happening at random is only 1 in 2900.

There seems to be a solid enough link between *E*-skip and tornadoes that some scientists believe *E*-skip can be strongly predictive of tornadic activity, but further study is required to prove this. The ionospheric signature of a funnel cloud seems to be distinctive: "During the extreme tornado outbreak of April 3, 1974, Hung et al. (1978) detected another two harmonics of [gravity] wave periods, 11 to 15 minutes and 26 to 30 minutes, in the CW Doppler array observational data." (Hung & Smith, p. 431)

During our observation on June 9, 1996, a funnel cloud was sighted over the Evansville, Indiana, area between 4:30 and 5:00 p.m., as we were monitoring an Evansville repeater (WA9QDZ/R) on *E*-skip (see Figures 3 and 4). The relative signal strength of repeater signals received throughout the day from the

"...our data clearly showed that the determining factor for* E-*skip was weather conditions* at the repeater site, *not along the path of propagation....!"

Evansville repeater is illustrated in Graph 5; the ups and downs of the day-long sporadic-*E* opening can be clearly seen.

Graph 6 shows a Fourier transform of this data. We used this to search for periodicity in the Evansville signal. Fourier transforms return vectors whose elements are the complex amplitudes of the various frequencies in the original signal and can be used to detect periodic recurring variations in signal strength, such as might be caused by gravity waves influencing the sporadic-*E* "pancake" in the *E*-layer of the ionosphere.

This shows a strong periodicity at 16.4 minutes and also at 4.07 minutes, (about the 4th harmonic of the first signal), corresponding to what Hung and Smith reported during their tornado research and possibly showing the signature of the Evansville funnel cloud.

Putting It All Together

How can gravity waves emanating from the site of a weather disturbance lead to sporadic-*E* with one end near the source, rather than in the middle? The nature of this apparent interaction is another mystery about which scientists are only speculating. Some suggest that when these waves "break" at the *E*-level of the atmosphere, they somehow generate a standing-wave phenomenon that sustains the *E*-patch by some kind of wind shear. Perhaps there's also some kind of waveguide phenomenon at work, or some other effect that occurs 500 to 1,000 kilometers from a storm. One of the scientists we contacted in our research studied ultra-low-frequency sound waves generated by tornadoes. These sound waves have been heard 600 to 1200 miles away from a tornado—the same range provided by a typical sporadic-*E* opening. Is there a connection? Maybe? Maybe not. That's what science is all about.

Be Your Own Researcher

Is there a definite connection between weather and *E*-skip? Our mini-study seems to suggest that there is, in fact, a strong link. Is there a cause-and-effect relationship? Nobody knows. Not all storms generate sporadic-*E*, and there are other serious unanswered challenges.

Neubeck (7/96) points out that *E*-skip openings also happen in the winter, when thunderstorms and tornadoes are rare in North America. Some recent studies have suggested that gravity waves (and thus sporadic-*E*) are associated more with storm supercells than with storms or tornadoes themselves, which would address this problem. And other data suggest that tropical *E*-skip, temperate-zone *E*-phenomena, and aurora-related polar sporadic-*E* are three different phenomena, with very different rules.

Why do *E*-skip openings seem to be associated with storms at one end of the propagation path, but not in midpath, which would seem more logical? These points need further study, and any ham with equipment for 2, 6, or 10 meters can investigate the question this sporadic-*E* season. Join the fun!

Notes:

1. *Ionospheric Sporadic*-E, Smith and Matsushita (Eds.), Macmillan, New York, 1962, p. 343.
2. *Dynamics of the Upper Atmosphere*, Kato, Susumu, Center for Academic Publications, Tokyo, Japan, 1980, p. 39

3. Repeaters in the experiment were located in Palm Desert and Nice, California; Boise, Idaho; Godfrey, Illinois; Evansville, Indiana; New Orleans, Louisiana; and Duluth, Minnesota. "Control" cities were Birmingham, Alabama; San Francisco, California; and Minneapolis, Minnesota.

*Editor's note: This article and its predecessor last month show that you don't have to be a professional scientist to conduct meaningful research. If you've made documented observations of sporadic-*E *or any other poorly understood phenomenon that affects VHF/UHF communication, we'd like to hear about it and to share it with our readers. Propagational research is one area in which hams may make significant contributions just by getting on the air!* ■

Two ADI 2-Meter Rigs—The AT-201 Handheld and AR-146 Mobile

How do these made-in-Taiwan radios stack up against the "big boys" from Japan? WB6NOA puts them through their paces.

By Gordon West, WB6NOA*

ADI equipment is showing up in more and more ham catalogs as well as at ham radio dealerships. Its growing popularity can be traced to relatively low prices compared to the competition and a relatively good reputation for staying on the air without catastrophic failures.

Since I had never operated any ADI equipment, I wanted to see how the company's AT-201 2-meter handheld and AR-146 2-meter mobile rig compared to such better-known names as Kenwood, ICOM, Yaesu, Alinco, Standard, and Azden. What could the ADI equipment do that the others couldn't? So the folks at Premier Communications, which imports ADI gear from Taiwan, arranged for me to test a couple of their units.

The AT-201 Handheld

The AT-201 is an improved version of ADI's first handheld entry, the AT-200, in that the 201 offers 40 memories which can store any offset or tone, as opposed to just 20 memories on their earlier unit. The 201 can also change the display from frequency to 1-40 channel readout, and the repeater TX offset can be automatic or manual. Plus the 201 clones while the older AT-200 does not. There's no way to upgrade the older ADI to the newer units with greater memory capacity and more flexibility with repeater pairs.

The AT-201 also offers out-of-band receive, but doesn't include AM reception on the aircraft band. I got it to easily receive from 130 MHz to 178 MHz. Receive sensitivity on the 2-meter band was excellent, better than .1 microvolts. But sensitivity is relatively easy to obtain, so we next hooked the AT-201 to an outside antenna to check for selectivity. There wasn't any appreciable intermod, squawks, or squeaks from the local paging transmitters. It was certainly no worse than other handhelds on an outside antenna, so I'd rate the receiver as comparable to other handhelds in this price category.

HT Controls

The AT-201 has two big knobs on the top: the left one for turning on the equipment and adjusting the volume and the right knob for changing the memory channel or the VFO frequency. Unlike some other new radios, this one didn't do away with the squelch function, which a

← *The ADI AT-201 2-meter handheld has a solid "feel" and is easy to adjust with one hand.*

The AR-146 gives you 50 watts out on 2 meters and includes most of the features most hams want, including standard CTCSS decode. ↓

Gordon West, WB6NOA, is Senior Contributing Editor of CQ VHF.

"Unless you have terrific vision, it may take you some time to figure out that the plus shift up is to the left of the minus shift down (I'd expect that plus shift up would be to the right)."

lot of hams like to continuously adjust for threshold. But it did "sink" the knob. The squelch control on the AT-201 is a flush ribbed adjustment located to the left side of the volume knob (see photo). It's easy to turn, simply by putting your finger on it and rotating. This is a handy way to keep from accidentally bumping the squelch to open or closed.

Behind the big knobs are the customary jacks for microphone and speaker, which are sized to accept the common speaker/microphone all-in-one plug.

On the left-front of the unit is a lamp button which beeps when you turn it on, with provisions for continuously lighting the back-lit display for nighttime operation. This is handy, but keep in mind that backlighting does suck up a little more juice. There's also a call button to get you back to a specific call frequency, and another button marked "SQL" which operates like a monitor button. Pushing it in overrides the squelch, letting you listen to activity on the channel that might be below the normal squelch setting. In my opinion, it would be more useful if, in the repeater mode, pushing this button would let you quickly switch to the input frequency and hear it unsquelched.

Frequency Selection

Setting a frequency is straight-forward. You can twist the top knob or punch it in on the keypad. You do not use the first "1" as it's "understood" already by the radio. Entering the duplex shift (repeater "split") and CTCSS tone is also straight-forward. Depending on how you have your split-function set, you can either put in the split manually, or let the radio figure out on its own whether it's a positive or negative split. You can manually enter odd splits into memory.

When you have properly executed many of these commands, the final keystroke will always give you a slightly longer beep to let you know that you executed the button-pushing correctly. That is, as long as you don't accidentally turn off the beep.

If you've used other handheld radios, you probably know that getting into some of the sub-functions requires pressing the "set" button. But if you strike the 201's set button too many times to look for specific functions, you'll accidentally turn off the beep. It took me a few minutes of fiddling to see how this radio operates in the set mode. It was clearly described in the instruction manual, but, like any good ham, I tried to program it without reading the manual first! Premier also includes a quick reference pocket guide that's useful for either the AT-201 or the older AT-200 model.

Additional Features

This unit scans, skips, dual watches, and pages just like more expensive handhelds. You may choose power settings of low (about 1/4 watt), medium (about 2 watts), or high (5 watts). I suggest using the 2-watt setting in most cases in order to conserve battery power.

And to keep that charge when you're receiving, there's a battery-save function that lets you monitor a quiet channel for several days without draining your battery pack. There's even an "automatic power-off" function, in which the unit beeps a couple of times after about 30 minutes of inactivity; if you don't adjust any of the buttons, the unit goes into a "sleep" mode, drawing a mere 5 milliamps. But keep in mind that this deep sleep mode doesn't actually shut the equipment all the way down, and you could still end up with a dead battery if you don't actually turn it off.

Operating the AT-201

The actual operation of the handheld is, again, relatively straight-forward. But there's an interesting quirk about checking the input of a repeater. If you're running the handheld in the automatic repeater shift mode, pushing the "reverse" button won't swing the unit over to the TX offset for receive. But, if you memorized the repeater with the specific plus or minus offset key, the reverse function works as it should. You'll need to play around with the plus and minus key to see which little black icon is which. Unless you have terrific vision, it may take you some time to figure out that the plus shift up is to the left of the minus shift down (I'd expect that plus shift up would be to the right).

"Overall, the ADI AT-201 is a nice little handheld with adequate features, and plenty of support from the factory personnel at Premier."

Members of the Military Affiliate Radio Service (MARS) and Civil Air Patrol (CAP) will appreciate the fact that the AT-201 doesn't require internal surgery to enable authorized out-of-band transmission. There's some serious button-pushing involved, and you'll want to get together with your dealer and show them your authorization to transmit on these frequencies to score the precise process.

A Nice Little Handheld

Overall, the ADI AT-201 is a nice little handheld with adequate features and plenty of support from the factory personnel at Premier.

The AT-201 lists for $214.95 and a high power version, the AT-201HP, lists for $234.95. Why not try one out and decide for yourself if it has the feel and sound quality to give it an edge over the other six brands of handhelds? Here in southern California, there are a lot of happy users of both the AT-200 and AT-201 handhelds, and this tells me it is a good solid product if you like the feel and features that it offers.

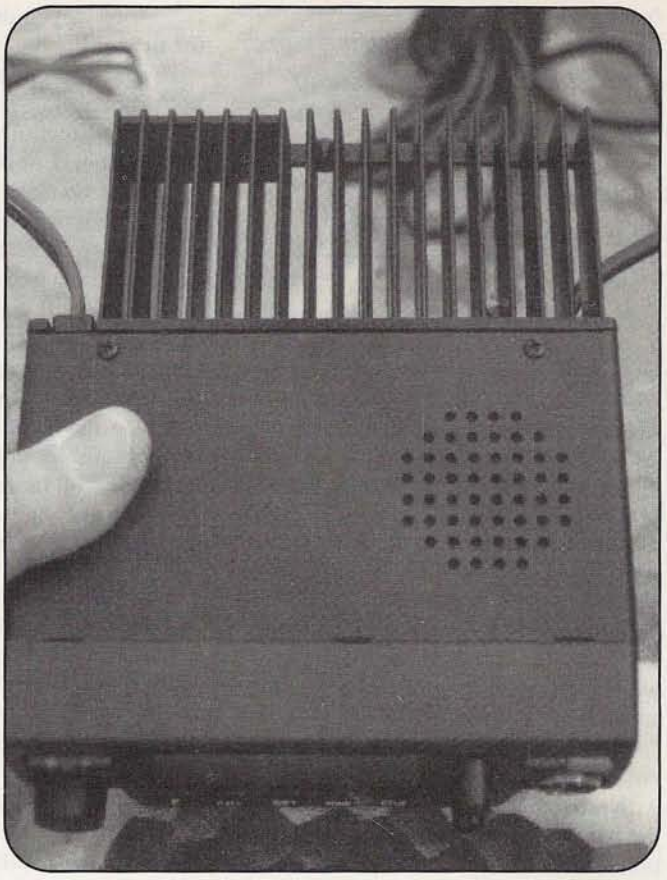
The AR-146 Mobile Transceiver

Premier Communications also imports the ADI AR-146, a 50-watt 2-meter mobile. It looks similar to another popular brand, but these days, it's not uncommon to find all amateur radio manufacturers closely paralleling the structure and layout of a popular competing radio.

The AR-146 includes *both* CTCSS encode and decode as standard features. Every manufacturer should copy this! These days, with band conditions getting very crowded, CTCSS decode is a must.

I liked the bold frequency display and the "feel" of the tuning knob: smooth and firm with the synthesizer tracking as fast as spinning the knob. I think this is an important feature to check out in a radio—if you're like me and many other hams who enjoy spinning the tuning knob

The squelch control on the AT-201 is recessed but accessible, unlike some HTs today that make squelch a menu function.



A hefty heat-sink helps keep the AR-146 cool at 50 watts output. Be sure to allow plenty of free air flow around the heat sink. →

"The AR-146 includes both CTCSS encode and decode as standard features. Every manufacturer should copy this!"

through the 2-meter band, seeing which repeaters are on the air, you can appreciate the fast phased-lock loop (PLL) pick-up on this transceiver. It doesn't miss a signal, no matter how fast you spin the knob. You can't necessarily say this about all VHF radios; some sets lose lock when the knob is rotated rapidly, so you could actually spin by a signal and not even know it's there. This isn't a problem on the ADI equipment.

Lots of Audio

Receiver sensitivity and selectivity appeared identical to other brands of equipment during side-by-side comparisons in a rather nasty RF environment, and the audio output seemed a little louder than others. This is good if you operate in a noisy vehicle.

"If you're looking for a good, powerful, 50-watt output transceiver, and a nice sensitive and selective receiver, the AR-146 works well."

The ADI mobile microphone is similar in look and feel to the new lightweight "Cobra head" style mics found on other brands. On the tip-top of the mic are up and down buttons, with the push-to-talk button on the side. By pushing one of four buttons on the front of the mic, you can select VFO or memory, call channel, or VFO MHz quick-tune. Since this transceiver receives out-of-band signals straight out of the box, the MHz button is a great way to quickly tune to, let's say, the 162 MHz weather band.

The mic also includes a DTMF keypad, so making an autopatch call is relatively easy. I looked at all levels of tones and voice on a service monitor, and they were all around 4 kHz deviation, which is just fine for the 2-meter band.

On the back of the mic is a key-lock slide switch, handy to prevent accidentally pushing a DTMF tone when in the middle of a conversation.

Value for Your Dollars

With a list price of only $279.95, the ADI AR-146 2-meter, 50-watt mobile works well and offers most of the features most hams like built in. While there are no alphanumerics or aeronautical reception, these features are usually not found in the "economy" 50-watt mobiles. And this unit is by no means stripped down—it's got plenty of features, including all of those paging and calling features that most hams never use.

If you're looking for a good, powerful, 50-watt output transceiver plus and a nice sensitive and selective receiver, the AR-146 works well. Check out this equipment at your local ham radio store, and see how nice all of the push buttons and spinning knobs feel in action. ■

Contact Info

For more information about ADI radios, see your dealer or contact Premier Communications, 20277 Valley Boulevard, Suite J, Walnut, California 91789; Phone: (909) 869-5711.

CQ VHF Ham Radio Above 50 MHz

Reader Survey—May, 1997

We'd like to know more about you...about who you are and where you live, about the kind(s) of work you do, and about your ham radio interests and activities. Why? To help us serve you better.

Each month, we'll ask a few different questions, and ask you to indicate your answers by circling certain numbers on the Reader Service Card and returning it to us (we've already paid the postage).

And, as a bit of an incentive, we'll pick one respondent every month and give that person a complimentary one-year subscription (or subscription extension) to CQ VHF. This month, we'd like to ask about your education, your job, and your basic VHF interests:

A. Tell us about yourself:	**Circle Reader Service #**
1. Please indicate the nature of your employment:	
If you have or are a...	
Full-time job	1
Part-time job	2
Temporary/Occasional work	3
Full-time parent/homemaker	4
Full-time student	5
Part-time student	6
Unemployed	7
Retired	8
B. Tell us about your ham radio interests/activities:	
1. Have you upgraded your ham license in the past two years?	
If your answer is...	
Yes	9
No	10
Licensed less than 2 years	11
Extra class more than 2 years	12
Not currently licensed	
2. Please indicate VHF modes you operate:	
If you have ever operated...	
Amateur TV (ATV)	13
Contests (VHF)	14
FM simplex	15
Fox-hunting	16
Packet	17
Repeaters	18
Satellites	19
SSB/CW (weak-signal)	20
Other	21
None of the above	22
3. Please indicate what groups you belong to:	
Circle all that apply to you...	
ARES	23
ARRL	24
CAP	25
Local	26
MARS	27
NTS	28
Packet club	29
RACES	30
Skywarn	31
Weak-Signal Club	32

Thank you for your responses. We'll have more questions for you next month.

What You've Told Us

Our February survey was the second part of a two-part poll on your attitudes toward the ARRL (American Radio Relay League). In January, we asked members why they *do* belong (see last month's "What You've Told Us"), and in February, we asked non-members why they *don't.*

Thirty-six percent of our readers who replied to the February survey are not League members. Reasons for not joining were mixed. The largest group of respondents (20%) said they can't afford the dues; followed by two groups at 19% each who a) opposed the League's continued support of a code requirement and b) said "no particular reason; I just haven't gotten around to joining." The next largest group (16%) disagreed with League positions on too many issues; followed by 15% who felt "the ARRL has nothing to offer me personally" and the 13% who believe "the ARRL is an HF-only organization."

Next, we asked non-members how much they felt the ARRL has to offer VHF-only operators. The majority feel it's not enough (28% "not very much," 19% "very little" and 8% "nothing"), while 20% don't know. On the other hand, a hefty 26% said "quite a bit."

Finally, we asked how likely these non-members were to join the ARRL in the future. And while nearly two in five said not likely (22% "probably won't" and 17% "definitely won't"), there was another 28% undecided, 16% who "probably will" join in the future, and 17% who "definitely will." There's an opportunity here, and we hope the League will grasp it.

Next month, we'll start reviewing our repeat questions, to see how our readership has changed over the past year. This month's winner of a free one-year *CQ VHF* subscription is James Murphy of Corbin, Kentucky. As always, thank you for sharing your views with us.

Switchbox on a Plate— A Modular Mic/TNC Switch

If your rig has a modular mic connector, AD5X has an easy-to-build switchbox to let you operate both voice and packet without constantly swapping cables.

By Phil Salas, AD5X*

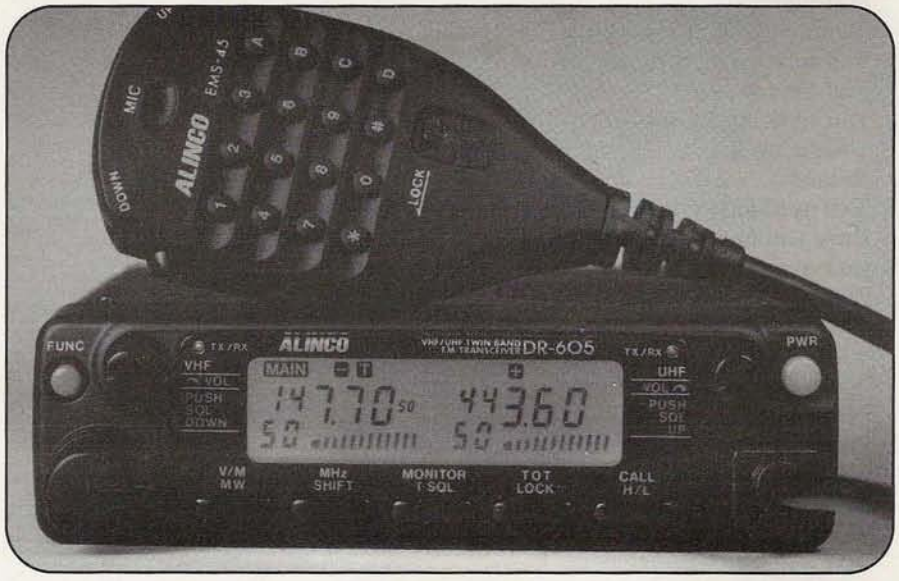
Here's a way to make your FM rig even easier and more convenient to use on both packet and voice.

I read with interest the product review of the Alinco DR-605T dualband (VHF/UHF) radio by Gordon West in the December 1996 issue of *CQ VHF*. I'd recently purchased one of these fine rigs as a base station for our all-ham family—KC5VGQ, N5UPT, and AD5X. Besides being able to use the DR-605T for normal voice operation, it was also important for us that it operate on packet.

As discussed in Gordon's product review, the DR-605T has a 9600-baud packet-ready connector on the back. Unfortunately, this input requires a high-level signal of 1 to 2 volts peak-to-peak (P-P). Most 1200-baud packet controllers, on the other hand, are designed for driving low-level microphone inputs. Therefore, I decided to hook up my 1200-baud controller using the standard "connect it to the microphone jack" method. (*As noted in Gordon's review, this is the* only *way to connect a 1200-baud TNC to the DR-605T.—ed.*)

The Modular Mic Jack

Like many of the new rigs on the market today, the microphone connector on the DR-605T is an 8-conductor telephone-type RJ-45 modular plug. So, besides the hassle of having to unplug and plug in different cables whenever I went from voice to packet, I also had to come up with an unusual mic plug. This turned out to be easier, and much less expensive, than I originally imagined. I also learned that there are several options.



The Alinco DR-605T is one of many radios that uses a modular mic connector. If you operate both voice and 1200-baud packet, AD5X's switchbox on a plate can make your life easier.

First of all, I needed an RJ-45 connector and cable. The first option was to purchase an eight-pin standard microphone connector-to-RJ45 adapter cable. ICOM sells these for its IC-706 for around $25. Another choice was to purchase a preassembled RJ-45 cable from various sources, cut off one connector, and use the remainder for the packet cable. Or, I could have bought an RJ-45 crimping tool, connectors, and 8-conductor wire to "roll my own."

"I built my switch box into an RJ-45 modular jack plate."

I went the more expensive route of purchasing the crimping tool, connectors and wire, since I could buy everything I'd need for a lifetime for less than the commercial $25 adapter. (For those of you interested in purchasing a ready-made cable, Mouser sells one very inexpensively. It's their part number 154-3005.)

OK, so this solved the cable problem, but how about all that plugging and unplugging when I needed to go from

**Phil Salas, AD5X, is a frequent contributor to* CQ *magazine. This is his first article for* CQ VHF.

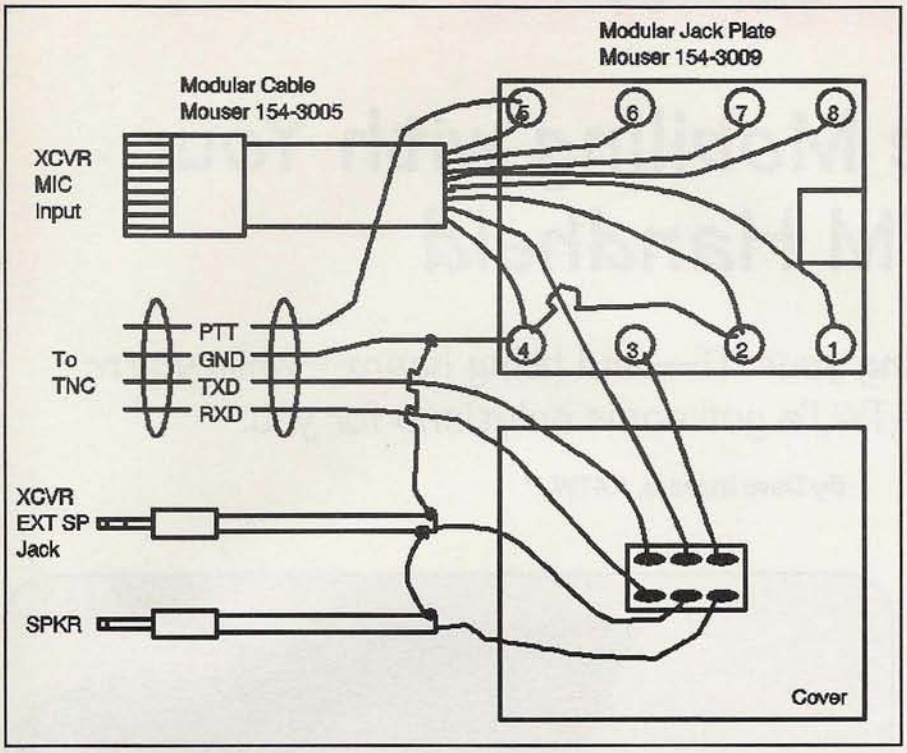


Figure 1. Wiring diagram for the switchbox-on-a-plate. The microphone plugs into the RJ-45 jack on the plate. The DPDT switch is wired to the terminals on the switchplate and to cables that go out to the radio mic jack, the TNC input and output, the radio's external speaker jack, and an external speaker.

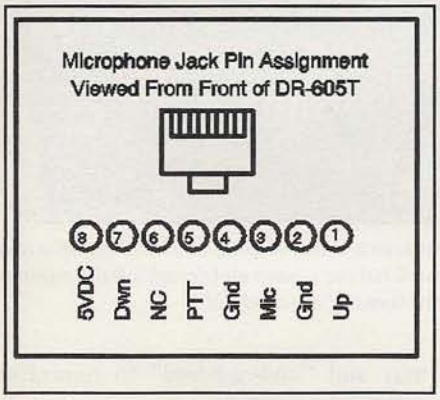


Figure 2. Mic jack wiring for the Alinco DJ-605T. If you're using a different radio/microphone, you'll have to adjust the connections to match. See your radio's instruction manual for details.

voice to packet? An inexpensive microphone switch box was the answer.

A Switchbox on a Plate

I built my switch box into an RJ-45 modular jack plate. These are available through many of the mail order catalogs (if ordering from Mouser, the part number is 154-3009). Figure 1 shows the wiring of the microphone switch box. The numbers shown on the RJ-45 modular jack plate correspond to the RJ-45 connector pin-outs. For reference, Figure 2 gives the pin functions of the DR-605T microphone jack. If you decide to try this project and are using a different rig, you'll need to match your wiring to your specific radio (see your rig's instruction manual for a wiring diagram).

I mounted a DPDT switch in the center of the cover as shown in Figure 1 and could then select either the microphone or the packet controller input, and either an external speaker (for voice) or the packet controller for the radio audio output. I soldered everything in place and checked each connection carefully with an ohmmeter and was done.

No Hassle!

That's all there was to it. I mounted the microphone switchbox alongside my DR-605T, plugged the RJ-45 pendant cable into the microphone jack on the radio, and plugged the microphone into jack on the switch box. Then, I hooked up the other cables to the TNC, the external speaker jack on the radio, and an external speaker. Now, when I want to switch between packet and voice, I just flip the switch. No hassle!

Now it's your turn. ■

Resources

The parts for this project are available from a variety of sources, including:

Mouser Electronics, 2401 Hwy. 287 North, Mansfield, TX 76063; Phone: (800) 346-6873 or (817) 483-4422; Fax: (817) 483-0931.

For more information on the Alinco DR-605T, contact your favorite ham dealer or the manufacturer directly at:

Alinco Electronics, 438 Amapola Ave., Torrance, CA 90501; Phone: (310) 618-8616; Fax: (310) 618-8758; Internet: <http://www.alinco.com>.

Big-Time Mobiling with Your FM Handheld

If you have trouble hearing your HT—and being heard—while you're operating in your car, K4TWJ's got some solutions for you.

By Dave Ingram, K4TWJ*

It doesn't take long to learn two things about operating with a handheld from inside a vehicle (especially a metal vehicle): 1) if you hold the HT anywhere except next to your ear, it may be hard to hear; and 2) if you're using a "rubber duck" antenna, people will probably have trouble hearing you. In this article, we'll look at connecting your HT to a trunk-mounted antenna and external speaker.

Why a Trunk Mount?

Let's look at the antenna first. Using your handheld with an external antenna always works out better than using a stubby "duck" in a metal enclosed vehicle.

The duck is a compromise antenna to begin with, designed for convenience rather than efficiency. And the metal body of the car acts as shielding, further reducing the amount of signal that a repeater or other operator can hear. But the same metal that blocks your signal from the inside can improve a signal that originates in an *outside* antenna by acting as a ground plane.

While a quarter-wave magnet mount antenna on the roof is certainly better than your rubber duck, I think you'll find that a trunk lid-mounted, gain-type antenna that electrically connects/grounds to the auto's metal body is even more effective. Plus it makes expanding to "big rig mobile" easier later. I say that because the main installation work will already be done. Furthermore, you'll have smooth antenna operation. Ready to take the plunge? Great! Let's get started!

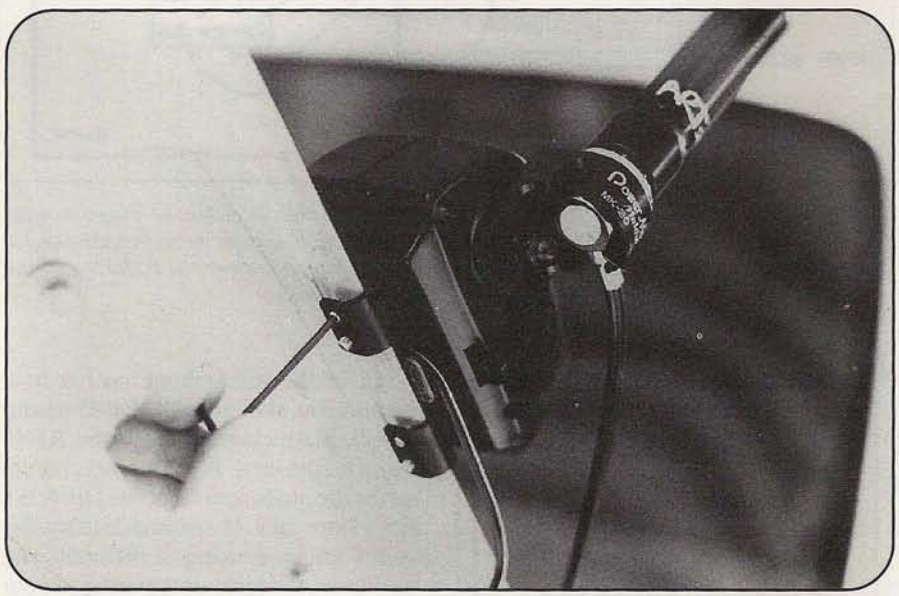


Photo A. The first step in antenna installation is selecting the desired trunk lid location and tightening mount's set screws as shown. Next, back out the screws and scrape off the paint so the set screw ends contact the metal of the trunk lid.

Things You'll Need

The main items you'll need are a good 2-meter or dualband (2 meter/70centimeter) antenna, a cable set, a trunk lid mount, and a mobile speaker in a trim enclosure. All of the above-mentioned items are readily available from amateur radio dealers nationwide. You can purchase them in person or over the phone and have everything delivered right to your door by UPS. The speaker can be new or a used hamfest special (since you can plug it into your FM handheld and check it on the spot you're safe buying used), but the antenna really should be new and "unweathered" to minimize unpleasant surprises.

Although your present interest may be only 2 meters, and this is the main band of FM activity across the country, planning ahead and starting out with a dual-

"The speaker can be new or a used hamfest special (since you can plug it into your FM handheld and check it on the spot you're safe buying used), but the antenna really should be new and 'unweathered' to minimize unpleasant surprises."

**Dave Ingram, K4TWJ, is a regular contributor to* CQ VHF. *Starting with this July's issue, he'll be writing a bimonthly homebrewing column.*

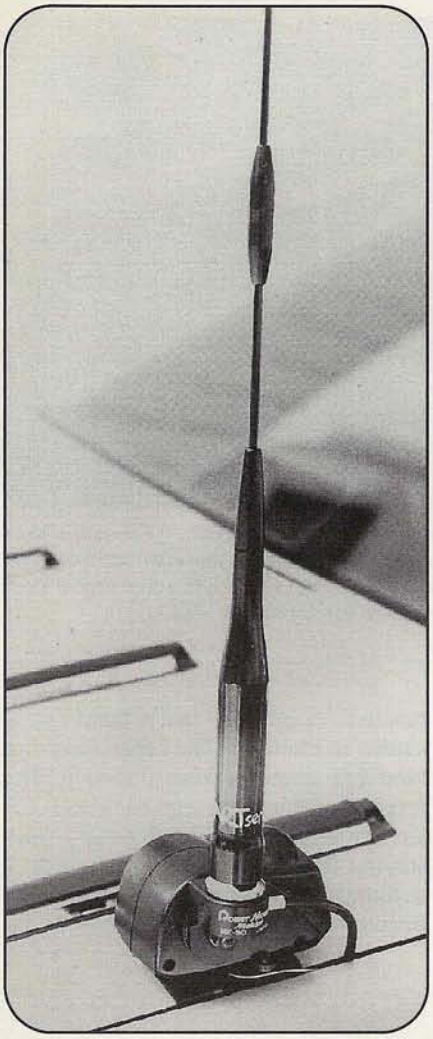


Photo B. After installing the trunk lid mount and connector, screw the antenna into its socket and check for proper upright positioning.

band antenna is clever thinking. If cost is a prime factor, however, rest assured that a 2-meter-only antenna is just as effective for monoband operation. A preassembled cable set that plugs right into your antenna is great here because it streamlines installation and eliminates tedious trimming and soldering. If you elect to "roll your own," however, be sure to use only new low-loss 52-ohm coax with a strong inner dielectric (such as marine grade RG-8X). Remember, this is your radio's lifeline to the world. No short cuts allowed!

Selecting an Antenna and Mount

What type of antenna best fits your needs and activities? Generally speaking, those in the three- to four-foot-tall category are ideal. Shorter antennas are good for slipping under low overhangs but seldom produce big signal results; and taller antennas, which are dandy for long range-communications on freeways, radiate a low-angled signal that's blocked by tall buildings in cities. Personally, I've found Maldol's 34.5-inch-tall ARD-10B (3 db gain on 2 meters and 5.5 db gain on 70 centimeters) and 48-inch-tall ARD-12B (4.3 db gain on 2 meters and 6.8 db gain on 70 centimeters) tops. They're pretuned, have a black satin finish, look terrific, and work great. Two mating trunk lid mounts are Maldol's AM-01B and MK-30T. The AM-01B has a tilt-over feature for garaging and a one-push lock to hold it vertical or tilted. The MK-30T has a built-in 13-volt motor for tilting the antenna and is even remote controlled by an (included) up/down switch you mount under the auto's dash. Just watching this mount and its attached antenna in action is a blast! Of course, there are also excellent antennas from other manufacturers.

Quick and Easy Antenna Installation

Now the fun begins. Start your installation by selecting a side- or trunk-lid mounting area approximately midway between the rear window and the trunk's rear edge. Next, raise the trunk lid and temporarily fit the mount in its selected position (see Photo A). Tighten the mount's set screws securely, install the coax cable's end fitting in the mount, screw on the antenna, then close the trunk lid to check clearances. You don't want the mount scraping against the body of the car. You may also need to slightly reset the trunk mount's adjustments at this point so the antenna will stand perfectly straight on a curved or angled/ leaning trunk lid (see Photo B).

Next, back out the trunk mount's set screws and set the assembly aside for a minute. Look closely under the trunk lid edge and find the indentations made in the paint by the set screws. Use a pocket knife to scrape off paint at two of those points, then reinstall the mount while making sure its set screws tighten onto the freshly-exposed metal. This special step ensures that the mount (and its attached coax shield) are solidly grounded at the antenna's base, and so pumps out the best signal possible. It also minimizes "floating RF energy" that can play havoc with modern computerized autos.

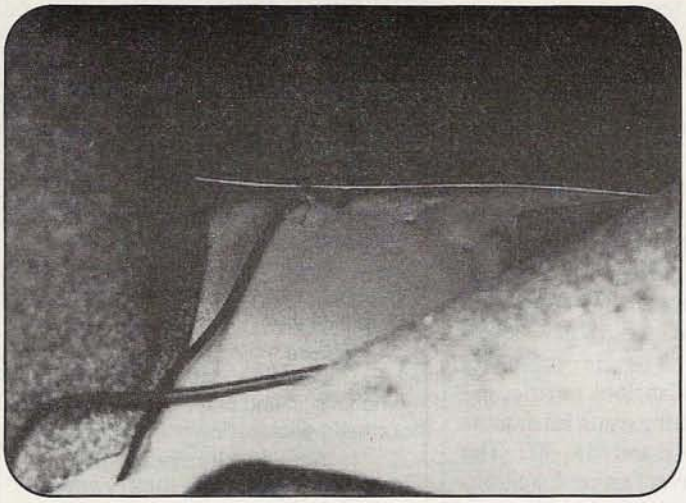


Photo C. Here the cable has been routed under trunk's carpet, through a crevice used to pass the seat belt, and into the auto's interior. After putting the carpet back in place, the installation really looks like it was done professionally.

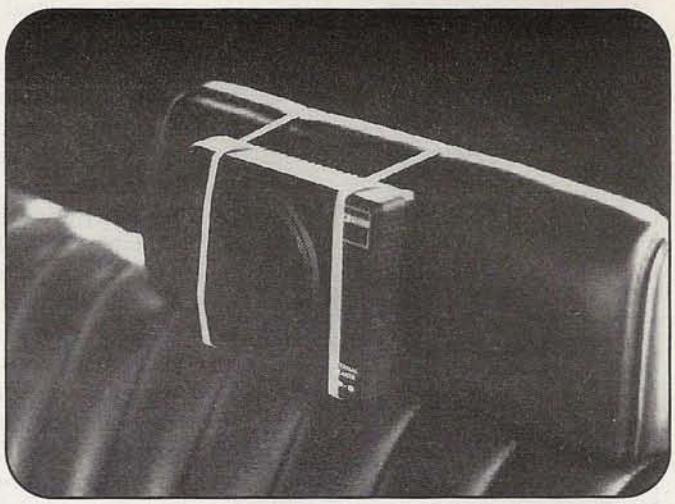


Photo D. An external speaker "rubber banded" to the auto's headrest really improves an FM handheld's audio, and eliminates the "lean forward to hear" syndrome. (Be careful, though, not to create a new safety hazard in the process.—ed.)

Routing the Cable

Your next step involves routing the coax cable from the trunk area to the auto's front seat area. Check the rear seat's mounting supports/installation from the trunk side first. You may spot a seat belt strap and its securing bolt or another small crevice through which you can slide the cable into the auto's interior. If necessary, move the trunk carpeting slightly for better viewing/access. No luck? Leave the trunk lid up so sunlight shines in, unbolt the rear seat's lower cushion, move it forward slightly, then look from the rear seat area toward the trunk for a guiding light.

Sometimes, poking at padding between the lower back of the seat and the trunk uncovers a good "cable sliding groove." Be careful when prodding with your bare fingers however: some autos have sharp burrs in these hidden areas. Another trick worth trying is pushing plenty of cable into a suspected-open crevice on the "trunk side," then pulling it into the "interior side" after excess builds up and reveals its presence. You can then route the cable to avoid sharp cutting edges, around the rear cushion, above or below auto carpeting as desired, and to the front seat. Hint: routing the cable on the auto's "driver's side" gives maximum separation from the on-board computer and minimizes interference. (see Photo C). If you have any excess cable, lay it out in a "lazy zig-zag" manner, rather than coiling it up. A tight coil may damage the cable.

A PL-259 connector is usually fitted on preassembled cables, but just add a PL-259-to-BNC adapter (available at RadioShack or amateur radio dealers nationwide) to fit your FM handheld. This way, you can simply remove the adapter and plug the cable directly into your high-power mobile FM transceiver when stepping up to a big rig later. Neat, eh?

The Better to Hear You with

Sounds from the small speaker in an FM handheld are easily drowned out by an auto's air conditioner or "window lowered" traffic noise, but hamming heaven is only one more plug-in step away. External speakers are made by Kenwood, Yaesu, ICOM, MFJ, etc., and they mount easily in areas that pump audio right to your ears. The 3.5-millimeter-diameter phone plug on these speakers' cable usually fits right into the HT's earphone jack. If, however, your rig uses a smaller diameter (2.5-millimeter) plug, you can get an adapter also from a local RadioShack.

My personal preference for speaker mounting, incidentally, is merely "rubber banded" to an auto seat's headrest, as shown in Photo D. The cable routes behind and under the seat to the rig. This arrangement lets me lean back and realize almost earphone-quality copy while staying fully aware of surroundings. It definitely beats leaning forward and reducing your field of view.

Final Notes

Check your setup before driving in traffic to ensure antenna and speaker cables are long enough to reach your face. Turn your head at a few angles, then recheck convenience and safety factors. If everything handles smoothly, you can pronounce the setup complete and enjoy mobiling in style!

Later on if you want, you can add an under-seat power amplifier for your FM handheld (a good theft-deterrent) or a fancy mobile FM transceiver. Cable lengths will fall right into place, leaving only one more step: connecting the new rig's power cable.

Building a mobile setup step-by-step has its advantages. Enjoy and good FM mobiling to you! ■

Resources

For more information about the antennas described in this article, contact your favorite ham radio equipment dealer or Maldol directly at 9655 46th Ave., SW, Seattle, WA 98136; Fax: (206) 938-3907; e-mail: <vjsh80a@prodigy.com>.

Just about every other major antenna manufacturer also makes mobile VHF antennas. Check out their ads in CQ VHF and other ham magazines.

RF Exposure Web Site

You can now perform "routine evaluations" of RF exposure levels at your station—right on the World Wide Web. This should be handy for people who don't have a lot of station setups to check on, and don't want to take up space on their hard drives with the "BASIC" program written by Wayne Overbeck, N6NB, and published in the January, 1997, issue of *CQ VHF*.

Using Wayne's program as a starting point, Ken Harker, KM5FA, created an "online RF safety calculator" on the University of Texas Amateur Radio Club's Web site. Users can log on, plug in the required information about power, antenna gain, frequency, etc., and Ken's program will calculate exposure levels and return the results to you.

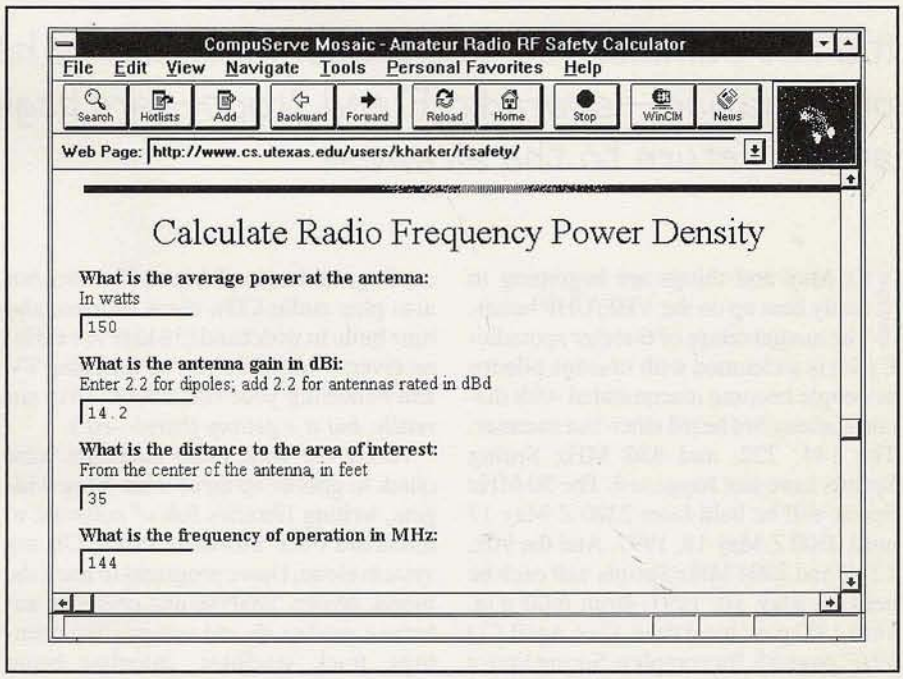
For those of you who understand such things, Ken says:

> This calculator is a World Wide Web front-end for a public domain "C" program written using the cgic library. This program has been derived directly from a public domain "BASIC" program written and published by Wayne Overbeck, N6NB, in the January, 1997 issue of *CQ VHF*. The source code for Wayne's original program and my adaptation are both available on-line for examination and further development.

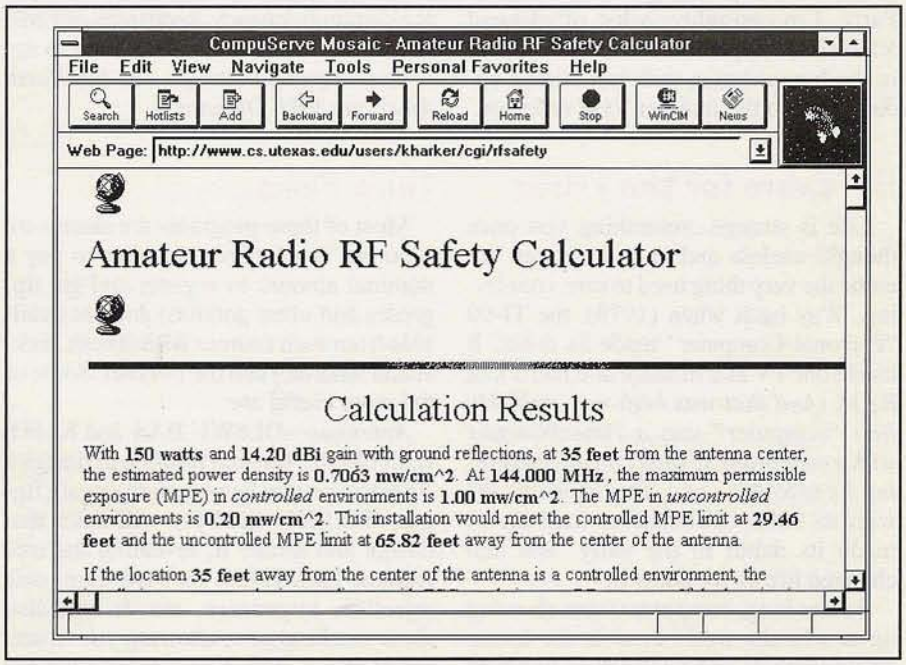
As of January 1, 1998, the FCC will require all amateurs to perform "routine evaluations" on their stations (excluding those stations operating with less than 50 watts output, and mobile stations using push-to-talk at any power level) to determine compliance with new RF exposure limits. For more information, see Wayne's above-referenced article.

The RF exposure calculator may be accessed via the UTARC Web page (which also includes a VHF sub-page) at <http://www.utexas.edu/students/utarc>. If you want your own copy of Wayne's original BASIC program, you can download it from the *CQ VHF* FTP site at <ftp://members.aol.com/cqvhf/97issues/rfsafety.bas>.

Thank you, Ken, for taking Wayne's very useful program and making it even more useful to an even greater number of people. This is another example of the spirit of ham radio in action. ■



When you access KM5FA's online RF exposure calculator via the University of Texas ARC's Web site at <http://www.utexas.edu/students/utarc/>, you'll be asked to enter various types of information about your station. The program will use this data to calculate your RF exposure levels.



After you've provided all the necessary data, the program will report the results back to you, telling you whether your station meets the standards for both "controlled" and "uncontrolled" environments, and the distances at which the standards will be exceeded.

Summertime Propagation Returns

It's not summer yet, but those summertime hallmarks of VHF propagation—sporadic-E and tropo—are beginning to make their annual return to the airwaves.

It's May and things are beginning to really heat up on the VHF/UHF bands. The annual return of 6-meter sporadic-*E* (*Es*) is welcomed with raucous pileups as people become reacquainted with distant stations not heard since last summer. The 144, 222, and 432 MHz Spring Sprints have just happened. The 50 MHz Sprint will be held from 2300 Z May 17 until 0300 Z May 18, 1997. And the 902, 1296, and 2304 MHz Sprints will each be held on May 10, 1997, from 6:00 a.m. until 1:00 p.m. local time. (See April *CQ VHF*, page 55, for complete Spring Sprint rules.) These events are wonderful for blowing out the cobwebs and getting things up and running for the summer.

Many of us are making last-minute plans for the upcoming June VHF QSO Party. I'm compiling a list of planned VHF Grid DXpeditions that will appear in the June column, with last minute updates posted the Internet VHF reflector.

Software for the VHFer

Life is strange...something you once thought useless and only a toy can become the very thing used to earn your living. Way back when (1979), the TI-99 "Personal Computer" made its debut. It used your TV as a monitor and had 5 k of RAM (*And that was high-end stuff. My first "computer" was a Timex/Sinclair with a membrane keypad and an astounding 1 k of RAM!—ed.*). The "modern" PC with its 8088 CPU (but no hard drive) made its debut in the early '80s and changed life as we know it.

Before long, computers were showing up at schools, work, even in the home. Their numbers and power grew to where now it's possible to own a machine that will not only run your database, word processing, and spreadsheet software, but also play audio CDs, show movies, and tune built-in wideband (30 kHz to 1 GHz) receivers—all while you're watching TV and balancing your checkbook. (*No, not really, but it's getting there!—ed.*)

Along the way, radio amateurs were quick to gobble up these whiz-bang widgets, writing libraries full of software to automate once mundane tasks. On my system alone, I have programs to track the moon, design, analyze and optimize antennas, predict *Es* and aurora (Au) openings, track satellites, calculate beam heading, distance and grid squares, predict the best path/time for various meteor showers, calculate the overall circuit loss of an Earth-Moon-Earth (EME) contact, calculate line loss for various cables at a certain frequency, keep track of EME skeds, etc....And that's in addition to my contest logging software and the *North American VHF Directory*.

Tim's Picks...

Most of these programs are shareware (you get 'em for free but have to pay a nominal amount to register and get upgrades and other goodies) and are available from such sources BBSs (both packet and landline) and the Internet. Some of the more useful are:

Antennas—DL6WU.BAS and K1FO.BAS (*ARRL Antenna Book*) will design a Yagi to a certain boom length or gain figure; YO.EXE (K6STI) will take that design and model it, revealing the true front-to-back (F/B), forward gain, side rejection, impedance, etc. It will also show stacking gain, allowing you to see, for example, how four similar antennas would work in a 2-high x 2-wide versus a 4-high configuration.

"The annual return of 6-meter sporadic-E (Es) is welcomed with raucous pileups as people become reacquainted with distant stations not heard since last summer."

EME—Several great packages exist to track the moon and provide data on the various factors influencing EME communications. SKYMOON.EXE (W5UN) gives a complete graphical display, making setting skeds much easier. EME.EXE (VK3UM) provides a text based tracking display that (with the appropriate hardware) can automatically steer your antenna array and leave you free to concentrate on operating. TRACKER.EXE (W7GJ) provides a simpler text-based EME tracking along with MOON.EXE (K7CA).

Meteor Scatter (MS)—Again there are several to chose from. VHFPACK.EXE (WA1OUB) is a group of text-based VHF utilities that do EME tracking, MS predicting, distance/heading, etc., and is well worth having. OH2IY has a wonderful package tailored to the more experienced "ping jockey," which provides more about MS than you ever need to know.

Propagation: ES.EXE and AU.EXE (KØBI) provide a line drawing map method of displaying existing *Es* (what you're hearing) and predicting what should be possible. It's wonderful during an opening or to analyze one afterwards from log entries. AN.EXE (N1BUG) is the best way I have ever seen to display Faraday Rotation (EME) and understand how it works.

Logging—CT.EXE (K1EA) Ken single-handedly changed forever how seri-

By Tim Marek, K7XC

"From here in EN92, had several good aurora contacts this evening into Wisconsin, Illinois, Minnesota, Iowa and Vermont."—WA3LTB

ous contesters operate. His idea to incorporate logging, DX packet spotting, multiplier hunting, duping, and report-generating into one easy-to-use package has earned him a place in the Contest Hall of Fame. Well worth the money! There are hundreds of smaller programs out there as well. My favorite is DUPER. EXE (K1CD). It's a very simple yet powerful program that I've been using for 10 years now and have over 100,000 contacts in the database.

Satellite—I've used many but I prefer IT.EXE (AMSAT) due to its ease of use and choice of text or graphic format. But more importantly, it drives the "Kansas City Tracker" hardware package and automates antenna pointing, which can be quite a chore on the low Earth orbit (LEO) birds.

Engineering—Literally thousands of DOS-based programs are out there to do all kinds of mundane things...from deriving the F/D (Focal point/Diameter) of a dish, designing power attenuators, calculating coax cable line loss, and building preamps, to figuring the total square yards of concrete needed for a new tower. Available from the Internet and hundreds of BBSs, they accumulate quickly on your hard drive.

Documentation—From various FTP (File Transfer Protocol) sites on the Internet are millions of documents pertaining to one part of VHF/UHF or another. These include things like power tube data sheets (Svetlana), plate transformer specs, contest rules/forms (ARRL, CQ, RSGB), and distance records.

Internet—With the dramatic growth the Internet has seen recently (e-mail, WWW, FTP, IRC, USENET, etc.), it's not an exaggeration to suggest "If you want info on anything, it's on the Net." Suffice it to say, there are way too many places available to list here but a few of the best to get started with are the ARRL Web site at <http://www.arrl.org>; GJ4ICD's ham radio page at <http://user.itl.net/~equinox>; and OH2BUA's Web DX spotting page at <http://www/clinet.fi/~jukka/webcluster.html>. These have plenty of links to other VHF/UHF/Microwave sources on the Net. (*And don't forget* CQ VHF*'s Web page, <http://members.aol.com/cqvhf/>, which also has a growing variety of VHF-UHF links.—ed.*)

Activity Reports

Except for EME activity, February and March are generally the slowest months of the year on VHF. However, several folks reported good success via Au. Ron Dunbar, K3PN (ex-WØPN) collected several comments posted to the Internet VHF reflector during a particularly good Au opening on February 27. We'll start with that:

From Ron, WZ1V, FN31mp:

Open over an hour since 2300 Z with Au, best 2-meter DX so far was KDØPY EN41 at 940 miles. Lots of 8s and 9s coming in, even one 4.

From Mark KB7UWC:

Hearing W7HAH beacon (DN26) on Au at 0230 from CN96!

From Mike VE7SKA:

VE6EMU/b on 6 meters into CN88. Point

your antennas north, people. Calling CQ on 144.125 CW.

From Earle VE6NM:

At 20:00 MDST (0300 UTC February 28) VE7SKA and VE6NA putting good CW sigs into DO05od with my Yagi pointing 350° true. Au buzz strong.

From Terry WA3LTB EN92:

From here in EN92, had several good aurora contacts this evening into Wisconsin, Illinois, Minnesota, Iowa and Vermont.

From John WØLER EN35ie:

Good Aurora on 144 MHz in Minnesota EN35ie. Hearing as far to the east as the VE3's in FN04.

From Barry VE6MK (ex-VE6BMR) DO33im:

Worked VE6XT on 144 MHz. Now hearing VE3s via Auroral-E (50 MHz). No full calls yet. Signals appear to be building.

From Ken N4UK (ex-KP4XS) South Carolina:

Thanks to W2DRZ for his Au alert! I got there a little too late. Listened on 6 meters and heard someone on SSB on 50.134 who was totally unintelligible due to the Au. On 2 meters I heard a W9A? and someone who gave a grid of either EM18 or EM19. Signals were quite weak here in EM84 at about 0030 Z. Five minutes after turning on the rig, all signals disappeared. Oh well...maybe next time! (K4QI in FM06 told me he worked about eight stations in W8/W9. Anyone know what the K index was?)

From Earle VE6NM DO05 (a bit later):

Have worked VE6NA and VE6MK, both 5/9. KL7NO boomed in a few times 5/9+20. Could hear him working stateside. My Yagi pointing NNW. VE6AMB, also DO 05, was hearing a VE4 beacon and VE3 CW stations on his vertical. I'm only a few blocks away from VE6AMB and couldn't hear them. He could hear VE6NA and VE6MK, but only very weakly.

From Ron K3PN:

...and here's poor me at work!

(Thanks, Ron, for collecting these reports and sharing them with the reflector...even though you had to be at work. Now lets' continue with some other reports—ed.)

From Carl, KM1H:

Thank you, Zaba, Russ, Jon, Martin, and others for contributing to all of our understanding of the auroral propagation mode. The suggestion to point an antenna due *south* during a major event was particularly intriguing...I had never considered that option. One of Zaba's comments reminded me of something I forgot to mention earlier and that is the Doppler shift...even on 2 meters. Now, I can't be certain if it was all Doppler or just the other stations' ability, but I have worked stations as far as 3 kHz above my indicated TX frequency. Always above, not below, my frequency, so I am assuming that this was true Doppler shift. Frequency differences of 1.5 to 2.5 kHz

"The suggestion to point an antenna due south during a major [aurora] event was particularly intriguing...I had never considered that option."—KM1H

are very common. This brings us to another problem or maybe a "Catch 22." By the way, I'm relating to CW only here. So here we go: The Au certainly raises the band noise so that those .5-dB preamps are not much of a help. An old tube-type 417A converter hears no worse than my 1997 GaAsFET version. You then have to narrow the RX bandwidth to compensate for the band noise. The Doppler shift means you will not hear signals when your transceiver is set for a narrow passband You need a narrow beamwidth AND you need a wide beamwidth. You need at least four hands to be efficient. I don't know about multimodes since I don't use them, but with a TS-940 as the IF platform for transverters, I find that being really successful on Au requires total concentration and flexibility. An entry level station with 10 watts and a small antenna can be real fun, BUT then the urge hits! Most of us started at that level.

On to the More "Mundane" Reports...

From Bill Harris, W7KXB, Mesa, AZ:

Several years ago, I remember one big ducting event, was when I was approaching Cairo, Egypt, in a DC-7. We were at 18,000 feet and descending and just made a VHF frequency change (near 120 MHz) as directed by Cairo air traffic control. Upon the change, Cairo center was being QRMed by a TWA flight calling Cleveland center. Yeah, you're right, I called the TWA flight and we exchanged our locations. He didn't QSL.

From Ed, WP4O FK68:

March 12, 1997—At 2320 LU5EJU was coming in from Argentina on 50.110 (*via Transequatorial propagation, or TEP—ed.)* but not very strong; and at 2200 Z approx. heard LU9EHF beacon on 50.014 579, but then it disappeared after about five minutes, propagation was very marginal.

From Larry WB5OMF CM98:

A hearty thanks to all for keeping track of me....The trip was CM98 to DM12, with a side trip to DM22. The trip down I-5 with side trip to DM06 was great on 144 and 432. Most stations worked then needed a county or grid along the way...they were great company and made the trip a good one. DM22 was slow—it was Friday, only day I could go...but...did work CM98, KA6CHJ and DM06, KK6LR....Outstanding! Local DM12, DM25, DM13, DM14, and DM03 stations were all

checking on me...DM12 started out slow... first site was not good...moved up to the FAA site on Mt. Laguna and had a great view... could see all of Salton Sea to the east and the hills and smog to the northwest. I worked CM98, KA6CHJ, KC6ZWT, CM88 was N6YM, CM97 K6YK, KD6WW, DM07 N7STU, DM06 KK6LR, N6AJ, DM25 K1VOW, DM03 N8EWU, and on and on and on....Some great stations. Met some great people who helped with directions and coffee....What can I say? This is a great hobby!

Earth-Moon-Earth

From DF9QX:

Mathias is working on adding 13 centimeters. He has 60 watts from a YD 1304 and is finishing up an IMU horn. He is also interested in details on G17B PA for 23 centimeters, where he is presently QRV with a 5 meter dish. His latest QSOs on 1296 were with F6KSX and K4QI.

From Yoshiro JA4BLC:

On January 19, 1997, I worked on 1296, JA6CZD (449/559), OH2AXH (559/559), SM4IVE (559/549) for initial #62 and F2TU (559/549), and on 432, JA5OVU and JA2KRW, and on February 15, 1997, on 1296 S59DCD (O/O) for initial #63, G3LTF (559/559) #64, JA6CZD (549/559), GW3XYW (559/449) #65, and on 432 JJ1NNJ (M/O) #238, DF3RU and JS3SIM. My e-mail address has changed to <ja4blc@web-sanin.co.jp>.

From Bill, NL7F:

Only four 23 centimeter contacts in February—I QSOd on 16 February OK1KIR (M/O), WA8WZG (M/O), and ZS6AXT (M/M), and on 20 February OE9XXI (559/559). Peter had a (33) SSB signal here. The short-path distance to ZS6AXT is about 15,684 kilometers. I wonder how this compares with the current 23-cm DX record. Unless someone wants to operate portable from Antarctica, this is the longest DX possible for me. After three months of EME activity, I'm up to initial #16, eight DXCC countries, eight states, and ready for more skeds; e-mail: <wbeam@polarnet.com>.

From Doug, VK3UM:

I'm now the proud owner of a 30-foot Kennedy dish in mint condition. I have to pull it down and transport it home! Its fixed on two frames on the horizon. I am after ideas for mounting/tower system you and others have employed. I don't have the specs either... weight, wind-loading, f/d, gain, upper freq limits, etc.? I have nothing! It's supposed to be good to about 6 GHz. It weighs about 1,800 pounds and has an f/d of about .445. Details of my mount are in PA3CSG's anthology of past 432 EME NL technical reports. Building something to keep it on the hill will be a bit of a challenge. (I have winds regularly over 125 kph!).

HF Net

From Bob Earl, KD6UIH:

Norm, KB6KQ, is starting a new VHF/UHF weak-signal net on HF in order to expand information and coordination over a wider area. We have members in five states and want to be able to include everyone in on discussions and information. Please tune in and help make this new effort by Norm a success.

Net time is 6:30 p.m. Sunday on 3.940 MHz +/- QRM. Those who do not have General or above licenses, please listen in and you can participate with input via e-mail to Norm at <kb6kqnorm@aol.com>.

"Xtra Crazy"?

Between the flu, the office, and preparing for the June VHF Contest, I don't know which way is up! Life sure gets a lot busier as time goes by. I think that's why I enjoy VHF weak-signal so much... it *demands* patience, perseverance, creativity, ambition, etc. After a weekend atop the mountain, the rest of life's problems gain a new perspective.

Our June VHF QSO Party crew is shaping up. New gear (1.5 kW on 432!), new

Italy's Monte Capra VHF/UHF/SHF Gang

Editor's Note: Want to compare your contest setup with one in Europe? Our Italian correspondent, Alex Della Casa, I4YNO, sent us these photos of his group's contest QTH and this description of their station.

These pictures were taken at our contest QTH on top of Monte Capra, a hill 444 meters (approximately 1,450 feet) above sea level just south of Bologna in Northern Italy, grid locator JN54OK.

The antenna farm is as follows:

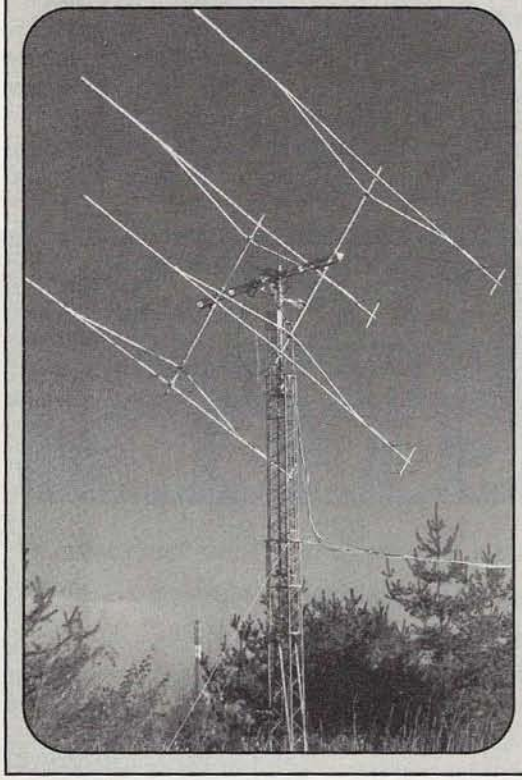
144 MHz	4 x 17 element F9FT (boom length about 6.5 meters each); single 20 element "Shark" (boom length 9.15 meters)
432 MHz	8 x 25 element "Shark"; 4 x 15 element DL6WU home made
1296 MHz	3-meter dish (not shown)
2.3/5.6/10 GHz	4-meter dish

The 4 x 17 array for 144 MHz is brand new. All the other antennas are about six or seven years old and are now undergoing some servicing, which should be finished late in Spring '97 (we hope). The 4-meter dish is normally used by I4CHY for 3-centimeter EME.

EME on 432 MHz should also be possible in 1997, as soon as the readout of the elevation rotor is replaced, as well as the old phasing lines and power splitter. Also planned for this year are a 6-meter array and a new 8877 power amplifier for working 144-MHz EME.

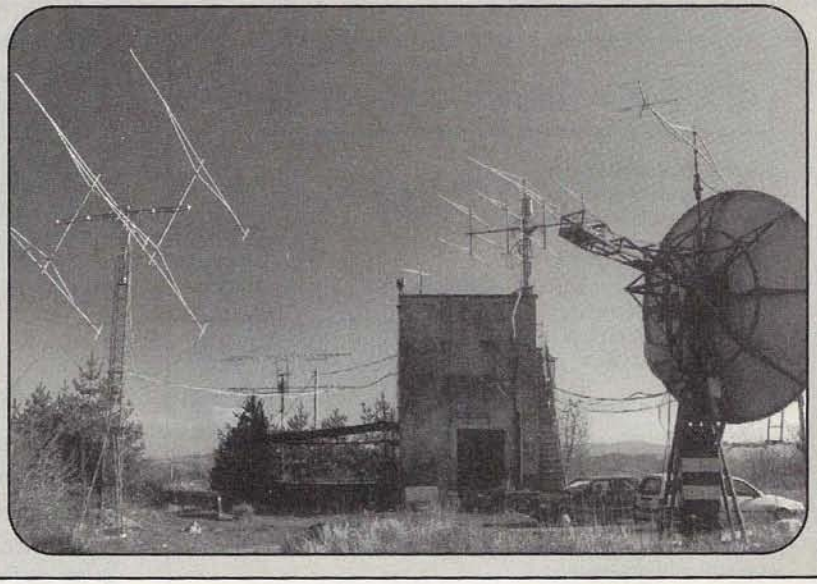
Members of this group are IW4ADT, I4JED, I4YNO, I4CHY and IW4BJT.

—I4YNO.



The 2-meter EME/tropo array at the Monte Capra VHF/UHF/SHF Gang's contest station north of Bologna, Italy. It's made up of four 17-element F9FT Yagis. (I4YNO photos)

A wide view of the Monte Capra Gang's contest station, showing all antennas except the 3-meter dish for 1296 MHz. See text for details.



ops (Russ, K6KLY, on 222/432), new antennas (4 x FO22's on 432 with full AZ/EL), and a brand new site, 8700-foot Mt. Moses in DN10 (about 50 miles south of Battle Mountain, Nevada). It's quite possibly the *best* radio site in the whole state. I just can't wait to find out! We will be QRV (on the air, that is) with Dave's new call, W7KK—I warned him about the many, many QSL requests he'll be getting (HI).

Speaking of new calls...in February, the FCC finally processed my vanity callsign application and issued me K7XC—"Kay Seven Xtra Crispy," "Kay Seven Xtra Crazy"...the possibilities are endless!

Thanks again for all the faxes, phone calls, and e-mail. Without your support this would not be possible. Also, I'd like to thank the *432 EME News*, *The West Coast VHFer*, and *The Upper Midwest VHF News* for their newsletters. Even in this day of the World Wide Web and instant globe-spanning communications, much information still is available only via the printed page. My e-mail address should have changed by now to K7XC@VHF.RENO.NV.US, while the rest remains the same—Fax: (702) 972-5011; Phone: (702) 972-4722; and Snail Mail Tim Marek, K7XC, 360 Prestige Ct Reno NV 89506. 73 and best of luck!

Tim, K7XC

When Seconds Count...Are You Ready—REALLY Ready?

Every Boy Scout learns to "Be Prepared." As ham radio public servants, our level of preparedness can sometimes be a matter of life and death. This month, guest columnist KE2HG asks a simple question of each one of us: "Are you ready?"

Editor's note: I'm pleased to announce that we've found a permanent columnist for "In the Public Interest." Starting next month, this column will be moderated by Bob Josuweit, WA3PZO, who's been active in public service and emergency communications for over two decades. We'll give him a more detailed introduction next month.

One of the most basic pretexts of the amateur radio service is that we should be ready and able to serve the community at a moment's notice. Our services may be called on with little or no warning and we may be the only communication link into or out of a disaster area. That communication can mean the difference between life and death.

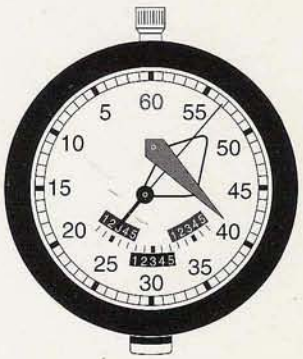
I know that sounds a bit melodramatic, but, in rare cases, it could be reality. Any one of us could be called on at any time to be the person that makes that difference. Are you prepared to meet that challenge? I mean, are you *really* prepared?

The December issue of *CQ VHF* magazine carried a profile article on Ed Kracum, WB2COP, a ham from Monmouth County, New Jersey. In case you missed it, Ed became involved with Civil Defense back in 1960 and became a ham in 1963. In more than 30 years of amateur radio, he's seen many changes in technology and has incorporated most of them into the ARES/RACES program in his county.

To say that Ed is prepared is, at best, an understatement. A quick scan of that article reveals that he has quite a large quantity of equipment dedicated to packet and emergency operations. What's a large quantity? How about this: 18 transceivers, 11 TNCs, six computers, 14 antennas, five amplifiers, plus a generator to keep them all running? How about a *spare* packet system including computer, TNC and radio, and two additional spare radios to replace anything that might just happen to go down when needed? That's what I call *prepared*!

"If the phone rang right now, would you be able to respond effectively?"

Do you need to make this kind of a commitment to emergency preparedness? Most likely not. But if the phone rang right now, would you be able to respond effectively? I've participated in many public service events over the years in which the amateur participants experienced all kinds of problems that made it impossible for them to communicate effectively. Keep in mind that these people had volunteered well in advance for a planned event. They knew exactly what would be required of them...and when. How would they have fared in an emergency? Probably not very well.



What can *you* do to be prepared? I have a few suggestions, but please don't treat this as a comprehensive list. These are just a few common-sense ideas that you may want to implement or to adapt to specific needs for your part of the country.

Personal Preparedness

1. Power, power, and more power. There's nothing more useless or frustrating than having the equipment and the skills needed for effective communication and a dead battery. How many times have you reached for your HT only to find that the battery is low on charge or worse?

If you're to be truly prepared for an emergency, you'll need to have all of your HT batteries fully charged and ready for action. Cycle your battery packs often and keep all of the spares at full charge. Remember that NiCds lose their charge rapidly in storage (2 to 3% per day!). You may want to consider purchasing a bat-

By Duncan MacRae, KE2HG*

**Duncan MacRae, KE2HG, is past president of the Cherryville Repeater Association in western New Jersey and is co-editor of the club newsletter,* Uplink, *in which this article first appeared.*

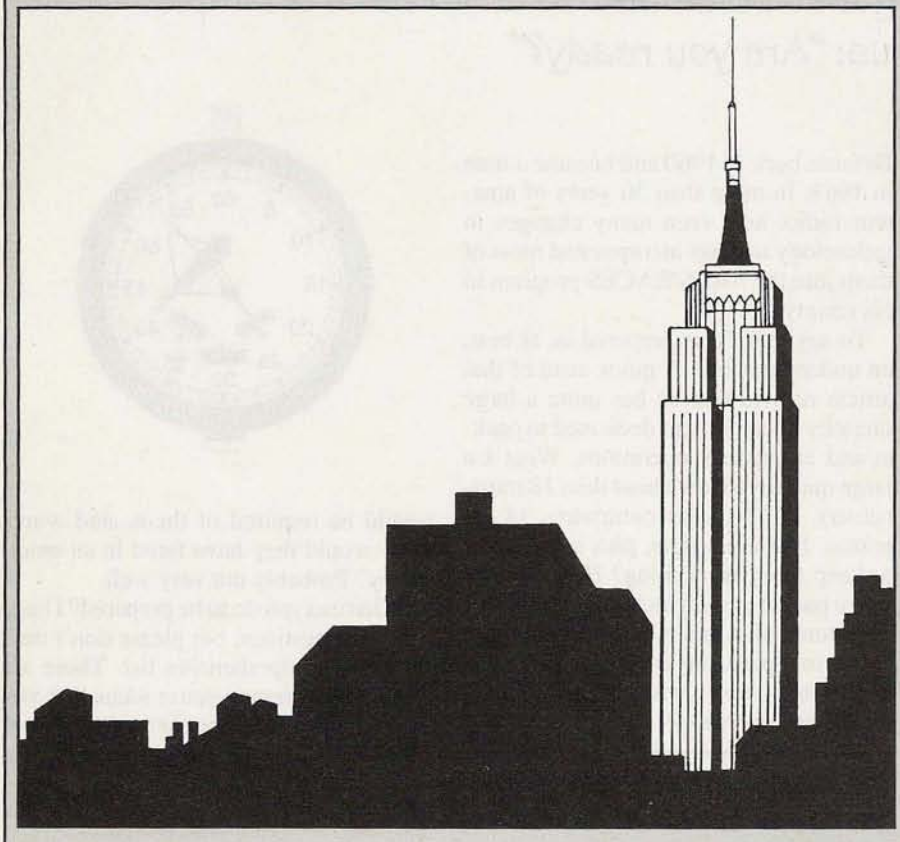
National Weather Service Adds APRS Capability in Metro New York

By Paul J. Toth, KB2WNZ

The National Weather Service (NWS) Forecast Office in Upton, New York, went online in February with amateur APRS (Automatic Position Reporting Service) technology. The station will be used by the National Weather Service as part of its Skywarn Volunteer Spotter Program.

The NWS APRS station monitors the area-wide APRS frequency, 145.790 MHz, for weather information using the latest version (v1.3.0) of WU2Z's and KB2ICI's "WinAPRS" software on a Windows 95 platform.

Amateur stations equipped with a 2-meter FM radio, a 1200-baud TNC, a computer and the APRS software (DOS, Windows, or Macintosh) can send the NWS station information on rain and snowfall amounts as well as severe weather reports. The APRS packages interface with a number of weather instrumentation packages, including those from Peet Brothers and Davis Instruments. Live weather data can be transmitted from these stations via APRS directly to the National Weather Service.



The Upton office of the National Weather Service serves New York City, Long Island, the Lower Hudson Valley, Northeast New Jersey, and Southern Connecticut. It joins the NWS office in Mt. Holly, New Jersey, on the Skywarn APRS Network. That office serves 34 counties in Delaware, Maryland, New Jersey, and Eastern Pennsylvania.

Amateur operators wishing to learn more about Skywarn should contact their nearest NWS office. For more information on APRS and how it can be used with the Skywarn program, contact:

Keith Sproul, WU2Z (APRS), at <ksproul@noc.rutgers.edu>; or Paul Toth, KB2WNZ, NNJ DEC/Skywarn at <ptoth@evertech.net>.

Editor's Note: Our incoming public service columnist, Bob Josuweit, WA3PZO, is planning to devote an early column to the use of APRS in the Skywarn program. So stay tuned for much more on this topic in the coming months.

tery pack that uses replaceable dry cells (such as alkaline batteries) to power your radio. Dry cells are readily available almost everywhere and can save the day in an emergency. Auxiliary power cords that can power your radio from the car's cigarette lighter are also an option. Plus, solar charging can keep gel cells or NiCds topped off independently of commercial power sources—at no cost.

2. Another power suggestion is to consider a *backup power system* for your main (home) station. Wouldn't it be nice to be able to call the power company or other utility when the power is off at home? The system could be as simple as a deep cycle battery for the ham gear or a complete auxiliary power system to run the whole house. The sky's the limit in this category. Don't forget about some battery powered lighting as well.

Pack a "Go Bag"

3. How long would it take you to find all of the things you'll need if you're called to an emergency. Think *now* about packing a few basic items that are always ready to go at a moment's notice. Things like food, water, radio equipment, clothing, a flashlight, etc. should be at the ready. Call it your crash kit! Others call it a "go bag."

4. Portable, easy-to-erect antennas are sometimes the difference between reliable communications and no communications. There are many designs for portable beams, J-poles, dipoles, and others that can multiply your handheld's low power and improve reception at the same time. Keep a length of nylon twine and a throwing weight in your kit, too. Getting

"In case you haven't heard, everyone in the world would like to take our frequencies away from us, and the only thing that can save them is active participation from the entire amateur community!"

your temporary antenna up 20 or 30 feet in the air can have dramatic results. Nothing's better than getting the antenna up a little higher!

Educate Yourself... and Practice

5. Look for other ideas here in *CQ VHF* and other ham magazines. I've seen several articles recently that can be very helpful in preparing yourself and your equipment for emergency service.

6. How are your radio skills? Have you participated in any net activities lately? Can you run a packet station? When the chips are down and the frequency is buzzing with traffic, will you be a help to the situation or a hindrance? Take the time *now* to participate in some nets or contests and maybe even try some traffic-handling to sharpen your skills. When every second counts, you don't want to be the one responsible for slowing down the net with readbacks, repeats, etc.

Get Involved!

7. Even if you are sharp as a tack and totally prepared, it won't help one bit if you keep it a secret. If you haven't contacted your local ARES/RACES or other emergency management group, do so *today*! Let them know that you have the skills and equipment to help out in an emergency. Better yet, volunteer to help out with the regular operations of the organization. *Get involved!* In case you haven't heard, everyone in the world would like to take our frequencies away from us, and the only thing that can save them is *active* participation from the entire amateur community!

You Can Make a Difference

Whether you choose to optimize the equipment you currently have or decide to go for the moon, the important thing is to do it today! Be ready when the call comes. You never know who will be counting on you! ■

ARRL VE Credential Update

If you're a Volunteer Examiner accredited by the ARRL/VEC and you've got a new vanity callsign, you'll have to fork over $2 if you want to get a new set of credentials with your new callsign on them. An updated badge is not required as long as you bring your old badge and a copy of your new license to any test session you help administer. ARRL/VEC Manager Bart Jahnke notes that there is no charge for a new badge if you wait until the regular renewal time for your VE accreditation. For additional information, contact the ARRL/VEC office at (800) 927-7583 or via e-mail to <vec@arrl.org>.

Antenna Concepts: Gain Figures and More

Is your 1/4-wave vertical antenna REALLY omnidirectional? WB2D says you'd better hope it's not! This month, a look at radiation patterns, antenna gain, and "decoupling."

There's a great chase scene in *Star Trek: The Wrath of Khan,* where Khan is pursuing Kirk and the crew through what amounts to a cosmic fog bank. As usual, Kirk and the crew of the Enterprise are at a terrible disadvantage, with the ship being barely able to move. The shields are down and Khan is gaining. Spock then tells Kirk that Khan shows a remarkable tendency toward *two-dimensional* thinking. At that point, Kirk orders the Enterprise to maneuver a small distance into the "Z" plane. Khan blindly moves in "under" the good guys, Kirk blows his ship to bits and the day is saved, all thanks to the modern advantages of three-dimensional thinking.

Three-dimensional thinking is absolutely necessary to even begin to understand antennas. Any antenna or anything *acting* like an antenna has a radiation pattern that exists in three dimensions, not just two! Vertically polarized "omnidirectional" antennas are a good place to start. It's pretty easy to understand what's going on with these ubiquitous devices. But the principles apply to any antenna.

An omnidirectional antenna (most typically used for VHF/UHF FM operation) usually consists of some sort of vertical pole cut to a specific length (typically 1/4-, 1/2-, 5/8-wavelength), some sort of mounting device, and a coax connector. You mount the radiator as straight up and down as you can and as far away from metallic objects as you can get it. Then it sends *all* its energy out toward the horizon, all 360° around. Nice theory, but you'd suffer the same fate as Khan.

Add in the "Z" plane and you can begin to understand what's really going on. (The Z plane is up and down, while the X plane goes left and right, and the Y plane goes forward and back.) Some of your signal is being sent toward the horizon and some of it isn't. What isn't going toward the horizon is going into the sky at some angle or warming the Earth beneath your antenna. Incidentally, "omnidirectional" is really a misnomer: a true omnidirectional antenna exists only in theory.

Measuring . . . and Marketing— Antenna Gain

You sometimes see antenna gain stated in *dBi*. That "i" stands for "isotropic," which is an imaginary antenna that *is* totally omnidirectional. It's imagined to be a finite point in space that radiates equally in all directions in all three planes (X, Y, and Z—see Figure 1). It's physically impossible to create such an antenna, but engineers like to use it because it makes some of their calculations a little cleaner. Marketing people also like to use it, because there's a little over 2 dB difference between the imaginary isotropic and the reality based 1/2-wave dipole (*dBd*), which is the other standard in use. In other words, a 1/2-wave dipole has about 2 dB of gain over an imaginary isotropic antenna.

What that means is that one manufacturer's 5/8-wave antenna referenced to an isotropic antenna (which exists only in theory) can *appear* to have about 2 dB more gain than a similar antenna manufactured by a guy who references his to a dipole. Does it really? No, at least not from the gain due to a particular size radiator. (There may be other factors involved, which we'll get to in a minute.) So, when you read an ad or tech specs on an antenna, watch for those little "i" characters—and make sure you're not adding apples and oranges. If you're comparing two antennas with gain figures quoted in dBi and dBd, just deduct about 2 dB from the dBi figure to see how they really stack up against each other.

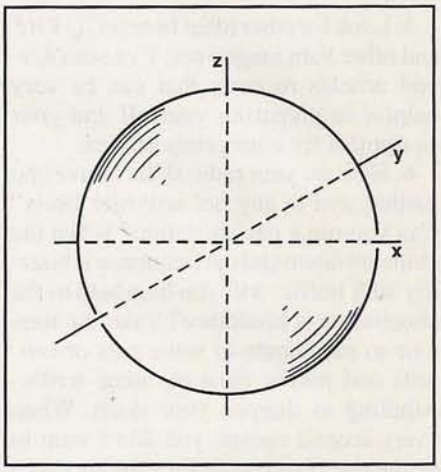


Figure 1. The mythical isotropic radiator. If it did exist, it would radiate a uniform signal in every direction in all three planes (X, Y, and Z).

The 1/4-Wave Vertical

A 1/4-wave vertical antenna is actually a dipole with one half bent sideways (see March, 1996, *CQ VHF,* p. 28) and is a good basis for comparison with other

By Peter O'Dell, WB2D

"Three-dimensional thinking is absolutely necessary to even begin to understand antennas. Any antenna or anything acting like an antenna has a radiation pattern that exists in three dimensions, not just two!"

antennas. Figure 2 shows the typical radiation pattern of a 1/4-wave vertical antenna. Some of the signal (the part that would have gone straight up into the "Z" plane is pulled down and mashed out toward the horizon and the lower sky angles.

Years ago, I often gave beginner antenna talks at hamfests. I'd get to the room early and find a "shill" to help me with a demonstration. The shill would sit in the front row holding a doughnut I had given him (I always picked a thin guy). When I'd start talking about gain, I would suddenly "notice" the guy and ask to borrow "his" doughnut. Then I'd smash it flat and excitedly tell the group that there is no change in the weight of the doughnut—nothing was created or destroyed—it was just rearranged. "Oh my, look what I've done to *your* doughnut. Oh, well, it was for a good cause."

This is the way an omnidirectional gain antenna works—nothing is created, there is no amplifier—you just flatten out the radiation pattern. In general, the higher the gain, the flatter the doughnut and the better your station will perform, particularly on weak links.

Going for the Gain

In terms of relatively simple base station antennas, the 5/8 wavelength is probably about optimal. Of the popular configurations, it has the most gain—about 3 dB over a 1/4-wave (see Figure 3). It's fairly inexpensive and provides good performance in most situations. If you're in a relatively flat area, you may want something with more gain, although a higher-gain antenna is likely to cost you quite a bit more because the construction becomes much more complicated. Up to 5/8 wavelength, you simply cut a piece of aluminum or stainless steel to a particular length, add a matching device of some sort, and attach the feedline. The longer the antenna, the more gain it will have. Above 5/8 wavelength, though, adding more length actually lowers the gain. Energy starts shooting out at different angles, making your signal less focused.

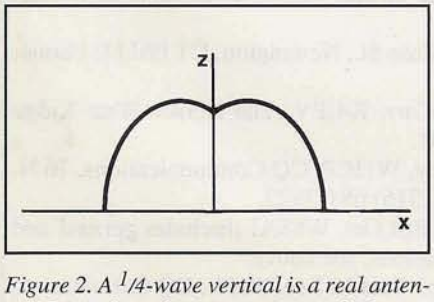


Figure 2. A 1/4-wave vertical is a real antenna. This is the radiation pattern to which most other vertical antennas are compared.

To get an antenna with more gain than a 5/8-wave, you have to *stack* elements. Stacking is a complicated design process, and the construction is always more complicated than it is for a simple antenna. To get the desired results, the elements have to be separated the right distance physically and also have some sort of matching device between them. Typically, the antenna is constructed and then inserted into a hollow fiberglass tube which is then sealed and weatherproofed. These antennas are usually called collinear arrays and they do perform well, but they usually cost a lot more. So, unless you really need it, stay with the much simpler 5/8-wave antenna.

Exceptions

In most cases, more gain is an advantage, but not always. There have been two or three situations in which I've experienced *more* gain being *less* effective. Years ago I had a huge fishing pole-like antenna on my trunk lid for 2 meters. Living in the relatively flat Northeast, it worked great. Then I moved to the mountains of West Virginia and noticed that I often had trouble communicating where other hams were getting through. They were using 1/4- and 5/8-wave antennas. What I finally figured out was that a lot of the communication was via reflections off the sides of mountains, so a significant amount of the signal was actually arriving from a higher angle. I've also noticed the same sort of thing driving around in "downtown" areas of major cities. There are other advantages to having a 1/4-wave in urban areas, too. Parking garages are less problematic, and

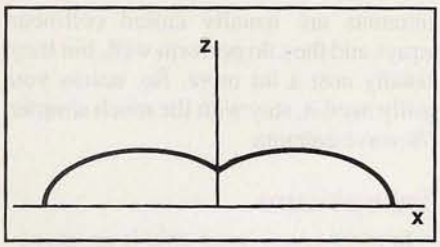


Fig. 3. The 5/8-wave antenna flattens out the "doughnut" pattern that you see from a 1/4-wave vertical (see text), and sends more of your signal out along the Earth's surface instead of into space.

the small antennas attract less attention to your vehicle.

Another application where low-to-medium gain is advantageous is in basic space communications. If you want to attempt communications with Mir or the shuttle, a 5/8-wave antenna is a great, *cheap* way to get started. It's certainly not as good as a full-blown az-el beam installation with computer tracking and such, but it's adequate and a lot less expensive for a newcomer's station.

Keep It Simple...

I've reached a point in my life where I like things very simple. If you own your car and your spouse will let you do it, drill a hole in the center of the roof and permanently mount a 1/4-wave antenna there. It's very effective and rarely a source of problems.

If you can't do that, then use a magnetic mount 1/4-wave—it won't perform as well and you may develop some problems in the feedline from shutting the door on it, but it's still a relatively clean installation. Trunk-lip mounts and glass mounts are OK mechanically, but you sometimes get funny radiation patterns. In other words, it's not going to be an "omnidirectional" pattern. Your car becomes a self-contained, motorized hybrid beam and rotator.

Decoupling

One of the first repeater groups that I ever joined had installed "the machine" on a hilltop four or five miles out of town. It was OK, but it didn't seem to have particularly good range compared with other repeaters in the area. One day that changed, at least in certain directions. There were some directions where the coverage was much better, but in others it was awful. So, Saturday morning a group of us headed out to the site. What we saw made no sense to me at all.

There had been a windstorm and now the mast and antenna were bent over almost horizontal. The dead spots certainly made sense, but how could the performance have been *improved* in some directions? I didn't understand.

Such are the mysteries that life presents to us from time to time. Much later, it became really quite simple.

There were no radials or cones or stubs on this antenna. It was simply a vertical element, a matching device, a coax connector, and a mounting bracket. That's all. Back in the first installment of this series, we talked about coaxial cable and how the RF traveled inside the cable along the outer surface of the center conductor and the inner surface of the shield. As far as RF is concerned, there's a *third* conductor that can become involved—the *outer* surface of the shield. If RF begins to flow along this part of the cable, then the whole length of the cable begins to act as an antenna. This is where the problem comes in, because the patterns of this unintentional antenna mix with those of the intentional one. In effect, they become a stacked array. I suppose, in some cases, you might actually get improved gain out of the situation. Mostly, though, you're likely to be sending your signal to the birds!

So, that's what had happened with this repeater antenna. All along, unbeknown to us, we were losing a lot of the signal that was radiating from the feedline and zipping off into space. Then the storm knocks the antenna over, and suddenly some of those major lobes just happen to be aimed at the horizon—in one or two directions only.

Keeping RF from flowing on the outside of the feedline is called *decoupling*. There are a number of different approaches that accomplish this. Assuming you're using good quality coax, the only way RF could get on the outside of the transmission line is by flowing back down from the antenna. It's rather easy to put a roadblock at the antenna's feedpoint to prevent this flow. One of the most effective and inexpensive forms of decoupling is to install a set of radials (1/4 wavelength each) at the feedpoint. Sometimes a second set of radials is added to the installation, usually placed a 1/4 wavelength down the feedline from the first set (this is often part of the mounting bracket).

Coneheads

Antennas with cones around the feedline are a special form of the radial approach. It's sort of one continuous radial that runs completely around the antenna. At HF, you see a lot of decoupling done with transformers and ferrite chokes of one sort or another. This is one of the main purposes of a *balun* (short for BALanced-UNbalanced transformer).

The exact form that the decoupling network takes isn't critical, but it is important that any base station antenna you use have something that isolates the feedline (the outer surface of the shield) from the antenna. Radials do the trick. If you don't see them, look through the tech sheets for something about decoupling. Incidentally, this isn't particularly important for a mobile antenna, particularly a permanent mount. The metal of the car body provides all the decoupling you'll need.

Try One Yourself

Antennas are one of the last remaining areas where the average ham can tinker and experiment. If you keep some of these simple concepts in mind, you can expand your own antenna knowledge and have a lot of fun in the process! ■

Resources

For more information on antennas in general, and vertical antennas in particular, we recommend the following books:

The ARRL Antenna Book, ARRL, 225 Main St., Newington, CT 06111; Phone: (860) 594-0200 (also available from CQ).

Practical Antenna Handbook, by Joe Carr, K4IPV, Tab Books, Blue Ridge Summit, PA 17294; Phone: (717) 794-2191.

Lew McCoy on Antennas, by Lew McCoy, W1ICP, CQ Communications, 76 N. Broadway, Hicksville, NY 11801; Phone: (516) 681-2922.

The W6SAI HF Antenna Handbook, by Bill Orr, W6SAI (includes general and VHF-related info as well), CQ Communications, see above.

The Vertical Antenna Handbook, by Capt. Paul H. Lee, N6PL, CQ Communications, see above.

Q: I read the article in *CQ VHF* about ham radio ballooning (Sept., 1996), and I'm interesting in obtaining information about sources of both helium and balloons. I have also read that ammonium nitrate (gaseous state) has about 2/3 the lifting capacity of helium, but only a fraction of the cost. Could you provide any information about this (especially sources, recommended storage containers, etc.). Do the balloons retain the gases indefinitely without loss?

Terry, KIØFW
(no address given)

A: Terry—We referred your questions to the authors of our September article on ballooning, Jerome (K5IS) and Bobette (N5IS) Doerrie. Here's their reply:

Hi, Terry! Congratulations for your interest in ballooning! We obtain our balloons from Kaymont Industries <http://www.800web.com/Kaymont/> or 1-800-644-6459 and ask for Paul.

For a source of helium, check with auto parts stores or stores that handle welding equipment or party balloon shops. The tanks are about five feet tall and about 12 inches in diameter. Pricing varies, so compare different stores. (The shop and agriculture departments in our high school have a usual source, and it is usually the lowest priced one around, except for donated helium.)

For additional information, look at the EOSS (Edge of Space Sciences) Homepage at <http://www.usa.net/~rickvg/eoss.htm>. Go to **links of related info**, then go to **Balloon FAQ** by Dave Mullenix. This is a nice introduction to ballooning.

We have not heard of using ammonium nitrate to lift a balloon, and therefore need to know more before we can suggest anything. It gets cold up there (-50° F), so some gases could liquefy. The lift for the balloon is the difference between the weight of the air displaced and the combined weight of the volume of gas and the balloon/payload weight.

Using a gas with less lifting ability than helium will require a *much* greater volume of gas to lift the same size payload. I'd expect the balloon to be filled to greater capacity, thus it would be more likely to burst before reaching the desired altitude.

The various balloon materials have varying rates of leakage. We haven't kept one on the ground long enough to observe how long it would stay inflated!

We are always thrilled to visit with another balloon enthusiast! But don't try anything unproven (such as ammonium nitrate) when you're starting out. Stick with what's known to work. Safety must always be your first concern.

Q: What in the world is "Mars"(not the planet) and "Caps"? Also, can anyone participate?

Greg Colon, KB2TPI
Bronx, New York

A. Greg—MARS and CAP are acronyms for military-related radio services in which many hams participate: the Military Affiliate Radio System and the Civil Air Patrol, which is the U.S. Air Force Auxiliary. We asked officials of each service to give us a brief description of what they do and how to join.

First, MARS:

MARS...not a stellar rock but a serious federal communications resource. The Military Affiliate Radio System (MARS) is a Dept of Defense-sponsored communications resource. Structured as Army, Air Force, and Navy-Marine Corps MARS, the affiliate service provides emergency communications support to the military and to federal, state, and local disaster response agencies; plus health and moral support to deployed American Service personnel. Disciplined voice and digital radio operations training, and international connectivity (as well as a special callsign) are provided to Amateur Radio Service license holders who volunteer. Minimal entry requirements include an Amateur Radio Service license, 17 years of age (with parental permission), 12 hours per calendar quarter participation commitment and ability to operate on MARS HF and/or VHF frequencies. For additional information, contact any MARS member or visit the Army MARS Web site at <http://members.aol.com/aat6fv/index.html>.

(*Courtesy Army MARS Emergency Director Al Uvietta AAA9ED/KC5S*)

Now, more info on CAP:

Civil Air Patrol is a non-profit organization made up of aviation-oriented volunteers. CAP's three missions are Aerospace Education, the Cadet Program for young people ages 12 (or attending 6th grade) through 18, and Emergency Services. CAP volunteers operate one of the world's largest general aviation fleets, flying over 85% of U.S. search and rescue missions. CAP was credited with saving 105 lives last year! The CAP Emergency Communications Network (in which many hams participate) spans the country to support local, state, and federal agencies during disaster relief, search and rescue, and other emergencies. CAP-owned aircraft communicate on CAP's own dedicated frequencies, while new systems coordinate and track search flights via sophisticated datalink.

For more information about Civil Air Patrol, call 1-800-FLY-2338 and request an information package. You can also check out CAP on the Internet at <http://www.cap.af.mil>, or write to: HQ CAP/DPM, 105 S. Hansell St., Maxwell AFB, AL 36112-6332.

(*Courtesy John Sistrunk, Chief of Membership Development, CAP National Headquarters*)

Both of these services use government frequencies just outside the amateur bands, meaning that most amateur gear will operate there either "out of the box," or with a simple modification (usually done at the factory or a service center when you present your MARS or CAP operating credentials). Be sure you're authorized before operating in these bands.

Q: I am in quite a bind. Living with my parents, I cannot put any kind of antenna up, simply because they do not want coaxial cable running through their house. I am an avid Internet user and use Microsoft NetMeeting to talk to people. I know I am not the only person to do this, let alone the only amateur. Now

(*Continued on page 74*)

Understanding Standing Waves

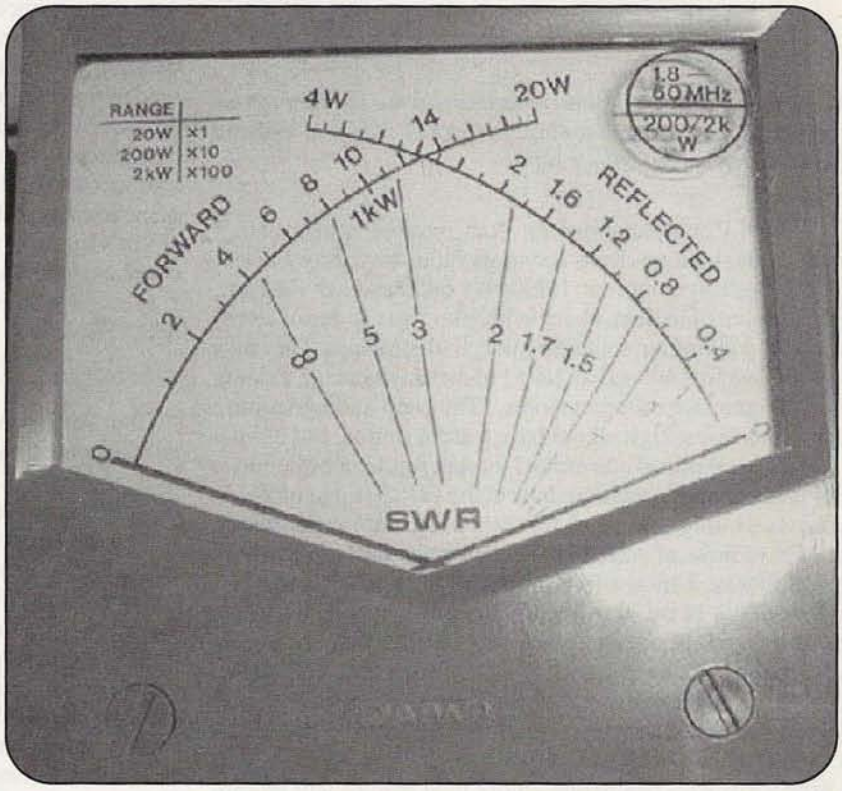
The name of the game is to have as much of your transmitter power as possible radiated by the antenna. Here's how you do it.

I believe it was Newton who theorized that everything that goes up, must come back down. He discovered gravity and its effects long ago, before we started building space stations and exploring the cosmos.

But when you send a *signal* up to your antenna, you certainly don't want it coming back down into your hamshack. The purpose of an antenna is to couple the high frequency alternating current it receives from your transmitter into radiation, which can be received at a remote location. Your radio frequency (RF) signal travels from your transmitter to an antenna by means of a transmission line. This is called the *forward* signal.

The maximum radiation will occur when all the impedances are matched. Before the nit-pickers devour me, let me add that this is not always true on the HF bands (3 to 30 MHz) where open wire transmission lines and antenna couplers are used. On VHF (30 to 300 MHz), we generally use coaxial cable, rated at 52 ohms, for the transmission line, rather than open wire line.

Just about every amateur transmitter on the air today has a 52-ohm output. This means it expects to "see" a 52-ohm transmission line connected to an antenna which exhibits a 52-ohm impedance. Virtually all properly designed commercial VHF antennas exhibit this impedance. There will usually be a method of adjusting the antenna impedance so that it provides a near-perfect match. Keep in mind also that the impedance of the antenna is a function of its resonant frequency. If you use an antenna above or below its resonant frequency, the impedance will vary from the nominal 52-ohm value (see "Antenna Bandwidth").



One of the most common hamshack accessories, the SWR meter compares your forward signal from transmitter to antenna with the reflected signal (if any) coming back down the coax and reads out your standing wave ratio, or SWR.

Reflected Power

If the transmission line "sees" something other than 52 ohms, some of the energy it receives will be reflected back down to the transmitter. This is called the *reflected* signal. To understand this, let's start with a line that is either mismatched (100-ohm load) as in Figure 1 or short-circuited as in Figure 2. At the shorted end of the cable, current is at a maximum and voltage is at a minimum. When the signal you send up the line reaches the short, there's nowhere else to go. But it can't just disappear; it must be returned down the line, and is said to be reflected. There's no voltage at the shorted end of the coax. How can there be? It's shorted out. But the *current* flow through the short circuit is at a maximum.

A quarter-wavelength down the line from the short (and every half-wavelength back down to the transmitter), there's a current minimum and a voltage maximum. If we move *another* quarter-wave back toward the transmitter (a half wavelength from the short), the waves are once again at a current maximum and a voltage minimum. The whole "picture" repeats every half-wavelength as shown in the Figures.

What happens when the *reflected* energy reaches the transmitter? There's a complex answer that involves vectors and other mysterious math, all of which can be found in the *ARRL Handbook*. Suffice

By Donald L. Stoner, W6TNS

"The purpose of an antenna is to couple the high frequency alternating current it receives from your transmitter into radiation, which can be received at a remote location."

to say that the answer depends on where along the length of transmission line the transmitter is located. In some cases, some or all of the energy may be absorbed by the transmitter output circuitry. With a different length of line, some or all of the energy may be reflected back up to the antenna, only to be bounced back again to the transmitter.

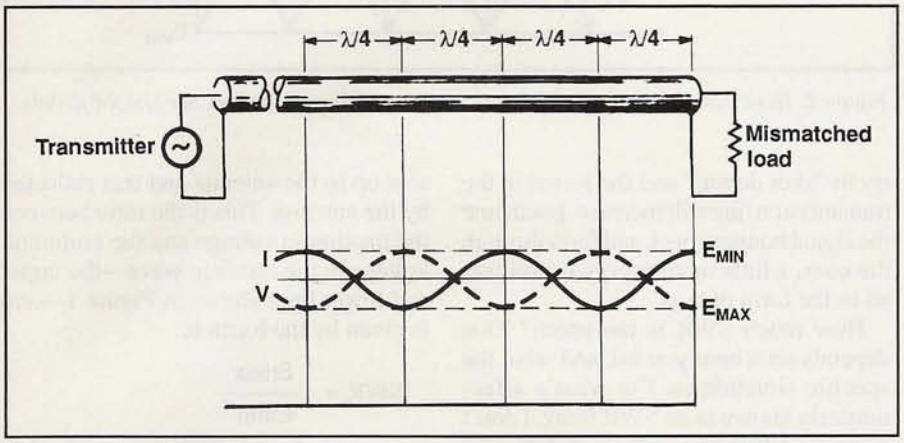


Figure 1. What your SWR meter can see, but you can't: the fluctuation of voltages on a transmission line with a high standing wave ratio. Here there's a mismatch between the transmitter and the antenna (load).

Standing Waves

The waves shown in Figures 1 and 2 are called *standing waves*. If the antenna were perfectly matched to the transmitter, there would be no waves. The voltage and the current would be the same anywhere along the length of the transmission line.

Let's say a recent windstorm had twisted around your coaxial cable until it became shorted. An obvious symptom of a problem is that you're not able to work anyone. What you can't see, however, are the standing waves on the transmission line as shown in Figure 1. Note that the voltage (the amplitude) of the standing waves is significantly higher than those shown in Figure 1. And remember, these standing waves appear all along the transmission line including at the antenna jack of the transmitter.

More voltage than normal will also appear on the transmitter power amplifier transistors. If the excessive voltage exceeds the transistors' rating, the silicon wafer in the transistors may "punch through" and short-circuit the devices. This happened a lot in the "good ole days." I wish I had one share of Microsoft

stock for each pair of "finals" that I've had to replace.

Modern equipment includes circuitry to protect the final transistors and almost entirely eliminates this problem. But this also provides one of the answers to the question posed earlier: When the transmitter "sees" too much reflected power, the protection circuitry shuts down or reduces the transmitter power output in an act of self-preservation.

Standing Wave Ratio, or "SWR"

If there are no standing waves present, the two voltages (minimum and maximum) are equal and the transmission line is said to be flat. We also call this an SWR of 1 to 1, which is written as 1:1.

Let's say the line in Figure 1 is terminated in a 100-ohm resistor, rather than the desired 52-ohm resistive antenna load. The SWR can be easily calculated since it equals the characteristic impedance of the transmission line divided by the load resistance. Don't worry if this produces a negative number. The SWR can also be calculated the other way around, by dividing the impedance of the line into the load resistance.

In the example given above, the SWR would be 2:1 since the 52-ohm cable impedance can be divided into the load impedance with a result of approximately 2. If a 25-ohm resistor were substituted for the 100-ohm resistor, the answer would still be 2:1.

As we have seen, we want to keep the SWR as close to 1:1 as possible, not only to prevent damaging the transmitter but to avoid loss of signal. If the SWR is high, the output circuitry in the transmitter will try to "shut down," and the losses in the transmission line will increase. Each time the signal bounces back and forth through the coax, a little more energy is dissipated in the form of heat.

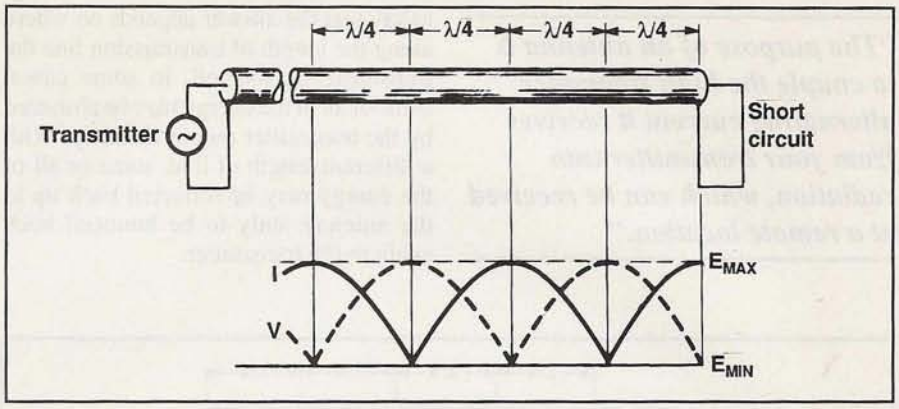


Figure 2. Here's an example of what happens if the feedline is shorted. See text for details.

How much SWR is too much? That depends on whom you ask and what the specific situation is. I'm what's affectionately known as an SWR freak. I don't want *any* SWR and I love to diddle with antennas until the transmission line sees a perfect match. Does it increase my signal? I doubt it. But I'm convinced I work more stations with an SWR of 1:1. It's a sickness, like keeping a tidy hamshack!

Usually an SWR of 2:1 is considered acceptable. It won't cause transmitter problems, and I doubt if it would result in any power reduction in commercial transmitter protection circuitry.

Antenna Bandwidth

Earlier, I mentioned that the match of the antenna is a function of its resonant frequency. A typical 2-meter beam might exhibit a 1:1 SWR at 146 MHz, but the standing wave ratio could rise to 2:1 at the band edges (144 and 148 MHz). If you consider this the maximum tolerable SWR, the usable *bandwidth* of the antenna would be 4 MHz. Often the manufacturer of an antenna will specify the bandwidth of the antenna as the two frequencies where the SWR is likely to exceed some specified value (a 2:1 bandwidth is common).

SWR Meters

While you can't see the standing waves, you can certainly measure them. The device for doing so is called a standing wave ratio, or SWR, meter. An SWR meter measures the voltage standing wave ratio (VSWR) between RF energy sent up to the antenna and that reflected by the antenna. This is the ratio between the maximum voltage and the minimum voltage in the standing wave—the upper and lower lines shown in Figure 1—and is given by the formula:

$$SWR = \frac{Emax}{Emin}$$

Most hams leave an SWR meter in line at all times. It will indicate your SWR whenever you transmit and will immediately alert you if there's a problem with the antenna.

Using Your Meter

Many SWR meters have a sensitivity control and you need to know how to adjust this. Do this by putting the meter in the forward position and adjust the sensitivity control so the needle reads full scale. Then switch to the reflected power position. This reading will indicate the SWR of your antenna. Hopefully it reads zero, indicating an SWR of 1:1.

SWR meters are available from ham stores and even electronic stores. But be cautious: SWR meters have a specified operating range. If you go to Crazy Joe's Electronics Emporium and buy an SWR meter, there's a good chance it's designed for checking CB antennas. There's an equally good chance that the meter will be very inaccurate at 2 meters and even more inaccurate at 440 MHz.

The type of SWR meter I prefer uses two movements and pointers on a single calibrated face. The one I use is shown in the accompanying photograph and is made by Daiwa. It shows any changes in the forward and reflected signal without moving any switches. Also this model indicates the forward and reflected power in watts when the SWR is near 1:1. If your

E-Mail Lists for Repeater Owners

If you operate a repeater using a controller made by Link Communications or ACC, WA3QKX has set up an e-mail list that you may join to compare notes with other repeater control-ops. According to a report on "Newsline," there's a separate group for each manufacturer. You may join either one by "surfing" to either of the following World Wide Web sites:

To join the Link controller list, point your Web browser to <http://rrc2@engmg.pitt.edu/~rrc2/link.html>.

For the ACC group, make that <http://rrc2@engmg.pitt.edu/~rrc2/acc.html>.

"How much SWR is too much? That depends on whom you ask and what the specific situation is...I don't want any SWR and I love to diddle with antennas until the transmission line sees a perfect match."

SWR meter is calibrated in watts, in addition to SWR, it's not at all unusual to see a reading with more power output than your transceiver is capable of delivering. This happens when the SWR is high.

Adjusting Your Antenna

One of the most valuable functions of the SWR meter is to adjust an antenna. Let's say you bought a 10 element 2-meter beam and want to check its performance. You'd start by checking the SWR on your favorite operating frequency of, say, 146 MHz. The SWR measures 1.7:1. Not bad, but not good if you're an SWR nut like me. Then if you check it at 144 MHz and it measures 1:1, it's probable that the antenna was designed to work the SSB frequencies just above the low edge of the band. It's equally probable that when you check the SWR at 148 MHz, it will be well above 2:1.

Again, maybe you can live with this performance, but maybe not. To fix it, you'd adjust the antenna by moving the slider that connects between the coax connector and the radiator element. Set this for minimum SWR at 146 MHz. It only came down to 1.5:1? In all likelihood then, you'll have to prune the elements. Start by taking 1/8 inch off each end of the radiator (driven element). The SWR on 146 MHz will drop because the elements were a "smidgen" (another highly technical measurement) too long. It's likely that the reflector and director elements are also a little too long, but you shouldn't start hacking away at the aluminum without another piece of test equipment called a field strength meter. When you reach 1:1 by moving the slider and trimming the driven element, call it a day. You've arrived.

Another Month, Another Meter

Next month, we'll talk about some of the fun you can have measuring signals with a field strength meter.

73, Don, W6TNS

Reader FEEDBACK!

Dear *CQ VHF*:

I wanted to comment on the Beginner's Corner article, "Understanding Antennas and Feedlines," by WB2D in the March, 1997, issue of *CQ VHF*. In this article, it was stated that 75-ohm hardline will cause "a significant reduction in the overall performance of your system. So avoid using CATV hardline, no matter how cheap it is."

This statement is not very accurate. Take 1/2-inch 75-ohm hardline as an example. From *The ARRL Handbook*, this has a matched loss of 2.25 dB/100 feet at 450 MHz. If you assume that your antenna impedance is 50 ohms, your additional loss due to this 1.5:1 VSWR is 0.144 dB, assuming that you are matched at your transmitter.

At the transmitter, the worst case impedance that could be presented would be 112.5 ohms, giving you a VSWR of 2.25:1. If your transmitter totally absorbed the reflected power, the total mismatch loss of the antenna, 75-ohm hardline, and transmitter would amount to 0.644 dB instead of the 0.144 dB with the matched transmitter, or only 0.5 dB more. However, if you trim your transmission line to a multiple of a half-wave (1/2 wavelength is about a foot at 450 MHz), then your transmitter should be matched and you would only add the 0.144 dB additional loss to the system. In any case, none of these sound like significant performance reductions. As an example, compare the worst case losses just described (2.25 + 0.644 dB = 2.9 dB) to the loss of LMR-400 (2.7 dB) at 100 feet. And with a little cable trimming, the 2.9 dB will be more like 2.4 dB of loss for the 1/2 inch hardline. Not much difference.

Another comment made was that copper was a good conductor, silver was better, and gold was the best. Actually, silver is the best, followed by copper, then gold. Gold does have the advantage that it doesn't oxidize.

Regards,

Phil Salas, AD5X
Richardson, Texas
(via e-mail)

Peter O'Dell, WB2D, replies:

Most modern rigs have an "SWR sensing/power decreasing" circuit that reduces power output as SWR rises. I've seen some of those set pretty tight. With those rigs, you would get a significant reduction in overall performance with a 2:1 SWR. Also, I'm writing a column for beginners, so I'm assuming little "real world experience" in these things for most of the readers. Plus, they probably have very little test equipment. It's simply safer to make very conservative suggestions to the target audience.

For instance, I once got a great deal on some hardline with foam dialectric. It had had water in it (I found out later). It seemed to be a perfect 50 ohms. The only problem was that there was tremendous loss: 100 watts in netted about 2 watts out. At the transmitter, it just seemed like the antenna wasn't working. I had a lot of test equipment at my disposal and a fair amount of experience. It still took me a long time to track down the real problem. So, I still think it is sound advice for beginners to stay away from used CATV line.

—WB2D

Introducing Spread Spectrum

In his classic novel, "1984," George Orwell said "Less is more." Spread spectrum advocates say "more is less." What exactly is spread spectrum and why should hams be interested?

Welcome once again to the Digital Data Link. This month, we'll take a look at spread spectrum (S/S): what it is, how it works, and why it's so wonderful. S/S operations aren't new—the idea was developed during World War II by the famous actress, Hedy Lamarr (see "Hedy Lamarr: Spread Spectrum Pioneer?" accompanying this article). However, recent changes in the communications industry and in technology have seen spread spectrum explode into the commercial marketplace.

S/S is just what the name implies: spreading out the spectrum of the transmitted signal to occupy a wider bandwidth than required. Although a wider bandwidth seems to be a bad thing—if you use a wider bandwidth, fewer channels would be available, right?—the reality is that by using spread spectrum, you can fit *more* users into a given spectrum, with no harmful interference.

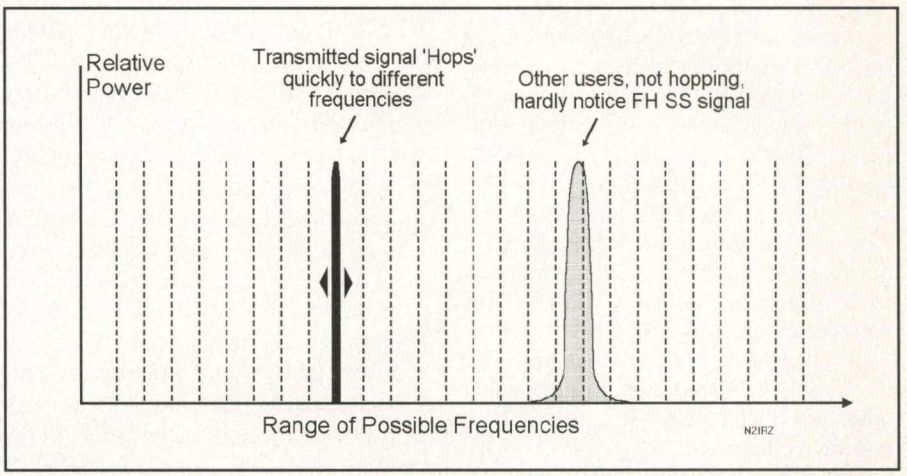


Figure 1. Frequency-hopping spread spectrum. The transmitted signal is sent for brief periods on different frequencies. Other receivers using a different sequence of frequencies, or a receiver on a single frequency, barely notice the occasional signal "blips."

Wider Bandwidth AND More Users?

Now wait a minute...you spread out your signal, and *more* people can use the spectrum? How can that be? To answer that very basic question, we have to look at *how* we spread the spectrum. While there are many S/S techniques, two that show the most promise for amateur radio are known as *frequency-hopping* (FH) and *direct sequence* (DS).

Frequency-hopping is the easiest to understand conceptually. Your transmitter changes frequency very quickly, tuning sort-of randomly around the band. The receiver tunes in exactly the same way, following these little blips of signal, and (as long as everything stays synchronized) the signal appears seamless, as if the frequency wasn't changing.

In contrast, direct sequence spreads the spectrum of the data signal by multiplying the data by a higher-frequency, data-like signal, simply widening the bandwidth (if this makes no sense to you, don't worry; we'll explain it later on). It's also possible to combine these and other techniques to create what's known as a hybrid system, further improving the benefits of S/S. To better understand how these systems work, and why we get improved communications and spectral efficiency, let's look at some examples:

Frequency Hopping

Consider a typical FM mobile radio with, say, 50 memories. First set each memory to a different frequency, choosing them more or less randomly. Find another radio just like it and set all of its memories identically. Now, as you begin speaking, switch from one memory channel to the next, say at about 10 times per second (this is your so-called *hopping rate*). Of course, you couldn't do this manually with much accuracy, but building a circuit to do this automatically isn't very difficult.

What you're doing is sending a very tiny bit of your signal—1/10th of a second's worth, to be exact—on each of the 50 channels. To anyone listening to any one of those channels, they'll just hear a little "blip" every five seconds or so. It's nothing they could understand as a message, or that would interfere with their QSO, just a brief pulse of RF.

Now, at the receive end, listen on one of the channels for a blip. As soon as you hear one, start running through the memory channels at the same speed, and in the

By Don Rotolo, N2IRZ

Forward Error Correction

If you want to increase the chance of a message getting through under adverse conditions, you use *Forward Error Correction* (*FEC*). A simple method of FEC is to say everything two or three times, or to spell everything using phonetics.

Standard AX.25 packet does not use FEC, but the much simpler technique of *Error Detection*. In AX.25, if an error is detected, the message is not acknowledged by the receiving station, and is thus sent again and again until it gets through. The advantage of FEC is that you don't have to acknowledge every good message, you just send enough information that most probable errors can be corrected at the receiver.

There are a number of methods of implementing FEC, some better at correcting errors but requiring more redundancy, others using less redundancy but less likely to be able to correct certain possible errors. The goal is to use the least redundancy to correct the most errors. Which specific type of FEC you use depends on the type and severity of the expected errors. Theoretical mathematicians who dislike PN Codes get *their* kicks by coming up with better methods for FEC.

For more information on FEC methods and their relative efficiencies, visit Phil Karn, KA9Q's Web page at <http://www.qualcomm.com/people/pkarn/>. This is especially interesting if you have a sound card, as you can hear various signals and the effects of FEC processing.

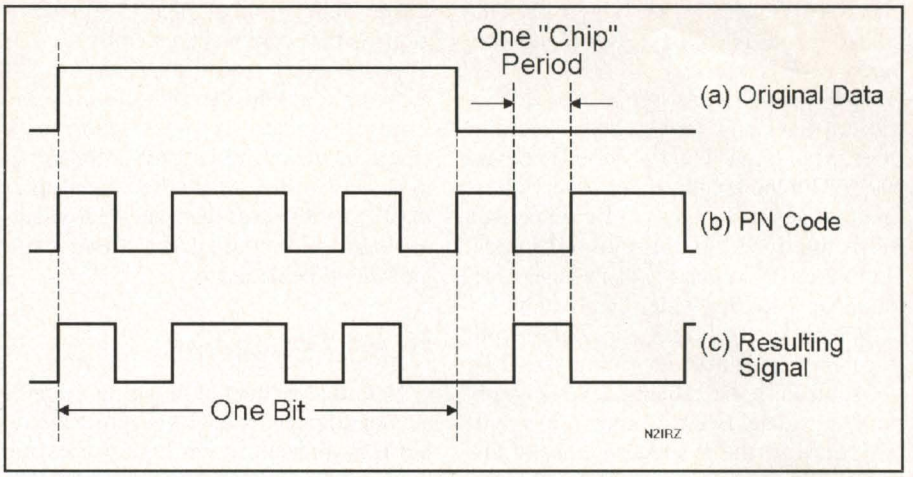


Figure 2. Direct sequence spread spectrum. The data signal (a) is multiplied by a repeating pseudo-random spreading code, PN Code (b), which increases the bandwidth of the resulting signal (c). Due to the effects of the PN Code, the signal resembles background noise. Receivers using the same PN Code can decode the signal, while those using different PN Codes, or narrowband receivers, see the signal as only noise.

same order, as the transmitter. If the signal remains as you tune, then you've locked onto the correct transmitter and are now synchronized with it.

If, on the other hand, the signal disappears as you tune, you probably heard someone else's blip, so stop and wait for another signal and repeat the process. Remember, you programmed the frequencies and their sequence randomly, so the chances of someone else picking all the same frequencies, and in the same order, is very small. If you think about it, you can select sequences that have little chance of being mistaken for one another. Such sets are said to have a low *correlation*, and the sequences used are said to be *orthogonal*.

OK, so now you (or some automatic circuit) have heard the transmitter, locked onto it and synchronized with it after a maximum of five seconds. Since both the transmitter and receiver are scrolling through the same frequencies, in the same order and at the same rate, the transmitted signal—all those blips—are all able to be heard, just as if the frequency weren't changing at all. So, once the receiver is *synchronized*, you can hear the transmitted signal perfectly. The idea behind the frequency-hopping technique is illustrated in Figure 1.

Why Bother?

Why go through the trouble? First of all, frequency-hopping S/S is resistant to interference: losing a blip or two for any reason (another signal's interference, multipath, whatever) makes little difference in understanding the message. A 1/10th of a second dropout is insignificant, in terms of the length of the word being spoken, so there's really no interference. In reality, losing even most of the blips makes little difference.

Second, since you aren't using any one channel, others can use the same technique—with a different sequence of channels, of course—to use the same frequencies at the same time you do. A further advantage is that, unless someone else knows your frequency selection and sequence, it's difficult to eavesdrop on, or jam, your conversation.

The main *disadvantage* to this technique is the time it takes for the two stations to synchronize, in this example as long as five seconds. If you increase the hopping rate (the speed at which you change channels), you can reduce this time, but then it becomes more difficult to build a radio that can change channels quickly enough.

To increase the relative value of this S/S technique, try to increase both the number of channels and the hopping rate. The resulting reduction of interference effects is called the *processing gain*, which is the added ability for the communication to "get through" in relation to conventional simplex or some other technique. This processing gain, measured in decibels (dB), is a real gain, just like using more power or a bigger antenna.

Direct Sequence

Direct sequence S/S works differently. Instead of spreading out the transmitted RF onto many different frequencies, it multiplies the data signal by another signal of much higher frequency, making the signal's bandwidth much wider. Let's try another example to illustrate this since it's a difficult concept to understand.

First, it's important to know that *the bandwidth of a signal, after modulation, is related to the highest frequency in the signal, and as the highest frequency increases, so does the bandwidth*[1]. So, you take a data signal and multiply it by another data-like signal, as shown in Figure 2. This higher-frequency, data-like sig-

nal repeats itself for every single bit. This added signal is called a *pseudo-random noise code* (PN code).

A PN code is just a repeating collection of ones and zeros, chosen more or less at random[2]. The PN code is characterized by the length of the code, or how many times it changes per bit. Each data bit is multiplied by the whole PN code, so longer PN codes result in higher frequencies and thus wider bandwidths.

What's interesting is that, unless your receiver divides the incoming signal by the same PN code, the signal is essentially random noise. Even if other S/S signals are heard by the receiver, the use of different PN codes means that the receiver "listens" to only your signal. An occasional overlap of the PN codes is possible (and likely), but since PN codes are carefully chosen, there's usually no effect upon the received signal. Recognizing such a signal on the air is also unlikely, simply because the bandwidth is so wide and the signal somewhat randomized, so it sounds like noise. In fact, the effect of a direct sequence S/S transmission is to slightly raise the noise floor at the frequencies of interest. (*See "Weak-Signal Worries About S/S," elsewhere in this article.—ed.)*

With its noise-like characteristics, the signal is immune to narrowband interference, multipath effects, jamming, and casual eavesdropping. Again, the processing gain thus realized is real gain, like you get from a power amplifier. For direct sequence systems, the processing gain increases with the length of the PN code, up to the point where the bandwidth is a little more than a megahertz, after which you begin to see a diminishing return due to wideband noise effects at the receiver.

The main disadvantage to this technique is the problems created by the *FM Capture effect* (see Figure 3). An FM receiver tends to demodulate only the strongest signal it receives, ignoring all others. If the desired signal is weaker at the receiver than some other signal sharing the bandwidth, then the desired signal is lost, even though the stronger signal cannot be decoded.

Hybrid Systems

Note that frequency-hopping systems are not affected by the FM capture effect, but it is difficult to get high processing gain in a frequency-hopping system. So, to get the advantages of both systems, while reducing the disadvantages, you simply combine them to achieve a direct sequence signal that hops to a number of different frequencies. This is called a *hybrid spread spectrum system*, and, because of its further improved noise immunity, the processing gain is even higher. You can even change the PN code at each frequency hop, further increasing the processing gain.

Further Gains

As a side note, if you use a Forward Error Correcting (FEC) technique (see sidebar) to allow minor bit errors to be corrected at the receiver, you further increase the processing gain, because even a slightly faulty signal still carries the information. In other words, it doesn't matter whether 95% of the data gets through because of large signal strength (dB of power) or because of processing gain (dB of software)—the effect is the same. Anyone who thinks that Morse code is the best mode for adverse conditions has never heard of processing gain. You can actually get a usable signal that is *under the noise floor*! Try doing *that* with CW.

FCC limits and the TAPR STA

At this time, Part 97 of the FCC Rules limits the number and length of PN codes used by amateurs to a selected few, as

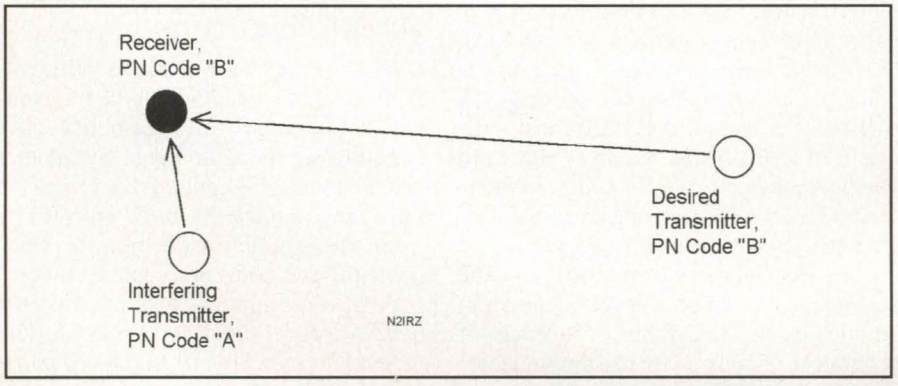


Figure 3. The FM capture effect. The stronger signal from the transmitter (a) "captures" the receiver's demodulator, effectively shutting out the desired signal from transmitter (b). This effect is well known from narrowband FM repeater operations, but it also affects direct sequence spread spectrum systems.

Hedy Lamarr, Spread Spectrum Pioneer?

It's hard to make people believe that the actress called "the most beautiful woman in the world" in 1940 was the first to hold an S/S patent—even when you show them the patent. But it's true!

Hedy Lamarr, for those of you who are baby boomers or younger, was a very popular and talented actress in the 1940s. Strongly anti-Nazi and concerned about the coming Hitler threat, she left her native Austria and her pro-Nazi arms-merchant husband in the late 1930s and came to America.

While making a career for herself in film, Ms. Lamarr and George Antheil, an accomplished American composer and musical innovator, got the idea for a "Secret Communications System" in which radio transmitters changed frequency rapidly to prevent the interception of messages. The 88-frequency system of frequency-hopping they sketched out was controlled by piano-roll strips (a piano has 88 keys). They were awarded U.S. Patent Number 2,292,387 on August 11, 1942.

Because the technology to implement the system did not exist, they let their patent rights lapse after the 17-year protection period had expired. A few years later, the Navy finally figured out a way to do it, and it wasn't until some 40 years after the war that the patent was declassified and the FCC allowed non-military use of S/S.

This information is based upon an Internet posting by David R. Hughes of Colorado Springs, Colorado. You can find out more about the S/S-Hedy Lamarr connection by visiting Phil Karn, KA9Q's Web page (see address elsewhere in this article) or "The Hedy Lamarr Page" at <http://www.geocities.com/hollywood/hills/1797/>.

well as the number of hopping frequencies. Ostensibly to allow the FCC to monitor communications for enforcement purposes, it really cripples our ability to use and experiment with S/S. Recognizing this, the FCC has granted Tucson Amateur Packet Radio (TAPR) a Special Temporary Authorization (STA) to experiment with S/S techniques presently prohibited on amateur frequencies. For more information on this project, including a list of presently-scheduled experiments and an application to be included on the STA (you have to be a TAPR member), visit the TAPR home page on the World Wide Web at <http://www.tapr.org>.

Some Problems

One problem, especially with direct sequence systems, is the FM capture effect discussed earlier. While this effect can be somewhat reduced by using a hybrid technique, this considerably complicates transceiver design. In cases where fixed stations are operating, the problem can be overcome by frequency (and PN code) coordination, judicious power levels, directional antennas, and plain old cooperation. However, where mobile operations are involved, the signal strengths vary wildly, and conventional control techniques are impractical. The answer is deceptively simple: *automatic power control.*

In a manner similar to the AMPS cellular telephone system used in North America, each receiver measures the signal-to-noise (S/N) ratio, and commands the other station's transmitter to increase or decrease its power. This ensures that the minimum power for effective communications is always used (that's in Part 97!), thus reducing the chance for, but not eliminating, the negative influences of the FM capture effect.

Power control is easier to implement than you think, especially with data communications. Some time ago, adding some power control bits to the AX.25 protocol was proposed, and work is in progress on that and many other improvements to AX.25.

Not Just for Data

It's important to remember that, while S/S is used for data transmissions, just about anything can be represented by data bits. One obvious application of S/S would be for dramatically increasing the

Dayton Weak-Signal Banquet

The VHF Weak Signal Group that meets Monday nights at 0200 UTC on 3.843 MHz would like to invite everyone who is coming to the Dayton Hamvention to our annual banquet. We have reserved a room, which will seat 150, for Friday night, May 16th, from 7:00 p.m. until 11:00 p.m. at the Holiday Inn North, Wagoner Ford Rd, Dayton, Ohio. There will be a cash bar as well as plenty of seating to allow you to mix and mingle with other VHFers from all over the country and the world. There will be over 50 prizes, including two grand prizes worth $300 dollars each. Drawings begin at 9:00 p.m. Also, there will be a guest speaker who will provide a short talk on VHF activity, plus a noise figure measuring table, so bring along your preamps for tweaking.

Tickets include the two-entree banquet dinner, and are $29.00 per person, limited to 150. You may order your tickets by sending $29.00 plus an SASE to either Tony Emanuele, WA8RJF, 7156 Kory Court, Concord Township, Ohio 44077, or Tom Whitted, WA8WZG, 4641 Port Clinton, East Rd., Port Clinton, Ohio 43452. Website info is at <http://WWW. WA8WZG.COM>.

This is one of the largest gatherings of VHF Weak-Signal enthusiasts in the U.S. so make sure to get your ticket early and join us for an enjoyable evening at the Dayton Hamvention!

"Anyone who thinks that Morse code is the best mode for adverse conditions has never heard of processing gain. You can actually get a usable signal that is under the noise floor! Try doing* that *with CW."

capacity of a voice repeater. Users could be on different, non-interfering "PN code channels" on the same machine, talking at the same time. High-efficiency *voice coding* techniques could considerably reduce the quantity required, and processing gain would reduce power requirements. Just think of how many "virtual" repeaters could exist, all on a single, wide-bandwidth machine! Of course it's somewhat complicated, both technically and politically, to actually do that, but it remains possible.

Less Interference AND Increased Efficiency

S/S is more than just a better way to pack more data into a given bandwidth. We have to not only be able to use the allocated bands when faced with interfering signals, but we must avoid interfering with the primary users of the band. S/S techniques offer a way of doing this, while giving us the added benefits of processing gain and greatly increased spectral efficiency.

I urge you to look further into S/S. The TAPR home page is a good start, as is any college library that has an engineering department. You can also take a look at some of the S/S-related links from Phil Karn, KA9Q's Web page, <http://www.qualcomm.com/people/pkarn/>. With the explosion of unlicensed Part 15 S/S transceivers in the commercial world, prices have plummeted for some S/S transceivers, often offering data rates of 115 kBaud or higher. These make perfect building blocks for high-speed data networks. Unfortunately, FCC rules make it difficult, even with the STA, to use these under Part 97, but they remain perfectly usable under Part 15, sometimes having a range of 15 miles or more!

The tools that we need for a high-speed digital network are out there. While they're still a little expensive, now is the time to experiment to find the best techniques, so that as prices fall, the amateur community will be ready to employ S/S to its fullest advantage.

"One obvious application of S/S would be for dramatically increasing the capacity of a voice repeater."

Looking Ahead

That's all the room we have for this month. Next month, I'll switch tracks a little and introduce you to FlexNet—the most popular packet networking system in Europe. It has numerous advantages over what we use in North America, and it can be considered another building block for higher-speed data networks. Until then, remember that this is a hobby and you should be having fun while learning new things with it.

73, N2IRZ

Notes

1. According to Carson's rule (*not* Johnny), the bandwidth of an FM system can be calculated with the equation BW = 2 (Fdev + Fh), where Fh is the highest frequency in the modulating signal, Fdev is the deviation of the FM signal, and BW is the resulting bandwidth.

2. Actually, PN Codes are carefully selected from groups of possible codes. They always have an equal (or nearly equal) number of ones and zeros, to preserve their noise-like quality, and are chosen to have a minimal chance of being misinterpreted as another code; in other words, they're selected to be highly orthogonal. Theoretical mathematicians like to amuse themselves by developing new families of PN codes.

Weak-Signal Worries about Spread Spectrum... and a Response

From the Editor:

The TAPR S/S experiments have been the subject of contentious debate, on the air, on the Internet, and even in the "Op-Ed" pages of this magazine. Many weak-signal operators, in particular, are worried that the increased noise floor caused by direct sequence S/S or by the every-five-seconds data "blip" of frequency-hopping will wreak havoc with their ability to copy signals that are barely above the noise level.

EME (Earth-Moon-Earth) communications, for example, routinely have path losses of nearly 300 dB and every additional dB of noise makes successful EME contacts more difficult. Meteor scatter (MS) contacts are made using extremely brief bursts of signal bouncing off an ionized meteor trail. An every-five-seconds data signal on an MS operating frequency would likely wipe out any chance of successful MS contacts.

S/S proponents counter that interference is not a given, and that one purpose of conducting the experiments under the TAPR STA is to determine what interference might result from S/S use on, say, 2 meters. Phil Karn, KA9Q, and Tom Clark, W3IWI, even presented a forum at last year's Central States VHF Society conference showing weak-signal operators how the processing gain of S/S could be used to improve such things as EME contacts.

We think Phil and Tom and CSVHFS are on the right track—there's certainly the potential for interference problems, but working together and respecting the value of all types of amateur communication greatly increases the chances that a compromise can be worked out that not only won't hurt either group's operating goals, but may enhance both in the process.

N2IRZ's Point of View:

While S/S *could* be operated in the weak signal portions of any given band, that's really impractically close to the band edges in most cases. In practice, the lower kHz of each band, where the weak-signal ops generally work, won't be affected at all. I envision that most S/S work will be in the repeater subbands, with frequency-hopping channels being between repeater channels. Most direct sequence channels, being about 1.25 MHz wide, would be confined to the centers of each band. So the potential for interference with weak-signal operations would be avoided.

Announcing

ARRL June VHF QSO Party, June 14–16, 1997

This is it, folks, the biggest VHF/UHF contest of the year! Even if you're not a contester, it's a good time to get on and see just how far you can talk...without using a repeater!

Here are the complete rules for the 1997 ARRL June VHF QSO Party, courtesy of the ARRL:

1) Object: To work as many amateur stations in as many different 2 degrees by 1 degree grid squares as possible using authorized amateur frequencies above 50 MHz.

2) Contest Period: Begins 1800 UTC Saturday, June 14, and ends at 0300 UTC Monday, June 16, 1997.

3) Categories:

(A) Single Operator: One person performs all operating and logging functions.

(1) Multiband.

(2) Single band: Single-band entries on 50, 144, 222, 432, 902, 1296, and 2304 and up categories will be recognized both in *QST* score listings and in awards offered. Contacts may be made on any and all bands without jeopardizing single-band entry status. Such additional contacts are encouraged and should be reported. Also see Rule 9, Awards.

(B) Single Operator, QRP Portable: Run 10-W output or less using a portable power source from a portable location. The intent of this rule is to encourage operation from "remote" locations, not to have home or fixed stations run low power.

(C) Rover: One or two operators of a single station that moves among two or more grid squares during the course of the contest. A rover vehicle may transport only one station using a single call sign; thus a rover may not operate with multiple call signs under the family rule 7 (C). Rover vehicles must transport all the equipment, power supplies, and antennas used at each operating site. This rule is not intended to prevent an operator from using the same call sign to submit separate logs for single operator (fixed station) and rover entries. Rovers sign "rover" on phone and /R on CW after their call sign. All Rovers are encouraged to adopt operating practices that allow as many stations as possible to contact them.

(D) Multioperator: Multioperator stations must locate all equipment (including antennas) within a circle whose diameter does not exceed 300 meters (1000 feet).

(E) Limited Multioperator: Multioperator stations that submit a maximum of four bands for score are eligible. Logs from additional bands used should be included as checklogs.

4) Exchange: Grid locator (see April 1994 *QST*, page 86). Example: W1AW in Newington, CT would send FN31. Exchange of signal report is optional.

5) Scoring:

(A) QSO points: Count one point for each complete 50- or 144-MHz QSO. Count two points for each 222- or 432- MHz QSO. Count three points for each QSO on 902- or 1296- MHz. Count four points for each 2.3-GHz-or-higher QSO.

(B) Multiplier: The total number of different grid squares worked per band. Each 2 degree by 1 degree grid square counts as one multiplier on each band it is worked.

(C) Final score: Multiply the total number of QSO points from all bands operated by the total number of multipliers for final score (see scoring example).

(D) Rovers only: The final score consists of the total number of QSO points from all bands times the sum of unique multipliers (grid squares) worked per band (regardless of which grid square they were made in) plus one additional multiplier for every grid square activated (made a contact from). Rovers are listed in the contest score listings under the Division from which the most QSOs were made.

6) Use of FM:

(A) Retransmitting either or both stations, or use of repeater frequencies, is not permitted. This prohibits use of all repeater frequencies. Contest entrants may not transmit on repeaters or repeater frequencies for the purpose of soliciting contacts.

(B) Use of the national simplex frequency, 146.52 MHz, or immediate adjacent guard frequencies is prohibited. Contest entrants may not transmit on 146.52 MHz for the purpose of making or soliciting QSOs. The intent of this rule is to protect the national simplex frequency from contest monopolization. There are no restrictions on the use of 223.50 MHz.

(C) Only recognized simplex frequencies may be used, such as 144.90 to 145.00; 146.49, .55 and .58; and 147.42, .45, .48, .51, .54 and .57 MHz on the 2-meter band. Local-option simplex channels and frequencies adjacent to the above that do not violate the intent of (A) or (B) above or the spirit and intent of the band plans as recommended in *The ARRL Repeater Directory*, may be used for contest purposes.

7) Miscellaneous:

(A) Stations may be worked for credit only once per band from any given grid square, regardless of mode. This does not prohibit working a station from more than one grid square with the same call sign (such as a Rover). Crossband QSOs do not count. Aeronautical mobile contacts do not count.

(B) Partial QSOs do not count. Both calls, the full exchange and acknowledgment must be sent and received.

(C) A transmitter or antenna used to contact one or more stations may not be used subsequently under any other call during the contest period (with the exception of family stations); one

operator may not give out contest QSOs using more than one call sign from any one location. The intent of this rule is to accommodate family members who must share a rig, not to manufacture artificial contacts.

(D) Only one signal per band (6, 2, 1 1/4, etc.) at any given time is permitted, regardless of mode.

(E) While no minimum distance is specified for contacts, equipment should be capable of real communications (i.e., able to communicate over at least 1 km).

(F) Multioperator stations may not include QSOs with their own operators except on frequencies higher than 2.3 GHz. Even then, a complete, different station must exist for each QSO made under these conditions.

(G) A station located precisely on a dividing line between grid squares must select only one as the location for exchange purposes. A different grid-square multiplier cannot be given out without moving the complete station (including antennas) at least 100 meters.

(H) Above 300 GHz, contacts are permitted for contest credit only between licensed amateurs using coherent radiation on transmission (e.g., laser) and employing at least one stage of electronic detection on receive.

(I) Marine Mobile (and Maritime) entries will be listed separately as "Marine Mobile" in the score listings and compete separately for awards.

(J) Participants are reminded that the segment 50.100-50.125 MHz is by convention reserved for intercontinental QSOs only.

8) Reporting:

(A) Entries must be postmarked no later than 30 days after the end of the contest. No late entries can be accepted. Use ARRL June VHF QSO Party forms, a reasonable facsimile, submit your entry on diskette, upload your entry to the ARRL BBS, or send your entry to ARRL HQ via Internet.

(1) Official entry forms are available from HQ in the *ARRL Contest Yearbook*.

(2) You may submit your contest entry on diskette in lieu of paper logs. The floppy diskette must be IBM compatible, MS-DOS formatted, 3.5 or 5.25 inch (40 or 80 track). The log information must be in an ASCII file, following the ARRL Suggested Standard File Format, and contain all log exchange information (band, mode, date, time in UTC, call of station worked, exchange sent, exchange received, multipliers [marked the first time worked] and QSO points). One entry per diskette. An official summary sheet or reasonable facsimile with signed contest participation disclaimer is required with all entries.

(3) You may submit your contest entry via the ARRL BBS (860-594-0306), via Internet to contest@arrl.org, or anonymous FTP to ftp.arrl.org. Send your summary sheet file (Make sure it includes all the pertinent information outlined in the official ARRL summary sheet.) and your log file following the ARRL Suggested Standard File Format.

(B) Logs must indicate band, mode, date, time in UTC, calls and complete exchanges (sent and received), multipliers and QSO points. Multipliers should be marked clearly in the log the first time they are worked. Entries with more than 200 QSOs total must include cross-check sheets (dupe sheets). Send entries to: ARRL Contest Branch, 225 Main St, Newington, CT 06111.

9) Awards:

(A) Plaques (if sponsored) will be awarded in the following categories:

(1) Top ten single operator scorers

(2) Top five single operator QRP portable scorers

(3) Top rover scorer

(4) Top ten multioperator scorers

(5) Top five limited-multioperator scorers

(B) Certificates will be awarded in the following categories:

(1) Single operator

(A) Top single-operator score in each ARRL/Canadian Section.

(B) Top single operator on each band (50, 144, 222, 432, 902, 1296 and 2304-and-up categories) in each ARRL/ Canadian Section where significant effort or competition is evidenced. (Note: Since the highest score per band will be the award winner for that band, an entrant may win a certificate with additional single-band achievement stickers.) For example, if WB0EM has the highest single- operator all-band score in the Iowa Section and his 50- and 222-MHz score are higher than any other IA single-op's, he will earn a certificate for being the single-operator Section leader and endorsement stickers for 50 and 222 MHz.

(C) Top single-operator QRP portable in each ARRL/Canadian Section where significant effort or competition is evidenced. QRP portable entries are not eligible for single-band awards.

(2) Top rover in each ARRL/ Canadian Section where significant effort or competition is evidenced. Rover entries are not eligible for single-band awards.

(3) Top multioperator score in each ARRL/Canadian Section where significant effort or competition is evidenced. Multioperator entries are not eligible for single-band awards.

(4) Top limited-multioperator score in each ARRL/ Canadian Section where significant effort or competition is evidenced. Limited-multioperator entries are not eligible for single-band awards.

10) Condition of Entry: Each entrant agrees to be bound by the provisions, as well as the intent, of this announcement, the regulations of his or her licensing authority and the decisions of the ARRL Awards Committee.

11) Disqualification: See Contest Disqualification Criteria for details.

Scoring Example

Band (MHz)	QSOs Points	QSO Squares	Grid
50	25 (x1)	25	10
144	40 (x1)	40	20
222	10 (x2)	20	5
432	15 (x2)	30	10
1296	6 (x3)	18	3
Totals	96	133	48

Final score = (QSO points) X (total no. grid squares): (6384 = 133 x 48).

Operating the Digital Satellites—Part 4: The 9600-bps Birds

The fastest birds in the ham radio sky, these three digital satellites help make the packet network truly worldwide.

In the first three parts of our series on digital (packet) satellites, we've discussed the nature of digital information and working satellites with standard 1,200-baud packet (February '97 *CQ VHF)*; sending messages through the 1,200-baud "PSK" satellites (March), and the special packet protocol—the PACSAT Protocol Suite—used for communicating with many of the digital satellites (April). This month we'll explore the most frequently used and the fastest digital amateur satellites—UO-22, KO-23 and KO-25, all of which were "born" at the University of Surrey in England (if the names confuse you, see "UOs and KOs" elsewhere in this article).

These three satellites communicate with ground stations in full duplex (simultaneous bidirectional communication) at 9600 bps. It's not uncommon using these satellites to capture 900 kilobytes of data in a single pass—far more than you're likely to get on one of the 1200-bps "pacsats."

Since all of the UoSATs and KITSATs have a common ancestry, they all basically share the same external design (see Figure 1) and some internal functions. The satellites themselves measure 35 x 35 x 65 centimeters (14 x 14 x 26 inches) and weigh about 48.5 kilograms (107 pounds). And while each one has its particular set of experiments (see Table 1), they all contain the same store-and-forward mail system and camera function. Let's take a closer look at each of those, starting with the camera.

Photos on a Gravity Gradient

Each of the satellites carries at least one camera to photograph the Earth. The satellite control system transmits the resulting digital pictures to interested satellite operators on the ground. It's important that the camera is facing the Earth when pictures are taken and that the antennas are pointing toward Earth to transmit the data reliably. To help ensure this, all the satellites were designed with something called a *gravity gradient boom.*

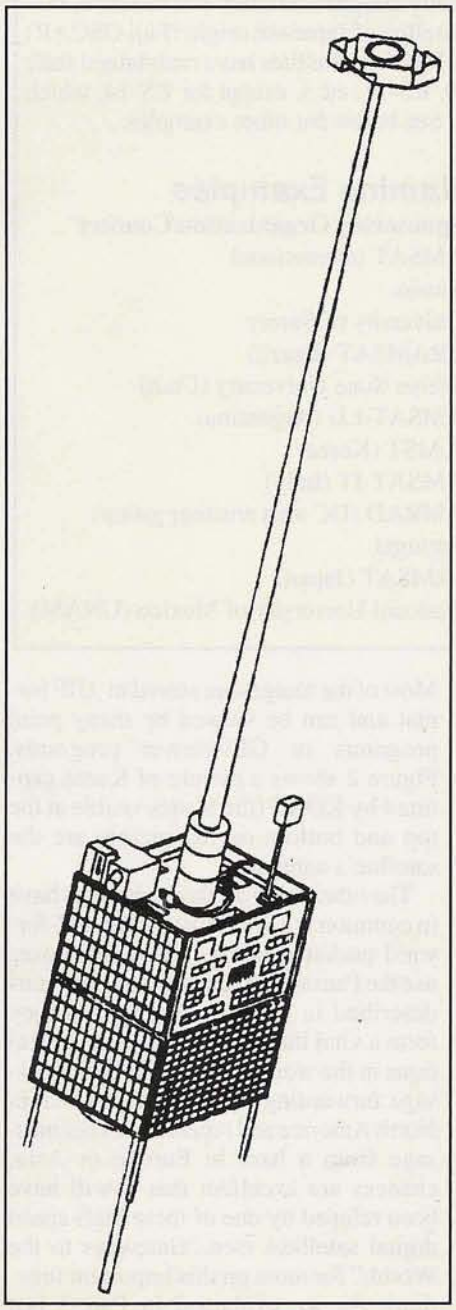


Figure 1. A 9600-bps digital amateur satellite. The boom in this image is actually extended to only one-third of its full length.

This boom, in conjunction with onboard electromagnets in each face of the satellite, reacts with the Earth's magnetic field to keep the satellite camera pointing down. The boom points into space and the antennas are kept *nadir pointing* (pointing toward the Earth). The onboard control system determines which magnets to pulse, and when, in order to keep the spacecraft properly oriented.

Figure 1 shows the boom partially deployed at about a third of the way. Once the satellite is in orbit, this boom is permanently deployed to a length of 600 centimeters (approximately 20 feet, or about two thirds longer than what's pictured).

Cameras and Mailboxes

The cameras aboard the UoSAT/KITSATs are CCD (charged coupled device) cameras. CCDs are semiconductors that produce a digital value in response to various light levels. They make possible the small, inexpensive handheld videocameras and very small security cameras commonly in use today.

A CCD camera is made up of a large number of individual cells that capture a

By G. Gould Smith, WA4SXM

UOs and KOs

Satellites designed and built by the Department of Electrical Engineering at the University of Surrey, in England, are known as UoSATs (University of Surrey SATellites); satellites launched by the Korea Advanced Institute of Science and Technology (KAIST) are known as KITSATs. The prefix UO stands for UoSAT-OSCAR; and KO for Korean or KITSAT-OSCAR. All three of these satellites had their origin at Surrey, where KAIST students learned the technology that went into KO-23, then brought it home and put it into practice building KO-25. (UO-22 is also known as UoSAT-5, the fifth satellite built there, and KO-23 and KO-25 are also referred to as KITSAT-A and KITSAT-B, respectively.)

All of the amateur satellites have two or more names. Multiple names are not given intentionally to make things more complicated for beginners, it's just that different groups tend to use their own naming conventions. The basic AMSAT convention for naming the amateur satellites is to first identify the sponsoring group or country, followed by OSCAR (for Orbiting Satellite Carrying Amateur Radio), a dash to separate, and finally an internationally assigned number. For instance, FO-29 tells us that this satellite is an amateur satellite of Japanese origin (Fuji OSCAR) and the 29th amateur satellite. Most of the Russian satellites have maintained their own name and numbering scheme (RS-10, RS-15, etc.), except for RS-14, which was also given the AMSAT name AO-21. See below for other examples.

AMSAT Satellite Naming Examples

Satellite	Prefix	Sponsoring Organization/Country
AO-10	AMSAT OSCAR	AMSAT international
RS-10	Radio Sputnik	Russia
UO-11	UoSAT OSCAR	University of Surrey
DO-17	DOVE	BRAMSAT (Brazil)
WO-18	Weber OSCAR	Weber State University (Utah)
LO-19	LUSAT OSCAR	AMSAT-LU (Argentina)
KO-23	KITSAT OSCAR	KAIST (Korea)
IT-26	ITAMSAT	AMSAT-IT (Italy)
AO-27	AMRAD OSCAR	AMRAD (DC area amateur group)
PoSAT		Portugal
FO-29	Fuji OSCAR	JAMSAT (Japan)
MO-30	Mexico OSCAR	National University of Mexico (UNAM).

picture as an array (like a wall of post office boxes) of light levels. Each "box" in the array stores a different light level and is called a *pixel*. These pixels together represent an image, like the dots that make up a newspaper photograph or the similar pixels that form an image on your computer monitor.

The combination of the number of pixels (horizontal and vertical) and the altitude of the satellite determines the resolution of the picture. For instance, UO-22 has resolution of about 2 kilometers per pixel. KO-23 has both a higher orbit and two cameras; its wide area camera has a resolution of 4 kilometers per pixel, and its narrow-field camera has a resolution of 400 meters per pixel.

Representative images taken by the satellites can be found on many computer bulletin boards (packet and landline), ham radio CD-ROMs, and the Internet. Most of the images are stored in .GIF format and can be viewed by many paint programs or GIF-viewer programs. Figure 2 shows a picture of Korea captured by KO-23 (the blades visible at the top and bottom on the picture are the satellite's antennas).

The other thing all three satellites have in common is a 9600-baud store-and-forward packet mailbox. These mailboxes use the Pacsat Protocol Suite of programs described in previous issues, and they form a vital link in the chain of relay stations in the worldwide packet radio message forwarding network. If you live in North America and receive a packet message from a ham in Europe or Asia, chances are excellent that it will have been relayed by one of these high-speed digital satellites (see "Gateways to the World," for more on this important function). As we explained in Part 3 last month ("Using 'PB/PG' and 'WiSP'"), users don't "connect" to the satellite mailboxes as they do with terrestrial packet bulletin boards (PBBSs), but use special programs and protocols to transfer the most possible information during the limited time of each satellite "pass." (See Table 2 for frequencies and callsigns of each of the 9600-bps digital satellites.)

Setting Up Your 9600-bps Station

Figure 3 shows the basic block diagram of the equipment needed for a 9600-bps satellite station. FM is used on both the 2-meter uplink and the 70-centimeter downlink, and the majority of 2-meter FM radios with 25-watt outputs are capable of being used for the uplink. Note that the downlink is around 435 MHz, and not every 70-centimeter FM rig covers this part of the band.

The antennas and computer programs ("PB/PG" or "Wisp," see last month's "Orbital Elements") are the same as for the 1200-bps PSK satellites. If you're all set for those birds, *and* your radio has a 9600-bps connector, the only new equipment you'll need for this mode is a 9600-bps modem or a DSP (digital signal processing) unit to convert the data.

Yikes! Radio Modifications?

If, however, you *don't* have one of the newer radios with a 9600-bps connector, your radio will have to be modified before you can work 9600-bps!

Most amateur radio transceivers (as well as telephones) have been designed for voice transmissions using only frequencies less than 3 kHz. A 1200-bps digital signal fits nicely within this voice band. So, it's a simple matter to just insert the 1200-bps transmit data into the microphone connector and get the audio from the speaker jack. But optimizing the radio for speech presents a major problem for 9600-bps digital data. Filters prevent both the transmit and receive data from getting into or out of the transceiver in a

If you don't have one of the newer radios with a 9600-bps connector, your radio will have to be modified before you can do 9600-bps operation!

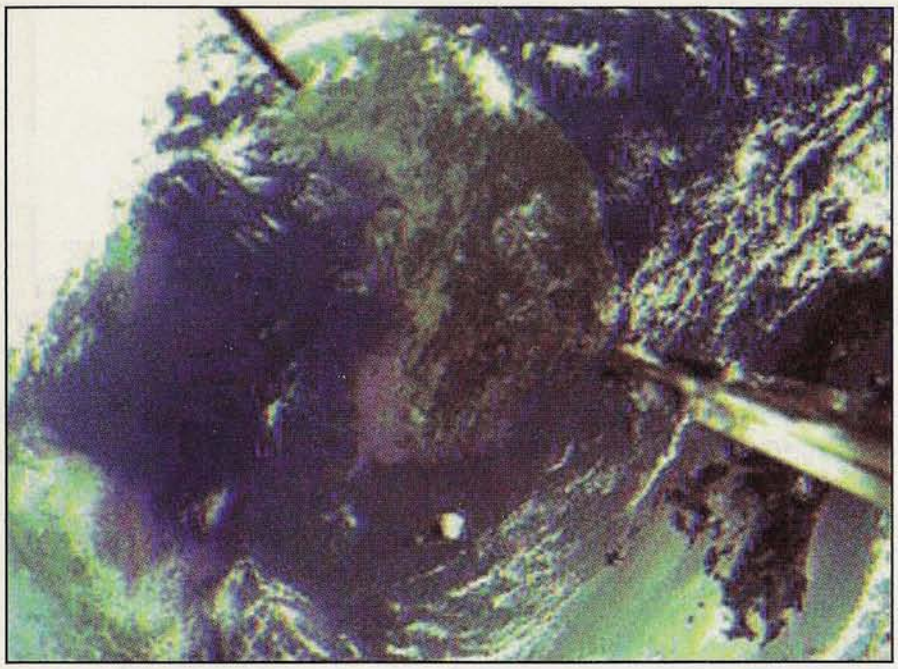


Figure 2. Picture of Korea taken from space by KO-23.

usable form. This is why the radios need to be modified.

These modifications involve: 1) locating the discriminator in the receiver section and taking the digital data from this point; and 2) modifying the transmitter section to allow you to inject the digital data into the varactor.

It's not a terribly difficult task and there are many descriptions of exactly how to do these modifications (see "Resources"). But the proliferation of surface mount devices in these radios adds additional challenges to this modification.

Hear What Signal?

Once you've made the "mods," you'll be ready to start listening for some 9600-bps signals.

If you've never heard a 9600-bps satellite signal, you're in for a big surprise. You *can't* hear it! You find the signal by tuning to the *quietest* place within about 20 kHz of where the downlink should be (*Doppler shift*—the apparent change in frequency caused by the movement of the satellite in relation to your station—causes the receive frequency to move around). The 70-centimeter band is very quiet compared to the lower frequency bands. Nevertheless, you'll be able to tell when the 9600-bps signal from the satellite causes sound from the speaker to become even quieter. For these satellites you tune for the *lack of sound*.

Your tuning will be greatly aided if your radio has a discriminator meter, in which case you simply center the needle. If you don't have one, tune around that quietest area and watch for the DCD light on your modem to lock onto the carrier. If you're manually tuning or tracking, keep the DCD LED illuminated and listen for the noise to return. If you hear the noise coming back, you're losing the satellite signal.

This loss of signal can be caused by incorrectly tuning the signal, by the antenna not tracking the satellite exactly, or by both problems simultaneously. And, the higher the receive frequency, the faster the Doppler shift will appear to change the receive frequency. You'll find yourself tuning much more often to track a 70-centimeter downlink signal than a 2-meter downlink.

There is equipment available that will calculate the Doppler shift and change the receive frequency of the radio and automatically control your antennas to track the satellite. But I recommend that you try operating manually at first. Starting out with automatic tuning and tracking adds an additional layer of complexity. Start simply, decrease the variables, and learn the system. If you understand the system, you can isolate any problems much more quickly. Then, when you're comfortable operating the satellite manually, you can add new features one at a time and eventually automate your station entirely.

Reminder: The Troubleshooting Tape

It's important to realize that 9600 bps is *different* from 1200, not just faster, since it creates new and different station requirements. While you can "cookbook" many of the pieces together, and there's a good chance you'll be able to work these satellites to some extent, there's also a greater likelihood of running into problems.

Table 1. Satellite Capabilities

While they all look the same on the outside, the UO-22, KO-23, and KO-25 satellites each have a unique set of capabilities. Here's a brief rundown:

UO-22 (launched 7/91)
- 9600-bps PACSAT Protocol Suite store-and-forward mailbox
- Earth Imaging System (EIS)

KO-23 (launched 8/92)
- 9600-bps PACSAT Protocol Suite store-and-forward mailbox
- High Resolution Earth Imaging System (EIS) Camera
- Digital Signal Processing Experiment (DSPE)
- Cosmic Ray Experiment (CRE)

KO-25 (launched 9/93)
- 9600-bps PACSAT Protocol Suite store-and-forward mailbox
- CCD Earth Imaging System (EIS)
- Infrared Sensor Experiment (IREX)
- KASCOM (KAIST Satellite Computer)
- Digital Signal Processing Experiment (DSPE)
- Low Energy Electron Detector (LEED)

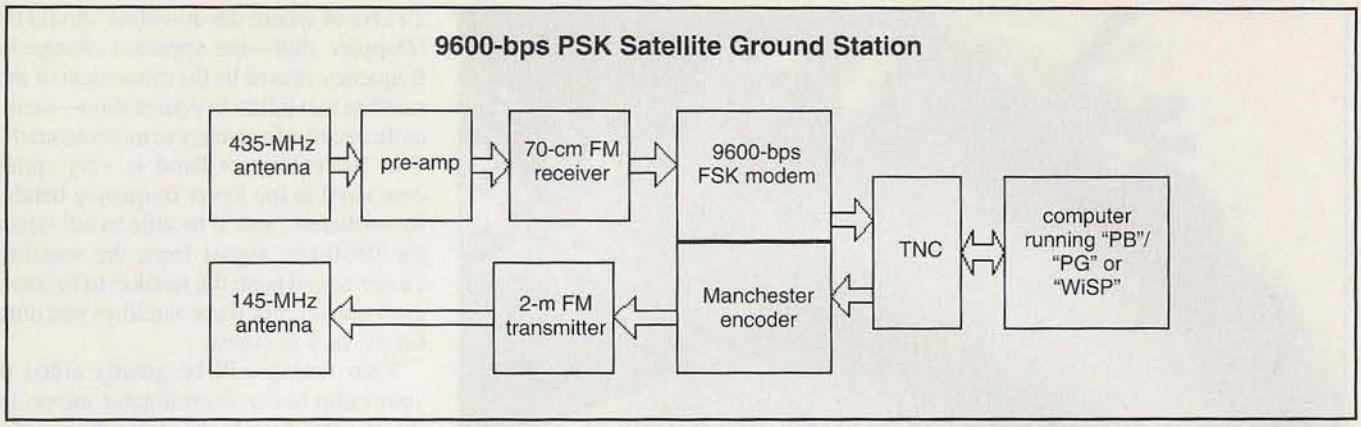


Figure 3. Block diagram of a typical 9600-bps satellite ground station.

Table 2. 9600-bps Satellites, Frequencies, and Calls

Satellite	Uplink	Downlink	bdcstcall	bbscall
UO-22	145.900	435.120	UoSAT5-11	UoSAT5-12
	145.975			
KO-23	145.850	435.175	HL01-11	HL01-12
	145.900			
KO-25	145.980	436.500	HL02-11	HL02-12
	145.870	435.175		

Q & A *(from page 59)*

here's something that I encountered just today that I am quite puzzled about.

While waiting on my normal contact with my girlfriend, I received a chat request from BV4OQ in Taipei. We chatted, rather sporadically, and he requested a QSL card. I was flattered. This, to my eyes, was a DX contact, less the antenna. I assured him I would send something and then ended the contact, heading off for work. As I drove, I wondered how I was going to report the QSO. It was most assuredly an amateur-based contact, but not on any mode of transmission that could be truly reported as a ham radio contact.

I asked some local OMs on the machine what I should do. They informed me that the Internet was not a method of communication that was reportable, and that I should send a postcard and nothing else. I had assured Tony that I would QSL.

Realizing that I have made an error, I am now stuck with a promise that I cannot keep. Any suggestions?

Hatton Humphrey, KC5SIG
Durant, Oklahoma

A: Yes. Send him the QSL card. In the spaces marked for frequency and mode, write "Via Internet." No, the card won't count toward any awards, nor will his count for you. Virtually every ham radio award requires that contacts be made by ham radio only, and generally without any relay devices. Since there was no direct, on-air contact from his station to yours, it's not a valid QSO for award purposes. But the key phrase here is "for award purposes." If you're not going to use that card in applying for an award, there's no reason whatsoever that you shouldn't exchange cards with him.

Now, as for your parents and coax, you should be able to find a way to run your feedline unobtrusively and there are ways to disguise most anything so it's not noticeable (I'm not suggesting that you try to deceive your parents, just that the cable can be concealed so that it's not in anyone's way and nobody even notices that it's there). Maybe some of the local hams can help you work something out with them.

Do YOU have a question about any aspect of "Ham Radio Above 50 MHz"? We'll do our best to give you a clear, concise answer—or if it's not a question that has just one easy answer, then we'll invite readers to offer their solutions. Send your questions to: Q & A, *CQ VHF* magazine, 76 N. Broadway, Hicksville, NY 11801; via e-mail to <CQVHF@aol.com> or <72127.745@compuserve.com>; or via our Web page at <http://members.aol.com/cqvhf/>. Be sure to specify that it's a question for "Q & A."

"If you've never heard a 9600-bps satellite signal, you are in for a big surprise. You can't hear it! You find the signal by tuning to the quietest place within about 20 kHz of where the downlink should be."

One of the biggest frustrations, when trying to figure out why you didn't get any data during a pass when you saw a strong signal at the transceiver is that, once the pass is over, you no longer have a signal to work with. For this reason, I'll repeat a suggestion from last month and strongly recommend that you record a strong pass on a HiFi VHS videotape (an audio cassette won't work), and use it to debug your system.

A Look Ahead

One digital mode we haven't discussed so far is 400 bps PSK. While there are no satellites using this mode at this time, the Phase 3D satellite (P3D) has the capability for this and many new digital modes. Once P3D is launched, I'll discuss this mode and introduce the others as they become operational.

Next month, we'll complete the digital satellite series with a look at the current "Grand Dame" of amateur satellites, UO-11. This venerable old bird was launched

"...I recommend that you try operating manually at first. Starting out with automatic tuning and tracking adds an additional layer of complexity."

Gateways to the World

A growing use of the 9600-bps satellites is for relaying traffic between *gateway stations*. Gateways are stations that transfer terrestrial packet data to the satellites and get messages from the satellites and put them into the terrestrial packet network. Most of the messages that the satellite gateways handle are going out of or coming into the U.S. Satellite UO-22 appears to be used more for gateway operation than do KO-23 or KO-25.

Take a look at the directories in Figure 4, and you'll notice the large number of gateway addresses during this UO-22 session. Also notice the wide variety of messages and the large number of international calls in both listings. These truly are international satellites.

View-Dir [UO-22]

File Setup Search Message Satellite

Changes to the directory | P | A | 1 | 2 | 3 | G | N

FileNum	S	To	From	Upload Time	F Size	% Title
5ECAC	N	GATEWAY	GB7LDI	1829 23Feb97	72224	GB7LDI GBR EAST SATGA
5ECAB	N	GATEWAY	GB7LDI	1334 23Feb97	12629	GB7LDI GBR EAST SATGA
5ECAA	N	GATEWAY	LA9SAT	1326 23Feb97	2955	LA9SAT NOR SATGATE
5ECA8	N	ARGNET	LU1HKO	1229 23Feb97	1631	cb2314t1.zip
5ECA7	N	GATEWAY	XQ2FOD	1224 23Feb97	1222	XQ2FOD CHILEAN SATGAT
5ECA6	N	GATEWAY	PY2GN	1215 23Feb97	9483	PY2GN BRAZIL SATGATE
5ECA5	g	F1SMV	F1TIV	1203 23Feb97	541	le retour ..2
5ECA3	N			2359 23Feb97	54754	WD022384
5ECA1	N	GATEWAY	GB7LAN	1156 23Feb97	24599	GB7LAN GBR-NORTH SATC
5ECA0	N	GATEWAY	JA6FTL	1128 23Feb97	3863	JA6FTL ASIA NET SATGA
5EC9E	g	F6CEE	F6HLG	1023 23Feb97	793	80 m
5EC9C	g	IK0NGL	I0WBX	1020 23Feb97	392	hello
5EC9A	g	F3ZD	F6HLG	1017 23Feb97	958	Re: ton msg.du 16/02
5EC99	N	GATEWAY	ON4KVI	1022 23Feb97	59332	ON4KVI BELGIAN SATGAT
5EC98	g	DJ3OC	DC2AO	1018 23Feb97	763	Gruesse
5EC94	N	GATEWAY	F6FBB	0838 23Feb97	4567	F6FBB FRANCE SATGATE
5EC93	g	UA0SNU	UA3CR	0838 23Feb97	1179	to rk9cww
5EC92	g	DK1TB	DL9BU	0834 23Feb97	1111	WinWisat/Tb
5EC91	g	LA6KJ	LA5QIA	0834 23Feb97	627	E-mail
5EC90	g	UA0SNU	UA3CR	0833 23Feb97	1136	path
5EC8F	N	GATEWAY	ZS1ABM	0719 23Feb97	14894	ZS1ABM S.AFRICA SATGA
5EC8E	g	UA0SNU	UA3CR	0835 23Feb97	113664	mail23a.msg
5EC8D	g	FO5GA	AD4EB	0452 23Feb97	34737	Re: WKCIDRU Request
5EC8B	N	GATEWAY	NR3U	0317 23Feb97	25457	NR3U MID-ATLANTIC SAT
5EC88	N	GATEWAY	N8DEU	0307 23Feb97	4540	N8DEU SEUSA SATGATE
5EC82	g	VK2AIT	VK3AHJ	0042 23Feb97	999	E-MAIL
5EC81	N			1439 23Feb97	39312	OA970223
5EC7F	N	JA6ZZC	JA6VOY	0021 23Feb97	596	test

View-Dir [KO-25]

File Setup Search Message Satellite

All files | P | A | 1 | 2 | 3 | G | N

FileNum	S	To	From	Upload Time	F Size	% Title
CE5B	N			0300 24Feb97	2574	AK970224
CE5A	g	G1OCN	G0JUL	2356 23Feb97	845	Hav'nt forgotten
CE59	g	LA6KJ	LA5QIA	2216 23Feb97	664	Storm igjen..
CE58	g	LA5QIA	LA1HU	2215 23Feb97	861	Printkort etc.
CE57	g	LA5QIA	LA1HU	2215 23Feb97	833	Artikkel
CE56	g	IK6IHH	IK6IHH	2212 23Feb97	734	PROVA WAV
CE55	g	F1TIV	F1SMV	2042 23Feb97	557	RE/LE RETOUR
CE54	D	ALL	IK8OZV	2037 23Feb97	986	File request pse.
CE53	N	F5NSF	F5NSF	2032 23Feb97	756	Test
CE52	g	I0WBX	IK0NGL	2031 23Feb97	790	Re: ciao
CE51	g	WB2REM	W3ETT	1736 23Feb97	673	andre
CE50	g	VE4LU	VE3BCG	1733 23Feb97	1008	re:update
CE4F	g	G3SBP	4S7AVR	1703 23Feb97	781	Re: dave
CE4E	g	KB2MVN	AD4EB	1607 23Feb97	658	Visit
CE4C	g	LU3DXU	LU4FIO	1306 23Feb97	1023	REGISTRACION
CE4B	g	LU1HKO	LU5HJD	1300 23Feb97	10538	FWD
CE49	g	GW0RHC	G4CFW	2217 23Feb97	791	Thanks
CE46	g	F1SMV	F1TIV	1049 23Feb97	661	S O S
CE45	g	IK6MSM	I6CGE	0919 23Feb97	1099	in portatile
CE43	g	I0WBX	IK0XBQ	0915 23Feb97	341	START
CE42	g	F1SMV	F1TIV	0910 23Feb97	430	essai
CE41	g	UA0SNU	UA3CR	1859 23Feb97	738828	mail2302.msg
CE40	g	WA5LUG	W0SL	0340 23Feb97	1300	Re: View-Dir.EQN
CE3F	g	K4UJA	KK4XZ	0339 23Feb97	1236	Re: Hello
CE3E	g	PY2GN	ZX0ECF	0312 23Feb97	4938	
CE3D	N			0040 24Feb97	1391	EL970223

Figure 4. Sample directories of UO-22 and KO-25 from the "WiSP" program DirView.

way back in 1984 and is still functioning 13 years later!

Meanwhile, I encourage you to learn more about the 9600-bps satellites. They offer great data transfer rates and interesting technical challenges. Take your time getting operational and learning how the system operates and you'll be rewarded with a great sense of accomplishment and a great deal more knowledge.

Resources

More information about the University of Surrey program and their satellites can be found on the World Wide Web at <http://www.ee.surrey.ac.uk:80/CSER/UOSAT/index.html>. Information about the KAIST program can be found at <http://satrec.kaist.ac.kr>.

The January/February 1993 issue of the *AMSAT Journal* has a very good article by Walter Daniel, N3KVQ, entitled "Computer Processing of UO-22 and KO-23 Images," for those wishing more information about the Earth photos taken by these satellites.

If you're interested in the design and theory of 9600-bps operation (something good to understand when things don't work), the ARRL has a relatively new book called *Packet: Speed, More Speed and Applications*. This is a collection of articles about advanced packet operation and is a very interesting and understandable book. In addition, AMSAT offers the *AMSAT-NA Digital Satellite Guide* to assist you in selecting and setting up your system. But best of all is the network of AMSAT volunteers who are willing to provide advice and to assist you. A current list can be found on the AMSAT Web site (see below) or some local help can be found by calling the AMSAT office at (301) 589-6062.

Finally, the AMSAT World Wide Web site has modification instructions to make certain popular radios (FT-736, IC-275, IC-820, IC-970 and the TS-790) work with 9600-bps data. These instructions can be found at <http://www.amsat.org> in the FTP area under "mods." In addition, the TAPR (Tucson Amateur Packet Radio) Web site has a list of 9600-bps modifications for many older radios in its DSP section. You'll find these at <http://www.tapr.org>. There are even a number of modifications described in the ARRL's *Packet: Speed, More Speed and Applications* (see above).

Don't Fault the ARRL Survey for the Sample Size

In our March editorial, we took the ARRL to task for drawing conclusions about the opinions of all amateurs based on a survey covering 1/10 of 1% of licensed hams. KM7W says we were off-base.

This is in response to your editorial concerning the ARRL survey. ("Line of Sight," March, 1997, *CQ VHF*) Let me state first that I have not seen this particular document. Your editorial, however, seemed to question the validity of the survey, based solely on the sample size used.

Statistics theory would disagree with you. I do not have my textbooks in front of me, but I would guess the survey (using the numbers given in your editorial) to have a margin of error of around 1%. This means that, had the entire population been surveyed, the resulting percentages would not have changed by more than +/- 1%.

National Polls: a Much Smaller Sample

If you consider national polls, the standard sample size is approximately 1,500, which produces a margin of error of +/- 3%. How can such a small sample size accurately represent the views of (give or take) 225 million Americans? The sample size used in national polls represents 0.000006 (6/1,000,000, or 6/10,000 of one percent) of the population. Yet, with such a small sample size, the margin of error is still only +/- 3%.

I do not believe anyone can fault the ARRL for their sample size. If we assume, for the sake of argument, that the sample size chosen has a margin of error of +/- 3%, then the minimum number of non-ARRL member amateurs favoring a code requirement is 51%. The minimum for ARRL members would be 60%. As you state, the "overall" support figure of 57% isn't valid, but not because of the sample size; rather, the math is in question.

"The sample size used in national polls represents 0.000006 (6/1,000,000, or 6/10,000 of one percent) of the population. Yet, with such a small sample size, the margin of error is still only +/- 3%."

Given that each is a valid survey, with a similar margin of error, then all we have to do is weight the percentages. You give a 23% to 77% member to non-member rate. So, the overall support for the code requirement, using the minimums above, would be (60% x .23)+(51% x .77), or 53.1%. If one used the survey results at face value, the resulting support would be 56.1% (see the 3% margin of error recurring again?).

Statistics: The Way of the World

Statistical theory is the way of the world. As an accountant and CPA, I use statistics to audit large businesses. My firm samples small sizes, like 80 of 10,000 transactions, in order to form a statistically valid measure of the financial statement caption. Think about your own auditors at CQ. I do not know who they are, but I am quite sure they use some sort of statistical basis to avoid examination of every transaction.

Thus, we conclude that the survey is statistically valid. Note (please) that I do not include criticisms of how the questions were worded—and neither did you. But the wording of the questions would be the only factor by which the survey could be criticized.

Since the faulty assumption on your part made the bulk of your reasoning in your editorial, I can only say the conclusions you reach about the survey and its use are invalid. It does indeed show strong support for the code requirement, both among ARRL and non-ARRL members.

Morse Code = Broccoli

Having said all that, I am one who disagrees with the code proficiency requirement, but believes a Morse recognition requirement should be maintained. Because of our proficiency requirement, we as amateurs have made Morse code the "broccoli" or "spinach" of radio modes. To this day, I refuse to eat broccoli and spinach because they were forced on me. Had they been offered to me, rather than forced, I may have even learned to love them. Morse and CW are similar. We

Marty Watt, KM7W, holds an Extra class license and operates VHF and HF (mostly QRP) from Jackson, Tennessee.

By Marty Watt, KM7W*

actually drive people away from the mode, who otherwise might love it.

I believe Morse to be an integral part of CW, as it is the standard encoding method. We can test the mode much as we test RTTY or other digital modes. We have questions about shifts of RTTY signals, why not questions on the theory exam to recognize the combination "di-dah-di-dit" as the letter "L"?

The idea of having an "apprentice period" of say six months is appealing. Having an Elmer sign off on a 610 form might help. Yet then, people would shop for the "easy" Elmer, unless some sort of standards were in place.

"Having said all that...we as amateurs have made Morse code the 'broccoli' or 'spinach' of radio modes. To this day, I refuse to eat broccoli and spinach because they were forced on me."

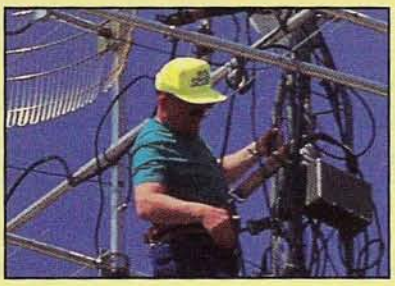
I am not sure what the answer is. I do know, however, that the requirements will not change until the views of the population of licensed amateurs change. That population will not change unless those who favor a codeless HF license buckle down and learn the code, realizing that once they do, they can then influence opinion. Sometimes you have to suffer, and do things you do not like, in order to clear the way to eliminate the burden for others. That is leadership. ■

• • •

The opinions expressed in this column are those of the author and do not necessarily reflect the views of CQ VHF *or its publisher, CQ Communications, Inc.*

If you have an opinion on this issue or another matter of importance to the VHF ham community, we'd like to hear from you. Well-reasoned, well-written commentaries will be considered for our Op-Ed page. If we publish your Op-Ed article, we'll give you a complimentary one-year subscription (or extension of your current subscription) to CQ VHF. *Submissions not accepted for the Op-Ed page may also be considered for Letters to the Editor.* CQ VHF *reserves the right to edit all submissions for length and style.*

"Since the faulty assumption on your part made the bulk of your reasoning in your editorial, I can only say the conclusions you reach about the survey and its use are invalid."



On the Cover

Jeff Bishop, W7ID, loves to put Idaho on the moon! He's been operating EME (Earth-Moon-Earth, or moonbounce) from his home in Boise since 1980—so far working 147 different stations in all 50 states and a bunch of countries besides (and that's just on 2 meters!). The antenna array you see on the cover launches Jeff's signals to the moon on three bands: 2 meters, 432 MHz, and 1296 MHz.

The biggest antennas are four 17-element KLM 17-LBX Yagis for 144 MHz (all of Jeff's antennas are from KLM). Inside that array are four 31-element Yagis for 432 MHz, and inside *that* array are two 44-element Yagis for 1296 MHz. Inside the shack, Jeff has all ICOM radios and home-built amplifiers. He puts out 900 watts on 6 meters (his 6-meter antenna is on a different tower), 1500 watts on 2 meters, 900 watts on 432, and 125 watts on 1296.

Jeff says his interest in EME was sparked by his preparations to work a satellite that never reached orbit. Back in the 1970s, Jeff says, he was very active on OSCARs 6 and 7, and built an array of four antennas in order to better work the Phase 3A satellite once it was launched. Unfortunately, that satellite was lost in a launch accident, and Jeff turned to using his new antennas for terrestrial VHF contacts. Then, he says, "In the middle of one night, I got up to go to the bathroom, and I saw the moon sitting on the horizon, about to set. I decided to fire up the radio and see if I could hear my echoes. I did! After that, I got an elevation rotor for the antennas, and on my first try at EME, worked two stations. I've been at it ever since."

Professionally, Jeff is Operations Director of KBCI-TV in Boise. After this photo was taken, Jeff moved to a new QTH in Caldwell, Idaho, about 25 miles west of Boise. He's hoping to have all of his antennas back up and to be back on EME by the time you read this. (Cover photo by Larry Mulvehill, WB2ZPI)

VHF-Related Web Sites & Mailing Lists

Some "Notes from the 'Net" of interest to VHF+ hams.

Meteor Scatter

Bernie Gapinski, DK3XT, reports that Ilkka Yrjola, OH5IY, author of "MS-Soft for PC," has a new Web page at <http://www.sci.fi/~oh5iy/>. Bernie runs the "Make More Miles on VHF" page at <http://www.ilk.de/sites/gap>, and has a list of U.S. stations active on meteor scatter (MS) at <http://www.ilk.de/sites/gap/uslist>. He also maintains a European list. (Tnx K4MRW).

Laser List

Jim Moss, WB9AJZ/6, reports on both a Web site and an e-mail reflector dedicated to laser communications. Jim has put together a Web page at <http://www.qsl.net/wb9ajz/laser/laser.htm>, comprised of messages from the LASER e-mail reflector, laser-related files and Web links.

Art Allen, KY1K, says the LASER reflector is a small group with very few off-topic posts, so it's really for folks with a serious interest in laser communications (if you're just getting started, start out with Jim's Web page). To join, send a message to <majordomo@berlioz.nsc.com> and type **subscribe laser** as the body of the message.

On the Trail Again...

Beau Bushor, N1MJD, has written a free guide to 2-meter repeaters located along the entire length of the Appalachian Trail (AT), and has posted it on two Web sites, the Appalachian Trail Home Page <http://www.fred.net/kathy/at/hamguide.html>, and the Appalachian Long Distance Hikers Association home page, <http://www.connix.com/~aldha>. Those unable to access the Web may request an e-mail copy from Beau at <bushor@lemming.uvm.edu>.

According to Beau, the guide follows the AT from south to north, using the Appalachian Trail Conference's *Appalachian Trail Data Book* for reference points. The Appalachian Trail extends from Georgia to Maine.

New Web Address for Central States

The Central States VHF Society has a new home on the World Wide Web, <http://www.csvhfs.org/>. According to an Internet posting by Chris Cox, NØUK (ex-AB0CN), the old address at the University of Minnesota will continue to work for a while, as well. But please note the new address to update your files (*and if you're even remotely interested in weak-signal VHF work, you should definitely check it out—ed.*).

General Stuff

Brian Carling, AF4K, sends word that he's put up a VHF-related Web site at <http://www.mnsinc.com/bry/hamlynx/hamvhf.htm>.

Editor's note: We haven't had a chance to check out these sites, so we can't vouch for them one way or another. You should be aware that people are still changing Internet providers about as often as they change their socks, so don't be too surprised if you go to one of these addresses and find that the page you wanted has moved. One Web site that we can *vouch for is our own—http://members.aol.com/cqvhf/>—and we* have *checked out all of the links we have from there to other VHF+ sites.*

Calling Frequencies

It's common practice on VHF/UHF weak-signal modes (SSB and CW) to look for contacts on a nationwide *calling frequency* on each band, then to move off frequency to complete your contact. There are even specialized calling frequencies on some bands for EME (Earth-Moon-Earth) contacts.

Plus, each band has a designated *national simplex frequency* for non-repeater FM contacts, generally based on the ARRL's national bandplan for each band. These frequencies are set aside by "gentleman's agreements" and, while there's no rule establishing them, it's considered poor amateur practice to tie up the calling frequencies with long-winded QSOs—and *that* is against the rules. So please respect the calling frequencies by moving off once you've established contact.

Keep this in mind, too: just because there's a calling frequency doesn't mean it's the *only* place where you can call CQ. Spread out, especially when the band is getting crowded.

Here's a list, by band, of designated calling frequencies and national simplex FM frequencies:

Band	Frequency	Notes
6 meters	50.110 MHz	DX Calling Freqency
(50–54 MHz)	50.125 MHz	SSB (Domestic) Calling Freqency
	50.400 MHz	AM (Domestic) Calling Freqency
	52.525 MHz	FM National Simplex Frequency
	(28.885 MHz)	(10-meter frequency used to report 6-meter band openings)
2 meters	144.010 MHz	EME (random; see below for scheduling frequency)
(144–148 MHz)	144.100 MHz	CW
	144.110 MHz	CW Alternate
	144.200 MHz	SSB
	146.520 MHz	FM National Simplex Frequency
	(3.818 MHz)	(Meteor scatter scheduling, unofficial)
	(14.345 MHz)	(EME scheduling—nets every weekend)
1.25 meters	222.100 MHz	CW/SSB
(222–225 MHz)	223.500 MHz	FM National Simplex Frequency
70 centimeters	432.010 MHz	EME (random; see below for scheduling frequency)
(420–450 MHz)	432.100 MHz	CW/SSB
	446.000 MHz	FM National Simplex Frequency
	(14.345 MHz)	(EME scheduling—nets every weekend)
33 centimeters	902.100 MHz	CW/SSB (some areas)
(902–928 MHz)	903.100 MHz	CW/SSB (other areas)
	906.500 MHz	FM National Simplex Frequency
23 centimeters	1294.500 MHz	FM National Simplex Frequency
(1,240–1,300 MHz)	1296.100 MHz	CW/SSB
13 centimeters	2304.100 MHz	CW/SSB
(2,300–2,310 MHz/ 2,390–2,450 MHz)	2305.200 MHz	FM National Simplex Frequency
9 centimeters	3456.100 MHz	CW/SSB
(3,300–3,350 MHz)		
5 centimeters	5760.100 MHz	CW/SSB
(5,650–5,925 MHz)		
3 centimeters	10,368.100 MHz	CW/SSB
(10,000–10,500 MHz)		

CBspeak/Hamspeak Dictionary

A translation guide for some common terms from "CB-speak" to "hamspeak."

Many new hams today come to amateur radio from CB, which is great. But they often bring with them a lot of CB jargon, which generally isn't used on the ham bands and immediately marks you as a "newbie," to borrow a term from the online world.

So here, for your convenience, is a guide for translating some of the most common CB lingo into ham lingo—along with an explanation of what it means in English. And speaking of English, there's usually no reason to use any shorthand at all, provided both parties in a QSO (oops, contact) speak the same language. There's no substitute for plain language.

"CBspeak"	**"Hamspeak"**	**Notes or English translation**
"Handle"; "personal"; "first personal"	"Name"	Some old-timers do use "handle."
"Handle" (as a station identifier)	"Callsign"	(but you already knew that one)
"10-4"	"Roger" or "QSL"	Yes; message received. *10-codes generally aren't used in ham radio.*
"10-20"; "20"	"QTH"; "location"	Location
"Good buddy"	"Old man"; "OM"	How you refer to someone when you've forgotten his name; you're expected to remember women's names, as I've never heard anyone say "Good morning, YL."
"Threes"; "73s"; "best 73s"; "all those good numbers"	"73"	"73," an old wire telegraphers' code for "best wishes." Making it plural, as in "73s," makes it "best wisheses," and "best 73s" means "best best wisheses."
"The four-lane"	"the highway"	
"Piggy bank"	"toll booth"	(but hams do sometimes pay tolls with "green stamps," dollar bills)
"Smokey"	"trooper"	"Smokey reports" are generally not done on ham radio.
"18-wheeler"	"truck"	
"4-wheeler"	"car"	
"work" (as in the place you work)	"the work QTH"; "the salt mine"	(Sometimes it's the hams who use the silly jargon.)
"rig"	"rig"	radio
"radio check"	"signal report"	"How strong is my signal?"
"Pinning the meter"	"Full quieting" (on FM); "5-9" (on SSB)	"Your signal is very strong."
"Breaker-breaker"*	"(your call) listening" (on FM); "CQ" (on SSB/CW)	

* Depending on where you are in the U.S., the term "break" may be used for joining a contact in progress or may be reserved for emergency use. Listen for local procedure. The double "break-break" is always reserved for an emergency.

VHF News *(from page 8)*

ceived a message to hams from Crew 22...and, here on Earth, there's a new Mir Web site on the Internet.

NASA reported on February 24 that a problem with an oxygen generating device ignited a small fire aboard the Russian space station, but it was quickly put out and there were no injuries to the six crew members. Three days later, a ham radio contact between Mir astronaut Jerry Linenger, KC5HBR, and students at a Michigan elementary school occurred on schedule. The ARRL reports that the fire was a prime topic of discussion during Linenger's 10-minute chat with the 15 students. There were over 300 observers on hand for the contact, including reporters from four TV stations and three newspapers.

As Mir Crew #22 prepared to return to Earth in early March, mission commander Valery Korzun sent two "goodbye" packet messages to hams on the ground. Wrote Korzun:

> Bye bye our nice and kind friends. We'll remember all [of] you and your support [of] us in space flight, your humour [and] your attention to our job on orbit....It was great to talk with you all—we enjoyed it a lot. We wish you good health, success and happiness. Dosvidania. 73.... (Tnx WF1F)

Finally, the AMSAT News Service reports that a German amateur radio group has put up a Web site dedicated to SAFEX, the German-sponsored ham radio experiment aboard Mir. The address is <http://www.op.dlr.de/~df0vr/home.htm>.

California Emergency Response Institute

If you're planning on being in the Sacramento area on May 17 through 18, you are cordially invited to attend this year's Northern California Emergency Response Institute. The two-day course will include sessions on recent flooding and the many uses of technology in emergency services operations. Anyone involved in emergency service operations is invited to the state-sponsored event. There's a $20 registration fee. For more information, or to register, visit the institute's Web page at <http://www.garlic.com/oes/eri/eri97.htm>; send an e-mail request to Institute Director Dave Larton, N6JQJ, at <larton@garlic.com>, by phone at (408) 778-7265, or by mail at ERI '97, P.O. Box 301, Fair Oaks, CA 95628. (Tnx N6JQJ) ■

Letters *(from page 11)*

No Trunking for Him

Dear *CQ VHF*:

I would like to comment on the "Futurescope" article on trunked radio (*CQ VHF* January '97).

I just don't get it, Rich. This dream system of yours has no relationship to the friendly, casual repeater nets that I enjoy. And what is the obsession with "finding a topic you want to talk about?" If I do not like the current conversation, I merely change the subject, and we may talk about a dozen things before QRT time. And yes, large commercial radio manufacturers (one in particular) have soaked state and local public service agencies to the tune of millions of dollars. What do they end up with? I carry a state-issued pager that sometimes takes 20 minutes to alert. I know of *no agency*, not one, that after buying into the 800 meg. dream, did not end up using their old radio systems—low band—regular repeater, etc. They do this because trunked systems are *all about money*. They *have not* proved to be reliable. They have proved to reliably use much of the tax money we pay every day. And the large companies (public service, radio manufacturer), one in particular, are just plain good at pushing their latest gizmos. Just look at the multi-million dollar mess in SC. I'm *very* familiar with it.

So don't push this garbage on me. The day ham radio is "trunked," is the day I quit the hobby. Remember (KISS), Keep It Simple, Stupid! I saw nothing attractive about your dream system except possibly simple, occasionally linked conventional repeaters for DX. I doubt you will print this and I cannot sign my name because of my employment.

Dear Reader:

Thank you for your comments. Commercial trunked repeater systems are working in some areas. Amateur trunking was presented only as one option, a starting point for discussion. The basic goal of the article was to get people thinking and talking about alternatives to the current, inefficient way in which we allocate repeater frequencies. ■

"...we're successfully creating new amateurs, but we're failing at creating new hams....We, as established members of the community, are failing to bring new recruits into the [ham radio] culture."

ham radio culture as a condition for upgrading your license.

There are numerous similarities between licensing procedures for amateurs and for pilots, along with a couple of significant differences.

First of all, there's no differentiation between amateurs and professionals in aviation. In order to earn the commercial or air transport grades of pilot's licenses, which allow you to become a professional pilot, you must first earn your private pilot rating. Every professional must start out as an amateur.

Secondly, and more importantly, you can't become a pilot until you show you can fly—solo—and until you've spent many hours with a flight instructor, learning not only the written rules, but also the *unwritten* rules: the culture.

Ground school and the basic FAA written exam, the equivalent of a ham radio licensing course and exam, don't even get you off the ground. You can't go any farther until you sign up with an instructor and actually learn to fly! Once you've logged 20 hours of flying *with an instructor,* you qualify for a student pilot license. This allows you to fly solo for the minimum 20 hours you'll need before being able to take a final exam given by an FAA-approved examiner. And this isn't a written test, it's a flying test.

Our proposal: Require that any ham wishing to upgrade spend a minimum number of hours operating with a certified radio instructor (attending ham radio activities could also count), and then a minimum number of hours operaiting "solo" (but reporting back to the instructor), before being allowed to take an upgrade exam. Fewer hours would be required for each subsequent upgrade.

"We propose that the licensing rules require some effort at becoming part of the ham radio culture as a condition for upgrading."

This will have a much greater impact on bringing amateurs into the ham radio culture and community than will a tougher code test. Once you feel like it's *your* hobby, and *your* culture, you'll want to protect it and you won't be as likely to downgrade it by cheating.

Proposal #2: The Broadcast Model

Another perennial problem we seem to face is introducing new people, especially young people, to amateur radio and recruiting the next generation of hams.

It's generally accepted that having a ham radio presence in schools is a good thing, especially since ham radio has quite a bit to offer educators as a teaching tool. For about the price of an average computer workstation (roughly $2,500), a school can purchase a *really* good ham station. The main problem with ham radio in schools is that clubs or classes will thrive *as long as there's a teacher on staff who's a licensed ham.* But as soon as that teacher leaves, the ham radio program generally leaves with him or her. How can we promote a permanent ham radio presence in our schools?

In the broadcast world, the FCC issues something called a Restricted Radiotelephone Operator's Permit upon the passage of the most basic of exams (it used to be called a Third Class Radiotelephone License when it required the same level of knowledge as a Novice license). This permit allows its holder to operate the transmitter of a broadcast station under the *general supervision* of a licensed engineer. The licensed engineer needs to periodically inspect the station to make sure it's operating properly (and to fix it if it isn't), and to be on call in case the permit-holder has a question or concern. Other than that, though, as long as everything's working OK, which it normally is, the permit-holder may operate the station without the need for the presence of a fully-licensed "control operator." This hasn't hurt the broadcast industry.

Our proposal: Create a Basic Amateur Permit, *with no callsign or independent operating privileges, to be issued on passing a test made up of the current non-technical questions in Elements 2 and 3a (rules and regs and operating practices/procedures), to teachers or other authorized staff members of an accredited educational institution. An amateur in the community could be trustee of a school (or school club) station, which would have a callsign and the trustee's operating privileges. The trustee would be responsible for the proper technical operation of the station and for general supervision of the Basic Amateur Permitholders who may function as control operators. The control operator would be responsible for the content of the school station's transmissions.*

We already trust our teachers with our children and their education, including teaching them how to follow rules. So it's safe to assume that we can also trust teachers to operate an amateur station at their school in accordance with the rules and not to let the kids run hog-wild on the air. The kids (or teachers, for that matter) want more? They want to do this at home, too? Well, the station trustee is their built-in link to the local ham community, connecting them to licensing classes, operating activities, etc. And if several (or all) of a school's teachers hold a Basic Amateur Permit, then the school station may be used at their convenience, and there won't be a traumatic effect if one teacher leaves; another can pick up the slack.

"Create a Basic Amateur Permit, with no callsign or independent operating privileges, [for use by] teachers or other authorized staff members of an accredited educational institution."

We don't have the resources that Apple Computer did when it donated a computer to any school that wanted one. But we don't need to. Computers have paved the way for us. Schools across America today have technology budgets, and they're used to installing and operating hi-tech electronic equipment.

The resources we have are human—hams across the nation who can tell and show (or is that show-and-tell?) educators how ham radio is relevant and can be a valuable teaching tool. Through the Basic Amateur Permit concept, we'll be able to provide every school in U.S. with the opportunity to put that tool to work for the maximum benefit of our children. And it won't hurt ham radio one little bit!

Memo to Newington

These proposals will enhance the value of your own plan to restructure amateur

licensing. We encourage you to incorporate these proposals in any final plan that's presented to the FCC, and we'll do our best to help promote support for such a plan in the amateur community. If you choose not to include these proposals, we'll file them independently to make sure that they're placed before the FCC for its consideration.

Masthead Notes

We've got a few changes coming up among our staff and regular contributors. First of all, a couple of callsign changes, starting with my own. If you look closely, you'll see that I'm now W2VU. Everyone asks me if there's any special significance to the callsign. I suppose you can say that it's short for "VHF/UHF," but a few of my friends have decided that it really stands for "Very Ugly." Come visit me at Dayton and decide for yourself!

Also, "Weak Signal News" columnist Tim Marek (nee NC7K) is now K7XC. Plus, we'll be adding two new names to our masthead over the next two months. Bob Josuweit, WA3PZO, will be taking over the "In the Public Interest" column, starting in the June issue. Bob has been involved in public service and emergency communications for over 20 years and is an excellent writer as well. Then, starting in the July issue, veteran *CQ* magazine columnist Dave Ingram, K4TWJ, will be joining us every other month with a brand new column on homebrewing, that is, building your own stuff. His column will be a combination of projects and tutorials, and he'll try to have something in each issue for both the beginner and the experienced builder. We'll introduce each of these gentlemen in greater detail when their first columns appear. For now,

73 de W2VU

Help Wanted

If you're involved with a project or activity that you think would be of interest to your fellow *CQ VHF* readers, we'd like to hear from you. Article submissions are welcome, as are "Op-Ed" opinion pieces if you have a point of view you'd like to share about a VHF-related topic. You can contact us by mail at 76 N. Broadway, Hicksville, NY 11801 (send an SASE for writers' guidelines), by e-mail to <CQVHF@aol.com>, or via our World Wide Web page, <http://members.aol.coms/cqvhf/>. We look forward to hearing from you.

You're Invited...to Write for CQ VHF!

"When are you going to run an article about (insert your favorite ham radio topic here)?" This is a question we hear regularly—and our usual response is: "When are you going to *write* an article about (same inserted favorite ham radio topic)?"

This is your formal invitation to become a *CQ VHF* writer as well as a reader.

Yes, we have our regular columnists, but we reserve the biggest chunk of editorial space each month for feature stories, generally written by readers like you. Preliminary results of our March, 1997, reader survey show that over 25% of our readers have been licensed for more than 25 years. One-third of you, according to the same preliminary survey results, hold Advanced or Extra class licenses. Clearly, a lot of you are active, experienced hams with knowledge and ideas you can share with the rest of us. We invite you to do so.

What Are We Looking for?

Here's a basic rundown of the types of articles we're generally looking for, along with some examples from recent issues:

Operating

• Beginner articles on all aspects of VHF/UHF operation, not only for the new ham, but also for the ham who's been around but is new to that particular operating activity. Examples from previous issues include:

"Moving Off Repeaters When You're on the Move," April, 1997
"Foxes, Hounds and Hams—An Intro to Foxhunting," September, 1996
"EME Operating Techniques for the Beginner," November, 1996

• More advanced articles on all aspects of VHF/UHF operation. Examples:

"OSCAR-13's Last Picture Show," February, 1997
"Secrets of Successful Rover Operating" April, 1997
"VHF DXpeditions to Cyprus and Tunisia," April, 1997

Public Service/Emergency

"The General Clinton Canoe Regatta," November, 1996
"Hams Just Do That" (A Report from the Blizzard of '96), March, 1997

Technical/Projects

• As above, both beginner's articles and more advanced projects. Examples:

"Build a Headset Mic for $5," January, 1997
"The Duplexer & Triplexer Connection," November, 1996
"Build a 6-Meter Beacon Transmitter," March, 1997
"2-Meter Moonbounce Basics," October, 1996

Ham Radio Science

• Reports on the science of radio communication, particularly as it applies to hams. Examples:

"Aurora: A New View," March, 1997
"The Great Sporadic-E Debate," two parts, April and May, 1997

First-Person/Ham Profiles

• Articles on notable hams and first-person stories about ham radio events with particular personal impact.

Let's Hear from You!

All of these are just examples. If you've got a story to tell, information to share, advice to offer, we'd like to hear from you. We recommend that you get a copy of our writers' guidelines before submitting your article. They're available on the World Wide Web at <http://members.aol.com/cqvhf/>, or by mail request (with an SASE) to *CQ VHF*, 76 N. Broadway, Hicksville, NY 11801. We look forward to hearing from you!

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LOOKING AHEAD in

CQ VHF Ham Radio Above 50 MHz

Here are some of the articles that we're working on for upcoming issues of *CQ VHF:*

- "SSB the Easy Way," by Charlie Zusman, WE2R
- "Converting to *Very* Narrowband FM," by Rod Wheeler, WA6ITC
- "A Tale of Two Rovers," by Tim Marek, K7XC, and Ken Neubeck, WB2AMU
- "902 FM: UHF's Final Frontier," by Dave Page, KD3NC

Plus...

- "First Look: Kenwood's New $199 HT" by Gordon West, WB6NOA
- "Build a 2-Meter Notch Filter," by Jim Ford, N6JF
- "An Experimental 6-Meter Noise Blanker," by Bob Witmer, W3RW

If you'd like to write for *CQ VHF*, you may download our writers' guidelines from the *CQ VHF* World Wide Web site at <http://members.aol.com/cqvhf/> or FTP to <ftp://members.aol.com/cqvhf/general> and look for the file, "writguid.txt". Or you may send a written request with an SASE (self-addressed stamped envelope) to *CQ VHF* Writer's Guidelines, 76 N. Broadway, Hicksville, NY 11801.

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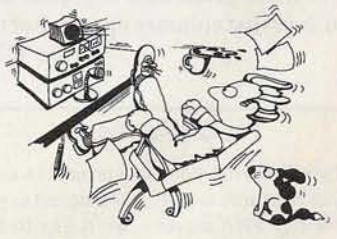

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