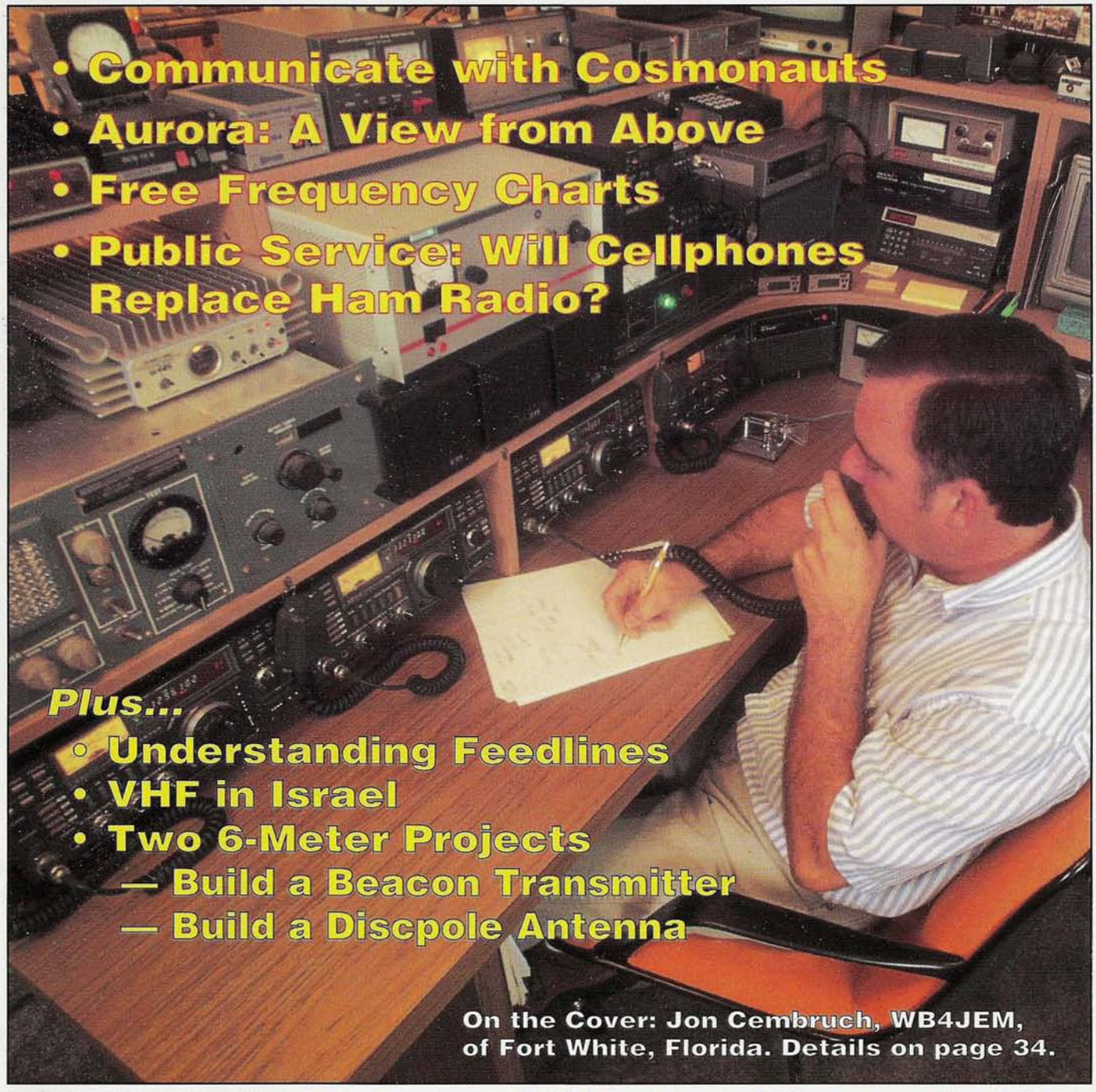
ICD 08237

CQ VHF

Ham Radio Above 50 MHz

March 1997



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On the Cover: Jon Cembruch, WB4JEM, of Fort White, Florida. Details on page 34.

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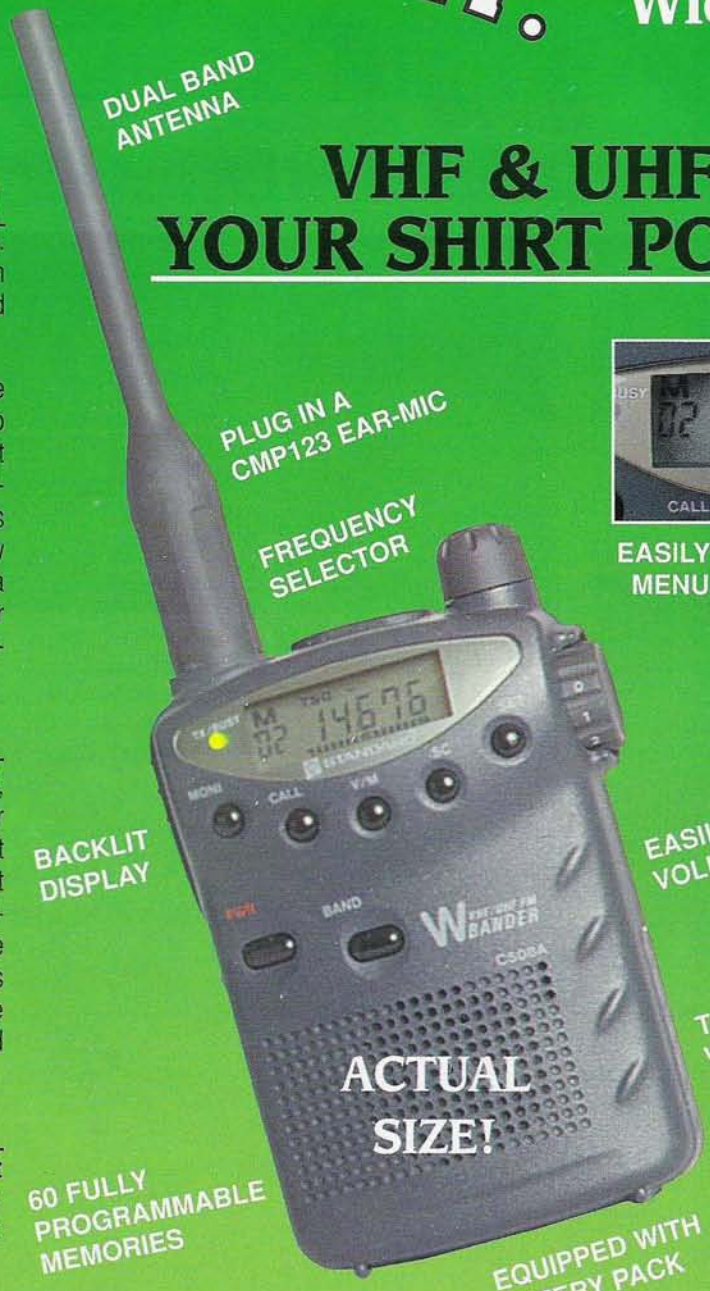

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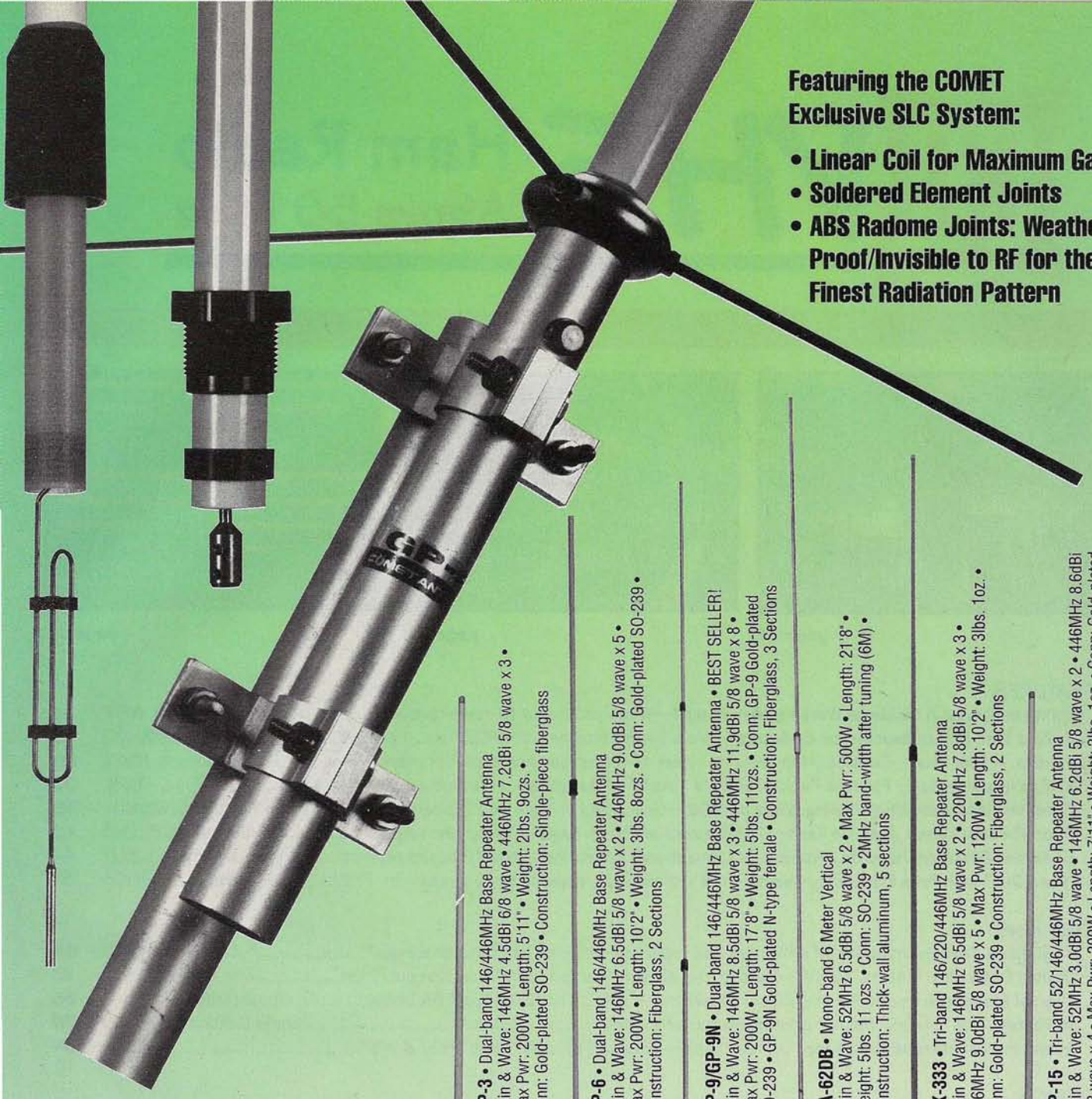

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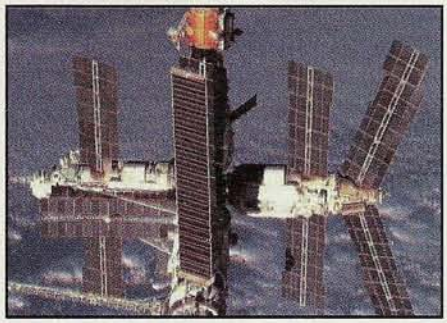
CQ VHF Ham Radio Above 50 MHz

Volume 2, Number 3—March, 1997



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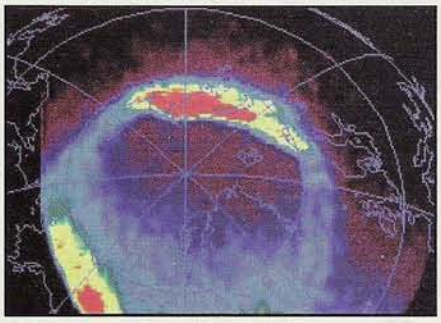

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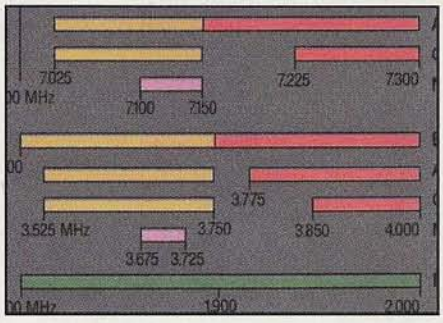

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Next Month: VHF DXpeditions to Cyprus and Tunisia

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Playing the Numbers

Statistics can tell you lots of interesting things—but they're not always everything they seem to be.

Numbers are very important to most of us in ham radio—the numbers on our clocks (synchronized to the second to WWV), the numbers of the bands we use ("I'm active on 6 through 1296"), the numbers of our repeaters ("Call me on the nine-four machine"),the number of points scored in a contest, the number of grids we've worked, the number of parallel pieces of metal on our antennas, and the number of feet above the ground where those pieces of metal reside. Numbers are pretty close to number one with us.

So, this month, I thought we'd take a look at some interesting new numbers and explore what they mean. These numbers are the results of the American Radio Relay League's survey on keeping or eliminating the international Morse code requirement for HF operation, plus some other numbers that tell us interesting things about ARRL members and *CQ VHF* readers.

The ARRL Survey

In an effort to gauge the feelings of its members, and of the general amateur community, toward proposals to eliminate the *international* rule that governments must require a knowledge of Morse code to allow amateur HF operation, the ARRL last summer conducted a survey of 1,600 hams: 1,100 League members and 500 non-members. (The survey, discussed in detail in the February, 1997, issue of *QST,* collected a variety of additional information—which we'll discuss later—but the biggest question clearly was about the code.)

Predictably, 63% of ARRL members favored keeping CW as an international licensing requirement for HF access (with 30% opposed and the rest not answering). But it was a bit surprising to see that 54% of the *non*-members surveyed also favored keeping the worldwide code requirement. Overall, that translated to 57% of both League members and non-members supporting the status quo.

"Predictably, 63% of ARRL members favored keeping CW as an international licensing requirement for HF access...."

How Valid Are the Numbers?

But are these numbers truly representative of the opinions of ARRL members and/or of hams in general? Well, yes and no. They are certainly accurate with respect to those people actually polled. The reply rates were quite impressive. And I have no question about the reliability of the company that conducted the survey, Readex, Inc. I worked with Readex just two years ago on the survey that pointed up the need for this magazine, and I was quite impressed with their professionalism. But I also learned a bit about the art of surveying in the process.

When we conducted our survey of newly-licensed hams in 1995, we sent out questionnaires to 650 of the 40,804 hams who were licensed for the first time in 1994. This sample represented about 1.6% of the total group, and was considered statistically valid, even though we considered it a compromise—balancing our desire for accuracy against our budget for the survey.

The ARRL is on a budget, too, and a very tight one right now. And I'm sure that's why it had to severely limit its sample size. Yes, they surveyed more than twice as many people as we did, but the numbers represent a much smaller percentage of the larger groups involved. They surveyed 1,100 of their 152,809 members (at the time), or $^{7}/_{10}$ of 1% of the total, plus 500 of 513,795 non-members, only $^{1}/_{10}$ of 1% of the total. And, as a percentage of the total ham population, the total sample of 1,600 represented about $^{2}/_{10}$ of 1%. But such small percentages of such large groups might make one question the statistical relevance of the sample.

In addition, any suggestion that the overall sample (members + non-members) is representative of hams as a whole is invalid, since the sample was composed of 69% ARRL members and 31% non-members, while the "real world" of ham radio in the U.S. consists of only 23% League members and 77% non-members. So you can throw out the 57% overall support figure for keeping the worldwide code requirement. It is valid only among the actual sample group.

Of course, none of this is likely to keep the League from using these figures to support a stand in favor of retaining the code requirement in the international radio regulations. By the time you read this, the ARRL Board of Directors will have met and voted on a position on the matter. I will be very surprised if they don't vote to keep things as they are, especially in light of these numbers (flawed as they may be). All in all, the numbers for ARRL members are probably *fairly* accurate, and as long as the directors use this survey as only one source of input for making their decisions, then the overall ARRL membership will probably be well-represented. Keep in mind that the only people who vote for ARRL directors

By Rich Moseson, NW2L, Editor

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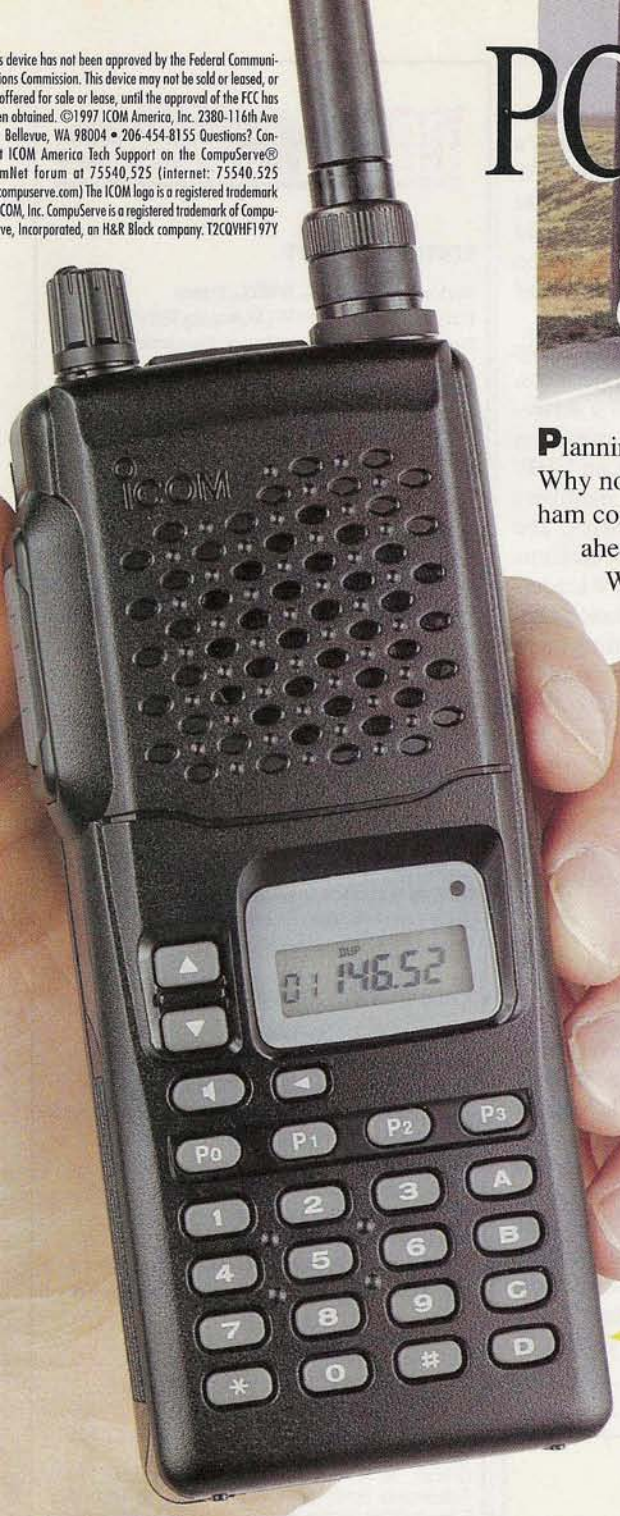

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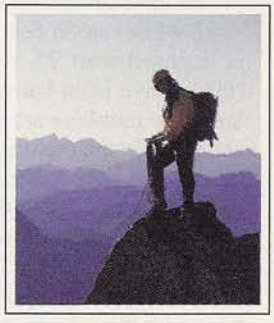

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"CQ VHF readers, as a group, tend to be younger than ARRL members as a group. They are also newer to ham radio and are less likely to hold an upper-level amateur license."

are ARRL members, and that the directors are elected to represent those members first. They represent ham radio in general only by default.

Other Numbers

The League's survey also asked a variety of questions beyond the code controversy (may as well get their money's worth!), and some of the results are very interesting, especially if we compare them with responses by our readers to the past year's worth of surveys in *CQ VHF*. (A quick note here: Our monthly reader surveys are highly unscientific and probably have a margin of error approaching 150%! They are admittedly *not* statistically valid, but are accurate enough to give us a snapshot of our readers and their interests and concerns at any given time.)

CQ VHF readers, as a group, tend to be younger than ARRL members as a group. They are also newer to ham radio and are less likely to hold an upper-level amateur license. The largest single group of ARRL members (29%) is age 65 or older, while the largest single group of *CQ VHF* readers (31%) is between ages 45 and 54. Their #2 age group is 45 to 54 (26%), while ours is 35 to 44 (29%).

Nearly 1/2 of the League's members (44%) have been licensed over 20 years. And, while one in five *CQ VHF* readers is licensed over 25 years, the majority (60%) have been hams for five years or less. The numbers are similar for license class: while the majority of ARRL members (51%) hold Advanced or Extra class licenses, compared with 26% of *CQ VHF* readers, the majority of this magazine's readers (65%) hold a Tech or Tech Plus ticket, as opposed to 31% of ARRL members with these licenses.

But does this mean that the League and *CQ VHF* are talking to two entirely different groups of hams? Not at all.

A Lot in Common

First of all, over half of this magazine's readers (52%) are ARRL members, nearly double the percentage of hams nationwide (23%). Secondly, in the League's survey question on band usage, only 11% of ARRL members said that they operate exclusively on HF. Another 22% said they operate VHF/UHF only, while the majority (60%) use both HF and VHF/UHF (the remaining 6% are inactive).

The League has always considered its "core membership" to be HF operators. But these numbers seem to tell a different story. While 71% of ARRL members operate on HF, 82% are active on VHF/UHF. Nearly 1/3 of League members hold Tech and Tech Plus licenses, and fully 1/3 of its members have been hams less than six years. The ARRL's leadership would be well-advised to look closely at these numbers and start putting more focus on making the organization more relevant to VHF/UHF hams, rather than focusing so much energy on persuading them to migrate to the already-overcrowded HF bands.

• • •

Wet Signal News

If any of you watched the news on TV in early January, you probably saw pictures of the water swirling through the streets of Reno, Nevada. Well, that's where Weak Signal News Editor, Tim Marek, NC7K, lives. And while Tim assures us that his house was safely above the high-water line, he was too occupied with staying dry and keeping his antennas rooted to the ground in 100 mph winds to finish his column. It'll be back next month (weather-permitting) from Tim's "beachfront" home in Reno.

73 de NW2L

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 <CQ VHF@aol. com>, or via our World Wide Web page, <http://members.aol.com/cqvhf/>. We look forward to hearing from you.

CQ VHF Ham Radio Above 50 MHz

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VHF News

Flooded West Relies on Hams

It was ham radio to the rescue once again in January when floods in the western U.S. knocked out power, telephones, and even the Internet. In Josephine County, Oregon, ham radio was the only means of getting messages out for several days, according to Newsline, including the county's official request to the governor for a declaration of emergency. Both Newsline and *The ARRL Letter* reported several additional instances of ham radio assistance in California, Nevada, Oregon, and Washington.

ARRL Committee Says "Keep the Code"

A key ARRL committee has voted to support a continued international requirement for Morse code knowledge as a condition for HF operating privileges. The recommendation was based largely on the results of a survey of both ARRL members and non-members (see "Line of Sight"), in which over 60% of League members supported the status quo. The full ARRL Board of Directors was expected to approve the committee's recommendation at its meeting in January.

RF Exposure Rule Delayed

In a Christmas present to hams and other radio users, the FCC on December 23 delayed by one year the effective date of rules intended to assure compliance with new, tougher RF emission standards. For the first time, many hams will be required to assess their stations for compliance. Amateur stations operating with less than 50 watts or mobile stations using push-to-talk (regardless of power) will continue to be exempt. The rules now take effect on January 1, 1998.

Phase 3D Launch Delay

Word from France is that AMSAT's Phase 3-D satellite is now scheduled for launch in early July aboard the European Space Agency's Ariane flight 502. AMSAT officials had previously expected a springtime launch. AMSAT-NA President Bill Tynan, W3XO, put a good face on the delay, telling the AMSAT News Service "it gives us a definite goal to shoot for in our preparations of the Phase 3-D spacecraft." Tynan also noted that the downside of the delay is that expenses will continue to mount until the satellite is launched.

Work continues at the P3D laboratory in Orlando, Florida, on preparing AMSAT's Phase 3-D satellite for launch, now scheduled for July, 1997. (AMSAT photo)

Hams to Share 5-centimeter Band with Computer Networks

The FCC in early January allocated 300 MHz of spectrum in the 5-GHz band to a new, unlicensed, computer-communication service—including a 100-MHz chunk that will be shared with hams. The new Unlicensed National Information Infrastructure (U-NII) devices will be allowed to operate on 5.15 to 5.35 GHz and 5.725 to 5.825 GHz. This latter band segment is also part of the 5-centimeter ham band (5.650 to 5.925 MHz). The amateur allocation on this band is already shared with, and secondary to, a variety of other services. U-NII devices operating on 5.725 to 5.825 GHz will be allowed up to 4 watts EIRP output. *(As noted last year when this service was first proposed, the "cloud" of added sharing may have a "silver lining" of producing a source of affordable, accessible equipment for ham use on this band. It could also be a perfect site for the ham/non-ham interaction idea that Don Stoner proposes in his "In Theory" column this month.—ed.)*

Additional Microwave Sharing Possible

The FCC has proposed a variety of changes in the Experimental Radio Service, according to a report in *The ARRL Letter*. The proposed changes include moving the current 2450 MHz experimental band to 2402 to 2483.5 MHz and adding new spectrum at 10.0 to 10.5 GHz. This includes part of the upper portion of the 13-centimeter ham band (2390 to 2450 MHz) and all of the 3-centimeter band, both of which are already shared with other services. The Experimental Radio Service is designed for students wishing to conduct microwave-RF experiments. Comments on the proposal were due by February 10.

Packet Info out of "Repeater Directory"

For years, the *ARRL Repeater Directory* has been a source of information not only on voice repeaters but also on packet radio digipeaters and bulletin boards. No longer. The digital listings are being dropped as of the 1997–98 edition of the *Directory* and will be made available online, courtesy of Tucson Amateur Packet Radio (TAPR). The new North American Digital System Directory will be updated regularly and will be available on the World Wide Web at <http://www.tapr.org/directory>. In a news release, TAPR President Greg Jones, WD5IVD, says the group is also hoping to make the information available annually on a CD-ROM.

Mir Changes Frequencies...Again

The 2-meter ham station aboard the Russian Mir space station has changed frequencies for the second time in three months. The AMSAT News Service quotes a message from Astronaut John Blaha, KC5TZQ, aboard Mir at the time, saying that as of January 1, both voice and packet operations would be conducted on a split frequency with a 145.200-MHz uplink (where you'd transmit) and a

Compiled by the CQ VHF Staff

145.800-MHz downlink (where you'd listen). The earlier shift to these frequencies from 145.550 simplex is still causing interference concerns. (*See "Hams in Space: A Guide to Working Mir" in this issue for more information.—ed.*)

Ham Crew Change on Mir

By the time you read this, astronaut John Blaha, KC5TZQ, should be back on Earth after a four-month stay aboard the Mir space station, with his spot taken over by another ham astronaut, Jerry Linenger, KC5HBR. According to the AMSAT News Service (ANS), the special third-party agreement that allowed non-hams to speak on the radio with Blaha—opening the door for a variety of "MIREX" contacts from schools—expired on his return. There was no word at press time as to whether a similar arrangement would be worked out for working Linenger.

A German astronaut, Dr. Reinhold Ewald, who holds the callsign DL2MIR from when he was a backup crew member for a German Mir mission in 1992, was scheduled to be aboard the space station between February 4 and 24, according to ANS. He was expected to use the digital voice recorder on the 70-centimeter SAFEX station aboard Mir to update interested hams on his activities in space.

New Russian Hamsat Set for Launch

There may be a new RS satellite in orbit by the time this issue reaches you. AMSAT reports that RS-16 was scheduled for launch sometime between mid-January and the end of February. According to preliminary and unofficial data, the new satellite will have a 2-meter uplink (145.915 to 145.948 MHz) and a 10-meter downlink (29.415 to 29.448 MHz), plus two beacons on 10 meters (29.408 and 29.451 MHz) and two beacons on 70 centimeters (435.504 and 435.548 MHz). The presence of this second set of beacons suggests that the new "bird" might also be equipped with 70-centimeter downlink capability.

28.8 Too Slow? Try 115.2—on Packet!

Tucson Amateur Packet Radio (TAPR) is in the process of making large-scale group purchases of commercial high-speed digital transceivers for 902 to 928 MHz, and making them available to members at greatly reduced prices. The first units will operate at speeds of up to 115.2 kilobits/second—four times the speed of your typical 28.8 kb/s telephone modem, and will sell to TAPR members for about $400. TAPR's Dewayne Hendricks says the group is purchasing circuit boards from commercial manufacturers and assembling them into specially designed TAPR cases.

The radios are primarily for use in TAPR's spread-spectrum experiments (under an FCC Special Temporary Authority, or STA), but officials note that the equipment will also be legal for unlicensed Part 15 use if the STA doesn't result in a permanent change in amateur rules. TAPR members may apply online to participate in the STA experiment by connecting to TAPR's Web site at <http://www.tapr.org/ss/tapr_sta.html>.

Digital Journal Ceases Publication

The *Digital Journal,* a specialty publication for RTTY and packet enthusiasts, announced plans to cease publication after printing its January, 1997, issue. The magazine began 45 years ago as the *RTTY Journal*. Editor Jim Mortenson, N2HOS, said that the magazine's publisher, the International Digital Radio Association (IDRA), couldn't afford to continue. Noting that the final issue was made possible only by "a major gift," Mortenson said "there are simply no funds for future issues." *(It's always sad for those of us in the ham radio publishing business to see one of our fellow publications fail.* Digital Journal *filled a small but important niche in the ham radio arena and it will be missed.—ed.)*

Schools Picked for First 1997 SAREX Mission

Students at 16 schools around the world will have the opportunity to talk via ham radio with astronauts aboard the space shuttle Columbia during flight STS-83, scheduled for launch in late March for a 16-day mission. According to the *ARRL Letter*, both voice and packet contacts will be possible with any of the three ham astronauts scheduled to fly on the mission (Mission Commander James Halsell, KC5RNI; Payload Commander Janice Voss, KC5BTK; and Mission Specialist Donald Thomas, KC5FVF). The 16 schools selected for scheduled contacts include 14 in the U.S., one in Okinawa, and another in the People's Republic of China.

Change in ARRL Contest Rules

The ARRL has extended its ban on using repeaters or repeater frequencies to solicit contacts during League-sponsored VHF contests to all bands. According to an ARRL news release, the rules previously banned the use of repeaters and repeater frequencies for contact solicitation only on 2 meters, but the Contest Advisory Committee and ARRL Awards Committee felt it was time to make the rule apply universally.

Ice Takes Down Broadcast/ Repeater Tower

The 146.880 repeater in Baraboo, Wisconsin, was literally knocked off the air by an ice storm on New Year's Eve. A report on Newsline says the 660-foot tower on which the repeater's antenna was installed collapsed after becoming overloaded with ice. There were no injuries. The Baraboo repeater covers a large part of southern Wisconsin, including the interstate highway between Chicago and Minneapolis, and serves as the hub for the South Central Wisconsin Skywarn Net. At press time, the Central Wisconsin Repeater Association, which operates the .88 machine, was not sure when the repeater would be back on the air.

ARRL Help Wanted

The *ARRL Letter* reports a job opening in the League's Washington, DC, office. ARRL is looking for an electronics engineer (BSEE or equivalent experience) with knowledge of or a desire to learn radio spectrum management. Duties would include representing the interests of amateur radio to U.S. government agencies, the International Telecommunications Union (ITU) and regional organizations. Public-speaking experience, professional-quality writing, and the ability to deal with people on an international basis are required. Spanish-language skills are a plus. If you're interested and feel you're qualified, send your resume and salary expectations to R. Boucher, ARRL, 225 Main St, Newington, CT. 06111; Fax: (860) 594-0298.

The Ultimate Choice in Amateur Radio

TM-261A

FM Mono Band Mobile

- 144 MHz operation
- 62 memory channels
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- DTMF memory for autopatch
- 50 watts output power
- Multi-scan capability
- Backlit microphone
- MIL-STD 810C and 810D
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- Built-in CTCSS encoder
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"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
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"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
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"Outstanding! Loud, clear audio and easy to use."

Kenwood is known worldwide for outstanding products. With over 50 years of design, engineering and manufacturing experience, it is easy to see how Kenwood sets itself apart from the competition. In the world of Amateur Radio, Kenwood has a strong and rich heritage based on one simple truth. We do our very best to build the best. Kenwood Amateur Radios not only have the look of a well designed and manufactured product with a superior "quality feel", but also have the same world famous Kenwood reputation on the inside. Now surprisingly affordable!

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Letters

Your Spot to Speak Out

Editor's Note: The computer gremlins have been at it again, and last month, they snuck in several letters that had already been published in previous issues. We apologize for the error, and I guess we'll have to start feeding the gremlins every two days instead of every four!

Dear *CQ VHF*:

Here's a proposal in response to various "keep-or-drop-the-code" letters in various magazines of late. One from WL7CKB on page 82 of *CQ VHF*'s October issue comes to mind.

Boiled down, most of the concern is not so much for the code itself, but a means instead for separating wheat from chaff, thus keeping "undesirable" operators off the air. Undesirable almost always means a QRMer, and neither the code nor increased technical testing will eliminate this.

In fact, there is evidence that instead of makeing things better, increased technical testing may make the QRMer problem even worse. To be blunt, and especially among the young, the highly ab- sorbed type of individual who can pass extremely technical exams is too often the same type who is "inward-turning" and lacks social development. This is the type who sits behind the safety of a mic and, as WL7CKB says, "gets his jollies." Old timers would call it a failure to be well-rounded.

What is really needed is a psychological screening test, but this would raise such a howl and be so hard to defend legally that it would never get done. Instead, I propose for starters (and with exceptions for the handicapped) what the Federal Aviation Administration has already done in pilot licensing: tie getting your ticket directly to having and keeping (there is automatic follow-up between agencies) a clean driving record. No wants, warrants, convictions, or history of accidents, you get your pilot's license. Bad record, no license for a period of years set by law. Period. It has worked and held up to Constitutional challenge due to the close, clear, and obvious co-relation between being a trouble-maker on the road and being an idiot in other walks of life.

If the FAA can use driving reports to keep lids out of the air, the FCC can use them to keep lids off the air. Of course, when it comes to lids, the FAA is active in the enforcement arena whereas the FCC is usually asleep, but that's another article. This proposal would help keep so much enforcement from becoming necessary in the first place.

In the opinion of this writer, the rapid increase of unchallenged QRMing and deliberate interference poses every bit as much a threat to the future of hamming as do Little Leos and the "Camel's Nose." (An excellent story!) Something clearly needs to be done in licensing and the above proposal has a proven track record.

Dave Smith, K9UIM
Certified Flight Instructor,
No#. 356320207CFIA
Olney, Illinois

Dave—Your idea is interesting and there certainly are many parallels that can be drawn between hams and pilots. In fact, I've used some of those parallels—and some of the differences—as the basis for a couple of club talks. Of course, there is a direct parallel between safe driving and safe flying, but the link to "safe hamming" is less clear. We not only have hams with disabilities that prevent them from getting drivers' licenses to begin with, but also young hams who are below driving age, elderly hams who may have given up their driving licenses, and city-dwellers who have never bothered getting a driver's license because they don't own a car and can get wherever they need to go by mass transit. A rule with too many exceptions would be unworkable and unenforceable.

The aspects of pilot licensing that I think ought to be considered as part of the amateur licensing process are the fact that no one can become a pilot without an "Elmer," flight instructor, and the requirement that—before you get your license — you prove you can fly solo and follow the rules...by actually doing it.

Is a No-Mount Mount Safe?

Dear *CQ VHF*:

Just thought I'd drop you a note regarding "RF Safety Proposal Aired" (Oct. '96 "VHF News") and "The No-Mount Mount" (sidebar to "No More Holes Antenna Mounts," same issue). It appears to me like we have a contradiction or maybe an opposing view or...on the matter of RF generation and its side-effects? I am a new operator, yet have been around electronic equipment enough to know that this installation should not be used, let alone recommended. We've heard warnings about 5-watt handhelds, and now people are transmitting mobile on 2 meters with 160 or more watts of power.

Claude Généreux, VE3YCG
(via e-mail)

Claude—First of all, there is significant disagreement among even experts on the possible health effects of low-level RF exposure. Second, and perhaps I wasn't clear on this in the article, the radio used here was a 3-watt HT on 2 meters. Third, since the roof of the van was fiberglass, taping the antenna to the roof would have resulted in the same level of RF exposure as putting it in the rear wheel well. Finally, using N6NB's exposure calculation program (which appeared in the January issue of CQ VHF*), a 146-MHz signal with 2 watts at the antenna, a gain of 2.2 dBi (0 dBd), and a distance from the antenna of two feet, results in an exposure level of .0711 milliwatts per square centimeter (mw/cm^2). This is well below the maximum permissible level of .2 mw/cm^2 for uncontrolled environments and 1 mw/cm^2 for controlled environments. So it would meet the new FCC standards. Note that this is only due to the very low power involved. If I plugged the HT into an amplifier and got 30 watts into the antenna, then the exposure level would be 1.06 mw/cm^2, just over the maximum for controlled environments and significantly above the uncontrolled maximum of .2 mw/cm^2 (the inside of your car is considered a controlled environment, and reducing the power at the antenna to 28 watts would meet the FCC standards).*

No Dummy Here...

Dear *CQ VHF*:

I eagerly read the article by James Kaplan ("Op-Ed," November, 1996), "The 'Dumbing Down' of Amateur Radio," and totally agree. I am a 16-year-old Tech-Plus and have been licensed for a year and a half. I would *love* to be able to build my own equipment, but can't find any info on how to get started. Is anyone out there teaching the new hams the art of homebrewing? Any help would be great. Thanks and 73,

Brian Kettell, KB8ZXX
(via e-mail)

Brian—Some radio clubs have occasional or regular "homebrewing nights,"

in which members either bring in their own projects to build, or the leader selects a project, gathers the parts, etc., and everyone works together on building whatever it is with guidance from experienced builders. If your club doesn't do this, you might suggest it. And, if the club leaders don't want to hear suggestions from "kids," show them this letter instead.

What can you build? All the major ham magazines regularly feature homebrew projects of varying levels of complexity. We had a great starter project in our January, 1997, issue—a simple matter of wiring up a headset mic for different handhelds. And last December, we had plans for an easy-to-build ATV repeater (!) and a power supply for certain 9600-baud data radios. Projects like these not only help you learn homebrewing skills but, if done as a club project, can help members set out on new operating adventures as well.

Canadian Perspective

Dear *CQ VHF*:

I've enjoyed *CQ VHF* ever since your first issue. I find it informative and very entertaining. I've always said, there's room for a VHF and above magazine!

In the November issue of *CQ VHF*, I read with great delight the news that Canada's amateur radio voice, RAC, has recommended to Canada's World Radiocommunication Conference (WRC) representatives to drop CW as a requirement for amateurs wishing to operate on our HF bands. I say delighted because this is the first positive step I've seen in some time towards the future of amateur radio. What is even more important was their rationale behind the recommendation.

We've all heard the arguments from both sides. I agree with you that there is a lot of emotion regarding this issue. But we can't allow emotion to dictate the future history of the amateur service. If we do, then the hobby and the public service it offers, will not last much into the next century.

CW will not die. Rather it will become yet another mode of operation in this great hobby of ours. In fact, in a lot of conditions, the only mode for making successful contacts. As for new qualifications, as stated in their report, RAC will recommend alternative testing that is more in keeping with the times. They are morally bound, as Canada's national radio amateur organization, to do so and I trust they will. As I also trust that the Canadian government will agree to those recommendations as an acceptable alternative.

RAC made the best decision and it did so for all the right reasons. They have put their cards on the table, for which I'm sure they will pay some price. I hope, for the sake of amateur radio, the ARRL will follow RAC's lead and make its recommendation based on the board members' heads and not their hearts.

Keep up the good work.

73,

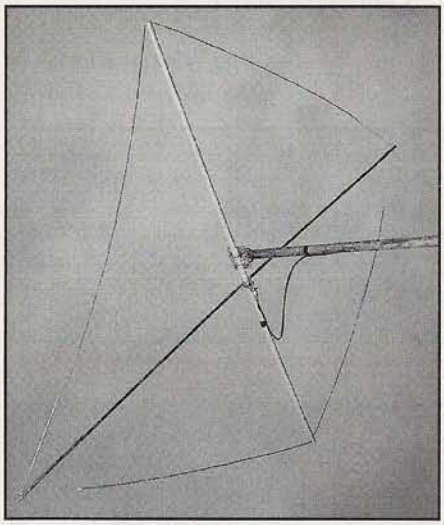
Ron Whaley, VE6RKW
Ardrossan, Alberta

CQ VHF *welcomes comments and suggestions from readers. We'll print a representative sampling each month, and we reserve the right to edit letters for length or style. All letters must be signed and show a return mailing address or valid e-mail address. Writers' names will be withheld from publication upon request. Address letters to: Letters,* CQ VHF, *76 N. Broadway, Hicksville, NY 11801; or via e-mail to <CQVHF@ aol.com>; <CQ@genie.com> or <72127.745 @ compuserve.com>. Please specify that it is a letter for* CQ VHF.

Product Update

AA Antennas Ultra-Light 6-Meter Beam

AA Antennas by VE9AA is offering a new ultra-light 6-meter beam antenna, with three elements on a boom approximately 7 feet (2.2 meters) long. The driven element is two-piece aluminum and the parasitic elements are made of wire. An overhead/birds-eye-view of this antenna is similar to a diamond shape. Gain is on the order of 6 to 6.5 dBd, and front-to-back ratio is in the 15 to 17 dBd range.



"I hope to fill a small niche in the market for the hilltopper, rover, beacon builder, or limited space operator," says Mike, VE9AA. "Hams with small rotors will have no problem with this antenna as the boom is also light and non-conductive!"

Price is $62.95 U.S. + S/H, payable by cash, money order, or certified check. For more information, contact AA Antennas, Mike Smith, 271 Smith Rd., Waterville, Sunbury Co., Canada NB E2V 3V6; Phone: (506) 357-1900; e-mail: <wynder @brunswick micro.nb.ca>.

Circle 100 on reader service card

"Ferromagnetic-Core Design and Application Handbook" by W1FB

Ferromagnetic-Core Design and Application Handbook, by Doug DeMaw, W1FB, is the newest book from MFJ Publishing. It will be a quick and handy reference or good study manual for amateur radio operators and sells for $19.95.

Amateurs who use inductors and transformers with magnetic cores will find the *Handbook* especially useful; according to the publisher, it's the only book that emphasizes the practical aspect of magnetic core materials from low frequencies through UHF.

DeMaw provides an in-depth look at basic theory and gives many practical circuit examples that use toroids, rods, and pot cores made of ferrite and powdered iron. All circuits were proven in the lab by the author.

For more information or your nearest dealer, contact MFJ Enterprises, Inc., 300 Industrial Park Road; Phone: (800) 647-1800, orders only, (601) 323-5869; Fax: (601) 323-6551; World Wide Web: <http://mfjenterprises.com>.

Circle 101 on reader service card

New Book from TAPR

Tucson Amateur Packet Radio (TAPR) has published what is likely to become a standard reference on the bookshelves of ham radio digital networkers, *Wireless Digital Communications: Design and Theory,* by Tom McDermott, N5EG.

In the book's preface, author McDermott explains that "the wealth and quality of literature in the professional world in (this) subject area is astounding, but much of it may not be readily accessible to the radio amateur, whether for reasons of advanced mathematics or simple lack of availability." McDermott says his aim in *Wireless Digital Communications* was to publish a single reference covering "a broad spectrum of amateur synchronous digital communications subjects," to present the information in a clear and straight-forward manner with a minimum of "rigorous mathematical theory" and "the maximum use of graphical and computer-assisted aids."

Wireless Digital Communications: Design and Theory includes a 3.5-inch diskette containing the programs used in the book and is available directly from TAPR for $39.99. For more information, connect to TAPR's World Wide Web site at <http://www.tapr.org/tapr/html/pub.wdcdat.html>; or write to Tucson Amateur Packet Radio, 8987-309 E. Tanque Verde Rd., #337, Tucson, AZ 85749-9399; e-mail <TAPR@TAPR.ORG>; Phone (817) 383-0000.

Circle 102 on reader service card

"Radio Monitoring" Guide Published

A new resource for the scanner monitor/shortwave listener is available from Index Publishing. *Radio Monitoring: The How-To Guide,* by T.J. "Skip" Arey, WB2GHA, contains more than 300 pages of detailed information on mediumwave, shortwave and VHF/UHF listening. This is not another frequency guide, but rather a "how-to" manual on equipment, propagation, and receiving techniques. If your radio interests extend beyond the ham bands, this might be a worthwhile addition to your bookshelf.

Radio Monitoring: The How-To Guide retails for $19.95 and is available in bookstores or directly from Index Publishing Group, Inc., 3368 Governor Drive, Suite 273, San Diego, CA 92122; Phone: (619) 455-6100, Order line: (800) 546-6707; Fax: (619) 552-9050; Internet: <http://www.electriciti.com\~ipgbooks>.

Circle 103 on reader service card

MIRAGE...160 Watts on 2 Meters!

Turn your mobile, base or handheld into 160 Watt powerhouses and talk further, longer, clearer . . . All modes: FM, SSB, CW . . . Superb GaAsFET preamp . . . Overdrive, high SWR, Over-temperature protection . . . Remote controllable . . .

B-5016-G
$299
Suggested Retail

The MIRAGE B-5016-G gives you 160 watts of brute power for 50 watts input on all modes -- FM, SSB or CW!

Ideal for 20 to 60 watt 2 Meter mobile or base. *Power Curve* chart shows typical output power.

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*™.

Fully protected from high SWR and excessive input power. Has warning LED.

Has smooth adjustable Transmit/Receive switching with remote external keying.

RC-1B, $45, Remote Control. On/Off, preamp 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

More 160 Watt, 2 Meter Amplifiers . . .

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

B-1016-G, $379. MIRAGE's most popular *dual purpose* HT *or* mobile/base amplifier. 160 watts out/10 W in. For 0.2-15 watt transceivers.

B-1016-G Great for ICOM IC-706!

B-215-G, $379. MIRAGE's most popular *handheld* amp. 150 watts out/2 watts in; 160 watts out/3½ W in. For 0.25 to 5 watt handhelds.

100 Watts for 2 Meter HTs

B-310-G
$199
Suggested Retail
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

- *100 Watts out with all handhelds up to 8 watts*
- *All modes: FM, SSB, CW*
- *Great for ICOM IC-706*
- *15 dB low noise GaAsFET preamp*
- *Reverse polarity protection/SWR Protection*
- *FREE mobile bracket* • *Auto T/R switch*
- *FREE handheld BNC to B-310-G cable*
- *Ultra-compact 4³/₄x1³/₄x7³/₄ inches, 2½ pounds*
- *One year MIRAGE warranty*

***Boost** your 2 Meter handheld to 100 Watts!* ltra-compact all mode B-310-G amp is perfect for *l* handhelds up to 8 watts and multimode SSB/CW M 2 Meter rigs. *Great for ICOM IC-706!*

35 Watts for 2 Meter HTs

B-34-G
$99
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*
- *All modes: FM, SSB, CW*
- *18 dB GaAsFET preamp*
- *Reverse polarity protection*
- *Includes mobile bracket*
- *Auto RF sense T/R switch*
- *Custom heatsink, runs cool*
- *Works with handhelds up to 8 watts*
- *One year MIRAGE warranty*

MIRAGE RUGGED!

35 watts, FM only . . . $79

B-34, $79. 35 watts out for 2 watts in. Like B-34-G, FM only, less preamp, mobile bracket. 3⅛x1¾x4¼ inches.

MIRAGE Dual Band 144/440 MHz Amp

BD-35
$199
Suggested Retail

MIRAGE RUGGED!

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

- *45 Watts on 2 Meters/35W on 440 MHz*
- *Auto Band Selection* • *Auto T/R switch*
- *Full Duplex Operation* • *5x1³/₄x5 inches*
- *FREE mobile bracket* • *"On Air" LEDs*
- *Single Connector for dual band radios and antennas*
- *Reverse polarity protection*
- *Works with all FM handhelds to 7 watts*
- *One year MIRAGE warranty*

Add this Mirage *dual band* amp and boost your handheld to a *powerful* mobile or base -- 45 watts on 2 Meters or 35 watts on 440 MHz! **Mirage's** exclusive *FullDuplexAmp*™ lets you talk on one band and listen on the other band at the same time -- *just like a telephone conversation.* (Requires compatible HT).

6 Meter Amplifier (50-54 MHz)

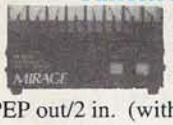
FCC Type Accepted

The A-1015-G, $389, is the *world's most popular* all mode FM/SSB/CW 6 Meter amplifier. 150 watts out for 10 in. For 1 to 15 watt transceivers.

70cm Amplifiers (420-450 MHz)

D-3010-N, $365, -- 100 W out/30 in. For 5 to 45 watt *mobile/base*. **D-1010-N, $395**, 100 W out/10 in. *Dual urpose* -- for handhelds or mobile/base. **)-26-N, $269**, 60 W out/2 in, for *handhelds*.

Amateur TV Amps



Industry standard ATV amps -- **D-1010-ATVN, $414**, 82 watts PEP out / 10 in. **D-100-ATVN, $414**, 82 watts PEP out/2 in. (without sync compression).

Remote Control Head for Amps

RC-1, $45, remote controls most MIRAGE amps. Power On/Off, preamp On/Off, switch for SSB/FM. 18 foot cable (longer available). 1³/₄x3³/₄x2½ inches.

Repeater Amps

11 models -- continuous duty all modeFM/SSB/CW repeater amps for 6, 2, 1 1/4 Meters, 70cm, 450 MHz ATV.

Low noise GaAsFET preamps

KP-1

KP-2

High gain *ultra low noise* GaAsFET preamps for receiving weak signals. Selectable gain prevents receiver intermod. 15 to 22 dB gain. Less than 0.8 dB noise figure. Automatic RF switching up to 160 Watts. **Choose** In-*Shack* model or *Mast-Mount* (includes remote control) model to reduce loss. Rugged die-cast enclosure.

Frequency (MHz)	*In Shack $139*	*Mast Mount $195*
28-30	KP-1/10M	KP-2/10M
50-54	KP-1/6M	KP-2/6M
144-148	KP-1/2M	KP-2/2M
220-225	KP-1/220	KP-2/220
430-450	KP-1/440	KP-2/440

1¼ Meter Amps (223-225 MHz)

Choose from 10 models -- 20 to 220 watts out for 2 to 50 watts in, $129 to $655.

Commercial Amps ($199 to $395)

FCC Type Accepted

Commercial amps for 150 - 174, 450-470 MHz and VHF marine bands, 70 -130 watts out.

Accurate SWR/Wattmeters

Read SWR directly andForward/ Reverse, Peak/Average power. Remote Coupler. 1.8-30, 50-200, 420-450, 1260-1300 MHz band models.

One Year Mirage Warranty

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MIRAGE . . . the world's most rugged VHF/UHF amplifiers

Hams in Space: A Guide to Working Mir—Part 1

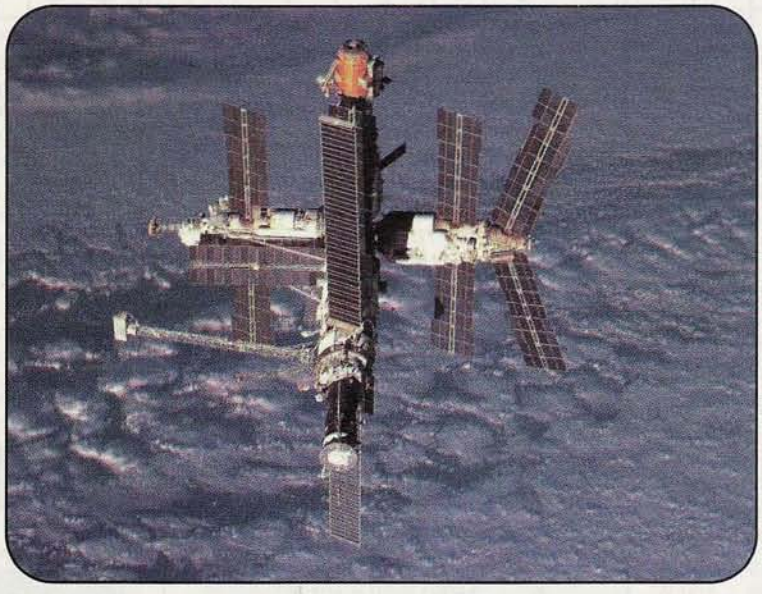
The Russian space station Mir has become arguably the most popular amateur radio satellite in (or slightly out of) the world. In Part 1 of this tutorial, we introduce Mir, its station setup, and what you'll need to make contact.

By G. Miles Mann, WF1F*

Working the Russian space station Mir is easier than you may think. I've been able to connect to Mir's 2-meter packet station on a regular basis with a very modest base station and even from the packet station in my car.

If you have a 2-meter packet station at home now, then you may already have all the equipment you need to start a friendship with the cosmonauts and astronauts on board Mir. The space station's packet station is *not* a Packet Bulletin Board, but instead is what's known as a *Personal Message System* or *PMS*. The Mir PMS experiment is specifically designed to allow easy access for beginners.

This is a rewrite and update of an article I published in *QST* magazine in November, 1993. A lot has changed in the three-plus years since that article appeared, including Mir's 2-meter frequencies and the addition of a 70-centimeter packet station and voice repeater. In this article, I'll describe the equipment you need to contact Mir, along with the features supported by the PMS and the proper operating procedure to ensure successful connects. I'll also give you basic operating tips for Mir's new 70-centimeter station. We'll cover hardware, software, and station setup here in Part 1, and in Part 2 we'll focus on operating tips.



The Mir space station complex includes two ham stations: one on 2-meter FM voice and packet, and another on 70-centimeter voice and packet, including an FM repeater. These photos were taken during shuttle mission STS-79 in September, 1996. (NASA photo S79E5327)

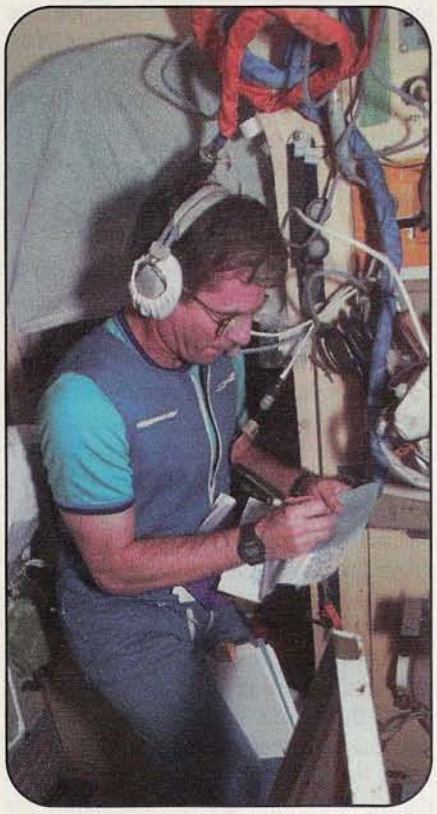
A Space—and Ham Radio—Veteran

The Mir space station has been manned continuously for over 10 years. Amateur radio has been in use on Mir for over six years. Every three to six months, there's a crew change. For one to two weeks, both crews live on board Mir, exchanging important information. One of those important things discussed is the ongoing amateur radio experiment, becoming known as MIREX. Many crews have realized that the amateur radio station can really be a big help in contacting friends and family, providing entertainment, and passing important information back and forth to Earth. During the uncertain times that followed the breakup of the Soviet Union, when the Mir crew was literally stranded in space, ham radio became a vital link to the rest of the world.

Today, the Mir crew usually consists of two Russian engineers and an international guest. Astronaut Norman Thagard was the first American to live on board Mir and stayed for over two months. American astronaut Shannon Lucid set a new American space endurance record with her 194-day stay aboard Mir from April to September, 1996, as a member of Crew #21.

Crew #22 arrived in two stages. Commander Valery Korzun and Flight Engineer Alexander Kaleri (U8MIR) arrived

**G. Miles Mann, WF1F, wrote about a school contact with Mir while three crews were aboard—outgoing and incoming Mir crews plus a U.S. shuttle crew—for the July, 1996,* CQ VHF.



Astronaut John Blaha, KC5TZQ, operates ham radio from space. He lived and worked aboard Mir from September, 1996, to January, 1997. (NASA photo S79E5151/STS-79)

"Many [Mir] crews have realized that the amateur radio station can really be a big help in contacting friends and family, providing entertainment, and passing important information back and forth to Earth."

via a Soyuz rocket on August 14. Then, on September 15, American astronaut John Blaha, KC5TZQ, arrived via the Space Shuttle Atlantis. Astronaut Blaha was due to return to Earth in January 1997, when the next "space taxi" came to take him home.

Mir's 2-Meter Station

For many years, the 2-meter ham station aboard the space station was an ICOM IC-228A transceiver, with voice and standard 1200-baud AX.25 packet on 145.550-MHz simplex. Recently, however, both the radio and the frequency were changed—twice.

The IC-228A was replaced with a Kenwood TM-733 (the European version). The simplex frequency of 145.550 MHz was causing interference with European simplex operations (*and the Europeans do a lot more simplex than we do here in the U.S.—ed.*) and was changed last November in accordance with a new band plan adopted by representatives from Region 1 of the International Amateur Radio Union (IARU), which includes all of Europe and Africa.

An additional change was made more recently. As of January 1, 1997, both voice and packet operations are on "split" frequencies, with uplink (where you transmit) on 145.200 MHz and downlink (where you listen) on 145.800 MHz. Always listen on 145.800 and set a –600-kHz offset to transmit.

(The change of frequencies has caused a great deal of consternation among many amateurs in the U.S. First of all, Mir's new uplink frequency of 145.200 is right between two repeater output *frequencies used in many metropolitan areas, 145.190 and 145.210. It's feared that strong repeater signals could "capture" the frequency and block communications with the Mir crew. Secondly, the new downlink frequency of 145.800 is just 10 kHz above the national APRS, or Automatic Position Reporting System, frequency of 145.790, raising more fears of interference. Thirdly, 145.800 marks the beginning of the internationally recognized satellite subband, 145.800 to 146.00, and users of other satellites are concerned about the presence of strong packet and FM voice signals in areas generally used for CW and SSB contacts. There have been discussions on solving this problem, but, at press time, no resolution had been reached.—ed.)*

The radio is currently connected to an externally mounted dualband antenna (2-meters and 70 centimeters). The typical power output is 25 watts, although power levels of 5 watts have been more common recently. Anyone on Earth with a similar setup should have no problem hearing the Mir crew or connecting to the Mir PMS.

Passing Over Your House

If you live in the U.S. or southern Canada, you should have six to eight opportunities a day to contact Mir. The space station is in a nearly circular orbit approximately 240 miles above the Earth. It takes Mir approximately 93 minutes to make one complete orbit around the world. If you were to look at Mir's path on a flat map, it would look as though it were tracing a big sine wave across the map. The top of the sine-wave orbit is approximately 51° North latitude. What all this means is that, if you live below 51° North latitude, Mir will pass directly over your house every few days. Mir will also pass within radio range of your QTH several times *every* day for up to 10 minutes per pass.

Your Station Needs

To work Mir from your home, you should have at least the following amateur radio equipment: a 2-meter radio with an output rating of at least 25 watts, an omnidirectional antenna or small beam fed with a short run of good quality coax (such as RG-213, 100 feet or less), and a standard 1200-baud AX.25 packet modem (TNC). That's about all you need for radio equipment.

Some of the fancier amateur radio satellites, such as WO-18, FO-22, and FO-23, require expensive SSB radios and a DSP-style modem costing hundreds of dollars *(DSP stands for Digital Signal Processing.—ed.)*. Mir's stations, on the other hand, support the inexpensive FM mode and standard 1200-baud packet. I use an inexpensive KPC-3 modem for my Mir packet connections.

You will, however, need a computer to tell you when Mir is in range of your station. Timing is the most important aspect of a successful contact with Mir, and there are many tracking programs out in the marketplace today to help you. Some programs, such as "STSPLUS," are shareware, while others cost a few bucks up front. (I don't have the space to review all the available programs in this article, but I can recommend DOS "InstantTrack," available from AMSAT. This program is very easy to use and works very well with older style computers, such as 80286-style PCs. "InstantTrack" costs $30 if you're an AMSAT member and $50 if you're not.)

Working with Doppler Shift

The Mir space station is traveling around the Earth at over 17,500 mph (28,000 kph). This great speed makes radio signals appear to shift in frequency, a phenomenon called *Doppler shift*.

Operating Tips for Mir's 70-Centimeter Repeater

Working Mir's 70-centimeter station is much more difficult than connecting with its 2-meter packet station, but still it *can* be done with the right equipment and the proper preparation.

The new SAFEX II project on Mir supports three different communications modes, Voice QSO, FM Repeater and 9600-baud packet. Each mode has been assigned a specific frequency pair:

Downlink/Uplink	Mode
437.925/435.725	FM voice QSO, used to talk to the Mir crew
437.950/435.750	FM repeater, used just like any FM repeater
437.975/435.775	FM 9600-baud packet

Only one mode is active at a time. Note that all modes, including packet, use "split" frequencies for transmit (uplink) and receive (downlink).

Doppler Times Three

The effects of Doppler shift (see main text) are approximately three times greater at 437 MHz than at 145 MHz—approximately 20 kHz instead of 7 kHz. There will be a plus 10-kHz shift during the first five minutes of the pass, followed by a negative 10-kHz shift during the last five minutes. The Doppler shift will cause the Mir transmit frequency (437.950) to look like it's approximately 10 kHz higher in frequency when Mir is approaching your location. Because of the large Doppler shift, the use of CTCSS on the repeater (see below) and the present antenna orientation, a large amount of ERP (effective radiated power, 500 to 1200 watts) is required to reliably access the repeater.

To access the FM repeater, you'll need to compensate for the Doppler effects during *each* transmission. You'll also need a radio capable of sending out a 141.3-Hz CTCSS tone to open the orbiting FM Repeater. The repeater is tone-controlled to help reduce interference.

During the initial testing of the repeater last July, it was noticed that if you were off frequency by more than 2.5 kHz, the repeater could not decode your CTCSS tone. This makes Doppler correction even more important, and it must be done on the downlink as well as the uplink. This means changing both your transmit and receive frequencies simultaneously and adjusting your offset with each frequency change. If your radio tunes in minimum 5-kHz steps, use the same method described in the main text for setting up memories for 2-meter Doppler compensation, but use five memories instead of three, as follows:

Mem#	Downlink	Uplink	Split
1	437.960	435.740	2.20 MHz
2	437.955	435.745	2.21 MHz
3	437.950	435.750	2.20 MHz
4	437.945	435.755	2.19 MHz
5	437.940	435.760	2.18 MHz

If your radio is capable of smaller steps, such as 2 or 2.5 kHz, use more memories with smaller steps, following this basic pattern. Remember to use a 141.3 Hz CTCSS tone.

Because many hams have radios that are channel-locked, you may not be able to make any fine tuning adjustments to either your receive or your transmit frequency. Most FM mobile radios and HTs can't make any frequency changes of less than 5 kHz. This creates a problem: Doppler shift will cause the Mir transmit frequency (145.800) to look as if it's 3.5 kHz higher when Mir is approaching your location, and up to 3.5 kHz lower as it's going away from you. If you listen on 145.805 or 145.795, your reception may actually improve.

To work around this problem, if you have a radio with 5-kHz minimum tuning steps, get out your manual, look up the section on "odd splits," and program the following frequencies into consecutive memories (this is for "simplex" packet operation):

Channel 1: 145.200 TX/145.805 RX
Channel 2 145.200 TX/145.800 RX
Channel 3 145.200 TX/145.795 RX

When Mir is approaching your QTH, use Channel #1. Then when Mir is overhead, use Channel #2. And after Mir passes your QTH use Channel #3. For best results, use an updated tracking program, which displays the current Doppler shift. A program such as "InstantTrack" will display the Doppler shift in real time and will help you determine when to change channels. If you don't have a tracking program, find a friend who does and who's willing to print out schedules for your location.

As you may have noticed, I don't recommend adjusting your uplink frequency for the 5-kHz radios. (*Standard practice among users of other satellites is to leave the receiver in one spot and adjust the uplink frequency to compensate for Doppler shift.—ed.)* This is because you may have better results if you leave your transmitter on 145.800. The Doppler shift is only at the +3.5-kHz setting for a few seconds, after which it slowly begins to approach 0. After five minutes or less, the Doppler shift will be 0 for a few seconds and then will begin to swing toward -3.5 kHz. (On 70 centimeters, with its greater Doppler shift, you'll need to change both receive *and* transmit frequencies to compensate. See "Operating Tips for Mir's 70-Centimeter Repeater.")

The 2-meter receiver on Mir can copy ground stations that are off frequency by as much as 3 kHz. This is because the radio on Mir has a "wide" receiver. Sometimes, a wide receiver is good, and we're lucky to have one on Mir. If the space station's receiver had good selectivity, it would actually make it *harder* for "channel-locked" stations to access Mir.

Interference Potential

Unfortunately, there are some drawbacks to this configuration. The optimum channel spacing for terrestrial 2-meter FM communications is a 20-kHz channel step *(in some areas, it's 15 kHz or even less, but there are compromises—ed.)*. While a 20-kHz channel spacing plan works very well for FM repeaters and simplex, it doesn't work for FM satellites.

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"If you live in the U.S. or southern Canada, you should have six to eight opportunities a day to contact Mir."

All satellite operations are considered "weak signal," even FM. The channel you're using for satellite operations must be clear for you to hear the weak signals coming from the satellite. The channels on either side of your operating channel also must be clear (no BBSs or repeaters) to help prevent adjacent channel interference. When you take into account the 3.5-kHz Doppler shift and adjacent channel interference problems, you'll come up with a different value for FM satellite channel spacing. For the 2-meter band, the recommended FM channel spacing for a satellite is 30 kHz. What this means is that there should not be any packet bulletin boards or repeater outputs within 30 kHz of the channels used by the FM satellite on 2 meters. (Note that the channel spacing varies by frequency; the 70-centimeter satellite FM band requires a 50-kHz channel spacing.)

TNC Configuration

Now that we've nailed down the frequencies and figured out when the Russian space station will be accessible from your location, let's set up your packet station to make contact. To operate the Mir PMS, you'll need to modify some of the settings on your TNC. Most of the parameter changes required for Mir will be compatible with terrestrial BBS operations. Using these suggested parameters will improve your connection rate and, at the same time, help reduce interference.

This is a portion of the TNC parameters for my KPC-3; your actual parameters may vary, based on what TNC you're using: AUTOCR OFF LFADD OFF MAXFRAME 4 MCON ON MCOM ON MONITOR ON PACLEN 72 RETRY 8-10 TIME STAMP ON. Now, let's explain a few of those:

LFADD—This value seems to interfere with normal Mir BBS operations. Make sure LFADD is turned OFF.

MCOM/MCON—These values are normally turned "OFF" for terrestrial BBS connections, but should be "ON" for connections to the Mir PMS. When MCON is ON, it allows you to see packets going to other stations while you're connected or attempting to connect. All courteous operators using Mir keep this value ON.

PACLEN—Lots of short packet lengths are less likely to be clobbered than a few very long packets.

RETRY—You don't want to set this value too high because you may cause QRM during your initial connect. Also, if RETRY is too short, you'll time-out during one of the four deep RF signal fades. (During each 10-minute pass, there are four RF polarity shifts in the signal coming from Mir. This shift is caused by the apparent position of the antenna on Mir in relation to your antenna.)

TIME STAMP—With TIME STAMP turned ON, you'll be able to log data to your disk while you're away and track the time and duration of the passes.

Once you've got your parameters configured correctly, you'll be able to monitor all the data coming from the Mir PMS. The data you see will typically fall into one of the following six categories:

C—Connect request
D—Disconnect request
DM—Disconnect mode
UA—Unnumbered Acknowledge
UI—Unconnected Information frame
I(n)—Information frame (n=0-7).

This is no different than the types of packets that you would see from a terrestrial station.

All Set?

Once you've got your rig and TNC set up the way we've described here, you'll be ready to make contact with Mir. In Part 2, we'll tell you how to pick a pass for a contact attempt, when it's OK to try to connect, and what to do once you're connected. Until then, practice listening for Mir and tracking its signal during the course of a pass. ■

Amateur Callsign Update

The following shows the last callsign in each group to be assigned for each VEC Region under the sequential callsign system as of January 3, 1997. It does not include vanity calls.

Radio District	Group A Am Extra	Group B Advanced	Group C Tech/Gen	Group D Novice
0	ABØDT	KIØFZ	**	KBØZHO
1	AA1RJ	KE1GR	N1YJC	KB1CBC
2	AB2CX	KG2JT	**	KC2AON
3	AA3PF	KE3YN	N3YNM	KB3BRK
4	AE4ZS	KU4AA	**	KF4OET
5	AC5KZ	KM5FW	**	KC5YLE
6	AC6ZG	KQ6MB	**	KF6IER
7	AB7TP	K7EC	**	KC7UAL
8	AA8YX	KI8AJ	**	KC8FSM
9	AA9TR	KG9IU	**	KB9PHE
N. Mariana Is.	NHØA	AHØAW	KH0FS	WHØABF
Guam	**	AH2DC	KH2RI	WH2ANR
Hawaii	AH7J	AH6OX	KH7CI	WH6DCW
Am. Samoa	AH8O	AH8AH	KH8DC	WH8ABF
Alaska	*	AL7QT	KLØCR	WL7CTY
Virgin Is.	WP2X	KP2CJ	NP2JO	WP2AIH
Puerto Rico	KP3V	KP3AO	NP3JD	WP4NMT

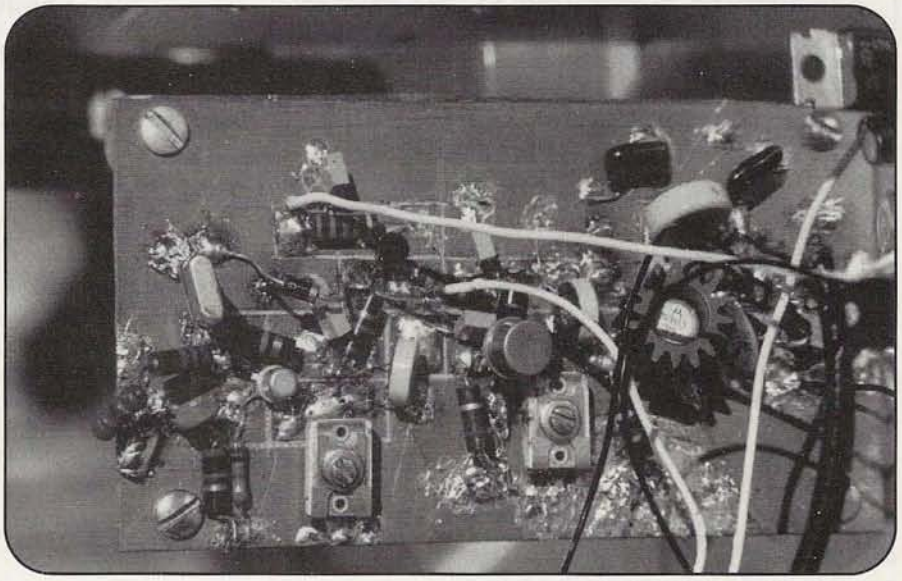
*2x1 callsigns are available for this group.
**All of the callsigns for this group have been assigned. Any request for a callsign from this group will be assigned a call from the next group. For more information, contact the Federal Communications Commission, Consumer Assistance Branch, 1270 Fairfield Road, Gettysburg, PA 17325-7245, toll free 1-800-322-1117. (*Courtesy FCC/ARRL*)

Build a Low-Power Beacon for 6 Meters

Here's an intermediate-level project for building a 1-watt beacon transmitter for the "magic band." Leave out the automatic keyer and you've also got a great QRP rig!

By Ken Neubeck, WB2AMU*

Author's Note: This is not a beginner's project. I am assuming that you have experience in building from scratch and that you've developed your own style of doing so. For those reasons, I am not including step-by-step instructions and I am leaving it to you to determine if you can build it and what to do when.



The 6-meter beacon transmitter board. Liberal amounts of solder were used to assure good connections. Note the squares that were etched out of the circuit board for the components. (Photos by the author)

Like buoys in coastal waterways, low-power beacons are useful navigational tools that operate 24 hours a day and are always there to help guide us to openings on the ham bands. When hams hear these beacons, they can get a good idea of whether a band is open, where it's open to, and how strong the opening is.

There are amateur radio beacons operating continuously on bands as low as 14 MHz and as high as 24 GHz. Typically, a beacon will transmit a CW signal consisting of a callsign followed by some location information. On frequencies above 50 MHz, this location information will usually be the four-character grid square locator (for example, FN30 for the grid encompassing Long Island, New York, where I live).

Six Meters—the Beacon Band

Six meters has somewhere in the neighborhood of 100 CW beacons, more than any other amateur band. These beacons are very useful for alerting 6-meter operators of sporadic *E* openings during the summer months, or of F2 openings during peak sunspot years. In the U.S., 6-meter beacons are typically located in the 50.060- to 50.080-MHz range (the FCC-designated beacon subband) and, for the most part, run less than 10 watts. Low power is a necessity when using battery power, as many beacons do. Antennas generally are omnidirectional, either verticals or "squalo"-type, to assure coverage in all directions.

Even though there are more beacons on 6 meters than on any other band, still more are needed. For example, until recently, there were no beacons on Long Island (grid square FN30) or in most of the surrounding grid squares. Many times, my friends in southern states, such as Florida, would tell me of a band opening toward my direction, based on their hearing the nearest beacon to me, which was W2CAP/1, on Cape Cod, in FN41. Yet this was over 150 miles away and not always sufficient to identify whether

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**Ken Neubeck, WB2AMU, is a regular contributor to* CQ VHF.

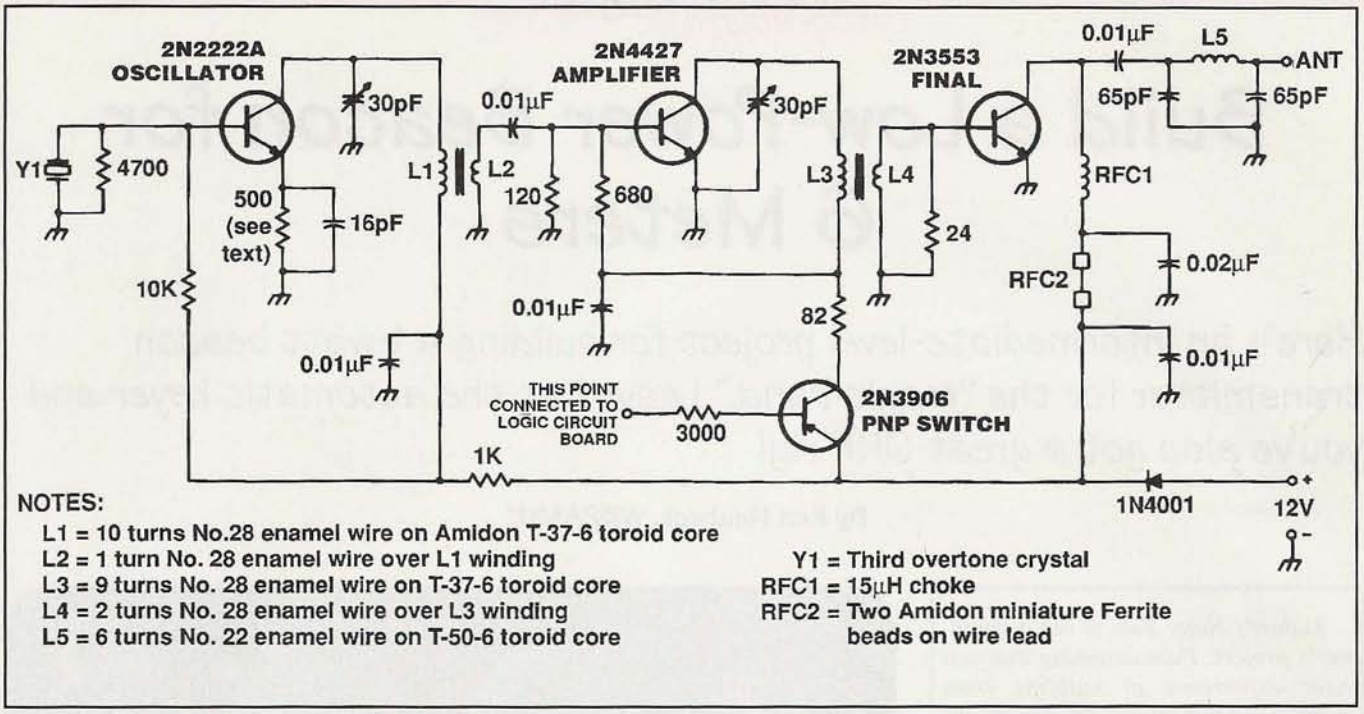


Figure 1. Schematic of the 6-meter transmitter board. It may be used in conjunction with the keyer/logic board in Figure 2 as a beacon transmitter, or on its own as a 1-watt QRP transmitter.

there was an opening to Long Island. It appeared that some kind of beacon coverage for Long Island was long overdue, so I decided to build one myself. The transmitter and keying circuits I built can be used as models for beacons elsewhere.

Beacon-Building 101

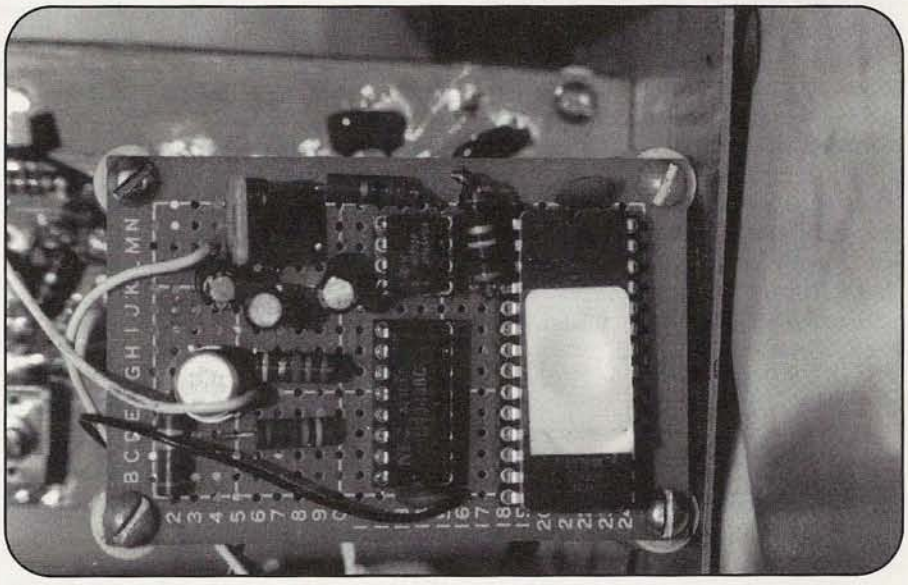
There are a couple of approaches that one can use for setting up a beacon. One way is to build a keyer circuit that keys a commercially-made 6-meter transmitter. This approach can be a little expensive and will use more power than desired, which could be a problem if the beacon is at a remote location and you want to use a power source such as a battery charged by solar panels. The other approach is to build from scratch a low-power beacon that's designed to draw low current and can be run from a battery. This is a less expensive approach and is more fun than simply plugging a keyer module into a commercial transmitter, but you should have at least some intermediate-level building experience before tackling a construction project of this magnitude.

In searching for a simple low-power design from previously published material, I found a basic 1-watt, 50-MHz CW transmitter design in the *ARRL Solid State Design* book by Doug DeMaw, W1FB, and Wes Hayward, W7OZI (1977). The design looked straightforward and I had many of the required parts in my junk box. The total cost of this project is in the $40 range if you buy all of the parts, but a good junkbox can lower that figure considerably. The most expensive parts I had to purchase were a third overtone crystal from Jan Crystals for $15 and an RF transistor that cost about $2.

Speaking of parts, I used 1/4-watt carbon resistors for all resistors and ceramic capacitors for the fixed capacitors. There are two 0–30 pf variable capacitors that can be ordered from any company that sells electronic parts (if you don't already have them in your junk box).

Starting with the Transmitter

I decided to work on the transmitter portion of the beacon first, followed by



The logic/keyer board. A miniature RadioShack breadboard had more than enough space for the components. The EEPROM is the large component on the right.

the automatic keyer circuit on a separate board. I drew my schematic layout of the transmitter section on graph paper, which I then glued onto a two-sided copper-clad circuit board with a fiberglass layer in between. Again, if you can't find a two-sided copper-clad board in your junk box, you can get one at RadioShack, other parts suppliers, and even at flea markets.

In the original design, DeMaw and Hayward recommended using the two-sided boards; however, I decided to scrape away the copper on the unused side of the board underneath the oscillator circuit to provide better isolation and minimize stray RF capacitance being introduced back into the oscillator. Experienced builders may come up with additional improvements as they go along in the design.

Updating the Circuit

After I started putting together the original design and had put in several hours of troubleshooting and tinkering, I realized that there were further improvements and updates that could be made to the circuit. Figure 1 shows the end result of the changes I incorporated.

The original designers' approach was to create a circuit that could use as many "junkbox-type" parts as possible for cost savings. For instance, they selected a 2N3904 transistor for the amplifier stage. While this standard junkbox transistor is acceptable in the design, examining its specification sheets shows that it's not the optimal transistor for VHF. A more suitable transistor is a 2N4427, which has higher power output at VHF. Although the 2N3904 costs pennies, the 2N4427 is not terribly expensive at the $1 price range, considering the improved performance it offers.

The change to this transistor required me to peak up the power a little bit in the circuit by changing some resistor values throughout the amplifier stage. Another update was required because the original design used a transistor in the final stage that has since become obsolete (a 2N925). The substitute called out in the manufacturer's data book is quite expensive, but the article recommended an alternate, the 2N3553 transistor, which is still readily available and fairly inexpensive (in the $2 price range). I used this—along with a heat sink for heat dissipation—in my final design.

"After I started putting together the original design and put in several hours of troubleshooting and tinkering, I realized that there were further improvements and updates that could be made to the circuit."

I also discovered that, when the authors said to put one turn of wire around a toroid core, they meant *exactly* one turn when viewed with respect to the center of the core. Extra turns will change the inductance and will actually load down the signal. Cores and the enamel wire you'll need to wind around them are inexpensive and, if you don't have them in your junkbox, you can order them from various parts companies that advertise in the back pages of ham radio magazines.

Put Your "Spurs" On

Next, I encountered a problem with spurious emissions where signals were appearing every 30 kHz above and below

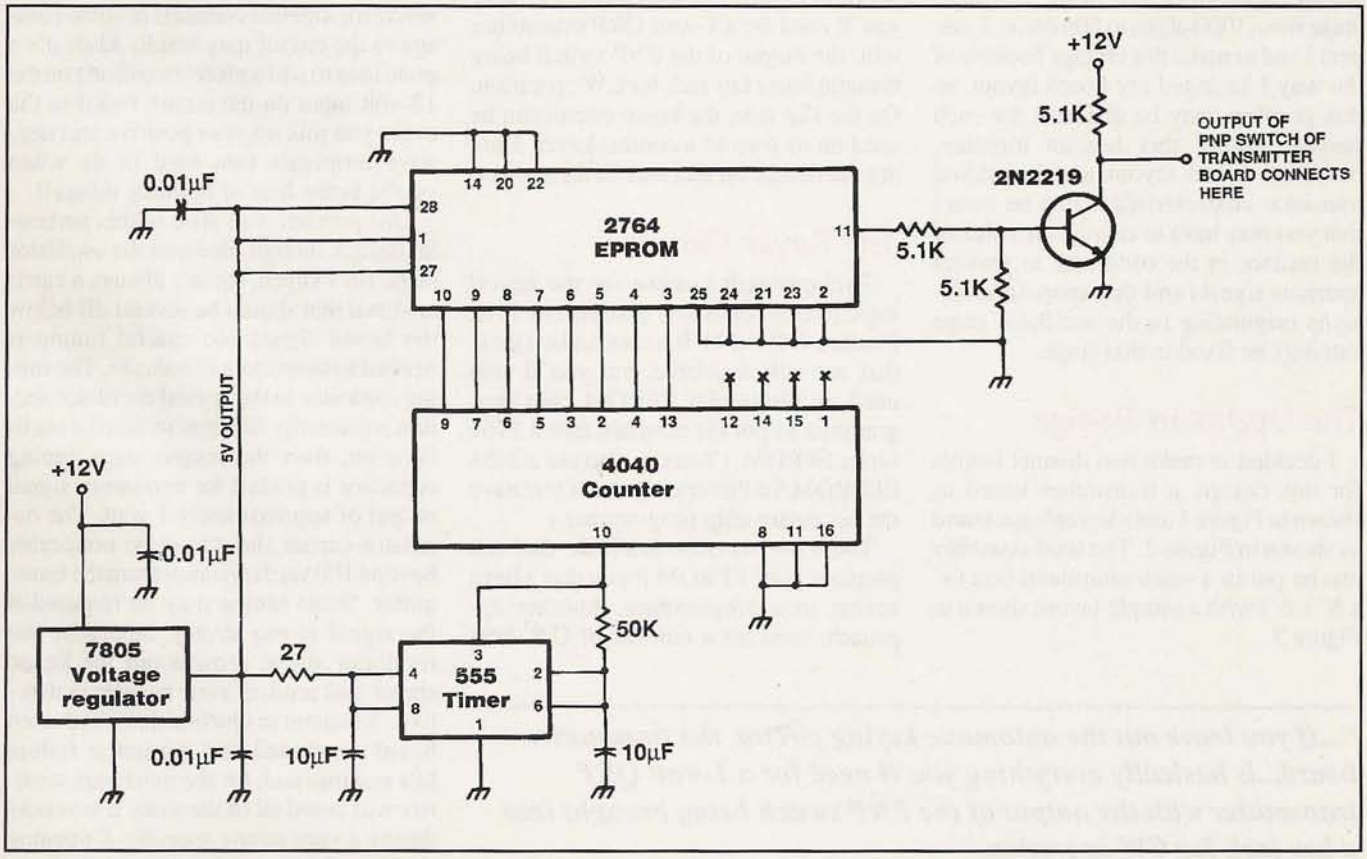
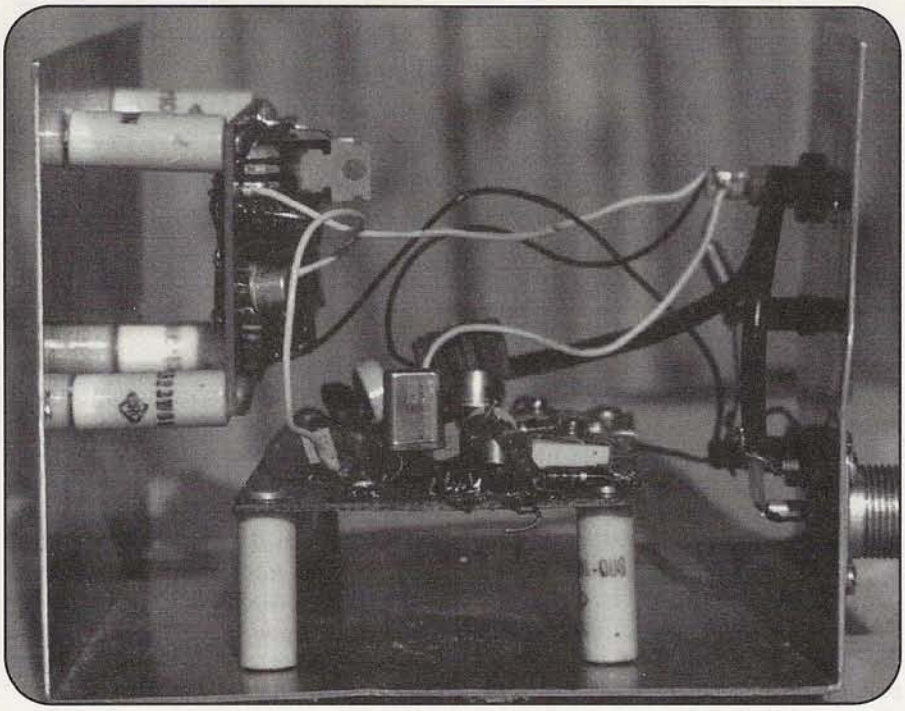


Figure 2. Schematic of the keyer/logic board, which may also be used on its own as a contest keyer.



Interior view of the 6-meter beacon transmitter. The transmitter board is mounted to the bottom of the case and the keyer/logic board is mounted to the side. Ceramic spacers are used to isolate the boards from ground.

the crystal frequency. I corrected this by changing the resistor value in the original RC network design of the oscillator stage from 1000 ohms to 500 ohms. I suspect I had to make this change because of the way I arranged my board layout, so this problem may be different for each person putting this beacon together, based on board layout and individual transistor characteristics. Just be aware that you may have to change the value of the resistor in the oscillator to prevent spurious signals and that spurious emissions originating in the oscillator stage can *only* be fixed in that stage.

The Updated Design

I decided to make two distinct boards for this design, a transmitter board as shown in Figure 1 and a keyer/logic board as shown in Figure 2. The total assembly can be put in a small aluminum box (4" x 5" x 6") with a sample layout shown in Figure 3.

By the way, if you leave out the automatic keying circuit, the transmitter board in Figure 1 is basically everything you'll need for a 1-watt QRP transmitter with the output of the PNP switch being brought into a key jack for CW operation. On the flip side, the keyer circuit can be used on its own as a contest keyer. Here are the details on that half of the project:

The Keyer Circuit

The approach I chose for the keyer/logic circuit board was designed by Fred Franke, WB2NFO. It uses standard parts that are still available, but you'll also need an ultraviolet EPROM chip programmer to put the program into a 2764 series EPROM. (You can also use a 2864 EEPROM for this application if you have the necessary chip programmer.)

There are services available that can program your EPROM if you don't have access to a programmer. Another approach, used for a number of U.S. beacons, is to buy a programmable keyer and hook it up to the transmitter board. Still another alternative is to purchase a commercial keyer chip.

For this specific application, I used a "1" bit as my "on' signal and a "0" bit as my "off" signal. I used three 1s for a dah and one 1 for a dit. For spacing between dahs and dits, I used one 0 bit; for spacing between characters, three 0 bits; and for spacing between words, five 0 bits. I mapped out a simple message on graph paper which included all spaces and listed the corresponding 1 or 0 bit for each part of the message. The message I used was "V V de WB2AMU/B FN30 LI"—a standard message that indicates the call, grid square, and abbreviation for location. This message took up 225 individual bits and required eight lines (the chip has a 256-bit limit) from the counter to the EPROM. (Note that only one output of the EPROM is used here; there are seven other outputs available for future expansion where different messages can be stored and retrieved using a rotary switch if desired.)

It took me several months' worth of spare time and two burned-out transistors before I finally got the circuit to work. Among the lessons I learned: You must always have a 50-ohm load on the output where the antenna connects or some damage to the circuit may result. Also, it's a good idea to add a protection diode on the 12-volt input on the circuit board in the event you mix up your positive and negative terminals (not hard to do when you're in the heat of building things!).

One problem can arise in this particular design, though. Because the oscillator stage isn't keyed, there's always a carrier signal that should be several dB below the keyed signal and careful tuning is needed to keep them in balance. The tuning capacitor in the crystal oscillator section is primarily adjusted to turn the oscillator on, then the output stage tuning capacitor is peaked for maximum signal output of approximately 1 watt. The oscillator carrier should not be noticeable beyond 100 yards distance from the transmitter. Some tuning may be required if the signal is too strong; otherwise the oscillator signal drowns out the keyed signal and renders your beacon ineffective. A beacon in Quebec that I had often heard developed this particular failure last summer and, for the most part, a carrier was heard all of the time. It was only during a very strong sporadic *E* opening that I could hear a faint keyed message

"...if you leave out the automatic keying circuit, the transmitter board...is basically everything you'll need for a 1-watt QRP transmitter with the output of the PNP switch being brought into a key jack for CW operation."

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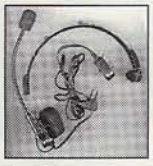
THE LOWE LEP 600M Headset Microphone

-8 Ohm, .5W max.
-85dB sensitivity
-10 to 1800Hz response
-dual jacks for Motorola radios
-1.5m cable length



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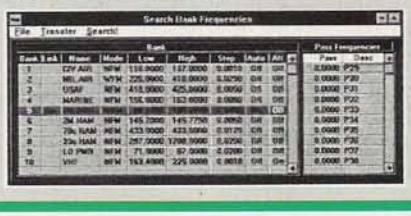
- Δ Max scan rate, user adjustable
- Δ Scan by radio or computer
- Δ Unattended frequency monitoring by time and date
- Δ Advanced computer control, you're not limited by the radios memory capacity or predefined operations.
- Δ Lockout unwanted signals
- Δ Rearrange all freq. in any combination by click/drag or entry
- Δ Open data base format.



CIRCLE 150 ON READER SERVICE CARD

"To register a new beacon, or if you'd like help in selecting a frequency, contact IARU Region II Assistant Beacon Coordinator Joel Harrison, WB5IGF, at 528 Miller Rd., Judsonia, Arkansas 72801, or e-mail to <wb5igf@arrl.org>."

and only then did the nature of the problem become clear to me.

Choosing Code Speed and Frequency

Code speed is set by the resistor on the output of the 555 timer (see Figure 2). I chose a 50-k resistor to simplify things by setting up the speed at 7 wpm, which is the ballpark speed for most beacons on 6 meters. Use a higher resistance for a slower keying speed, and a lower resistance for a faster one. Another alternative is to use a 50- or 100-k potentiometer to let you vary the speed. If you use this approach, though, you'll also need to add a 2000-ohm resistor in series with the pot or damage to the circuit may result.

Selecting a frequency for an automatic 6-meter beacon can be a little bit like a parking problem. The band of frequencies from which to pick is only 20 kHz wide (50.060 to 50.080 MHz) and even if you are the only beacon in your particular grid square, you want to be clear of beacons in neighboring grid squares.

Unlike frequency coordination for repeaters, which is nearly mandatory, beacon coordination is practically non-existent. The International Amateur Radio Union (IARU) tries to keep track and maintains a database, but it imposes no requirements on people putting up automatic beacons. On 6 meters in particular, beacons come and go quite frequently, so much so that it's hard to maintain a current list and to know what potential problem may lie in selecting a particular frequency. Sometimes it pays to listen for a while on the band and also to solicit observations from stations worked via skip concerning any beacons they may hear near your grid square area. In my case, I chose 50.063 MHz as my beacon frequency, with the beacon nearest to me, both in frequency and distance, being one in Maryland on 50.065 MHz, over 200

Parts List

Transmitter Board

Capacitors, fixed (ceramic)
- (1) 16 pf
- (2) 65 pf
- (5) .01 µf
- (1) .02 µf

Capacitors, variable
- (2) 30 pf

Coils and Chokes (see notes on schematic)
- #22 enamel wire
- #28 enamel wire
- (2) T-37-6 toroid core
- (1) T-50-6 toroid core
- (1) 15-µH choke
- (2) Amidon miniature ferrite beads

Crystal
- (1) Third overtone crystal (see text)

Diode
- (1) 1N4001

Resistors (1/4-watt carbon, in ohms)
- 1 each: 24, 82, 120, 500 (see text), 680, 1 k, 3 k, 4.7 k, 10 k

Transistors (1 each)
- 2N2222A
- 2N3906
- 2N3553
- 2N4427

Keyer/Logic Board

Capacitors, fixed (ceramic)
- (3) .01 µf
- (2) 10 µf

ICs (1 each)
- 555 Timer
- 2764 EPROM (see text)
- 4040 Counter
- 7805 Voltage regulator

Transistor
- (1) 2N2219

Resistors (1/4-watt carbon, in ohms)
- (1) 27
- (3) 5.1 k
- (1) 50 k

Misc. (all are shared for both boards)
- 2-sided copper-clad circuit board
- (1) 10-µf capacitor (see Figure 3)
- (8) ceramic spacers
- Coaxial cable (50 ohm) from Tx output to antenna terminal
- Enclosure (4" x 5" x 6")
- Hookup wire for +12 V
- (1) 50-ohm antenna socket (SO-239 or BNC)
- Terminals for +12V supply voltage

Parts Sources

Except for the following special parts, all components may be purchased from any electronic parts supplier, such as RF Parts, RadioShack, etc.

Toroid cores, enamel wire, and RF chokes are available from Amidon Associates.

Third overtone crystal is available from any one of several crystal manufacturers, such as Jan Crystals.

Amidon Associates, Inc., P.O. Box 956, Torrance, CA 90508

Jan Crystals, 2341 Crystal Dr., P.O. Box 60017, Ft. Myers, FL 33906-6017; Phone: (800) 526-9825

RF Parts, 1320-16 Grand Ave., San Marcos, CA 92069; Phone: (800) 854-1927

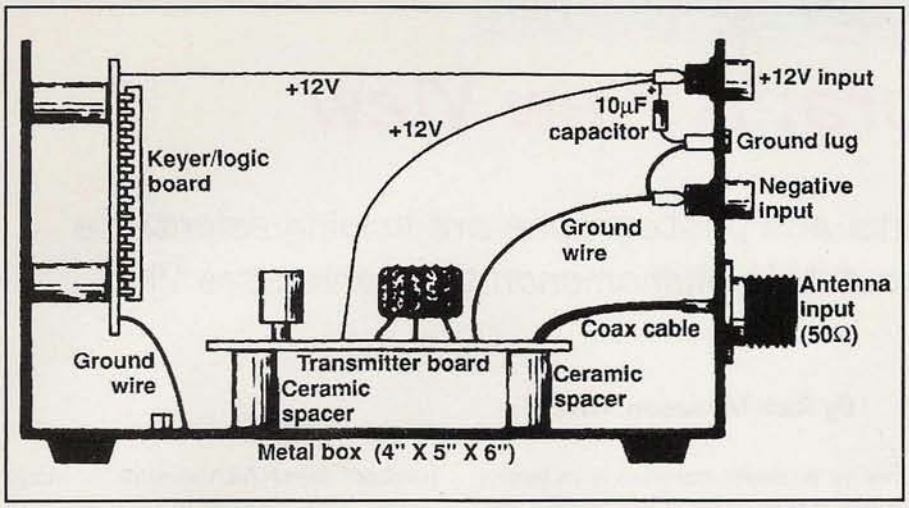


Figure 3. Suggested layout of the completed beacon transmitter. Note the 10-µf capacitor placed between the +12-volt line and ground for extra noise filtering.

miles away. The low power levels would assure that the two beacons would not interfere with each other.

To register a new beacon, or if you'd like help in selecting a frequency, contact IARU Region II Assistant Beacon Coordinator Joel Harrison, WB5IGF, at 528 Miller Rd., Judsonia, AR 72801, or e-mail to <wb5igf@arrl.org>. (*Updated 6-meter beacon lists are posted periodically on the Internet. We'll try to keep a current copy on the* CQ VHF *Web or FTP site.—ed.*)

Beacon Callsigns and Locations

While some stations in Canada have the luxury of separate callsigns for their beacons, there's no requirement in the U.S. for special permission or a special beacon callsign: just your own call with a "/B" at the end. Simplicity itself.

On the other hand, finding a permanent location for your beacon may be somewhat tricky. It works out fine to have the beacon operating at home when you're not there. But a 1-watt signal can really overload your receiver's front end if you want to listen to 6 meters when you are home. And turning off the beacon when you're on the air will deprive others of an alert to band openings, which is the reason for putting it up in the first place.

My temporary solution has been to run my beacon off my car battery at my job location while I'm working. The beacon draws little current and the mag mount ground plane vertical is a decent omnidirectional antenna that will be heard during a strong sporadic *E* opening. (Omnidirectional antennas are generally best, so your signal can be heard in any direction to which there's a band opening.) The only limitation is that the beacon is only on the air during daylight hours on weekdays. I hope to have the beacon on the air full time when I find a permanent location. Your best bet in searching for a location is to enlist the help of someone with access to a commercial tower site or the roof of a tall building and the authority to let you put the beacon there.

Closing Thoughts

Here's a bit of advice for those who use beacons to spot band openings. I've found that listening for beacons on 10 meters, between 28.200 and 28.300 MHz, has been a good warning for upcoming 6-meter sporadic *E* openings. Normally, by the time beacons are heard on 6 meters, the band is already open. But the 10-meter beacons can give you some advance notice.

Once I made the design changes, actual construction took me about two or three weeks of spare time, primarily because of the time needed to troubleshoot. The beacon made for a very good wintertime project when the 6-meter band is generally closed and I can listen to the quiet band while working on the beacon.

Finally, I would like to thank Fred Franke, WB2NFO, and Ray Neubeck, W2ZUN, for their help in troubleshooting this design and for their input to this article for *CQ VHF*.

The 6-meter band can still use more beacons! Maybe you'll be the next to build one. ■

Aurora: A New View

Exciting new satellite data and photographs are helping scientists and hams learn more about this phenomenon that enhances VHF communications.

By Rich Moseson, NW2L*

Editor's Note: This article was prepared from information provided by NASA along with the diagram and photographs reprinted on these pages.

Shimmering multicolored lights in the northern sky. If you've ever seen the aurora borealis (or aurora australis in the southern hemisphere), you've no doubt marveled at its beauty. And if you're active in VHF weak-signal communications, you've no doubt marveled at the ability of these curtains of light to refract radio waves. Of course, what we see as an enhancement, other spectrum users see as a disruption. And the disruptions attributed to auroras go far beyond radio communication.

"Electromagnetic disturbances in space have been found to affect a number of complex high technology systems on which society is becoming more dependent," says NASA scientist Dr. Mario Acuna. Thus, interest in studying these phenomena goes far beyond ham radio. According to Acuna, who is Project Scientist for the International Solar Terrestrial Physics Program, "the ultimate goal of this research is to be able to predict when and where disturbances might occur in the magnetosphere and ionosphere, and how severe they may be."

New research into aurora has shown that it's not just light—aurora is "visible" at ultraviolet and X-ray frequencies as

Rich Moseson is Editor of CQ VHF.

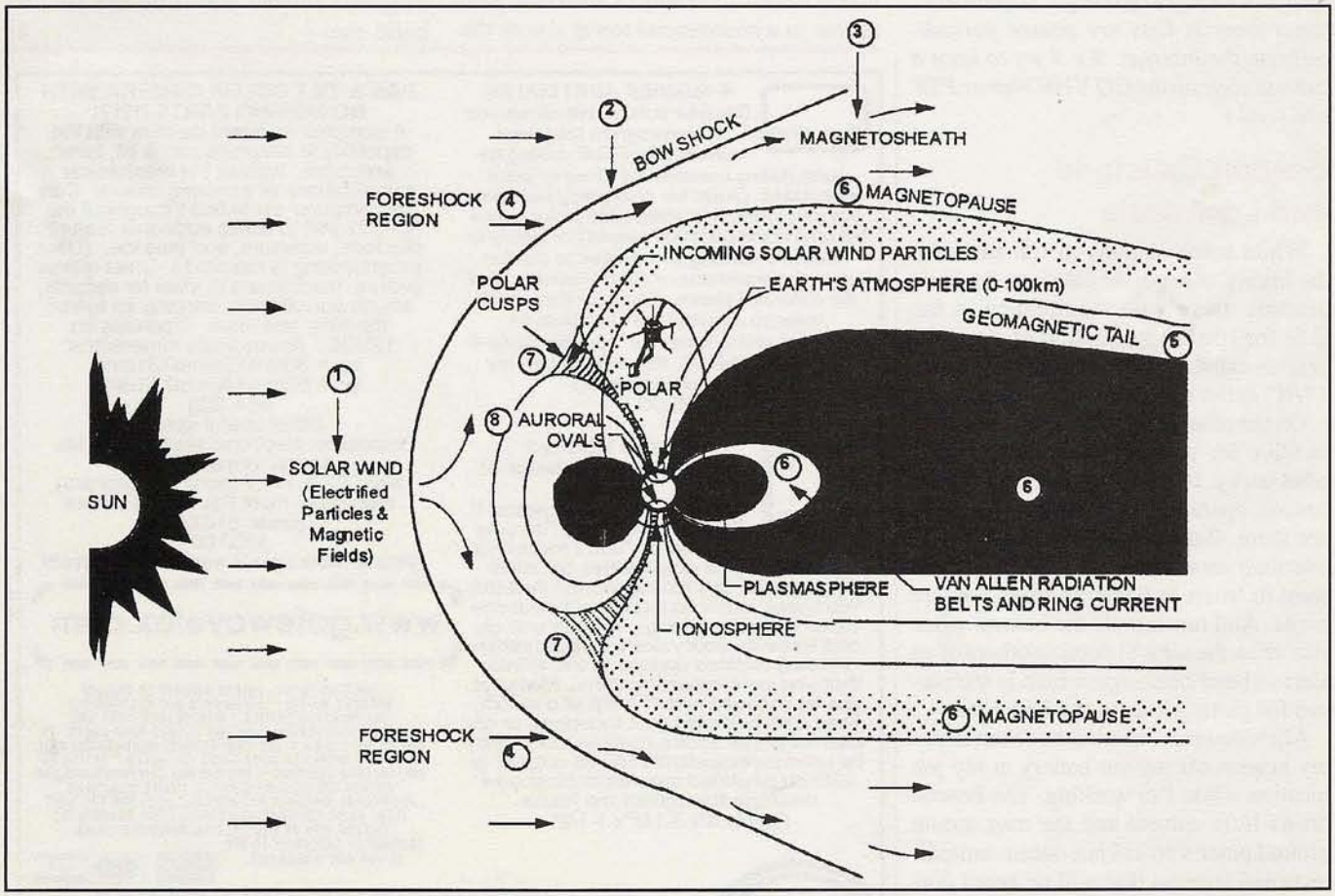


Figure. The Geospace System, showing the interaction between the Solar Wind and Earth's magnetosphere. The polar cusps (7) and auroral ovals (8) are of particular interest to VHF amateurs. See text for details. (Courtesy NASA)

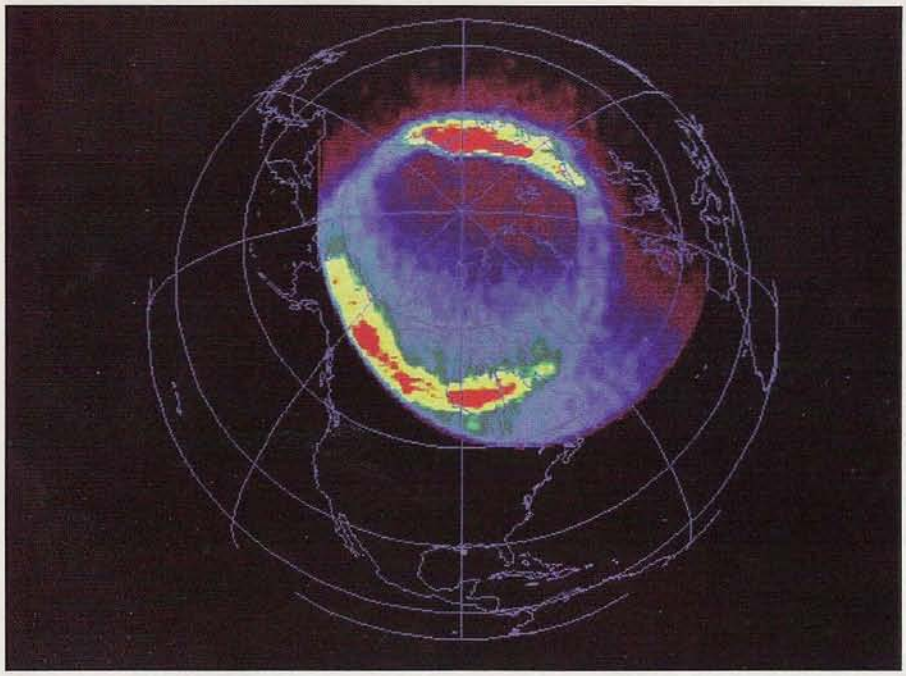


Photo 1. Ultraviolet image of the aurora borealis (northern lights), showing the entire auroral oval and separate, intense areas of auroral activity on both the daytime (foreground) and nighttime sides of the Earth. (All photos courtesy NASA)

well. And new satellite photos are showing us those images. The photos accompanying this article were taken by the new *Polar* satellite, launched in February, 1996, as part of NASA's Global Geospace Science program.

Polar's primary mission is to study the interactions between the *solar wind* and Earth's magnetic field. The solar wind consists of ionized particles in the form of hot, streaming gas that travels throughout the solar system, carrying its own magnetic field. This gas is also known as *solar plasma.* The magnetic field of the solar wind interacts with the Earth's *magnetosphere*, the area within the Earth's magnetic field. But what does this have to do with aurora and ham radio?

Direct Solar Energy

Well, when there's any notable increase in magnetic activity on the sun, and thus in the solar wind, some of these particles make their way into Earth's upper atmosphere near the north and south poles, exciting the atoms and molecules there and prompting them to emit light—the auroras.

The Figure of the Geospace System shows what happens to the solar plasma as it encounters Earth's atmosphere. The items of greatest interest to us (and the only ones we'll cover here) are #7, the *polar cusps,* and #8, the *auroral ovals.* The polar cusps are funnel-like openings leading to the Earth's polar regions, through which solar plasma can travel and reach the upper atmosphere. The auroral ovals are the areas where these solar particles intersect and interact with the atmosphere and produce the northern and southern lights, which NASA describes as "a visible signature of this energy transfer from the sun to the Earth."

Polar Images

The Polar satellite has been photographing the auroras at ultraviolet and X-ray wavelengths, it and has produced the best images ever of them, including the first direct evidence of independent "dayside" and "nightside" aurora. (In case this isn't obvious to you, "dayside" is the side of the Earth on which it's daytime when a photograph is taken; "nightside" is the half where it's nighttime.) One advantage of ultraviolet and X-ray imaging is that the photos are not obscured by daylight. In fact, some of these photos show more intense auroral activity during the day than at night. The images were first presented last spring at a meeting of the American Geophysical Union in Baltimore, Maryland.

Simultaneous Day/Night Aurora Activity

Photo 1 is an ultraviolet image of the entire northern auroral oval, with separate levels of activity visible over Canada and Siberia. Red areas indicate the most intense activity, while the blue regions have relatively low activity levels. The colors, by the way, are not real. They were added by the computer at the Goddard

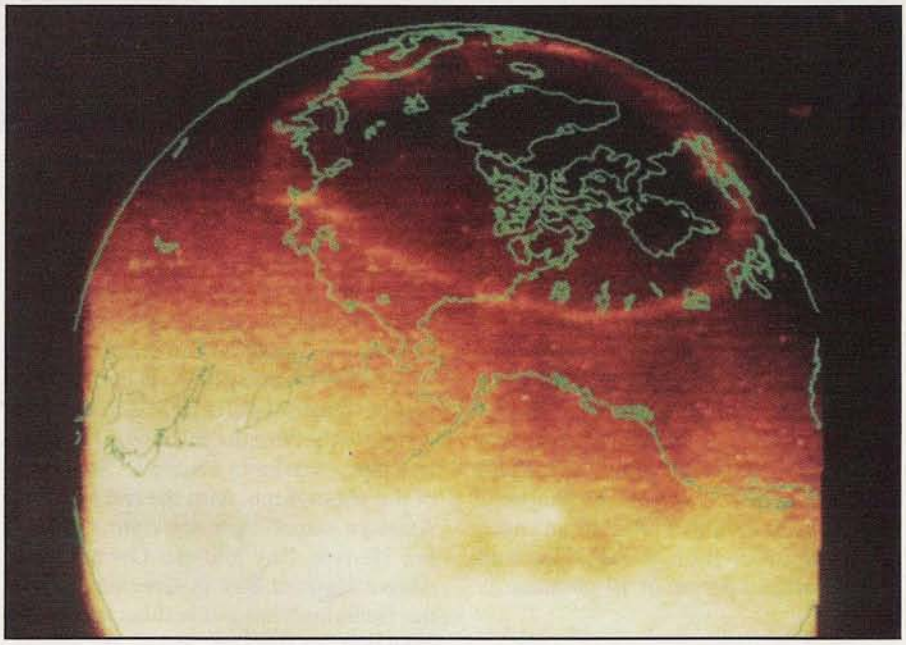


Photo 2. The complete northern auroral oval is visible in this photo, in ultraviolet light. It appears as a "crown" in the top portion of the image. At the time this photo was taken, the auroral oval extended from just north of the Great Lakes on Earth's "dayside," in both directions to the Scandinavian peninsula on the far "nightside."

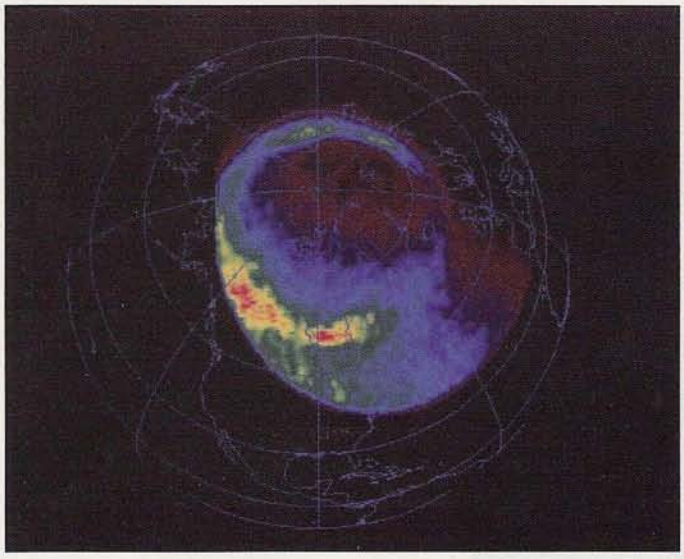


Photo 3A. The beginning of a 47-minute sequence in auroral activity. There is moderate activity on the Earth's "dayside" and very little on the "nightside."

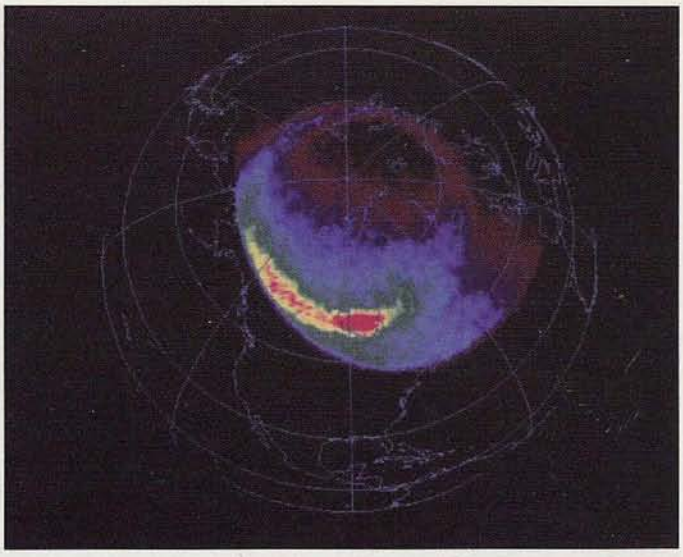


Photo 3B. Forty minutes later, the dayside aurora has intensified considerably. There is still very little nightside activity.

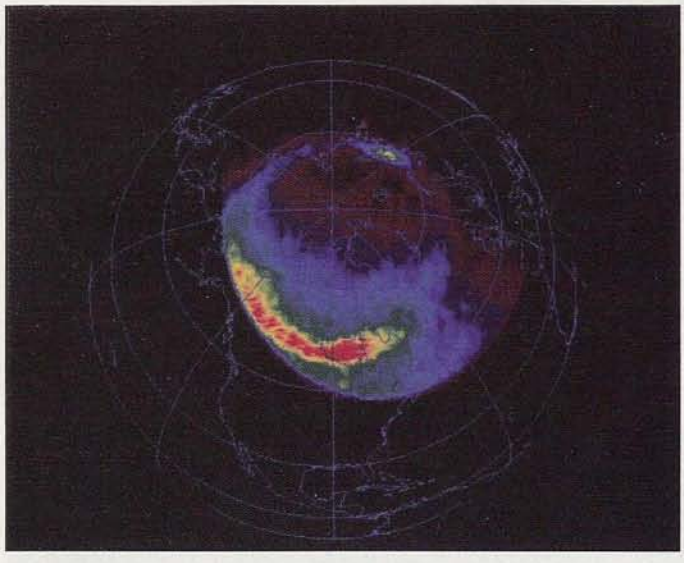


Photo 3C. At 42 minutes, a brightening over Russia signals the start of an "auroral substorm" on the nightside of Earth.

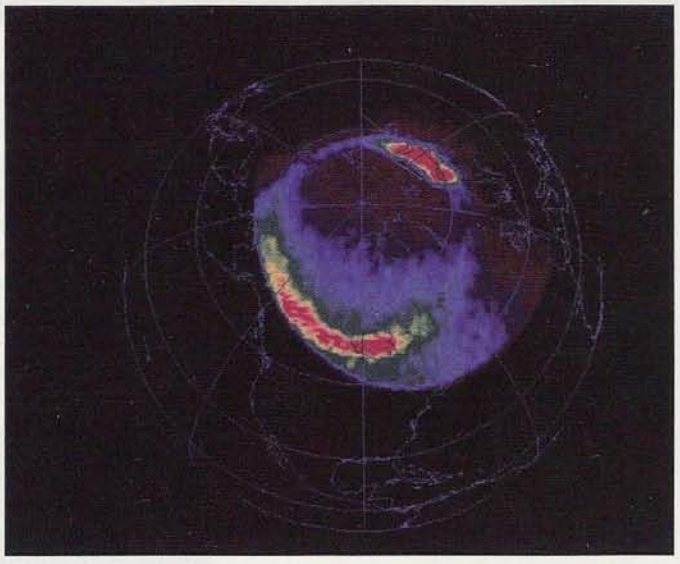


Photo 3D. The final photo, at 47 minutes, shows the auroral substorm over Russia in full swing, while the primary dayside aurora remains quite intense.

Space Flight Center, which is analyzing the data retrieved from Polar. Since we can't *see* ultraviolet light at all, we also cannot detect differences in "brightness." These "false colors" help us to do so.

According to NASA, this is the final photo of a sequence taken over a one-hour period. The sequence showed continuous, evolving, activity on the "dayside" of earth, and a sudden onset of an "auroral substorm" on the nightside, which developed over a period of 15 minutes.

Complete Auroral Oval

You'll have to look closely at Photo 2 and ignore the brightly lit area at the bottom. This is the glow from the sun's illumination of the Earth's upper atmosphere. The photo was taken by the Earth Camera, one of three cameras in Polar's Visible Imaging System. It uses a filter that passes ultraviolet light not normally visible to the human eye. Now, to get your bearings, Alaska is visible at the center of the photograph, with the rest of North America extending to the right. You can see Hudson Bay and the Great Lakes. Above Hudson Bay is Greenland, with the Scandinavian peninsula, appearing sideways, at the very top of the image. Northern Russia is on the left.

Now, if you look carefully, you'll see a line of light that enters North America

Pulling a FAST One

During the summer, the Polar satellite was joined in orbit by "FAST," the Fast Auroral Snapshot Explorer satellite. While Polar takes its photographs from high above the Earth's surface (eight Earth radii, according to NASA) and shows how auroral energy is distributed around the globe, FAST will stay closer to home (up only 1,250–6,250 miles) and, says Project Scientist Dr. Robert Pfaff, will concentrate on studying how particles are accelerated in space to create the aurora. FAST was launched on August 21, 1996.

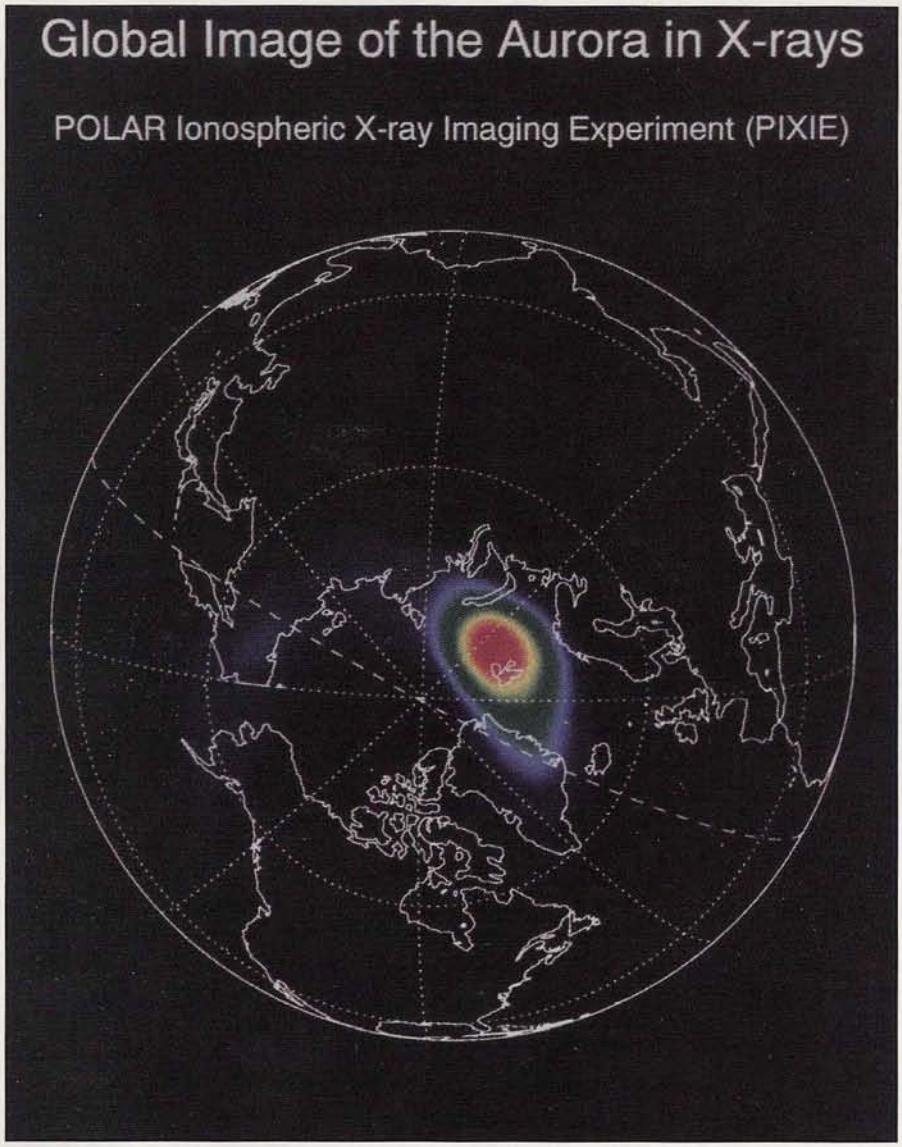


Photo 4. The first-ever global X-ray image of the Earth's aurora, taken by the PIXIE camera (see text) aboard the Polar satellite. In addition to the "hot spot" over the Arctic Ocean, there is a band of weak X-ray emissions following the auroral oval around the Earth.

in the Prudhoe Bay area of northern Alaska, comes down across Canada, crosses just north of the Great Lakes and continues around, crossing over Scandinavia before looping back through Siberia to our starting point in the Arctic Ocean. This is the *northern auroral oval*. The photograph was taken at around 2200 UTC on March 25, 1996. With the aurora dipping as low as the Great Lakes (although it wasn't very strong), if you're a weak-signal operator, you might want to check your log for any aurora (Au) contacts on that date.

Time-Lapse Photos

An amazing sequence of four ultraviolet images (Photos 3A-D), taken during a 47-minute period on April 9, 1996, shows the independent development of dayside and nightside aurora. In these photos, it's daytime over all of North America and nighttime over most of Asia and Europe.

The first photo (3A), taken at zero minutes into the sequence, shows very active dayside auroral activity over Canada and relatively little activity on the nightside of the auroral oval over Siberia. In Photo 3B, taken at 40 minutes, Siberia is still quiet—in fact, even quieter than before. But the dayside aurora over Hudson Bay has intensified greatly.

Just two minutes later, Photo 3C shows the first sign of an *auroral substorm* on the nightside, seen as a sudden brightening of the aurora in a small area over Siberia. In the final photo, taken 47 minutes after the first one and just five min-

Ham Radio Aurora Basics

Because the particles that form the auroral curtains are ionized, they have the ability to reflect and refract radio signals at certain frequencies. Intense auroral activity can disrupt or even shut down HF communications, but it can provide significant enhancements at VHF and UHF. Distances of nearly 2,500 miles are possible via 6-meter Au, and 1,000 miles or more is not out of the question on 2 meters, 1.25 meters, and 70 centimeters.

A directional antenna is essential, along with a rotator that can let you "follow" the aurora. Ideally, you should have an "az-el" rotor that can go up and down as well as left and right. High power (we're talking 500 watts, not 50) is also helpful, but it is possible to make Au contacts with low power if all the other conditions are just right. And you'll also need a multimode (SSB/CW) radio.

CW is the most popular Au mode, since the constant shifting of the auroral curtain creates a constantly changing Doppler shift, making it difficult to copy SSB signals. FM is virtually impossible.

Au signals are recognized by the buzz or hiss that accompanies them. If you suspect an Au opening, tune to the CW or SSB calling frequency for the band you're on, then aim your beam north and listen or call CQ. You'll also want to swing the beam about 45° each side of north, since the most intense auroral activity may be either to your northeast or northwest.

Finally, your chances of making Au contacts increase as you go up in latitude. So you're more likely to hear (and work) Au if you live in Minnesota than if you live in North Carolina. For more information on Aurora communications, we recommend *The VHF "How-To" Book*, by Joe Lynch, N6CL (CQ) and the *ARRL Handbook* (ARRL).

utes after the previous one, the auroral activity over Siberia has greatly intensified and spread in all directions. (These auroral substorms typically last 30-60 minutes and vary greatly in intensity.) Meanwhile, there has been no significant change in the dayside aurora over Canada, which remains bright.

All of these ultraviolet photos are made possible by the use of newly-developed narrow-band far-ultraviolet filters for Polar's UVI, or *Ultraviolet Imaging*, System. These filters are "solar blind" and permit the clear imaging of dayside aurora for the first time.

These photos offer two lessons for amateurs: 1) There's as much, if not more, of a chance of working Au during the day as at night; and 2) Significant Au can develop very quickly and with little advance notice. By the way, NASA notes that all of this activity is relatively low level because we're at a sunspot minimum. It's expected to increase greatly as solar activity builds with the next sunspot cycle.

Aurora in X-Rays

Photo 4 is the first-ever global X-ray image of the Earth's aurora. You can easily see the X-ray "hot spot" north of Scandinavia and European Russia, but you'll have to look very closely to see the wide blue band of weak X-ray emissions that nearly spans the globe, stretching through the night and morning hours to noontime. (The dashed line is the day/night *terminator*. In this photo, North America is in daylight; Europe and most of Asia are in darkness.)

The X-rays were produced by energized electrons from the Earth's magnetosphere striking the upper atmosphere (as noted earlier, these electrons are energized by ionized solar plasma and pushed into polar cusps by the solar wind). This image was taken by yet another camera aboard the Polar spacecraft—PIXIE, which stands for the Polar Ionospheric X-ray Imaging Experiment.

Polar's Potential

Judging from these early photographs, the Polar satellite and NASA's Global Geoscience Program are just beginning to open the door to our understanding of not only aurora, but also of the overall interaction between the Earth and the solar plasma.

We as amateurs will certainly benefit from this greater knowledge. And who knows? We might even be able to contribute to that knowledge if we can get NASA to take a look at correlating our Au operating results with the data received from satellite photos and other scientific sources. ■

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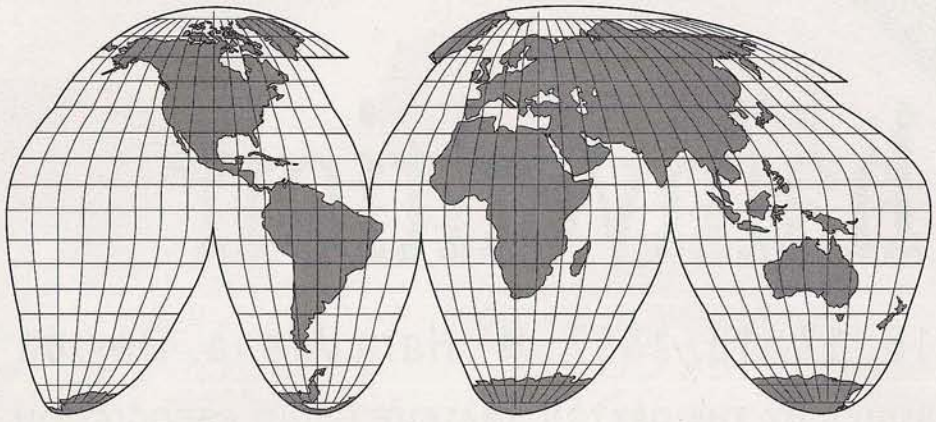

VHF in Israel: Mostly FM and Packet, with "a Touch" of Satellites

Eleven repeaters cover the whole country on 2 meters...and packet connections with Cyprus are "run of the mill." Here's a glimpse of VHF/UHF activity in the Holy Land.

By Ron Gang, 4X1MK*

VHF and UHF are common meeting grounds for all Israeli hams. All license classes, including Novice, are allowed to operate all modes on 2 metres and 70 centimetres. Advanced, General, and Codeless Technicians are free to roam the entire VHF/UHF spectrum as per the ITU Region I frequency schedule *(ITU is the International Telecommunications Union, a UN agency, and Region I covers Europe, Africa, and a little bit of western Asia.—ed.)*. The 6-metre band was opened here only a few years ago, so there is still just a little bit of activity there. Two metres and 70 centimetres are the main workhorse bands, and you'll find mainly FM and packet, along with a touch of satellite activity. There are only a few serious terrestrial (weak-signal) fanatics going for sporadic-*E* DX, the main one being Ralph, 4X1IF, who is also active on 1296 and is an avid moonbouncer. Ralph is also a 50 MHz fiend. What follows is a sampling of recent VHF-related news from Israel, excerpted from the Israel Amateur Radio Club's *Israel Ham News* newsletter.

Ron Gang, 4X1MK, is Editor of the Israel Amateur Radio Club's newsletter, Israel Ham News, *from which this information is excerpted.*

Israel to Germany on Packet

Tropo and sporadic-*E* cause a lot of excitement here during the summer months in Israel. In August, 1995, Eli, 4X4FD, of Beersheva, is believed to have made history with the first direct Israel-Germany packet QSO on 2 metres. Eli was playing around on 144.675 MHz at 1400 UTC on August 6th, connecting to different nodes and BBSs, when he received a connect from Wolfgang, DG8NBB, in Landsberg in southern Germany. The equipment at Eli's end was an old Johnson 20-watt, crystal-controlled rig and a five-element vertical Yagi that was pointed in the right direction at the time, just after a run-of-the-mill Cyprus connection. Eli says he didn't have the audio set right on the rig and he encountered several disconnects, but the contact lasted over several minutes.

"Coverage of this repeater is sensational, with QSOs between the Negev, Coastal Plain, Jerusalem area, and parts of the Galilee becoming commonplace. It is indeed a national repeater."

Beacons and Contests

Neil Carr, GØJHC, reported via the Internet VHF reflector that Ralph, 4X1IF, has been authorized by Israel Communications Ministry to run a 50-MHz beacon from his home to alert hams to band open-

"When the bombing massacre occurred at Tel-Aviv's Diezengoff Centre shopping mall during a school holiday, the national telephone network...crashed and all telephones were temporarily rendered useless. Hams jumped in to help on the Tel-Aviv 2-metre repeater, this being the only workable form of communications at the time."

Repeater Operating in Israel

If you bring your handheld with you on your next visit to Israel, and take care of reciprocal licensing requirements (check with your national ham radio association), here's the list you'll need to keep in touch with hams all around the country:

Name	Location	Coverage	Output Freq.	Input Freq.	CTCSS (PL) Tone
R 12	Migdal HaEmeq	Lower Galilee	145.300	144.700	91.5, 192.8 Hz
R 12	Eilat SIMPLEX link to Yatir	Links to R13 rptr via 433.300 link Negev, Arava (no squelch tail)	145.300 hears link only	144.300 triggers UHF xmtr link only	91.5 Hz (to use as a repeater in Eilat, listen on 433.300 MHz)
R 13	Yatir	Negev and South-Central Area	145.325	144.725	91.5, 192.8 Hz
R 14	Safed	Galilee	145.350	144.750	91.5, 192.8 Hz
R 15	Tel-Aviv	Tel-Aviv Young Generation	145.375	144.775	
R 16	Natanya	Natanya, Northern Coastal Plain	145.400	144.800	91.5, 192.8 Hz
R 0	Ariel	Central Coastal Area	145.600	145.000	91.5, 192.8 Hz
R 1	Jerusalem	Jerusalem	145.625	145.025	91.5, 192.8 Hz
R 3	Haifa	Haifa Region	145.675	145.075	91.5, 192.8 Hz
R 5.5	Haifa	Haifa	145.7125	145.1125	91.5 Hz
R 6	Beersheva	Beersheva City	145.750	145.150	91.5 Hz
R 7	Tel-Aviv	Tel-Aviv	145.775	145.175	91.5, 107.2 Hz
	Natanya RX	northern coverage	"	"	192.8 Hz
	Rishon RX	southern coverage	"	"	77 Hz
		UHF RX	"	431.825	107.2 Hz UHF
RU70	Tel-Aviv	Tel-Aviv	438.650	431.050	91.5 Hz
RU71	Haifa	Haifa	438.675	431.075	91.5 Hz
RU72	Jerusalem	Jerusalem	438.700	431.100	91.5 Hz
RU73	Safed	Galilee	438.725	431.125	91.5 Hz
	link between R12 Eilat and R13 Yatir	Southern Arava Valley, north of Eilat	433.300 (Simplex)	433.300	91.5 Hz transmit only when channel clear

ings. Neil says that Ralph has already installed a halo antenna on his tower and the beacon system itself is now complete. The beacon was scheduled to go on the air last May on 50.058 MHz running about 3 watts and using Ralph's call.

The annual Inland VHF-UHF test was held on Israel's 48th Independence Day in May, 1996. With a low-pressure system and some scattered rain, propagation conditions were minimal, yet there were many mobile and portable stations out activating rare areas.

This year a new scoring system came into effect: no multipliers or gimmicks, but points based completely on the distance between the Holy Land squares (10 km x 10 km) of the stations working each other. Activity ran high, and even some 250-km. contacts were made between the Northern Negev and the Golan Heights. Oded Regev, 4Z5BS, wrote a friendly computer programme for calculating contest points.

Repeater News

The IARC Repeater Committee has installed a new machine operating on top of Mount Gilo, just south of Jerusalem, on 145.600 MHz, repeater channel R0. Coverage of this repeater is sensational, with QSOs between the Negev, Coastal Plain, Jerusalem area, and parts of the Galilee becoming commonplace. It is indeed a national repeater. (See "Repeater Operating in Israel," for a complete list of repeaters throughout the country.)

In January of this year, the IARC's repeater committee made some further refinements in R7, the Tel-Aviv repeater. A new southern-end receiver has been added on the top of a high rise in Ashdod. This complements receivers in Natanya and Tel-Aviv. In the past, to get the best signal into the repeater for your location, you had to use different PL tones to trigger the different receivers. Now, all PL tones have been standardized to 91.5 Hz for all receivers, and a system of automated "voting" has been adopted, with the receiver with the strongest signal in its input automatically selected to operate the machine's transmitter.

Repeater TVI?

While hams enjoy the great VHF/UHF conditions that prevail in the Eastern Mediterranean during the hot summer months, many TV viewers suffer. Why? The same great conditions that bring the DX also bring TV QRM with strong signals skipping in from the neighboring countries and creating havoc with local TV stations.

Last winter, the R0 repeater on 145.600 was relocated to Mount Giloh in southern Jerusalem, affording great coverage. But when the conditions got hot, the residents of the building housing the repeater pointed the TVI-accusing-finger at R0's antenna. The IARC repeater committee was forced to take it down with no explanations accepted. It was said that if the interference did not stop after the repeater was dismantled, they'd understand that the repeater was not the culprit. But alas, no go.

Still, it all worked out for the best. R0 was relocated to a *higher* point in Giloh, with even better coverage and an added bonus: A linked receiver and transmitter

On the Cover

Jon Cembruch, WB4JEM, of Fort White, Florida, enjoys working VHF and UHF on all bands from 50 MHz to 1.2 GHz. His well laid-out station is built around a set of four ICOM transceivers—an IC-551D on 6 meters, an IC-271A on 2 meters, an IC-471A on 70 centimeters, and an IC-1271A on 23 centimeters. Jon also uses a Kenwood IC-751 as the 2-meter IF for his Down East Microwave 903-MHz transverter. Plus, he has a DEM 222-MHz transverter feeding a Uniden HR-2510 10-meter IF rig. A row of amplifiers gives Jon 1000 watts out on 6 meters, the legal limit on 2, 150 watts on 222 MHz, 700 watts on 432, and 50 watts each on 903 and 1,296.

Outside, Jon has a six-element, 6-meter quad at 75 feet, single-band Yagis on 2, 222, and 432, and loop Yagis on 903 and 1,296. He's in the process of building a 2-meter EME (moonbounce) array, consisting of 16 10-element Yagis mounted on an H-frame at 40 feet.

Moonbounce is Jon's latest operating interest. "I've played with ATV, repeaters and satellites," he says, noting that he believes satellites are "almost like repeaters. Just point at them and talk to people. I did enjoy working the shuttle, though; worked eight of them in a row a few years back." Jon's current interests include VHF DXing and CW. He has 200 grid squares and 39 states confirmed on 2 meters, and he plans to use his EME array to finish off his 2-meter Worked All States and DXCC awards.

Professionally, Jon is a telecommunications technician with Florida Power Corp. He discovered ham radio as a sailor serving in Vietnam. He met a ham while in the service and was introduced to messages sent home via MARS. Jon got his own license in 1974 and has been active on VHF/UHF since 1984. (Photo by Larry Mulvehill, WB2ZPI)

operating on 433.300 act as another input and output for the repeater, so one may use a UHF transceiver operating on this frequency to access the machine. No PL tones are necessary, and there is no repeater tail, so you won't know that you're accessing it if nobody answers you.

The 433.300 frequency is used as a link at Shaharut in the Arava between Eilat (R12, 145.300) and the Yatir repeater in the Northern Negev (R13, 145.325). It was hoped that Giloh could be tied in with this far-away link, but even with a high-gain Yagi, Shaharut, 200 kilometres away, couldn't be raised. 4X6ZH says that with the smart controllers being installed in all IARC repeaters, linking up of the machines all over the country is planned. Itzik and his faithful team will not rest until a ham in Israel's southernmost city, Eilat, can have a reliable QSO on his HT with a ham in Metullah, the country's northernmost town.

A Gift of Repeaters

Last March, the IARC received five modern VHF repeaters from Motorola Israel. The machines had been retired from commercial service. One was put to immediate use—the Tel-Aviv repeater, R7, had suffered a direct lightning stroke, making it more or less a total loss. It was replaced with one of the "new" Motorola repeaters. Repeaters to be exchanged in addition to R7, now working perfectly, are those in Jerusalem, Safed, and Yatir. The fifth repeater's operating site is not yet designated.

The IARC is most grateful to Motorola Israel and its officers for these new repeaters and supplied spares. Motorola has over the years donated many repeaters to us and also supplies the home for the IARC offices.

Emergency Communications—Bombs and Breakdowns

A year ago, we experienced some ghastly terror bombings. When the bombing massacre occurred at Tel-Aviv's Diezengoff Centre shopping mall during a school holiday, the national telephone network became overloaded by phone calls. The result was that the system crashed and all telephones were temporarily rendered useless. Hams jumped in to help on the Tel-Aviv 2-metre repeater, this being the only workable form of communications at the time.

"Ham radio is much more than just a mode of communications. Ham radio is friendship.... Ongoing contacts build a community of people who are not strangers to each other.... People is what ham radio is all about."

A week later, after driving some friends to the airport, the car I was driving broke down. On the Tel-Aviv repeater, one ham took care of the vital phone calls home for me while another ham, a mechanic by profession who was in the general vicinity at the time and monitoring the repeater, at his own friendly initiative, drove over to where I was stuck to help me out.

Thoughts on Ham Radio's Future

Like other hams around the world, we often wonder how our hobby will fare with the ready availability of cellular telephones and the Internet. What can we offer that they can't? I found my answer when, on a recent visit to Jerusalem, accompanied by a non-ham friend, I dropped in to an informal get-together of hams. My friend was most impressed by the warmth of the group, and commented to me on our way home that "you must be really good friends with all these people." Actually, I had to admit that I had only seen them face to face on a few occasions, but we had been talking together on the radio for years.

Then it hit me. Ham radio is much more than just a mode of communications. Ham radio is friendship. Ham radio is a fraternity. Ham radio counters alienation. Ongoing contacts build a community of people who are not strangers to each other. Thus the willingness to help each other and to host visiting amateurs from other countries. *People* is what ham radio is all about.

Now that the Internet and cellular phones have liberated amateur radio from having to be "useful," it is simple to see what distinguishes it from the former. Ham radio is an art form. We are into it because we like it for what it is. In the words of the "global village" guru, Professor Marshall McLuhan, "The medium is the message." Long live ham radio!■

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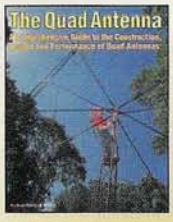

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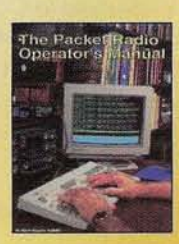

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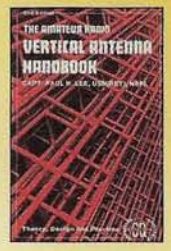

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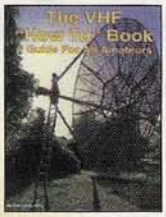

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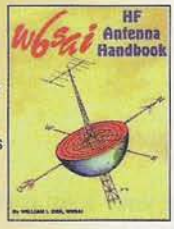

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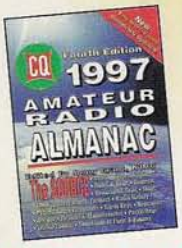

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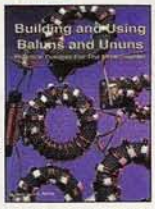

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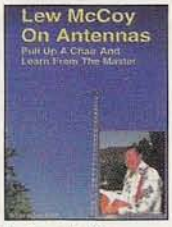

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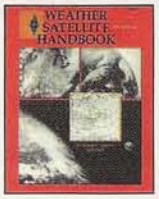

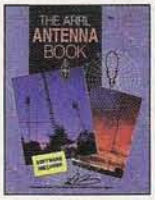

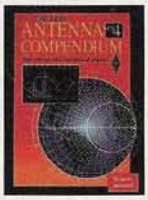

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What You've Told Us

In our December survey, we asked you to tell us the highest price you'd pay for various types of VHF/UHF radios. Here's what you told us:

For a single-band FM handheld, 44% of you would spend no more than $300, with 34% saying no more than $200, and only 12% willing to spend more than $300 (the other 10% said "don't know/no interest").

Overall, you're willing to spend an extra $100 to get an extra band in your handheld. On the question of how much you'd spend for a dualband FM HT, 46% replied $300–$400; 21% said $300 or less (but 17% would lay out $400–$500 for a dualband handheld). Only 3% would pay more than $500, and 13% didn't know or weren't interested.

Our next question was about single-band FM mobiles. Over half of you (53%) won't spend more than $300 for one of these rigs. The next group was 30% in the $300–$400 range, with only 4% willing to spend more than $400 and 13% unsure or not interested.

When it comes to dualband mobiles, 39% of you are willing to pay $400–$500 for one; while 31% won't pay more than $400, and 19% would pay over $500. Eleven percent didn't know or weren't interested.

The last two questions covered multimode (SSB/CW/FM) rigs. Here, 33% of you would spend $400–$500 for a single-band multimode rig (manufacturers, are you listening?), while 23% want to spend less than $400 and another 23% are willing to pay *more* than $500 ($^2/_3$ of *that* group is in the $500–$600 range), and 21% answered "don't know/no interest."

Finally, there was no clear consensus on what you'd pay for a multiband multimode rig. The largest group (23%) said they'd be willing to pay more than $700. Next came the $500–$600 group at 21%, followed by the $600–$700 group at 20%. These figures were bracketed by 18% each in the "under $500" and "don't know/no interest" groups.

Congratulations to our November survey subscription winner, Bob Faginkrantz of Everrett, Washington.

CQ VHF Ham Radio Above 50 MHz

Reader Survey—March, 1997

We'd like to know more about you...about who you are and where you live, about the kinds(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 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).

As an incentive, we'll pick one respondent every month and give that person a complimentary one-year subscription (or subscription extension) to CQ VHF.

For the next few months, we're going to repeat our questions from a year ago, to learn whether, and in what ways, the makeup of our readership has changed.

A. Tell us about yourself:

1. If you are...	**Circle Reader Service #**
Male	1
Female	2
Single	3
Married	4
2. If your age is...	
Under 18	5
18–24	6
25–34	7
35–44	8
45–54	9
55–64	10
65–74	11
75 or over	12
B. Tell us about your ham radio activities:	
1. If you've been a ham...	
Less than a year	13
1-2 years	14
3-5 years	15
6-10 years	16
11-25 years	17
over 25 years	18
2. What class of license do you hold? If...	
Novice	19
Technician (No-Code)	20
Technician-Plus	21
General	22
Advanced	23
Extra	24
3. Please indicate all bands on which you are active...	
50–54 MHz (6 meters)	25
144-148 MHz (2 meters)	26
222-225 MHz (1.25 meters)	27
420-450 MHz (70 centimeters)	28
902 MHz and above (microwaves)	29

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

Who's Using What on 902

If you've been thinking about trying your hand at operating the 33-centimeter (902-MHz) band, but don't know where to find equipment, here's a handy list of what some active operators are using.

By Dave Hockaday, WB4IUY

Editor's Note: WB4IUY posted the following message on the Internet VHF Reflector, after asking 902-MHz operators about the equipment they're using on that band. Dave graciously gave us permission to reprint his posting, and asked that we pass on his request for information to other readers who may not have seen his original message. Please note that some terminology may be unfamiliar to less-experienced VHFers.

I recently polled the Reflector for input on conversion of various commercial gear to 33 centimeters. This is what I have so far, including my own work in this area:

I'm using analog cell site transceivers for the core of my repeater. They do about 2 watts output, and I have a commercial cell site PA (power amplifier) that has been swept and tweaked up to my repeater output of 919.5 MHz. These transceivers are "spec'd" from 750 to 1000 MHz by the manufacturer. You change the TCXO (temperature-compensated crystal oscillator) and set the internal DIP switches to program the transmit and receive frequencies.

The person to contact for this gear is Dick Elliott. He can be e-mailed at <WC_COMM@SWOCA.OHIO.GOV> or at <relliott@co.warren.oh.us>; his phone number is (513) 933-1319, Fax (513) 933-2973. Dick can sell you the transceivers and supply an information packet with schematics. He's the guy from whom I bought my transceivers at Dayton when I got off on this 33cm tangent. Tell Dick I said hi! Nice guy, and *very* knowledgeable.

Info Collected from the List...

GE MARC-V trunking radios have a synthesizer with a "test mode" that allows you to program frequencies manually using a DIP switch, no microprocessor needed. Of course, the RF sections do need *extensive* realignment. Some guys in the San Francisco area have done a paper on modifying the things for ham use at 800 MHz, to be used with a frequency multiplier for their 2400-MHz repeater system. But it looks like the thing can be coaxed up to 900 if you are good with RF tweaking (the VCO—voltage-controlled oscillator—has to be moved 100 MHz up in frequency, and retuning of the RF deck is then required). If you are interested, you can get the e-mail addresses of some of the guys who have done the MARC-V mods from Harry Chase, WA1VVH, at <Harry_Chase@ smtpgwy.windata.com>.

Hamfest Hunting

Cellular phone parts. Many of them have the RX IF strip as a module that's almost complete in itself—45 MHz in, audio out—and a nice log/lin response RSSI that has a 70 to 80 dB range. All you have to add to this is a squelch circuit. The power modules in most phones are still good at 900 MHz, although at somewhat reduced gain and power. You can typically expect 2 W output from a module that was rated 3 W at 845 MHz. These phones are showing up in droves these days at flea markets, often for $5 or less, so it's sort-of no risk. Again, this wealth of experience was from Harry Chase, WA1VVH, at <Harry_Chase@ smtpgwy.windata.com>.

Commercial 900-Meg Gear

GE TMX 10W 900-MHz radios can be modified for amateur use and be completely programmable from the headset. They are reprogrammed with a custom ROM that is socketed. The person who makes the new ROMs will do so for a nominal cost. It's thought that the ROM will also work on other band versions of the TMX. Ed Parish, WA2SCA, said his friend Brian can supply custom ROMs for the TMX. Ed's email address is <eparish@netcom.com>.

The *Motorola 900 MHz Maxtrac* is one of the few other commercial radios that have been successfully converted with just some minor mods and some hacking into its codeplug archive. This info was courtesy of Brian McGinness, WA3WJD, at <wa3wjd@wirelessinc.com>.

What About You?

Does anyone else have experience with 33-centimeter conversion they would like to share? Please e-mail me at <wb4iuy@ipass.net>, or send regular mail to my *Callbook* address. Thank you.

Another Editor's Note: The VHF Reflector is an Internet mailing list with a focus on weak-signal (non-repeater SSB and CW) operating on VHF and UHF. If you're interested in weak-signal work, and have e-mail access, you may join the Reflector by sending a message to <vhf-request@w6yx.stanford.edu>. The text of your message should say (without the quotes and parentheses), "Subscribe (your e-mail address)". If you have trouble, contact the list administrator at <vhf-approval@w6yx.stanford.edu>. ■

"Hams Just Do That"

This is a story from the northeast's "Blizzard of '96". But something like it could happen any year, in any part of the country, to any of us.

By Tom Brouard, KB2VNB

The Blizzard of '96 is long gone—remembered by some in the Northeast as a time off from school, by others as days of backbreaking shoveling, and by a few as a time to sip cocoa and marvel at the winter wonderland. But for me, it was a time to make friends on the Northeast Connect. The hams I met on this 2-meter and 70-centimeter repeater network helped me make my way home on a very snowy, blowy night.

I started out from Manhattan on that Sunday evening, after eight inches of snow had already fallen, and headed 65 miles north to my home in Orange County, New York (see map). Purely by habit, I headed toward the Palisades Interstate Parkway, a lovely road in nice weather that can turn treacherous in snow and ice. Looking back, I probably should have stayed in New York City; but, nonetheless, I started on my way.

I pulled out of the parking garage, turned on my radio, gave my callsign and Brian, WA2FWM, responded. Brian and I had talked earlier that day and he remembered that I was planning to travel home during the storm. He was concerned about my well-being and decided to monitor the frequency just in case I needed help. The reason he gave was simple: "Hams just do that." This was the first true lesson I learned as a new ham.

I received the callsign KB2VNB on August 14, 1995, but it was well into December before I made my first transmission. After getting one or two QSOs under my belt, I stumbled on the Northeast Connect and met Brian. He was friendly, patient, helpful, and he made me feel welcome on the repeater network. (*A good example for the rest of us.—ed.*)

Into the Storm

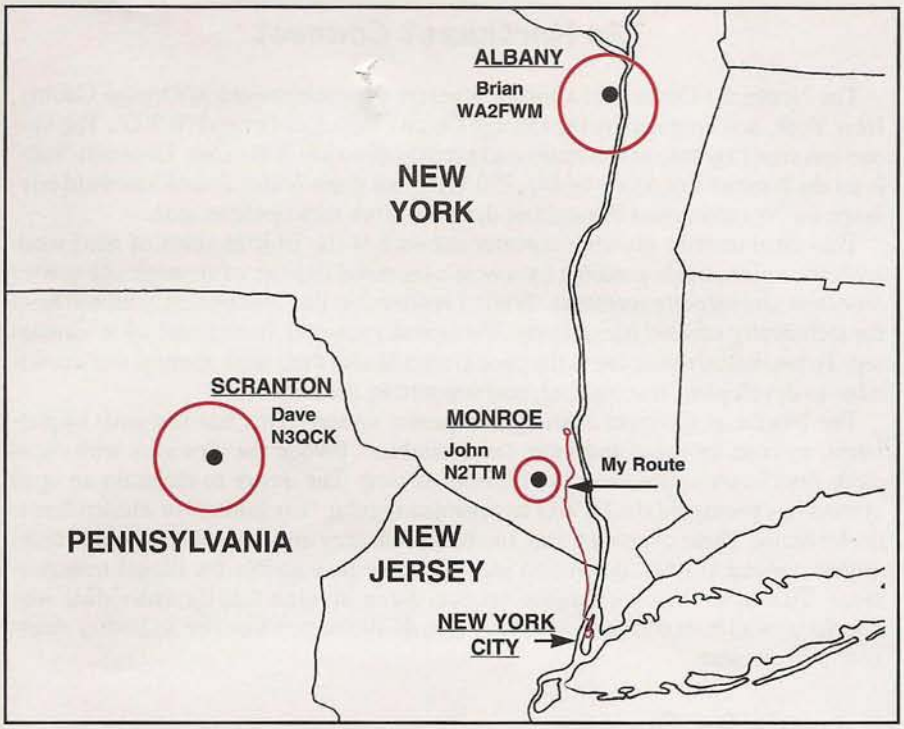
As I drove, we began our QSO with the topic du jour, the weather, and I maneuvered through the medium-sized snowdrifts that were forming in the middle of the road. I knew all along that this idea was not the ripest banana of the bunch and I should have gotten a hotel room, but by now I was committed. Brian offered several times to call my home and update my wife of my progress. I couldn't believe that he was willing to make a long-distance call for me. And he wasn't the only one to offer.

Tom Brouard, KB2VNB, and his son, Austin, pose in the cab of their truck. Tom was by himself on the night of the Blizzard of '96, but he was far from alone, as his fellow hams kept him company on his five-hour trip home.

Soon after my adventure began, Dave, N3QCK, joined the QSO and was willing to call my wife. I was finally convinced when a third station near my QTH, John, N2TTM, offered to telephone my wife. These guys wanted *one* thing and that was to help. "Hams just do that."

The four of us talked about almost everything. I don't remember much of the content but I do remember that it felt as if I had these guys in the car with me. In actuality, Brian was transmitting from the Albany, New York, area, 100 miles to my north; Dave from Scranton, Pennsylvania, about the same distance to the west; John from Monroe, New York, not far from my destination, and I was treading snow somewhere alongside the Hudson River on the Palisades Parkway.

"These guys wanted one thing and that was to help. 'Hams just do that'."



KB2VNB's route took him through a relatively small stretch of New Jersey and New York. But the hams who kept him company on the snowy night he describes here were as far away as Albany, New York, and Scranton, Pennsylvania.

What made it all possible was the linked repeater network known as the Northeast Connect (see sidebar).

Keeping Tabs

There were plenty of times when I just drove and didn't talk. Each time my voice was absent for more than 10 minutes, Dave would call me. He was very adamant about getting me home (I'm convinced he used a stopwatch). "Hams just do that."

In all of the storms I've driven through on this particular road, this was the first that there was *no other vehicle of any kind* on it, from beginning to end. But I had plenty of company. The trip took over five hours and all three stations stayed with me through it all. They wanted to hear me safely home—and I did.

Helping All Mankind

A few days later I spoke to Brian again and he told me that, to him, "HAM" means *H*elping *A*ll *M*ankind. Lesson #2. I now have regular QSOs with Brian and Dave. I haven't spoken to John since and

Improved Foreign Distribution—All foreign *CQ VHF* subscribers are now receiving their copies via a new Air Post system. Copies are picked up, polybagged (in environmentally friendly wrap) and air freighted to various international distribution points. This new system does cost a bit more, but the expedited delivery is well worth it.

In most cases international delivery will be only one week later than domestic USA. We hope you'll enjoy this new expedited service. Let us know how it's working–send your comments to CQ Communications, Inc., 76 North Broadway, Hicksville, NY 11801, Attention Melissa.

The Northeast Connect

The Northeast Connect is a linked repeater system centered in Orange County, New York, and operated by the Orange County Repeater Group (OCRG). The system has coverage into seven states and a radius of nearly 300 miles. The main "hub" is on the 2-meter frequency of 145.250 MHz, but there is also linked handheld coverage on 70 centimeters throughout the New York metropolitan area.

This continuously growing repeater network is the fruit of years of hard work and cultivation, made possible by a well-conceived linkage of strategically placed repeaters and satellite receivers. While I realize that this description is all too brief for technically minded hams, to me, the repeater network itself is not what's amazing. To me, what is amazing is the people who devote their time, money, and knowledge to developing, maintaining, and supporting the network.

The Northeast Connect is an open repeater system. This has not gone unpunished, as costs increase and more "undesirables" invade the airwaves with malicious interference. But there are benefits as well. The desire to maintain an open system has prompted the OCRG to organize regular "fox hunts," or hidden-transmitter hunts. These events are fun, of course, but they also hone the skills and techniques needed to track down and identify those responsible for illegal transmissions. This is an important public service. Keep in mind that the individual who interferes with ham transmissions may also do the same on police and other emergency frequencies.

Formula for Success

The main ingredient for the success of the Northeast Connect is a collaboration of privately owned repeaters, repeater systems, and other vital equipment. The major contributors are Ike Bell, WB2BQW, Barry Groupp, N2HDW, and Tom Cooleen, N2HBD. Catch any one of them on the network and they'll be more than happy to fill you in on the technical details of the system.

If you live in the Hudson Valley area, or are just passing through, be sure to tune in to the Thursday Evening Net at 8:00 p.m. (on Thursdays, of course), or the Friendship Connection Net at 8:30 on Sunday evenings. You'll find a great bunch of people who are looking forward to meeting you.

The Orange County Repeater Group and the Northeast Connect...remarkable people with a remarkable idea!

would like to extend my appreciation for his help. The unsung heroes of all this are the people of the Northeast Connect, who work hard to make the network function in time of need and demand only excellence from the stations that operate on it. My sincere thanks to all.

"Helping All Mankind...Hams just do that."

Editor's note: We'd like to hear your "First Person" stories of how you've used ham radio either to help someone else or have received help yourself. Writers' guidelines may be downloaded from the CQ VHF *Web page, <http://members.aol.com/cqvhf/> or from our FTP site, <ftp://members.aol.com/cqvhf/general>, may be requested by e-mail to CQVHF@aol.com or by regular mail with an SASE to:* CQ VHF *Writers' Guidelines, 76 N. Broadway, Hicksville, NY 11801. We look forward to sharing your stories with your fellow hams.* ■

Linked Repeater Networks

The Northeast Connect is one of several wide-coverage networks of linked repeaters across the United States. Other examples include the *Colorado Connection* in Colorado, the *Condor Connection* in California and Nevada, the *Evergreen Intertie* in the Pacific Northwest, the *Piedmont Coastal Radio Network* in North Carolina, and the *Zia Connection* in Arizona and New Mexico. In addition, there are other, smaller linked systems all over the U.S. Linked repeater networks are one more example of ways that hams are cooperating to provide extended communication range for repeater users, an ability that's always fun, but that can be critical in times of emergency.

—NW2L

CQ knows that some things... ...a ham's just got to have!

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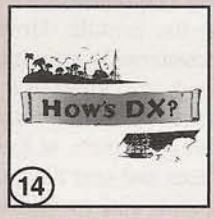

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Build the 6-Meter Discpole Antenna

If you're looking for a compact, apartment-sized antenna for the "magic band," why not build a discpole?

By Rick Littlefield, K1BQT*

The magic band is coming alive these days with new activity in the FM portion of the band (52 to 54 MHz), as well as the CW/ SSB area (50 to 50.2 MHz). So if you're looking for a compact, apartment-sized antenna for 6 meters, why not build a discpole?[1]

This somewhat unconventional-looking antenna is only half the size of a conventional 1/2-wave radiator, yet it packs equal punch. Designed and developed for commercial wireless applications at higher frequencies, the discpole also works great on 52 MHz! *(It works well at 50 MHz, too, but it's vertically polarized and most SSB/CW ops use horizontal polarization.—ed.)*

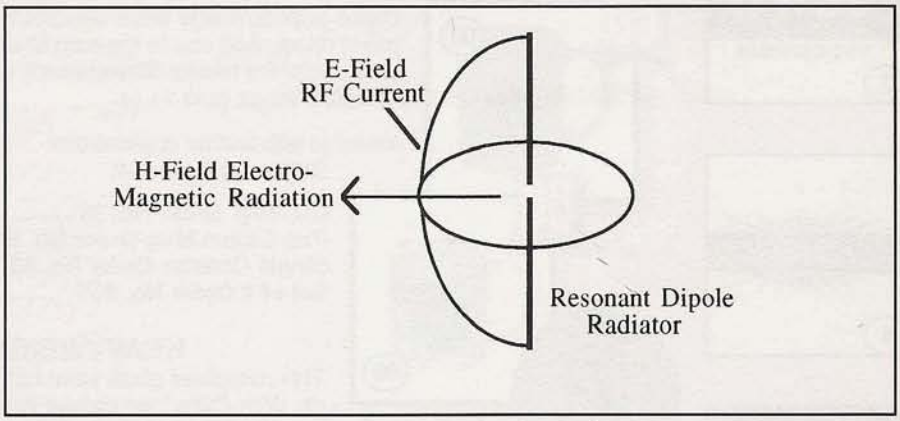


Figure 1. RF radiation is a two-step process in which the high-current portion of the antenna's E-Field (electric field) induces electro-magnetic radiation at right angles to form the H-Field (electro-magnetic field).

Theory of Operation

Physics tells us that "radio waves" are generated by a two-step process (see Figure 1). When RF power is fed into an antenna, an *electric field (E-field)* is set up along the element. If the antenna is a resonant 1/2-wave dipole, the high-current portion of that E-field occurs along the central portion of the element. The central, or high-current, portion of the antenna's electric field is especially important because it induces a second form of radiation called the *H-field*, or *electro-magnetic field*. The H-field forms at right angles to the E-field and represents the actual radio wave component of the transmitted signal.

The discpole is a shortened version of a 1/2-wave dipole antenna with capacitive loading discs inserted in place of the element ends. Discs were chosen over loading coils because they preserve the entire high-current portion of the element (see Figure 2). Most antenna textbooks state that a single straight tubular radiator with low ohmic losses represents the best physical structure for inducing magnetic radiation—and that's exactly what the discpole provides. Element shortening is confined to the ends, or high-voltage portion of the antenna, where little radiation normally takes place.

A Price to Pay

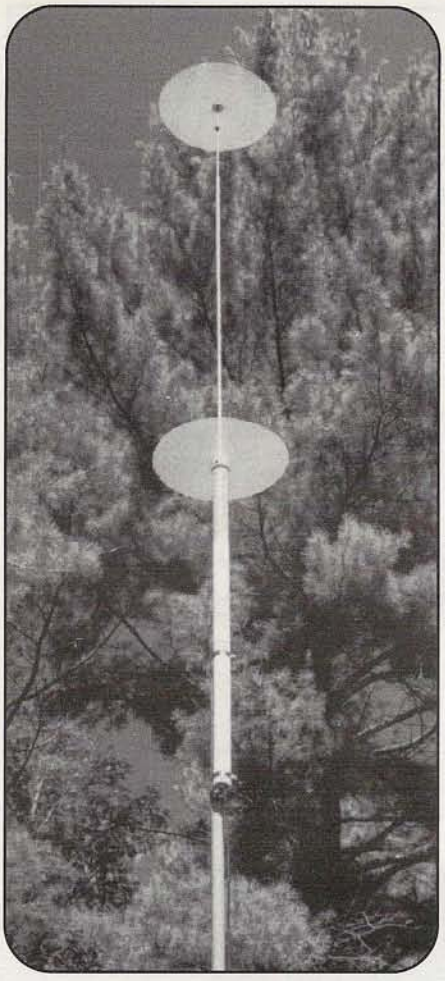
Of course, with any compromise, there's a price! When you reduce antenna length through loading, two side-effects occur.

First, as the radiator becomes shorter, its bandwidth narrows. Fortunately, when using capacitive loading, this effect is minimized by the disc structures. These increase the apparent diameter of the element, making it electrically "fat." This restores much of the lost bandwidth.

"The discpole is a shortened version of a 1/2-wave dipole antennas with capacitive loading discs inserted in place of the element ends."

Second, as the antenna shrinks, its central impedance drops, no longer providing a convenient 50- to 70-ohm feedpoint at the middle. However, this effect is countered by moving the feedpoint away from the center to a point where impedance is naturally higher. The discpole is fed off-center, at the junction of the element and one disc, to provide a 50-ohm match and to allow the antenna to be tipped on end and fed at its base. Off-center feed requires that a high-impedance coaxial choke be installed between the element and its feedline. This prevents the feedline from detuning the element, and it blocks RF current from flowing

Rick Littlefield, K1BQT, is a regular contributor to CQ VHF *and a columnist for* Communications Quarterly.



The discpole antenna is light enough to be mounted on 36-foot telescopic mast without guying. (Photos by the author)

down the outer surface of the coaxial feed and radiating.

To summarize, the discpole uses capacitive loading to shrink antenna size by 50% without causing a significant loss in efficiency or bandwidth. It also uses off-center feed to provide a 50-ohm feedpoint that is positioned conveniently for vertical mounting.

Construction

I picked up most of the materials for this antenna in the Midwest Fasteners and plumbing sections of my local hardware store and from RadioShack (see "Parts List"). Aluminum tubing may be more difficult to find, but the scrap bin at local machine shops may prove a good source. RG-316 is available through several catalog houses. The Macklanburg-Duncan perforated-aluminum sheet stock is commonly sold as a grill-facing for radiators and vents.

"The discpole uses capacitive loading to shrink antenna size by 50% without causing a significant loss in efficiency or bandwidth. It also uses off-center feed to provide a 50-ohm feedpoint that is positioned conveniently for vertical mounting."

Begin preparing your materials by cutting two 14-1/2-inch diameter perforated-aluminum discs and drilling a 1/4-inch hole in the center of each. Next, cut a 4-foot length of 3/8-inch aluminum tubing. Saw four 3/4-inch long compression slots at one end (90° apart), and drill a single #6 clearance hole 2 inches from the opposite end. Cut a 1-foot length and a 6-inch length of 5/16-inch tubing and run a 1/4-20 tap down one end of each piece. For lightweight fender washers, cut two 1-1/2 inch discs from aluminum panel stock and drill a 1/4-inch hole in the center. Finally, cut a 3-1/2 inch length of 1/2-inch ID (inside diameter) PVC water pipe for the coax choke and a 3-foot length of 1-1/4 inch ID Schedule-40 PVC pipe for the insulated mast.

Before drilling the PVC end-cap insulator, test for dielectric contamination. To do this, place it in a microwave oven, along with a glass of water to serve as a load, and cook on high for one to two minutes. If the PVC heats up significantly, it's contaminated and is not suitable as an RF insulator. Replace it. (*And don't eat it, either.—ed.*)

Preparing the Insulator

To prepare the PVC insulator, locate and mark the exact center of the cap. Then, draw a circle with a 9/16-inch radius from the center and mark off three equally-spaced points around it. Now, drill a 1/4-inch hole at the center for element mounting and three equal-spaced #6 clearance holes on the circle for disc mounting. To complete preparation of the antenna base assembly, temporarily bolt one of the perforated discs to the PVC cap and transfer the three mounting holes to it, using the cap as a template. Finally, unbolt the disc and enlarge its center hole to 5/8 of an inch using a punch, nibbler, or reamer.

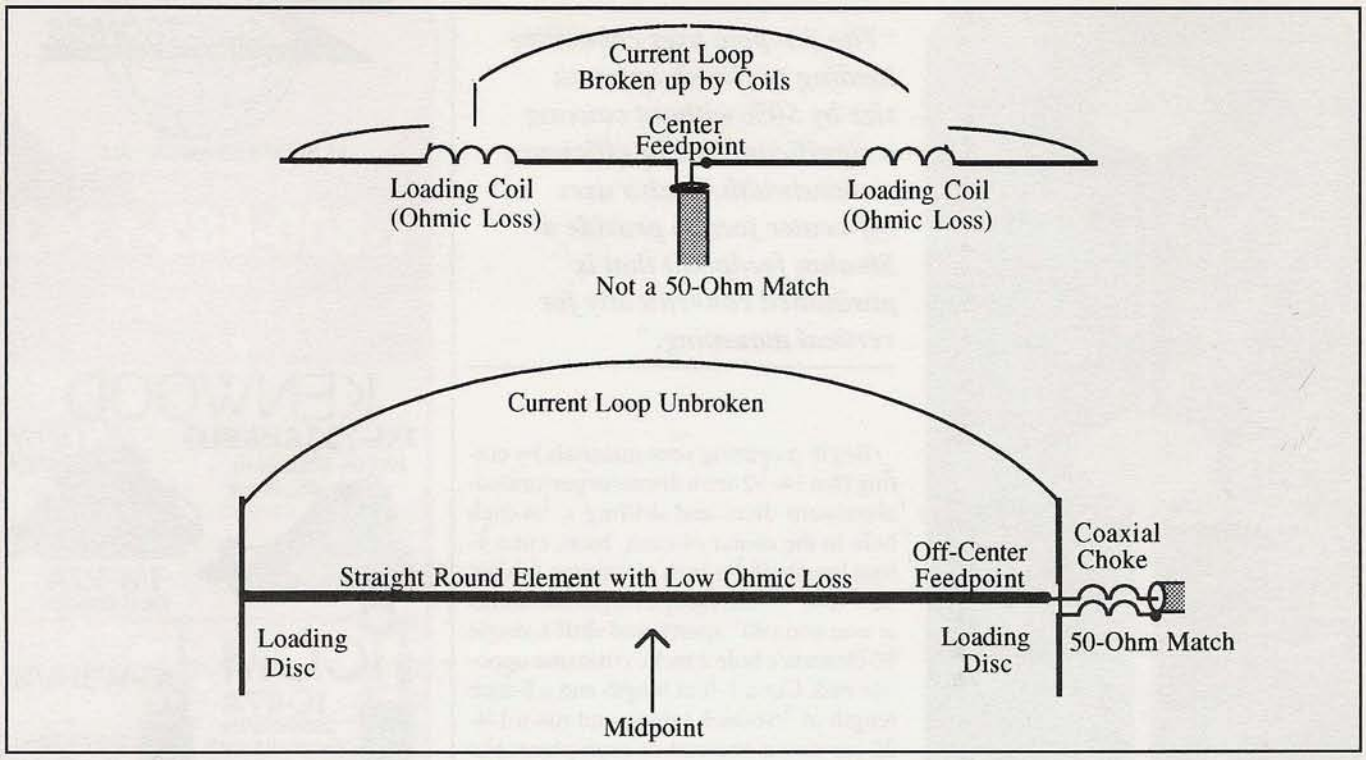
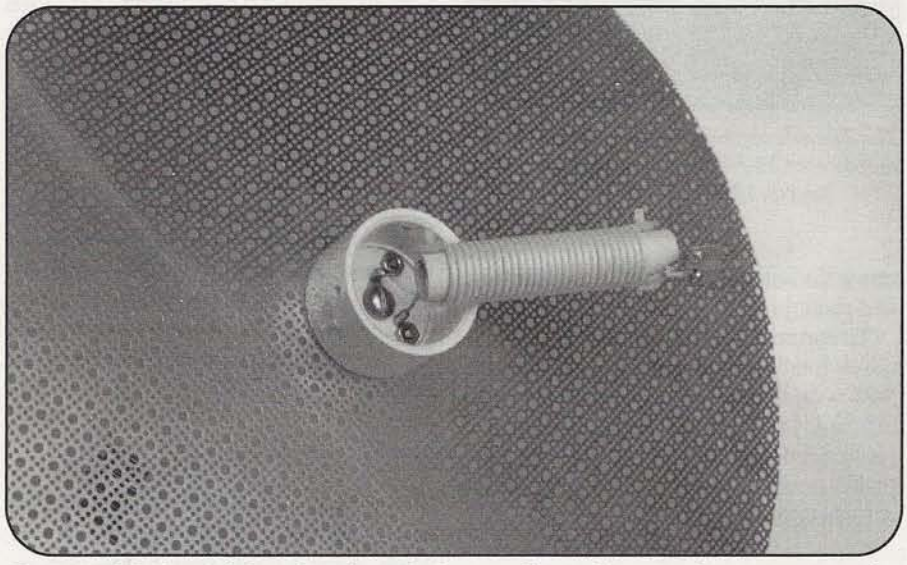


Figure 2: Comparison of inductive and capacitive loading illustrates how the discpole can provide the same efficiency as a full-sized antenna. Note the use of a high-impedance coaxial choke to prevent unwanted coupling between the feedline and antenna.

Prepare the PVC form for the coaxial choke by through-drilling #6 clearance holes 2-15/16 inches apart, one at each end. Install a 1-1/2-inch nylon screw in each hole, but do not tighten the nuts. Now, cut a 63-1/2 inch length of RG-316 Teflon™ coax and wind 27 turns onto the form, using the nylon screws to immobilize the winding at each end (see construction detail Figure 3). Dress out and tin 1-inch pigtails at each end of the RG-316. At one end, install a small splice transition made from a small scrap of printed circuit board. This will allow you to connect RG8/M feedline to the choke without risk of shorting. If your feedline is long, it may be easier to slip the 3-foot PVC base section over the cable before making this splice.



Close-up of the lower disk and insulator/choke assembly. At this point, the antenna is ready for feedline attachment and final assembly.

Assembling the Antenna

To begin final base-section assembly, mount the lower aluminum disc on its PVC insulator using #6 hardware. Install a #6 solder lug inside the PVC cap on one of these mounts for connecting the shielded side of the choke. Next, install a 1/4-inch solder lug on the 1/4-inch x 2-inch stainless machine screw and slip it up through the PVC insulator. Place two 1/4-inch nylon flat washers on top and secure the assembly tightly in place with a 1/4-inch nut. To prepare the main element, find the 5/16-inch x 6-inch tube and slip its unthreaded end into the unslotted end of the 3/8-inch x 4-foot tube. Secure the two pieces together by drilling a pilot hole through the pre-drilled opening in the outer element and installing a 1/4-inch x 6-32 self-tapping screw. The discpole's main element may now be installed on its PVC base.

To assemble the antenna's top section, place a 1-1/2-inch aluminum fender washer on each side of the remaining disc, and secure this assembly to the threaded end of the 1-foot x 5/16-inch tube using a 1/4-inch x 3/4-inch aluminum machine screw (use aluminum hardware on the top section—it weighs less than stainless steel). Then slip the top section into the slotted end of the main element.

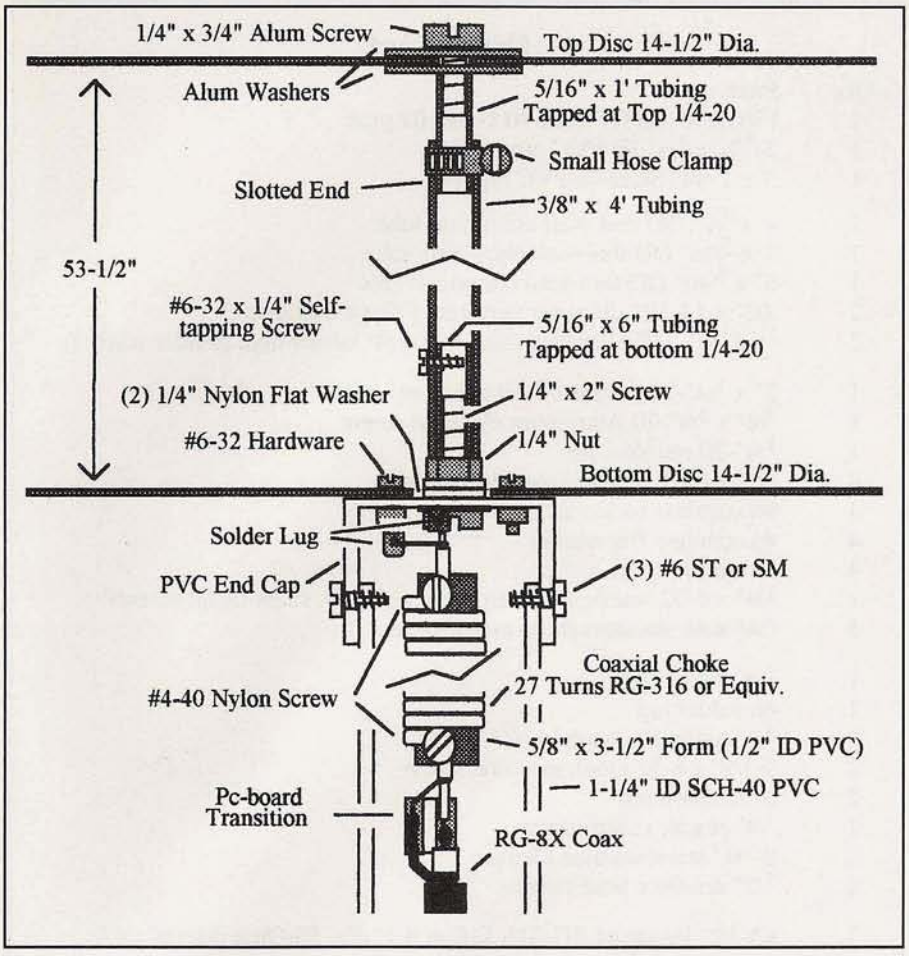


Figure 3. Assembly detail for the 6-meter discpole antenna.

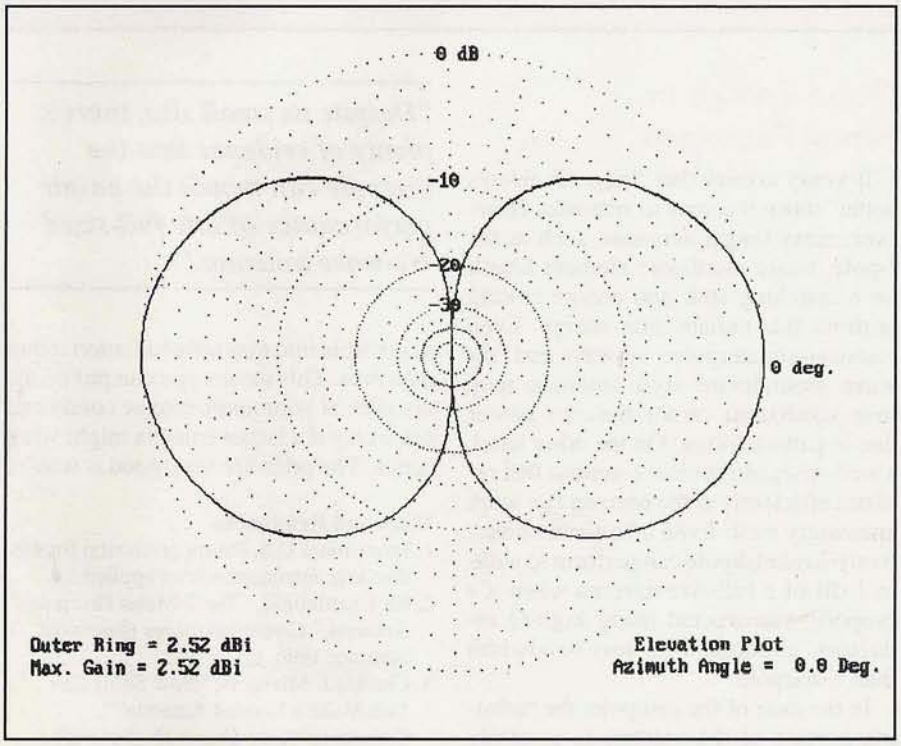


Figure 4. Radiation pattern for the 6-meter discpole antenna as rendered on EZ-NEC.

For now, set the total distance between discs at 53-1/2 inches and secure the top section in place with a small hose clamp. To complete discpole assembly, friction-fit the PVC insulator over the PVC mast and secure with three #6-3/4 inch sheet-metal screws (do not cement the cap to the mast). Secure the RG-8/M feedline at the base of the PVC pipe with a 1/4-inch plastic cable clamp. This should be installed just inside the bottom end of the PVC pipe using #6 hardware.

Testing and Installation

When mounting the discpole, provide at least 12 to 15 inches of clearance between the bottom disc and metal support mast to prevent element detuning. As with any VHF antenna, mount well clear of other feedlines, antennas, or large metallic surfaces. To clamp the PVC mast on a metal mast, use 2-3/4 inch hose clamps rather than TV-style mast clamps; these are less likely to crush the plastic pipe. Finally, immobilize the coax by taping it securely to the mast.

For tuning, I mounted my discpole on a temporary mast 15 feet above the ground and connected a MFJ-259 antenna analyzer to monitor VSWR. I then adjusted the length of the top section for minimum VSWR at the 52.525-MHz FM simplex calling frequency (the preset element length of 53-1/2 inches should be close). If most of your operating is on repeater channels, you may choose to tune the discpole slightly higher, say in the 53-MHz repeater-input portion of the band. By the same token, if you operate only SSB, you may tune it for 50.125 MHz without modifying disc size.

Once the discpole was tuned, I transferred it to a higher permanent mast with little change in VSWR. Height above ground counts—especially at VHF. One of the primary advantages of a small, lightweight antenna is that you can install it higher without resorting to heavy-duty masts and guy wires. You may even choose to hang it from a high tree limb with nylon line, if this offers the loftiest or least conspicuous support available. Mine sits atop an un-guyed 36-foot RadioShack telescopic mast, and I can bring it down quickly when necessary to avoid lightning strikes or entanglement in rooftop antenna work.

Discpole Performance

My prototype 6-meter discpole exhibits a 2:1 VSWR bandwidth of about

"Height above ground counts—especially at VHF. One of the primary advantages of a small, lightweight antenna is that you can install it higher without resorting to heavy-duty masts and guy wires."

7.7%, covering from 50.8 to 55 MHz (1.5:1 bandwidth is 51.7 to 53.6 MHz). This covers the FM simplex and repeater segment of the band. Despite its small size, there's plenty of evidence that the discpole can match the on-air performance of any full-sized 1/2-wave antenna. A 2-meter version of this antenna was compared to several popular 1/2-wave designs using accurate field-strength measurements, and it was found to perform equally well in all cases.[2] Also, EZ-NEC simulations confirm that on-the-horizon performance equals that of a full-sized dipole (see Figure 4). Finally, my 6-meter discpole appears to perform just as well as the larger and heavier 6-meter groundplane it replaced.

Parts List

Qty	Part
1	PVC end cap for SCH-40 1-1/4" ID pipe
1	3-1/2" x 1/4" ID PVC pipe
1	3' x 1-1/4" SCH-40 PVC pipe
1	4' x 3/8" OD thin-wall aluminum tube
1	1' x 5/16" OD thin-wall aluminum tube
1	6" x 5/16" OD thin-wall aluminum tube
2	.02" x 14-1/2" diameter perforated-aluminum disc
2	1/16" x 1-1/2" aluminum disc with 1/4" center hole (fender washer)
1	2" x 1/4"-20 stainless steel machine screw
1	3/4" x 1/4"-20 Aluminum machine screw
1	1/4"-20 stainless nut
4	1/2" x 6-32 stainless machine screw
4	#6 stainless lock washer
4	#6 stainless flat washer
4	#6 stainless nut
1	1/4" x 6-32 stainless self-tapping (or equiv. sheet-metal screw)
3	3/4" x #6 stainless sheet-metal screw
1	1/4" solder lug
1	#6 solder lug
2	1/4" nylon flat washer
2	1-1/2" x 6-32 nylon machine screw
2	6-32 nylon nut
1	1/4" plastic cable clamp
2	2-3/4" stainless hose clamp
1	1/2" stainless hose clamp
1	63-1/2" length of RG-316 Teflon 0.1" dia. 50-Ohm coaxial cable
1	misc. length RG8/M coax with connector on one end
1	pc board cable transition (see text).

Good Things in Small Packages

It's easy to think that "bigger is always better" when it comes to antennas. However, many longer antennas, such as the J-pole, waste inordinate element length on a matching stub and charge-storing portions that radiate little energy. Even resonant-counterpoise 1/4-wave and 5/8-wave groundplane-style antennas may lose significant on-the-horizon power due to pattern tilting. On the other hand, a well-designed compact antenna that radiates efficiently at the horizon can work amazingly well! Even a half-size inductively-loaded dipole can perform to within 1 dB of a full-size antenna when it's properly constructed using high-Q inductors, although with less bandwidth than a discpole.[3]

In the case of the discpole, the radiating portion of the antenna is carefully optimized to convert as much RF energy as possible into magnetic radiation rather than heat. This means you can put up the discpole at your apartment or condo and not worry if a larger antenna might work better. The odds are very good it won't!

"Despite its small size, there's plenty of evidence that the discpole can match the on-air performance of any full-sized 1/2-wave antenna."

Notes and References

1. Provisional U.S. Patent protection for the discpole antenna has been applied for.
2. Rick Littlefield, "The 2-Meter Discpole Antenna," *Communications Quarterly*, Summer 1996, pp 77–81.
3. Charles J. Michaels, "How Short Can You Make a Loaded Antenna?", *Communications Quarterly*, Summer 1992, pp 73–80.

Hamfest Calendar

The following hamfests are scheduled for March 1997:

March 1, Ocoee Amateur Radio Society Hamfest, George R. Stuart School, Cleveland, TN. Talk-in: 147.18. For informa-tion, contact Alan Pinney, AE4FC, at (423) 478-1141. (exams)

March 1, "Springfest '97" Hamfest, Holy Spirit High School, Absecon, NJ. For information, contact SPARC, P.O. Box 142, Absecon, NJ; Phone/Fax: (609) 653-1987.

March 1, Annual North Jersey Hamfest, Pal Building, Parsippany, NJ. Talk-in: 146.985/146.385. For information, contact Bernie, WB2YOK, Phone/Fax: (201) 584-5399 (24 hours); on line <75503.3221@COMPUSERVE.COM>.

March 1, N.E.GA. "Bubba" Net Hamfest, Madison County Fairgrounds, Comer, GA. Talk-in: 147.300+. For information, contact James Daniel, AE4HS, 152 Windfall Dr., Winterville, GA 30683; Phone (706) 742-2777. (exams)

March 2, Annual Hamfest and Flea Market, Bristol East-ern High School, Bristol, CT. Talk-in: 146.880 FM and 224.800 FM. For information, send SASE to Pete Brunelli, 358 Andrews St., Southington, CT 06489; Phone: (800) 620-0176. (exams)

March 8, HamCom '97, Tringali Community Center, East Englewood, FL. Talk-in: 146.700. For information, contact John Fogle, WD7H, at (941) 697-7946, or Ken Anderson, W4JQT, at (941) 475-3172. (exams)

March 8, Hazard Swapfest, Hazard High School Cafeteria, Hazard, KY. Talk-in: 146.07/.67. For information, contact John Farler, K4AVX, at (606) 436-5354 or Sid Adams, WI4M, at (606) 439-3589. (exams)

March 15, Kerbela Hamfest, Kerbela Shrine Temple, Knoxville, TN. Talk-in: 144.83/145.43 or 146.52 simplex. For information, contact Paul Baird, K3PB, 1500 Coulter Shoals Circle, Lenoir City, TN 37772, or call (423) 986-9562.

March 15, Spring Swapfest, Am. Legion Post, Linda CA. Talk-in: 146.085, +600, WD6AXM/R. For information, contact Ron, W6KJ, at (916) 674-8533, or Clara, KC6JPP, at (916) 742-2674.

March 15, 44th Annual Hamfest, Jim Miller Park (frmly. Cobb County Central Park), Marietta, GA. Talk-in: 146.28/ 88. For information, contact Margaret, KB4QKW, at (770) 977-4405. (exams)

March 15–16, St. Patrick's Day Hamfest, Midland County Exhibit Building, Midland, TX. For information, contact Midland ARC, P.O. Box 4401, Midland, TX 79704 or call Larry Nix, N5TQU, by e-mail: <oilman@lx.net>. (exams)

March 15–16, 1997 ARRL Oklahoma State Convention, Maxwell Convention Center, Exhibit Hall B, Tulsa, OK. Talk-in: 145.24(-) and 443.750. For information, call (918) 622-2277 Voice/Fax (24 hrs); e-mail: <megriffin@ionet.net>, Web page: <www.greencountry.com/hamfest>. (exams)

March 16, Annual Hamfest, Jefferson County Fairgrounds, Jefferson, WI. For information, contact TCARC, W9MQB, 711 East St., Fort Atkinson, WI 53538; (414) 563-6502 (eves. please)

March 16, 37th Annual Hamfest, Sterling High School Field House, Sterling, IL. Talk-in: 146.25/146.85 W9MEP. For information, call Lloyd Sherman, KB9APW, at (815) 336-2434 or e-mail: <lsherman@essexl.com>. (exams)

March 16, 42nd Annual Hamfest/Computer Fair, Lucas County Recreation Center, Maumee, OH. For information, send SASE to Paul Hanslik, N8XDB, TMRA, P.O. Box 273, Toledo, OH 43697-0273 or call (419) 243-3836.

March 22, Annual Hamfest, Pritchard Community Center, Elizabethtown KY. Talk-in: 146.980. For information, call Harold Bennet at (502) 351-9599; e-mail <ke4zev@juno.com>; or Bill Grieb, e-mail: <w4bej@ecc-uky.mci.net> or write to LTARC, P.O. Box 342, Vine Grove, KY 40175. (exams)

March 22, 21st Free Hamfest, Martin County Fairgrounds, Martin County, FL. For information, call Dave Millard, President, MCARA, at (561) 288-7100. (exams)

March 22, Hamfest, West Orange High School, West Orange, NJ. Talk-in: 147.415 in/146.415 out and 146.520 simplex. For information, contact Jim Howe, N2TDI, at (201) 402-6066.

March 22, Hambash '97, Ararat Temple, Kansas City, MO. For information, contact Steve, WJØI, at (816) 941-0620; Fax: (816) 941-3392; e-mail: <sdowdy@qni.com>. (exams)

March 22, Sebring's 4th Annual Hamfest/Computer Show, National Guard Armory, Avon Park, FL. Talk-in: 145.330. For information, contact Clyde Scruggs, K4CS, at (941) 453-7181 or Roy Loweke, KE4JCT, at (941) 382-4607.

March 23, WECAFEST '97, Yonkers Raceway, Yonkers, NY. Talk-in: 147.060 MHz (+600). PL 114.8. For information, contact Thomas Raffaelli, WB2NHC, at (914) 741-6606. (forums, exams)

March 23, 19th Annual Hamfest, Madison High School, Madison, OH. For information, contact LCARA, Len Sechrist, WS8O, PR Chairman, 8550 Nowlen St., Mentor, OH 44060 or call (216) 255-0112. (exams)

March 23, LAMARSFEST '97, Lake County Fairgrounds, Grayslake, IL. Talk-in: 147.945/.345 NSRC repeater; 146.52 simplex. For information, contact Frank Avellone, W9GLO, 650 Green Bay Rd., Lake Bluff, IL 60044 or call (847) 234-4124 until 10:00 p.m. (exams)

March 23, Hamcomp '97, Tall Cedars of Lebanon picnic grove, Trenton, NJ. Talk-in: 146.670(-). For information, contact P.O. Box 7024, West Trenton, NJ 08628; (609) 882-2240.

March 29, IRS Hudson NH Flea Market, Hudson Lions Club, Hudson, NH. Talk-in: 146.25/85, 222.86/224.46, 444.625/449.625. For information, contact John, KA1FYB, 1 Paget Dr., Hudson, NH 03051; Phone: (603) 881-5796; Fax: (603) 598-0181; e-mail: <brunelle@tiac.net>.

March 29, Annual Hamfest, National Guard Armory, Tullahoma, TN. Talk-in: 146.70(-). For information, contact Ian Haynes, AB4SW (615) 649-5187, fax: (615) 649-2941 or e-mail: <ithaynes@edge.net>.

March 29, Michigan City Hamfest/Computer Flea Market, Michigan City High School, Michigan City, IN. For information, contact Ron Stahoviak, N9TPC, 5802 N 400 W, La Porte, IN 46350, or call (219) 325-9089.

Operating Notes

For March and April 1997:

March	
7	Moon Perigee (closest to Earth)
April	
4	Moon Perigee
14	ARRL Spring Sprint (144 MHz)
22	ARRL Spring Sprint (222 MHz)
22	Lyrids Meteor Shower peak
30	ARRL Spring Sprint (432 MHz)

Compiled by the CQ VHF Staff

"Freq Out" with Free Frequency Charts

They're colorful, informative, and—best of all—FREE for CQ VHF readers!

By Gordon West, WB6NOA*

So you think you know your band limits and national band plans? If you were asked to tune in the 80-meter Novice CW portion of the band, could you identify the upper and lower band limits? Are they...

A. 3700–3750 kHz
B. 7100–7150 kHz
C. 3675–3725 kHz

Answer A is incorrect—this is what it was several years ago. Answer B is incorrect because this is the 40-meter Novice band. C is the correct answer.

Now, do you know where *not* to transmit FM on the 2-meter band? 144.000 to 144.100 MHz is reserved exclusively for CW by the FCC. But you should also avoid using FM on 144.100 to 144.300, where weak-signal operators use CW and single sideband (SSB) to bounce signals off of everything from passing meteors to ducts created by stratification of the atmosphere. And 145.800 to 146.000 is the popular satellite sub-band where only CW and SSB are used—no FM! You won't find these restrictions in the FCC rules, because they're set aside voluntarily by nationally-recognized band plans.

Next, if I asked you where on 6 meters you would do little transmitting, but lots of listening for international DX stations, the band plan could tell you that 50.100 to 50.125 is the 6-meter "DX window." When the band opens up later this spring, you should try to operate single sideband for domestic contacts only on 50.125 and higher. This way, the long-time worldwide DXers will have plenty of room to seek out those signals coming in from another continent. Of course, there's no reason a newcomer to 6 meters shouldn't chase DX, too, but be sure to do some listening first to learn proper procedures—and be sure to learn the band plan.

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

Free Band Charts

Do experienced hams commit every band plan to memory? Perhaps a few do, but most have band charts to help them keep track of where to operate which modes. And it's easy to get one of these charts for free!

Equipment manufacturers such as ICOM America, Alinco, Yaesu, and Kenwood produce free color frequency charts that are usually given away at hamfests but can also be ordered free of charge in reasonable quantities for your club by following the instructions at the end of this article.

These frequency charts are based on FCC rules and regulations for areas it regulates in ITU Region 2 (this side of the world). Most of the charts also reflect widely-accepted national band plans to prevent chaos on our HF, VHF, and UHF ham bands.

The Grand-daddy of Them All

The black and white, single-page ARRL band plan chart deserves special mention. It's widely circulated in virtually all ARRL publications, is always kept up to date, and has become the "model" after which most other band plan charts have been patterned.

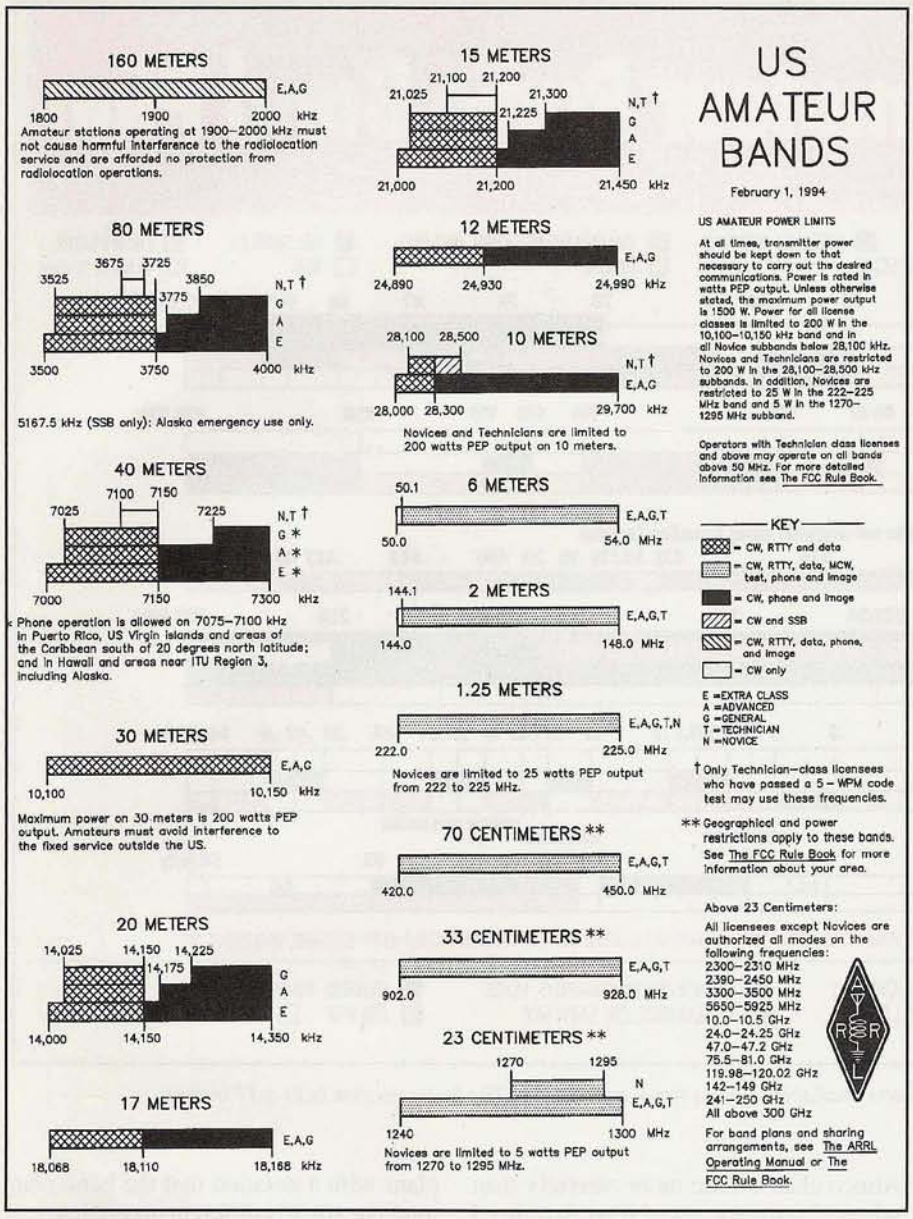
The ARRL chart doesn't show notations for specific U.S. band plan uses, but *The ARRL Operating Manual* has over 32 very detailed pages that take you from the lowest ham band at 160 meters all the way through 250,000 MHz. Although different parts of the country may opt for slight variations on these national band plans, the details are extraordinary, and every ham should invest $22 in a copy of *The ARRL Operating Manual.*

"Do experienced hams commit every band plan to memory? Perhaps a few do, but most have band charts to help them...."

The ICOM Chart

The slick paper ICOM band plan charts have been in use for over 10 years, and they're free for the asking when you follow the instructions in this article. The chart was originally two 8-1/2 x 11-inch coated-stock color sheets, but now, by popular demand, the free ICOM band chart is 11 x 17 inches, big enough to frame and hang on your wall for an easy glance. But you'd better find a double-sided frame because, while one side of the ICOM chart is devoted to HF frequencies, the other side includes the common prefixes of DXCC countries, an AMSAT guide to amateur satellite frequencies, and a VHF/UHF band plan chart covering 6 meters (50–54 MHz) through 23 centimeters (1240–1300 MHz).

The HF (10 to 160 meters) portion of ICOM's frequency chart shows the frequencies available for each specific class of license. This is much like the ARRL chart, but in color. The color areas correspond with the grade of license and type



The ARRL frequency chart, while simple and black and white, is the model on which all the others are based. Reprinted with permission from The ARRL Handbook. *(All other charts courtesy of their respective publishers/manufacturers.)*

of permissible emission, and white areas indicate no privileges.

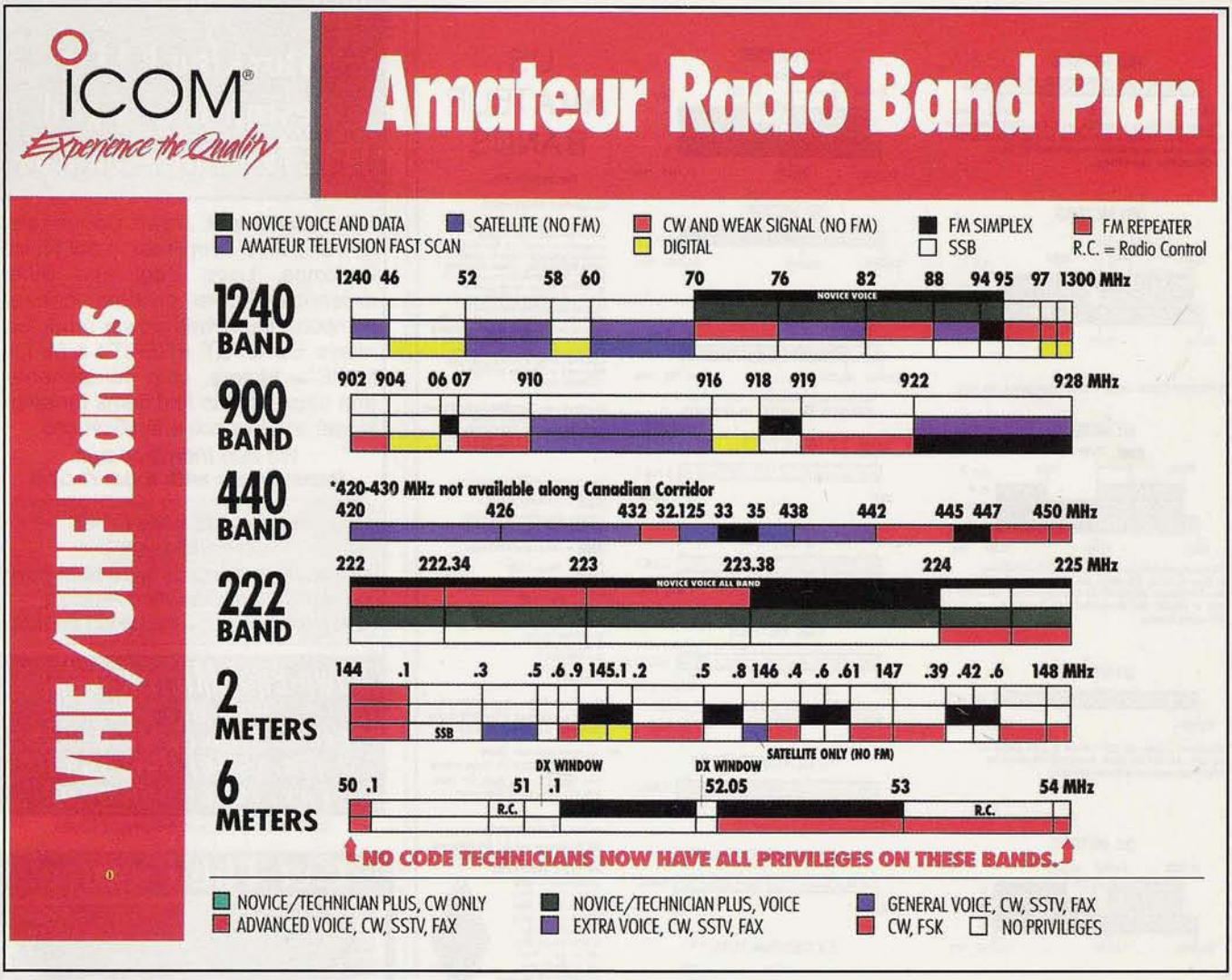
The VHF/UHF portion of the ICOM chart illustrates band plan agreements and where certain types of VHF/UHF operation take place. The chart shows all privileges for all classes of licenses plus a specific call-out of Novice privileges on the 222-MHz and the 1270-MHz bands.

Yaesu's Chart

The Yaesu band plan chart is sized 8-1/2 x 11 inches and shows HF privileges by class of license on the left and VHF/UHF bands with Novice notations on the right. A color key illustrates permissible modes on the different bands.

Yaesu's chart details specifics about operation outside of Region 2 (North and South America). It has an excellent paragraph about U.S. amateur power limits and specific power limits for those operating on Novice subbands and those Novices operating on the 1.25-meter and 23-centimeter bands.

The flip side of the Yaesu chart shows time zones of the world. It looks pretty good, but I think VHF and UHFers would rather have seen the back side be a grid square map. And HF operators probably would prefer to see the world map show



ICOM has been making band charts available to hams for over a decade. The latest version is 11 x 17 inches.

country prefixes, rather than more common time zones.

Nonetheless, the Yaesu color chart is well done and full of great information.

Alinco: A Novel Approach

Alinco Electronics broke out of the horizontal color line idea for illustrating upper and lower band privileges, and went with frequency displays showing upper and lower limits as if you were looking at them on an Alinco DX-70 or DR-610 LCD color readout. This is innovative, attractive, and slick! On one side of the extra-long chart, Alinco illustrates Technician and Novice privileges, plus VHF/UHF band limits all the way up to 1295 MHz. The flip side illustrates General, Advanced, and Amateur Extra class high-frequency privileges.

Although you'd need to study the Alinco chart a little more carefully than others if someone asked if an Advanced class operator could QSY to 21.300 MHz, you can easily see that Advanced privileges start at 21.300 MHz and go all the way to 21.450 MHz.

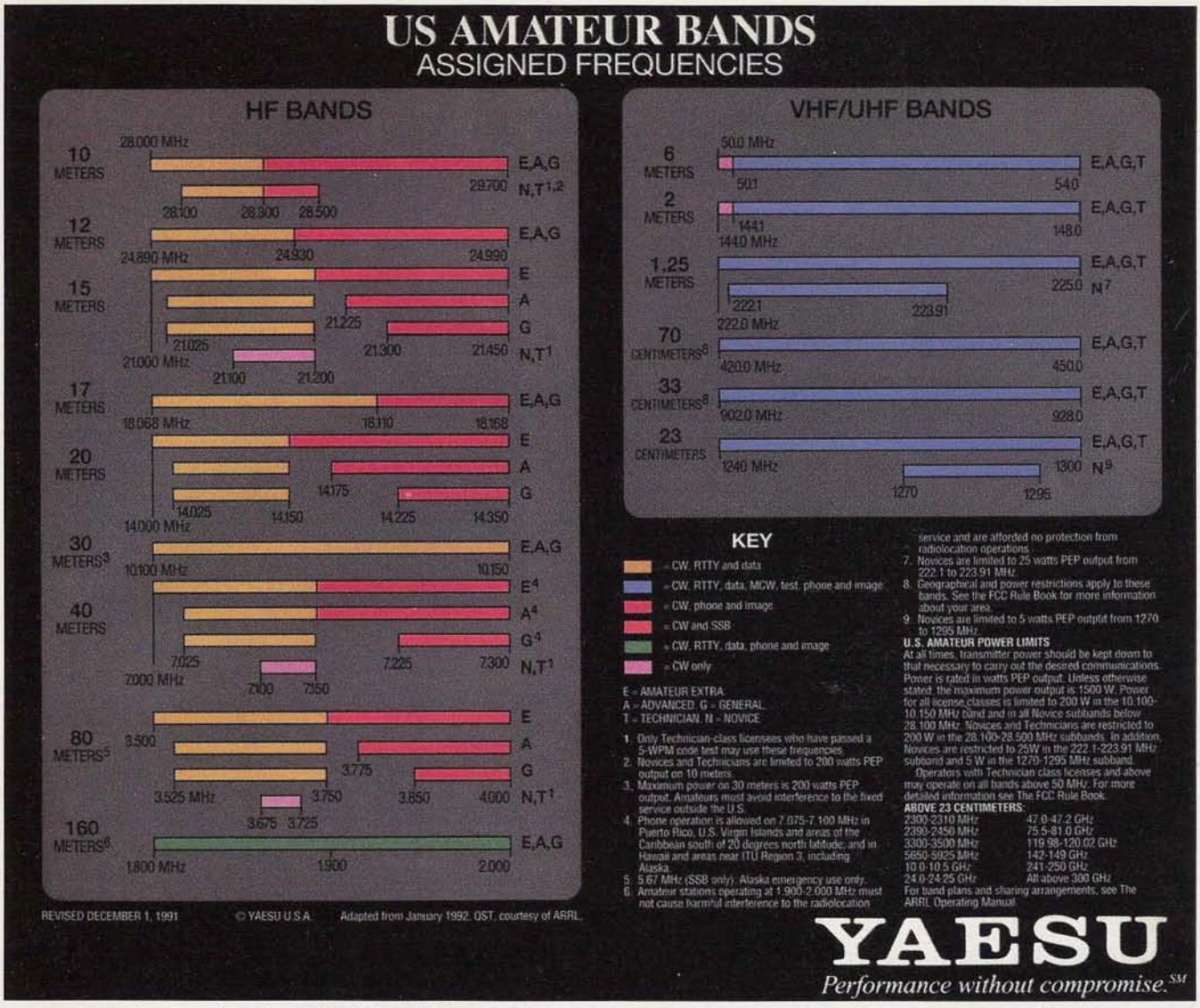
The New Kid on the Block

Kenwood has just come out with its own version of the band plans in blazing color and is going with brighter day-glo colors than Yaesu or ICOM. And instead of long square boxes, Kenwood is adopting "tubes" that give its HF, VHF, and UHF charts a three-dimensional look.

One side of the Kenwood chart shows the VHF and UHF band plans, going from 6 meters all the way up 10,000 to MHz. Since microwave operating habits tend to vary by region, the Kenwood chart is a collection of the most often used band plans with a notation that the band plan might be slightly different in certain areas of the country. The other side of the chart shows the HF bands, along with notations of some special band plans, such as slow-scan television, beacons, and packet.

Free for the Asking

The color band plan charts probably cost the equipment manufacturers about 25 cents per chart in major quantity print runs. While each manufacturer has its name and logo on the chart, 95 percent of the chart is vital non-commercial information that every amateur should have at his or her radio operating position. Let's face it, even though amateur examination test questions ask upper and lower frequency limits, there aren't too many hams out there who can precisely list all frequencies and all privileges between



Yaesu's color chart shows both HF and VHF/UHF frequencies on one side and has a world time zone map on the back.

160 meters and 10,000 MHz! But, with these charts, all of this frequency information—including the suggested band plans—is at your fingertips.

Again, the charts are usually given out free at ham shows, one per customer. Occasionally, at the end of the show, you might get five or 10, but the charts are generally too expensive to give away in bulk quantities without a little justification on your part.

Good News!

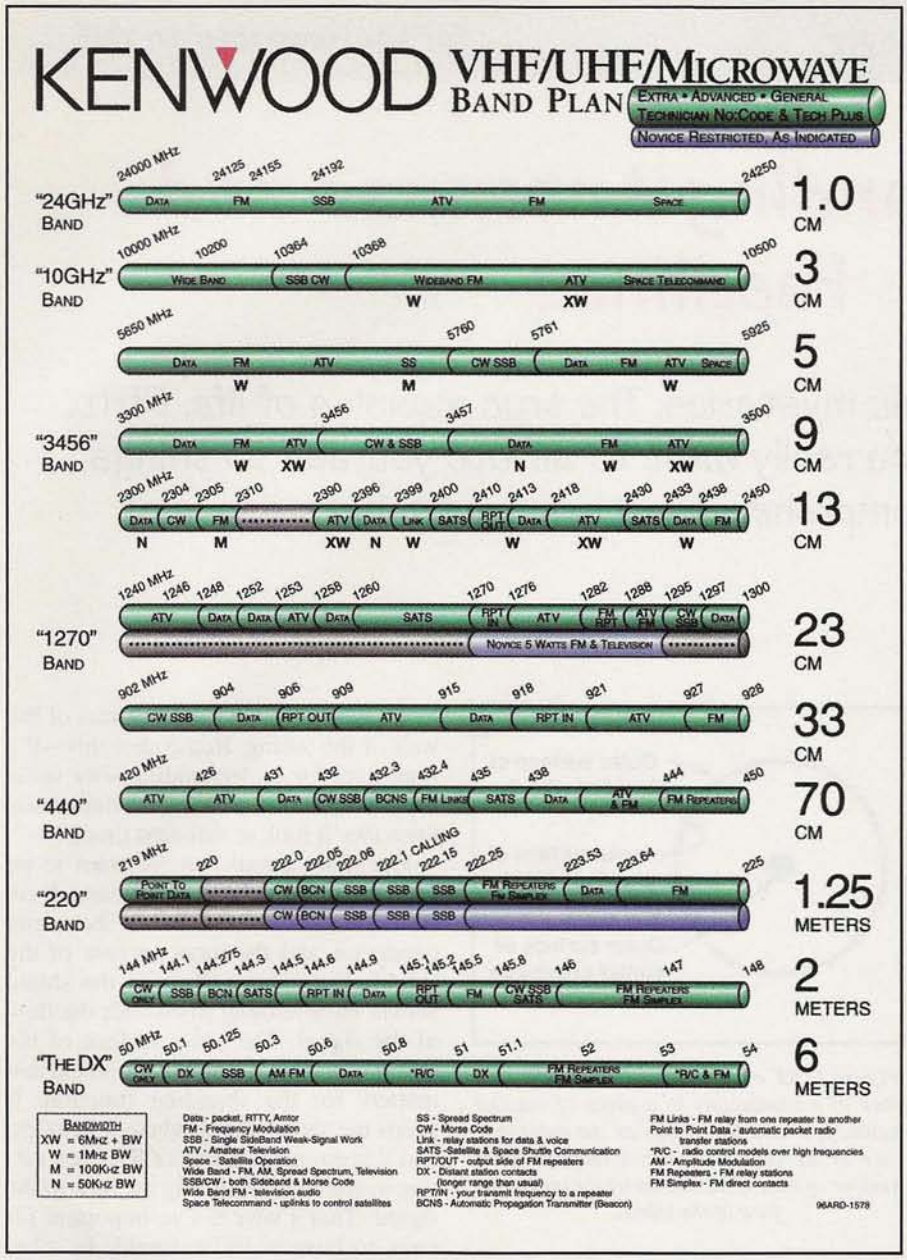
However, each equipment manufacturer has agreed to make these charts available to *CQ VHF* readers who send in a large self-addressed stamped envelope capable of holding the chart with a minimum of bends. A couple of first-class stamps on your large envelope will

If the bar graphs on the other guys' charts don't do much for you, Alinco's band chart uses frequency displays on its radios to show upper and lower band limits.

certainly be enough to cover the cost of mailing you a couple of free charts. But do send postage—remember, they're *giving* you the charts.

If you're ordering charts for your entire club, you'll need to develop a letter that somehow shows regular meeting attendance for the number of charts you're requesting. Be sure to send your request on club letterhead, and include about $3.00 in postage if you're going to be asking for many charts that might collectively weigh up to a couple of pounds. Also, be sure to include a hefty envelope so the charts don't get damaged in shipment.

Finally, don't call the manufacturers—the free charts are available only by mail, with self-addressed stamped envelopes, and quantities of the charts will only go out with proper enclosures. Simply scratching a note that says, "Send me 100 charts," won't get the job done. Requesting the charts without any postage won't get results, either. But with the right letter, and plenty of postage on the right kind of return envelope, if you've got a licensing class coming up for which 30 people are already registered, you might receive up to three dozen color band plan charts for those prospective



Kenwood is the most recent manufacturer to offer band charts. It opted for day-glo colors and 3D-looking "tubes."

Where to Write

Alinco Electronics, Attn: Taka and Crew, 438 Amapola Avenue, Suite 130, Torrance, CA 90501

American Radio Relay League, Attn: Rosalie White, Education Division, 225 Main Street, Newington, CT 06111

ICOM America, Attn: Pat and Chris, 2380 116th Avenue, N.E., Bellevue, WA 98009

Kenwood Corporation, Attn: Paul and Maria, 2201 E. Dominguez Street, Long Beach, CA 90810

Yaesu USA, Attn: Chip and Sekiu, 17210 Edwards Road, Cerritos, CA 90703

Don't forget that large, double-stamped, self-addressed envelope, and why not include a big thanks to the ARRL and the ham radio manufacturers for making these free charts available to *CQ VHF* readers!

"The VHF/UHF portion of the ICOM chart illustrates band plan agreements and where certain types of VHF/UHF operation take place."

hams. *(Speaking of licensing classes, free sample copies of* CQ VHF *are also available for prospective hams. Same deal—send us a letter on club letterhead telling us when your class begins and ends and how many people are signed up, and we'll send you out a package of sample issues.—ed.)*

So go ahead and take advantage of one of the best deals around in ham radio and get something that's attractive, necessary...and FREE! ■

Understanding Antennas and Feedlines

Black magic. Deep cosmic mysteries. The true meaning of life. Pffft. Trifles. Bush league. If you really want to devote yourself to things that are truly beyond comprehension, then try to make sense of antennas and feedlines.

I don't believe that anyone *fully* understands the mysterious beasts that we call antennas and feedlines, yet there are some simple ideas and concepts that can make your life as a ham radio operator a lot saner. You do want your life to be sane, don't you?

If you look through most ham magazines, you can probably find a monthly column devoted primarily to antennas and feedlines. If you follow the correspondence section, you'll probably find periodic battles of opinion on this subject. And if you listen to the airwaves, antennas and getting the most signal to them are the perennial number one on the top 10 list of ham topics. So, there is no shortage of opinions.

Starting at the Transmitter

This month, let's start with feedlines; we'll follow with connectors and antennas. For VHF/UHF, hams are almost always going to be using some form of coaxial cable for the feedline. Waveguide is certainly an option for the higher frequencies, but it's difficult to work with mechanically, not to mention expensive. Twinlead and ladderline are usable for VHF signals, but they can be a real pain to route into and around the shack. For the most part, coax is it. There is, however, a wide variety of coaxial cables that can be used for different situations. Using the wrong cable or connector can be disastrous. Let's avoid unnecessary disasters if we can.

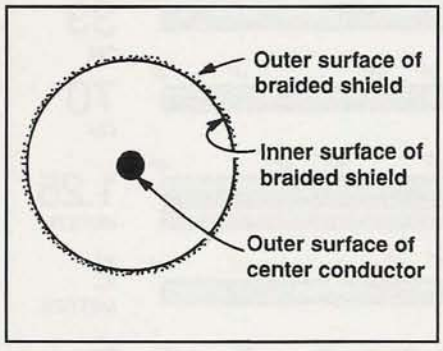


Figure 1. RF energy flows only on the surface of a conductor. In a piece of coaxial cable, you want RF to flow on the outer surface of the center conductor and the inner surface of the shield, but not on the outer surface of the shield.

Coax—The Inside Story

First, let's look at what goes on inside a piece of coax. The first thing to keep in mind is that RF travels on the surface of a conductor. A section of coax, then, has *three* surfaces to be reckoned with: the outside surface of the center conductor, the inside surface of the shield, and the outside surface of the shield (see Figure 1). It's as if the inner and outer surfaces of the shield were made of different metals and separated from each other. If the RF is on the inside of a piece of tubing (and there are no holes in the tubing), it never goes through the thickness of the wall of the tubing. Remember this—it's important for understanding why some antennas perform poorly in certain situations (we'll look at that next time).

The radio signal that we want to go from the transmitter to the antenna, then, flows on the outer surface of the center conductor and the inner surface of the shield. The outer surface of the shield *should* have nothing to do with the flow of the signal. The outer surface of the shield is, in fact, the part of the shield that matters for the shielding function. It keeps the signal inside where it belongs, and it keeps other forms of RF from getting inside and messing up the flow of the signal. That's why it's so important for coax to have a 100% shield. In other words, the center insulator should not be visible through the shield at all.

For the most part, however, this is only an issue when you're dealing with coax that has a shield made up of fine braided wires. Before you buy coax, peel off an

"RF travels on the surface of a conductor. A section of coax, then, has three surfaces to be reckoned with: the outside surface of the center conductor, the inside surface of the shield, and the outside surface of the shield."

By Peter O'Dell, WB2D

inch or so of the outer covering and look at the braid (Figure 2). If you can see the inner insulator through the braid, it's probably just as well to pass on this coax. You'll find some types of coax that have two or more layers of braid (often called double-shielded coax). This type is usually a much better performer than the single-shield variety, all other parameters being equal.

Some coax uses a foil-type shield and is often used for cable TV and similar video applications. Frequently, there's a copper or aluminum wire on the outside of the inner insulator and a layer of aluminum foil over the wire. This kind of coax can be useful in some low-power applications, but I personally don't care for it. Also, this coax requires special connectors, and using commonly-available connectors is almost always less expensive and less hassle.

Hard Facts on Hardline

Another type of cable, usually referred to as hardline, is the rigid or semi-rigid variety with a solid shield. The better varieties of hardline consist of a copper center conductor (solid or hollow, depending on the diameter of the cable), a foam-type dielectric material for the insulator, and an outer conductor made of copper tubing, all covered with a weather resistant plastic casing. The outer conductor often has a rippled surface to add flexibility to the line. For some larger-diameter hardlines, the foam dielectric is replaced with plastic spacers every few inches. The line is then filled with helium or some other inert gas. This is an excellent feedline, but it requires a lot of maintenance as well as a continuous supply of helium to keep the line pressurized. Gas-filled installations should be left to the *very* serious ham.

Make no mistake about it, hardline is not very bendable to start with, and it will not stand up to a lot of repeated flexing. You want to use hardline only where you can install it, strap it down, and never move it again. Standard procedure for an installation requiring flexibility at some point of the installation is to run the hardline along, say, the tower. At the top of the tower, terminate the hardline with an appropriate connector. Then run some sort of flexible cable the rest of the way to the antenna so that the rotator can turn the antenna freely.

Hardline always requires special connectors. Prices for these proprietary devices often range from $25 *each* and upward. Sometimes you can locate used ones or surplus connectors at hamfests, but those sources are not particularly reliable. Also, unless you have a complete metal-working shop, your chance of "homebrewing" a reliable connector is not very good. This is especially true for VHF/UHF applications.

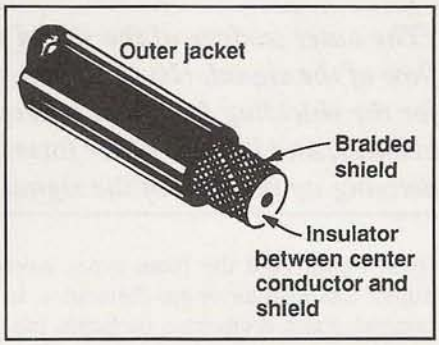


Figure 2. Before you buy coax, peel back an inch or so of the outer jacket. You shouldn't be able to see the insulation (dielectric) through the braided shield. If you can, spend a little more and buy cable with 100% shield.

Hardline would almost never be used in a mobile installation, with the possible exception of an oceangoing vessel or some other really large vehicle. Once a "kink" develops in hardline, the only option is to physically cut out the part that has the kink and terminate each new end with an appropriate connector. Since every connector is going to have some amount of loss, a better solution would be to replace the kinked run with a brand new piece of hardline. (For a description of what "loss" means, see below.)

As with any other form of coaxial cable, there's always the possibility of moisture getting inside the line. If there's moisture in the dielectric between the inner conductor and the outer conductor, the cable will be worthless. Depending on the exact type of dielectric, it might be possible to dry it out and use the cable again, but I wouldn't count on it. There's a risk that the water will have left some sort of sediment on the dielectric or conducting surfaces that will interfere with the normal impedance of the line and cause excessive loss. That's why the bargain hardline that the nice man at the hamfest sold you may not be such a good bargain after all. *Caveat emptor.*

Cable Characteristics

What are the other parameters of coax? There are really only three or four rating characteristics that make a big difference in most installations. The first of these, which was mentioned above, is "loss." Feedline loss is really very easy to understand, although the exact cause and cure are not always obvious.

Suppose you have 100 feet of coaxial cable, with each end terminated with an appropriate connector. Place a wattmeter at each end of the cable. Call one of the wattmeters the input meter unit and the other the output unit. Connect a 100-watt transmitter to the input and a dummy load to output wattmeter. Key the transmitter and notice the meter reading at each unit. They'll probably be different.

Suppose the input unit reads exactly 100 watts. What will the output unit indicate? That all depends on the loss through the line, but it will be something *less* than the input unit. The difference is the power lost (the loss) in the line. How much less? That will vary with the quality of the cable, the length of the cable, the quality of the connectors, and the *frequency*. Remember this, too: loss applies to both transmitted and *received* signals. Whatever is happening to your transmitted signal is also happening to the received one.

What if the cable is really pretty bad? You might have a reading of 100 watts at the input and a reading of 50 watts at the output. In technical terms, that means that you have a 3 dB loss per 100 feet of cable at this frequency. If you double the length of cable, you double the loss. That is, for a 200-foot run of cable, you'd have an output reading of 25 watts for an input of 100 watts—a whopping 6 dB loss! Of course, this assumes that all the loss is coming from the cable and not from the connectors, which is unlikely.

Adding up the Losses

What factors contribute to loss? Probably the biggest factors are the frequency, the size (diameter) of the cable, the material used in the dielectric, and the resistance of the conductors (only the surface counts, since RF flows only on the surface). The higher the frequency, the higher the loss. It's usually not a linear relationship, but cable that's useful at HF often becomes a real liability at VHF and even more so at UHF and higher. When you're deciding what kind of cable to use, look up the manufacturer's loss figures—for the frequency that you plan to use! You can find this information for most popular cables in the *ARRL Handbook*, available from the ARRL, CQ, and other ham dealers.

The size of the cable has a direct bearing on loss. In general, the smaller the cable, the greater the loss per 100 feet, all other factors being equal. Years ago I used a handheld radio in my car. It had a BNC female connector, so it was easy to attach the feedline of a roof-mount antenna (RG-58) directly to the handheld. The trouble was that the RG -58 was not all that flexible. Although the loss figures for RG-172, which has the diameter of spaghetti, is quite high for 2 meters, it's quite flexible. I decided that a little extra loss from a five-foot jumper of RG-172 was well worth what it added to the overall system. But I would not want to run 100 feet of RG-172 to an antenna for use at 2 meters or some higher frequency.

These days, I have a mobile unit permanently mounted in my car, but I use a handheld cellphone (900 MHz). I have an outside antenna that connects to the phone with about 10 feet of RG-172. I refuse to look up the loss of RG-172 at this frequency—I just don't want to know. Nonetheless, the cellphone works much better with the outside antenna and the short run of RG-172 than with its built-in antenna inside the car. Our world is often one of compromise.

The quality of the dielectric is another factor that contributes to loss. Solid dielectrics usually have higher loss than foam types. And the foam types have higher loss than air or gas dielectrics. In general, foam dielectrics probably present the best compromise in terms of loss. Another caveat applies here, though: Avoid tight bends in cable with foam dielectric. Over a period of time, the center conductor will tend to "migrate" towards the outer edge of the bend, resulting in an impedance lump or, in the worst case, a direct short. An impedance lump increases losses. Not a good thing.

"The outer surface of the shield should have nothing to do with the flow of the signal. (It) is, in fact, the part of the shield that matters for the shielding function. It keeps the signal inside where it belongs, and it keeps other forms of RF from getting inside and messing up the flow of the signal."

Don't Forget Impedance

Impedance is another characteristic to consider. Most ham equipment has a nominal 50-ohm termination. In other words, the radio and antenna are both designed to "see" a 50-ohm connection. That means that the feedline should also be 50 ohms. On the other hand, most cable TV systems use 75-ohm equipment and cable. Without an impedance matching device at each end of the surplus CATV cable, it will present a mismatch to your transmitter and antenna. It's not a huge mismatch, but it will cause additional losses and a significant reduction in the overall performance of your system. So avoid using CATV hardline, no mater how cheap it is.

Incorrect or improperly applied connectors can also cause impedance lumps and the corresponding increases in loss. We'll take a look at connectors next time.

Finally, there's the issue of the material from which the conductors are made. Aluminum is OK, copper is good, silver is very good, and gold is excellent. Silver plated connectors and braid coax with silver-plated conductors are around at reasonable prices. These are good compromises for ordinary installations. You can probably special order silver- or gold-plated connectors for hardline, but the cost is likely to be prohibitive.

What Cable Should I Use?

In general, for short runs at 2 meters, say 50 feet or less, RG-58 is probably OK, unless you're are involved in weak-signal applications. For 440 and up, RG-58 should be used for only very short runs, such as in a typical automobile installation. The RG-8-size (RG-213 for instance) is about as small as you'd want to go for lengths of 100 feet or more. Hardline would be better for these runs, with 7/8-inch hardline being better than 5/8-inch. Of course, hardline is much more expensive than regular braid type coax. Another compromise.

Size also has a direct bearing on the amount of power that the cable can handle. In general, the bigger the cable, the more power it can handle. I would be hesitant to use RG-58 for anything more than 50 watts or so at 2 meters, and I wouldn't use RG-172 for any power level greater than a typical handheld. Play it safe.

Coming Up: Connectors

Next time, we will take a look at the various types of connectors available in today's ham market. ■

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 photo 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.

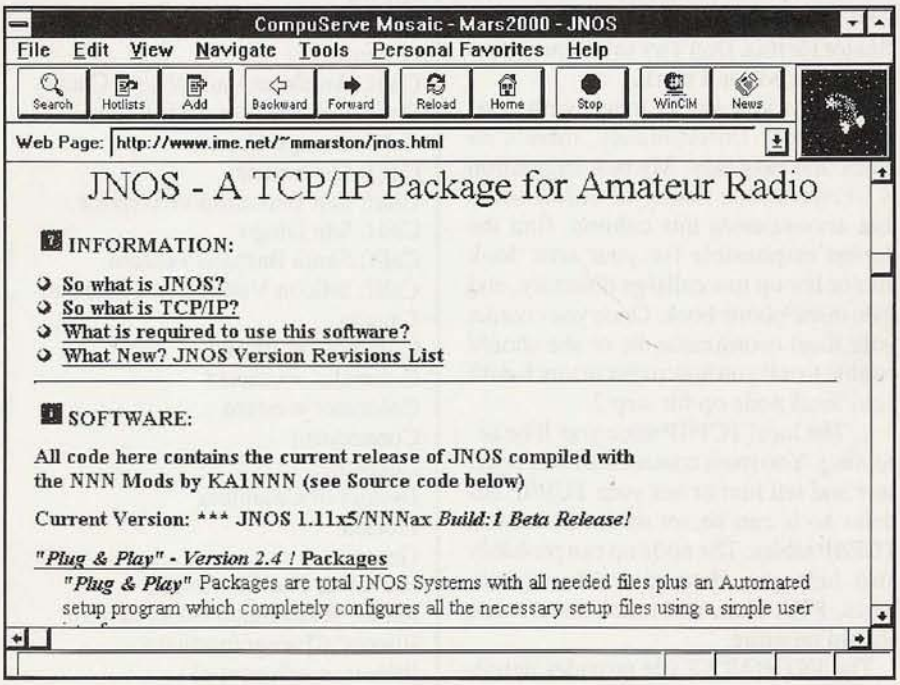
Instant TCP/IP—Part 2

Last month, we told you WHY you should consider using TCP/IP on packet. This month, we'll show you HOW to get started using KA1NNN's JNOS package.

Computers use a protocol known as TCP/IP to talk with each other on the Internet. Many hams use TCP/IP on packet, as well. But until now, it's been difficult to get up and running with TCP/IP on packet if you weren't already an expert. This has limited its popularity.

Last month, I explained the advantages of using this protocol on packet, and introduced a package put together by Mark Marston, KA1NNN, to simplify installation and setup of the latest version of ham-TCP/IP, known as JNOS. (Last month's column also included a glossary of TCP/IP-related terminology, so you may want to refer back to that if you bump into words here that you don't understand.)

Now, let's take a look at how you can get, install, set up, and use KA1NNN's JNOS package.



Here's where to find the latest version of JNOS, on KA1NNN's Web page at <http://www.ime.net/~mmarston/jnos.html>.

Getting the Software

First, you have to get the software. If you have Internet access (which, according to the *CQ VHF* survey, 70% of you do), just go to <http://www.ime.net/~mmarston/jnos.html> and get the JNOS file—the Web page will lead you to it. If you don't have Internet access, contact the source at the end of the column.

The next step is to unzip the file, which creates five files: three documentation files, a batch file for installation, and a compressed version of all the JNOS files. Be sure to read the README file for the details of the installation process and the disclaimer file for legal reasons. In addition, the DOC file gives a little background on the process.

Installation

To start the installation, first move the batch file and the compressed JNOS file to the root directory of the hard drive you want to install to. The files take up nearly 5 MB after decompression. A word of caution: don't try to install the JNOS files manually or (as the README file warns) nothing will work. Use the installation batch program, instead.

To run the installation program, specify the source drive and the destination hard drive. If you're installing from a hard disk, the source and destination drives must be the same. You cannot install the package to a floppy drive. For example, to install from drive A to drive C, you would type **INSTALL A C**, and to install from/to hard disk D, you would type **INSTALL D D**. The hard disk to hard disk installation runs much faster.

What You Need First

After starting the installation program, the JNOS files are first decompressed and placed into their proper subdirectories.

"Don't try to install the JNOS files manually or (as the README file warns) nothing will work. Use the installation batch program, instead."

By Don Rotolo, N2IRZ

"You'll find the user interface a little easier to use than the typical BBS interface, once you get used to the commands."

Once most of that is complete (a few minutes), you'll end up reading the file INTRO.TXT located in the \HAM\ directory just created. This in an informative article on TCP/IP in general and on the configuration program in particular. At this point, you need to get the following two bits of information:

1. Your personal TCP/IP address. You have to contact your area's TCP/IP coordinator for this. Don't try to invent a number; it just will not work.

How do you get in touch with your coordinator? Unfortunately, there's no quick and easy way. My best suggestion is to consult the listing of coordinators that accompanies this column, find the person responsible for your area, look him or her up in a callsign directory, and then in the phone book. Once you contact your local coordinator, he or she should be able to tell you how to get in touch with your local node op for step 2.

2. The local TCP/IP node you'll be accessing. You must contact the node operator and tell him or her your TCP/IP address so it can be set up in the node's TCP/IP tables. The node op can probably also help you determine which mail, news, FTP, chat, and other servers you should be using.

The INTRO.TXT file provides details on a few other things you have to figure out, such as SSIDs, COM ports, and mailer programs. Just read the file carefully, consult with your local node op if you have questions and you'll do just fine. There are also three README files in the \HAM\ directory which will help. The program then continues into the main installation program.

Personalizing the Program

Now comes the fun part: Once you have the information you need, either from a regional support file or from your coordinator/node op (most likely, both), the Q & A begins: Callsign, local node, TCP/IP address, name and personal info, mailbox password—and the program creates the files to store all this information.

You then select some TNC parameters, two blocks of text that describe yourself and your station, and the servers you'll be using. The last things you select are the newsgroups to which you want to subscribe and which external mailer (PC ELM or Bdale's Mailer) you prefer. The program then stores all that information and asks if you want it to update your CONFIG.SYS and AUTOEXEC.BAT files. You'll then have to reboot your computer for the changes to take effect.

Using the Program

To use the program from DOS, you'll have to change to the \HAM\ directory

Local TCP/IP Coordinators—A Selected List (as of July 1996)

To contact these TCP/IP area coordinators, you should either look them up in the *Callbook*, or ask your local node op if he or she knows how to contact them. To contact local node ops, send them a message on the local BBS, or look them up in the *Callbook* or other callsign reference!

(Note: This list includes only North America and certain other selected countries. The complete list will be posted to the CQ VHF *FTP site on the Internet: <ftp://members.aol.com/cqvhf/97issues>.—ed.)*

Area of Coordination	Name	Callsign
North America		
Alabama	Bruce Tenison	KE4NJB
Alaska	John Stannard	KL7JL
Arizona	Keith Justice	KF7TP
Arkansas	Richard Duncan	WD5B
Calif: Antelope Valley/Kern County	Dana Myers	KK6JQ
Calif: Los Angeles—SF Valley	Jeff Angus	WA6FWI
Calif: Orange County	Terry Neal	AA6TN
Calif: Sacramento	Bob Meyer	K6RTV
Calif: San Bernardino/Riverside	Geoffrey Joy	KE6QH
Calif: San Diego	Brian Kantor	WB6CYT
Calif: Santa Barbara/Ventura	Don Jacob	WB5EKU
Calif: Silicon Valley/San Francisco	Douglas Thom	N6OYU
Canada	Barry McLarnon	VE3JF
Colorado: northeast	Fred Schneider	KØYUM
Colorado: southeast	Bdale Garbee	N3EUA
Colorado: western	Bob Ludtke	K9MWM
Connecticut	Bill Lyman	N1NWP
Delaware	Butch Rollins	NF3F
District of Columbia	Richard Cramer	N4YDP
Florida	Brian A. Lantz	KO4KS
Georgia	Doug Reed	N3AIA
Hawaii & Pacific Islands	Derek Young	WH6BH
Idaho; Washington State, eastern	Steven King	KD7RO
Illinois: Chicago/northern	Ken Stritzel	WA9AEK
Illinois: south/central	Chuck Henderson	WB9UUS
Indiana	John Naab	KA8TNA
Iowa	Ron Breitwisch	KCØOX
Kansas	Dale Puckett	KØHYD
Kentucky	Allan B Dayton	NØKFO
Louisiana	James Dugal	N5KNX
Maine	Carl Ingerson	N1DXM
Maryland	Howard Leadmon	WB3FFV
Massachusetts: eastern & central	Gordon LaPoint	N1MGO
Massachusetts: western	Bob Wilson	KA1XN
Mexico	Regnerus Dantuma	XE2/WP2B
Michigan (eastern lower peninsula)	Jay Nugent	WB8TKL
Michigan (upper peninsula), Wisconsin	Thomas Landmann	N9UDL
Michigan (western lower peninsula)	Dan Thompson	N8WKM
Minnesota	Bob Brose	NØQBJ

Mississippi	John Martin	KB5GGO
Missouri	Stan Wilson	AKØB
Montana	Don Heide	WB7ETT
Nebraska	Mike Nickolaus	NFØN
Nevada: northern	Bill Healy	N8KHN
Nevada: southern	Earl Petersen	KF7TI
Nevada: special use	Richard Hallman	KI3V
New Hampshire	Gary Grebus	K8LT
New Jersey: northern	Dave Trulli	NN2Z
New Jersey: southern	Bob Applegate	WA2ZZX
New Mexico	Tim Baggett	AA5DF
New York: eastern	Bob Bellini	N2IGU
New York: NY & Long Island	Steve Dworkin	N2MDQ
New York: NYC	Frank Garofalo	WA2NDV
New York: western	Dave Brown	N2RJT
North Carolina: eastern	Mark Bitterlich	WA3JPY
North Carolina: western	Charles Layno	WB4WOR
North Dakota/South Dakota	Steven Elwood	N7GXP
Ohio	John Ackermann	AG9V
Oklahoma	Joe Buswell	K5JB
Oregon	Ron Henderson	WA7TAS
Oregon: NW & Portland; Vancouver WA	Tom Kloos	WS7S
Pennsylvania: eastern	Doug Crompton	WA3DSP
Pennsylvania: western	Bob Hoffman	N3CVL
Puerto Rico	Karl Wagner	KP4QG
Rhode Island	Charles Greene	W1CG
South Carolina	Mike Abbott	N4QXV
South Dakota/North Dakota	Steven Elwood	N7GXP
Tennessee	Jeff Austen	K9JA
Texas: north	Eric Martin	KC5ENU
Texas: south	Kurt Freiberger	WB5BBW
Texas: west	Rod Huckabay	KA5EJX
U.S. Virgin Islands	Bernie McDonnell	NP2W
Utah	Matt Simmons	KG7MH
Vermont	Ralph Stetson	KD1R
Virginia	Jim DeArras	WA4ONG
Virginia (Charlottesville area)	Jon Gefaell	KD4CQY
Washington State: eastern; Idaho	Steven King	KD7RO
Washington State: western (Puget Sound)	Bob Donnell	KD7NM
West Virginia	Rich Clemens	KB8AOB
Wisconsin, Michigan (upper peninsula)	Thomas Landmann	N9UDL
Wyoming	Reid Fletcher	WB7CJO
Selected Other Locations		
Australia	John Tanner	VK2ZXQ
Germany	Ralf D. Kloth	DL4TA
Italy		I2KFX
Japan	Isao Seki	JM1WBB
	Toshiyuki Mabuchi	JF3LGC
Netherlands	Rob Janssen	PE1CHL
Outer Space (AMSAT)	Tom Clark	W3IWI
South Africa	Wessel du Preez	ZS6BLY
United Kingdom	Paul Taylor	G1PLT

and type **JNOS**. You can also run JNOS under Windows®. To do so, you would create a new program item (in the Windows 3.1 Program Manager, select FILE, then NEW, then PROGRAM ITEM) and use the file JNOS.PIF as the command line argument.

Assuming both the TCP/IP coordinator and your local node op have done their jobs, you're ready to roll. Figure 1 shows the main JNOS screen. There are commands for establishing TCP/IP sessions, working with the mailer application, getting various kinds of information, and

"Not every network supports TCP/IP. If your local network doesn't, you're just out of luck, unless you're very persuasive."

some other miscellaneous actions. Reading the documentation, which is quite good, will explain everything in detail—I wish I could cover it here, but it would take up dozens of pages.

Although it's possible to set up JNOS so you can use your regular Internet applications (like Netscape) on packet, this takes a bit more effort than can be easily explained. In essence, you have to reconfigure your JNOS to act as a router for your Winsock, or run a second computer with a PPP connection on one side and JNOS on the other. If you understand what all that means, contact Mark and he might be able to help you out. Otherwise, play with the JNOS package as it is, and rest assured that many people are working on a Plug-N-Play way to set up Netscape (etc.) for packet, too.

OK, Now What?

Once you have it all set up, you should go and fetch some bulletins off the news server, look at what files the FTP server has available (maybe upload some yourself), see if anyone's on the chat server, and play around with the mailer application. You'll find the user interface a little easier to use than the typical BBS interface, once you get used to the commands. If you want to go back to AX.25, you'll have to exit from JNOS and start up your regular packet program—TCP/IP and regular AX.25 are not inter-operable (they can't talk to each other).

That doesn't mean you'll lose your friends on regular packet. Mail gateways between TCP/IP mail servers and the regular PBBS system exist, and they're easy to use: you just send the message to the server and tell it where it has to go. Similarly, incoming messages will end up in your mail server.

There's Always a Catch

I've saved the bad news for last: Not every network supports TCP/IP. If your local network doesn't, you're just out of luck, unless you're very persuasive. ROSE, TheNET X1J, FlexNet, and TEXNET all support TCP/IP, so if that's the type of network software being run in your area, the node ops only have to configure the network for TCP/IP. Maybe you can persuade the network operators to set everything up!

Thanks, Mark!

I'd like to take this opportunity to thank Mark Marston, KA1NNN, for all his hard work toward making TCP/IP so much easier to enjoy, as well as the time he spent patiently answering my questions. I encourage everyone reading this to download the JNOS package and at least try it. Getting a TCP/IP address is as easy as sending a message to your local coordinator, and he or your local node op will help with the rest. If you do try it, and enjoy it, please send Mark a message thanking him—he most certainly deserves it.

Finally, as I mentioned before, if you're somewhat knowledgeable about the TCP/IP network in your area, download the package and create some support files. Mark will be happy to post them, and you'll be helping TCP/IP grow.

Thanks, Everyone!

This column marks the first anniversary of the Digital Data Link. It didn't appear in the premiere issue, but in the second one (March, 1996). I must say that it's been quite enjoyable writing about the digital modes on VHF and above, and I expect to continue as long as you still enjoy what I'm writing about.

With that in mind, I'd like to say thanks to all of you who have taken the time to write, whether with ideas for columns (those are really helpful), or just to say that you enjoy the column. To all the rest of you out there, I encourage *you* to write, too. Every circuit works best with feedback, and I'd really enjoy hearing from you—what you like, what you're up to in the digital area, network maps, whatever. It's what makes this so much fun.

That about covers it for this month. Next month, I'll tell you all about my experiences with one of the Garmin GPS-20 receivers from TAPR (Tucson Amateur Packet Radio), and I'll describe how to build the power supply and interfaces you need to make it work with APRS.

Until then, keep the bit bucket full!

73, N2IRZ

Resources

If you want a copy of the JNOS package described this month, but can't download the software from the Internet, just send $1 (and your return address!) to Amateur Networking Supply, P.O. Box 219C, Montvale, New Jersey 07645-0219. The dollar will be used to load the latest version of the software onto an IBM-compatible 3.5" floppy, and to mail it to you. If you live outside the U.S., you can send four IRCs or two dollars.

Operating the Digital Satellites—Part 2: The 1200-bps PSK Birds

In our second installment of WA4SXM's series on working ham radio's digital satellites, we find out about the five OSCARs that use PSK at 1200 baud.

In last month's column, I discussed basic digital operation and 1200-bps AX.25 (standard packet) satellite operation, which I'll call Mode 1. This month we move to the next two levels, Mode 2 and Mode 3—1200-bps PSK (Phase Shift Keying) satellite operation. But before we dive into operation of the PSK satellites, let's explore some more of the basics of digital communication.

Half Duplex and Full Duplex

Nearly all terrestrial packet operation is *half duplex*. One station transmits then goes to receive mode and waits for a reply from the other station, then transmits again, receives again, etc. This is necessary because only one frequency is used; the transmitter and receiver for the same frequency cannot be on at the same time. On the other hand, nearly all satellite operation is *full duplex*—both stations transmit simultaneously, using frequencies on separate bands.

The separation of transmit and receive frequencies allows each station to receive and transmit at the same time. Full duplex mode automatically allows twice the data throughput of half duplex mode. This increase in throughput is important when you consider that the 2,000-mile diameter *footprint* of a digital satellite gives many times more amateurs the capability of using the satellite BBS than the typical 30- to 50-mile footprint of a terrestrial packet BBS.

Not Your Everyday TNC

The TNC (Terminal Node Controller) most commonly used for terrestrial packet operation is actually two devices in one: a modem and a packet protocol handler. Both are included in the TNC box for convenience since only one mode is used: 1200-bps FSK (Frequency Shift Keying) using the AX.25 protocol.

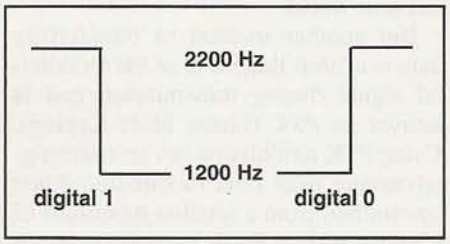


Figure. Simple Manchester encoding. Zeros and ones are indicated by changes in tone frequency rather than by the tone frequency itself.

The modem (modulator/demodulator) section transforms audio data to digital data and vice versa. The *modulator* section converts the digital data (ones and zeros) into audio tones of different frequencies and sends them to the transmitter to be inserted into the RF signal as modulation. This FSK audio data shifts between 1200 Hz and 2200 Hz for each zero and one, 1,200 times per second. The *demodulator* takes the audio signal output from the receiver and converts it into digital data. The packet protocol handler then takes the received digital data and organizes the bytes into packets. These packets include fields for the addressee, the type of data, how much data, what to do with the data, the data itself, and a checksum of the packet. The specifics of how it's done depend on the protocol being used.

In addition, the packet protocol handler takes care of "ACKing" (sending an acknowledgment packet when a packet to the addressee is received with a correct checksum) and sending retransmit packets. On transmitted data, the packet protocol handler combines the addressee's callsign, path to the addressee, sender's call, packet length, message type, information/text, and checksum together into

The Different Digital Modes Used on Ham Satellites

The six digital modes used on the amateur satellites (those in **bold** are discussed this month):

1) 1200-bps AFSK, AX.25 (terrestrial packet) for DO-17, Mir, Shuttle (see last month's column and WF1F's "A Guide to Working MIR," elsewhere in this issue)

2) 1200-bps PSK, AX.25 for FO-29 BBS

3) 1200-bps PSK, PACSAT Protocol for AO-16, WO-18, LO-19, IO-26

4) 1200-bps FSK signal, using Bell 202A modem (not the common Bell 212 modem) for UO-11 (coming up in a future issue)

5) 9600-bps FSK, PACSAT Protocol for UO-22, KO-23, KO-25 (coming up in a future issue)

6) 400-bps PSK, AO-13 telemetry, P3D telemetry (coming up in a future issue)

By G. Gould Smith, WA4SXM

Table 1. TNC Parameters for Fuji-OSCAR-29 (FO-29) BBS

Recommended TNC setting	
FULLDUPLEX ON	
FRACK 6	(minimum 6)
MAXFRAME 2	(maximum 3)
MONITOR ON	(optional, to see all messages)

a packet(s) and sends it out to the modulator, then on to the transmitter.

If a different type of protocol or a different modulation technique is used, a change must be made to the TNC. Working the 1200-bps PSK satellites requires an external 1200-bps PSK modem *in addition to* a standard TNC. Most TNCs that follow the Tucson Amateur Packet Radio (TAPR) TNC design have a *modem disconnect header* available. This is used to disable the 1200-bps FSK modem section of the TNC and allow data transfer with an external modem, while still using the packet protocol handler section of the TNC.

That's how we set things up for PSK satellite operation. But what exactly *is* PSK, anyway?

FSK, PSK, and Manchester

When packet operation was developing in the 1980s, operational decisions were made to facilitate the acceptance and usage of packet radio. The simple FM FSK modulation technique selected took advantage of the large base of 2-meter FM equipment already in place in the amateur world.

But another method of transferring data is to shift the *phase* of the modulated signal during transmission and is known as *PSK* (Phase Shift Keying). Using PSK modulation has an enormous advantage over FSK modulation when transmitted from a satellite thousands of kilometers from Earth, especially since a satellite has to use a small, fixed transmit power level. A PSK-modulated signal can offer an equal data recovery rate with less than half the received signal strength of an FSK-modulated signal. Even considering the entrenched FM radio base, it made sense to use an SSB signal with PSK modulation for digital satellite transmissions (this is actually known as *BPSK,* for *Binary* Phase Shift Keying, since only binary data is being sent).

Stations on the ground don't have the same power restrictions, so it *didn't* make sense to require individual users to transmit PSK as well. As a result, the uplink transmit data modulation technique used in the 1200-bps PSK satellite modem is *different* than the downlink demodulator. Uplink signals are transmitted in FM, but use a special FM tone mechanism called *Manchester encoding* . Here, the "1" or "0" digital information is not associated with the frequency of the tone (as in the case of FSK), but instead with the *transition* from one tone to another. At the appropriate *bit time* (^{1}/1,200th of a second, or every 0.833 milliseconds), the modem causes the signal to change state. Ones are a high-to-low transition and zeros are a low-to-high transition. Of course, if there are consecutive zeros or ones, the signal must change state in between those designated "bit times," so that the same transition will occur at the correct time (see Figure).

Table 2. PSK Satellites Using Pacsat Protocol

Satellite	bdcstcall	bbscall
AO-16	PACSAT-11	PACSAT-12
WO-18	WEBER-1	n/a (WO-18 is downlink-only)
LO-19	LUSAT-11	LUSAT-12
IO-26	ITMSAT-11	ITMSAT-12

Currently-operating 1200-baud PSK satellites using the Pacsat protocol, along with their calls. See text for explanation.

PSK Modem or DSP?

With the number of different digital satellite modes available, each requiring a different modem, it becomes cost-effective to think about a *DSP modem* if you're planning to operate more than one digital satellite. These boxes use a Digital Signal Processor (DSP) chip to mathematically modulate and demodulate most of the different types of digital signals. In one box, with one interface and one set of cables, you get 1200-bps FSK and PSK, 9600-bps FSK, 400-bps PSK, as well as CW, RTTY, SSTV, AMTOR, PACTOR, and many other digital modes.

Both TAPR and AMSAT (the Radio Amateur Satellite Corp.) currently have the DSP-93 kit available. This kit is not for the beginner, but, in addition to providing all the satellite modems, it offers an excellent platform to learn and experiment with DSP programming. The hooks are all in place for you to develop and design your own modems, filters, or decoders. There's even a programming guide available on the TAPR Web site, <http://www.tapr.org>.

Commercial DSP modems include the L.L. Grace DSP-12 and AEA's DSP-2232/1232 units. These models are not directly supported anymore, but are good, reliable units if you find them for sale used.

Radio Needs

The 1200-bps digital PSK satellites use *Mode J* (also known as *Mode VU)*, which means using a 2-meter FM uplink and a 70-centimeter (435-MHz) SSB down-

"A PSK-modulated signal can offer an equal data recovery rate with less than half the received signal strength of an FSK-modulated signal."

link. The 2-meter FM transmitter hardware for the uplink is probably not a problem for most, and a transmitted signal of about 25 watts will do fine. On the other hand, a 435-MHz SSB receiver may pose a challenge. While a growing number of 70-centimeter FM rigs cover 430 to 440 MHz as well as 440 to 450, you still need to be able to tune in an SSB signal.

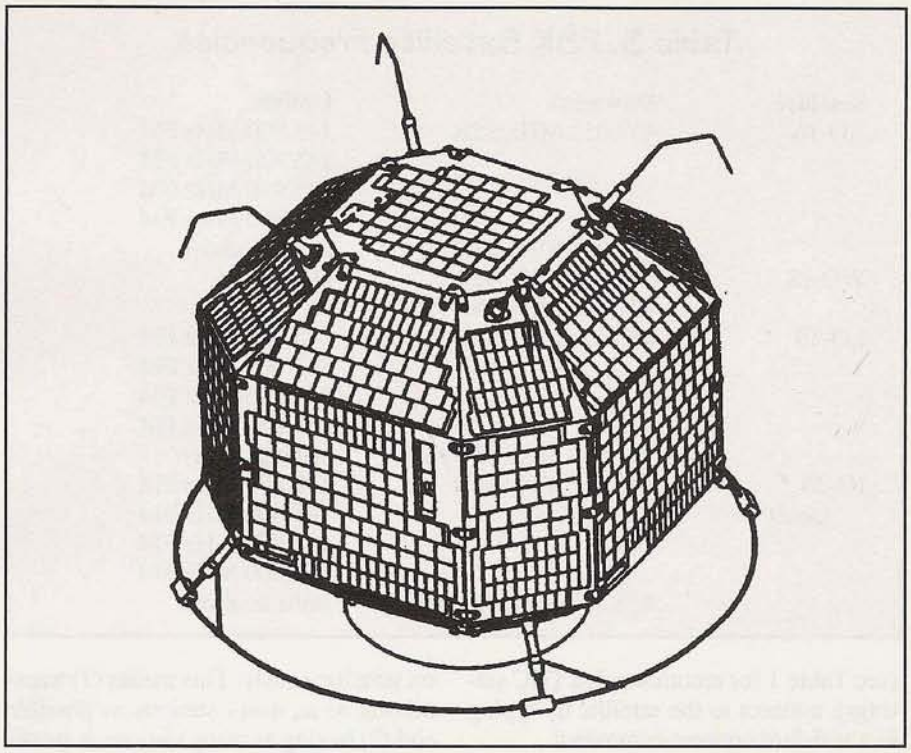
But if you don't have an SSB UHF radio, don't let that stop you! I've successfully used an inexpensive downconverter (a device that shifts 435.5- to 437.5-MHz signals to the 29-MHz portion of the 10-meter band) and an HF SSB receiver to receive the PSK satellite data. I will admit, though, that manually keeping the signal tuned throughout the pass (because of Doppler shift) offers quite a challenge. The HF radios I've used don't have as fine a tuning ability as the VHF/UHF radios, so a small turn on the HF dial covers a wider frequency range.

Make sure that you separate the 2-meter and 70-centimeter antennas by at least eight to 10 feet. The 2-meter transmission has a harmonic right on the 435-MHz band (the third harmonic of 145.8 MHz is 437.4 MHz). If you're using a preamplifier for the 435-MHz downlink (which I recommend), you'll also amplify the 2-meter harmonic, often desensing the 435-MHz receiver and leaving yourself with no decodable downlink signal. Good antenna separation should eliminate that problem.

Putting It All Together

Now that you know what goes into communicating with the 1200-bps PSK digital satellites, here's your shopping list to set up the station you'll need:

- 435-MHz antenna
- 435- to 437-MHz *SSB* receiver
- 2-meter antenna
- 2-meter FM transceiver
- 1200-bps PSK modem
- TNC with a modem disconnect header (connected to the PSK modem), and
- a computer running a terminal program talking to the TNC.



Japan's Fuji-OSCAR 29 (FO-29) satellite uses standard terrestrial packet protocols along with PSK-modulated SSB on the downlink and Manchester-encoded FM on the uplink. Other digital satellites may require specialized (but free) software for automated operation. See text for additional information.

Once all the pieces are assembled, all the switches are set, and the cables are connected correctly (no small feat), you're ready to operate the BBS on FO-29 (Fuji Oscar 29). A standard terminal can be used for the FO-29 BBS, as no data logging or storage is necessary. A few more steps are required for Microsat operation (such as on AO-16 or LO-19), but we'll cover that in a future installment.

FO-29

Fuji OSCAR-29 was launched in August of 1996 to replace the ailing FO-20 satellite. FO-29 operates in analog mode (JA) for voice and CW communication, a telemetry mode (sending 1200-bps PSK data), a Digitalker mode, and a digital BBS mode (JD). The telemetry sends PSK data every few seconds, describing the current state of the satellite. The Digitalker mode has the satellite "speaking" computerized FM messages in English and Japanese. Both the Digitalker and telemetry may be heard on 145.91 MHz.

Currently there is no fixed mode schedule for this satellite. Check with the AMSAT Web site, <http://www.amsat.org>, or listen during a pass to see whether you hear voice or digital data. If you hear data, and it's not telemetry (you'll have to see what shows up on your screen), then you can try to make contact with the satellite's bulletin board.

FO-29 BBS

The BBS uplinks on FO-29 are FM, 1200-bps, AX.25, Manchester encoded data on four frequencies: 145.850, 145.870, 145.890, and 145.910 MHz. Choose one that you think fewer other people will use *(Darts may be a useful method!—ed.)*. The satellite listens to all four, so you're competing only with the other signals on that frequency. The satellite transmits with 1 watt of power on the downlink frequency of 435.910 MHz, using a 1200-bps, BPSK, SSB modulated signal; the bulletin board's callsign is 8J1JCS. Make sure you hear digital data before attempting to connect to the satellite so as not to interfere with the satellite if it's in analog mode.

Using FO-29's BBS

Operating the BBS on FO-29 requires operator intervention and real-time responses just like a terrestrial BBS. Once your equipment is properly configured

Table 3. PSK Satellite Frequencies

Satellite	Downlink	Uplink
AO-16	437.051 MHz SSB	145.900 MHz FM
	"	145.920 MHz FM
	"	145.940 MHz FM
	"	145.960 MHz FM
	437.026 MHz SSB (alt)	same as above
WO-18	437.102 MHz SSB	na
	437.075 MHz SSB (alt)	na
LO-19	437.125 MHz SSB	145.840 MHz FM
	"	145.860 MHz FM
	"	145.880 MHz FM
	"	145.900 MHz FM
	437.150 MHz SSB (alt)	same as above
IO-26	435.867 MHz SSB	145.875 MHz FM
	"	145.900 MHz FM
	"	145.900 MHz FM
	"	145.900 MHz FM
	435.822 MHz SSB (alt)	same as above

(see Table 1 for recommended TNC settings), connect to the satellite by typing in a standard connect command:

Cmd>Connect 8J1JCS

If you're successful, the BBS will respond with:

8J1JCS>(your callsign): FO29/JAS1c Mailbox ver. 2.00
commands [B/F/H/M/R/U/W]
Use H command for Help

Then operate the way you would on any other packet bulletin board. That's about all you need for working FO-29. *NOTE: Be sure to disconnect from the BBS before the satellite goes out of sight* or you'll tie up one of the "queue" positions, keeping others out. The "AMSAT-NA Digital Satellite Guide," available from AMSAT, has more information about this and the other digital satellites.

The PACSAT Protocol Suite

While FO-29 functions like a terrestrial BBS, most other digital satellites use something called the *PACSAT Protocol Suite*. The most noticeable difference between the two systems is that a computer program must perform most of the data exchanges with satellites using the PACSAT Protocol Suite. Real-time operator interaction is minimal.

Here's why: Recognizing the problems associated with many operators wanting to use an orbiting mailbox at the same time, Harold Price, NK6K, and Jeff Ward, GØ/K8KA, designed the PACSAT Protocol Suite to provide maximum data transfer with numerous users logged on simultaneously. This means (1) transmitting to as many stations as possible and (2) having as many stations as possible "connected" to the satellite to upload data or requests. When you "connect" to a satellite BBS using these protocols, you're placed in a waiting line, or "queue," to send your requests, messages, and other information. The BBS on the satellite tells your station when to transmit. Receiving is a little different: everybody receives everything.

To get as much information as possible to as many stations as possible within the limited time of a satellite pass, Harold and Jeff took advantage of one of the additions to the AX.25 (Amateur X.25) protocol not found in the standard network X.25 protocol, the *UI (Unnumbered Information)* frame. Simply put, this is a broadcast packet, sent to all stations, requiring no acknowledgment. Broadcast from the satellite to all stations in the footprint, the information in these packets includes the telemetry data, the directory data, and the file data requested by stations logged on.

All stations receive all of the data and keep what they want and throw away what they don't want. The protocol decides what information to transmit in the UI packets. Each of the data types—user-requested files from each "connected" (stations in the queue) station, directory data, general bulletins and telemetry data—is assigned a certain number of packets to be transmitted in a round-robin fashion. If two or more stations want the same file, they all get it at the same time and store it on their disk drives, rather than having to retransmit the same data multiple times to individual stations.

"(In Manchester encoding,) the '1' or '0' digital information is not associated with the frequency of the tone (as in the case of FSK), but instead with the transition from one tone to another."

To handle the problem of multiple stations uplinking data, Jeff and Harold devised a scheme where the ground stations can spread out on four different uplink frequencies, then allow multiple connects on each channel. Requiring the groundstation computer to handle the data requests and transfers takes care of the largest problem, time wasted waiting for human operators to make decisions. Stations under complete computer control can connect, transfer data, then disconnect quickly. If additional data is needed, the station can reconnect and get a new place in the queue, when available (or wait for the next pass).

This process allows the maximum number of operators to communicate with the satellite during the 10- to 18-minute passes. In fact, most outgoing messages should be written, processed, and queued before the satellite pass. If you'd like more detail on the PACSAT Protocol Suite, see the *9th Computer Networking Conference Proceedings*, available from the ARRL. Jeff and Harold have a series of papers there describing the protocol design and software.

Special Software—But It's Free!

The software that implements this PACSAT Protocol Suite is known as "PB/PG" and is available for free on many BBSs and on the AMSAT Web site. It's also included with the "AMSAT-NA Digital Satellite Guide" mentioned earlier. The PB/PG program takes care of connecting to the satellite, uploading your messages, updating your satellite directory, and downloading messages addressed to you or specific message types that you've requested.

Another AMSAT program, called "WiSP," operates under Windows and combines satellite scheduling, selection, antenna tracking and "PB/PG" operation with the satellites—it does it all. *(While*

the "PB/PG" program is free, "WiSP" is not. But your purchase helps support amateur satellites.—ed.)

My advice is to use the "PB/PG" program for awhile to get familiar with the structure and operation of hands off digital satellite communication. Then if you want to switch to "WiSP," you'll understand how to answer the many setup options required. Meanwhile, let's take a look at some basic setup requirements for either type of software.

The SSID

To allow multiple packet stations to belong to the same operator, the SSID (secondary station identifier) was added. Each physical ground station has a call with an SSID between 0 and 15 attached. If an SSID isn't specified, then 0 is used, but not displayed. This applies to terrestrial packet stations as well as satellites.

Since the PACSATs use two different types of packet operation, broadcast and BBS, each has an assigned call with a different SSID. The one for the uplink is known as the *bbscall*; the one for the downlink is known as the *bdcstcall* (broadcast call). These must be set up in the "PB/PG" or "WiSP" setup files to address the satellites correctly. Table 2. lists the current 1200-baud Pacsat protocol PSK satellites and their callsigns.

"Be sure to disconnect from the (FO-29) BBS before the satellite goes out of sight or you'll tie up one of the 'queue' positions, keeping others out."

KISS Mode

There's one more thing you'll need for communicating with the PACSAT class of satellites. Your TNC must be equipped not only with a modem disconnect header, but also with the *KISS mode* (Keep It Simple Stupid) command. The TNC is often placed in this mode automatically by the "PB/PG" and "WiSP" software to enable it to perform its functions. (Don't worry, most TNCs today include KISS mode as a standard feature.)

KISS mode causes the TNC to exercise only the most elementary portions of the AX.25 protocol (like ACKs) and pass most of the protocol data out the serial port. In packet satellite operation, "PB/PG" or "WiSP" will do the protocol interpretation. After you type

Cmd>KISS ON

the software commands the TNC to RESTART. This is not a reset, but just a restart to have the KISS operations take effect. Normally the TNC will blink the LEDs three times on RESTART. If the TNC blinks three times on reset or power-on, it's informing you that the TNC is in KISS mode.

If your TNC doesn't operate correctly after using or experimenting with the PACSATs, make sure that the TNC is not in KISS mode (three blinks on power-on). The TNC will retain this mode even across a power-down. The best way to get the TNC out of KISS mode is to run the "PB/PG" program, then exit and answer **YES** when the computer asks you whether to take the TNC out of KISS mode.

Looking Ahead

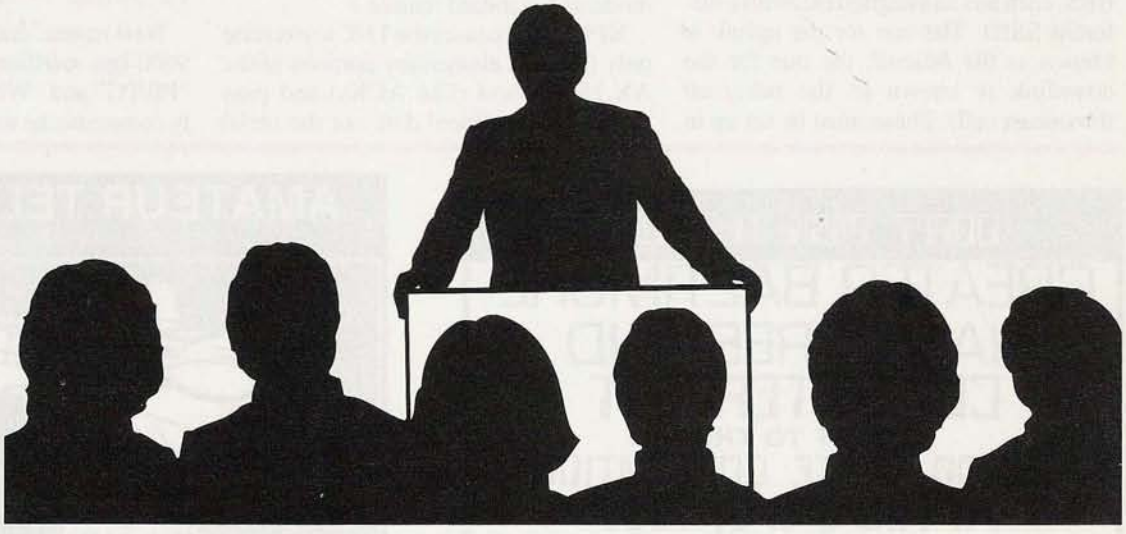
Next month, instead of jumping into the 9600-bps satellites, I'll talk more about "PB/PG" and "WiSP" and how to actually communicate with the digital satellites.

A Different Kind of Theory

Instead of his usual discussion of electronic theory, W6TNS mounts his soapbox this month and shares some theories on the future of ham radio. We hope you'll find "food for thought" in his ideas.

Did you ever want to go to the nearest hilltop and shout, with all your might, about something that was bothering you? Maybe you were driven to do so by the past election, the commercialization of the holidays, or any one of a zillion things that grate on our nerves in this high stress era. Few of us ever make the futile gesture. Instead we bottle up our frustrations while our stomach ulcers grow little ulcers of their own.

I've been feeling that way for months now, and my ever-suffering editor has allowed me to bellow from the mountaintop called *CQ VHF*. I'm really bugged about the status and direction of ham radio and I've got to unload on someone. So forgive me this once if I don't talk about wavelengths, dipoles, modulation, etc., and focus on our hobby's future.



The No-Code Debate

It's unbelievable that I still see gigabits of messages when I log on to CompuServe, the Internet and so on, debating the merits of the No-Code license class. I mean, get a life, guys! Nothing you say or do is going to change the fact that we have a license class which you can earn without needing to know Morse code. If these naysayers spent as much time and energy helping newcomers as they do berating the No-Coders, our fraternity would be in much better shape.

Whether you admit it or not, the Technician Class license is the best thing to happen to ham radio since the invention of the microprocessor. Many hams seem to have forgotten why we have this license class. Until the rules were changed, ham radio was a hobby for old geezers. The average age of a ham radio operator was above 50 years old! Those of us who battled for the No-Code license class wanted to get more people into the fraternity who didn't need walkers to get to their ham gear. We accomplished that goal very nicely, thank you. The ranks of ham radio literally exploded.

Sure, a lot of those who took the No-Code test settled for a handheld radio and didn't go further. But that's our fault, not theirs. We crafted extensive programs and promotions to draw people into the hobby, but expended very little thinking and effort on what to do with this valuable resource once these people got their tickets. And sure, many newcomers never even get on the air. But again, this is our fault. What they saw, once they became hams, failed to stimulate their interest sufficiently to progress further.

But don't lose sight of the fact that even these people represent numbers. When ARRL representatives visit a Congress-critter, they can honestly say they represent the interests of 700,000-plus radio amateurs. Don't think for a minute this fails to impress Senator Cleghorn and his cronies. He listens to what our representatives have to say, and, when a bill comes up that affects our fraternity, he remembers the message of voter strength that was delivered. Like it or not, numbers are responsible for the string of successes that the ARRL has had in Washington.

The FCC listens to numbers, too. They get gobs of letters and petitions from wild-eyed hams with great ideas about what should be done with the ham bands. But unless they also get tons of supporting letters for an idea, it usually "dies on

By Donald L. Stoner, W6TNS

"I'm really bugged about the status and direction of ham radio and I've got to unload on someone. So forgive me this once if I don't talk about wavelengths, dipoles, modulation, etc."

the vine." But numbers are why the Commission listens to the ARRL and often does what it suggests...there's a reasonable assurance that many hams support any position that the League takes.

Morse Code

I wonder if there was the same hate and discontent evident when the rules were changed to outlaw spark gap transmitters in favor of stabilized vacuum tube equipment? Contrary to what you may think, I am not old enough to remember those days. Even though I was not around to wind helixes and breathe ozone fumes, I doubt that hams of that era were as spiteful as those of today. ARRL founder Hiram Percy Maxim (the original W1AW) would be hanging his head in shame if he could receive 75 meters up there.

Again, I see message after message extolling the virtues of Morse, interspersed with those saying it's dead and offering to cart it away. Thank heavens it isn't possible to fire a shotgun over a ham rig or the casualties would exceed those of World War II.

We've lost sight of the purpose of Morse as it relates to the licensing process. Today, code is just one aspect of our hobby and a fun activity for many hams. But there are many who resent having those dits and dahs shoved down their throats as an entry requirement for HF.

What everyone seems to overlook is that Morse code as a licensing requirement is nothing more than a *filter* for separating the motivated from the unmotivated. Let's be honest and admit that we really don't need more hams on the HF bands. We lowered licensing standards to bring more people into our fraternity and the program accomplished this by giving No-Code Technicians access to the VHF spectrum. But there is no overriding need to increase the population densities on HF. At the moment, the 20, 40, and 75 meter bands are chock-a-block full.

Have you ever read about experiments where too many rodents are housed in too small a space? That's right, they start fighting amongst themselves to lower the density. You can see the human equivalent of this experiment in our daily life. You saw it happen on the Citizens Band, and it's starting to happen on our high frequency bands. If you doubt that, listen to the intentional QRM between the slow-scanners and DXers on 20 meters.

One often hears the argument that Morse has become irrelevant in ham radio. "Why not use a different test to permit access to the HF bands," they ask? But no one has yet come up with a filter that's as good as Morse code for regulating the population densities on the high frequency spectrum.

Getting access to HF is, and should be, something special. These bands are the "jewels" in the ham radio crown. I say this not as someone who has "got mine" and doesn't want anyone else to get theirs. But trying to wedge a signal into a slot on 20 meters can evoke all sorts of hostility. Get too close to the frequency a rare DX station is on and the wrath of the gods will descend upon you. Snuggle up alongside a net operation and you're "dead meat." And keep in mind that we're at the bottom of the sunspot cycle. When the solar flux gets up in the hundreds, you're going to see absolute chaos on the high frequency bands even with the current densities.

I doubt that the current testing requirements will change significantly in the near future. Even though the number of Technicians continues to increase, the majority of ARRL members do not want the code eliminated or the speeds reduced. Like it or not, until their position changes, that's "life in the big city," folks.

Let's Get on with It

For the sake of this discussion, let's assume that I'm correct. What can be done to make the best of the present situation? What can be done to motivate the unmotivated?

We tend to think of Morse as a difficult hurdle. And to a certain extent, it is. I know. I'm still trying to earn an Extra class ticket. Other than giving up the weed (tobacco, not that other stuff), getting my code speed up is the biggest challenge I've ever faced. To be absolutely honest, I don't like Morse. But 20 words-per-minute is a mountain that I must climb if I want to upgrade.

Why don't we make learning Morse a fun activity? Carole Perry, WB2MGP, one of the only teachers in the nation to have a ham radio class in school, has done it time and time again. She tells her students that Morse is a "secret code" that their parents and "outsiders" can't understand. The students' reaction? They love learning Morse.

Did you know that one of the big sellers at RadioShack stores is the tiny-talkies with Morse keys attached? You know the kind I mean. They have a chart of the Morse code on the back and children can use the code to send messages. Unfortunately they have very limited range (*imagine CW on CB!—ed.*)

My favorite idea is to create a Part 15 segment in the 160-meter ham band. Part 15 is the section of the FCC Rules and Regulations having to do with unlicensed transmitters. It covers such things as the tiny talkies just mentioned, wireless microphones, garage door openers, and so on. My vision is to create a simple transistor CW rig that anyone could buy at a ham emporium or any number of other consumer electronics stores. A rig like this would sell for less than $100. The specs would permit all the power output you could deliver from a 12-volt, 1 ampere wall-mounted transformer. The maximum antenna length permitted would be 50 feet. Now this doesn't sound like much, but I built a pair of these devices and was able to communicate more than 10 miles.

Just imagine of the possibilities. Youngsters could communicate with anyone in their school. Scouts could earn merit badges for working X number of stations. What better way to revitalize a ham club than to start a construction project building up kits of these tiny and inexpensive rigs?

One of the most important byproducts of such a band would be the *intermingling* of amateurs with the general public. I believe this is one of the most beneficial things that can accomplished in future licensing and allocations. The amateur radio special interest groups (SIGS) on

"Those of us who battled for the No-Code license class wanted to get more people into the fraternity who didn't need walkers to get to their ham gear."

"My favorite idea is to create a Part 15 segment in the 160-meter ham band...create a simple transistor CW rig that anyone could buy...(and promote) the intermingling of amateurs with the general public."

CompuServe, America Online, and the Internet are often visited by curious but unlicensed people. They represent a great pool of potential new amateurs. An on-the-air equivalent would be very beneficial to the growth of ham radio.

Could it be done? Sure! It would take the ARRL to push it and the FCC to buy the idea. But wait a minute. What about international regulations? Don't they say you have to demonstrate a proficiency in sending Morse code? That's right. But they also say that this is for access to the *high frequency (HF)* spectrum, and 160 meters is in the *medium frequency (MF)* band. Isn't this a loophole, you ask? Correctimundo once again. But it's no bigger a loophole than the one which permits FCC licensing without a sending test. If you can receive it, the Commission rationalizes, then (wink, wink) surely you can send it. The bottom line is: where there's a will, there's a way.

What About 10 Meters?

Another idea I'd like to toss out is to permit a similar operation on the 10-meter CW band. It would work like this: Any amateur wishing to "Elmer" people would be permitted to let his or her call letters be used by others with a dash and numerical suffix. For instance, I would be permitted to let up to 10 or 12 totally unlicensed people use W6TNS-3, W6TNS-9, and so on. It would be *my responsibility* to see that they were fully conversant with FCC rules and regulations, and *I* would be responsible for their correct and legal operation. Only CW operation would be permitted between say, 28.1 and 28.3 MHz. You can bet your boots that if I allow others to use my call, I'm going to make certain they won't abuse the privilege.

What about equipment? Let them use commercial rigs with 100 watts maximum power. But won't they bootleg on the SSB portion of the band? I doubt it. First, if you pick your "Elmerees" carefully, and educate them properly, this won't happen. And second, what's to prevent Joe Blow from buying a rig and bootlegging anyway?

Which idea is best? I don't know, but where is it written that you have to do one or the other? Why not do both?

How About a Digital Highway?

As I said earlier, letting amateurs intermingle with the general public, on the air, is an important concept. We currently have a unique opportunity to do exactly that and, at the same time, create an amateur radio digital highway on the 902- to 928-MHz band. Agree or not, packet is "dying on the vine" because of its slow speed and even slower throughput. Once you've been ripping along on the Internet at 28.8 kilobaud, 1200 bps seems painfully slow. Have you ever tried to download a picture via packet at 1200 bps? Don't even think about it unless you want to stay connected to your local node overnight.

But the 902- to 928-MHz band is unique. We have amateur privileges on this band and the general public is also allowed to use it with Part 15 (unlicensed) equipment for wireless LANs (local area networks). It would be possible to design equipment that would permit Ethernet speeds (10 Mb/s) in a gigantic amateur radio LAN. The general public could use the same equipment on the same frequency under Part 15. Want to communicate with them? Why not? Want to talk business? Just don't use your call letters when sending messages to your office and limit your power to Part 15 levels.

Certainly, I have greatly simplified the problems involved in creating a digital highway, not only in the area of equipment design and procedures, but also with respect to licensing. Letting the amateur community intermingle with an unlicensed public is a concept that is totally alien to the FCC and, I suspect, to the League as well. But I still maintain that, if you want to do it and it's good for amateur radio, a way can be found to accomplish it.

Getting the Ball Rolling

The Tucson Amateur Packet Radio (TAPR) group, always on the leading edge of the digital world, may have already started the ball rolling. They're making a group purchase, for their members, of some commercial 902- to 928-MHz frequency hopping spread-spectrum transceivers. These units operate at 173 kbaud (up to 115 kbps throughput), have 1-watt output, and a range of 20 miles. The price? For TAPR members only, $399. In the commercial marketplace, the unit is much more expensive, so this represents a real bargain and a real service for amateur radio. Now, 115 kbps may not permit the creation of a digital highway, but it's honkin' fast compared to present TNCs and even 28.8 kbps modems. (*These radios are intended primarily for use with TAPR's spread-spectrum experiments conducted under special FCC authority. But they may also be used by anyone else under Part 15 rules. See "VHF News" for more info.—ed.)*

If you want to join TAPR or would like more information on this product, check out their home page on the Internet at <http://www.tapr.org>. You can also contact them by e-mail at tapr@tapr.org or, for those of you not yet ready for the 21st century, by phone at (817) 383-0000 or by mail at 8987-309 E. Tanque Verde Rd., Tucson, AZ 85749-9399.

What About the Manufacturers?

I'm sure you've seen numerous messages and heard a number of divisive comments about the supposed greed of ham radio manufacturers. This is absurd. The ham radio business is in the doldrums these days. Many old, established companies have gone out of business, including a number of ham radio dealers. Next to the FCC and the ARRL, those who supply ham equipment are some of the best friends we have. Naturally they want to sell more and more ham gear. Their stockholders demand it. But they know it would be foolish to do anything, or support any regulations, which would harm or diminish their market.

However, the ham equipment manufacturers are not without fault. My principal "beef" is that, in an effort to compete with each other, they add more and

"I suggest ham manufacturers start thinking like King Gillette. He gave away razors but made a fortune selling razor blades."

"Letting the amateur community intermingle with an unlicensed public is a concept that is totally alien to the FCC and, I suspect, to the League as well. But I still maintain, if you want to do it and it's good for amateur radio, a way can be found to accomplish it."

more features and make products which are more and more expensive. Fewer and fewer people, including newcomers, can afford them. I suggest ham manufacturers start thinking like King Gillette. He gave away razors but made a fortune selling razor blades. I believe there are mass market products that every amateur will want to buy. There are products that will interface amateur gear with the Internet. But they have not yet been conceived of or invented.

Just think of the marketing possibilities if the idea for a Part 15, 160-meter radio became reality. Dealers could sell it for $99.50 and when the buyer was ready for something more snazzy, Kenwood, ICOM, Yaesu, or others could give a $100 trade-in on the purchase of one of their products. The dealer could resell the QRP rig or even give it away to the local school and take a tax credit. Essentially, this would make the radio, and the use of it, free. These days, everyone wants something for nothing and a program to "give away" ham radios would be a marketer's dream.

Reclaiming the Future

People have only a limited amount of leisure time available. The lure of family, television, video games, sports, and the Internet weaves a tempting web (no pun intended). If we truly want to attract more people to our hobby, then we must consider the competition and plan our campaign accordingly. In a battle between Archie and Super Mario, Archie will lose. At the moment, we amateurs are the Archies of the 21st century.

73 Don, W6TNS

Editor's note: The opinions expressed in this column are those of the author and do not necessarily represent the views of CQ VHF *or CQ Communications, Inc.*

Cellphones vs. Ham Radio

As more and more public safety agencies become equipped with cellular telephones, some are starting to question the continued relevance of amateur radio emergency communications. The challenge: What can hams offer that cellphones can't?

A few months back, there was a discussion on the ARRL Field Organization reflector on the Internet about how to justify ham radio emergency communications in a world of cellular telephones. We thought you might find the exchange interesting and useful, and we apologize to those whose remarks we edited or whose callsigns may have changed recently.

(*For those of you who are new to ham radio emergency communications, ARES is the American Radio Relay League's "Amateur Radio Emergency Service," RACES is the "Radio Amateur Civil Emergency Service," run by state and local offices of emergency management, and FEMA is the Federal Emergency Management Agency.—ed.*)

The "thread" started with the following message from Bob Dougherty, N8UOQ, ARRL Emergency Coordinator (EC), Seneca County, Ohio:

Each day here in northwest Ohio, more and more agencies such as the Red Cross, the local FEMA agency, and others, are deciding that, in the event of an emergency, the cellular phone companies will be the choice for emergency communications. Many of these agencies have come out and said that amateur radio is no longer needed and would no longer be supported, and that cellphones would serve as their backup communication system. Some have even told the local ARES/RACES groups in neighboring counties that they no longer need the services of the amateurs in their counties. This opinion is becoming stronger each day. To make it clearer, they are telling the local hams thanks for the help in the past, it was fun, have a good life, and see you later. We no longer need your radios.

Now, here's something to think about: With cellphone technology advancing at the rate it is and with satellite phone systems becoming more and more available and affordable each day giving the same services as the cellphone systems but without the dead spots in locations like cellphones have, where does that leave the local amateur radio operator? What service can you provide that some other more advanced system can't handle? In other words, what difference can you make in a world that is technically leaving you in its dust? I live in an area that has a very slim chance of an earthquake (possible, but unlikely). There isn't much that could do enough damage to leave the area without some type of communication. Again, with the satellite phone becoming more available, that means your area will soon have a communication system that can not be knocked out by natural means.

What does that leave you to offer that would be useful? Where do you as an amateur radio operator fit into this technologically advanced world? What can you offer that can't be accomplished with some other more advanced system? These are the questions we need to ask ourselves. Any thoughts on this?

Trained Operators Are the Key

The first response came from Steve Strong, KS4EL, the ARRL EC for Broward County, Florida:

Bob, I don't know if you really saw what happened here in south Florida after Hurricane Andrew. Cell phones need to talk to something...after a hurricane like that, all the somethings (antenna towers) looked like pieces of licorice tied in knots on the ground. All the land-wire based phone systems, which cellular ties into, were seriously overloaded.

What can we as hams offer that cell phones can't? Perhaps the most important thing we can offer is our training, or at least the training we should have. You'll find that most of these government agencies don't have anyone trained to handle large volumes of traffic. Cell phones also don't talk to several people at once, but ham radios can.

We were involved recently in a mock air disaster exercise, and the emergency management officials were very impressed and didn't fully understand what we could do for them until this exercise. We had a packet station set up and people on the patient transports and were able to track each patient, where they were, and what the status was of each. They had no other way of doing this due mainly to the lack of resources and training. They just can't hire people to sit around and be trained on volume traffic-handling to be placed when needed. With the hams, they get it for free and, due to the lack of bureaucracy, probably get it better than they could do on their own.

We still have a lot to offer. Maybe all the ham groups aren't doing a very good job of letting government know what we can do for

Many places where communications are needed are found outside the coverage area of cellular phones. This wilderness checkpoint for a dog-sled race in Maine may be an extreme example, but disasters don't always happen in heavily-populated areas. (N1LON photo)

them—that, I'd believe. We have lots of advanced systems as well, packet, APRS, pactor, etc. Yes, we may not need to do much every day, but when disaster strikes, that's when we really show our worth. Just like at Hurricane Andrew, the LA earthquake, the Oklahoma City bombing, major air disasters (when there are survivors), and even things like bombs. Basically, we are useful whenever the normal communication systems are out or inadequate.

It's amazing how everyone thinks cell phones will do the trick. They just can't, they don't work without towers and wires that are very likely to be damaged in a major disaster and they don't do dispatch.

I agree though, if we don't continue to improve, advance, and sell our services, then more government agencies will lose sight of our benefits. We do need to continue to look to the future and not just rest on our laurels of the past.

Cellphones Are Great, But...

Next, Clay Jackson, N7QNM, added perspective from someone who knows the weak points of cellular systems:

I'm pretty familiar with cellphones and cellular/PCS technology (used to work for a major player). There are several flaws in this argument, in fact; so many that I probably will forget more than I remember. But here goes:

1) *All* of these services are designed more or less along the same premise as the landline phone system. One of the most important premises here is that only a *very small* percentage of the *possible* users of the system will actually be using it at any point in time (I don't know what the *exact* assumptions are, but it's a small number). Consider the numbers: Even if a given cell site had 100 radios, then only 100 people could use that site simultaneously. Most cell sites have far fewer than 100 radios. Ask anyone who uses a cell phone in a major metro area how often they get "no service" or delays because of high usage. And, during *any* kind of disaster, the usage rates go through the roof, as everyone calls their sisters, cousins and aunts, and asks "didja feel/see/hear that?"

2) Even *if* the cell site survived, and all of the radios were *not* busy; communications from the cell site to the MSC (Mobile Switching Center), which must happen in order to handle the call, are often carried over landline phone circuits. These are, of course, subject to disruption from all sorts of sources, including overload, downed lines, earthquake, etc.

3) Again, even *if* the cell site itself remained intact; some cell sites are placed in areas where, for whatever reason, backup power is difficult to come by and/or not possible (for example, in some cases, the site is so close to residential areas that the carriers are forbidden to use backup generators, or are allowed to use them during only certain hours). Battery backup is fine, but only lasts so long. And the list goes on.....

A couple of final comments:

Please don't misunderstand the above to mean that cellphones/PCS/wireless is *completely* useless, or that the carriers are not doing *all* that they possibly can to make them more useful and more reliable/robust. But emergency managers need to also understand that all of these carriers are in the business of (trying to) make money during *non*-emergency periods, and so their primary focus is *not* to build a disaster-hardened communications system. They'll do the best they can with the resources they have.

"What service can you provide that some other more advanced system can't handle? What difference can you make in a world that is technically leaving you in its dust?"—N8UOQ

As a practical example of the above: Here in the Seattle area in the last year, we've had two *minor* earthquakes. In *both* cases, the cell networks for *both* carriers were disrupted (i.e., unavailable) for up to a half hour (according to news reports after the fact) due *only* to *volume* (there were no reported system problems, other than call volumes). Also, during two recent windstorms, both networks were again impacted due to volume, power problems, and landline issues. Yet, in all of these cases, the local ARES groups were up and running and checking in on various nets (there were only a couple of "informal" activations, but there were lots of trained communicators ready to go if they had been needed). Remember, it's easy to *not* prepare.

Don't Forget Politics and Economics

Neil Fullagar of Alameda County, California, added political and economic considerations to the technical limitations that Clay outlined:

There is nothing wrong with using cell phones as a tool. I have one. It is *a* tool. It would be quite foolish to think it's *the* tool. The same is true, by the way, of amateur radio.

Technical advances per se won't eliminate the limitations of cell phones. Most of the shortcomings of cell phones (and for that matter of landline phone service, the agencies' everyday radio systems, etc.) have less to do with technical limits than with economics and sometimes politics. That said, here are some specific problems faced by cellular systems that hams can easily avoid/overcome:

1. Areas of no coverage. I live in a multi-million-person metropolitan area (Alameda, California, across the bay from San Francisco) Cell coverage at my house is marginal. I know of many places within less than ten miles of home where there is no coverage at all. Could there be service? Sure, but there money's not there, so there isn't. At a seminar last week, it was noted that most of the major wildland fires in California have been foolishly held in places where there is no cell coverage.

2. Saturation. If the landline system overloads in an emergency, what makes people think that the cell system won't? It makes no economic sense to provide lots more capacity than is used on a day-to-day basis. (Again, not a technical problem.) Even routine events like conventions and ballgames choke the sys-

tem. Even though a priority system is provided for in the standards, most carriers are deathly afraid of implementing it. (I've heard of some telling agencies they will have priority when in fact they don't.)

3. Even within a given cell carrier's system, service is dependent on multiple connections between cell sites and the computers controlling the operation. Some are fiber optic connections which tend to be pretty secure (although we came very close to losing the major fiber line between SF and the East Bay in 1989) but many others are rooftop to rooftop microwave, subject to damage by earthquake or wind. Again, we know how to build extremely robust facilities, but economics will dictate what is "good enough."

4. If both parties to the call are not using the *same* cell carrier, completion of the call is dependent on the landwire system.

5. What happens when power lines are down? Most cell sites have battery power for a few hours. After that, zip. Yes, most of them have connections in place for a generator to be hauled to the site. That's fine for an isolated failure. Last I heard, one of the local carriers had two generators for the whole region.

6. Cell phone conversations are quite different in nature from most amateur radio or public service agency radio systems. A cell phone call is one-to-one (and sometimes that is a plus!) But you can't use it to rapidly inform 20 locations of something. You can't very well use it to canvass for which location has a surplus of some resource, or who knows where Captain So-and-So is. Another facet of this is that you have to know the phone number of the person with whom you need to get in touch. We have had experiences in the Bay area where the carriers brought in hundreds of phones (bless them) which were distributed to agencies and which were helpful, but nobody had lists of who had what phone. There was traffic over other radio channels asking, "What's your cell phone number?"

7. Of course, there's also the matter of cost. Cell phones are expensive. We're free. Satellite phones are *wildly* expensive both to buy (last time I priced one it was in five figures) and to use (dollars per minute.) They are probably a valuable tool, but we're not going to see them widely deployed anytime soon. When we do, of course, that will largely take care of the coverage area issue but it still leaves the capacity issue.

I don't doubt your report that agencies are thinking along these lines. I also don't doubt that they've been encouraged to do so by the carriers' marketing people. I do question the wisdom of placing complete reliance on cell phones for handling emergencies.

Next, Ken Harwood, WA5QZI, ARRL EC for Bexar County, Texas, highlighted ham radio's strong points:

Bob, during a *real* emergency, cellular phones become gridlocked due to over-use by everyone trying to contact everyone else, rendering the system totally useless to the people actually trying to handle the emergency. Take a look at what happened during the California earthquakes, Hurricane Hugo, etc.

Also, nothing beats a network of stations all monitoring the same frequencies at the same time for getting maximum information passed among the stations. During emergencies requiring opening lots of shelters, people managing those shelters need to communicate among themselves and with other agencies. It is a much easier task if all those shelters are manned by amateur radio operators listening to the same net.

Serve Your Served Agency Better

The ARRL Colorado Section Emergency Coordinator Richard Ferguson, KAØDXM, added his suggestions:

I was thinking about Bob Dougherty's question about what to do when your served agency decides that since they have cellphones or other radio systems, that they do not need hams. I have three answers:

1. Consider offering the agency something that they do not have. In other words, they already have people with clipboards and HTs. Offer them packet radio for hard copy messages. Offer them amateur TV. Some groups in Colorado have been very successful with these services, although they sometimes provide plain voice as well. I was recently at a meeting where a served agency representative said that he expected police cars to have data radios in the next few years, but that amateur TV was something that the police would probably never have. In other words, amateur packet could be "obsolete" at some point. Note, however, that different agencies have different capabilities, and an agency with a limited budget may look at hams differently from an agency that has recently installed a new communications system.

2. Serve your served agency better. It may be that the local ARES group has not been providing what the served agency wanted, or perhaps the amateurs were perceived as more of a hassle than an asset. It might be hard to get a straight answer from the agency, especially if the EC is part of the problem. (Please don't take this personally; I have no information about Ohio ARES, so cannot judge the groups there.) The California RACES group sends out a series of bulletins about focusing on the served agency. If you have access to packet look at the EMCOMM bulletins. It is also available on the WWW. I may not agree with 100% of that they say, but I agree with their focus on the served agency.

3. Wait for an event to demonstrate that their communications systems are not adequate, and let them know you are still available if needed. Frequency overload is real, and common in disasters.

4. One other thing that amateur radio operators provide is ham ingenuity. Usually the ham can figure out how to do the communications job one way or the other. This can even include finding stuck transmitters on public safety frequencies. Most radio users have limited understanding of their radios, so any problem causes communications to stop. This can be a selling point.

I do not think that amateur radio is obsolete; it was recently used fairly extensively at a major forest fire in Colorado. I have not seen any evidence in Colorado of a reduction in interest in amateur radio from the served agencies. Good luck.

The Problem of Capacity Limits

Howard Coleman, N6VDV, wrote from personal experience about a time when ham radio worked fine but cellphones failed:

As one of those awakened by the Northridge Earthquake here in California, I can personally attest to the failure of the cellular system. My ex-wife grabbed her cell phone within five minutes of the quake and was not able to get a line for almost three hours. My HT was in use within five minutes of the quake as the wireless ham radio network activated.

I am also an employee of one of the largest international telephone companies in the world (don't want to say which one, as they frown on employees not fully supporting the company line) and would not trust a cell phone during an emergency due to the system structure. Normally, the cell sites can only handle 30 to 100 calls at a time. The number fluctuates depending on various factors. In rural areas where emergency help is usually a distance away, the number of calls is reduced to a very small number—if the area has cellular coverage at all.

An easy way to confirm how many possible calls can be handled at any one time is to look at the frequency allocation for cellular telephones, then divide the frequency into bandwidth required for each channel. You will find that the number is very small com-

"Emergency managers need to also understand that all of these carriers are in the business of (trying to) make money during non-emergency periods, and so their primary focus is not to build a disaster-hardened communications system. They'll do the best they can with the resources they have."—N7QNM

pared to the number of cellular phones that are in operation.

Cellular phones serve a very valuable function but that should not be counted on any more than the traditional wire based telephone system as the wireless system uses the wired system to carry the vast majority of the calls. Human nature calls for us to seek security during an emergency by communicating with some one. The average person is going to pick up that telephone, be it wired or wireless, to seek comfort following an earthquake, hurricane, flood or any of the other disasters that affect large groups. That is what ties up the telephone system and is why we constantly hear the emergency workers telling people to stay off of the phone unless they need emergency help.

Hams Avert Hospital Chaos

Finally, April Moell, WA6OPS, ARRL EC for Orange County, California's Hospital Disaster Support Communications System, added her perspective on the ham vs. cellular question:

No agency should put all their alternate communications needs in one basket. Cell phones have their limitations and so do business band walkie talkies and so does amateur radio, etc. The key is to know the advantages and limitations of each and prioritize the use of the various resources.

Our Hospital Disaster Support Communications System in Orange County, Califor-nia, has responded to a number of emergencies involving hospitals and find the more resources the better. Cell phones alone can't do it. In the Laguna fire and floods, cell sites were damaged and/or overloaded. The batteries in the two cell phones at one hospital in the flood area failed as well after a short time. Amateur radio operators assigned to the hospital provided the only outside communications. In the Laguna fire, we backed up the intermittent phones at four hospitals for their outside communications, as most cell phone communications in and around the area didn't work.

In a complete phone failure affecting one of our supported hospitals in December, 1995, the hospital used its pay phones and cell phones for outgoing calls with us as back-up if needed. Most of what we did, though, was assist with internal communications around the hospital. Hospital walkie talkies weren't enough, and four hours into the eight-hour incident, the batteries had failed on all of them. Our hams were well prepared and we could also bring in fresh operators.

One other situation has cropped up on at least three occasions in phone outages at hospitals. The 2–3 cell phones that the hospital sometimes has seem to get commandeered by administration rather than going to patient care areas.

Summing Up

In summary, cellular phones are here to stay. Satellite phones, when they arrive, also won't go away. And each will be useful in its own way. But neither will replace amateur radio's ability to operate independently of the telephone network, to communicate with many locations simultaneously, and to provide a pool of trained communicators who can free up emergency personnel to save lives while our volunteers handle the messages—at no cost to the agency or the taxpayer. If you face a situation similar to that presented here by N8UOQ, this column should give you plenty of ammunition with which to back up your basic response: Don't put all your eggs in one basket—especially not when lives are on the line. ■

Through Other People's Eyes

While his example may not be specifically related to VHF, KO6UX has some thoughts for all of us on how we appear to others.

One fine spring afternoon I was, as hams often are, on my roof (erecting a new 20-meter vertical) when my neighbor wandered into my front yard. "What do you have?" he asked, raising an eyebrow and looking up at me in wonder, "a CB radio?"

"Ah-ha," I thought. "Here's a great opportunity to sell another poor lost soul on the graces of amateur radio."

"No," I replied proudly as I ducked under my dipole, side-stepped a guy wire and leaned against the mast of the beam. "I'm a ham radio operator."

Pointing to the HT on my belt, I was just about to sing the praises of the amateur service and offer to take the time to demonstrate what my home station could do (I did need to check out the new antenna, after all), when he opened his mouth and spoiled my day.

"Yeah, I knew somebody had a CB or...something around here. You see, someone's been interfering with my TV reception...."

I was distraught. I had taken great care when assembling my station to prevent hearing just such a lament from my neighbors. All of my equipment and antennas were grounded, I had installed low-pass filtering on my HF rig, and everything was in tip-top working order. My antennas (and, therefore, my radiation patterns) weren't as high above the roof as I would have liked, but on a city lot, what ham's are?

But even if my station wasn't the cause of his TVI problem, whether I liked it or not, I had a responsibility to my neighbor, morally even if not legally, to help track down and correct the problem. There was no reason that his pastime and my passion couldn't coexist, even if it meant I had to go a little out of my way.

Like it or not, every other amateur has the same responsibility, both to his neighbors and, more importantly, to other hams.

Our Neighbors: An Amateur Resource

Public awareness of amateur radio is, without a doubt, the most important factor in the future viability of the Amateur Radio Service. Every contact between a ham and one of his or her neighbors can either benefit or harm the reputation of ham radio, whether you're discussing TVI or the weather. Non-hams will base their opinions of the service on the individual amateurs they know, and that means that each of us has to act as an ambassador of sorts.

As things stand, few people outside of the service understand the attraction of ham radio, or even have a basic working idea of what the amateur service is. This isolation is the only reason that commercial interests have had any success at all vying for control of our precious spectrum. The amateur bands are often metaphorically compared to national parks, yet they don't attract nearly the amount of support afforded those other, less ethereal resources.

The infamous (and as yet unresolved) "little LEO" incident can be likened to a big business lobbying for the rights to log the forests of Yosemite, an event that would have caused massive outcry from the public at large. Letters, phone calls, and e-mail should have been generated by the general public, crying out against this perceived threat to public safety as they would against an ecological attack on the great American wilderness. Yet little of the correspondence written to protect 2 meters and 70 centimeters was generated by non-hams. The reason is simple: non-hams are only dimly aware that ham radio even exists.

"Every contact between a ham and one of his or her neighbors can either benefit or harm the reputation of ham radio, whether you're discussing TVI or the weather."

While some have folded their arms, closed their minds, and decided that the public at large isn't technologically inclined enough to understand the complexity of spectrum allocation and management, I heartily disagree. I think that the average person is sophisticated enough to tackle the issue and intelligent enough to see that the Amateur Radio Service deserves to be preserved.

If ham radio is to survive in its current form we need a grass-roots education movement, one that involves both you and your neighbors.

Outside Looking In

Unfortunately, many people equate ham radio with Citizens Band. This egregious, but fixable, mistake occurs largely because many people come into contact with their amateur radio operator neighbors only while trying to locate the source of a TVI problem. Thanks to the proliferation of Citizens Band radio, almost everyone has had an experience with an inconsiderate neighbor—the kind who disrupts TV and radio reception for blocks using excessive, illegal power and modulation. Following the natural course

By Ken Collier, KO6UX

of human generalization, most people automatically assume that anyone causing TVI must have a "CB."

This confusion has led to problems and has helped to handicap the amateur service. Most restrictive covenants and local ordinances against outdoor antennas are the direct result of the CB boom of the 1970s, which brought television and broadcast radio reception to an all-time low. Much to the detriment of hams everywhere, very few of these covenants differentiate between CB and ham antennas because few outside of amateur radio acknowledge that there is a difference between the two.

Even those who are aware that the amateur service is distinctly separate and different from CB radio often overlook the valuable aspects of the service. Too often, hams are viewed as eccentrics instead of as public servants. Most non-hams view the local antenna farm as a liability instead of a public asset.

How Do We Fix It?

Fixing this problem takes effort. We can overcome the mistaken generalizations if everyone chips in and helps educate his or her neighbors. Be polite and considerate in everyday life. If you're inconsiderate, you'll likely have a negative influence on the way your neighbors think about the Amateur Service.

Most importantly, if your neighbor comes to you complaining of TVI, try to help him fix it. Many cases of RFI are the result of poor filtering on the TV set (or radio, CD player, computer, toaster, or other consumer electronics device), but do begin by checking your equipment to see that it's working properly. Make sure all your coax connectors are on tight, that your equipment is grounded, etc. The ARRL has a wealth of printed material available on RFI, and your local Section Manager can refer you to a Technical Specialist in your area who can also help.

You're not legally required to spend any money to correct a problem with your neighbors' electronic equipment, but you can help suggest what types of filtering to buy and help install the filters. In most cases, simple and inexpensive RF chokes made out of ferrite beads will do the trick, if you put them in the right places.

Sell While You Help

Take advantage of any RFI hunt. Use it as an opportunity to teach the non-amateurs involved about ARES and other amateur emergency communications groups. Let them tour your shack, and even operate third-party if they wish. Go out of your way to convince them that amateur radio operators are public servants, and show them that the service is worthwhile and valuable.

The more people who recognize and believe this, the easier our lives will be. Public awareness is the key to reducing the number and seriousness of threats to our bands and removing the hand-cuffs of covenants restricting outdoor antennas.

A Job Well Done

I was finally able to resolve the situation with my neighbor...sort of. I asked him to call me whenever he had any kind of interference problem. Over the course of the next two weeks, he called me once when I was on the radio, and three times when I wasn't.

After a little investigating I determined that his main source of interference wasn't my station (obviously), but instead it was a local truck driver with a CB radio. (I live near a rock quarry and there's a steady stream of gravel haulers passing by the neighborhood at all hours of the day.) I was causing a slight bit of interference when I operated 10-meter SSB, though. A few strategically placed torroids greatly reduced this, and now my neighbor and I peacefully coexist. (It also helps if there isn't a band opening during "The X-Files"!) Others in the neighborhood have cable TV so, as of yet, no one else had complained about my operation (knock on wood).

Think Win-Win

The greatest benefit of this encounter, though, was that I helped my neighbor learn about ham radio by giving him a tour of my shack, explaining to him about the public service and emergency relief aspects of the service, and letting him sit in on a few of my QSOs. Conditions on 20 meters might seem deplorable to me, but they were quite impressive to him.

With similar effort on the part of others we can raise public awareness of amateur radio and help keep the service viable heading into the next millennium. Everyone has to do his part to make this work, though. Even you. ■

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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.*

Oops...

We've got two boo-boos to correct this month, although only one of them is directly from *CQ VHF*. We've presented our World Wide Web address a couple of different ways in the past two issues. This is the correct URL (Webspeak for address): <http://members.aol.com/cqvhf/>. The "/" at the end means it'll automatically go to the default file, which is generally "index.htm".

The second item, which was snagged by eagle-eyed WB2RQX, is an error in the 1997–98 CQ calendars. In the month of June, the correct dates for the ARRL VHF QSO Party are the 14th and 15th, and Field Day is on the 28th and 29th. We regret the errors and encourage you to participate in both events—but on the proper weekends!

Q & A

Q: I am a 16-year-old Tech Plus and have been licensed for about a year and a half. After saving up all my money, I followed popular advice and bought a 2-meter HT. Frankly, I've been rather bored and don't use it much. I'm interested in getting active on weak signal, but I'm afraid of the same thing happening. Is there anyone (dealers, manufacturers, etc...) who would let me rent a rig to see if it is something I would like to invest in? I want to try it out, but don't want to invest a lot of money yet. Thanks.

73,

Brian Kettell, KB8ZXX
Peachtree City, Georgia

A: Wow! What an interesting question and concept! I'm not aware of anyone renting ham equipment, but it sure seems like an interesting idea, not only for newcomers, but also for contesters who need gear for additional bands for a weekend, or someone who wants to try out a new band or mode without the full investment of a purchase! It sure works with cars, power tools, and party stuff. Why not ham gear? Dealers...are you listening? Brian, I think you've got a winner.

Q: What is your definition of a weak-signal operator as compared to a low-power station?

73,

Julius Gresham, KD4MIN
Tampa, Florida

A: A weak-signal operator very often runs very high power—up to the legal limit, in fact. The term comes from his/her station's ability to detect and receive weak signals, such as those being bounced off of the moon. They may have started out strong, but after a half-million mile trip with a lot of loss at the moon, they're pretty weak when they come back. In general, a weak-signal operator refers to someone who uses SSB (single sideband) or CW (Morse code) to make contacts on VHF/UHF beyond the normal line-of-sight coverage of a given band, using various types of enhanced propagation (meteor scatter, aurora, sporadic-E, for example), but without relying on artificial means, such as repeaters. You can read about many of these signal-enhancing modes in CQ VHF.

Q: I started studying to get my No-Code Tech license, but the book that I was studying with only had the questions and answers. I want something that will teach me the concepts behind the answers. What books would you recommend for me?

Sincerely,

James
(no address given)

A: The ARRL's Now You're Talking *is probably the most comprehensive Technician study guide, in terms of explaining the material as well as giving you questions and answers. It costs more than the other manuals ($19), but that's because you're getting a mini-textbook as well as a study guide. And congratulations, by the way, on wanting to understand the concepts as well as learn the answers!*

Now You're Talking *is available at most RadioShack stores, directly from the ARRL (225 Main St., Newington, CT 06111; Phone: (860) 594-0200), from many ham dealers or from the CQ Bookstore (800/853-9797).*

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."

Announcing

Southeastern VHF Society

First Annual Conference, April 4–5, 1997, Atlanta, Georgia

The first annual conference of the newly formed Southeastern VHF Society will be held on April 4 and 5, 1997, at the Atlanta Marriott Northwest Windy Hill, in Atlanta, Georgia.

Some highlights of the scheduled presentations include:

- 6-meter EME arrays
- Digital TV techniques
- VHF EME DXpeditions
- Doppler shift airplane scatter
- Two introductory sessions for hams new to weak-signal VHF.
- Antenna gain measurements, and
- Noise figure testing

There will also be a banquet on Saturday night. Registration is $35 (including Proceedings) and the banquet is $30. Checks payable to Southeastern VHF Society should be mailed to SEVHFS, Conference Registration, P.O. Drawer 1255, Cornelia, GA 30531.

For additional information, visit the SEVHFS Web site at <http://www.akorn. net/~ae6e/svhfs>, or contact Tad Danley, K3TD, at (770) 513-9252 or via e-mail at k3td@amsat.org.

Basics

Introduction

"Basics" is a special section of *CQ VHF* that will appear each month as a service to our readers who are unfamiliar with some or all of the various topics we cover. Everyone is new at *something* sometime, so this section is *not* only for new hams. There are many "old timers," for example, who may have spent years on the HF bands but are only now discovering packet radio or amateur satellites. So whatever you're new at, don't feel that you're alone...even if what you're new at is everything (at last count, there were about 4,000 new licensees entering our hobby every *month*).

The "Basics" section includes short introductory articles on various VHF/UHF activities, along with charts and additional information. Some topics will repeat from month to month for the benefit of new readers or for review; others will vary so we can cover more material over the course of several months. But if you decide to skip an article elsewhere in the magazine because you don't think you know enough about the topic to understand it, check back here to see if we've included a "Basics" article on that subject.

We'll try to cover all the bases, but with so many different things to try in the world of VHF ham radio, we're bound to miss something. So if you have any questions—about the "Basics" or about any article in *CQ VHF*—just drop us a note by e-mail to CQVHF@aol.com or by letter to *CQ VHF* Basics, 76 N. Broadway, Hicksville, NY 11801.

Ham Radio Glossary

222 MHz: The ham band (see "frequency band") between 222 and 225 MHz.

2-Meter Band: The ham band between 144 and 148 MHz.

6-Meter Band: 50-54 MHz, the lowest frequency VHF band.

70-cm Band: Also known as "440," the amateur band extending from 420-450 MHz.

AM (Amplitude Modulation): A radio transmission mode; except for some AM activity on 6 meters, you'll generally find only a *type* of AM, called Single Sideband, used on VHF.

Amateur Satellites: An international fleet of communications satellites carrying amateur radio stations (see OSCAR).

Autopatch: A component which allows telephone calls to be placed through a repeater.

Az/El (*Az*imuth and *El*evation): When you are aiming an antenna at a satellite or other object in the sky, you need to set the azimuth heading (compass bearing) as well as the angle of elevation above the horizon. An *az/el* rotator will perform both functions.

BFO (Beat Frequency Oscillator): A variable pitch tone oscillator, used mostly on older style radios, to permit reception of single sideband and Morse code signals on an AM receiver.

Band Opening: A condition that results in greater-than-normal communication range on VHF and UHF amateur bands.

Band Plan: A voluntary system of frequency allocations for each amateur radio band.

Bandwidth: The width of a signal on the radio spectrum. The greater a signal's bandwidth, the more frequency space it occupies.

CTCSS (Continuous Tone-Coded Squelch System): Also called sub-audible tones or "PL" tones (trademarked name by Motorola). This is a tone which is transmitted by your radio in addition to your voice signal. When it is equipped with a CTCSS decoder, a repeater will not function unless it hears both the CTCSS tone and the "carrier" signal from your radio.

CW (Continuous Wave): commonly used as an abbreviation for Morse code.

Controller: The "brain" of a repeater. Among its many possible functions are turning the repeater on and off, timing transmissions, sending the repeater's identification signal, and controlling the autopatch and CTCSS encoder/decoder.

Courtesy Tone: An audible signal transmitted by a repeater which lets users know that the repeater has reset at the end of one person's transmission and is available for use by the next person.

Crossband Repeater: A repeater whose input and output frequencies are on two different bands. For example, a signal received on 70 centimeters would be retransmitted on 2 meters, and vice versa. Many dual-band FM rigs include this feature.

DTMF (Dual Tone Multi Frequency): A tone signaling system used in push-button telephones and many ham rigs. Commonly known by AT&T's trade name, "Touch-Tone."

Duplexer: Highly selectable, tunable filters which allow a repeater's transmitter and receiver to use one common antenna.

FM (Frequency Modulation): The radio transmission mode used for most VHF amateur communications.

Full Duplex: Simultaneously receiving and transmitting on one radio. Normally, the receiver is muted during transmit to avoid feedback. In full-duplex operation, the receiver stays active, but is generally tuned to a different frequency or, most often, a different band.

Frequency Band: A group of frequencies designated by government regulation for a specific purpose. Bands reserved for use by amateurs are called "amateur bands" or "ham bands."

Gateway: A a link, or bridge, from one type of communication network to another.

GHz (GigaHertz): A unit of frequency measurement (1 GHz = 1,000 MHz).

Handheld: An amateur radio transceiver that's

small enough to be carried in your hand (often abbreviated "HT"). Typically, amateur handhelds are for VHF/UHF use.

HF (High Frequency): The region of the radio spectrum between 3 and 30 MHz.

Hz (Hertz): The basic unit of frequency measurement (cycles per second).

Impedance: a measure of resistance to the flow of RF energy (see below) based on a combination of actual electrical resistance in the wire of a feedline or antenna (resistance) and losses due to inefficiency in the feedline or antenna wire or a mismatch between the two (reactance). Just to confuse matters, resistance, reactance, and impedance are all measured in ohms. Most ham transmitters work best into an antenna system with an impedance of 52 ohms. Ideally, you'll use a 52-ohm feedline (such as RG-8) to an antenna with an impedance of 52 ohms at its "feedpoint," the point where you feed in the signal through the feedline.

Input Frequency: The frequency on which a repeater receives and the one on which you transmit to the repeater.

Intermod: Short for "Intermodulation Distortion" (IMD); interference that results when strong signals from a nearby transmitter mix with the desired signal in a radio receiver.

kHz (kiloHertz): A unit of frequency measurement (1kHz = 1,000 Hz).

Keplerian Elements (Keps): A collection of data relating to the position of a satellite in its orbit at any given time. This information is interpreted by satellite tracking programs to predict time and duration of satellite "passes" and directions in which to point antennas. Named for the 19th century scientist Johannes Kepler.

LCD (Liquid Crystal Display): A type of display used on many radios and other electronic devices. Characteristics include dark (usually black) numbers and letters on a lighter background.

MHz (MegaHertz): A unit of frequency measurement (1 MHz = 1,000 kHz).

Memory Effect: The tendency of rechargeable nickel-cadmium (NiCd) batteries that are repeatedly recharged without being fully discharged to "remember" the point at which they're normally recharged and indicate a discharged condition. There is debate over the causes of memory effect, but it's always best to fully discharge a NiCd battery before recharging.

NOAA (National Oceanic and Atmospheric Administration): Parent agency of the National Weather Service. (NOAA Weather Radio is a 24-hour-a-day weather reporting service, using several frequencies in the 162 MHz range.)

OSCAR (Orbiting Satellite Carrying Amateur Radio): Acronym describing amateur satellites generally; with a number attached (e.g., AMSAT-OSCAR-16, or AO-16), the name of a specific ham radio satellite.

Offset: The difference between a repeater's input and output frequencies. The offset on 2 meters is generally 600 kHz.

Output Frequency: The frequency on which a repeater transmits, and the frequency to which you tune your radio.

Packet: Common short form of "packet radio," also the actual information package sent in a packet radio transmission.

PL: A trademarked name by Motorola. Has the same meaning as CTCSS.

Packet Radio: The most popular form of amateur radio digital communications, in which computers hooked to radios exchange data in packets.

PACSAT (PACket SATellite): Amateur satellite used to store and forward digital (packet radio) messages.

Propagation: The means by which radio signals are carried from one location to another.

RF (Radio Frequency):the radio waves generated by your transmitter (as well as your computer, your cordless phone, etc.) are, not surprisingly, within the "radio" portion of the electromagnetic spectrum. Energy produced at these "radio frequencies" is called "RF" or "RF energy."

Repeater: An automatic relay station, generally in a high location, which is used to increase the range of handheld and mobile FM transmitters.

Repeater Control Operator: A licensed amateur designated by a repeater trustee who offers assistance with autopatch and listens for inappropriate use of the repeater. (This is different from the FCC's definition of a control operator, which is anyone in control of an amateur transmitter.)

Repeater Directory: A listing of repeaters in a given area. Typically,a repeater directory shows a repeater's location, the output frequency, the offset, and whether or not a CTCSS code is required.

Repeater Pair: Each repeater requires two frequencies: an input frequency and an output frequency

Rubber Duck: Common term for the flexible rubber-covered antenna generally supplied with handheld radios.

S-Meter: A meter that provides a rough indication of received signal strength. (Actually, an s-unit is a rather precise measure, determined by mathematical formula. But it's the rare radio that's calibrated accurately enough for the numbers to be anything more than a rough measure.).

Signal Report: A report given in numerical values of signal strength and quality.

Simplex: Generally used among FM operators to refer to making direct contacts without the use of repeaters. Frequencies set aside for simplex contacts (such as 146.52 MHz) are often referred to as "simplex frequencies."

Single-Sideband (SSB): A type of AM transmission which occupies less bandwidth than a standard AM signal.

Squelch: A control on a radio that keeps the speaker silenced (squelched) until the signal level exceeds a certain point. Normally, you set the squelch to block out noise and allow signals to pass.

Sub-Audible Tone: Another term for CTCSS.

TNC (Terminal Node Controller): The "box" that goes between the computer and the radio in a packet station.

Tail: Most repeaters continue to transmit for a brief period after someone stops talking. This extra transmission is called a repeater's "tail."

Timer: A component in a repeater system that measures transmission length. The timer is set to a pre-determined length.

UHF (Ultra High Frequency): The region of the radio spectrum between 300 and 3,000 MHz (3 GHz).

USB (Upper Sideband): Every AM signal has two sidebands, upper and lower. In single sideband (SSB), only one is transmitted. USB is used on VHF (see AM and SSB).

VFO (Variable Frequency Oscillator): A general term used to describe the device on a radio that lets you move progressively higher or lower in frequency by turning a dial or pressing a key. Today's digitally-synthesized radios usually use a tunable phase-locked loop (PLL) instead of a true VFO.

VHF (Very High Frequency): The region of the radio spectrum between 30 and 300 MHz.

VHF Contest: An on-air competition in which activity is encouraged on VHF and UHF ham bands.

Basics

Connecting with Packet Networks

There are three ways of making contact with someone on packet radio. If the person is nearby, within range of your transmitter and antenna, you can connect directly. To do that, simply type "C-space," and the call of the person you want to contact. Then press return.

But if you're too far apart for a direct connection, you'll need to use a *packet network.*

Network stations are called *nodes* or *switches.* They receive, briefly store, and then forward your packets either to another ham, a bulletin board or another network node station.

Using "TheNet" Nodes

The most common nodes are part of networks using "TheNet" or "NetRom" software. You connect to the node and, from there, connect again, either to another node or to the station you're trying to contact.

Nodes generally don't use regular ham callsigns. Instead, they use shorter "aliases" which are intended to give you some idea of what they do or where they're located. So, if you live in Raleigh, North Carolina, you connect to "RNC." The WA2SNA bulletin board in Northern New Jersey uses the alias, "BBSNNJ." It *is* legal, by the way, since the node sends out its callsign along with its "alias."

If you're not sure how to route your message, connect to the node, then type "nodes" and it will send you a list of other nodes that it can contact. You then use the same "C <callsign or alias>" command to connect to the next node in line.

The node acknowledges each of your transmissions itself, then retransmits what you sent with your callsign followed by a "dash-15." That means your message is being relayed through a network node. You can then string together as many nodes as you need to reach the station you want to contact.

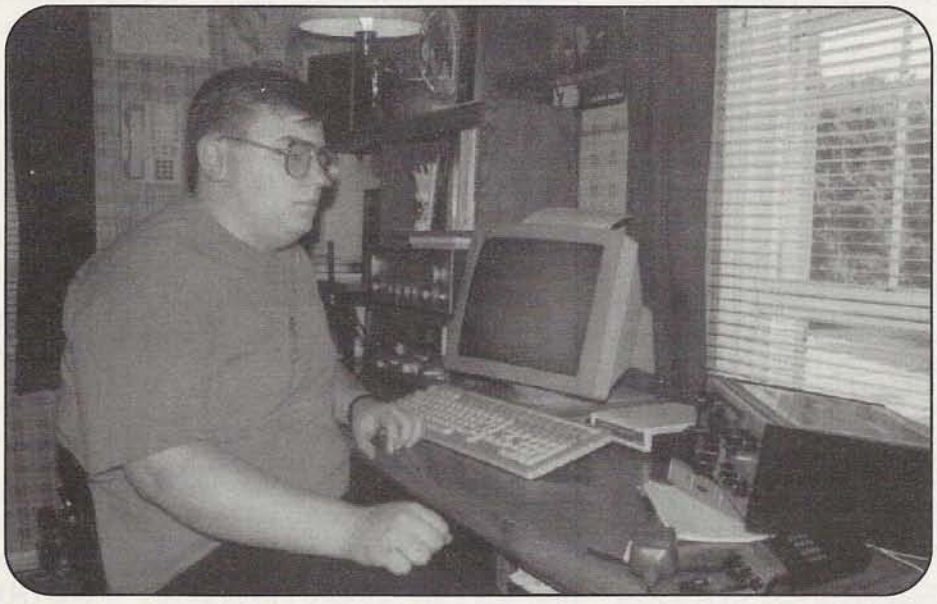
When you're done with your contact, you need to disconnect—generally by typing "B" or "BYE" and pressing "enter." Often, you must disconnect separately from each link in the chain. This can be good, though, if you want to explore what the different nodes along the way have to offer. If your first disconnect dropped all the links, then you'd have to rebuild the chain for each new connection.

If you get confused, sending the node a "/h" or "/?" command will generally bring you to a help screen. Many nodes include the procedure for getting help in their sign-on messages, so be sure to read those carefully. One final note: After you've disconnected, you may still be in "converse" mode, so you may have to tell your TNC to re-enter the "command" mode before you make your next connection.

Other Networks

While "TheNet" and "NetRom" are the most commonly-used networks, there are several others in use around the country. These include the ROSE network and Texnet, among others. Each uses a slightly different approach to getting you hooked up with a far-away station. And the digital ham radio satellites have their own special system for relaying information. What they all have in common, though, is their ability to let you relay real-time contacts (except on satellites), messages, files, and computer programs.

If the tips we suggest here don't seem to work for you, try to make a direct contact with a packet station in your area (look for a regular callsign with a "*" before it and no numbers after it), and ask for help. You might even make a new friend in the process. ■



Packet networks can expand your VHF horizons by connecting you with other hams and packet "servers" (automated stations performing a specific function beyond the range of your own signal. Here, Lenny Mack, KB8KTC, operates his packet station in Fair Lawn, Ohio.

HAM SHOP

Advertising Rates: Non-commercial ads are 20 cents per word including abbreviations and addresses. Commercial and organization ads are $1.00 per word. Boldface words are $1.50 each (specify which words). Minimum charge $2.00. No ad will be printed unless accompanied by full remittance. All ads must be typewritten double-spaced.

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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:*

- "Hams in Space: A Guide to Working Mir—Part 2," by Miles Mann, WF1F
- "Driving the Public Service Highway," by Ken Collier, KO6UX
- "VHF DXpeditions to Cyprus and Tunisia," by Alessandro Della Casa, I4YNO
- "Rescue on Mt. Evans," by Randy Simons, NØLRJ

Plus...

- "An Antenna in a Pipe," by Van Field, W2OQI
- "Build a 2-Meter Notch Filter," by Jim Ford, N6JF
- "Midwest Rover Techniques," by Rod Blocksome, KØDAS

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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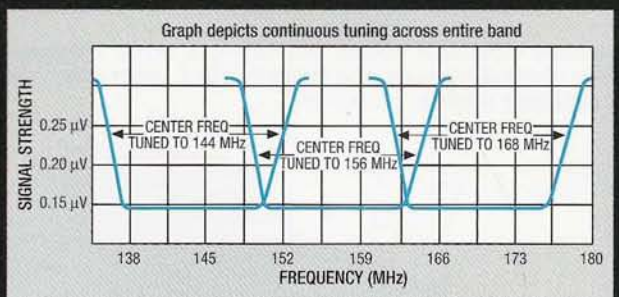

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TM-V7A

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The TM-V7A has not been approved by the F.C.C. This device is not, and may not be, offered for sale or lease, or sold or leased until the approval of the F.C.C. has been obtained. Pending approval (11/96).

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