ICD 08237

CQ VHF Ham Radio Above 50 MHz

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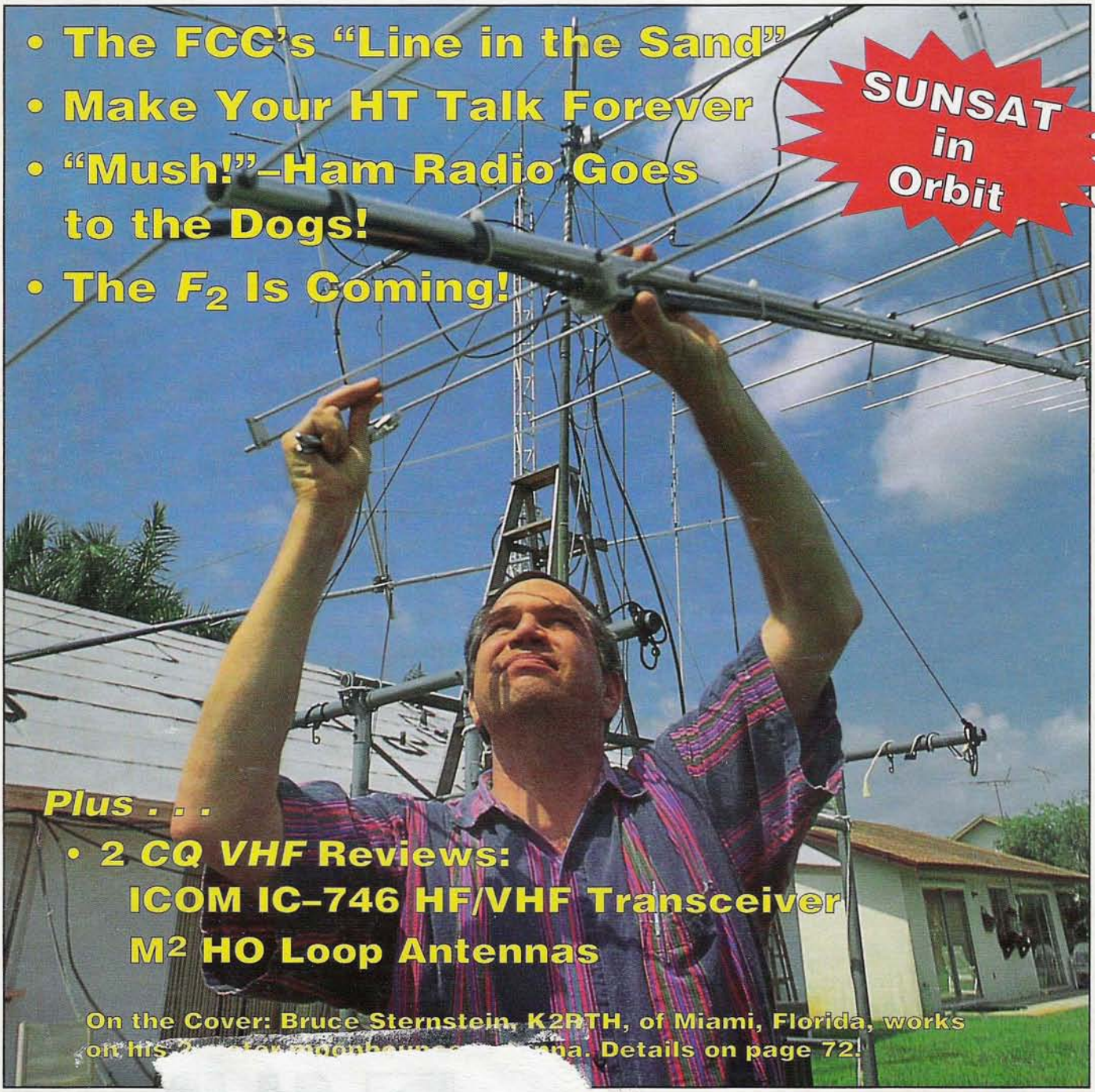
May 1999



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On the Cover: Bruce Sternstein, K2RTH, of Miami, Florida, works on his [illegible] antenna. Details on page 72!

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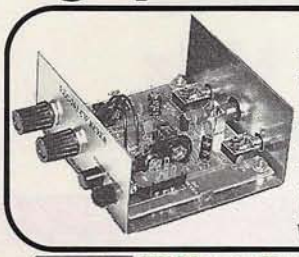

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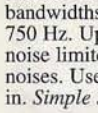

Super SSB Audio Filter Kit dramatically improves readability with 8 poles. Optimizes audio bandwidth, reduces sideband splatter, low, high pitched interference, hiss, static crashes, background noise, 60/120 Hz hum. 375 Hz highpass cutoff. 2.5, 2, 1.5 kHz low-pass cutoffs. Plugs into phone jack to drive head phones. Use 9V battery. 1¾x4x 3½ in. *Simple skill level.* Order **VEC-830K, $19.95.**

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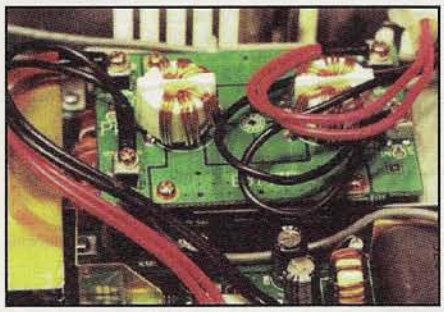
CIRCLE 130 ON READER SERVICE CARD

CQ VHF Ham Radio Above 50 MHz

Volume 4, Number 5—May, 1999



page 16

page 21

page 54

FEATURES

COLUMNS

BASICS

DEPARTMENTS

Next Month: "A Field Day GriDXpedition," by Bill Hays, KD4GHQ

ICOM IC-2800H

NEW Top-of-the-Line Dual Bander Adds Video Excitement to Audio Excellence

HIGH VISIBILITY COLOR LCD
Customizing the brightness, contrast and background color to fit your operating requirements is fast and easy.

APRS, SSTV, GPS... NOW YOU'RE READY. The '2800H's color LCD screen is more than a pretty face. Display the latest in visual ham communications, and open up a new dimension to your hobby.**

9600 BPS PACKET CONTROL.** Packet popularity is growing. Have fun! The '2800H offers a dedicated data port on the main unit.

INDEPENDENT BAND CONTROLS. Independent controls make it easy to work V/U, U/V, or cross band repeat. Tuning, AF and squelch level, and four function switches are available per band.

EXTERNAL VIDEO INPUT
Accepts NTSC video signals (PAL in European model). Simple connection works with most digital camera or VCR plugs.

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Install the main body under a seat, in the trunk, or wherever it remains out of the way.

FULL FUNCTION MICROPHONE
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*Simple packet connection.***

SPECIFICATIONS

Transmit: ..... 2 Meter, 440 MHz (70 CM)
Receive: ..... 118-174 MHz, 440-450 MHz
(guaranteed 144 - 148 and 440 - 450 MHz only)
Mode: ..... AM (118 - 135.9 Rx only), FM
Power: ..... 2 Meter: 50W/20W/10W/5W
440 MHz: 35W/20W/10W/5W
Power Supply Requirement: ... 13.8 V DC
Memory Channels: ..... 232 Total
Including 12 Scan Edges, 10 Log, 10 Repeater, and 2 Call
Size & Weight (approximate):
Control head: . 5.5(W) x 2.75(H) x 1.3(D) in.
140(W) x 70(H) x 34(D) mm.
10.2 oz /290 g
Main Unit: ..... 5.5(W) x 1.6(H) x 6.6(D) in.
140(W) x 40(H) x 165.8(D) mm.
2 lb, 9 oz /1.15 kg

FEATURES

- **Totally Separate Control Head**
  - Independent band controls
  - High visibility TFT color LCD monitor
  - Connection cable included
- **Independent Tuning Controls**
  - Tuning, AF and squelch level, and 4 function control switches per band
- **Tone Squelch (CTCSS Encode) with Pocket Beep and Tone Scan (CTCSS Decode) Standard**
  - 50 independently programmable tone frequencies for repeater and tone squelch use, respectively
- **On-Screen Menu "Soft Keys"**
- **Simple Band Scope**
- **9600 BPS Packet**
- **Fast Scanning**
- **Air Band Rx**
- **Auto Power OFF**
- **Built-in Duplexer**
- **Selectable Attenuator**
- **Auto Repeater Function**
- **Rugged ICOM Construction**
- **Mounting Brackets Included**
  - One for controller, one for main unit
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A third party 6-pin serial cable is required for PC packet connection

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**Optional and/or third party equipment required.

Move Over, "Elmer"... Ham Radio Needs a "Homer"

The future of amateur radio probably won't start with the "powers that be," says WB2D in this guest editorial, and it probably will come from thinking "outside the box." Just tell 'em Homer Hickam sent you.

This started out as Peter's "Beginner's Corner" column for this issue, but I thought his message was important enough to be shared with all of our readers, not just those who consider themselves "beginners." I became even more convinced after following Peter's advice and seeing the movie, "October Sky." So without further ado, let me turn this month's podium over to Peter O'Dell, WB2D.—W2VU

A couple of months back, I climbed on a soap box and griped about the current efforts to lower standards for entry and upgrading in ham radio. Not because I think that anyone should be excluded, and I certainly don't want to be lumped in with the "I had a miserable time upgrading, so I don't want you to get off easy" crowd. No, my thinking was and is that this approach is equal to rearranging the deck chairs on the Titanic. This is a pointless diversion from the real problem: *ham radio needs to be actively sold to the public*. Consumer technology has raced past our technology and stripped ham radio of its mystique. The sizzle is gone. There's very little left here to fuel the dreams of would-be hams. In short, the hobby no longer sells itself.

Monday Morning Quarterbacking

It's real easy to be a Monday morning quarterback and badmouth what some people perceive to be a lack of leadership in our hobby—the "shooting big fish in a small barrel with an Uzi" metaphor comes to mind. Certain people have made small fortunes doing that for years. But they haven't presented any real solutions, either...just a lot of whining and hot air.

So, rather than continue ranting about mediocrity in high places, I want to offer what I hope is a possible alternative course of action. Action in the sense of a different way of thinking about the problem. I'll be the first to admit that I don't know what the solution is, not yet, anyway. But I think there's a way that you and I can begin to think about the problem that will provide a solution, perhaps even a revolutionary one.

If you're relatively new to the hobby, you may be doubting your ability to provide insight and solution. To be honest, my money is on you. Old buzzards like me are too locked into what we *know* to be true—never mind whether it actually *is* true—we just *know* that it is. It's a difficult mindset to break out of, particularly when most of the people who have it are not aware that they have it. So, I'm betting the solution will come from you new guys and gals.

Innovation from Outside

If we look back over the history of ham radio, most of the innovation has come from "outsiders." A classic example of this is the amateur satellite "program." Go back to October, 1957, when the "space age" began with the Soviets' launch of Sputnik, the first man-made satellite. There was no AMSAT, and I seriously doubt that anyone connected with the "powers that be" (PTB) had given any thought to ham radio going into space. To be fair, there was (is?) a display in the ARRL museum about some award set aside in the 1930s for the first contact with Mars. When I worked at HQ, staffers conducting tours mentioned this item with raised eyebrows, rolling eyes, and a sly wink.

The first serious public mention of the idea of ham radio in space came in Don Stoner, W6TNS's semiconductor column in *CQ* magazine in 1958. That column prompted a few hams connected with the aerospace industry to get together in their garages and build ham radio's first satellite, OSCAR I. The PTB were not involved in its construction or launch.

A couple of months ago, I alluded to the 2-meter FM revolution saving ham radio in the 1970s. It certainly wasn't orchestrated by the PTB. No, in fact, the best that could be said for the PTB's involvement was "benign neglect." ("If we just pretend it is not there, it will go away, so let's just focus on the *real* ham radio stuff. In the meantime, let's just feel sorry for these poor devils from the wrong side of the tracks.") When one famous VHF editor retired from a major publishing company, he simply walked out and left his desk "as is." A friend of mine cleaned it out and found a stack of 20 or so articles dealing with 2-meter FM in its infancy. There was no indication that the authors had ever received so much as an acknowledgment of receipt from the editor. Keep in mind that such behavior could only have occurred in an overall atmosphere of total indifference. Those articles did eventually find their way into print in "lesser" publications and became "instant classics" in the 2-meter FM field. Some would argue that, even today, the PTB still looks down its collective nose at FM operation.

By Peter O'Dell, WB2D (wb2d@cq-vhf.com)

True innovation usually comes from outsiders. Ham radio is not the exception, but rather the rule in this department. Often, innovation is not welcomed by the society. It's a curious fact that society tends to honor its live conformists and its dead non-conformists. By definition, innovation does not come from conformists. So, I think one or more of you has the potential to develop an idea that will turn this hobby around. But it seems unlikely that the PTB will welcome it, so you've got to have enough faith in what you're doing to persist on your own for a while until some of us old buzzards catch on.

"October Sky"

As I write this column, *October Sky* has just been released. Due to the normal lag time in publishing a magazine on paper, this movie will probably be relegated to $1.50-per-seat theaters by the time you read this, or it may already be out on videotape. Whatever, it's worth tracking down and watching. It's the story of four boys in a backwoods West Virginia coal town at the time of the Sputnik launch.

Their parents, the school principal, most of the teachers, and society in general expect the boys to become coal miners. "It's an honorable profession" says the principal. Your only escape to the outside world, they're told, is to play football well enough to get a scholarship to *the* University. Homer Hickam and his three friends couldn't make the team as waterboys, let alone star players.

Watching Sputnik pass over in the night sky, Homer gets a whim that he can build rockets—and that somehow he can escape the ignorance and poverty of the coal mining life. No one believes that his dream will amount to anything, but the four persist in the face of their own "failures" and ridicule from those who "know" it can't be done.

On the surface, it sounds like a Hollywood fantasy. But, you see, it's a *true* story and Homer Hickam got his college scholarship, graduated as an engineer, and went on to play a major role in the Shuttle program for NASA. Let the "Elmers" step aside. What ham radio needs now is a few "Homers."

Looking for Vision

So what made Homer different from all the other students in his backwoods high school? He was not a great student, particularly in math. But in spite of his mediocre academic record, when it became necessary, he taught himself calculus. Lacking tools and skills to build certain items, he found and enlisted the aid of people who could supply them. In short, Homer had a vision that he kept in front of him. Sure, it started out vague and ill defined, but he worked out the details as he went along. The point is, he imagined what he wanted. Then, he took action—whatever action it took to get the job done.

How do you *get* a vision? That's like asking how you become creative. If your answer is that a few lucky devils are born with it, but most of us average chumps don't have a creative bone in our bodies, I can't help you. But I will point out that there is no record of the birth of an eight-pound-six-ounce baby rocket scientist—never, nowhere. Creativity and vision are activities that people *do*. One method of learning how to do something is to look at someone who already does it well, and try to figure out how *they* do it. Technically, this is called *modeling*.

We can turn to Walt Disney as a model. It's safe to say that Disney was creative.

(Continued on page 78)

CQ VHF Ham Radio Above 50 MHz

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VHF News

FCC Shuts Down California Repeater

A San Francisco-area repeater system that was allegedly home to all sorts of illegal activities has been shut down by the FCC until the end of June. FCC amateur radio enforcement chief Riley Hollingsworth, K4ZDH, called the K7IJ repeater system on Grizzly Peak "a runaway repeater" whose licensee and control operators demonstrated "an alarming and unacceptable lack of control over the operation of these repeaters." In addition to ordering the repeaters off the air, Hollingsworth said the FCC is investigating the activities of two of the system's control operators and four users. The repeaters were shut down by the site owner on March 2 after repeated attempts to contact the licensee were unsuccessful.

According to the *ARRL Letter*, Hollingsworth told other repeater owners not to panic...unless, of course, their repeaters are out of control. "There is no general cause for alarm," he said. "The only repeater owners who need to be worried are those who fail to maintain control over their repeaters." The ARRL also reported that, on March 5, the FCC suspended for 120 days the VHF/UHF operating privileges of the repeater system's primary control operator, Blake Jenkins, N6YSA.

For more details on the Grizzly Peak case and background on FCC repeater enforcement efforts in general, see WA6ITF's article, "Grizzly Peak: The FCC's Line in the Sand," on page 8 of this issue.

FCC Enforcement Crackdown Continues

In addition to the high-profile Grizzly Peak repeater case, and the New Jersey repeater-to-repeater interference case we reported on last month, the FCC is also starting to single out individual hams for enforcement action. Among those cited were hams accused of broadcasting, either on or off the ham bands, jamming and other interference complaints, and certain hams whose license upgrade exams are being questioned. And the FCC's Riley Hollingsworth issued a warning to self-appointed ham radio "cops" to "back off."

In an interview with the "RAIN Report," Hollingsworth told producer Hap Holly, KC9RP, that "I don't want to see a lot of good, qualified, long-term operators get fines and revocations because they were jamming the jammers....I know that they saw no presence from the FCC and they think that they are helping to police the bands. But we need them to back off and let us take the hard-cord riff-raff out, so to speak."

SUNSAT in Orbit on 12th Try

SUNSAT, the newest ham radio satellite, is in orbit and operating well, according to controllers. It was launched on February 23 from Vandenberg Air Force Base, California, aboard a Delta II rocket it shared with the U.S. Air Force's Advanced Research and Global Observation Satellite (ARGOS) and the Danish Orsted satellite. It was the 12th launch attempt, the previous 11 being canceled either due to weather or mechanical problems.

According to news reports, ARGOS will collect environmental data and perform technology demonstrations for Air Force space programs, and Orsted will be used to study the Earth's magnetic and electrical fields.

SUNSAT is a digital store-and-forward satellite built by students at the University of Stellenbosch in South Africa. It has two VHF and two UHF transceivers and will be used for remote sensing and amateur radio communication. Among the features on board is a "parrot" repeater, which will digitally record an uplinked voice signal, then play it back on the same frequency. According to the AMSAT News Service, this feature will be used primarily for educational demonstrations.

ANS also reports that SUNSAT has been designated as SUNSAT-OSCAR-

Compiled by the CQ VHF Staff

35, or SO-35. Controllers hoped to have it ready for general amateur use by the end of March. For the latest information, visit the SUNSAT Web site at <http://sunsat.ee.sun.ac.za>.

Additional Satellite News

Control operators for PanSat, PO-34, are continuing to get the satellite ready for full operation, but expect that the commissioning process will take several months. PanSat was built by the Naval Postgraduate School and launched from the shuttle *Discovery*. It is the first amateur spread-spectrum (s/s) satellite. Project Manager Dan Sakoda, KD6DRA, says that special software to use the satellite should be available at about the time that it is opened for general use. Meanwhile, according to the AMSAT News Service, he recommends reading *The ARRL Spread-Spectrum Sourcebook* to learn the basics of s/s communication. TAPR's *Spread Spectrum Update* is another good resource.

Special software for processing image files from TO-31 (TMSAT) is now available. According to ANS, it's called ProcMail V2.00G, and it may be downloaded from the KO-23 (if it's back on the air) or KO-25 satellites, or via the Internet from AMSAT's FTP site at <ftp://www. amsat.org/amsat/software/win32/wisp>.

State Department Nixes APRS Satellite

Once again, world politics has kept a ham radio satellite on the ground. First, there were the ongoing problems surrounding the launch of AMSAT's Phase 3D satellite. Now, there's word from Annapolis, Maryland, that politics and bureaucracy have grounded a planned APRS satellite. APRS is the Automatic Position Reporting System, and it's one of the hottest areas in packet radio today.

APRS developer Bob Bruninga, WB4APR, reported on the Internet that Boeing had offered a free ride into space for an APRS satellite on a test flight of its SEA LAUNCH system. But then bureaucracy got in the way. It seems that, since the launch was going to be made from international waters, on a Scandinavian ship, using a Russian booster, Boeing needed (and got) a Technology Export License from the U.S. government. But that license called for a dummy payload, and the State Department said substituting a live satellite was a change that would require a modification to the license—a process that can take months, if you're lucky. Boeing, with a billion-dollar launch on the line, argued with the bureaucrats for about a month, then finally gave up and bumped the APRSat, rather than delay their launch by many months.

On the bright side, says Bruninga, "we *do* now have a satellite *ready to go* for the next opportunity! (Anyone know of another free launch?). Get in line behind P3D, Bob...

Spectrum Protection Act Reintroduced

The ARRL-backed Amateur Radio Spectrum Protection Act has been reintroduced in Congress by Rep. Michael Bilirakis (R-Florida), and designated as HR 783. According to the *ARRL Letter*, the bi-partisan bill is co-sponsored by New Jersey Democratic Rep. Frank Pallone, and would prohibit the FCC from reallocating any current amateur radio or amateur satellite spectrum without providing "equivalent replacement spectrum" in exchange. Last year's version of the bill garnered 83 co-sponsors, but was not acted on. The text of HR 783 may be viewed online at the Library of Congress Web site at <http://thomas.loc.gov>.

AMSAT Call for Papers

AMSAT-NA has issued its initial Call for Papers for the 17th AMSAT Annual Meeting and Space Symposium, to be held October 8 to 11 in San Diego, California. Any topic of interest to the amateur satellite community will be considered. One-page abstracts are due by May 1, with authors being advised by June 1 if their proposals have been accepted. Camera-ready copy of accepted papers is then due by August 1.

Proposals for presentations may be e-mailed to <ko6bt@amsat.org>, or mailed to Duane Nagle, KO6BT, AMSAT Symposium Chair, 4111 Nemaha Dr., San Diego, CA 92117.

Grizzly Peak: The FCC's Line in the Sand

Like a volcano that suddenly erupts after lying dormant for years, the FCC has ended a 15-year absence from the amateur radio enforcement scene. If today's FCC were a volcano, it would likely be named Mt. Hollingsworth.

By Bill Pasternak, WA6ITF*
(BillWA6ITF@aol.com)

When San Francisco's Grizzly Peak repeater was ordered turned off at midnight, Sunday February 28, 1999, it was more than the FCC simply punishing a repeater licensee for failing to properly police the on-the-air activities of his users. It also sent out a message to every other ham whose callsign appears on a repeater identifier. It said that the FM community had finally gotten its request for enforcement noticed by the federal regulatory agency. More importantly, it told *all* hams that this was no longer a "do-nothing" FCC.

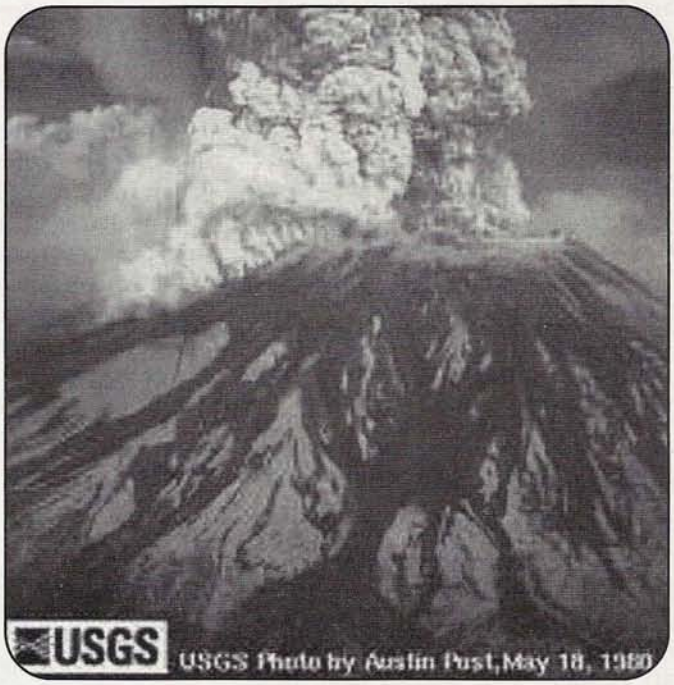
To the Dawn of History

To understand the importance of what has transpired, you have to go back more than 30 years to the dawning of the FM and repeater age in ham radio. Our "way-back machine" takes us to New York City in the year 1968 and a human "frog" on a now defunct repeater. The "frog" was a system user who spent half of his operating time as one of the regulars and the rest as an unknown jammer who mimicked a swamp creature.

After just a few letters of complaint, a then rather active FCC stepped in, located the wayward user, issued the creature a fairly hefty fine, and suspended his license for its term.

The next major action in this realm took place in Los Angeles during the late 1970s and early 1980s. It involved several users on two repeaters. One was the former Palisades Amateur Radio Club system on the 146.01/.61, and the other was what has become known as the "Animal Farm Repeater." These days, it operates on 146.40 MHz in and 147.435 MHz out.

While I don't have time to cover all the nuances of this strange situation, let's just say that, at one time, the user base of the .435 machine invaded the .61 repeater, waged a highly successful war and took it over. As a result, the Palisades ARC, which was already suffering internal political strife, simply took the system off the air and abandoned the channel pair. It was eventually re-coordinated outside the Los Angeles basin and has been relatively interference-free for over a decade. The same cannot be said for .435.



Like a dormant volcano that surges back to life with little warning—as Mt. St. Helens did nearly 20 years ago—the FCC's amateur enforcement activities are in full swing after "lying dormant" for 15 years. WA6ITF explains how it all came about. (USGS/Cascades Volcano Observatory photo)

It was during the .61/.435 turmoil, and at the urging of the late Joseph Merdler, N6AHU, that the FCC again became involved in prosecuting wayward users. It took a number of the .435 users off the air for the remainders of their license terms. One particular ham who stayed on after his license was canceled eventually went to prison. But it was another case, in which a cited user fought back, that brought almost all ham radio enforcement to a halt for more than a decade.

While I don't recall all the details, the basic story revolved around a citation and license suspension issued against a par-

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ticular ham, based on the language he had allegedly used on the air. This was at a time when the FCC had announced its "community standards" interpretation for language in the broadcast industry. Under this interpretation, whether or not language was considered obscene or indecent depended at least as much on where you were and when you were on the air than on what you actually said. So a broadcast comment that would offend the average listener in Peoria at 3 a.m.—but wouldn't even raise the eyebrows of a New Yorker at 8 p.m.—was legal in New York but against the law in Peoria.

The ham successfully argued that the same standards should be applied to ham radio communications, and that his transmissions were further protected under the Constitution's First Amendment. A court (I believe it was the 9th Circuit Court) agreed. The court not only restored his Amateur Service privileges; it also ordered the FCC to issue a public apology to him.

From that point on, FCC enforcement regarding any ham radio problem seemed to melt into the background. I suspect that the Commission was fearful of losing more rounds in the courts and simply walked away from policing the Amateur Radio Service. As a result, a handful of malcontents across the nation grew into a small armada. Problems appeared not only on big-city repeaters. They also took root on two of our very popular high frequency bands: 75 and 20 meters.

The 15-Year Gap

For 15 years, there was really no enforcement action in ham radio except for the FCC twice again targeting that same former ham who refused to leave the .435 "Animal Farm" repeater in Los Angeles. The situation on 20 meters, which earned the unofficial title of the "Net-Mess," was left to fester as the two or three people who were harassing the various service nets operating between 14.300 and 14.315 MHz grew into dozens. This eventually included a goodly number of individuals who apparently heard the melee while perusing the band, bought a transceiver or transmitter, and joined in the fray. The result was chaos.

A similar situation developed on 75 meters, surrounding a rather right-wing discussion net. Its supporters and detractors created a melee on that band that spread to several other frequencies. But through all of this, the only action that the FCC would take was to go after a tiny number of unlicensed individuals whom the Commission knew could not stand on the First Amendment, since they had no legal right to be there in the first place.

That was the basic situation from about 1983 until late in 1998. It was a little-noticed change at the FCC that signaled a renewed interest by the agency in helping radio amateurs to eradicate the blotches that they had been complaining about for the better part of 15 years.

ARRL Persistence

Without any doubt, a lot of credit for the new initiative goes to the ARRL. After years of pressing without success for real changes in the Commission's enforcement policies, it took advantage of structural changes within the FCC to meet with several key people, right after the changes were in place, to apprise them of the difficulties that ham radio was facing in policing itself. League officials convinced the FCC that, at least in the most egregious cases, enforcement was too much to leave with the Official Observer Corps or the Amateur Auxiliary. Self-policing just was not working in these cases, and both the ARRL and the FCC knew it.

This hit pay-dirt and resulted in a new, proactive approach to solving all such problems by both FCC Chairman William Kennard and Compliance and Information Bureau Chief Richard Lee. Chairman Kennard had also determined that over the last decade, FCC enforcement was not strong enough. He wanted it to hold the same level of respect as the Securities and Exchange Commission, the Federal Trade Commission, or the Internal Revenue Service.

In the fall of 1998, a meeting was held between the Wireless Telecommunications Bureau (WTB) and the Compliance and Information Bureau (CIB) to decide the future of Amateur Service enforcement activities. At that conclave, it was determined that Amateur Service enforcement under the purview of the WTB was not working. CIB Chief Lee suggested that the activity be transferred under his jurisdiction. This was done almost immediately, at which point Lee appointed W. Riley Hollingsworth as Legal Advisor for Enforcement with the Compliance and Information Bureau. Why Hollingsworth? The FCC has never said, but he is a ham—K4ZDH—as well as an FCC lawyer. As such, he can understand the trials and tribulations faced by the United States Amateur Radio Service in a way that no non-ham could ever comprehend.

Mr. Hollingsworth Comes Calling

After clearing out a backlog of minor complaints, Hollingsworth took his own rather unique approach. Along with issuing the usual citations and warning letters, he unexpectedly began showing up on the air—in the various high-frequency trouble spots. In a recent interview with Hap Holly, KC9RP, of the Chicago, Illinois-based Radio Amateur Information Network (RAIN Report), Hollingsworth called this an "in your face" approach to enforcement by making it known to one and all that the FCC is not just out there, but is listening and ready to help to solve the issues that are dividing different facets of the ham radio community.

It was during this same interview that Hollingsworth made yet another interesting revelation regarding those who hide behind the First Amendment while using ham radio as a tool to harass others:

> The First Amendment is alive and well and certainly does not need any help from amateur radio. Amateur radio was not set up to enhance the First Amendment. If these groups keep it up, they will be on Internet chat lines in the future—talking about how they pushed for the First Amendment on ham radio. They will be asking whatever did happen to those ham frequencies? Who bought them at auction? What third-world countries ended up using them for a national telephone system? This has nothing to do with the First Amendment and that is not the justification for Amateur Radio.

A few days after that interview aired, the first of what is expected to be an ongoing wave of repeater enforcement actions began when Hollingsworth and the CIB issued a series of orders regarding the Grizzly Peak repeaters serving the San Francisco Bay area of California.

Grizzly Peak

The Grizzly Peak situation (see details below) is not new. It may be new to the system's latest owners and licensee, but locals have told me that the problems plaguing this system date back to when it was first created in the 1970s, that this was always a home for those who are politically on the extreme left, and has for years been more of a broadcast station than a viable communications tool. Moreover, it has been viewed by the rest of ham radio society as a sore spot and an embarrassment. What can best be described as the silent majority of San Francisco's

ham community wanted it dealt with, but, until the coming of Hollingsworth to the CIB, their years of complaining had fallen on deaf ears at the FCC.

That all changed on Wednesday, February 25th, when the Commission acted in this rather grizzly affair. As described by the *ARRL Letter*, the FCC shut down for 120 days, commencing at midnight on February 28, 1999, the K7IJ repeater facility on Grizzly Peak and told the licensee that his ham ticket could be in jeopardy.

The *ARRL Letter* story continues by stating that:

> The FCC took the action by modifying Bruce Wachtell, K7IJ's, license to prohibit repeater operation starting midnight February 28, 1999. The repeater operates on 145.29, 223.78, 440.175, and 441.175 MHz. The FCC also set aside recent license grants of four individuals accused of unlicensed operation on the repeater prior to obtaining their amateur tickets and other behavior.

But the action did not end there. Again quoting the *ARRL Letter*:

> The FCC's Riley Hollingsworth, K4ZDH, said that for almost a year, the repeater's control operator, identified as Blake B. Jenkins, N6YSA, of Berkeley, California, "has apparently not only allowed, but encouraged, use of the repeater by unlicensed operators, rebroadcast of cordless telephone calls, playing of music, and profanity and obscenity." He said extended QSOs have taken place between the control operator and unlicensed stations. Hollingsworth said the situation was brought to the attention of the licensee, Bruce Wachtell, who lives in Carson City, Nevada, but nothing was done.
>
> "Such operations are not only contrary to the Amateur Radio Service rules and frequency allocations, but degrade the service for legitimate radio licensees as well," Hollingsworth said in his certified letter to Wachtell dated February 25.

That letter also included a warning to Wachtell that the operation of the K7IJ repeater system in this manner may reflect adversely on his qualifications to hold a Commission license.

The ARRL story continued by noting that Hollingsworth asked Wachtell to provide details about the operation of the K7IJ repeater system since January 1, 1998, including names of control operators, instructions provided to them, and any agreements he had with them. He also asked about complaints received about the K7IJ repeaters.

Hollingsworth said Jenkins' "actions and omissions" while control operator were under separate FCC review, along with those of the secondary control op, Steven R. Rossi, KE6LNH, of Novato, California. The FCC set aside the recent license grants or upgrades of four other amateurs, pending further investigation. In addition, the FCC issued a warning to another ham about alleged jamming and rebroadcasts of cordless phones, according to Hollingsworth, and one more warning to a non-ham about unlicensed operation on the K7IJ repeater.

The Big Picture

What does this mean to the rest of the nation's repeater owner-operators, their control stations, and their users? To the majority, who have always abided by the Amateur Service Part 97 Rules, it has little consequence. Everyone makes a minor mistake now and again, and people at the FCC like Riley Hollingsworth are acutely aware of this. They are not looking for that accidental once-in-a-lifetime slip of the tongue that every human makes.

Rather, they are targeting the persistent and tenacious offenders. Those who openly flaunt the law and who dare society to stop them. This seems to be well understood among repeater

system owners and several comments posted to the Repeater Owners Remailer (e-mail reflector) tend to back this up. For example, one ham wrote in part:

I also am a...trustee of several repeaters... I, as well as my repeater partner, have a lot of money invested so that everyone can have as much fun as we do working on them. When we hear profanity, we plan to address it. When we hear what we believe is a "bootlegger," we plan to address that individual. Not because the FCC wants it that way, but because it's the thing we feel is the right thing to do. If someone wants to curse or operate illegally, it will not be supported or condoned by us...."

Another system licensee wrote:

As an owner of a repeater, who has put a system up totally out of my own pocket and operated a repeater for several years, I just wanted to add that I don't allow any illegal activities or such on my system and have pulled the plug once or twice over the years...on the rare occasion when it was needed. I just wanted to say that I'm in favor of keeping illegal uses off of repeaters as well as all the ham bands.

Obviously, repeater owner-operators understand the need for this stepped-up enforcement. It was, in part, their ongoing complaints to the FCC and to the ARRL that brought it about. While I am certain you'll soon be hearing complaints from a few hams about the time and effort it will take to properly monitor their repeaters at all times when the system is in operation, I suspect that these complaints will be few and far between. The main reason is that most repeaters don't suffer from these problems, which seem to be focused on a select number of repeaters that are primarily located in heavily populated areas. And it is in these select situations that the FCC has decided to act.

A Line in the Sand

In taking this and other enforcement actions, the FCC has responded to the desire of the ham radio community to rid itself of those who would abuse the terms of their licenses. It is also a very clear warning to those in amateur radio who wreak havoc on their fellow radio amateurs under the guise that what they do is constitutionally protected freedom of expression. After 15 years of inaction, the FCC has, in effect, told rules violators and potential rules violators that it has drawn a proverbial "line in the sand" which it dares them to cross. If they do, they had also better be prepared to face the consequences of their actions. This definitely is a shift in Amateur Service enforcement. And it appears that there is a lot more to come. ■

Make Your HT Talk Forever!

New technology and careful power management can greatly extend the useful "life" between charges of your HT battery pack. Making the most of both can make your handheld talk (nearly) forever.

By Ken Collier, KO6UX*
(ko6ux@adi-radio.com)

All right, your batteries may not last *forever*, but the amount of time that a handheld radio can operate before its battery pack needs to be recharged has increased greatly in the last decade. These advances are the result of an upswing in battery and power consumption technology. The circuits of today are more efficient and require less power to operate, and modern battery packs last longer than ever before.

As hams, we have reaped the rewards of these technologies, but there are still ways to extend your operating time without resorting to using a power supply! Here are a few simple ways to make sure that you're getting the maximum amount of operating time from each charge cycle.

On many of today's handhelds, the battery pack makes up half the size (and more than half the weight) of the unit. Taking good care of your battery pack is just as important as taking care of the lightweight half of the radio.

How Long Should My Battery Pack Last?

Before you set out to extend the operating life of your handheld radio's battery pack, it's important to know how much time you *should* be getting. There are a few factors that determine how much operating time you'll get out of a given battery pack. The most important are the battery's *capacity* and the *current draw* of your radio.

As an analogy, you can think of a battery as a lake or reservoir of water being emptied by a river or canal. The amount of water (i.e. power) that can be stored in the reservoir is the battery's *capacity*. The amount of water being emptied into the river is similar to the *current* being drawn out of the battery by the radio. The higher the current draw, the more quickly the battery will be depleted. The deeper the lake, the longer it takes to become fully drained. Likewise, the higher the battery capacity, the longer it will take to completely drain the battery.

Capacity is measured in both current and time. For instance, a typical nickel metal hydride (NiMH) battery might be rated for 1000 *milliamp hours* (mAH). That means that the battery is capable of delivering 1000 milliamps (1 amp) of current for one full hour before it needs to be recharged. The same battery would also be capable of delivering 500 milliamps for two hours, 250 milliamps for four hours, etc. You just divide the battery's capacity by the radio's current draw to arrive at the length of operating time.

You can determine the current draw of your radio by consulting the specifications for the radio that are published in the radio's User's Manual. Typically, there are several different ratings given. For instance, your radio will have a different rating for receive, receive with the Power Save mode turned on, and transmit at high, medium, and low power settings.

If you know the capacity of your radio's battery and the radio's rated current draw on both transmit and receive, you can easily approximate the maximum

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Figure 1.

$$\frac{\text{Capacity of Battery (in mAH)}}{.95X_1 + .05X_2} = \text{operating time in hours}$$

X_1 = Radio's current draw (mA) on *receive*
X_2 = Radio's current draw (mA) on *transmit*

Figure 1. The standard formula for figuring out the typical "life per charge cycle" of a battery. This assumes a "95/5" operating ratio, in which you spend 95% of your time listening and only 5% talking. If your operating habits are different, replace .95 and .05 in the formula with the appropriate figures.

amount of operating time you'll get from a battery pack. The standard for determining this is called "Ninety Five, Five," and it's used by Motorola and other commercial radio manufacturers to rate the average operating time of their portable radios. It assumes that 95% of the radio's operating cycle is in the receive mode and 5% in transmit mode.

Take a look at the formula in Figure 1. Now, let's suppose we have a radio that draws 40 milliamps (.040 amps) on receive and 800 milliamps (.8 amps) on high-power transmit. If the radio is being operated by a 700-mAH (.7-amp) battery pack, approximately 8.9 hours of battery life would be typical (see Figure 2). Of course, this only a generalization. If your operating habits differ from the 95/5 rule, then you can expect slightly different real-world results.

Give Yourself a Charge

All of this assumes that your battery pack is operating at 100% of its potential capacity. This may not always be the case. Several problems can occur which may reduce the capacity of the battery and severely shorten your time on the air.

The single greatest factor in preventing decreased capacity and extending the overall lifespan of a battery is how it's recharged. Generally speaking, it's always better to slow-charge a battery than to fast charge it. Conventional fast-charging relies on delivering a high amount of current into a battery, which can cause the battery to heat up. This heating actually results in a boiling away of the battery's electrolyte, reducing the battery's capacity and life span. This type of high-current charging is especially bad for the newer NiMH-type batteries, reducing overall life span by as much as 50% (see below for additional cautions on NiMH packs).

Optimally, you want to pick a slow charger that has a voltage rating of 125% of the battery and a current rating of no more than 1/10 the current rating of the battery, although less is OK. For instance, if you have a 12-volt, 600-mAH pack, you want a charger rated for 15 volts and no more than 60 milliamps. To determine the approximate needed charge time the pack will need, just divide the capacity of the battery by the current rating of the charger. In the case of our example, a full charge will take 10 hours.

It's not always convenient to slow-charge your batteries, though. In these cases, it's wise to employ modern *pulse-charging* techniques. While pulse-charging will still cause some decrease in battery life span, its effects are not as serious as those of conventional fast-charging.

Getting a Pulse

Unlike conventional chargers, pulse-type chargers do not force a constant high current into a battery. Instead, a pulse charger constantly varies or "pulses" the amount of current the battery is receiving. The current being input into the battery will be changed several times per second.

For instance, the charger might input 350 milliamps into the battery for 200 milliseconds, 100 milliamps for the next 100 milliseconds, no current for 100 milliseconds, followed by another 100 milliseconds of no charge. The whole cycle might then be repeated.

In this way, the charger is able to input relatively high net current into the battery, while still allowing enough rest time for the battery's cells to dissipate some of the heat of charging. A pulse charger will completely charge a typical 700-mAH battery in about two hours.

You also want to make sure that your quick charger uses both a battery voltage sensor and a temperature sensor. Some manufacturers' fast chargers use only a timer to shut off the charge circuit. Timed circuits have no way to sense whether or not a battery is charged, which can result in overcharging and overheating of your battery, especially if the battery is removed from the charger part way through the cycle, then put back in, resetting the timer to the beginning. Again, this could lead to a loss of capacity and life span in a battery pack, or, worse yet, to a meltdown and/or fire.

Using a voltage sensor allows the charger to shut down before a battery goes into overcharge, while the temperature sensor makes certain that a charger will shut down if a battery becomes exceptionally hot for any reason, such as a short or a bad cell in the pack.

Exercise Keeps Fit

So what can you do if you aren't getting the expected amount of operating time from your battery pack? Well, just like people, batteries need exercise. While your battery pack isn't in danger of developing a potbelly or clogged arteries, it can suffer from decreased capacity caused by *crystalline formation*, and that can cause it to perform poorly.

The process of crystalline formation takes place because, as the battery ages, the electrolyte in the cells can actually begin to solidify into crystals, making it harder to move electrons through them. The larger the crystals, the greater the reduction in the capacity of the battery.

Often, you'll hear this phenomenon mistakenly referred to as "memory," a condition in which repeated partial charges make a battery "think" it's fully charged when it isn't. In reality, the effects of crystalline formation aren't true memory, and modern rechargeable battery packs suffer from little or no real memory. Nonetheless, crystalline formation can cause your batteries to fail when you need them.

In order to keep your batteries in top-notch shape, these developing crystals need to broken up into smaller pieces, allowing power to flow readily through the cells. This breaking up of the crystals is accomplished by "exercising" the battery pack.

"Exercise," in this sense, is accomplished by discharging the battery pack deeply, to about 1 volt per cell. You can do this manually, by monitoring the battery pack very closely while using it. As an aid, many modern radios have built-in

battery voltage meters that effectively allow you to see the voltage of the battery, even under load. Many drop-in battery chargers these days also employ some sort of "discharge" function that effectively "exercises" the pack for you.

While it's important to come as close to the 1 volt per cell standard as possible, it's also important not to discharge your battery pack completely. In fact, you should always avoid discharging your battery completely, as doing so can cause a short or battery cell reversal to occur. This is when the polarity of a battery cell is reversed, and the "+" side is really negative, while the "–" side becomes positive. They don't work too well like this.

Batteries should only be exercised about once a month for nickel cadmium (NiCds) and only once every three months for NiMH batteries. There's no benefit to doing it more often, as regular exercise is sufficient to prevent crystalline formation from taking place. If done too often, this type of strenuous discharge can do more harm than good for the battery. Just like a human, your battery can get worn out from too much exercise.

If a battery pack has been truly neglected and/or used improperly, the effects of crystalline formation can become more pronounced. In order to break up these kinds of very large crystals, an even deeper discharge cycle needs to be applied—a discharge that effectively takes the battery to less than 1 volt per cell. This can only be safely done using a good *battery analyzer*. Although outside of the price range of most individuals, an analyzer can help you determine what kind of shape your battery pack is in, determine its capacity, detect any catastrophic flaws (such as shorts or reversed cells), and can restore capacity to poorly maintained batteries. These days, many radio clubs own battery analyzers, along with service monitors and other assorted pieces of test equipment beyond the budgets of most individuals.

Better Batteries

While most manufacturers are still packaging their radios with older NiCd battery packs, some significant leaps in battery technology have been made in the last few years. So, if your NiCd pack just isn't doing the job, and you want something that offers increased capacity, the most promising advance thus far is the new and improved NiMH battery technology.

NiMHs offer an increase of as much as 150% capacity over similarly sized NiCd battery packs, and they're as much as 50% lighter. That makes for super-long operating times. NiMHs are also more easily recycled and are therefore more environmentally friendly than their NiCd cousins. Plus, NiMHs are easier to care for, and, as we mentioned above, do not have to be "exercised" as often as NiCds.

While they represent a significant increase in performance, NiMH batteries typically cost about 25% more than a similar NiCd pack. There are also some other considerations with NiMHs, such as they'll have to be replaced up to 25% sooner than NiCds, and they may require special chargers if you plan on fast-charging them (*see Ken's article, "Are NiMH Batteries REALLY Better?" in the January, 1999, issue of* CQ VHF.—*ed.*). NEVER use a fast charger with an NiMH battery unless the charger has both voltage and temperature sensing cut-off circuitry! NiMHs get much hotter than NiCds when overcharged and can create a danger of meltdown or fire.

On the horizon, be on the lookout for new lithium-ion battery packs to become available soon from various manufacturers. These packs offer even increased capacity over NiMHs, though they're currently too expensive to be used in most applications. And who knows what new battery cells might become available even further down the road! At the rate battery technology is progressing, the next big advance may be just hours away!

Saving Your Power

If you're ready to get more out of your battery, don't overlook your radio's battery saver function. These days most handhelds have a built-in power save feature that can conserve energy and increase your listening time even more! All of these features function in a more or less identical way: they actually shut off the radio's receiver for a fraction of each second.

Say your handheld's receiver draws 40 milliamps of current when operating without the power save feature. If the radio's power save feature is turned on, the receiver might be shut off for as much as half of each second, reducing the current draw by nearly 50%. Your radio might now have an average current draw of only 22 mA. The battery could last nearly twice as long between charges!

The exact amount of time that the radio's receiver is shut off with power save engaged (and therefore the amount of power that's saved) varies from radio to radio, and some more advanced rigs even allow you to program this variable according to your own preferences. This won't affect the radio's current draw on transmit, though, so it will only extend your listening, not your talk, time.

Even though your receiver is being shut off, you aren't going to miss any signals. Once the radio detects a signal in the receiver it will automatically switch off the power save mode until the frequency you're monitoring quiets down. The worst that will happen is the first half-second or so of any signals you hear might be clipped off.

This power save function isn't really compatible with scanning, though, and most radios automatically disengage the power save feature when you start the radio scanning. If you have a handheld that scans 25 channels per second, a relatively low number compared to some of today's high-powered scanners, your radio will only listen to each channel for approximately 40 milliseconds. If the power save function is set to turn off the radio's receiver for 400 milliseconds, you could miss activity on up to 10 channels!

Power Down

The best and easiest way to prolong battery life is often the most overlooked:

Figure 2.

$$\frac{\text{Capacity of Battery}}{.95X_1 + .05X_2} = \frac{700}{.95(40) + .05(800)} = \frac{700}{38+40} = \frac{700}{78} = 8.9 \text{ hours}$$

X_1 = Radio's RX (receive) current draw = 40 mA
X_2 = Radio's TX (transmit) current draw = 800 mA

Figure 2. Practical application of the formula in Figure 1. This example uses a battery with a capacity of 700 milliamp hours (mAH) and a radio with a current draw of 40 mA on receive and 800 mA on transmit. Applying the formula and assuming a listen-to-talk ratio of 95:5, you should get 8.9 hours of operating time between charges.

"Optimally, you want to pick a slow charger that has a voltage rating of 125% of the battery and a current rating of no more than 1/10 the current rating of the battery, although less is OK."

use a lower transmit power setting on your radio! These days, many radios offer a super-low-power setting of merely a fraction of a watt output, as well as possibly offering a middle-power (1 or 2 watts) setting! Transmitting at one of these lower power settings is sure to extend your operating time, and it may even save you some money! True, lower power could result in a degradation of the quality of your signal into the local repeater, but it doesn't have to be that way. You can more than make up for reduced output power by adding a gain antenna.

In fact, you might even decide to skip buying a high-*power* battery pack for the radio, opting instead for a less-expensive, higher-*capacity*, low-power pack. This could free up enough money to buy a killer gain antenna and still have some cash left over.

As an added benefit, using low power will also help keep your radio's final transistors alive longer. Power transistors generate a significant amount of heat when they operate, and ultimately it is this heat that causes the transistors to fail. By using low power, you reduce this heat buildup and extend the overall life of the transistors. In the long run, that will save you additional money. Installing new final transistors typically costs $100 or more, depending on the radio and whether or not you can do the work yourself (as always, performing surgery on a HT is recommended only for the experienced).

And, of course, low-power operation also keeps you in line with good amateur practice and FCC Part 97. Remember that hams are allowed to use only the minimum RF output power necessary to maintain reliable communications. It's always a good idea to attempt to operate on the lowest possible power setting and to go up to the next highest setting only if needed, rather than just smashing your way along at a constant 5 watts out.

Conclusion

New technology is very helpful when it comes to keeping your handheld ham station on the air. Modern radios with low power consumption needs and power-saving circuitry can be easily coupled with today's high-capacity batteries for a great combination in the battle to extend operating time. Still, the most important soldier in the battle is you! Your operating and battery charging habits play a huge role in the overall performance of your equipment, so it's worth taking the extra time needed to care for your equipment and to ensure that you're using it properly and wisely.

With the latest equipment and careful operating habits, you can get more life out of your HT battery pack than you ever dreamed possible. It might not last forever between charges, but the ham station on your belt can indeed provide you with many hours of contacts before the person on the other end has to listen to you saying, "Gott___o, ba____s dead."

ICOM IC-746 HF+VHF Transceiver

If you're looking for power, flexibility, and ease of operation on HF, 6 meters, and 2 meters, the ICOM IC-746 should be on your "short list" of options.

By Rich Moseson, W2VU*
(w2vu@cq-vhf.com)

The "HF-plus" revolution continues to expand as more and more full-featured ham rigs come onto the market with one or more VHF bands included along with the nine HF ham bands. ICOM America's IC-746 gives you HF, 6 meters, and 2 meters all in one mid-priced package—with 100 watts out on all bands—plus a general coverage receiver that's ideal for tuning in international broadcasters and other shortwave stations, and a wide-coverage VHF receiver for monitoring public safety, aircraft, and other services between 108 and 174 MHz.

Two meters has long been my favorite VHF band, and the ability to pump out 100 watts on SSB without an outboard amplifier is a major plus in my book. For someone who started out on VHF with 5 watts on 2-meter AM, this is the ultimate luxury. If I can hear 'em, I can work 'em. And the IC-746's twin passband tuning makes it much easier to hear 'em when the band is crowded, such as during a contest.

This, to me, is one of the greatest benefits of an HF-plus rig. All of the receiver design features that help you pull out a weak signal on always-crowded 20 meters, or to minimize QRM (interference) from an international broadcaster on an adjacent frequency on 40 meters, are at your fingertips for making those tough contacts on 6 and 2 meters as well.

Rich Moseson, W2VU, is Editor of CQ VHF *magazine.*

Photo A. ICOM's IC-746 covers all nine HF ham bands plus 6 and 2 meters, with 100 watts out on all bands. In addition, the radio includes a general coverage receiver tuning 300 kHz to 60 MHz and 108 to 174 MHz.

But the greatest asset of the IC-746 is its incredible flexibility.

A Confession

Before I go any farther, I have a confession to make. The IC-746 is the first new "full-featured" radio I've had in my shack for more than a decade. For me, just having the ability to change bands without "tuning up" the transmitter is a minor miracle. So if I seem a bit over-enthusiastic about some of this radio's more recent innovations, you'll have to take it in the context of a kid in a candy shop.

First of all, there's still nothing quite like unpacking a brand new radio from its shipping box, especially if it's a big box with a big radio inside. And the IC-746 definitely falls into the "big radio" category (Photo A), measuring 4 1/4 x 11 1/4 x 12 1/4 (HWD) inches. This is not an IC-706 "with shoes on" (more power than "barefoot"). While capable of operating mobile—and I did operate it mobile on a trip—this radio is built to sit on a desk, not under a dashboard. And it has a "big radio" feel as well. The controls are actu-

Photo B. The backlit LCD display panel on the IC-746 provides you with a wealth of information, from frequency and mode to an incredible array of customizing options using the "soft" function buttons labeled at the bottom of the screen. (Photo courtesy ICOM America)

ally designed for use by adults with normal, adult-sized hands. You don't need to get your kids or grandkids to come turn the dials or push the buttons for you. And the big backlit LCD display (Photo B), one of the radio's more outstanding features, is designed for adult eyes (even older adult eyes), as well. Virtually everything, from the frequency readout to the memory channel numbers and all the function labels for the five multifunction buttons underneath the display, is readable without a magnifying glass.

Now, back to the kid in the candy store and all my favorite features on this radio. First, my absolute, number-one favorite: the built-in automatic antenna tuner *with memory*. I have always used multiband wire dipole antennas on HF, and I've always had to use an antenna tuner to fool the radio into thinking it was looking into an acceptable SWR (standing wave ratio). For those of you who have never had the pleasure, this is at least as complicated and time-consuming as tuning up the finals on a tube transmitter (which you've also probably never had the pleasure of doing; well, believe me, it's a real pleasure *not* to have those pleasures!).

"The controls are actually designed for use by adults with normal, adult-sized hands. You don't need to get your kids or grandkids to come turn the dials or push the buttons for you."

On the IC-746, not only is the tuning and tweaking done automatically, but the radio knows whether it needs to retune if you've changed frequencies, and—this is my favorite part—if you've tuned up the antenna on the new frequency in the past, *the radio remembers the settings* and goes right to them in a matter of one to two seconds. I don't know if I can ever go back to my manual antenna tuner. (A couple of people on the Internet have reported having trouble with the internal antenna tuner on the 746, but mine has worked flawlessly.)

Mucho Memory

Speaking of remembering things, the IC-746 has 99 memory channels in which you can store not only frequency but operating mode, antenna tuner setting, and CTCSS tone (also for FM). Plus, you can give each memory a name, and you may store separate receive and transmit frequencies in each memory. This gives you the flexibility to store repeater frequencies with standard or "odd" offsets, and to set up memory channels for split-frequency operation on HF. There is also one "call channel," with all the features of standard memory channels, plus two scan-edge memories, each of which stores one frequency and one mode as the borders for programmed scanning. In addition, there is a "memo pad" in which you can quickly store up to five frequencies for quick retrieval (expandable to 10 as a menu option). And the radio has a "triple band stacking register." This

"Another totally cool feature of the IC-746 is its touch-sensitive main tuning dial....When you turn the dial slowly, one full revolution moves you 5 kHz, in 10-Hz steps. Spin the dial quickly, and each revolution moves you 25 kHz, in 50-Hz steps."

means that it remembers the last three frequency/mode combinations you've tuned in on each band, and you can toggle through them by repeatedly pushing the tuning button for that band.

Touch Tuning

Another totally cool feature of the IC-746 is its touch-sensitive main tuning dial. The faster you spin the dial, the faster the rate of frequency change. What's different about that? This: When you turn the dial slowly, one full revolution moves you 5 kHz, in 10-Hz steps. Spin the dial quickly, and each revolution moves you 25 kHz, in 50-Hz steps. The 10-Hz default tuning step applies only to SSB, CW, and RTTY. On AM, the default is 1 kHz, and it's 10 kHz on FM. But if those steps don't satisfy you, don't worry. In CW, you can hit the "1/4" button and cut the tuning rate to one quarter of the usual.

Plus, you can program in any one of eight different tuning steps between 100 Hz and 25 kHz. And, for super-critical tuning, hold in the "TS" button for two seconds and you can tune in *1-Hz steps*! Oh, you can also lock the VFO to prevent accidental retuning, and there are separate controls for RIT (receive incremental tuning), ΔTX (transmit frequency tuning), and a special XFC button to let you check your transmit frequency when you're operating split (there are special provisions for split-frequency operating on HF). As I said back at the very beginning, flexibility is a hallmark of this radio.

In fact, the flexibility can get to be a bit overwhelming at times. There are two function menus offering any number of choices—choices which vary depending on your choice of mode and/or what you've chosen in the previous step. I haven't dug deeply enough into these menus to get a full appreciation of all they can do for you. But the manual is quite detailed in this regard and takes you through the menu choices step by step.

Touring the IC-746

One of the most visually outstanding features of the IC-746 is the band scope on the bottom of the LCD display panel. It can give you a "snapshot" of activity above and below your starting frequency (how far depends on the tuning step value you program in), so you can "see" strong signals on adjacent frequencies. This can be very handy, either when looking for activity or when looking for a clear spot to make a call.

The band scope has only one drawback, which limits its usefulness somewhat. The receiver is muted while the band scope is scanning, and, by the time you turn it off and tune to a frequency with a strong signal (if you're looking for activity), that station may have stopped transmitting. And it can't continue to monitor band conditions while you're listening, so you won't be able to see the strong station that comes on 15 kHz above you as the signal comes on the air.

While we're on the topic of the front display panel, let's take a close look at Photo B to see what you'll find there. The most obvious feature is the frequency readout, again resolved to 10 Hz (except if you turn on 1-Hz tuning and a smaller digit appears at the far right). Above the frequency display is information about which antenna you're using (there are three choices; see Photo C), whether the automatic antenna tuner is turned on, and what mode you're in.

Below the frequency display are three bar graphs (only one is active in the photo). The top one is an S-meter on receive and a power out meter on transmit. In the middle is an ALC (automatic level control) meter to let you know if you've got your mic gain properly set. And below that is a built-in SWR meter. To the right of the bar graphs is space for the RIT and ΔTX indicator, along with a display of how many kHz you're shifted off of the VFO frequency; and then an indicator of which VFO you're using and which memory channel is selected.

Underneath the bar graphs is a variety of function on/off indicators. Below the solid line are the labels for the "soft" function buttons below the display. As mentioned earlier, each menu choice you make changes what some or all of the keys will do. (In Photo B, the band scope is turned on and has replaced the label in the display.) Plus, if you've given names to your memories or programmed in offsets or other memory-specific information, it's displayed there when the memory channel is selected.

To the right of the display panel (keep looking at Photo B), you'll find a keypad that functions primarily as a band selector, but can also be used (after pressing the "F-INP" button) to punch in the specific frequency of your choice. Below the LCD display panel are the function buttons and the mode buttons. The radio will operate in upper or lower sideband, CW (Morse code), RTTY (radioteletype), packet, AM, or FM.

On the rear panel (Photo C), there are three antenna connectors: two for HF and

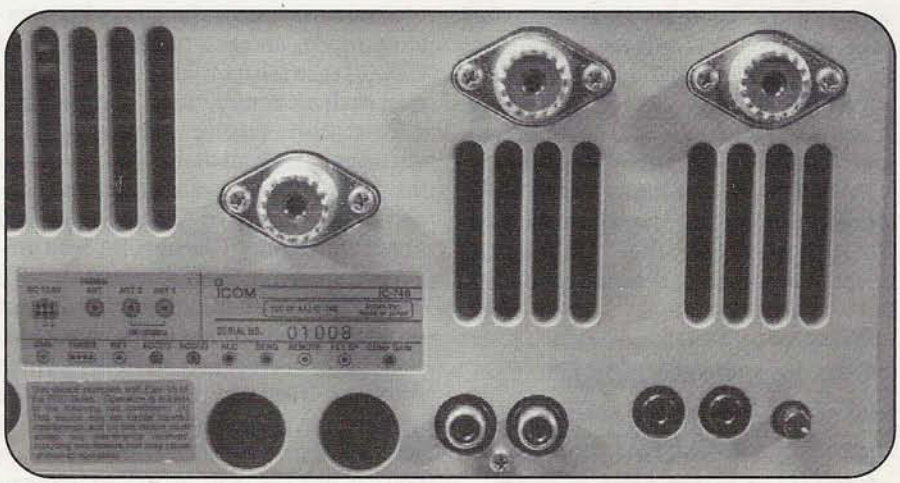


Photo C. The rear panel of the IC-746 has three antenna connectors: two for HF and 6 meters (at the top; the radio remembers which antenna you last used for which band) and one for 2 meters (left and down). The rear panel also includes accessory sockets and the compression gain control.

6 meters, and the third (off by itself) for 2 meters. At the bottom are sockets for connecting various accessories, from a code key or an external speaker to a linear amplifier.

When I took off the cover to look inside, I was greeted by yet another cover (Photo D), indicating the effort that ICOM has taken to produce a well-shielded radio. After removing that cover as well (Photo E), you can see the very well-laid-out and neatly assembled circuit boards. You'll need to access the "innards" of the radio to install any of the optional IF filters or the voice synthesizer unit—or just to explore.

On the Air

Signal reports on the air with the IC-746 were uniformly good. Audio reports were excellent as well (and, by the way, yet another option allows you to tailor the SSB audio to your voice). I didn't do too well on HF, but that had nothing to do with the radio and everything to do with the fact that half of my dipole is lying on my garage roof. On 6 meters, where I'm using an AEA Halo-6 loop antenna, I've been able to talk to virtually anyone within a typical groundwave radius (and even one or two tropo contacts) and had no problem with sporadic-*E* (*Es*) openings, easily working single-hop from my QTH in New Jersey to the Southeast and Midwest. On 2 meters, where I'm using a 10-element Yagi (inside my attic, unfortunately), I've been able to talk to everyone I've heard. And, in terms of groundwave contacts, 2 meters outperformed 6, showing the benefit of a Yagi versus an omnidirectional loop.

I also took the 746 mobile on a trip to Maine and got yet another lesson in cross-polarization losses. On six, my only mobile antenna is a 1/4-wave vertical whip. There was no *Es* when I was operating, and the cross-polarization made it very difficult for me to contact much of anyone on six. Those who did manage to hear me did so weakly. On the other hand, I brought along my collapsible two-element quad for 2 meters, and, while I couldn't use it while driving, I did set it up at the top of Cadillac Mountain outside Bar Harbor. Six still sounded dead with the whip, but having the combination of correct polarization and a directional antenna on 2 meters let me easily work several stations in other parts of Maine, down into Massachusetts and across the water into Nova Scotia. Clear-

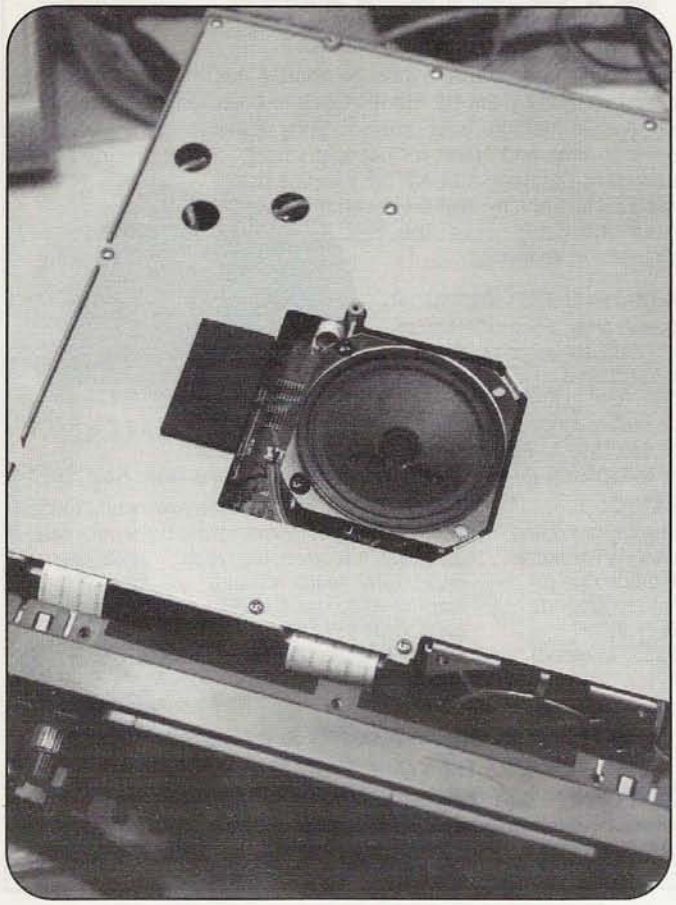
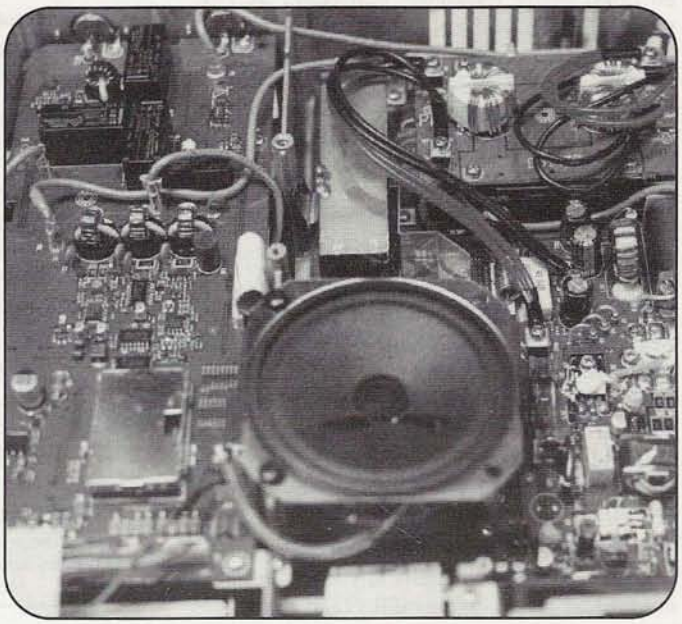


Photo D. RF shielding was certainly on the minds of ICOM's engineers when they designed the IC-746. When you take off the cover, you're confronted with a metal shielding plate to help keep RF both inside and outside the rig where it's supposed to be.

Photo E. Once you remove the shielding plate, you can access the interior of the radio to install optional IF filters or a voice synthesizer unit that will announce your operating frequency, a definite benefit for visually impaired users.



ly, a 6-meter antenna upgrade for the car is in order if I'm going to do much SSB work while mobile. And yes, I have to pick up my HF antenna off the garage roof! The fact that I'm able to make any HF contacts at all is a testament to the quality of the 746.

So What Don't I Like?

My only gripe with the operation of the radio itself is in switching modes, especially from SSB to CW. Since SSB audio is shifted a few Hertz above or below the center frequency, the radio automatically compensates for this when you're in the SSB mode. When you switch to CW, that shift is removed and the radio listens on the center frequency. I found this frustrating during contest operation, when most of my QSOs were in SSB. I'd occasionally tune down to the CW segment to see what was there (but still listening in USB). If I found a signal, I'd switch to CW to answer it...and the signal would disappear. I'd then have to tune around again to find it, but with the short calls that are common in contesting, the station was often done transmitting before I found it again.

My only other gripe is that, for a radio that offers such flexibility and so many choices, everything (except the receive coverage) comes to a dead stop at 148 MHz. The IC-746 is a great radio for someone who wants to work HF and terrestrial DX on 6 and 2 meters. But if you want to operate satellites (other than the Russian birds that use only 2 meters and HF), you're out of luck. ICOM's new IC-706MKIIG includes 70 centimeters, and it's too bad that the 746 doesn't as well. In addition, you can't use the 746 as an IF rig for transverters to higher frequencies without adding on a signal attenuator to drop your output down to the milliwatt range normally required for input power to a transverter. Other radios in this class offer a low-level RF output for driving a transverter, and the 746 should as well. If ICOM offered 70 centimeters and a transverter output on this rig, the IC-746 would be darn near perfect.

All-in-One Convenience

On the other hand, if you're not into satellites and the microwave bands, then there's very little *not* to recommend about the IC-746. Between its broad receive coverage, 100-watt output power on all bands including 2 meters, excellent on-air performance, tremendous flexibility, and the ability to customize the radio to your personal tastes, the IC-746 is one of the best all-around ham rigs I've seen in recent years. List price is $2,228, but it's selling in the mid-$1,700s in many ham stores. (You'll need a 30- to 35-amp 12-volt power supply to operate it at home, so if you don't already have one, factor that into your cost equation as well.) If you're looking for an all-in-one HF/VHF multimode transceiver, the IC-746 should certainly be on your short list of radios to consider. ■

Resources

For more information about the ICOM IC-746, visit your local dealer, or contact ICOM America, Inc., 2380 116th Ave., NE, Bellevue, WA 98004; Phone: (425) 450-6088; Internet: <http://www.icomamerica.com>.

M² "HO" Loop Antennas

Operating SSB mobile on VHF is often difficult because a vertical whip often won't get you through to stations using horizontally polarized antennas. For many of us, the answer is an omnidirectional "loop" antenna. The HO loops from M² are the newest "loop" offerings.

By Gordon West, WB6NOA*
(wb6noa@cq-vhf.com)

The popularity of HF rigs with 6-meter, 2-meter, and even 440-MHz capabilities, has dramatically increased the number of weak signal (single sideband and code) operators on the VHF and UHF airwaves. But your mobile whip or other vertical antenna used for FM won't cut it on SSB or CW. That's because virtually all VHF and UHF weak-signal work is conducted using horizontally polarized antennas. *Cross-polarization* can result in signal degradation of 10 dB or more, making all but the strongest stations difficult or impossible to contact.

"...I knew I was missing some good DX when everyone around me in the parking lot could hear a station 100 miles away, and I couldn't hear a thing running my normal 2-meter whip."— Brian Stamm, KF6JPB

"I didn't realize there was all of this excitement on the 2-meter band until I switched over to SSB and tuned into the Western States Weak Signal Society net on Sunday evenings at 8:00 p.m. on 144.240 MHz," comments Brian Stamm, KF6JPB. "But I knew I was missing some good DX when everyone around me in the parking lot could hear a station 100 miles away, and I couldn't hear a thing running my normal 2-meter whip."

The solution? For many mobile weak-signal ops, the answer is a *loop* antenna, small enough to be unobtrusive yet horizontally polarized for good SSB and CW contacts from your car.

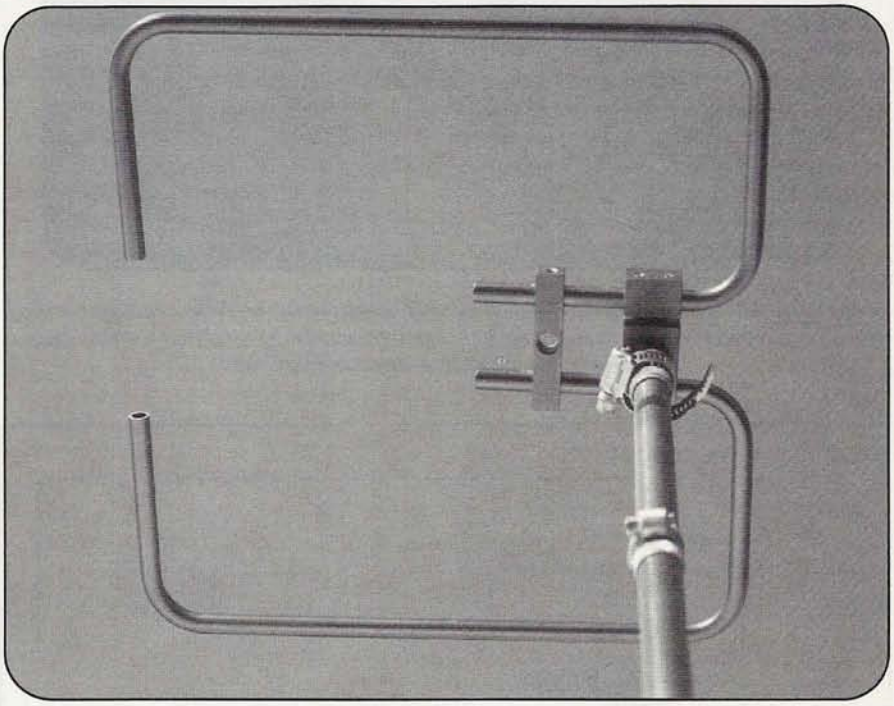


Photo A. A close-up of the 2-meter HO loop antenna from M². It goes together in about 10 minutes and gets you on the air with an omnidirectional, horizontally polarized signal for making SSB or CW contacts. (Photos by the author)

Going Mobile Horizontally

Loop antennas intended for mobile operation are an ideal way to get a good omnidirectional pattern mobile with horizontal polarization. About a year ago, I tested many different varieties of horizontal loops, and test results revealed many different construction techniques that led to almost identical signal reports from distant stations (see "Two-Meter Loop Shootout," May, 1998, *CQ VHF*). I found the biggest gain in getting more signal out was to stack a pair of loops, giving us noticeable signal strength increase on both transmit and receive. But when it came to comparing individual loops, they were all just about the same.

I *did* find that construction techniques will make a big difference in how long a loop antenna may be expected to perform on a vehicle in rough terrain and encoun-

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

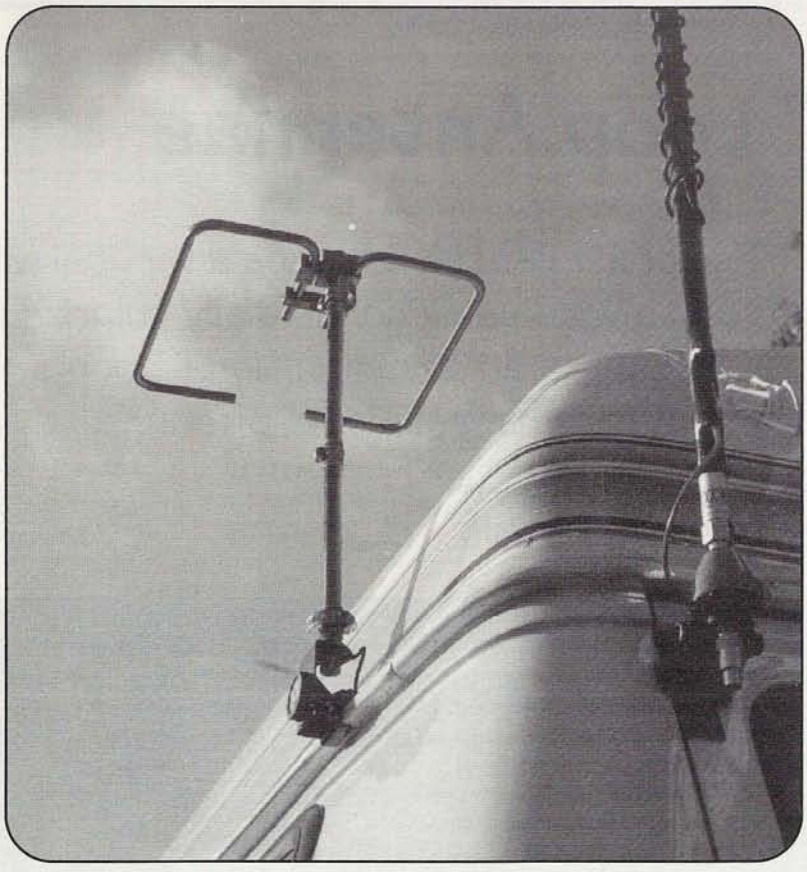


Photo B. The HO loop mounted on WB6NOA's communications van. While designed primarily for mobile use, the antenna is equally at home in base station installations where space is limited or you want an omnidirectional antenna.

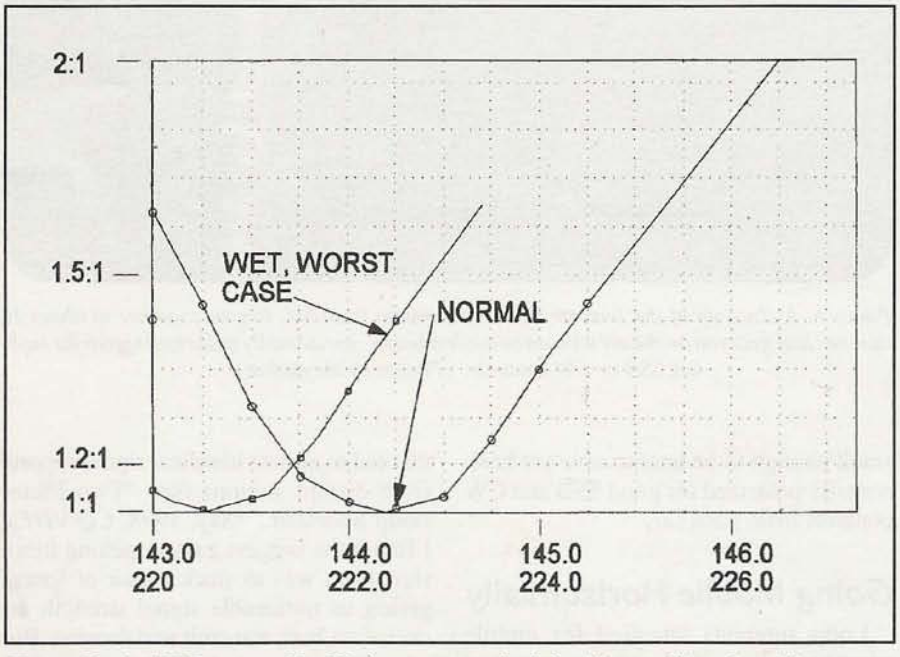


Figure. Typical SWR curve of the HO loop antenna, both dry ("normal") and wet ("wet, worst case"). Note that the SWR at the "normal" resonant frequency is still below 1.5:1, even in the worst-case/wet scenario. M² explains that the wet test was done with no wind and no physical movement to allow maximum water buildup on the antenna. And it says that any light wind or movement will reduce the shift to about one-half of what is pictured here. (Courtesy M² Antenna Systems)

ters with trees. We concluded that most loops we tested worked great in the clear, but worried how much abuse they could tolerate in encounters with tree branches, melting ice and snow, and all of the other things that can severely disrupt the radiation from these high-Q tuned circuits.

The M² Solution

M² antennas, developed by Mike Staal, K6MYC, are well known for their ability to hold up in heavy weather. Mike makes some incredible base station antennas and has recently redesigned the company's 6-meter, 2-meter, 222-MHz, and 432-MHz mobile loops into new "HO" loops that feature rigid construction techniques (Photo A). For this article, I tested the 2-meter version. Mine was bright blue anodized aluminum, and other colors are available as well, all as options. The standard "color" for the HO loops is plain anodized aluminum.

The antenna took about 10 minutes to assemble from the plastic bag, and a simple set of diagrams gives you approximate settings to begin your SWR measurements. I set the antenna for minimum SWR at 144.200 MHz, the 2-meter SSB calling frequency. Virtually all weak-signal contacts are made within 50 kHz of the calling frequency, except during contests and other periods of high activity.

Mike advertises the loop as "broadbanded" and it certainly is. After I tuned the M² 2-meter loop to minimum SWR at 144.200, I found that SWR barely budged anywhere between 144.100 and 144.300 MHz. And Mike's typical SWR curves (see Figure) show a 1.5:1 bandwidth of just about 2 MHz, with 1 full MHz on either side of the center frequency.

The SWR graph shows another important feature of the HO loops: their resistance to detuning by water. According to Mike, water detuning—a change in the resonant frequency caused by a buildup of water on the antenna element(s)—has long been a major problem with virtual-

"While the HO loops don't eliminate the problem [of water detuning], their wide bandwidth allows them to continue providing an SWR below 1.5:1...even when detuned by nearly 1 full MHz due to water buildup."

"The final test of an antenna is performance—and I found the M² loop's to be equal to other similar-sized loops on both transmit and receive, but with extra points for resistance to water detuning and rock-solid construction that will probably withstand all but the biggest ice storms."

ly all loop antennas, including some of his company's previous models. While the HO loops don't eliminate the problem, their wide bandwidth allows them to continue providing an SWR below 1.5:1 up to about 144.400 MHz (assuming a center frequency of 144.200), even when detuned by nearly 1 full MHz due to water buildup. So your rig shouldn't even notice a difference between wet and dry when using the HO loop.

How Omni Is Omni?

One question to ask about any horizontal loop antenna is how close it comes to being truly omnidirectional. There is typically a ±2dB difference between the sides of a half-wave loop antenna and the "ends" with the feedpoint and the gap between elements ends (more gain from the feedpoint/gap ends than from the sides). One of the antennas I tested in the past with almost no fades was the popular KB6KQ Mini-Loop, with about the best radiation pattern I've seen. How does the M² stack up?

The radiation pattern of the M² 2-meter loop was determined by using a Palomar PFS-1 antenna field strength meter, along with a half-wave dipole placed 50 feet away, in an area with nothing close by that could affect the signal strength readings. The radiation pattern on the M² was very acceptable, with a slight increase in signal strength favoring the ends of the loop pieces, as would be expected. Next, I repeated these tests on my communications vehicle (Photo B), and the M² loop was very good in holding a distant signal's strength as I drove around in circles. It was slightly better off the ends than on the sides, but you really couldn't tell the difference by listening or by looking at your signal strength meter.

Sturdy Construction

I was also impressed with the sturdiness of the M² 2-meter loop, and it should hold up well in rough environments. I did need to plug up the open holes at the ends of the tube to cut down on the amount of "singing" and whistling as we drove down the road. Apparently, this happens infrequently and only when the antenna is in a specific position relative to the wind, so if you encounter this problem, try reorienting the antenna first. If that doesn't take care of it, Mike suggests using some RTV (a non-conductive sealant) to fill the *inside* of the tube openings. He warns that putting a cap on the outside of the tubes will detune the antenna.

M² offers several different types of vehicle mounts including the "Big Foot," a four-legged mag-mount that can actually hold three loops at a time if you really want to get serious about operating SSB mobile on as many as three VHF/UHF bands. Plus, of course, there's no reason you can't use these antennas at home if space is limited.

The Bottom Line?

The final test of an antenna is performance—and I found the M² loop's to be equal to other similar-sized loops on both transmit and receive, but with extra points for resistance to water detuning and rock-solid construction that will probably withstand all but the biggest ice storms. This is one more useful horizontal loop antenna system that will give the mobile or fixed station operator good omnidirectional unity gain capabilities with horizontal polarization. And if you want just a little bit of gain in all directions, stack a pair with the optional M² stacking kit.

The M² 2-meter HO loop sells for $39. The stacking kit, which includes a two-cable harness, two mast sections, and a "T" junction block, is $59. ■

Resources

For more information, or to order, contact M² Antenna Systems, Inc., 7560 N. Del Mar Ave., Fresno, CA 93711; Phone: (209) 432-8873; Fax: (209) 432-3059; E-mail: <m2sales@aol.com>; Web: <http://www.m2inc.com>.

What You've Told Us...

Our February survey asked about your education, employment, upgrading plans, and on-air activity. As in past years, the results show that *CQ VHF* readers, as a group, are better educated than most Americans, with 34% of you being college graduates and 16% holding postgraduate degrees (that's a total of 50%, for the rest of you). In addition, 24% are technical school graduates, 22% are high school graduates, 2% are currently in elementary or secondary school, and another 2% are high school dropouts.

The largest single job category response was retired, with 27%. Another 3% are disabled and not working, and 2% are currently unemployed. Among those readers who are currently working, 26% hold professional or executive jobs, 22% have technical jobs, another 22% work for government agencies, 12% are in the "educator/writer/creative" category, 9% work in service industries, 4% are factory workers, 3% are students, and 1% are homemakers.

Moving on to ham questions, two-thirds of you who *can* upgrade your licenses plan to do so within the next two years. Finally, we asked about your operating mode(s). Not surprisingly, 89% of you are active on FM, followed by 57% on SSB, and 31% on packet. There was a tie at 8% each for APRS and ATV, and 5% of you are not active on any of these modes.

As always, thanks for your responses to our survey. This month's winner of a free one-year subscription to *CQ VHF* is Dave Thier of Toney, AL.

CQ VHF Ham Radio Above 50 MHz

Reader Survey—May, 1999

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

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

And, as a bit of an incentive, we'll pick one respondent every month and give that person a complimentary one-year subscription (or subscription extension) to CQ VHF. *Over the next couple of months, we'd like to find out—from your perspective—how* we're *doing:*

1. Please indicate whether this issue of *CQ VHF* was addressed to you:	**Circle Reader Service #**
Yes	1
No	2

2. If you are a subscriber, you should have received this issue in mid-April. Was it...	
Early	3
On time	4
Late	5

3. If your answer to Question 1. was "No," please indicate where you got this issue:	
At a bookstore/newsstand	6
From a ham radio dealer	7
Directly from CQ (e.g., at a hamfest)	8
From a friend	9
From a club, school, or public library	10
Other	11

4. Please indicate whether—overall—*CQ VHF* (circle all that apply):	
Meets the needs of newer hams	12
Meets the needs of experienced hams	13
Meets *your* ham radio needs	14

5. Please indicate whether *this issue* of *CQ VHF* (circle all that apply):	
Meets the needs of newer hams	15
Meets the needs of experienced hams	16
Meets *your* ham radio needs	17

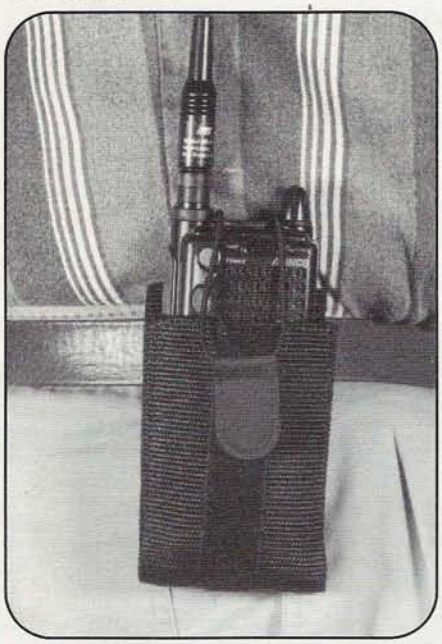
6. Please indicate whether you would like to see future issues of *CQ VHF* include (circle all that apply):	
More high-level technical articles/projects	18
More beginner-level technical articles/projects	19
More operating-related articles	20
More news/opinion-related articles	21
The same mix of articles as in this issue	22

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

Product Update

MFJ HamGear™ Radio Pouches

MFJ has introduced a Tactical Chest Harness and Belt Radio Holder to its line of HamGear™.



You can instantly adjust the radio chest harness to hold your handheld radio or cellular phone snugly to your chest for worry-free *and* hands-free operation. Use it for portable hamfest use, DXpeditions, Field Day, biking, hiking, search-and-rescue, etc. The chest harness has twin elastic antenna holders for short and long HT antennas and an adjustable Velcro® closure to accommodate any radio width. A 5-inch-wide by 7-inch-tall cargo pocket can hold another radio, maps, tools, compass, etc. Made of durable heavy-duty twill burlap, it's water resistant and will cushion your radio from blows and scrapes. Adjustable shoulder straps are made of high-strength nylon with heavy duty high-impact plastic shoulder strap adjustments. The harness is firmly held in place by a stretchable interwoven elastic belt with snap hook and adjustable sliders supported by nylon straps. One size fits all.

MFJ's Belt Radio Holder holds your radio vertically to improve reception. Strong, durable twill material protects small radios and cellular phones from damage while riding securely on your belt, which will easily slide through this 2-inch by 3-inch heavily stitched loop and remain firmly locked in place. It fits any size radio with handheld antenna, and its strong elastic cord with Velcro closure easily stretches over larger HTs and completely covers smaller radios. Belt not included.

MFJ HamGear merchandise is protected by MFJ's *No Matter What*™ one-year limited warranty. For more information and pricing, contact MFJ Enterprises, Inc., P.O. Box 494, Mississippi State, MS; Phone: (601) 323-5869; Fax: (601) 323-6551.

Circle 100 on reader service card

Cyber-Tour of Svetlana Tube Manufacturing

Svetlana invites you to take a cyber-tour of the company's tube manufacturing facility in St. Petersburg, Russia. Go to "The Tube Zone" at <http://www.svetlana.com> and click on "What's New" to view a series of photographs recently taken at the Svetlana plant in St. Petersburg. In some circles, tube manufacturing is no longer considered to be high-tech; however, it's a fascinating and intricate process steeped in the tradition of electronic manufacturing and, according to the folks at Svetlana, well worth your time to take the photographic tour.

For more information, contact Svetlana Headquarters, 8200 South Memorial Parkway, Huntsville, AL 35802; Phone: (256)-1344; Fax: (256)-8077; or Marketing and Engineering at 3000 Alpine Road, Portola Valley, CA 94028; Phone (650) 233-0429; Fax: (650) 233-0439; E-mail: <info@svetlana.com>; Web: <http://www.svetlana.com>.

Amateur or Commercial?

Choices are limited for amateur radio equipment kit-building, so the question for those of us who like to "tinker" is whether to use gear built specifically for ham radio or to adapt commercial equipment for ham use. W5LEP looks at the pros and cons of each.

By Larry Page, W5LEP*
(larrypage@seanet.com)

The rules of the Amateur Radio Service convey privileges and choices that are unmatched in any other radio service managed or regulated by the FCC[1]. As a result, we are the only radio service with the choice of purchasing purpose-built equipment (that is, equipment built specifically for amateur use), adapting equipment from other radio services, assembling equipment from kits, or designing and building equipment from scratch.

A number of earlier articles in *CQ VHF* have discussed how scratch-building was a necessity in earlier days of the hobby (and it still is an option or even a necessity for experimentation with esoteric modes or frequency bands). Some might claim that kit-building offers fewer choices than it once did, although there are still some opportunities to save money versus purchasing assembled equipment, or to experience the enjoyment of operating a useful piece of gear that one has built.

Although a few companies still offer kits for assembly, advances in technology and component packaging have made it difficult for an individual to assemble a product with the same capabilities as those manufactured in a factory environment. One interesting option which remains, however, is adapting commercially manufactured gear intended for other radio services for our use as amateurs.

Photo A. Motorola's "Railroad Spectra" is an adaptation of the company's popular high-end automotive radio. Special features include a dual-voltage power supply option and extensive DC filtering and conditioning. Remember...these were used in cabooses, where they were battery powered, and in locomotives, where they had to coexist with hundreds of volts and thousands of amperes of traction power.

Why Do It?

The first question that you might ask is, "Why, with all the excellent commercially manufactured amateur gear available, would I want to go to the trouble and expense of trying to use equipment from other services?" There are a number of really good answers to this question. Some of the best are also some of the least logical. The first one is that it can be fun.

My first experience in adapting equipment grew out of one of my other hobbies: railfanning (we chase locomotives instead of DX). When the railroads retired most of their cabooses a few years ago, a number of specialized railroad radios became available through surplus channels. My first non-amateur radio was a Motorola[2] railroad Spectra. This is a very high-end, wide-band intermod and cross-mod resistant VHF radio with 99 channels and 40 watts RF output. It's completely self-contained and its design and operation is unlike any other radio in

**Larry Page, W5LEP, is a native Texan who has lived in the suburban Seattle, Washington area for the past three and a half years. Originally licensed as KC7MKX, he is now W5LEP, in honor of his Texas heritage.*

Photo B. This is the more common automotive "dash-mount" version of the Spectra. Not shown are the required external speaker and the microphone.

my shack (see Photo A). In addition, this radio can be programmed for any VHF frequency between approximately 136 and 176 MHz without any physical modifications that would void its FCC type acceptance. This means that I can use it to listen to railroad communications, talk to other amateurs, or, upon authorization, communicate with local non-amateur organizations in emergency situations. Standard automotive mobile versions of the Spectra are also available for several bands (see Photo B).

As most of us are aware, one experience in life usually leads to another. I now have an additional interest: finding, repairing, and refurbishing Railroad Spectras and other railroad radios. This new activity allows me to experience the satisfaction that comes from taking a radio that I might receive as a "junker" (or more accurately, nearly a junker) and restoring it to as near new condition as possible, both operationally and cosmetically. It also gives me a means of "improving my communication and technical skills," in compliance with Part 97 rules describing the purposes of the Amateur Radio Service.

Finally, using commercial equipment has allowed me to solve an operational problem that I was unable to solve using any other approach. Much of my time is spent in downtown Seattle, Washington. Because several commercial television transmitters are located here, along with the area's National Weather Service transmitters, high-power VHF paging transmitters, VHF marine base stations, and a host of other signal sources, this area is filled with intermod and cross mod interference problems (see Photo C). In addition, in case of a disaster, my assignment is at a local hospital, complete with its own additional rooftop transmitters and interference sources. My commercial radios are the only ones that are reliable in this environment, due to the use of six-pole filters and tracking filters in the input signal path (tracking filters are designed so that their passband actually moves as the receiver is tuned).

Making a Choice

As with any set of choices, there are positives and negatives to both amateur and commercial gear. I have both in my shack and vehicle. Making a choice involves analyzing the tradeoffs and choosing what's best for you. Your choice may not be the same as mine. And mine might not be the same if I were living somewhere else with a different operating environment and different operating requirements.

Let's first discuss the pros of operating using manufactured amateur equipment. First, that equipment gives us an incredible amount of control over our operation. Even basic units provide a VFO, variable squelch, transmitter/receiver frequency offset, transmit and receive subaudible tones, and transmitter power output adjustments. Most also provide automatic repeater offset and some means of generating DTMF signals to access the local autopatch or repeater controls. Other features are then added, such as memories, scan capability, and "paging" functions. And we just assume that virtually any radio will include an accurate S-meter. The end result is equipment that supports incredible operating flexibility. In addition, most of our equipment comes from the manufacturer set up to transmit only within amateur frequency limits. We don't have to worry about accidentally transmitting out-of-band...the radio takes care of it for us.

On the negative side, my experience is that the trend toward miniaturization has created some problems. My pet peeve is control panels and displays that are too small and crowded to be used safely in a vehicle, especially when the placement of

Photo C. The transmitting towers in this photograph are about a mile north of downtown Seattle on Queen Anne Hill. The array of TV, FM broadcast, and other antennas mounted on them generates an interesting "soup" of signals for receiver front ends to sort out.

controls is not consistent from one radio to another. Many units have heatsinks that are too small (my opinion), leading—in extended use—to elevated operating temperatures that almost certainly will result in eventual component failure. In addition, microphones, cables, and connectors are marginally designed, with controls that are too small, cables and connectors that are too delicate, and limited strain relief. Undersized speakers and underpowered audio amplifiers in modern compact handie-talkies can lead to problems hearing received signals in anything less than ideal operating environments, even using a headset.

Another problem, in the case of at least one manufacturer, is that there are significant limitations on subaudible tone capabilities (the inability to use different transmit and receive tones). This can cause operating problems when using some repeater systems.

Finally, for some reason, most amateur equipment available for VHF and UHF frequencies is quite homogeneous. There are a few choices between FM-only and all-mode radios, for instance, but otherwise everything seems to be aimed at the same "price point." There is not a choice to spend a little more and get a more rugged radio with similar features.

The natural parallel here is to the power tool industry, where a single manufacturer will build a variety of models of each type of power tool. For example, electric drills are available, ranging from very inexpensive models with small motors and sleeve bearings, to models with larger motors and ball bearings (for a higher price), to premium models with big motors with roller bearings and perhaps even a "hammer drill" function. All of these drills perform the same basic function. Certainly all of them will drill holes, but, for additional money, a purchaser can choose additional features, added capacity, and added durability.

Examining Commercial Gear

Commercial radios are generally available in a variety of performance and construction grades. In Motorola's case, the most economical models are generally the "Radius" products. Other models covering the same bands are typically the MaxTrac, the Spectra, and, finally, the Astro.

In addition, commercial radio equipment is routinely used in difficult environments. Besides being built to be physically more rugged, with multiple forms of strain relief on the cable leading to the almost indestructible (and perhaps noise-canceling) microphone, the audio systems are typically capable of 5 watts output or more (a railroad Spectra can deliver 20 watts of audio into a 3.2-ohm speaker). Mounting brackets are made of heavy-gauge steel and offer a large number of pre-drilled holes for a secure installation in a variety of settings. High-quality external speakers can be mounted in the location that will provide best audibility.

Because audio quality is important on both transmit and receive, almost all of these units will offer true frequency modulation, rather than the phase modulation or reactance modulation common on much ham equipment. Most are type-accepted for a number of services, so the operating band, or "split" will probably be wide (*this is a different use of the term "split" than you may be used to with ham rigs, for which it indicates the repeater offset, or difference, between its transmit and receive frequencies—ed.*). Because many licenses involve shared use of channels by multiple licensees, most will have extensive subaudible tone capability and flexibility, probably including digital subaudible signaling.

On the Other Hand...

Before you say, "Let's just ditch the amateur manufacturers and use commercial stuff," you need to understand the limitations of commercial equipment.

First, as I hinted above, equipment for commercial and public safety application will almost never provide front panel VFO control. This means that field flexibility may be severely limited, especially in radios with only a few "channels," or memories.

Second, with some exceptions, there will be no transmit power control. If

Software and Firmware

It's rare to purchase any two-way radio today which does not contain at least one microprocessor. In some cases, these may be radios of rather "traditional" design, using a microprocessor to manage front panel displays and controls, remember the memories, and control the VCO (voltage-controlled oscillator) in the tuner. The trend in commercial radio equipment, however, is to bring all radio functions under the control of one or more microprocessors. In this case, power output, deviation, tuning, and most other basic functions may be controlled by DC voltages that are set by these microprocessors. Special software and hardware may be necessary to adjust these functions.

It's important to make a distinction between radio parameters that are intended to be user-controlled via the manufacturer's programming software and any necessary interfaces and those functions intended to be internal to the radio. While it may be possible to render a radio inoperable by thoughtless use of the programming software, it's not likely that the software will allow you to permanently damage the radio or void its type acceptance. Changes made directly to the radio's internal controlling software or firmware are a different story. This is something you should consider very carefully before delving into a radio through any means other than those intended for the field user or technician.

While it's true that some basic radio functions and capabilities can be extended or changed by tweaking or "hacking" in some models, doing so may create problems, such as excessive spurious emissions, improper deviation limits, or overdriven PA (power amplifier) finals. As a result, manufacturers typically take a dim view of this sort of tweaking, especially in a case in which your radio for some reason might later find itself back in commercial or public safety service. In addition, the manufacturer has generally copyrighted the software driving the radio and probably considers it valuable intellectual property.

Finally, if you had purchased the equipment new, part of what you would have received would have been a software license similar to the license that comes as part of PC software. Some manufacturers, Motorola among them, have been aggressively pursuing protection of their software and intellectual property rights. Motorola has recently won a significant court case against a person in Canada who was using and selling illegal copies of the software used to program and service its two-way radios.

there is control of transmitter output at all, it will likely be via having the same frequency stored in multiple "channels," with a power level setting as part of the channel's parameters. Remember, the FCC says you should use only the minimum amount of power needed for effective communication.

Third, these broadband radios will require diligence to avoid transmitting improperly "out-of-band" and ensuring that they don't fall into hands where they might be misused. Fourth, frequency selection will require PC programming, probably using special software and hardware that may be expensive to obtain. S-meters are generally unheard of, although some models will offer a "channel busy" indicator, usually a simple light-emitting diode (LED).

Finally, even though the radios themselves are usually available through surplus channels at a fraction of their initial cost, replacement parts and repairs will almost certainly be very expensive. Replacement parts for older models may not be available at all. And beware especially of radios that require "channel elements" or one-time EPROMs for frequency control (see Photo D). While likely still available if you look hard enough, these are no longer mainstream items and can be very expensive.

Photo D. The MCX100 railroad radio (left) requires expensive EPROMs and a special programmer to change the operating frequencies. The MT500 (right) can be purchased very inexpensively, but it uses individual transmit and receive channel elements, which can be very costly to purchase. Like most other commercial HTs, it's available with or without a keypad.

Getting Started

If you decide to branch out into gear produced for commercial or public safety use, your first decision will be what to buy. As with any endeavor, knowledge is power here. The range of surplus and used equipment available is almost mind-boggling. You must gain at least some knowledge about the model names and numbers. Almost without exception, one radio will cover one band, but in most cases, radios of each model name were made in several versions, each covering one band or maybe a portion of one band. You need to know about low, middle, and high band splits (136 to 150 MHz, 146 to 162 MHz, 156 to 176 MHz, for example), and if a radio is listed as 146 to 162, you need to know if it will really tune down to 145 or so to cover local repeaters.

Next, you'll have to decide what level of effort you're willing to expend to make the equipment work on amateur frequencies. It may be simply a matter of programming. One popular handheld will tune all the way from 146 to 174 MHz via software (see Photo E). Another model is also software programmable, but re-quires adjustment of a coupling capacitor for maximum transmitter output and a coil slug for maximum receive sensitivity. Older units may require adjusting as many as seven or eight coils in the receiver and four or five in the transmitter for proper alignment. If these adjustments are not done properly, either performance can be unacceptable, or spurious emissions can exceed legal allowable limits.

Still other units may require replacement of one or more components to allow operation on the amateur bands. This is an important distinction, because when a component is changed from what was initially in the radio, any existing FCC type acceptance is generally voided. Once this happens, that radio can no longer be used legally to transmit on business or public safety bands. And some radios just cannot be reasonably made to operate "out-of-band."

An example of this case is the Motorola Spectra designed for the 900-MHz business band. Several of us have been interested in modifying these radios to operate in the 902- to 928-MHz amateur band. This is a very difficult band for operation due to the proximity to our band edges of extremely high-power paging transmitters and AVL (automatic vehicle location) base stations, in addition to the ISM (industrial, scientific, and medical) emissions with which we share this band. The Spectra's performance characteristics would be perfect for this band. Unfortunately, we just haven't been able to make it happen. Why? Because the six-pole filters which give the Spectra the specifications we're looking for are designed to block reception of interfering ISM and paging signals. As a result, they also block reception of any amateur signals in the 902- to 928-MHz range. The filters would have to be replaced, and, once that was done, the outstanding performance characteristics of the receiver would be lost.

Finding Equipment

Once you have decided what to buy and made the decision to move ahead, the question becomes, "Where do I find it?" I have found that there are three major viable sources, with a fourth that can sometimes work well. The first and best is to locate a knowledgeable and trustworthy local used/surplus dealer who knows about what he's selling and is will-

Photo E. These Motorola Saber Handie Talkies correspond to the Spectra mobiles in design and age. The VHF Saber will program to any frequency between 146 and 174 MHz, with any repeater offset you wish, and offers a full range of subaudible tone and digital squelch control capability.

"If you decide to branch out into gear produced for commercial or public safety use, your first decision will be what to buy. As with any endeavor, knowledge is power here."

ing to treat you honestly and share his knowledge with you. Once you've established yourself as loyal customer, you're likely to have your questions answered and receive some other help as well. (Remember, though, that dealing in used and surplus equipment is difficult and that it's hard to make a lot of money at it. Don't become a nuisance.) Much equipment is available through hamfests and swap meets, which I include in this category as well.

The second source of used commercial equipment is the Internet. Several sites contain listings of used and surplus equipment for sale by companies and individuals. One aspect of Internet shopping of which I'm not particularly fond is that prepayment has become almost the de-facto standard for doing business. This essentially puts all the risk on you, the buyer, in case your seller is running a fraudulent advertisement or is unreasonably slow to ship. My preference is COD (collect on delivery), because, even though the cost may be somewhat higher, protection is provided for both buyer and seller. My strategy: offer to pay shipping costs if a shipment is sent COD, but require the seller to cover the shipping within his advertised price if advance payment is required.

The third source is commercial radio shops. They often accept used equipment in trade toward newer equipment, then either resell this equipment as received, or refurbish it for resale. Listings can be found on the Internet or in the back of commercial two-way radio publications. The advantage here is that purchases can usually be made with a credit card, and many card agreements contain provisions to protect the purchaser. The disadvantage is that prices are usually significantly higher than for similar equipment purchased through other sources.

The final source of used or surplus equipment is via direct purchase from the prior owner. This may be for a set price per item if buying from a business or individual or via some sort of bidding process if buying from a government agency. The big advantage here, of course, is price. There is no cheaper way to buy. The disadvantage is that you generally have limited control over which units you receive when bidding to buy from a government agency. There is a real likelihood of getting a "parts only" radio or maybe even a complete junker. So be careful and understand very explicitly what you are bidding for.

Some Thoughts about Used and Surplus Equipment

No matter which source you choose, be aware that most of these radios, whether mobiles or HTs, have been used under very demanding service conditions. Some may have been used in all types of weather without protection. Some may have been dropped one or more times. Some may have been used in corrosive environments. They almost certainly will have received less care than your favorite radio has. So take seriously any notations about condition which are included in listings. Be on the lookout for worn-out units in new cases. And be prepared to pay a premium for the rare exception—the "technician's radio"—which should be as clean and shiny as the day it was first taken from the box.

It's important to understand that used radio equipment is in many ways like used cars. First and foremost, it's equipment that someone, for some reason, didn't want any more. There are several reasons that this might be true.

First, the stuff may not work. Some organizations will not go beyond simple, basic repairs if a radio stops working, unless it's a very recent purchase. The reason is that repair costs can quickly approach the cost of a new radio. Even when the repairs are completed, the owner still has an "old" radio with the associated shortened remaining life and reduced reliability.

Second, it may just be worn out. After repeated visits to the radio shop for service and routine maintenance, many of the fasteners holding things together may be missing. Screw threads may be stripped. Connectors between circuit boards may be worn and unreliable. Interconnecting wires may have broken or become unsoldered. Parts may be loose inside. The antenna connector may be so bent or distorted that the mating connector will no longer fit.

Third, and hopefully most commonly, retired equipment may just be older models or represent a previous generation of technology. For instance, addition of a channel or channels to a station license may have required an upgrade to a trunking system, requiring that all "conventional only" radios be retired. Activation of a co-channel licensee may have required the use of subaudible tone squelch control, rendering obsolete any remaining equipment incapable of tone squelch. Or replacement may have been ordered in the belief that repair parts availability is or soon will be a problem.

You need to be aware of all these factors when considering the purchase of any used equipment. Hopefully, the man-

ufacturers and sellers will keep them in mind as well, and keep the resale and programming service prices under control, because amateurs represent their most viable opportunity for ensuring that this material finds its way into the hands of responsible final users.

In Conclusion

While it's not right for every amateur or for every situation, there are times when adapting used equipment from other radio services may be just the thing for hams. Under the right conditions, and after the right research and for the right price, however, doing so may solve operational problems, save money, or just be educational and a lot of fun.

Notes

1. I believe that I have a reasonably good understanding of Part 97 rules and of the general framework within which wireless and broadcast services operate. On the other hand, while I am familiar with Part 90 of the rules, governing the various commercial and public safety radio services, I in no way claim to be an expert in that area beyond the areas in which I have operated. Anyone who plans to operate a transmitter in any of these services is responsible for understanding these rules and operating according to them. And don't even think of operating outside the amateur bands without making absolutely certain you have the permission of whoever has the license for the frequency you plan to use.
Also...my interest in commercial equipment is currently centered on one manufacturer. This article reflects that interest, although there are and have been a number of other makers of good equipment usable in the amateur service.
2. Motorola, Handie Talkie, Spectra, MCX100, MT500, MaxTrac, Radius, and Saber are trademarks of Motorola, Inc. ■

Resources

To find a two-way dealer in your area who buys and sells used commercial radios, check your *Yellow Pages* under "Radio Communication Equipment & Systems" or something similar.

You can find a directory of surplus radio dealers on the Web at <http://www.cdi2.com/build_it/surplus.htm>.

It's also a good idea to get to know the people who maintain the two-way radio equipment for your local government agencies.

Mush! Hams and the John Beargrease Marathon

Think it was cold last winter where you live? Try the north woods of Minnesota...in January...providing communications for a 325-mile dogsled race. Now that's, well, doggone cold!

As ham radio operators, many of us will be participating this spring and summer in bike races, walk-a-thons, and other outdoor events. But this month, we're going to look back a few months, to January, and take a look at a few hardy ham radio operators who traveled to the shores of Lake Superior to participate in the John Beargrease Sled Dog Marathon. As we'll see, this group of hams serves in the public interest in some of the most extreme conditions any of us would ever face.

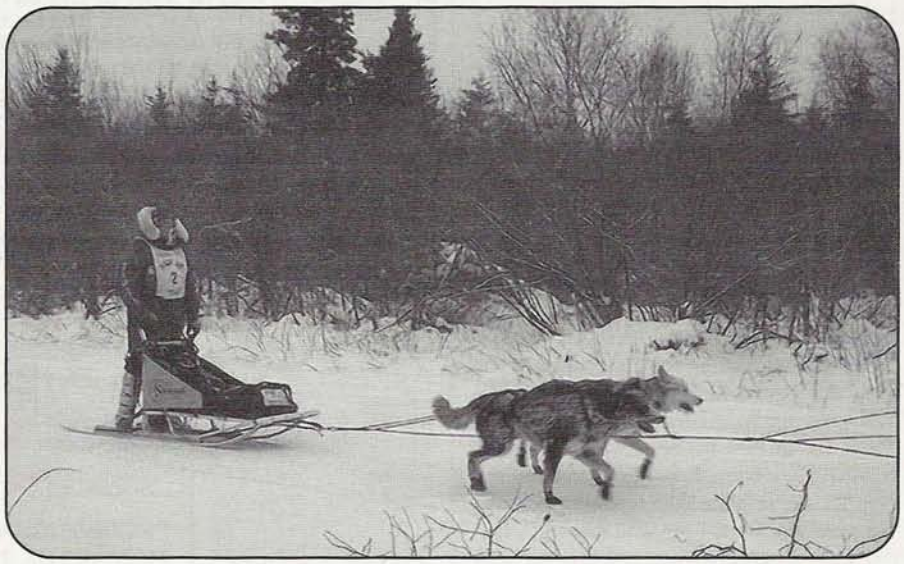


Photo A. A racer and part of his dog team compete in the annual John Beargrease Sled Dog Marathon in Minnesota. Note the "booties" on the dogs' feet to protect them from being cut on the icy surface. (Photo courtesy of Kyle Krown and John Sumner)

Who Is John Beargrease?

John Beargrease was best known for his legendary mail delivery runs from 1887 to 1900. He hiked, sailed, rowed, and, during the winter, traveled by dog sled, delivering the mail up the north shore of Lake Superior between Two Harbors and Grand Marais, Minnesota. Beargrease would make one, and sometimes two, round trips every week, depending on the volume of mail going to Two Harbors. His fastest time one way, using a team of four sled dogs, was 20 hours. Considering that there were no trails over land and no bridges across the streams and rivers at that time, this was quite an impressive accomplishment. The annual John Beargrease Sled Dog Marathon (see Photo A) commemorates his pivotal role in the development of the North Shore of Lake Superior.

This year's race took place in mid-January, starting out from Duluth, Minnesota, and traveling northeast over snowmobile trails to Grand Portage, Beargrease's home some 300 miles away (see Table 1). No, this race is not the same as the Indianapolis or Daytona 500, but the enthusiasm of the crowd is just as intense. For the ninth year, some 20 hams, members of the Beargrease Amateur Radio Coalition (BARC), ventured out into the cold to provide valuable communications.

First Order of Business—Find Snow!

Race officials reported that weekend snowfall had given the north shore enough snow to hold the race. Beargrease officials found up to 12 inches of snow on the course and two lakes frozen over. Alex Angelos, a race coordinator, felt confident there would be enough snow to safely hold a race. While the racers were out to win one of the most prestigious and challenging mushing events (see "Mushing Glossary" for dog sledding terminology) in the lower 48 states, they were also chasing one of the largest sled dog race purses: a guaranteed $40,000.

There were two divisions, the Marathon and the Mid-Distance. Each Marathon team was to stop in Two Harbors, Beaver Bay, and Finland and run up the Gunflint Trail before finishing in Grand

By Bob Josuweit, WA3PZO (wa3pzo@cq-vhf.com)

Table 1.

Checkpoint location	Segment miles	Total miles
Canal Park to Prime Time	15	15
Prime Time to Two Harbors	49	64
Two Harbors to Beaver Bay	41	105
Beaver Bay to Finland	24	129
Finland to Sawbill	31	160
Sawbill to Trail Center (Poplar Lake)	77	237
Trail Center to Devil's Track (Skyport) (Mandatory 6-hour layover and vet check)	29	266
Devil's Track to Grand Portage	58	324

Table 1. Race distances, courtesy of the Beargrease Web page <http://www.beargrease.com>.

Portage. Mid-distance teams would stop in Two Harbors and Finland before finishing in Sawbill. There were 19 teams of up to 14 dogs entered in the marathon race and 32 teams of up to eight dogs entered the 150-mile mid-distance race.

Baby, It's Cold Outside!

At the start of this year's race (Photos B and C), the temperature was about -24 degrees (*yes, minus 24—Fahrenheit—ed.*). Temperatures at night got to be 38 degrees below zero. As Race Coordinator Angelos put it, "It's downright cold."

Russ Marsolek, NØQKG, operated the event for the first time this year. He said it was very challenging for a couple of reasons. "The first and biggest challenge was the temperature. The morning of January 10th, it was 58 degrees below zero wind-chill! Cold enough to turn my two 5-gallon water containers into two 5-gallon ice cubes!"

While accommodations might not have matched a fancy New York hotel, conditions inside Marsolek's camper (Photo D) were not that bad. He said setting up late Sunday night was simple. "Find the location, off-load my generator, crank it up, warm up, and get some sleep," he said. "That night it was 10 degrees below zero actual temperature inside the camper. By 0100, I had it up to 30 degrees above zero, and when I woke up at 0630 on Monday, it was 60+ degrees inside! Toasty!"

Photo B. Mushers leave the starting gate at the beginning of a 330-mile journey. (Courtesy Rick Schroeder)

"Temperatures at night got to be 38 degrees below zero. As Race Coordinator [Alex] Angelos put it, 'It's downright cold.' "

Being Prepared

Before venturing out in this environment, it was important for every person to know what was expected of them and what they were to do. BARC officials developed an operating manual which explains the role of all groups participating in the event and how the hams should send information to the Net Control Station (NCS). The procedures detailed how to report arrival times, bib numbers, number of dogs, etc. At race headquarters, this information was entered onto a spreadsheet to keep track of the musher's progress.

Jeff Hunter, NØTCM, provided communication guidelines. Acceptable types of communication included:

1) Transmissions related to health, safety, and welfare of mushers, dogs, or race participants;
2) Emergencies: any incident requiring immediate attention involving a life or death situation of a human or dog;
3) Requests to locate any officials;
4) Reports of each team's arrival and departure times ;
5) Any discrepancies regarding arrival and departure times and dog counts.

Unacceptable transmissions included:

1) Information known by the ham operator to be false, even if provided by an official;
2) Discrepancies between officials, except where a phone or cellphone is not available. The ham operator was not to be placed in a position to referee a discrepancy between officials.
3) Requests from handlers/mushers, officials for net control to calculate specific team average speeds, unless related to health, safety, and welfare of the race participants.
4) Any swearing or abusive language not permitted by FCC rules.

There were even specific instructions on how to handle emergencies involving

either a human or a dog. Q-signals, or standard abbreviations, were incorporated for these special situations. They included QIH, Injured Human; QID, Injured Dog; QDH, Dead Human; and QDD, Dead Dog.

Reporting for Duty!

Since he was visiting the race for the first time with Gary and Gladys Peterson, NØZOD and KBØTUT, Marsolek was assigned to the Two Harbors checkpoint. This gave him a chance to learn exactly what was expected by monitoring the radio for traffic from earlier crossings or checkpoints. By the time the mushers and dog teams arrived at Two Harbors, he was ready just by listening to the previous reports. Later, he was given the opportunity to move to the Sawbill checkpoint.

The hams' duties at each checkpoint were to log and report to NCS which "musher" (driver) checked in, at what time, and with how many dogs (Photo E); the same information was to be logged and reported for each musher leaving the checkpoint. Also at every checkpoint were official judges, handlers, and veterinarians. The vets checked over every team to ensure that the dogs were in good shape: no cuts on the paws, the harnesses had to be padded, and the dogs could show no sign of any abuse.

(In fact, the average person would think the dogs are treated better than the people. "Believe me," Marsolek said, "when I state that the dogs are very well maintained and cared for." The dogs were fed a mixture of warm broth, mixed with raw meat (beaver or beef) One owner said the costs of food alone for a team of 16 dogs was in excess of $40,000! Add on all of the other expenses and, as Marsolek put it, "Too rich for me!")

So what kinds of problems do the hams deal with? Shortly after the marathon runners left the starting chute, BARC members reported seeing a dog team crossing a road a few blocks away from the official crossing...minus its sled and musher. The BARC radio team and volunteers chased down the dogs and held onto them while trying to determine who they belonged to. The word on the trail was to watch for a musher walking through the woods, trying to catch up. The musher eventually regrouped with his team and got back on the trail.

Dogs are no different from humans when it comes to protecting feet on the hard and icy trails, and they had to wear special protective "booties" (look closely at the dogs' feet in the photos) which had to be changed when they were damaged. The mushers were doing a lot of booty changing at each checkpoint. For the hams at the checkpoints, the first challenge was sorting out who was there with how many dogs, while simultaneously dealing with routine requests. A typical request of needing volunteers at a particular street crossing was radioed ahead. No one wants to have a dog or rider hit by an oncoming car. At one point, unfortunately, the hams did have to handle a report of a downed dog.

Photo C. Dogs and sleds set a good pace early in the race along Duluth Lake Walk. (Courtesy of Kyle Krown and John Sumner)

Bob Linneman of the Duluth *News-Tribune* calls the BARC members the "guardian angels" of this annual race. In the event of trouble, he notes, they can immediately call for help—often in places where cellular telephones don't work and telephone land-lines don't

Mushing Glossary

Basket—The body of the sled in which freight or passengers may be carried.

Chief Judge—The person with the final say in determining all race rules and regulations.

Chute—Starting point of the race.

Dog Bag—The large bag carried in the basket of the sled. Used to carry injured dogs back to a checkpoint or finish line.

Hike—Voice command used to get the dogs running. *Let's go* or *Hup* is also used.

Mush—A term falsely thought to be what a dog driver uses to get his dogs to go.

Musher—A name for anyone who drives a dog team.

Toboggan Sled—A sled with a low, smooth bottom on the basket. Used when traveling through deep snow or a soft trail.

Trail—The prescribed, marked course that the team must follow. Also the terminology used when a driver wants a clear pass by the team in front of him.

Trail Help—Those standing at road crossings and dangerous parts of the trail to help the drivers.

Whoa—The voice command used to slow and stop the team.

*#!!$%^@#%—Language sometimes used by a musher when the team takes a short cut or scenic route without the musher's permission. Also used frequently when dogs tangle the lines.

Reprinted from the Beargrease Web page <http://www.beargrease.com>.

Table 2.

Steve Rasmussen

Checkpoint	Into Checkpoint	Dogs In	Out of Checkpoint	Dogs Out	MPH	Early ETA	Average ETA	Late ETA
Start			1/10/99 13:31	14				
Prime Time	1/10/99 14:59	14	1/10/99 15:16	14	10.2			
Two Harbors	1/10/99 19:31	14	1/10/99 21:10	14	9.3	1/10/99 18:29	1/10/99 19:08	1/10/99 20:06
Beaver Bay						1/11/99 0:50	1/11/99 1:34	1/11/99 2:40
Finland								
Sawbill								
Poplar Lake								
Devil's Track								
Finish								
If musher has scratched, change this 0 to a 1:							0	

Table 2. Sample BARC spreadsheet used to track each musher. Courtesy BARC, from its Web page at <http://www.cp.duluth.mn.us/~kb0kqa/barc/>.

reach. "The volunteer radio operators who dot the course during the race can be the only link to the outside world."

BARC president Steve Durst, KBØVLW, recalled a story from last year's race. He described a sick musher pulling into the Cascade River checkpoint. He was vomiting and extremely cold; the race had taken a heavy toll. It was 22 degrees below zero and the musher's frozen beard had literally locked his mouth shut. Durst picked ice off of the musher's beard, helped him thaw out and allowed him to drink fluids. The musher had made himself ill by drinking water from an empty dog-food container and had been sick for miles on the trail. Durst nursed the musher back to health to the point that he finished the race.

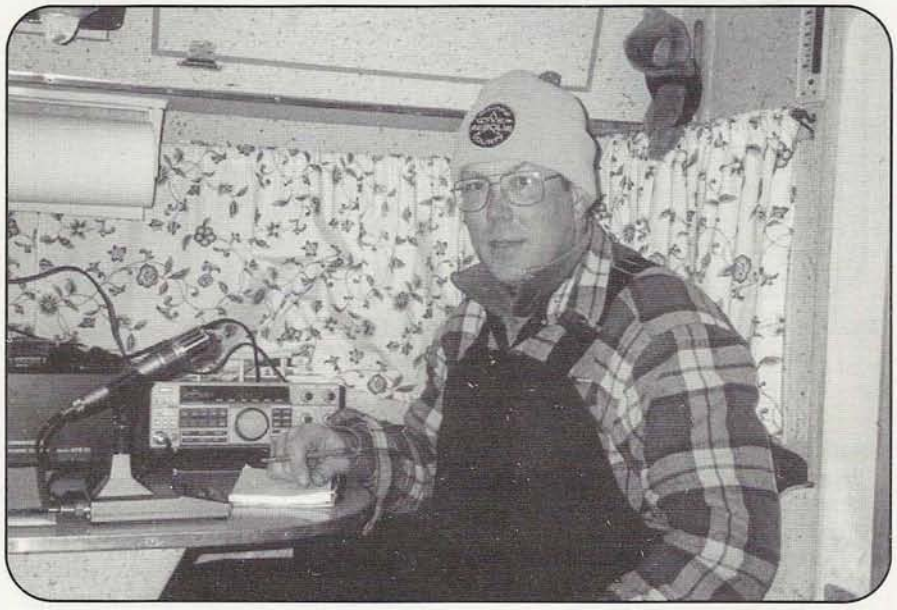


Photo D. Russ Marsolek, NØQKG, stays "toasty" in his camper. (Courtesy NØQKG)

Why Leave the Comfort of Home?

Durst, who is an avid outdoorsman, has been on expeditions to the Arctic among other places. "It's knowing you will be there when someone is needed," he explains of his motivation to volunteer for this event. "For me, it's being out in the north. You connect with the dogs and the mushers."

Fred Floura, KBØSPB, who coordinated BARC's checkpoints this year, said, "As a group we're always there ready and willing to donate time and communication. The camaraderie is what gets a lot of people going."

Two years ago, when a train crashed along the race route, the radio group helped mushers find their way to the checkpoints through a confused jumble of road closures and emergency vehicles. Floura said it's the radio group that helps make sure road crossings are clear when teams come through so no one gets hurt. It's the radio group that can help steer teams away from potential danger.

Finally, Jeff Hunter, NØTCM, listed his top 10 reasons for getting involved in the Race:

1. We provide a safety net for an event that is rather unique.
2. This is public service at its finest.
3. It takes a special dedication to provide this type of public service, and after it is over we all have a sense of accomplishment
4. This race is run non-stop, 24 hours a day, for a little over five days; it is about the best emergency communications preparation a ham can get.
5. The course takes the mushers out into the dark of night and the cold of Northeastern Minnesota with temperatures as low as -48 degrees F.
6. The race is tough on the mushers; fewer than 50% of all starters will finish this marathon.
7. We have been involved with operations that have recovered mushers from the trail.

Photo E. Both mushers and dogs must protect themselves from the extreme cold as they make their way through the wilderness. (Courtesy Kyle Krown and John Sumner)

8. Our efforts-have been truly appreciated by the mushers, handlers, vets, and spectators.
9. I know several people who became hams after I met them during this event.
10. This is a volunteer-driven event; anyone you work with is there because they want to be. It is just plain fun to do.

Personal Goals

One of Marsolek's personal goals on his first time out was to test out his equipment in a situation similar to an emergency. From inside his camper, he was able to reach the Grand Portage repeater. This repeater, along with others, are all linked, so he had solid communications with the NCS in Duluth. He said flexibility and quick planning are important elements.

I wanted to monitor other simplex traffic (as well as the repeaters), so I hooked up an HT to the 2-meter antenna located at the rear of the camper. Perfect! The problem, however, was when I was working outside near the dogs. My other dual-band HT could not reach any repeater, so I programmed the camper radio in a crossband mode. That way, from outside on an HT, I transmitted on UHF into the camper where it sent it out my transmission on VHF to the repeater (and the repeater's output was sent back out to my HT on UHF). Not quite earth-shattering, but it was what was needed. My entire operation was also without commercial power.

My highlight, however, was when I had the "OK" to go to Sawbill. I had been hearing all week how this was a difficult location to cover as it was in a very remote spot, surrounded on three sides by huge hills and the Temperance River on the fourth. Perfect for me wanting to get away!

What did I learn? First off, carry your drinking water in the cab of your vehicle in the wintertime. Know your equipment. Having my radio manuals in the camper was perfect. Know how long your generator will run on a full tank of fuel (exactly five hours, in my case). Have spare HTs with you. Gel cell batteries, too. Bring several pencils (pens don't work when it is that cold!) and a clipboard.

Here is a big lesson learned: Common power connectors were invaluable! I was able to switch radios between several power supplies without any glitches because of the connectors. If other sites would have had the same connectors, we could have left gear for them to use as well. Finally, *wear warm clothes and keep the skin covered*!

Marsolek will be back next year and hopes others will join him.

The Public Is Listening!

The race is big news in the area and many avid spectators are interested in following the progress of the mushers as they make their way along the course. Many of these spectators turned to the Beargrease Internet Web site for information. Here, a non-ham monitored BARC communications and reported on events that were talked about on the radio. The typist was extremely complimentary of the professionalism that BARC members displayed on the radio. Other reports on the race teams were also posted. With a running dialog of reports from 6 a.m. until 10:30 p.m., this Web site provided some of the most up-to-date written information available on the race.

Do You Have a Story to Tell?

We're always looking for information about how *your* group is serving in the public interest. Just drop us a line, either by mail or to our e-mail box at <wa3pzo@cq-vhf.com>. ■

Oops...

We left out part of an Internet address in the "Digital Data Link" Resources box in the March issue. If you want to view the DCC paper on high-speed modems by Thomas Sailer, HB9JNX, and Johannes Kniep, DG3RBU, that was referenced in the article, the correct URL is <http://www.ife.ee.ethz.ch/~sailer/ham/dcc98/epp_dcc98/epp.html>. Thanks to eagle-eyed reader Mark Bary, N4EOC, for not only catching the error, but also figuring out what we'd left out.

Letters

Your Spot to Speak Out

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, *25 Newbridge Rd., Hicksville, NY 11801; or via e-mail to <letters@cq-vhf.com>. Please specify that it is a letter for* CQ VHF *magazine.*

Swatting the Y2K Bug

Dear *CQ VHF*:

The Y2K arrival presents a human service as well as public relations opportunity that ham radio cannot afford to pass up, especially with the ease of VHF communications via simplex and repeaters which are often quite independent of the common power and communication systems. So with some planning, our RACES and ARES nets have the experience to collect, verify, and handle any important, accurate information as the passage of new year occurs.

With preparation, hams worldwide could establish official "Y2K Nets" on various HF frequencies from time zone to time zone, monitoring and reporting VHF net information which could be useful to the next area(s). Obviously, there are some who could even arrange satellite communications. Information needs to be accurate, for we would expect there will be many SWLs and media people monitoring. If nothing much happens, then many public fears will be quelled. If there should be any unexpected problems, the information may be of preventative help elsewhere. Note also: as is our history, we always need to have some additional people in readiness to help local public services if needed.

Bill Breuer, KE4SGV
Louisville, Kentucky

Bill—What an excellent idea. I hope that it's noticed by the "PTB" (powers that be), to whom Peter O'Dell refers in this month's editorial, and put into action nationwide.

A Very Satisfied Customer

Dear *CQ VHF*:

Being an electronics store manager, I am involved with the advertising aspect of the business as well as store operations. One of my biggest problems when it comes to budgeting ad dollars is never really knowing if the ads work or not. I never get any feedback. Which is why I think you should tell one of your advertisers, Yaesu USA, that a subscriber to your magazine *did* buy.

The June, 1998, review of the FT-847, by Gordon West, sparked my interest and I must have read it 50 times. The review was well written, wonderfully illustrated, and I trust the opinion of Mr. West. Actually, I never saw the rig in person, nor did I read any other reviews. My decision was based solely upon your fine reputation and that of Gordon West. The radio was everything he said it was and more. I love it. I think Yaesu deserves to know this.

Thanks for a great magazine every month. I only hope you get twice the amount of ad space filled so I can have twice the articles to read. When my renew letter comes in the mail, you can count on my check.

Rick Yuhas, KT4DU
Cropwell, Alabama

Rick—Thank you very much for all the compliments. I hope we continue to earn your respect and that you continue to enjoy CQ VHF.

Dear *CQ VHF*:

Re: the reduction in number of licensed hams—try this!

1. Get rid of Morse code as a required bit of never-to-be-used knowledge, prerequisite to use of HF bands.

2. Get rid of ARRL—or set aside for them segments of HF bands commensurate with the amount of code used thereon by the dying breed who *had* to learn it.

Today's hams, in the main, and those who would be worthy new hams, have learned to walk instead of crawl—and to speak with accent where and how they want it—and they won't go back.

W. H. Stewart
Milwaukie, Oregon

Dear *CQ VHF*:

I came to your Web site after finding it in this month's issue of *CQ VHF*. Do you intend at any time in the near future to have open chat rooms, where we can go and talk to other radio hams on the Web?

I enjoyed the article about the declining membership of ham radio operators.

Regards,

David Mahaffey, KCØACO
Enterprise, Kansas

David—While I appreciate your interest in having a chat room on our Web site, we already have the original, and the world's biggest, chat room where you can talk with other hams—and there's no monthly access fee. It's the RF spectrum, of course. If we were to have a chat room on our Web site, we would be encouraging hams to use the Web instead of the radio for two-way communication, and that would be driving a nail into our own coffin. I strongly encourage you to chat with other hams...but on the radio, not the Internet.

Off to See the Wizard...

The following letter was directed to "Beginner's Corner" editor Peter O'Dell, WB2D:

Hi Peter:

My budget for magazines is small. I scrutinize each new issue at the newsstand closely to see which one has any useful information. Well, today I looked at *CQ*, *QST*, and *CQ VHF* and they were all nice, but only one was interesting enough to take my money—*CQ VHF*!

Your article in "Beginner's Corner" on "Charlie and the Wizard" made my day! Thank you so much for the great wisdom. 73,

William Carter, WD4BRP
King, North Carolina

ATV at Public Service Events

Amateur television is finding a growing role in ham radio public service activities, as Houston's HATS group demonstrated in January. This month, N5EM takes a broad look at the use of ATV in public service and emergency communications.

As we should all know, one of the reasons that amateur radio exists is to provide a resource to the public. One of the very visible ways we do this is by providing free communication services for public service events. Hopefully, every amateur has participated in some type of public service event. For one thing, it's great fun. For another, it brings amateur radio into the eye of the public. Traditionally, these public service events require supplemental voice communications between various locations and for various functions. This is most often provided using VHF and UHF FM communications and repeaters.

This past January saw the running of the Houston Methodist Healthcare Marathon and the Houston Amateur Television Society (HATS) was there to provide video coverage (Photo A). This marked the fifth year that HATS has come out in force to demonstrate to Marathon officials the value of amateur television (ATV) to public service events. In that regard, Houston is still behind some cities in the U.S. where active ATVers have been using video for public service for a number of years. But, we're catching up quickly. This year, the goal is to add additional "video enabled" public service events.

Ham Radio Public Service

I thought it might be useful this month to cover some of the basics of public service as it relates to amateur television. These ideas are just some of the ones that come to mind, but if you've never thought about them, they may be very helpful to you in your own public service activities.

Photo A. HATS members Mike Scarcella, WA5TWT, and John Ross, WA5WOD, operate a portable ATV station from Mile 12 of the 1999 Houston Marathon. (Photos by Andy MacAllister, W5ACM)

The first question is, "why do we as amateurs do public service in the first place?" Hopefully, we all know the answer to this one. But we must always remember that we have newcomers every month to our hobby. Besides, it never hurts to be reminded of our responsibilities. Especially today, amateurs realize that the spectrum we use is incredibly valuable. One of the reasons we continue to have it is because we're a communications resource for the public.

Most people are unaware of this resource until they experience some type of disaster and happen to come into contact with an amateur providing some sort of emergency communication. Fortunately, most people never need this assistance. Unfortunately, it also means that few people actually know who amateurs are and why we might be important as a group. That's why participating in public service events outside the scope of a disaster is important. We need to be visible and we need to gain the experience to be prepared when society really needs us.

The ATV Advantage

As ATV operators, we bring a new and exciting dimension to public service communications. In fact, one problem with adding the dimension of video to a public service activity is that event coordinators often don't know what to do with it. If they've never had the option available, they may need some help integrating the new medium into their operations. This is where the ATV-equipped club can act as a consultant. You know what is possible and what other clubs are doing with ATV. You can suggest some possible applications for television.

In Houston, I've found that our participation in events is at first done in an experimental role. The important communications that the event relies on continue to be handled by traditional voice and packet modes. ATV is used for demonstrations the first few times. Based on those demonstrations, some of the real and often unfulfilled needs begin to

By Ed Manuel, N5EM (atv@cq-vhf.com)

Photo B. Knowing where the main body of runners is located can be very important for race officials. Here, runners are slowing down for a drink at the Mile 12 water station. And, yes, the trash IS picked up later.

emerge. Remember that the only video many of these officials have ever seen is commercial broadcasting.

For example, at the Houston Marathon, video coverage is normally not provided by broadcasters. It's an expensive proposition to set up and provide video coverage over a marathon course. If there is no commercial revenue to pay for it, it's just not going to happen. Three years ago, one of the local television stations decided to give the Houston Marathon some local coverage. They budgeted about $150,000 for the event. This coverage consisted of cameras at the start/finish line and a mobile unit that preceded the lead runners. This camera unit relayed its video feed to a helicopter that flew overhead and acted as an airborne repeater to the broadcast studio. I guess they figured it would be difficult to drive the 26-mile marathon course with that 40-foot mast on their news van fully extended.

Now, consider the purpose of this video coverage. The television station cut to the live marathon coverage at intervals of about 15 minutes, checking the progress and pace of the few runners at the head of the pack. After the main runners finished the race, the video coverage was dramatically reduced. After all, anyone *really* interested in the Houston Marathon's thousands of participants was somewhere along the course cheering them on.

Needs of Event Organizers

Now consider what might be important to the event organizers. With thousands of athletes running 26 miles, knowing where they are along the course is important. While the marathon officials know when the lead runners will finish within a margin of about 10 minutes, those thousands of other runners aren't so predictable. Knowing where along the course those runners are spread out is more of a visual concept than something that can be easily communicated with a handie-talkie (Photo B).

For the first time this year, we provided a video feed at the Houston Emergency Operations Center (EOC). During the event, a marathon official is located at the EOC along with representatives from other organizations, such as police, fire, and medical. As the ATV crews located along the course at different locations flipped from mile to mile, the transmissions provided a very easy picture of the density of runners along the racecourse. This was acknowledged to be very helpful.

In previous years, we had a reception station located in the VIP lounge over-

looking the start-finish line. It's a curious thing that many of the important sponsors of the event watch the start of the race and the finish of the race, never seeing any of the intervening 26 miles. We provided live coverage of various points along the racecourse for them to watch while waiting for the winning runners to finish. The first year, we were very embarrassed, as a club, at the quality of the video. We were still learning how all this went together and what was really needed in the way of equipment and experience. Surprisingly, though, that did not matter to the people watching. They were as excited to see mediocre video from the course as we were to be doing it.

The lesson learned was that people realize that you're volunteers and are "amateur" television operators. They don't expect perfection. We may strive for it as amateurs, but the important thing is to jump in and do what you can. Don't wait until you're "professional." This year, we elected to forego the VIP location in favor of the EOC. The result was that we were missed and our presence was requested at both locations next year. Once they start to get used to ATV, they'll miss it if it's not there. That does make you feel good.

Promise Only What You Can Deliver

Remember to be realistic with event organizers as to what is possible. You must know your capabilities and describe them honestly. If you plan to use an ATV repeater, know its range to the typical portable station. Go out to the site of the event in advance and try different locations. It's very embarrassing to find on the morning of the event that you can't shoot through those 100-foot trees that no one noticed before, or that 20-story office building that just happens to be right in your path.

One request we've had is for mobile ATV. That's a huge problem as the marathon weaves in and out of the forest of office buildings along the course. So far, our one effort was interesting, but not particularly useful. But we gave it a try. Never be afraid to tell your event organizers that this may be difficult. Remember that they had nothing before. Even limited success is impressive the first time you do it. We're still thinking about a better way, using auxiliary repeaters spaced around the course. Here's an area ripe for experimentation. I, for one, would like to see a couple of comprehensive articles on successful mobile ATV describing different antennas and bands. (*Anyone have this experience and expertise to share? Get in touch with Ed at <atv@cq-vhf.com> or with me at <w2vu@cq-vhf.com>.—ed.*)

Remember the Ground Rules

When working with an event to add video, remember that there are limits to what amateur radio and television can be used for. In our enthusiasm to be helpful public servants, we sometimes forget that we're not to be used for commercial purposes—and this can happen with a public service agency. Know the rules and keep your perspective. Don't be afraid to say no when the circumstances require.

Get the widest possible support from the local ham community. You don't need to be an experienced ATVer to run a camera; you don't even have to be licensed. Our club routinely enlists member's children who want to participate. They don't operate the transmitters, but they have a lot of fun operating a camera. Get other amateurs who would normally operate only a handie-talkie to help. They just might like it and want to know more.

We can provide conventional communications as well. We carry the ubiquitous handie-talkie, too. We use one repeater just for video directing. The director uses the repeater to inform each video location when it's time to transmit and time to stop transmitting. This allows the director to provide a smooth transition from location to location. Additionally, it allows an event official to ask the director to show a particular location he may want to see. This has worked well for us, and, next year, the director will actually be located in the EOC to facilitate this close communications.

Since we're also FM equipped, the communications organizer at the marathon notes where we'll be. If he or she is running short of volunteers (when aren't they?), the ATV folks can be relied on in a pinch to fill in on voice. This is particularly important for getting additional supplies (they pass out a lot of water and use a lot of cups for 5,000 runners) and for summoning medical help for ailing runners. All ATV operators are given a complete list of all the frequencies in use just in case they're needed to provide backup communications or need to report a problem on the course. Additionally, the water-stop captains are told to look for the television operators if they need communications help. It's nice to be visible and easily identified.

Document What You Do

Document your work. Here's an area we're working to improve. You need to make sure that your members are taking still pictures as well as video for the club.

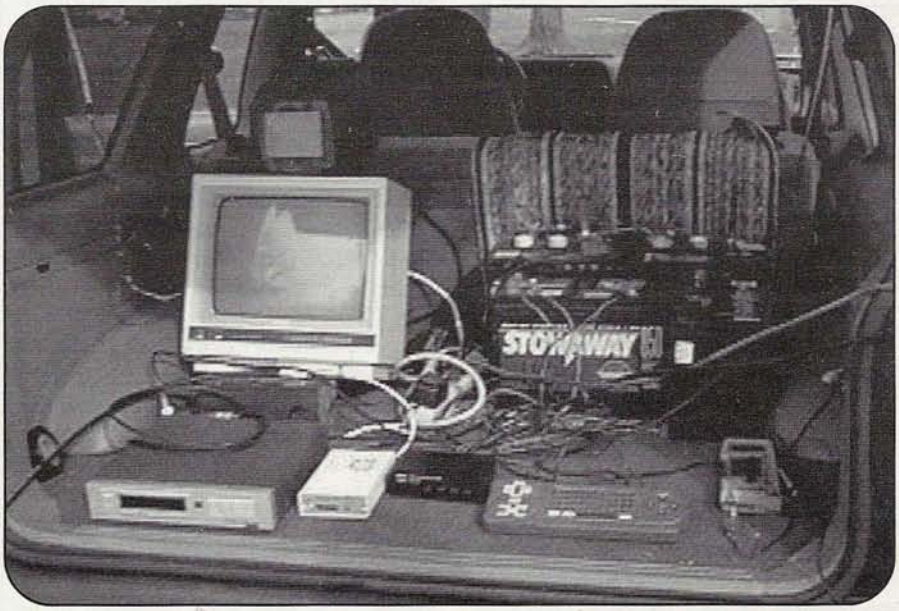


Photo C. How big is a portable ATV station? Well, this is WA5TWT's setup, consisting of (from left) a satellite receiver for 1.2-GHz reception, monitor, 1.2-GHz HATS transmitter, video switch box, video titler, some serious 12-volt DC power, and, finally, a multimeter.

Good photos require planning and effort. You want pictures that show the event and ATV in operation. As I look back at our pictures, I find we can do a better job. We seem to be good at taking pictures of our equipment and pictures of the event in progress, but I noticed that we don't seem to get ones that put ATV *in* the event. If your club has a Web site, put the pictures on it. If you don't have a Web site, then make a scrapbook to use later when you do get a Web page going.

When someone shows an interest in your capabilities, don't just tell them what you've done before — *show* them. It only serves to help and protect the amateur radio service if they remember what you did. Help them remember.

Don't forget that you might be able to help a public service event even without a single transmitter; you've got all those camcorder-toting video folks. Got a good video editor in the group? Maybe the event doesn't lend itself to on-air coverage, but maybe edited videotape with material from 10 points of coverage would be valuable to them. You can bet that your video skills are at least as good as (and probably better than) a few volunteers who just happened to have a camcorder. Just remember the rules. You can't do this for compensation—even if they offer.

Be Honest with Yourself

Always do an honest post-mortem within your club and with the event organizers. Find out what they liked and could use and what didn't really help. Make notes, don't try to remember it until next year. Get every member who participated to offer his or her suggestions. Now is the time to fix technical problems that cropped up and to consider new ideas or new ways of doing things.

Don't try to do too much. You certainly don't want to burn folks out by trying to cover an event a month. We have to haul a lot of gear to do ATV (Photo C). It's a bit easier if you just need 10 hams with "talkies" to do an event.

Don't try to find new events all by yourself. Go to the existing clubs in your area and see what they're doing. Most amateur radio clubs have one or more events for which they provide communications. Offer to add the dimension of video to an appropriate event, as part of *their* operation. You'll still get the practice and recognition you need, but you'll make their club look better and get to expose their members to ATV.

Political Support

One final thought. Even though there are good reasons to provide the public with services to fulfill our obligation to be good stewards of our spectrum, there's something else we stand to gain. When someone comes looking for a chunk of our spectrum for one reason or another, we need to enlist those we help to help us. Amateur radio and amateur television need groups and events that will step forward and say that the services we provide at no charge to them are valuable and important. Just look back over the last few years at different spectrum "grabs" and some of the groups that have supported the amateur radio service. They *do* make a difference and the more of them we have in our camp, the stronger we are. ■

Questions and Answers About Ham Radio Above 50 MHz

Q: I've been trying not to get into a war with our Field Day organizer, but I need an official answer for a question. See, our FD organizer is basically an HFer. Our configuration is a free Novice table (10-meter CW, I think), two HF tables with three bands each, and one VHF table, with two bands last year, three bands this year. We register as 2A.

When getting under way, he visited each of the tables (actually tents spread out over a nice big field), and went over the rules. When he got to our table, he gave the regular, "now remember, choose your bands carefully because once you transmit on a band, you have to stay on it for 15 minutes." I replied, "no, that does not apply to VHF." He checked, and confirmed that as correct. Then he added, "also, you can only transmit on one band at a time."

Trying to remain non-combative, I asked the club president, and he said that we would have to up our transmitter class to 3A to operate all VHF radios simultaneously.

Is that true? Do we get charged a transmitter count if we operate all VHF bands simultaneously? It was very disheartening to work a station on 6 meters while hearing another op from the same station call "CQ Field Day" on two! I'd rather not repeat that situation, but I want to get a clear answer on this. Any help would be appreciated!

73, and keep up the great work!

Steve Jackson, N3VZL
Fairless Hills, Pennsylvania

A: Your president is correct. I checked with ARRL HQ for you, and the "free" VHF station applies to only one signal on the air at a time. The 15-minute rule does not apply, so you may change bands as often as you wish, but if you have more than one VHF signal on the air simultaneously, you will have to change your category. That, of course, is a strategic decision that the club will have to make—does it want to stay in 2A or increase the number of bands on the air at one time. If it were my club, considering that it's unlikely that multiple VHF bands will be "hot" simultaneously, I'd stick with 2A and QSY the VHF station to follow the activity.

*Just remember the basics on sporadic-*E *:if six is open, and the skip starts getting "short" (300 to 500 miles), then you need to start checking for action on two (after you knock off those close-in sections on six). Plus, it's not uncommon to have an FAI (Field Aligned Irregularities) opening pop up on 2 meters as a 6-meter* Es *opening is fading away.*

"Q&A" Goes Online!

We've added a "Q&A" page to our Web site, so anyone visiting us on the Internet can pose any question they'd like about Ham Radio above 50 MHz. Answers may come from anyone who has them (not just *CQ VHF* authors and editors) and, just like the olden days on packet bulletin boards, you'll be able to follow a "thread" of questions, answers, responses, and replies on each topic. Just point your Web browser to <http://www.cq-vhf.com> and click on the "Q&A" button on the left-hand side. Then follow the instructions to post questions or answers, or to read what others have posted.

Hamfest Calendar

The following hamfests are scheduled for May, 1999:

May 1, 3rd Annual SARS TAilgate Party, Windsor Community Center, Co. east of **Aiken, SC.** Talk-in: 147.030, CB-22. For information, contact Ray Thomas, WA4OMM, 484 Rosewood Farm Lane, Elko, SC 29826; Phone: (803) 266-4759; E-mail <rose2@sc.tds.net>.

May 1, Annual Amateur Radio & Computer Swap Meet, Cadillac Middle School, **Cadillac, MI**. Talk-in: 146.98 repeater. For information, contact Dan, KE8KU, Waxaukee ARC, P. O. Box 163, Cadillac, MI 49601; Phone: (616) 775-0998; E-mail: <ke8kundan@juno.com>. (exams)

May 1, Hamfest, H.A. Alexander Park, **Moulton, AL**. Talk-in: 53.17, 146.96 & 442.425. For information, contact Rex Free, KN4CI (256) 905-0822 or Ed Weatherford, K4EKW (256) 974-0436; Web: <http://www.symetric-inc.com/N4IDX>. (exams)

May 1, SwapFest/HamFest, Fallsburg Community Center, **Louisa, KY**. Talk-in: 147.390 +600. For information, send e-mail to <wa4swf@foothills.net>.

May 1, Area Swapfest, Lewis-Palmer HS, **Monument, CO**, Talk-in: 146.970 (-) (100 Hz), 146.520 (S). For information, contact Dennis Major, NØABC, P.O. Box 62343, Colorado Springs, CO 80962-2343; Phone: (719) 535-1160; E-mail: NØABC @qsl.net.

May 1–2, Convention & Hamfest, Abilene Civic Center, **Abilene, TX**. Talk-in: 146.160/760. For information, contact Peg Richard, 1442 Lakeside Dr., Abilene, TX 79602; Phone: (915) 672-8889; E-mail: <jimr@swconnect.net>. (wheelchair access) (exams)

May 1–2, Hamfest & Computer Show, Zamora Temple, **Birmingham, AL**. For information, contact Glenn Glass, 8368 Country Circle, Pinson, AL 35126; Phone: (205) 681-5019: Web site: <bro.net/barc>.

May 2, Annual Hamfest, Middletown Grange Fairgrounds, **Wrightstown, PA**. Talk-in: 147.69/09 repeater and 146.52 simplex. For information, contact John D'Onofrio at (215) 675-9165, or write to him at P.O. Box 3211, Warminster, PA 18974. (exams)

May 2, Swap Meet/Tailgate, Lake Maggiore Park, **St. Petersburg, FL**. Talk-in: 147.060 repeater. For information, contact Gerald Turner, N2MNC, 10132 64th St N., Pinellas Park, FL 33783-3040; Phone: (727) 548-7474.

May 2, Giant Electronic Flea Market, Lincoln High School, **Yonkers, NY**. Talk-in: 440.425 MHz PL 156.7, 223.760 MHz PL 67.0, 146.910 MHz, 443.350 MHz PL 156.7. For information, contact Otto Supliski, WB2SLQ, at (914) 969-1053. (exams)

May 2, Hamfest & Computer Show, Hagerstown Community College, Athletic & Recreation Building, **Hagerstown, MD**. Talk-in: 147.090 + repeater ARA Club. For information, contact Tina Jones, KB8ZQM, Chairman & Donald Jones, KB8WHW, Co-Chairman; Phone: (304) 728-7769: Club fax line: (304) 728-3024, 24 hours/day; E-mail: <kb8zqm@intrepid.net, Club Homepage URL: <http://www.erols.com/rjlong61/ara>. (exams)

May 2, Hamfest, Sandwich Fairgrounds, **Sandwich, IL**. Talk-in: 146.73-, simplex 146.52. For information, contact Bob Yurs, W9ICU, at (815) 895-3219; E-mail: <w9icu@tbcnet.com>: Web: <http://tbcnet.com/~jleonard/hamfest.htm>.

May 8, Auction & Fleamarket, Ste. Suzanne Church, **Montreal, Quebec**. Talk-in: 146.91- or 443.050+. For information, contact Sam, VE2CWI; Fax: (514) 684-7698; E-mail: <samuel.galet@sumpatico.ca> or <VE2CWI@rac.ca>; Web site: <http://www.pubnix.net/wiarc>.

May 8, Hamfest & Computer Fleamarket, Anderson County Fairgrounds, **Anderson, SC**. For information, contact Robert G. Watson, Jr., W4RGW, 501 Ferguson St., Clinton, SC 29325-2419; Phone: (864) 833-2204; E-mail: <w4rgw@backroads.net>; Web: <http://www.brars.org>. (exams at Anderson College)

May 8, 1999 Hamfest & Computer Swapfest, Manitowoc County Expo Ctr, **Manitowoc, WI**. Talk-in: 146.01/61. For information, send SASE to Mancord RC, P.O. Box 204, Manitowoc WI 54221-0204, or call Red at (920) 684-3733 or Fred at (920) 682-9312. (exams)

May 14–16, Dayton Hamvention®, Dayton, OH. For information, contact Dayton Hamvention, Box 1446, Dayton, OH 45401-1446; Fax: (937) 454-5655; Web: <www.hamvention.org>; for a brochure e-mail to: <info@hamvention.org> or fax: (937) 274-8369.

May 15, "ECARC Radiofeast 1999" Annual Swapmeet, East Carolina Radio Museum, Parking lot, **Grimesland, NC**. For information, contact Bill Engstrom, 218 Bent Creek Rd., Greenville, NC 27834, (252) 355-8732, or Herman Schnur, K4CTG, 3205 Brick Kiln Rd., Greenville, NC 27858, (252) 752-2264.

May 15, Poor Man's Dayton Free Tailgate Party, on the Beachaven winery grounds, **Clarksville, TN**. Talk-in: 147.39. For information, contact Hank Koebler, N3ORX, 1150 Hutcheson Lane, Clarksville, TN 37040; Phone: (931) 645-5206; E-mail: <n3orx@arrl.net>.

May 16, Tailgate Electronics, Computer & Amateur Radio Fleamarket, Albany and Main St., **Cambridge, MA**. Talk-in: 146.52 & 449.725/444.725 - pl2A - W1XM/R. For information,

Operating Notes

For Late April & May, 1999:

April	
20	222-MHz Spring Sprint (see announcement, last issue)
23	Lyrids meteor shower peak
23–25	**CQ VHF Spring Activity Weekend (SSB/CW)** (see March *CQ VHF*)
25	Good EME Conditions
28	432-MHz Spring Sprint
May	
5	Eta Aquarids meteor shower peak
8	50-MHz Spring Sprint
21–23	**CQ VHF Spring Activity Weekend (specialty modes)(see March *CQ VHF*)**
23	Good EME Conditions

EME data courtesy W5LUU. More contest info is available on the CQ VHF *Web page at:* <http:/www.cq-vhf.com/navhfcon.htm>.

call (617) 253-3776, or write to W1GSL, P.O. Box 397082 MIT BR., Cambridge, MA 02139-7082. (handicapped accessible)

May 22, Swapmeet, Lions Club, **Londonderry, NH**. For information, contact Paul, K1LL, at (603) 432-1538, or e-mail: <K1LLX@juno.com>.

May 23, Annual Swapmeet, Bella Vista High School, **Fair Oaks, CA**. For information, call Earl Mead, K6ESM, at (916) 331-1115; E-mail: <nhrc@k6is.org>.

May 30, Hamfest, Howard Co. Fairgrounds, **West Friendship, MD**. Talk-in: 146.76, 224.76, 444.00. For information, contact Craig, WA3TID, P.O. Box 19, Annapolis Junction, MD 20701, (410) 987-6042.

Conferences

May 1–2, Trenton Computer Festival, The 1999 Trenton Computer Festival will be relocated from Mercer County Community College to the spacious New Jersey Convention and Exposition Center at Raritan Center in **Edison, NJ**.

In its 24th year, the "world's longest running computer show" will feature hundreds of exhibits and seminars, guest speakers, special activities, an Internet cafe, and a 1,000-space outdoor market, complete enough for the novice to the most experienced end-user. Computer professionals will be able to talk with many potential employers at the planned on-site hi-tech job fair. Traditionally, there are also amateur radio-related exhibits and activities.

Owned and sponsored by area non-profit computer clubs, proceeds will be applied to club operations and scholarship funds at The College of New Jersey. These clubs are the Amateur Computer Group of New Jersey, Central Jersey Computer Club, The College of New Jersey, IEEE-CS/ASM, Princeton Chapter, the Computer Education Society of Philadelphia, and the New York Amateur Computer Club. In addition, the show will now be managed by KGP Productions, the oldest and largest PC show promoter in the Northeast.

For additional information, check the Trenton Computer Festival Web site at <www.tcf99.com>, or contact Ms. Marin Light, KGP Productions, (800) 631-0062, e-mail: <marinlight @earthlink.net>.

May 14th, Weak Signal Group Dayton Banquet, the VHF Weak Signal Group, which meets Monday nights at 0200 UTC on 3.843 MHz, would like to invite everyone who is coming to the Dayton Hamvention to its Annual Banquet on Friday, May 14th, from 6:30 until 11:00 p.m., at the Holiday Inn North, Wagoner Ford Rd., **Dayton, OH**.

This is the largest gathering of VHF Weak Signal enthusiasts in the U.S., so get your tickets early and join them for an enjoyable evening and a 2-entrée banquet. There will also be a cash bar as well as plenty of seating to allow you to mix and mingle with other VHFers from all over the country and the world.

There will be over 50 prizes, with two grand prizes worth over $300 dollars each, being drawn starting at 9:00 p.m. Also, there will be a guest speaker who'll provide a short talk on VHF activity. There will also be a noise figure measuring table, so bring your preamps to tweak.

Tickets are $30 per person, with a maximum of 125. To order, send $30 plus an SASE to either Tony Emanuele, WA8RJF, 7156 Kory Court, Concord Township, OH 44077, or Tom Whitted, WA8WZG, 4641 Port Clinton East Rd., Port Clinton, OH 43452. Web site info is at <www.wa8wzg.com>.

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*:

- "Astronauts on Your Repeater," by Phil Chien, KC4YER
- "222 MHz—The Forgotten Band," by Bill Cameron, KB2BZP
- "Field Day GriDXpedition," by Bill Hays, KD4GHQ

Plus...

- "Hollywood Ham Watch," by Bill Tracy, KE6EJQ
- "Communicating with Your Computer," by Lew Ozimek, N2OZ
- "Converting 800-MHz Rigs to 902 MHz," by Gene Colson, W7UVH

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://www.cq-vhf.com> or FTP to <ftp://ftp.cq-vhf.com/cqvhf> and look for the file, "writguid.txt." Or, you may send a written request along with an SASE (self-addressed stamped envelope) to *CQ VHF* Writers' Guidelines, 25 Newbridge Road, Hicksville, NY 11801.

The Fool on the Hill

Do the folks in your club talk about the local repeater as if it were alive? Well, here are the nuts and bolts of...a bunch of nuts and bolts (not to mention a few circuit boards).

Have you ever listened to how some hams describe their local repeaters? Not just the words, but the inflection and tone of voice. Sometimes it's done with the reverence normally reserved for deities (self-proclaimed and otherwise). Just listen in a bit and pay more attention to *how* they're talking than to *what* they are saying. When you go to the next club meeting, watch these guys in person. They talk about *the repeater* or *the machine*. As they mention it, their eyes glaze over a bit, their voices become softer, fuller, and you may even notice their faces becoming a little more symmetrical—you'll have to look really closely on this last one, but it's there. It's as if they're in love with the repeater.

The Truth about "The Machine"

I think repeaters are wonderful, and I think that ham radio would have died off if not for the FM "craze" of the '70s. But I also believe we need to recognize a repeater for what it is: a technological communications system. More specifically, it's an automatic relay station designed to boost the communications range of (primarily) portable and mobile stations. The more you know about how a repeater is constructed, the better you can use it and benefit from it. And it could save you from sounding like a greenhorn...even if you are one.

To be sure, there are all sorts of different kinds of repeaters around. Most packet TNCs (terminal node controllers) can serve as digital repeaters, or "digipeaters" as users often call them. You can also have single-frequency repeaters that use time delays for store-and-forward operation (the only common examples are a few of the amateur satellites). And there are ATV (amateur television) repeaters. But again, they are relatively rare. So let's limit this discussion to voice repeaters on the VHF/UHF bands. Most towns big enough to have their own post office have one or more of these repeaters around.

There are two aspects of repeater operation that set it apart from other radio stations: 1) the frequencies are "fixed" and cannot easily be changed; and 2) a repeater must, by definition, transmit and receive at the same time—all the time it's in use! The technical implications of this are profound.

In addition, many repeaters are exposed to temperature and humidity extremes. The typical repeater site is often on a hill or the top of a tall building. Housing varies, but it ranges from a heated/cooled room to a shack with a tin roof to a metal box strapped to the side of a tower. "Heated/cooled" is a good thing...the poorer the housing, the more durable the equipment should be.

Repeater Subsystems

There are four main subsystems of a repeater: transmitter, receiver, controller, and antenna. Each of these subsystems has a set of "needs" associated with it that set it apart from your home station. Let's go through each of them.

The transmitter has to be capable of operating non-stop for a long time. It transmits while you are listening, but it also transmits while you are talking. That is called a 100% duty cycle. The average off-the-shelf rig is not designed for this kind of treatment, so most repeater transmitters are ones that have been specially designed and built for this use, or they're heavy-duty units "retired" from commercial service.

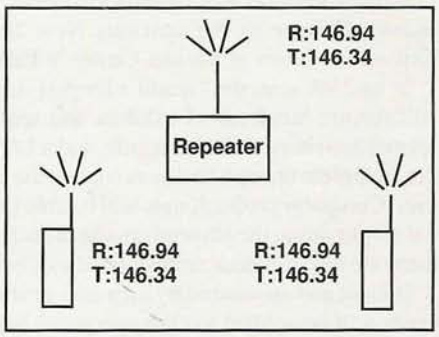


Figure 1. A basic repeater system, showing two handhelds communicating through the repeater, even if they're outside of direct-contact range. Note that the repeater's receive and transmit frequencies are the opposite of the handhelds'.

Since the transmitter is always transmitting when the receiver is receiving a signal, RF isolation becomes a major issue. If any stray RF finds its way out of the transmitter and into the receiver—say, along power leads—it's going to degrade the performance of the receiver. The only RF coming out of the transmitter must be that coming out of the antenna connector (theoretically, it should be that way for your home rig, too; it's not always the case, but it should be). And the only RF coming out of the transmitter should be on the intended transmitting frequency.

This sounds silly, I know, but you'd be surprised at how many transmitters do have small spurious signals. At home, you may never notice it. At a repeater site,

By Peter O'Dell, WB2D (wb2d@cq-vhf.com)

it can be a disaster, especially if that site is shared with other radio systems, because stray RF can cause all sorts of interference. Shielding, bypassing, and decoupling have to be "bullet-proof." ("Decoupling" is circuitry designed to keep different stages of a radio from "coupling," or interacting, with each other in unintended ways.)

It's also critical for the receiver to be well shielded. Just as you don't want stray RF coming out of the transmitter, you don't want stray RF getting *into* the receiver, so you'll find similar shielding, by-passing, and decoupling at the receiver. It's also mandatory for a repeater receiver's front end to have good *selectivity*, or the ability to reject unwanted signals on adjacent frequencies. You want the *passband* of the front end to be as narrow as you can make it so that only a small range of frequencies is allowed to pass through to the amplifier stages. At VHF and low UHF frequencies, this usually means using devices called *helical resonators*. You won't find these very sharp filters in many of the rigs designed for home use. In a home rig, sensitivity is generally more important than selectivity. Just the opposite is true for a repeater receiver, which usually makes up for any lack of sensitivity by its location at a very high point.

"There are four main subsystems of a repeater: transmitter, receiver, controller, and antenna. Each of these subsystems has a set of 'needs' associated with it that set it apart from your home station."

Repeater Interference Problems

If a strong off-frequency signal gets into the receiver, it will cause a problem known as *desense*, or "desensitization," in which the receiver's automatic gain control (AGC) circuit tries to protect the front end by reducing overall sensitivity. If some of the transmitter's energy is leaking into the receiver, the desense will be constant, but if it's coming from another source, desense will only happen when the other transmitter is on the air. To the extent that desense occurs, it will block out weaker signals. In severe cases, a repeater can be made virtually useless by desense.

An associated problem is called "*intermodulation distortion*," or IMD for short. Here the offending signal is the product of two or more off-frequency (often out-of-band) signals that mix in a nonlinear device. In plain English, this means that two or more signals happen to arrive at the same time at something that is acting like a diode, say a corroded connector, the front end of a poorly installed receiver, or whatever. These signals then mix or *heterodyne*, creating two new signals, one on the frequency that is the sum of the two original frequencies and one on the difference frequency. If, by chance, one of the products falls into the input range of the receiver (or someone else's receiver), interference will result (see "Intermod Detectives" for an example). Eventually, you'll hear hams talking about desense and IMD. These are the problems they're talking about.

Since a repeater receives and transmits at the same time, its receiver and trans-

Intermod Detectives

Tracking down *intermodulation distortion*, or IMD, can require quite a bit of detective work. As explained in the main text, intermod occurs when two or more signals happen to arrive at that same time at something that is acting like a diode. When the signals mix or *heterodyne*, they create two new signals, one on the frequency that is the sum of the two original frequencies, and one on the difference frequency. This can create interference. Here's how:

Let's say your club operates a 146.34/.94 repeater like the one in Figure 1. The repeater receives on 146.34 MHz and transmits on 146.94. Your tech committee doesn't know it yet, but there's a corroded connector in the receiver's antenna line. Now let's say there's another repeater a few miles away on 146.79 MHz, and another, poorly shielded radio at your repeater site with a 455-kHz IF (intermediate frequency). The 455-kHz signal is continually getting into your receiver's antenna line, but it's so far off frequency that the receiver ignores it. But when the.79 repeater on the next hilltop comes on, those two signals mix, creating two new signals—at 147.245 MHz (146.790 + .455) and at 146.335 MHz (146.790 - .455). The 147.245 signal is also too far outside your receiver's passband to be a problem, but the 146.335 signal is only 5 kHz away from your receiver's center frequency of 146.340 MHz. Assuming that the receiver is set to receive a normal FM signal on 146.34, it's *impossible* for it to block out that new signal on 146.335. There will be interference on your repeater's input whenever the .79 machine is on the air.

Detectives at Work

Here's the likely scenario for tracking down the problem. Someone on your tech committee will end up at the site with a *spectrum analyzer*, a special device that can visually show you all of the signals on a selected piece of the RF spectrum. The spectrum analyzer will show that there's a signal on 146.790 whenever the interference occurs. The tech folks will probably also see signals on 146.335 and 147.245. Even if they don't, they'll subtract 146.34 from 146.79, and get .45. Someone will say "450 kHz! I'll bet it's really 455, and every radio on this site has a 455-kHz IF somewhere."

Now the real detective work begins as they try to figure out where in the system the 146.79 signal and the .455 signal are mixing and getting into the receiver. Sooner or later, they'll discover the corroded connector, replace it, and the problem will magically vanish. If they can't find the problem at their site, they'll probably contact the owner of the .79 repeater to check for problems there, since a similar problem there could create a strong enough signal on 146.335 to interfere with the 146.340 input.

Now suppose it's *three* signals mixing to produce a product that's near your repeater's input frequency. The interference will only occur when *all three* transmitters are on the air at the same time. This will give your repeater tech crew nightmares and will likely require even more extensive detective work to track down.

mitter obviously cannot be on the same frequency (see Figure 1). The receiver frequency is called the *input* frequency, while that of the transmitter is the *output*. Pretty straightforward. The difference between the two is called the *split* or *offset*. On 2 meters, the standard split is 600 kHz. There's nothing magical about this particular frequency. It grew out of the maximum front-end passband (the farthest you could separate the receive and transmit frequencies while using one radio) of some of the early commercial radios that were converted to ham use. So 600 kHz became the standard split because of a historical accident. But it's not the only split. Flip through the *ARRL Repeater Directory* and you'll find repeaters with other splits, mostly 1 MHz. Most modern equipment is set up to easily handle these "odd-ball" offsets.

Capture the Frequency

One of the most desirable aspects of FM operation is what is called the "capture effect" of an FM receiver. What this means is that if two on-frequency signals show up at an FM receiver input at the same time, the stronger signal will "capture" the receiver. It will be as if the second signal were not there at all. The difference doesn't have to be significant, either. On AM, a signal 100 times weaker than another still causes annoying interference. On FM, even when two signals are close to each other in signal strength, the stronger one captures the receiver. It makes for much more pleasant listening than on AM-based systems, in which the two signals compete for the receiver's attention. (When you get two FM signals of nearly identical strength, the result is what's commonly called a "double," in which the listener hears bits and pieces of each transmission.)

Also, FM receivers tend to have a fairly sharp cutoff in terms of signal strength. At a certain point, a weak signal simply drops out. These two factors together give FM (and repeaters) a distinctive, limited coverage area. Cross that magic line, and you are "out of range." Terrain plays a big part in this, too.

That point was driven home to me dramatically during the flight of STS-9, the inaugural manned-use of ham radio in space. The day after launch, as the shuttle Columbia was coming down over the western edge of the U.S., I was in Houston with Roy Neal, K6DUE, then NBC News space correspondent. Officially, we were not expecting ham-astronaut Owen Garriott, W5LFL, on the air for another few hours. But Roy guessed that he might come on early and left his handheld tuned to Owen's frequency. Sure enough, Owen's voice came booming out of the receiver as he worked several West Coast hams. Roy was on the sixth floor of the Hilton across the street from Johnson Space Center. We later estimated that it was about 1,300 miles, but there was nothing in between the two radios except a few air molecules. Ah, the blessing (and curse) of a "tall tower."

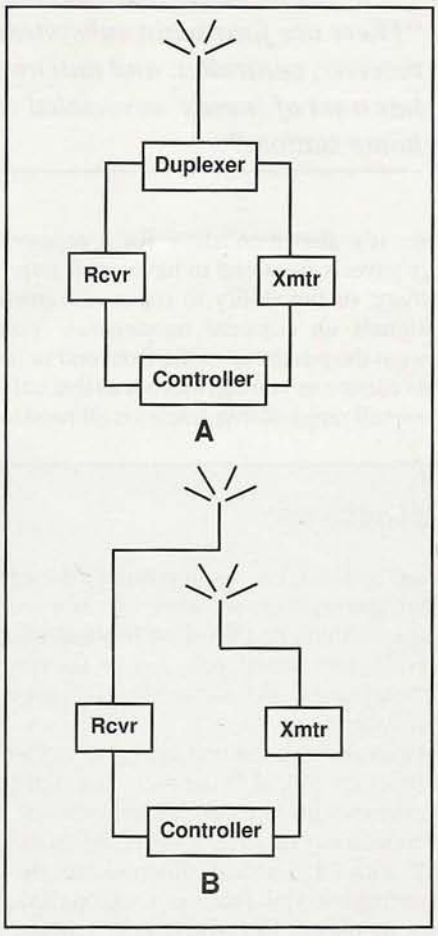


Figure 2. Two typical layouts of repeater systems. The most common, at A, uses a single antenna fed through a duplexer (a specialized filter system) for both the receiver and the transmitter. In B, the transmitter and the receiver each use a separate antenna. It's important that the receive antenna be directly above the transmit antenna and that they have the greatest possible vertical separation.

Who's in Control?

A repeater controller serves several functions. First, it turns on the transmitter when a signal is received, with a device called a Carrier Operated Relay (COR). And it turns the transmitter off once the signal disappears. This second part satisfies some of the FCC rules about repeaters.

In addition, a number of "timers" are usually built into a controller. Most repeaters have a timer set to shut the transmitter off when the input signal has been present for an extended period of time, typically around three minutes (*also to satisfy the FCC, which requires that a repeater shut down by itself after three minutes if the control link fails—ed.*). If you're long winded, you run the risk of "timing out the machine." This is not considered a good thing to do.

Another common feature is the "hang-time" timer, which keeps the transmitter on the air for a few seconds after the input signal disappears. The purpose of this is to reduce wear and tear on the transmitter, particularly older ones that use mechanical relays. Also, if a signal is marginal—say a mobile at the edge of the coverage area—the signal strength will bounce above and below the critical value that the receiver detects. Without a hang-

time timer, the transmitter would pop on and off as the received signal level bounces up and down. This is not a good thing to listen to.

Most repeater controllers also include an identifier. This is the only practical way to observe the FCC's requirement that every amateur transmitter be identified every 10 minutes during a conversation. Most IDers use CW, voice, or a combination of the two. Of course, there's another timer associated with the IDer.

Finally, at the level of the controller, repeaters can really start to shine, with all sorts of bells and whistles. Sophisticated controllers have a Dual-Tone-Multi-Frequency (DTMF) receiver that's used to activate various functions. You probably know DTMF by the telephone company's trademark, "TouchTone." The keypad on your handheld or mobile microphone generates the same tone signals as those on your phone at home.

If the repeater controller has a DTMF decoder in line with the receiver, you can turn virtually any device or accessory on or off and, depending on the design, control its setting, just by pressing the right combination of buttons on your keypad. The most popular use of DTMF over the years has been the *autopatch*. An autopatch is an automated connection between the repeater and a telephone line. In short, with an autopatch you can make phone calls from your handheld or mobile. (*This feature was a lot more popular before virtually the entire world went out and got cell phones.—ed.*)

Other uses for DTMF include turning on remote receivers, connecting to repeaters on other bands (cross banding), making measurements of power, deviation, temperature, wind speed or whatever, controlling antenna rotators and a host of other possibilities. The biggest limits are money and imagination.

Another common feature of many repeater controllers, although not necessarily located physically inside the controller, is a tone receiver for the Continuous Tone Coded Squelch System (CTCSS), also commonly called "PL" which is simply the Motorola trademark for CTCSS. A CTCSS encoder adds a low-level tone to a transmitter's signal. If the receiver is equipped with a CTCSS decoder and the decoder is active, it controls the turning on of the repeater transmitter. A strong signal without the proper CTCSS tone may capture the repeater receiver, but the controller will not turn on the transmitter. CTCSS is commonly used to reduce interference and to limit access to certain repeaters. Next month, we will explore its usage further.

Look, Up in the Sky

Finally, a repeater has an antenna system. Since the transmitter and receiver are on at the same time, antennas are a problem. You cannot simply connect the receiver and transmitter to a single antenna. The front end of the receiver would blow out the first millisecond that the transmitter turned on. For 2 meters and higher, a *duplexer* is commonly used (Figure 2a) to allow both the receiver and transmitter to share one antenna. A duplexer consists of a series of extremely narrow tuned circuits that isolate the transmitter from the receiver. Duplexers are relatively large and expensive—the good ones, anyway.

Some repeaters are configured with separate antennas for transmit and receive (Figure 2b). In these cases, the antennas should be mounted with the receive antenna directly above the transmitter antenna, with as much vertical separation as possible. This is the best of the separate antenna configurations and it's poor at best. Better to invest in a good duplexer.

On lower frequencies (50 and 29 MHz), duplexers are impractical. The most common configuration here is simply having two separate *sites* a few miles apart, one for the receiver and one for the transmitter. A wire or radio link is used to get the receiver audio over to the transmitter. As inconvenient as this is, most groups find it more practical than attempting to construct duplexers for these frequencies. Once in a while, you'll come across a 2-meter repeater using separate sites, but this is rare (much more common, though, is a repeater system using multiple receive sites which are then linked together to feed a single transmitter).

The Fool on the Hill

So, the repeater is just a machine—a fool on the hill—with no intelligence or personality of its own. Those qualities come from the people who use the repeater. Well, I see the sun's going down, so I guess it's time to stop for this month. When the next issue spins around, we'll look at the social aspects of repeaters. ■

The F_2 Is Coming! The F_2 Is Coming!

The wintertime propagation smorgasbord we featured last month continued in late February and early March, with a little bit of long-haul 6-meter F_2 propagation thrown in for good measure. Here are the reports.

The arrival of F_2 propagation on 6 meters is the VHF highlight of every 11-year sunspot cycle, heralding the possibility of worldwide DX on the "Magic Band." As of mid-March, there hadn't been any transatlantic openings, but Al Lugaro, KP3A, reported long, strong openings between Argentina and his station in Puerto Rico.

Greetings, just wanted to report the first (to our knowledge) F_2 openings from Puerto Rico into South America. It seems that it has started very early in the year. We have had TE (transequatorial) openings regularly during the winter; however, the past two nights (02-24 and 02-25-99), from about 1700 Z to around 2130 Z, I have received signals 59+40 from several stations in Argentina, particularly from LW5EJU. Signals have been so strong and lacking any type of distortion that we decided to try some SSTV. Fantastic signals! Attached is a sample picture from LW5EJU (see Photo A) as received at my QTH in FK68vx on the northern coast of Puerto Rico, 60 miles west of San Juan.

Photo A. Slow-scan TV picture from LW5EJU in Argentina, received on 6 meters by Al Lugaro, KP3A, at his station on the northern coast of Puerto Rico. Al says the length and strength of the opening suggests it was F_2 propagation rather than the more common transequatorial propagation (TEP). (Photo courtesy KP3A)

Puerto Rico was clearly the place to be in late February if you're a VHF DXer. In addition to Al's multiple contacts with Argentina, Ed Rodriguez, WP4O, reported on the Internet VHF reflector that he'd worked two new countries on six, although it's not clear if they were via F_2 or other propagation modes.

2/25/99—Just worked Helios, FY5KE, in French Guiana on 50.110. Time 2342 Z; Reports 57 me, 55 him. My first contact with that country on 6 meters.

2/26/99—Just worked a new one, HC5K, in Ecuador, at 0122 Z. His name is Ted and he is running an IC-706 and two stacked Cushcraft six-element Yagis at 80 feet. Sigs 58 into Puerto Rico.

Point South! Point North!

The two major forms of VHF propagation available in late February and early March to those of us who weren't in Puerto Rico were tropo and aurora (Au). Since most of the tropo ran along north-south paths, stations to the south of the U.S. population centers posted Internet messages saying, "point your beams south!" Aurora, of course, occurs to the north, and in order to work stations using this mode—even stations to your east or west—you have to "point your beams

Compiled by Rich Moseson, W2VU (cq-vhf@cq-vhf.com)

Pacific Ducting Pioneer KH6HME Honored

Paul Lieb, KH6HME, has been named the winner of the Dayton Hamvention's 1999 Special Achievement Award. According to the *ARRL Letter*, Lieb, of Hilo, Hawaii, was cited for "his pioneering and record-setting work in tropospheric ducting and VHF, UHF and microwave communications." Lieb operates three VHF/UHF beacon transmitters on the slopes of the Mauna Loa volcano—on 144.170, 432.070, and 1296.100 MHz—which alert hams on the west coast of the continental U.S. to regular tropospheric ducts that occur between Hawaii and the mainland. When these ducts occur, stations within them can talk the 2,500 miles from California to Hawaii with a handheld! In many cases, the ham that Californians talk to in Hawaii is KH6HME himself, who rushes up the side of the volcano whenever he's alerted to the existence of a duct (give or take demands of job and family).

CQ VHF Senior Contributing Editor Gordon West, WB6NOA, wrote about Lieb in our June, 1996, issue. The article included several photos of his beacon station, a record-setting ATV picture he sent, and a distinctive QSL coconut (reproduced here in Photo B). Lieb's award will be presented on May 15 at the Dayton Hamvention banquet.

Photo B. A QSL coconut confirms the first 1296-MHz contact between Hawaii and California, made on June 23, 1984, by Chip Angle, N6CA, and Paul Lieb, KH6HME. Lieb is being honored for his pioneering work on VHF/UHF/microwave ducting as recipient of the Dayton Hamvention's 1999 Special Achievement Award. (Photo courtesy N6CA)

north!" One of the problems was finding people to work! Let's look in first on the tropo, then the Au.

From Oscar Morales, Jr., CO2OJ, Cuba:

2/27/99 8:35 a.m.—Tropo to the north from Cuba now. Worked some stations in south Florida, but also K4YYD in EL79 (the Florida panhandle!) with 57 signals both sides. He was working stations to his north. Where is everybody????

2/27/99 5:55 p.m.—Tropo keeps improving! In the middle of the afternoon (not too "normal" a time for tropo), I worked lots of stations in EL87, 86, 86, 95. Most signals S9+40. Maybe things will get better later. Turn your beams to the south!

From Paul Womble, AJ4Y, EL97bx:

2/27/99—Nice 2-meter opening tonight here in Florida. Worked KF4NEM in EM50 (Alabama) @ 0318 Z on 144.230. Dexter had a very nice signal. He and his neighbor, KF4WCG, worked several stations in central and south Florida. Also the W5VAS/B beacon (also in EM50) was in for quite a while with signals between 519 and 559.

I also worked N5HVJ in EL59 (Louisiana) @ 0353 on 144.200. Ken was a little weaker than the others, but still FB copy. Both of these guys are new states for me. Thanks!

Heard some of the locals on 2-meter FM simplex also worked into Alabama. I worked with FT 736r barefoot to a 10-element Yagi @ 78 feet.

From Fernando Garcia, Monterrey, Mexico, DL95vp:

Last month 1000+ miles tropo was observed on UHF Television:

2/18 Atlanta, Georgia (weak), but strong into Birmingham-Tuscaloosa, Alabama (900 miles range).

2/20 Tampa, Fort Myers, Naples, Miami, West Palm Beach, Florida.

2/26 Tampa, Orlando, Melbourne, Florida.

2/27 All central to south Florida, both east and west coasts.

2/28 Florida, from Fort Myers-Melbourne to south including some Florida Keys LPTVs (low power TV stations).

The great openings of the last three days of February extended into the first two days of March for five days in a row of tropo openings to 1,200+ miles. The best three months for tropo, from my location (March, April, and May) are just beginning.

Aurora's Not Boring, Alice

All right, so it's a bit of a stretch to come up with "Aurora's Not Boring, Alice," from "Aurora Borealis," but there certainly was quite a bit of Au activity around the beginning of March, and it certainly wasn't boring, providing excellent contacts on all bands from 6 meters to 70 centimeters. Our Internet reports include a couple of Au-related "Q&A"s, which were almost as interesting as the reports themselves.

From Ev Tupis, W2EV:

2/28/99—I don't know how she did it, but my wife mentioned how "light" the northern sky looked out of the car window. I looked, but didn't see anything I'd say was very special...as it was overcast. I get home and check...sure enough, Au returns on 2-meters. She sure is a sweetie! Now...I've got to introduce her to the stock market!

KØMQS...you're loud into New York, but it must be one-way....Point your beams north and call, folks!

From Al Goss, K2SPO, FN13:

2/28/99—While making a few QSOs on 222 tonight, I noted that half the stations that replied to my CQs were 1 kHz below me. My frequency counter said my transmit frequency was OK on the IC-375. I'm doubtful it was Doppler...so...does this mean that some ops are using 706s or such with the CW-R (CW-reverse) active or what? 2nd choice RIT?

Stations worked: W9GA EN53; NY1E FN43; W9JN EN54; N1DPM FN32; W1COT FN31; VE2JWH FN35 (heard him calling K2YAZ in EN74 but no Q?); K2YAZ EN74.

One of my best 222 "times" via Au. Heard NIL on 432.

From Joe Reisert, W1JR (in reply):

Al—The offset is aurora doppler. At times, I've seen almost 1 kHz on 2 meters and, on

SMIRK Looking for Database Help

The following request for assistance was received from SMIRK Vice President Bill Tynan, W3XO:

The Six Meter International Radio Klub (SMIRK) needs the help of a computer-literate person, or persons, who can take our list of about 6,000 members and match it with the call letter data base to give us names and most current addresses for as many as possible. We want to mail out an announcement to our members, but do not have current addresses for enough of them to make it worthwhile. We do, however have a list of SMIRK numbers and callsigns. Of course, we know that some calls will not be current because of the vanity program. Anyone who might be able to help is asked to contact SMIRK Secretary Pat Rose, W5OZI, at w5ozi@ktc.com. Thanks very much and 73.

432, I've seen several kHz shift from aurora propagation. Good reason to tune around! Many times, I don't get a reply on my first call when the other station is apparently not using an RIT. When this happens, I simply move my TX frequency and call again until I find the right offset combination.

From Jay Hainline, KA9CFD, EN40:

3/1/99—Worked KAØRYT in EN34 on 432.1 MHz CW last night (2/28) during the aurora. Wonder how high in frequency can aurora propagation occur? I don't have 902 or 1.2-gig equipment, so have never tried.

From Ev Tupis, W2EV (in reply):

Hi Jay—As far as I know, the highest RF frequency for amateur aurora communications is 903 MHz, with quite a narrow "sweet spot." I think the stations were only a couple of hundred miles away from each other, and signals were marginal. To date, nothing done, 2-way, any higher. I'd be interested in "listening" to aurora using a laser receiver. I'd bet it's full of whoops and whistles.

From Eric Olson, N7EPD, CN87:

3/1/99—Worked N7EIJ DN17 at 0458 Z on 144.199 CW and VE6PY DO20 at 0515 on 50.125 USB aurora. CQ'd in CW on 222.1 for a while with nothing.

From Jordan Arndt, DO21:

3/1/99—I just spent 30 minutes on CW with K7NQ CN87 into DO21 de VE2SWL/VE6...this was on 2 meters...5-9+++A. Right now, KL7NO is 3-3 A on .125. Earlier, VE8JL DP22 into DO21 5-9+30 *Es*/Au very little distortion.

Point South, Point North (Again!)

As we headed toward deadline, we got these last-minute reports of excellent conditions on 6 meters from the southeast and continued Au in the northwest...

From Ed Rodriguez, WP4O:

3/8/99—Six meters wide open to LU/CX (Argentina and Uruguay) and W4 land from Puerto Rico. Seems like 20 meters—wide open; band is full from 50.100 thru .150 and signals 59 plus...both ends.

From Bill Harrison, KK4XO:

3/8/99—Ditto for south Florida...stations heard included LW5, LW6, LU6, LU8, LU9, CX1, CX8, and KP4 (very weak). Opening lasted approximately 1-hour...2220 Z-2320 Z.

From Paul Womble, AJ4Y, EL97:

3/8/99—Wow! Today was the first time in a little over a year that I have been active on 6 meters that I have heard South American stations *that* loud. Sounded just like conditions during the ARRL DX contest this past weekend on 10 meters. *Lots* of LU stations. Worked LU9APM @ 2239 Z in GF05, CX8BE @ 2234 Z in GF15 plus several other LUs and CXs were all-time new countries and grids for me. Thanks. Hope the wait between openings is not so long until the next one!

From Max Walls, K4MRW, EM64:

3/8/99—Best 6-meter opening to South America in a couple months. Very good signals into Alabama from GF05, GF15, FF95 (many LU, LW, CX), with most of them running average power/antennas. Hope the next good opening doesn't wait so long.

From John Kirk, VE6XT:

3/8/99—Yet another night of aurora here in the Pacific Northwest/Western Canada (think this makes 9 consecutive nights now). Point north!

VHF DXpeditions

National Contest Journal Editor Dennis Motschenbacher, K7BV, will be going to Aland Island to operate the new OHØZ super station in the CQ World Wide WPX CW contest (May 29–30) at the invitation of station owners Ari OH1EH, Jukka OH2MAM, and OH1JT. Before and after the contest, Dennis will be using the callsign OHØ/K7BV.

In addition, there's a very high probability the DXpedition will include a three- to four-day OJØ/K7BV operation from Market Reef, thanks to a generous invitation from Seppo OH1VR and Lars OHØRJ, who control the operations of the beacon on the reef. OH1VR will accompany K7BV to the reef and then operate in the CQ WW WPX CW contest after Dennis's departure by helicopter back to OHØZ.

K7BV's DXpedition will run from May 23 to June 3, 1999. He plans to operate all HF bands plus the RS-12 satellite and 6 meters, if he can borrow a small transceiver for the band. CW will be the preferred mode of operation on all bands.

QSL Information: OHØ, OJØ/K7BV via KU9C; OHØZ via OH1EH: Ari Korhonen OH1EH, Kreetalank. 9 As 1, FIN-29200 Harjavalta, Finland. (Tnx K7BV & N7STU) ■

Update

1999 Spring Sprints

There are changes in the e-mail addresses for log submissions in the non-ARRL Spring Sprints (see announcement on page 65 of last month's issue for details). The following e-mail addresses (along with postal addresses and Sprint dates) were provided by Sprint organizer Dave Bostedor, N8NQS:

Mail or e-mail complete ARRL-format logs to:

144 MHz Sprint (4/12/99): Rocky Mountain VHF+ Group, P.O. Box 473411, Aurora, CO 80047; E-mail: nrclog@aol.com

222 MHz Sprint (4/20/99): *50 MHz DX Bulletin*, 12450 Skyline Blvd., Woodside, CA 94062; E-mail: frank@horizon.sri.com

432 MHz Sprint (4/28/99): North East Weak Signal Group, 458 Allentown Rd., Bristol, CT 06010; E-mail: wz1v@ntplx.net

902, 1296, and 2304 MHz Sprint (5/8/99): Badger Contesters, 2342 Glendale, Appleton, WI 54914; E-mail: akyser@edci.com

50 MHz Sprint (5/16/99): Great Lakes VHF/UHF Group, 434 Pattie Ave., Jackson, MI 49202; E-mail: vhfuhf@voyager.net

Six-Meter Rigs Are Everywhere!

Ten years ago, you could hardly find a ham rig that included 6 meters. Today, it's hard to find one that doesn't!

For the longest time, the growth of 6-meter activity was hampered by the lack of suitable and affordable equipment. This problem was probably at its worst during the last sunspot peak, at which time there were only a few new radios available for the band. Vintage rigs from a few sunspot cycles past were all that were available for many stations. Nowhere has the turnaround in increased activity in the 6-meter band been more noticeable than in the greater availability of new 6-meter radios.

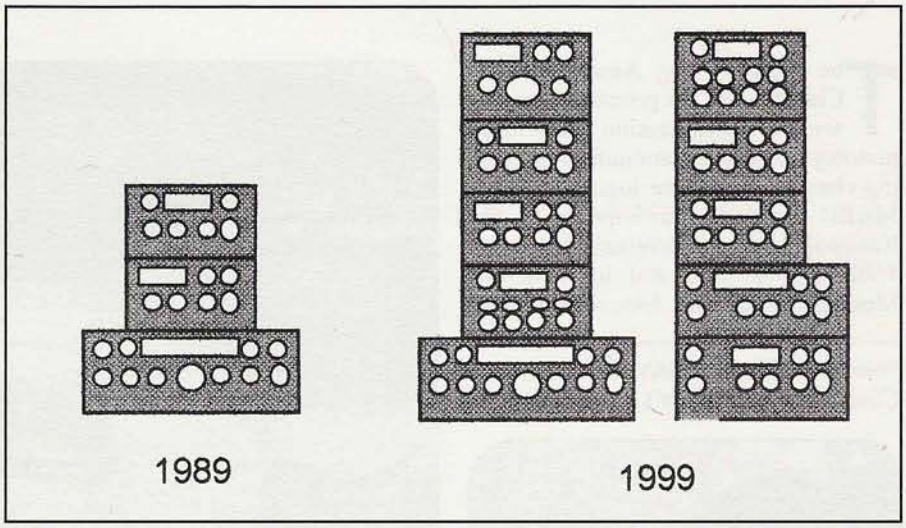
Looking Back in Time

The lack of new equipment for 6 meters during the last sunspot peak can be confirmed in two ways: by looking at the ads in ham radio magazines from 1989 and by examining QSL cards indicating the equipment used for contacts. Perhaps the biggest change with equipment availability came about only three years ago, when the ICOM 706 was introduced.

In the early 1990s, there were only about half a dozen radios available from the big three radio manufacturers (ICOM, Kenwood, and Yaesu) with 6-meter SSB capabilities. Only one radio, the Yaesu FT 690R Mark II, was a single-band unit, which was priced at around $550 at the time; the other radios were various HF plus 6-meter radio combinations (such as the FT 650 or the TS 680) that were all priced at $1,200 or higher. A new rig was then not necessarily a viable option for someone starting on six in 1990. As a result, many 6-meter operators resorted to using older rigs, such as the 1960s vintage Swan 250, the 1970s vintage Yaesu FT 620, and the 1980s vintage Kenwood TS 670.

Today's Marketplace

Now compare this with the huge selection (see Table) of SSB 6-meter rigs avail-



The number of new 6-meter radios on the market has increased greatly in recent years.

Table

Manufacturer	Model	Description
Alinco	DX 70T, TH	HF + 6 m
Cherokee	AH-50	6 m handheld
ICOM	IC-706	HF + 6 m + 2 m (+ 70 cm on IC-706G)
ICOM	IC-746	HF + 6 m + 2 m
ICOM	IC-756	HF + 6 m
Kenwood	TS-60	6 m all-mode
Kenwood	TS-570S(G)	HF + 6 m
MFJ	MFJ 9406	6 m SSB/CW
Patcomm	PC-9000	HF + 6 m
Pryme	PR-52	6 m handheld
Yaesu	FT-100	HF + 6 m + 2 m + 70 cm (not yet available)
Yaesu	FT 690R Mark II	6 m all-mode
Yaesu	FT 847	HF + 6 m + 2 m + 70 cm
Yaesu	FT 920	HF + 6 m

Table. A snapshot of current radios offering 6-meter multimode capability. Prices range from under $300 to over $2,000, so there's something for nearly every budget. This is a far different picture from the scant and expensive offerings of a decade ago.

(Continued on page 78)

By Ken Neubeck, WB2AMU (wb2amu@cq-vhf.com)

Motorcycling Amateur Radio Club

Here's a radio club that not only has fun and provides public service, but it also raises money for charity and serves as a testbed for certain ham accessories.

The Motorcycling Amateur Radio Club (MARC) is primarily a public service organization providing motorcycle-mobile communications during charity events (see logo, Photo A). MARC regularly participates in the National Multiple Sclerosis Society's 150K bicycle ride and in numerous Muscular Dystrophy Association "love

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

Photo A. The Motorcycling Amateur Radio Club logo, painted on the side of KV6FHN's Honda Gold Wing. (Photos by the author)

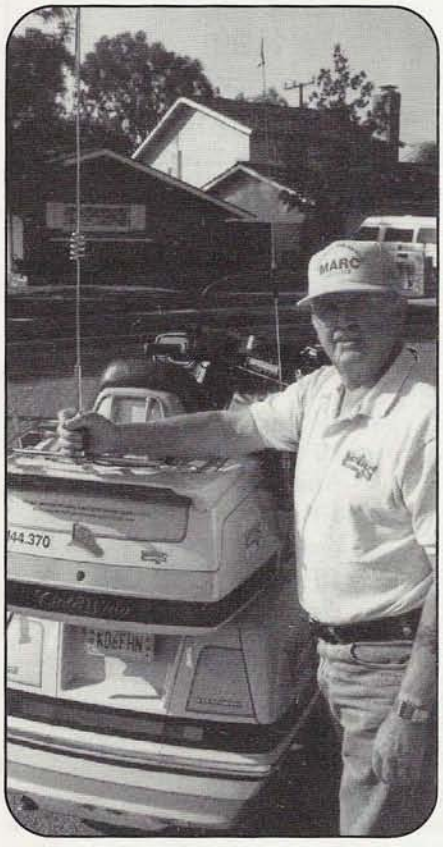


Photo B. Ray Davis, KV6FHN, founder and past president of the Motorcycling Amateur Radio Club (MARC).

Photo C. Detachable-head radios that stand up well in motorcycling use are of special interest to MARC members, and they are regularly reviewed in the club newsletter.

By Gordon West, WB6NOA* (wb6noa@cq-vhf.com)

Photo D. MARC members provide field-testing for certain specialized ham products, such as noise-canceling headset microphones.

ride" events. MARC is six years old and has amassed very enviable sums of money for charity—to the tune of $8,000,000! "Yes, folks, that is over $8 million charity dollars earned by the Motorcycling Amateur Radio Club," comments DeWitt Morgan, KM6UK, MARC's Disaster & E-Mail Coordinator.

MARC was started by Ray Davis, KV6FHN, a retired public safety officer and a major proponent of charity work on two wheels (see Photo B). "I will always remember that first meeting when eight MARC members sat around a couple of tables in Huntington Beach, California, and had no idea where we were headed, and what a marvelous ride it would be together," comments Davis, who recently underwent hip replacement surgery and has stepped down from the MARC presidency.

"Ray has been a hard driver, and will be a tough act to follow," notes Morgan, KM6UK, adding that their founder is not leaving the club's leadership. "Ray will remain as a board member and help to shape the direction that MARC goes from here."

Field Testers

Every month, MARC publishes an informative newsletter that talks about upcoming events, high-frequency and VHF/UHF nets, radio tips for riders, and reviews of detachable head radios that have survived on the handlebars of a motorcycle (Photo C). MARC riders have also been recruited to field-test certain ham accessories in the high-vibration environment of motorcycle operating, including VHF and UHF antennas from Comet and helmet headsets and noise-canceling boom microphones manufactured by Adonis USA (Photo D).

If you're into operating motorcycle mobile, this organization may be a fun one to monitor. It's done a lot for charity in the past; and even though its president is taking a break, the group still plans to do a lot more in the future. ■

Resources

For more information, visit MARC's home page on the World Wide Web, at <http://members.home.net/ve6hgw/marc/>, or a page of links to individual MARC members with Web sites at <http://www.telusplanet.net/public/afriesen/marcmemb.htm>.

To subscribe to MARC's newsletter, send a check for $12 per year to: Motorcycling Amateur Radio Club, c/o Ray Davis, KV6FHN, Past President, 3 Lindberg, Irvine, California 92620-3367.

For more information on the products mentioned in this article, contact:

Adonis/RF Limited, P.O. Box 1124, Issaquah, WA 98027; Phone: (425) 558-9592; Fax: (425) 558-9704; Internet: <http://www.rflimited.com>.

Comet Antennas, NCG Company, 1275 N. Grove St., Anaheim, CA 92805; Phone: (800) 962-2611 or (714) 630-4541; Fax: (714) 630-7024.

fast FACTS!

Finding a Radio Club

Where can you find experienced hams to help you learn new things or to answer your questions when you're confused? Where can you find used gear at reasonable prices? Or help putting up your new antenna? A magazine like this one can help with the first three, of course, but sorry, we don't do antennas (except our own).

For hands-on, in-person help and education, not to mention interesting activities and the chance to make new friends, you simply can't do better than your local radio club. But clubs can sometimes be hard to find. Here are some suggestions:

1. On the air—if you've got a radio and you've found your local repeater, listen for announcements (many repeaters are sponsored by clubs) or get on and simply ask someone.

2. The ARRL (American Radio Relay League)—many of the most active clubs are affiliated with the ARRL. A list of affiliated clubs in your area is available by calling (860) 594-0200, or via e-mail request on the Internet to <mbourgoia@arrl.org> (ignore the < and > in the address; they're just there to set off the address from what's around it.).

3. Try the phone book—some clubs have their own phone numbers (often hooked to an answering machine) and separate listings in the directory.

4. Your local Radio Shack or ham store—these are often sources of information on area clubs.

5. Online—America Online's Ham Radio Club offers a directory of ARRL-affiliated clubs, broken down by state.

Once you find a club, get in touch with a member or just show up at a meeting. If you do just show up, be prepared to take the initiative to introduce yourself and let people know you're a new ham. Many hams are friendly but shy, and they may not feel comfortable approaching a stranger. (If that description fits you as well, you'll probably do best to contact a member before the meeting so that someone is expecting you and can begin introducing you to other members.) In nearly all cases, you'll be warmly welcomed both to the club and to the worldwide community of ham radio.

A Mini Course in Microphones—Part 2

No matter what type of microphone you have, there are ways to customize its audio to make you sound better to whomever's listening on the other end. Here's how "equalizing" can set you apart from the crowd.

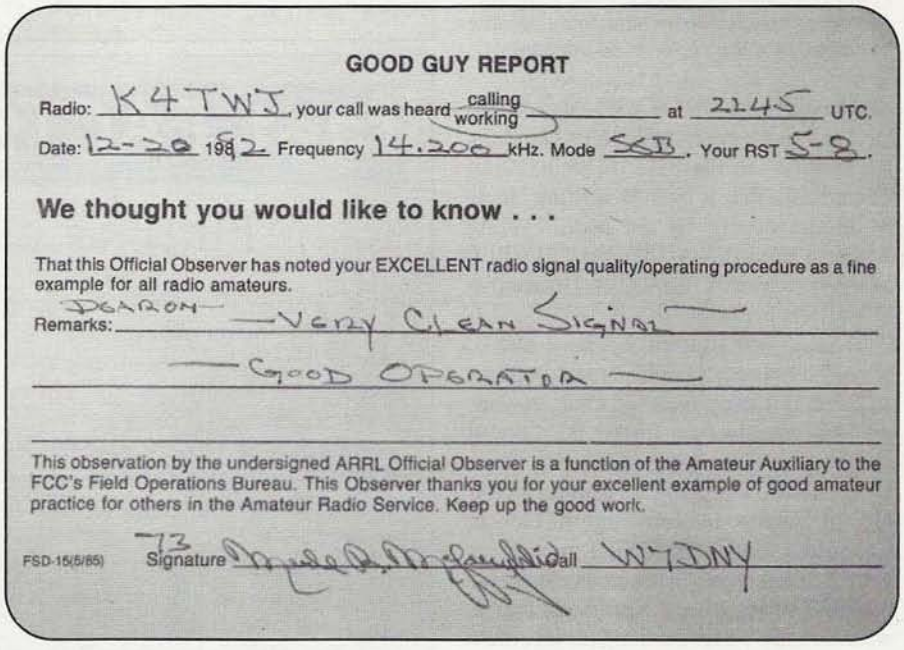
Last month's column introduced the open-ended area of microphones and discussed how they differed in element types and technical specifications. This month, we continue with more facts, notes, and tips on equalizing microphones and tailoring transmitted audio to fit your particular needs and applications.

This study of microphones promises to be both interesting and informative, and the "end product" resulting from our pursuit of perfection can put you 10 dB above the crowd in audio quality. Really! Get ready for a positive learning experience and read on as we show you how to develop a fresh, new on-the-air image!

"Most transceivers are built first-class. Why degrade them to second-class or no-class with an unnecessarily compromising mic?"

Although difficult to believe, I understand how many amateurs may assume that any microphone that will plug into a rig's mic socket and make its meter move is suitable for communications. Some folks also visualize a $5 mic adapted to work with a favorite rig as a bargain. Does either conviction hold merit? Each person's answer and supporting logic differ here, but I always say that even the best setup is limited by its weakest link. I also find that you usually get what you pay for—or less Sorry about that, but Brother Dave tells it like it is!

Most transceivers are built first-class. Why degrade them to second-class or no-class with an unnecessarily compromising mic? That's akin to putting four used-bald tires on a new Cadillac. Go for the "whole enchilada!" Live a little!



GOOD GUY REPORT

Radio: K4TWJ, your call was heard calling / working at 2245 UTC.

Date: 12-20 1982 Frequency 14.200 kHz. Mode SSB. Your RST 5-8.

We thought you would like to know . . .

That this Official Observer has noted your EXCELLENT radio signal quality/operating procedure as a fine example for all radio amateurs.

Remarks: DEARON — VERY CLEAN SIGNAL — GOOD OPERATION

This observation by the undersigned ARRL Official Observer is a function of the Amateur Auxiliary to the FCC's Field Operations Bureau. This Observer thanks you for your excellent example of good amateur practice for others in the Amateur Radio Service. Keep up the good work.

FSD-15(5/85) 73 Signature [signature] Call W7DNY

Photo A. What's better than a great sounding signal? An Official Observer "Good Guy" report stating same and complimenting your operating expertise, naturally! Yes, and such reports are really collected! Just keep your signals and operating savvy top rate, and you may unexpectedly receive one too!

Audio and Microphone Equalization

Surely the main reason (and ultimate reward!) behind most amateurs' efforts to adapt and use a special mic is to help their signal stand above the crowd in audio quality. And, yes, you'll know when that goal has been reached by the large number of unsolicited compliments received on your transmitted audio. Ensure that your operating techniques and on-the-air manners are equally clean and impressive and you're well on your way to establishing a terrific amateur radio image (Photo A).

Basically, there are three ways of tailoring your transmitted audio to produce a desired sound. First is seeking out a

By Dave Ingram, K4TWJ (k4twj@cq-vhf.com)

Photo B. New Heil mini headset with boom mic is lightweight for comfortable long-term operations, and it sounds terrific on both transmit and receive. Mic case will accept various Heil elements for customizing to your voice. All Heil elements are dynamic type and designed to match the input impedance of modern solid-state transceivers. Photo courtesy Heil Sound Ltd.

microphone or element with a near-optimum *response curve* (see last month's column for a discussion of response curves) and then adapting it as necessary to work with your rig (by blocking "phantom" DC voltage, adding a PTT switch, etc.). Second is adding *equalization circuitry* to a favorite or already-in-use mic so it has a "bright lights and glamour sound." Third is installing an external equalizer unit between your existing mic and rig for terrific sounding audio plus plug-and-play convenience. Let's take a closer look at each approach.

Choosing the Right Mic

Initial selection of a microphone or element with a near-optimum response curve will mainly depend on its planned mode of use. A wide-range mic with both bass and high frequency/treble response up to around 6000 Hz will sound marvelous on FM or AM, especially when the receiving station has a full-range speaker system. A mic or element "peaked" in the voice range of 300 to 3000 or 3500 Hz (with a mild 5- or 6-dB rise on the high end) will yield good audio clarity for SSB.

Some outstanding and affordably priced microphones and elements filling that bill are produced by well-known audio engineer Bob Heil, K9EID, and sold by amateur radio dealers nationwide. Bob has worked with sound systems for the Grateful Dead, the Who, ZZ Topp, Dolly Parton, among others, and he flat knows audio. His HC-5 mic element is wide-range for full-bodied sound, his HC-4 element is peaked for SSB use, and a brand new unlabeled element has peaks in both the bass and treble ranges, so it sounds unbelievably good on FM, AM, or SSB. You simply must hear one of these new elements to believe it! Another new Heil Sound item destined to become a big star is the mini headset with boom mic shown in Photo B. It's ideal for hands-free operating stints and available with your choice of Heil element. See "Resources" for more information on Heil elements, mics, headsets, etc.

Additional choices in microphones are limited only by your imagination. Always-popular varieties are Shure's famous 55SH and 510DX, Astatic's classic D-104 (all three highlighted last month), and many others. If possible, test a selected mic with a clip-lead hookup to an audio amplifier (or your rig!) before making a buying decision. That way, you'll have a good idea of which one best fits your voice and what you're getting for your money.

Equalizing Your Current Mic

Adding equalization to a favorite mic is a clever idea if you have the time, patience, and audio engineering background to make the venture successful. This will involve first impedance-matching a microphone or element with its connected preamp or rig for an accurate frequency response curve, then rolling off low and/or high tones to produce the desired results. This audio tailoring may be done "actively," with frequency-sensitive IC circuits, or "passively," with only a capacitor and potentiometer.

The basic "How It Works" theory here is illustrated in the Figure. It's based on the fact that a capacitor acts like a frequency-dependent resistor to audio tones, with higher-pitched tones passing through while lower-pitched tones are attenuated or blocked. A capacitor in shunt or parallel with a mic element will "kill" or pass high tones to ground, and thus leave only bass tones. By including a potentiometer in series with that capacitor, we can determine the amount or extent of high-frequency rolloff. If a similar value capacitor is placed in series rather than in parallel with a mic element, it will allow similar high tones to pass or be output while blocking bass tones. If desired, a potentiometer can be connected in parallel with that capacitor for varying low-frequency rolloff. Remember to include a second, "unbypassed with a pot," capacitor to block phantom/DC voltage, if supplied to the original mic/element.

Graphic Equalizers: What They Are and How They Work

Multiband graphic equalizers are often used in recording studios, professional sound systems, and "high-end" stereos or Hi Fis. Their concept of operation involves separating the audio range of 20 to 20,000 Hz into 2, 4, 8, 16, 24, or more narrow bands of frequencies or tones that can each be varied 10 to 18 dB from a center "zero dB" or "flat response" point. This arrangement lets us emphasize or de-emphasize distinctive tones unique to a desired sound and thus acquire really great sounding audio. Such sound enhancement glamorizes your voice like those "Hollywood Photo studios" at the mall glamorize your appearance.

What's the difference between a tone control and an equalizer, you ask? A tone control lets you boost bass tones while reducing treble tones accordingly (or vice-versa). It also has a limited range and cannot emphasize a specifically selected mid range of tones (like "S" sounds on "yess") without over-emphasizing higher pitched tones or "dropping off" lower pitched tones.

By comparison, a multiband equalizer lets you set bass and treble levels independently plus boost or attenuate small groups of mid-range frequencies to yield any type of sound desired. A multiband equalizer can also be adjusted to emphasize voice characteristics like a bass growl, or a "through-the-teeth" whistle. It can also be quickly reset for second and/or third ops. Professional multiband equalizers are usually overkill for amateur radio applications (and many are not protected from RF overloading). Fortunately, equalized mics and/or stand-alone equalizers are usually available for amateur radio if you search magazine ads diligently.

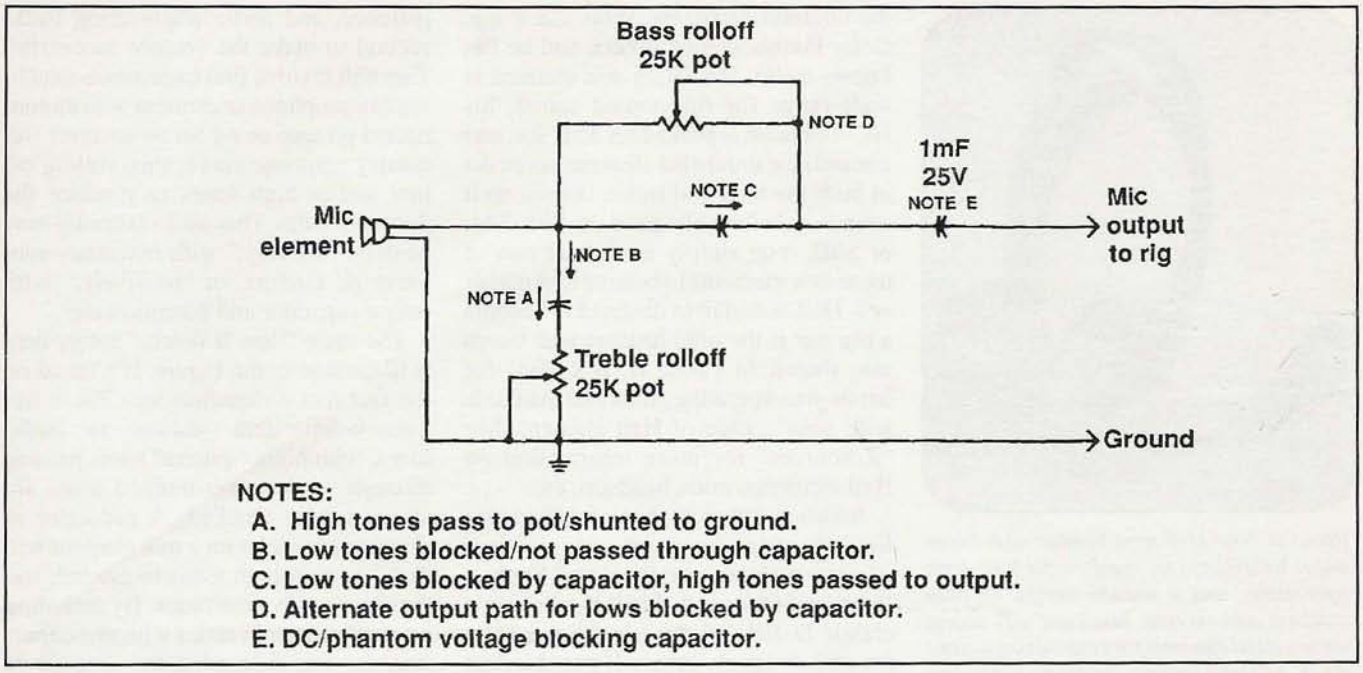


Figure. The basic concept of equalizing a microphone's audio response to fit your needs involves rolling off low and high frequencies as illustrated here. See text for full discussion.

A 1-µf, 15-volt (or larger), non-polarized tantalum capacitor works fine and doesn't alter frequency response. Conversely, exact values of capacitance and resistance used to roll off bass and treble ranges will depend on frequencies and levels of rolloff desired and can quickly become a separate study of its own. A.01-µf or .1-µf non-polarized tantalum capacitor and a 10k ohm or 25k ohm pot usually make good starting points for homebrewed mic tone/response controls.

Photo C. Greg Weremey of Electronic Service Professionals checks out one of the Astatic D-104 mics he modifies or equalizes for full-bodied sound. This reworked delight even demonstrates good bass response (gasp)! Photo courtesy E.S.P.

Going to Greg

Incidentally, if you like classic mics but lack time or test gear for equalizing their response, Greg Weremey is an audio and broadcast engineer who can help solve your dilemma.

Electret Mics and Elements: A Special Note

Last month, I mentioned that an electret mic or element required phantom DC voltage for powering its associated preamp. To the best of my knowledge, this preamp is usually within the mic element's case for various handheld FM transceivers, and is contained on a separate circuit board in the mic's case or base in other (and larger) rigs using electret mics. This is where the mic game gets a mite confusing.

All models of base and mobile ICOMs I've checked or studied use electret mics with preamps included somewhere in their case. I've also noticed electret mics are used with some (all?) Alincos, some (all?) handhelds, and possibly some (all?) Standards. I'd like to be more specific here, but checking every model of handheld, base, and mobile transceiver is impossible. As a good working alternative, I'll tell you how to check any rig, old or new, small or large, so you can answer that question for yourself—now or later. Fair enough?

First look in your rig's manual and note which number pins on its mic socket connect to the actual microphone element rather than the PTT switch or Up/Down tuning buttons. Then use your Volt Ohm Meter (VOM) to check if phantom output voltage is present on those mic pins. Yes? The rig uses an electret mic. No? The rig uses a dynamic or crystal mic.

Why the special concern over electret mics? If you change mics or element types for more custom-tailored or equalized audio, two considerations must be kept in mind. If a different type mic element (like a dynamic or crystal) is substituted, phantom DC voltage must be blocked from reaching the element. Also, if the electret element's preamp is disconnected or disabled, the mic's level will drop approximately 10 dB. On some transceivers, the mic gain control can be increased enough to compensate for this loss. Otherwise, an added preamp stage will be required (a "try it and see" situation).

I've slipped by this requirement with several ICOMs using handheld mics by replacing only the mic element with a Heil element and continuing to use the mic's built-in preamp. I have not, however, doublechecked resultant frequency response to ensure I was getting the full benefit of using a Heil element. Ah, but the good news is Heil now offers a mating plug-in-and-use (model HMP) preamp for no-miss success and top results. Check it out!

He modifies stock D-104 mics for rich, full-bodied sound with more punch and less splatter on SSB or FM, and the demos I heard of his mods were amazing. Truly, this is the no-fumbles, no-hassles way to enjoy owning and using one of amateur radio's all-time popular mics. Whew!

In talking with Greg, I learned his D-104 mod includes reworking the mic's base-mounted preamp for a closer match to the cartridge's high impedance. The preamp, in turn, is low-impedance output with select value capacitors tweaking frequency response and blocking phantom mic voltage.

Comparing "before" and "after" response curves reveals more interesting details. An original D-104 has a 10- to 12-dB peak between 2000 and 4000 Hz, treble response to 10,000 Hz, and bass response that rolls off 10 dB or more between 100 and 700 Hz. After modification, the same D-104 exhibits an almost flat response from 30 to 1000 Hz, a "presence" peak of roughly 6 dB between 2500 and 3500 Hz, and treble response up to 6000 or 7000 Hz. In other words, it's a D-104 with mellow bass and without the tin can sound The thing even makes an FM rig sound like a broadcast station. It's awesome!

Greg performs D-104 mods on owner-supplied D-104s (Photo C) for $75. He also modifies Kenwood TS-520s, TS-530s, and TS-830s, and possibly other rigs, for broadcast-quality audio. Want more details (need I ask)? Check out Greg's contact info in "Resources."

"Adding equalization to a favorite mic is a clever idea if you have the time, patience, and audio engineering background to make the venture successful."

External Equalizers

Installing an *external equalizer* between your existing mic and transceiver is probably the easiest and most versatile

Photo D. This add-on equalizer is available in kit or preassembled/plug-in-and-use versions from W2IHY in New York, and it features easy plug and switch selection for use with Kenwood, Yaesu, and/or ICOM mics and rigs. The unit also has an adjustable noise gate for removing undesired background noise. See discussion in text.

technique worthy of consideration. In addition to direct plug-in compatibility, this arrangement has the extra advantage of settings that can be changed to fit a particular mood, mode, or second operator. Two groups of settings could be color-keyed for FM and SSB use by the OM, for example, and two more groups color-keyed for use by the XYL. A third (or fourth) group might even mark a "Wolfman Jack sound" for those times when we want a touch of funky audio to change pace. Handy idea, eh?

One popular microphone equalizer presently available in both kit and wired/preassembled form is the W2IHY unit shown in Photo D. This gem is a combination two-band equalizer and adjustable noise gate that works with Kenwood, Yaesu, and ICOM transceivers using 8-pin mic connectors. It includes a jumper for applying or disabling rig-supplied phantom power for a connected electret mic, plus rear sockets for using a separate/special mic or element and foot switch (stomp to talk!).

I've used this equalizer on both SSB and FM, and it works like a champ for producing a broadcast studio sound or adding audio punch to a signal. The noise gate also does a terrific job of minimizing in-shack noise from such things as linear amplifiers or air conditioners. You can even connect more than one type of mic and switch between them. Neat! The equalizer is supplied with a rig-interfacing cable and an AC "wall wart" (or you can power it from 13 VDC for mobile use). Check it out! See "Resources" for ordering information.

Tips, Tidbits, and Notes

Before leaving our subject of equalization, a couple of additional words of wisdom warrant sharing. First is a quick and easy way to add an extra touch of glitz and glamour to almost any rig. When choosing an FM rig, select one with true frequency modulation rather than phase or reactance modulation—and speak into your custom-tuned microphone for it like you're using a $1,000 mic.

Second, using your SSB rig's speech compressor to enhance high frequency/treble response and add "presence" to your signal gives it a crisp and impressively clean signal. Just punch on the compressor and set its level (if adjustable) to near *minimum*. You don't want the "compression sound" or audio "pumping"—just a tad more high tones, that's all (Photo E). Don't turn up your mic gain or get closer to the mic's grill—that will defeat your glamorizing technique. Just "talk up" and maintain an air of confidence in your voice. The technique works great! Honest! Would Doctor Dave lead you astray?

Space is now tight, so let's quickly squeeze in one final tidbit for this month. If you use a multimode transceiver and a custom mic with what's called a super-cardioid pickup pattern, you can get a full-bodied sound for FM *and* a bright articulate sound for SSB. How so? If you "close talk" the mic (lips against its grill), bass tones will get a 10 to 15 dB boost. If you move back six or seven inches from the grill and talk louder rather than increasing mic gain, high tones will get a comparable boost. Really! Try it!

That's all the space for this time. Stay tuned for more information next month on interfacing mics and rigs, homebrewing mics and special tricks for acquiring great audio. If you would like to see more technical details and discussions on audio tailoring in this column, let us know and we'll answer your requests in future columns. Meanwhile, continue striving for great audio and may the force of good signals be with you! 73.

—Dave, K4TWJ

Photo E. The speech compressor in most SSB transceivers is also beneficial for enhancing your transmitted audio, if properly adjusted and used. You want just enough compressor action to accentuate high tones but not compress the audio and cause "pumping." Typically, this equates to minimum rather than maximum ALC-metered action.

Resources

For more information on Heil mics and elements, contact Heil Sound, Ltd., 5800 North Illinois, Fairview Heights, IL 62208; Phone: (618) 257-3000; Fax: (618) 257-3001; E-mail: <info@heilsound.com>; Web: <http://www.heilsound.com>.

For more information on modifying Astatic D-104 mics for better SSB/FM performance, contact Greg Weremey, Electronic Service Professionals, 13 Kildee Rd., Harwichport, MA 02646; Phone: 508-432-8831.

W2IHY external mic equalizers are available from Julius Jones, W2IHY, 19 Vanessa Lane, Staatsburg, NY 12580; Phone: (914) 889-4933.

The Y2K Bug and Digital Weathermen

How will the infamous "Y2K" bug affect packet networks and your TNC? The key to answering that question, says N2IRZ, lies in really understanding what this computer "bug" is all about. And then there's the weather report...

It seems that you can't turn your head without hearing about the impending doom that the Y2K bug is going to cause. In case you've been in a cave for the past few months, "Y2K" stands for "Year 2000." It seems that early computer programmers, trying to save a little storage space, used only two digits for the year, instead of four. When we move into year 2000 in a few months, all the computer programs they wrote won't know if it's 1900 or 2000, so any calculations involving the year might come out a little screwy. Think of the penalties when your mortgage company claims you haven't made a payment in 99 years!

Personally, I'm planning on staying in bed for the first few months of 2000, until everything gets straightened out again. I just hope I can continue to send in columns. (*Can't wait to hear about packet in 1900!—ed.*)

Seriously, while there might be some cause for concern in essential matters of life, is what's going to happen to our computer-based radio networks really important? Will everything stop working at midnight of December 31, or will all the radios, thinking it's 1900, revert to wideband spark operation using quenched coils? Of course, even if we assume the very worst—the network converts to a *notwork*—we will all survive. Let's hope the power company has a better plan.

Get a Horse!

I work for a car manufacturer and you simply would not believe how many inquiries we've received so far, asking if our vehicles are Y2K compliant. You see, the media have managed to drill one part of the message into everyone's head: computers are affected by some Y2K thingie that can become a problem. Cars use lots and lots of computers (microcontrollers, really, but most reporters can't tell the difference). Thus, the logical conclusion is that my car will simply cease working at midnight on December 31, 1999.

The part they forgot to mention is that for any effects of Y2K to become apparent, the object in question (car, dialysis machine, whatever) must be aware that *the year has changed*! Unless the computer knows what the date is, there can be no possible Y2K effects. This eliminates the majority of all devices, including those in cars. The device must also use a two-digit (or less) representation of the year; four-digit years should be OK until the Y10k bug hits. There's something else, critically important: not only does it need to *know* the date and time, but it needs to actually *use* the year as part of a calculation! No calculation, no effect.

Y2K and Packet

As we look at the packet network, we see that most devices we use—TNCs and radios, for instance—don't use the date, or at least don't use it for calculations. Some devices we use, especially older computers, might not be Y2K compliant. Consider your local BBS, DX Cluster server, TCP/IP system, or PC-based network node: could these stop working at midnight on New Year's Eve? Maybe.

"Will everything stop working at midnight of December 31, or will all the radios, thinking it's 1900, revert to wideband spark operation using quenched coils?"

Right now would be a good time to double-check.

Most packet network server programs use the date, but not necessarily in a calculation. Some already use a four-digit year, so there's no problem. Others might give out some screwy data, like telling you your last log-in was 99 years ago, but should keep working for the most part. If not, we can either change software, or postpone the problem by resetting the date to 1990. Similarly, network node software probably won't be affected. I'm not aware of any networking software that uses the year in calculations. Nonetheless, we can switch software or move back into the '90s.

If you're a sysop of a server or network facility, take a few minutes to think about everything your system does with the date and consider whether Y2K can affect it. A simple check would be to just set the system time and date to 11:59 p.m. on 12/31/99 and see what happens after a minute. Let the system run for a few days like that, just to be certain. If you're a user, you should urge your sysops to think about it as well, maybe even test the system. You can also explore the system,

By Don Rotolo, N2IRZ (n2irz@cq-vhf.com)

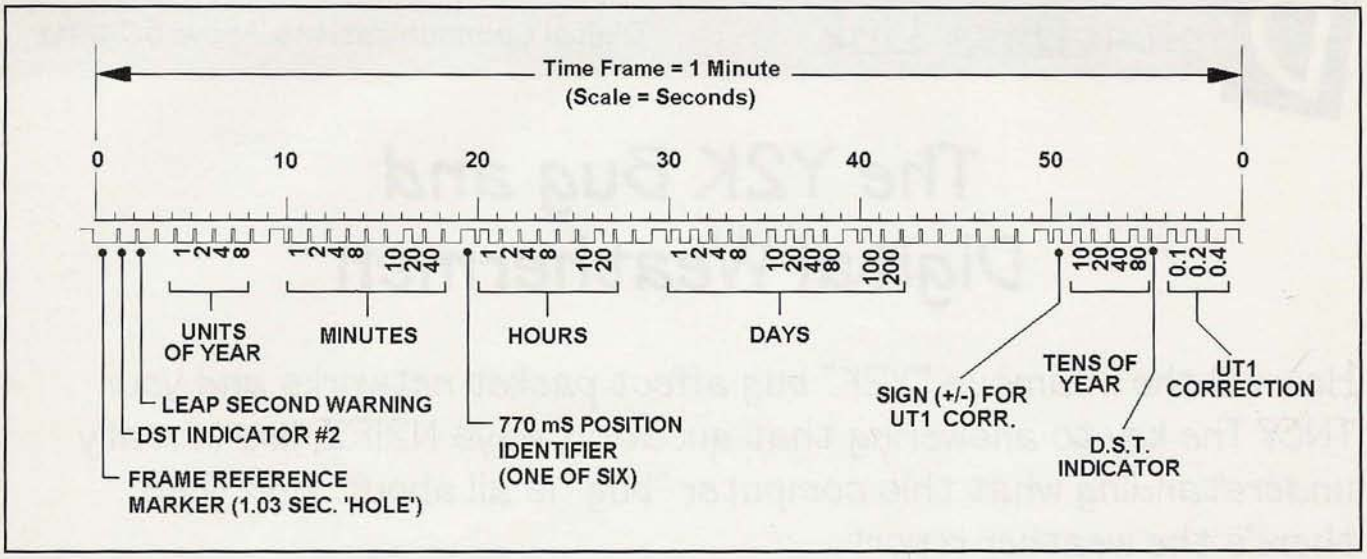


Figure. The time code format for WWV and WWVB. Each second, a pulse of 100-Hz audio is sent on a subcarrier, with the pulse length denoting a one or zero. Bits are sent one second apart, and each has a specific meaning. The beginning of the minute is marked with a "hole" in which no pulse is sent, and every 10th second is marked with a long pulse. To arrive at the value for each quantity, you add the "weight" of each bit. For example, if the "hours" bits are 1001 10 (with weights of 1, 2, 4, 8, 10, and 20, respectively), this represents 1 + 8 + 10 = 19 hours, or 7:00 p.m. A narrow pulse is a zero, a wide pulse is a one, and this example shows a time of 21:10 UTC on the 173rd day of 1990.

looking for dates or any calculations involving dates.

You know, it wouldn't be a bad idea to try that simple test on any computers you use at home, too. But make sure you have a boot disk handy, just in case...

While the packet world probably won't see any issues at all from Y2K, or, at worst, some minor inconveniences, it never hurts to look into it before the big day.

• • •

WWV Data

While we're looking at time, it makes sense to look at the mother of all time, radio station WWV. The U.S. government, along with some others, broadcasts a highly accurate time signal on shortwave radio frequencies. While not exactly on amateur frequencies, and not above 50 MHz, it's kind of interesting. Besides, accurate timekeeping and the propagation information broadcast by WWV can be quite useful to VHF operators as well as those stuck below 30 MHz.

WWV and its sister station, WWVB, broadcast from the National Institute of Standards and Technology (NIST) offices in Boulder, Colorado. Their signals on 10, 15, and 20 MHz, as well as on 50 kHz, can be heard in most of the contiguous U.S. all the time, as well as over much of the world with good conditions. For areas in the Pacific, WWVH broadcasts from Hawaii, with essentially the same information.

If you've ever tuned to WWV, its sound is unmistakable, a series of clicks spaced a second apart, with some periods of silence and some tones. There is a voice announcement of the time as well, but the overall effect is kind of monotonous. However, encoded within the signal on a 100-Hz subcarrier is the exact time, sent one pulse (bit) per second. During each minute, enough bits are sent to express the minute, hour and day of year, two digits of the current year, and some supplementary information, such as UT1 correction and Daylight Savings Time indication.

Data is coded by differing the time of each 100-Hz pulse. A 170-mSec (millisecond) pulse denotes a zero, and a 470-mSec pulse denotes a one. The numbers are sent using Binary Coded Decimal (BCD) encoding. Refer to "Binary Coded Decimal" elsewhere in this article for information about BCD. The 100-Hz subcarrier is sent between each audible "click" marking the seconds, starting exactly 30 milliseconds after the click.

Looking at Figure 1, we can get an idea about how the data is sent. At the top of each minute (point "A"), the first second has no subcarrier pulse, creating a 1.03-second "hole" (0.03 sec. = 30 mSec). This unique *Frame Reference Marker* is used for synchronization, marking the beginning of a new *Time Frame Minute*. Then, 30 mSec after each click, a one or a zero is sent. At every 10th second, a special 770-mSec *Position Identifier* pulse is sent.

"...for any effects of Y2K to become apparent, the object in question (car, dialysis machine, whatever) must be aware that* the year has changed*! Unless the computer knows what the date is, there can be no possible Y2K effects."

There is some relationship between this and the first part of this column: the two-digit date. Unless your software understands decades, there's no way—from the WWV broadcast—to tell the difference between July 29, 1990 and July 29, 2000. NIST understands this and has created a test facility for software and system Y2K compatibility.

The idea is simple: just broadcast the exact time, but set the year exactly two years ahead. Understandably, they can't do this over the air, but there is a Web server that developers and system administrators can use for live tests of their systems. For more information, look at <http://www.boulder.nist.gov/timefreq/y2kupdate.html>.

• • •

Digital Weathermen

Here in the New York City area, we receive the National Weather Service's VHF broadcasts (NOAA Weather Radio)

"Consider your local BBS, DX Cluster server, TCP/IP system, or PC-based network node: could these stop working at midnight on New Year's Eve? Maybe. Right now would be a good time to double-check."

from station KWO35 on 162.55 MHz. I listen to it frequently, as it offers much more detail than the typical radio or TV weather report, allowing you to come to your own conclusion as to what the weather will be. In some parts of the country, such as in Tornado Alley in the midwest, listening to NWS can save your life with a tornado warning.

Although the material is a little bit dry, which is understandable, the human announcers each have their own personalities, and this seeps into their reports. Comments like "and to make the evening commute even more fun," or "this should serve as a reminder that winter is still here" lighten up the otherwise dull monologue. Some announcers really make the words flow smoothly, while others tend to stumble; I'm guessing that these are the trainees.

My car radio is equipped to receive the NWS broadcasts, and I have about a 10-minute commute to and from work, so I tend to eschew music or news stations for the NWS broadcasts, listening about twice a day. Thus, it was with quite a start that I heard a new announcer the other day. He was a bit difficult to understand at first, with an odd accent that I couldn't place for a few seconds. Then it hit me: it was synthetic!

I listened carefully, raising the volume, and, indeed, this guy was fully electronic. The cadence of the words was somewhat difficult, with one word being spoken quickly and the next slowly, making listening a bit tiring. Some words were pronounced strangely ("Buoy" came out as a kind of muted bleat), but after 15 minutes or so I got used to it.

The second I got home, I logged onto the Web and went to the OKX site—that's the identifier of our local NWS office on Long Island. The top of the page contained a link to a "what's new" page, explaining the funny voice I was hearing. This also links to the National Weather Service's main page, where enormous detail can be found. Some of the software release notes are fascinating, with a real-life look at the problems and issues associated with the deployment of such a complex system. Have a look at <http://www.nws.noaa.gov/nwr/nwrcrs.htm> for some FAQs (Frequently Asked Questions).

It turns out that their Console Replacement Program (CRS) is a suite of software that takes manually and automatically generated weather forecast scripts and speaks them aloud. The main speech program is DECtalk, which is considered the industry's best-sounding speech synthesizer. Other than some odd words, such as local place names with unusual spellings, it can speak any word there is. While far from perfect, it is simply amazing how good it is. The pronunciation tables are constantly updated, so the odd words tend to disappear, and overall the system is constantly improving. They're even working on generating a variety of male and female voices, simply for variety.

CRS will allow the NWS to take the resources previously spent on recording broadcasts and reallocate them to more important tasks, such as forecasting and warnings. The automated system allows for more precise report timing, even with variable report lengths, so users can tune in at a specific time for the report they need to hear. (*When I read this segment, I immediately reached for my HT and tuned in NOAA Weather Radio. Yikes! I can understand it, but I still vote for the humans.—ed.*)

Can We Use It on Ham Radio?

I find this use of technology fascinating. As soon as I understood the concept, I immediately thought of amateur digital data. We send text to each other in a fairly efficient manner—even 1200 baud is faster than normal speech. What if someone were to take one of these text-to-speech converters, hook it up to their TNC, and be able to hear packet? Yes, I know it's been done (a local sight-impaired ham has been doing just that for over a decade) but what if we could generate a facsimile of our own voices? That would be a wonderful area to investigate, with a lot of possibilities. Maybe it's been done already—if so, please let us know. Just think of how something like that could change our concept of repeaters.

Binary Coded Decimal

Binary Coded Decimal, or BCD, is a common scheme for a binary representation of decimal digits. Usually, four bits can represent the numbers from 0 to 15, but in BCD, we use four bits to represent 0 through 9. Yes, a few possible combinations are "wasted," but BCD encoding makes many design tasks much easier. A BCD table looks like this:

BCD	Decimal	BCD	Decimal
0000	0	0101	5
0001	1	0110	6
0010	2	0111	7
0011	3	1000	8
0100	4	1001	9

The remaining possible number combinations (1010, 1011, 1100, 1101, 1110, and 1111) are never used and represent non-valid states.

Data's All for Now

Thank goodness we don't have to rely upon our radio data networks for critical applications. If we did, we'd have to invest a bit of time and money in Y2K compliance. But, with just a small effort, we can easily test our systems, and (like a Boy Scout) be prepared. Data is all around us, even in the air, if we only take a look. This month, I challenge all of you to take a look at ordinary things, those you see every day, and try to see them in a new way. You never know what you might find!

Next month, I'll continue to diverge from the purely technical, with a column on promoting packet. Many of these lessons can be used to promote just about anything, from 4-H clubs to one's business, so it should prove interesting. I also have to admit that it isn't an easy topic for a column.

In closing, I just want to thank those of you who write to me with comments about the columns. Hearing from each of you is by far the best part of any day. Don't hesitate to write, as I appreciate the feedback and—as we all know—systems work better with feedback. Until then, 73.

—N2IRZ

What's a Molniya Orbit?

Molniya orbits have many favorable characteristics for amateur radio satellites. Both OSCAR 10 (AO-10) and OSCAR 13 (AO-13) were placed in Molniya-like orbits, and AMSAT's Phase 3D spacecraft will be placed in a "true" Molniya orbit. Here are the pros and cons of Molniya orbits.

Molniya is the Russian word for "lightning," and Molniya orbits are named after a class of Russian communications satellites. The Russians use this orbit type extensively because of some advantages it offers them. The main advantages are that it's relatively easy to get a satellite into this orbit and that the ground coverage footprint can be positioned to give better coverage to high latitudes than can be provided by geostationary orbits. Because Russia has much of its landmass above 50 degrees latitude, the Molniya orbit's high latitude coverage is particularly attractive.

This orbit type offers similar, but slightly different, advantages to amateur radio satellites. This article will look at the characteristics of Molniya orbits with a focus on their advantages and disadvantages for amateur communications.

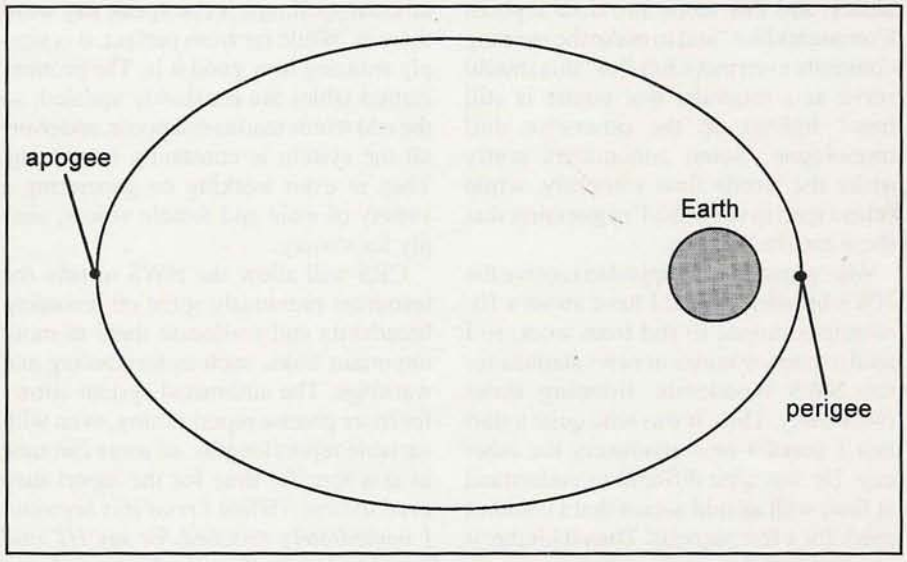


Figure 1. Kepler's First Law says satellites orbit in elliptical paths, with the Earth off-center so the lowest altitude (perigee) and highest altitude (apogee) are along the long side of the ellipse.

Molniya Orbit Characteristics

A Molniya orbit is highly *elliptical*, or elongated, and the satellite spends most of its time at high altitude. The satellite's lowest altitude, called *perigee*, is at or slightly above a typical low altitude orbit. The satellite's highest altitude, called *apogee*, can be at or above a *geosynchronous* orbit's altitude. The orbit's *planar tilt angle* (called *inclination*) is 63.4 degrees for a "true" Molniya orbit. Other highly elliptical orbits may be called *Molniya-like* orbits.

Any orbit with a significantly elliptical shape will have a corresponding high and low altitude and the satellite will spend more time at the higher altitude than at the low altitude. These two characteristics are the result of basic physics and are expressed in Kepler's first and second laws of orbital motion. Kepler's laws were discussed in the August, 1998, "Orbital Elements" column. I'll give a brief review to explain the two characteristics of highly elliptical orbits.

We can paraphrase *Kepler's First Law* by saying that satellites orbit the Earth in elliptical (oval) paths with one end of the ellipse at perigee and the other end of the ellipse at apogee, as shown in Figure 1. The more elliptical the orbit is, or the greater its *eccentricity*, the greater the difference between the apogee and perigee altitudes. Typical Molniya orbital altitudes are 1,500 kilometers (900 miles) at perigee and 39,000 kilometers (23,400 miles) at apogee.

Kepler's Second Law states that a line drawn from the center of the Earth to a satellite sweeps out equal areas in equal intervals of time. The implication of Kepler's Second Law, as illustrated in Figure 2, is that satellites orbit with their fastest speed at perigee and slowest speed at apogee. The greater the difference between the apogee and perigee altitudes, the greater is the corresponding speed difference.

So what does all this mean? In simple terms, a satellite in a typical Molniya orbit

By Ken Ernandes, N2WWD (n2wwd@cq-vhf.com)

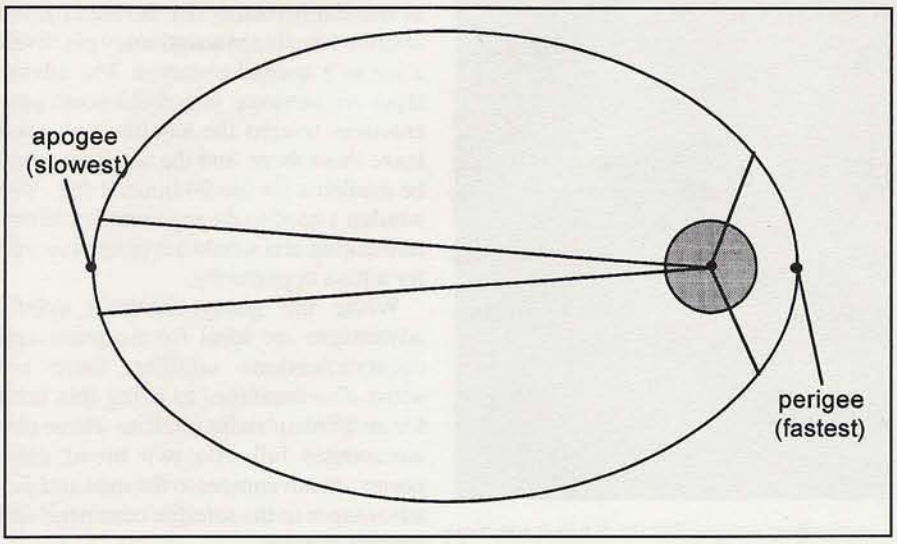


Figure 2. Kepler's Second Law says a satellite sweeps out equal areas in equal amounts of time. That means it moves fastest at perigee and slowest at apogee.

spends about eight hours at high altitude and about four hours at low altitude. In other words, the satellite spends most of its time up high with line-of-sight coverage to about half the Earth (providing lots of good DX). It also spends very little time at low altitudes, so you don't need to wait long for the satellite to be back at high altitude again.

An interesting aside is that Molniya orbits are *so* elliptical that the satellite moves very slowly at apogee. So slowly, in fact, that at apogee the Earth rotates faster than the satellite orbits. This produces some interesting effects on the satellite's ground track. If you use satellite tracking software, you're no doubt familiar with the typical *sine wave* shape of a low-altitude satellite's ground track. However, since the Earth is rotating faster than a Molniya satellite's speed at apogee, the satellite appears to be moving *backward* against the ground when it's at high altitude. Figure 3 illustrates this fold back in the ground track near apogee.

Getting to a Molniya

Amateur satellites going to Molniya-like orbits ride as secondary payloads on boosters that insert them into a *geosynchronous transfer orbit* (GTO). A GTO is already a Molniya-like orbit. However, a GTO's perigee altitude is usually too low to be safe and the inclination is usually considerably less than the 63.4 degrees of a true Molniya orbit. Therefore, the spacecraft needs to go through a series of maneuvers to raise perigee (and apogee if desired) as well as inclination. The thruster-firing maneuvers to raise apogee or perigee consume very little fuel compared with what is needed to get a geosynchronous orbit. Unfortunately, a considerable amount of (very expensive) fuel is needed for maneuvers to raise the inclination to the 63.4-degree true Molniya inclination. This begs the question of what's important about the 63.4-degree Molniya inclination.

Apogee-Perigee Rotation

Since the Earth isn't perfectly round, different mass concentrations produce forces on the satellite as it moves through its orbit. The net force *torques* the orbit. One effect of this torque is that, depending on the orbit's *inclination* (tilt), the apogee-perigee line will rotate forward or backward. It turns out that there are two balance points where the apogee-perigee line doesn't rotate (inclinations of 63.4 and 116.6 degrees). A "true" Molniya orbit uses a 64.3-degree inclination to stabilize the apogee location for consistent coverage at the best location.

Intuition may suggest that allowing the apogee-perigee line of an amateur satellite to drift could be a good thing in terms of giving everybody equal access to the satellite and thus also providing the most DX variety. At one time, I examined the merits of a nearly equatorial Molniya-like orbit, since you wouldn't need much propellant to get there from a GTO. In analyzing this as a candidate orbit, though, I discovered that, from my location on Long Island, New York, I would never have any good contact opportunities with Australia.

I was pleasantly surprised, however, that a true Molniya orbit (63.4-degree inclination) with apogee set 45 degrees north (along the orbital track)—as was selected for Phase 3D—has many good contact opportunities with Australia. Fortunately, the analysis also showed *why* this works so well. The good contact times with Australia occur when the apogee of the spacecraft is over central Asia. Apogee is elevated high above the equator, so I have a good line of sight to the satellite when it's on the other side of the Earth (by looking over the pole). For the Molniya orbit I tried with the equatorial inclination, I could not see the satellite at apogee when it was on the other side of the Earth. This is no doubt the reason AMSAT chose the true Molniya orbit with apogee elevated 45 degrees north for Phase 3D.

Catastrophic Decay Issues

Gravitational force decreases in an inverse square with your distance from

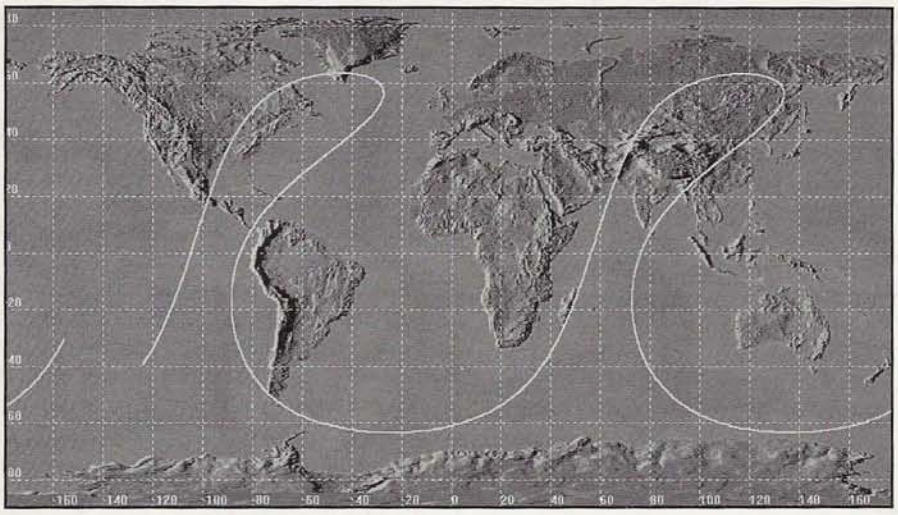


Figure 3. A satellite in a Molniya orbit can move so slowly at apogee that the Earth is rotating faster than the satellite is orbiting. This causes the satellite to double back on its ground track.

the center of the Earth. Thus the Earth's gravitational force is considerably weaker at a Molniya orbit's apogee than it is at perigee. In fact, the Earth's gravity is so weak at apogee that the gravity of the sun and the moon can significantly disturb the orbit.

Computing these disturbances is complicated, but they have some general characteristics. These characteristics fall into both "cause" and "effect" categories. In the "cause" category, the disturbances tend to be stronger for higher inclinations and higher eccentricities. Thus, the true Molniya orbit tends to have strong lunar and solar tidal effects because both eccentricity and inclination are high.

One noteworthy "effect" characteristic is that the eccentricity of the orbit can change significantly while the size of the orbit remains relatively constant. The eccentricity may either increase or decrease. If it decreases, perigee altitude will increase and apogee altitude will decrease by about the same amount. On the other hand, if eccentricity increases, perigee altitude will decrease and apogee altitude will increase.

The amateur satellite community has seen both an eccentricity decrease and an eccentricity increase for the satellites that they placed in Molniya-like orbits (AMSAT-OSCAR-10 and AMSAT-OSCAR-13). AO-10 experienced an eccentricity *decrease*, while AO-13 experienced an eccentricity *increase*. The eccentricity increase in AO-13 caused its perigee to go so low that, in December, 1996, the satellite collided with the Earth's atmosphere and a catastrophic orbital decay occurred (*it re-entered the atmosphere and burned up—ed.*). AO-10, the older satellite, remains in orbit and continues to function.

What was the difference between the two? It was partially the relative arrangement of the Earth, moon, and sun to the orbit that favored AO-10's orbit and frowned on AO-13's. The fact that AO-13 achieved the intended 57-degree inclination (which AO-10 had failed to achieve) also contributed to AO-13's demise. Since we already know the lunar-solar effects are more severe at higher inclinations, why does AMSAT insist on tempting fate and using a 63.4-degree inclination with Phase 3D? Fortunately, the situation isn't just "dumb luck," now that we understand what's going on, and we will do some corrective planning when Phase 3D is launched.

What adjustments can be made? Remember that the goal is to situate apogee 45 degrees north of the equator. There are two positions along the orbital track that are 45 degrees from the equator: one when the satellite is moving in a northerly direction (ascending) and the other when the satellite is moving to the south (descending). Based on the arrangement of the Earth, moon, and sun at launch, we can determine whether it's the ascending or the descending position that's safe (i.e., perigee increases and apogee decreases and *not* vice-versa).

Comparing with a Geosynchronous Orbit

Some in the AMSAT community favor designing a future satellite for launch into a geosynchronous orbit. Since geosynchronous satellites orbit at the same rate as the Earth rotates (by definition), the satellite remains in a stationary place relative to a ground observer. The advantages are obvious: you could point your antennas toward the satellite once and leave them there, and the satellite would be available for use 24 hours a day. You wouldn't need to do any complex antenna tracking and would never need to wait for a pass opportunity.

While the geosynchronous orbit's advantages are ideal for a commercial communications satellite, there are some *disadvantages* to using this orbit for an amateur radio satellite. These disadvantages fall into two broad categories: disadvantages to the user and disadvantages to the satellite command and control stations.

A disadvantage to the amateur satellite user is the "all or none" nature of the geosynchronous orbit. If you're inside the coverage "footprint," you're always in. If, on the other hand, you're outside the coverage area or have the satellite in a marginal location, that will never change, either. If you have good coverage, the only disadvantage is lack of DX variety. You'll always have access to the same geographic areas and that won't change.

Contrasting the geosynchronous orbit with Phase 3D's planned Molniya orbit, you won't have the satellite all the time, but within any 48-hour time period, you'll have at least one opportunity to contact a station at any other location on the Earth. Thus, one satellite in a Molniya orbit spreads its coverage so users around the Earth get part-time access; a satellite in a geosynchronous orbit gives full-time coverage to users on about half of the Earth and none to users on the other half.

A disadvantage of geosynchronous orbits to satellite command and control is that the spacecraft generally needs to carry a lot of on-board fuel to cancel the lunar and solar gravitational disturbances. This becomes extra launch weight that must be traded against the amount of radio transponder equipment the satellite can carry. The fuel is also consumable. Once exhausted, the ground controllers can no longer keep the spacecraft "on station."

An alternative to carrying extra fuel is positioning the spacecraft in one of the two geosynchronous "gravity wells." The gravity wells are two "valleys" at 105 degrees West longitude and 75 degrees East longitude that are stable enough that a satellite will stay put even in the presence of lunar and solar gravitational

"If you're inside the coverage 'footprint' [of a geosynchronous satellite], you're always in. If, on the other hand, you're outside the coverage area or have the satellite in a marginal location, that will never change, either."

disturbances. Without stationkeeping maneuvers, the gravity well effectively chooses your satellite's location.

The geosynchronous orbit also has another big disadvantage to command and control when compared with a Molniya orbit. Since the Molniya orbit has a low perigee, the controllers can point the spacecraft's body—and thus the antennas—by pushing off the Earth's magnetic field with on-board electromagnets, a process called "*magnetorquing*."

For the low altitudes, the torque rods are small and consume a relatively small amount of power, making magnetorquing very efficient. At geosynchronous altitude, the Earth's magnetic field is so weak that the spacecraft would need very large torque rods and/or consume a prohibitive amount of electrical power to point the spacecraft by magnetorquing. Geosynchronous spacecraft usually use thrusters to assist in pointing the spacecraft, but once the fuel is expended, controllers can no longer point the spacecraft. A spacecraft in a Molniya orbit can continue to use magnetorquing as long as there is enough electrical power.

An Excellent Choice

Molniya orbits are highly elliptical satellite flight paths in which a satellite spends most of its time at high altitude and very little time at low altitude. This orbit type gives excellent long-range coverage and spreads that coverage to users all over the world. This gives equitable coverage to all users and offers the largest variety of DX. Getting a satellite into a Molniya orbit that won't suffer a catastrophic orbital decay (unplanned reentry) requires careful mission planning which can't be finalized until the launch date and time are known. However, taking the advantages and the disadvantages as a whole, the Molniya orbit is an excellent choice for amateur radio spacecraft.

Reader FEEDBACK!

A Better Laser Explanation

Dear *CQ VHF*:

I just received the March 1999 issue of *CQ VHF* (which I love, by the way) and the laser on the front cover immediately caught my eye. My physics background compelled me to flip there first. I quickly scanned the article "Lasers to the Limit—Part 1: What's What in 'Laserland' " by Eric Stroud, KB2TCQ, and focused on the "Laser Basics" sidebar.

I experimented with laser communication during my college days in the late '60s and early '70s, so I was interested in seeing what Eric had to say. I noticed a couple of small but significant errors. Mr. Stroud stated that "...when atoms move to a higher energy level, they release energy." There are, I believe, two errors here.

The first error is more a matter of technical semantics, I suppose. Technically speaking, atoms do not move to higher energy levels in a laser system. It is, rather, the electrons which are affected. When an atom is irradiated with electromagnetic energy (light, radio waves, etc.) of exactly the right frequency (wavelength), then certain of its electrons will absorb this energy and move into an excited state; that is, into a higher orbit. Which new state the electrons move into is determined by the frequency of the E-M energy. So, it is the electrons, rather than the atoms, which move to a higher energy level.

Now, let's move to the second problem. Electrons will not normally remain in an excited state; they will spontaneously drop to a lower energy level and, in doing so, will then release energy. Electrons will always try to reach the lowest possible energy level. They may do so in one large jump or through a series of smaller jumps. At each jump they will release energy in the form of E-M radiation. The frequency (wavelength) of the energy released is determined by the "size" of the jump.

In a laser, lots of atoms are "excited" to a higher energy level at the same time by the application of the external E-M energy. When one of the atoms (or rather its electron) drops to a lower level, it "stimulates" the other atoms to also "emit" their energy at the same frequency and thus the "laser" action.

I hope this will clarify what is actually happening. Thanks for a great magazine.

Roger D. Joyner, W4AYO
Kernersville, North Carolina

Roger—Thank you very much for the excellent explanation. Actually, the "Laser Basics" sidebar was added during editing, so the responsibility for getting it straight lies more with me than with the author. Your explanation of how a laser works is the clearest I have ever seen. I appreciate it very much and I'm sure the readers will, as well. Thank you again.—W2VU

European Microwave Equipment Update

There are only a few sources of amateur microwave equipment in the U.S. So we asked "European Microwave News" Editor Simon Lewis, GM4PLM, to bring us up to date on microwave equipment offerings on his side of the Atlantic.

This month, we turn over the keyboard to guest columnist Simon Lewis, GM4PLM. Simon is Editor of the "European Microwave News" newsletter and is a regular contributor to *CQ VHF*.—WA5VJB

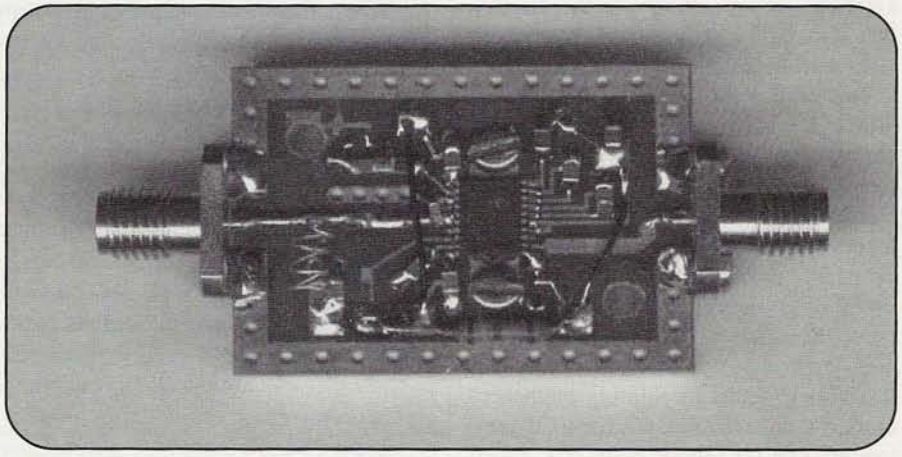


Photo A. The WDG015 1-watt GaAs MMIC amplifier module for 13 centimeters (2.4 GHz). Designed as a matching accessory to a G3WDG transverter, it should work well work with just about any transmitter for the band. (Photos courtesy of the author)

Ham radio microwaving is very popular in Europe, and it is here that many of the most recent microwave distance records have been set. Much of the equipment we use was designed and built on this side of the Atlantic. With the extensive use of the Internet, it's now very easy to view and order parts and equipment from European sources. Many companies have realized the value and potential of Internet sales and offer excellent catalogues to view or download via the net. It's almost certain that Internet commerce will increase over the next few years and we should make the most of this. Com-bined with European finance changes now occurring, purchasing microwave parts from Europe can be a very attractive deal. Enjoy your radio shopping!

G3WDG's Latest Offerings

Charlie Suckling, G3WDG, and his wife, Petra, G4KGC, run the Microwave Component Service (MCS) from their home in Northampton, England. Charlie and Petra originally ran the MCS for the Radio Society of Great Britain (RSGB). However, when the RSGB decided to close the MCS due to costs, Petra and Charlie took over the stock and name and turned it into a private venture. The MCS has since gone from strength to strength and is now one of the major microwave suppliers in Europe. In addition, Charlie has become a major player in the European microwave design scene, and both Charlie and Petra can regularly be found on the bands, pushing microwave technology and operating to the limit.

Charlie was instrumental in the boom in 10-GHz operating in Europe with his G3WDG 10-GHz transverter design. The design was reproducible and cost-effective, is still in widespread use today, and may be the most popular design in microwave history! Charlie continues to produce designs that represent the cutting edge of amateur technology and that are totally reproducible by anyone who can solder correctly and can follow simple instructions. As new designs become available, you'll be able to read about them in *CQ VHF*—keep watching! The designs shown here are the latest offerings from the 'WDG labs.

WDG015 1-Watt GaAs MMIC Amplifier Module

CQ VHF recently reviewed one of the latest microwave transverters from Charlie for the 13-centimeter band (September, 1998). In that article, I men-

By Simon Lewis, GM4PLM* (emn@pacsat.demon.co.uk)

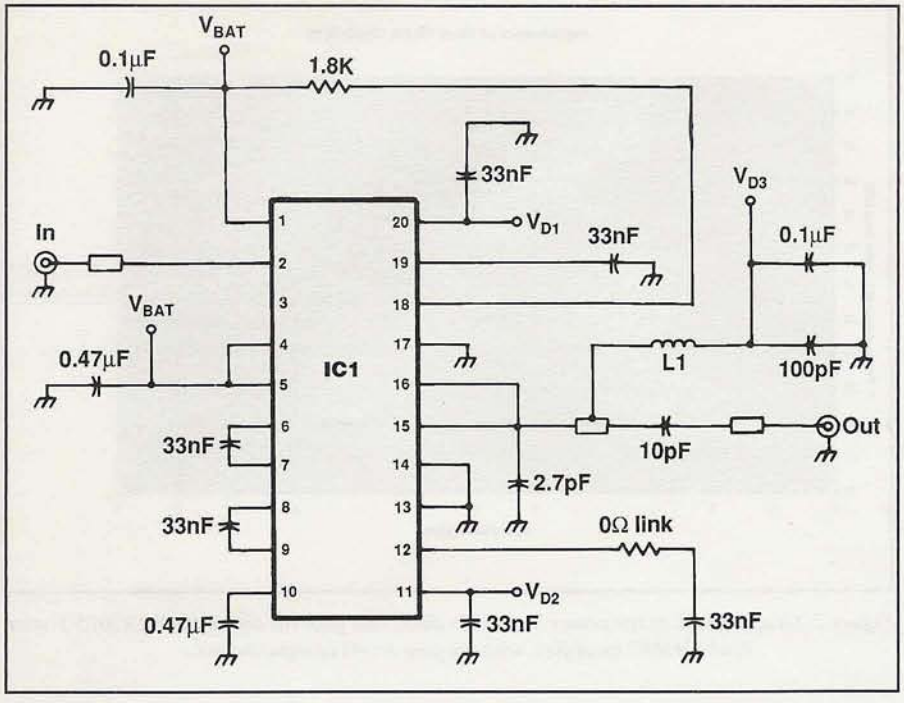


Figure 1. Schematic of the WDG015 1-watt GaAs MMIC amplifier module for 13 centimeters (2.4 GHz).

tioned that matching 1-watt and 10-watt amplifiers would soon be made available. I'm happy to announce that the first of these amplifier modules is now available in the form of the WDG015 1-watt GaAs MMIC (Gallium Arsenide Monolithic Microwave Integrated Circuit) module (see Photo A and Figure 1). This small module measures only 25 x 35 millimeters (approximately 1 x 1.5 inches; see Photo B) but packs quite a little punch. Although intended to match the 13-centimeter transverter, it will also be suitable for anyone looking for a compact amplifier for this band. The GaAs MMIC is designed for the cellular telephone bands, but performs very well at 2.3 GHz (see Figure 2). The MMIC contains a three-stage power amplifier and a negative voltage generator for gate bias supplies. No external bias generator is required, making the design simple and very compact.

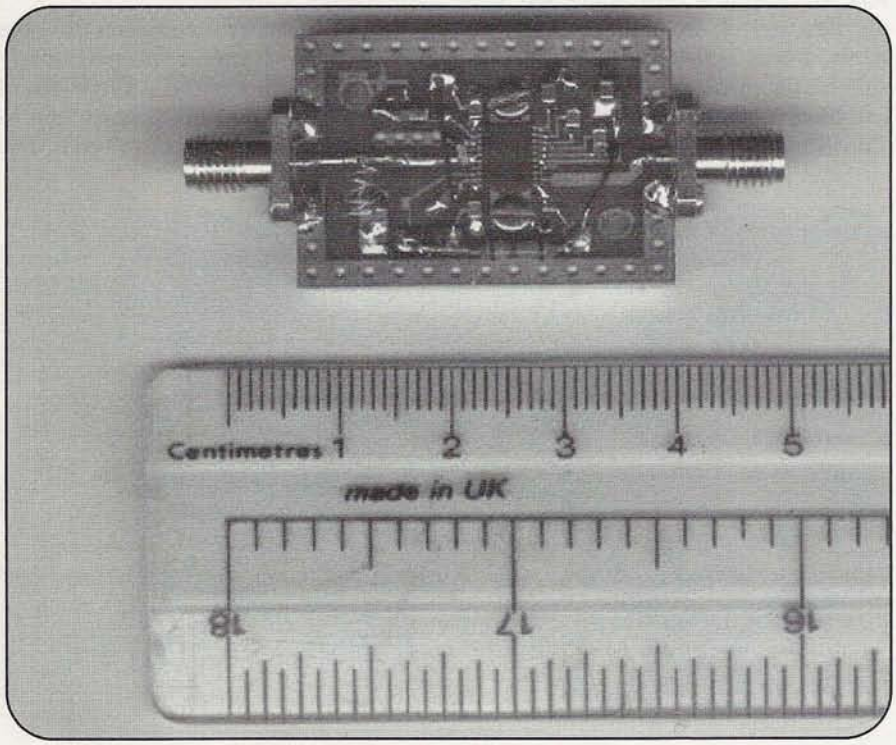


Photo B. The G3WDG 13-centimeter amplifier packs quite a punch despite its tiny size. Its total length, including connectors, is just barely two inches.

"The WDG015 amplifier is supplied as a full kit, with the MMIC pre-mounted to a drilled and tapped aluminum heat spreader....This simplifies construction and makes it completely reproducible in the true 'WDG fashion."

The WDG015 amplifier is supplied as a full kit, with the MMIC pre-mounted to a drilled and tapped aluminum heat spreader (Photo C). This simplifies construction and makes it completely reproducible in the true 'WDG fashion. The pc board is through-plated so that ground connections can be made from topside connections. Again, this simplifies the construction process. The small aluminum heat spreader will require mounting on a more substantial heatsink once construction and testing are complete.

The little amplifier performs very well and will give in excess of 1 watt for around 3 milliwatts (mW) input. Not bad from a 5-volt powered miniature device!

Please note that connectors are not supplied with the kit as these are left to the preference of the constructor. The kit retails at £55.46 (approximately $94 U.S.) and is available from stock. Please see "Resources" for ordering information.

'WDG013, High-Current Negative-Voltage Generator

The G3WDG013 is a new design from Charlie that fills a design gap for negative bias voltage generators (Photo D). Modern high-power GaAsFETs can sink or source many hundreds of milliamps (mA) of gate current almost instantly, depending on drive/load operating conditions. Simple negative-voltage genera-

On the Cover

"Six meters was wide open today," said Bruce Sternstein, K2RTH, of Miami, Florida, when we interviewed him in early March. "I worked a bunch of South Americans and one of them, LU1VK in Argentina, was running only 1 watt!"

Of course, Bruce's four-element beam and kilowatt on six helped just a tiny bit. Bruce also has kilowatts on 2 meters and 222 MHz, 100 watts on 432, 3 watts on 1296 (with which he's worked out to 1,200 miles, west to Texas and north to the Carolinas!), and he's building a 250-watt amplifier for 2304 MHz! His antennas are all single Yagis—except for a vertical on HF and the four-stack of 2-meter antennas in the photo on the cover. Bruce uses that H-frame array for EME (Earth-Moon-Earth) contacts.

On 6 meters, Bruce has worked about 50 countries; the count on 2 meters is also about 50 countries, 45 states, and 300 grids, including some 75 grids in Europe, all worked via EME, of course. Bruce notes that his EME array is very low to the ground, with a mean height of only 18 feet. That's actually helpful, he says, since the surrounding houses help block a lot of noise that would otherwise interfere with his ability to hear signals off the moon.

Bruce's terrestrial antennas share two additional towers: the 6-meter and 1298 Yagis on one at about 35 feet, and the 2-meter and 432-MHz beams on a 45-foot tower, with the antennas themselves up a little higher.

Bruce, who practices law together with his wife, Marian, KA4ULJ, says he's been interested in VHF since he became a ham in 1955, at age 11. "My first rig was a Civil Defense 'Gooney Bird,' " he said. "I worked aurora on CW with that rig, and, ever since then, I've been primarily on VHF." (Cover photo by Larry Mulvehill, WB2ZPI)

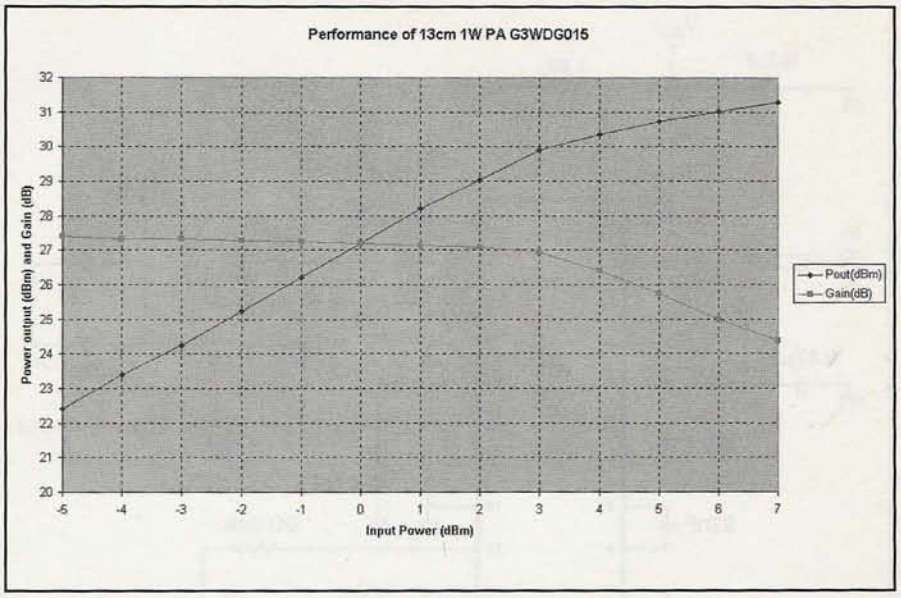


Figure 2. Graphic look at the power output (in dBm) and gain (in dB) of the WDG015 1-watt GaAs MMIC amplifier, with varying levels of input power.

tors, using devices such as the ICL7660, are no longer suitable and a new design was needed.

Maxim Electronics has recently released the MAX1673 negative-voltage generator IC. This SOT21-packaged device forms the basis of a high-current negative-voltage generator capable of supplying up to 125 mA of output current. The design is very simple and, with the addition of six additional components, forms a flexible bias generator suitable for modern GaAs devices. A typical Maxim circuit is shown in Figure 3. Construction is surface mount and the device is suitable for even the most compact amplifier designs.

The WDG013 is supplied as a full kit, including pc board, and is priced at £11.21 (approx. $19 U.S.). Again, see "Resources" for ordering information.

'WDG011, 23-Centimeter Transverter

After recently constructing the WDG010 transverter, I was particularly impressed with Charlie's single-board designs and started to persuade him to continue the designs for other bands. The

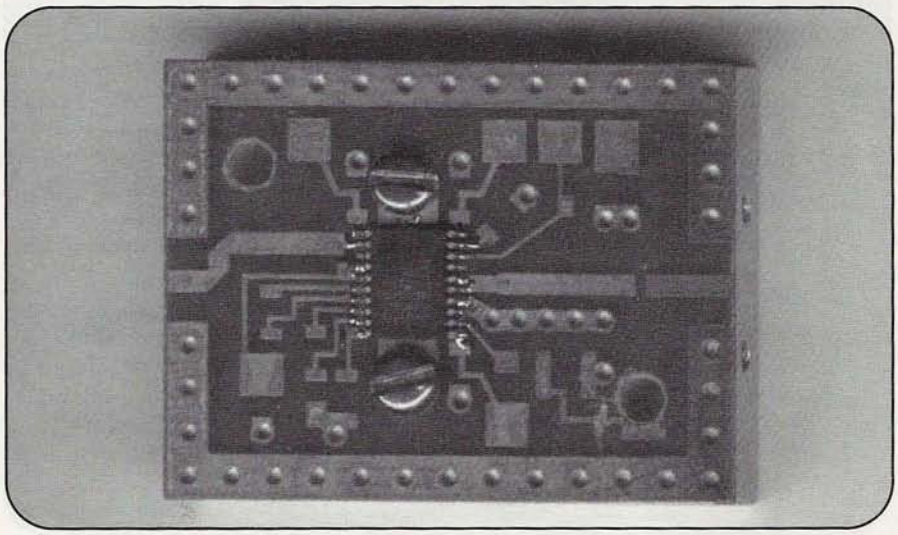


Photo C. The WDG015 amplifier board comes as a full kit with the main IC already attached, saving considerable work for anyone building the unit.

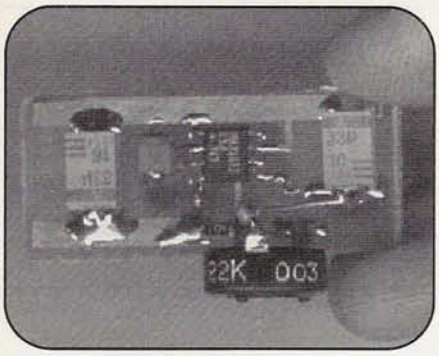


Photo D. G3WDG's high-current negative-bias generator, model G3WDG013. See text for details.

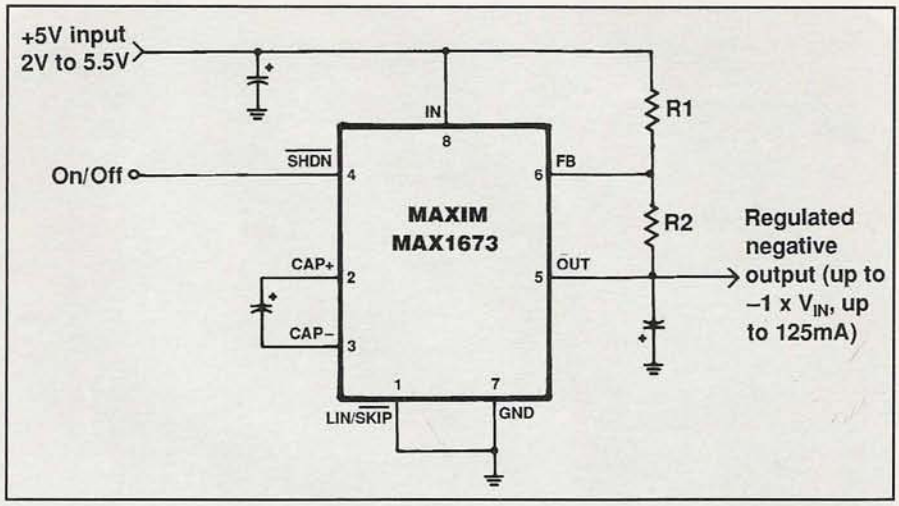


Figure 3. The Maxim MAX1673 chip is at the heart of G3WDG's high-current negative-voltage generator, the G3WDG013. This figure shows a typical operating circuit for the chip.

first product of this expansion is the WDG011 (Photo E). This single board 23-centimeter (1296-MHz) design is based on technology found in the other 'WDG modules and has been modified to suit the requirements of the band.

The WDG011 is based on various parts of the other 'WDG modules, combined with modified circuitry for the RF sections. A quick tour of the pc board reveals the standard 'WDG IF preamp, coupled with the G4FRE023 bias generator, which has cleverly been included on the board. The receive IF preamp is relay-switched and is driven directly from an FT-290 or IC-202. A transmit attenuator is included on the board as well. PTT (push-to-talk) switching can also be modified during construction for a ground-to-transmit option. The antenna switching voltages from the 290/202/PTT line drive a small onboard transmit/receive switch, which operates the relay.

A relay has been used to remove harmonic-related mixing products in the final output (the 9th harmonic of 144 MHz). The PIN diode switches of the higher frequency transverters did not perform well at 23 centimeters. A Mini Circuits SM (surface mount) mixer package has been used in the 23-centimeter version for the same reasons.

The LO (local oscillator) signal is at final frequency (1152 MHz, which, when added to the 144 MHz IF, produces a signal at 1296 MHz). The LO input can be driven from either a G4DDK001B or

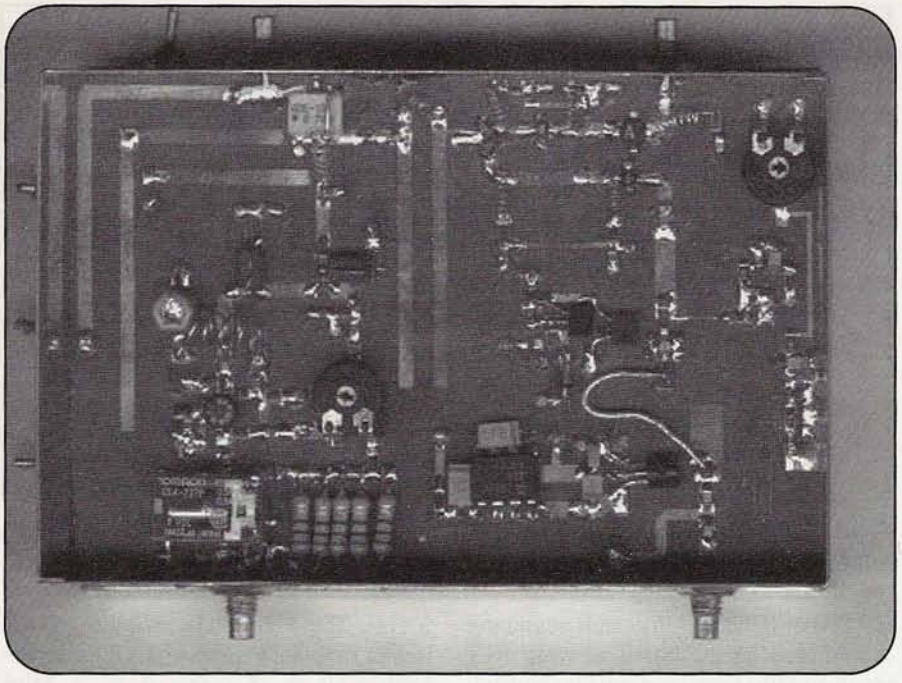


Photo E. The G3WDG WDG011 23-centimeter transverter. This 1296-MHz unit is the first "clone" of Charlie's very successful transverter for 10-GHz operation and shares many of its best features.

"After recently constructing the WDG010 transverter, I was particularly impressed with Charlie's single-board designs and started to persuade him to continue the designs for other bands."

from a modified G4DDK004. The instructions for modifying the '004 for the 2.3-GHz version are irrelevant for the WDG011 and can be disregarded.

The attenuated, mixed, and filtered transmit signal is fed via a MAR 6 MODAMP MMIC and MAV11 MODAMP MMIC to the transmit RF connector, giving an output power of around 10 mW, sufficient to feed the future matching 1-watt amplifier, or a 3-watt "black brick" amplifier. The receive signal is fed to a HEMT preamp (High Electron Mobility Transistor, a low-noise, high-gain device) based on DJ9BV's preamp, which the designer feels has the best performance of any 23-centimeter design around and is also very stable, requiring no stabilizing rubber in the lid of the tin plate box. From the HEMT, the received signal is routed via another MAR 6 MODAMP to the mixer/filtering and subsequent IF preamp.

The transverter is housed in a standard tin plate box (Piper 7660 measuring 73 x 110 x 30 mm, or 2.9 x 4.3 x 1.2 inches) and is etched on a PTFE substrate (polytetrafluoroethylene, a low-loss pc board material more commonly known by DuPont's brand name, Teflon®). Construction follows standard practice and took about four to five hours to complete. Alignment is very simple and the only adjustments to be made are peaking the IF preamp, setting the HEMT bias voltage, tuning the input inductor for lowest noise figure (NF), and adjusting the transmit power output.

Photo E shows the first model, and some fine tuning and adjustments were required to get the unit to the beta test state. The original PIN switches and mixers have been removed and replaced with a relay IF switch and a surface mount mixer to remove the X9 144-MHz harmonic from the transverter output. These changes have resulted in a transverter that produces an excellent signal with a fantastic receive performance (less than 1-dB NF with >30-dB receive gain). Well done, Charlie!

The kit will be easy to build and should suit just about anyone, including newcomers to microwaves. Matching transverters for other bands are being considered! (Charlie, when can I test the 3.4-GHz version?)

The G3WDG011 is now available from stock and is priced at £98.41 (approximately $167 U.S.). It's highly recommended for anyone looking for a low-cost, but high-performance, transverter for 23 centimeters.

The Future

Charlie has some more designs due out this year and the matching 10-watt 2.3-GHz amplifier will be available very shortly. Please keep reading *CQ VHF* for regular updates on the European microwave scene. ■

Resources

To order or for more information, contact Microwave Component Service, c/o Charlie and Petra Suckling G3WDG/G4KGC, 314A Newton Road, Rushden, Northamptonshire, NN10 0SY, UK; Phone (from the U.S., dial 011 for international access, then dial the number): +44 (0) 1933 411446; E-mail: <charles_suckling@mcimail.com> (Charlie) or <ps1@nhlab.demon.co.uk> (Petra).

Prices (in British pounds; see notes below for other currencies):

G3WDG015 1-watt 2.3-GHz Amplifier: £55.46 (kit); £73.16 (built)
G3WDG013 High-Current Negative-Voltage Generator: £11.21
G3WDG011 23-Centimeter Transverter: £98.41

Shipping: For orders from Europe, please add 5% to total order value. For U.S., please add 10% to cover air mail.

For European orders, payment may be by Eurocheque, Travelers Cheques, or Sterling Cheque drawn on a UK bank. For U.S. orders, payment in dollars (cash or check) is possible. Please use an exchange rate of $1.70 to 1 British pound. Please add $10 to cover exchange costs.

An MCS catalogue can be found online at the European Microwave News Web site: <http://www.pacsat.demon.co.uk>.

Stopping the Pendulum: What Is the Real Purpose of Testing?

In the ongoing debate over licensing requirements, says the writer, an important focus has been lost: What is testing intended to accomplish? "Good" testing, he says, should be a learning experience, not a stumbling block.

By Neil Dabb, KC7GCL*
(neild@cc.usu.edu)

In the January, 1999, "Op-Ed" by Fred Maia, W5YI, we heard one side of the pendulum that is swinging with respect to FCC license restructuring. At one extreme, we have those who would throw all semblance of the current system out the window, including the names of the license classes as they are now. And at the other end of the pendulum swing, we have those who would leave everything as it is, clinging to every bit of history and tradition that has ever been a part of the radio art. Is there some middle ground?

The word "testing" is generally associated with a rite of passage, a hoop to jump through. But testing can, and in many cases, should, be a learning process; a means of introducing students to material they need to know. For example, the material on amateur radio licensing tests should be the starting point for operators in the process of "furthering the radio art," which is one of the purposes of the amateur radio service.

Ham Test Topics

This being the case, let's look at some of the things that *should* be on the test. Currently, there are questions concerning nearly every operating mode that hams use, including packet, radio-control, and Morse code (I'm talking about the code test itself here). Passing a five-word-per-minute code exam is the equivalent of knowing how to set up a TNC or how much power may be used in a radio-control vehicle. Basic electronic theory is a must for all operators, even if they never build a single piece of equipment. Knowing the basics makes using the equipment much easier and allows the operator to function more effectively, especially in adverse conditions.

Some people have said that Morse code is outdated and is today a novelty means of communication. Even if this were the case, it would still need to be covered on the test. Movies like "Independence Day" illustrate a point made a few months back in a *CQ VHF* letter to the editor: Morse code is like a candle in the drawer. Thanks to the "Y2K bug," no one really knows how much of our technology will still be working on January 1, 2000. When all the fancy technology that's trying to replace the code goes down, it will still be there and will still get a message through.

In virtually every field of study, there is a brief section given somewhere on the history and the background of the field. Leaving the names of the licenses the same will avoid initial confusion and will help keep that link to the past. It is much easier to move forward if we know where we have been and can build on our past.

A Matter of Balance

Testing will, of course, have to balance the link to the past, evolving technologies, and the basic theory on which all radio communication is based. The testing should be a learning experience, and a starting point, that will give hams the basic skills they need to take amateur radio into the 21st century and beyond.

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.*

By Dave Bostedor, Jr., N8NQS*

Neil Dabb, KC7GCL, lives in Logan, Utah, and works in a technology initiative program at Utah State University. He is a frequent contributor to CQ VHF.

Antenna Construction Tricks: The Amazing Wire Stiffening Method!

One of the many things that ham radio teaches you (we hope) is a different way of thinking—thinking in terms of solutions rather than problems. Here's an example of an ingenious solution to a common antenna problem.

A ham acquaintance of mine who was starting his own antenna company was trying to use copper tubing for the individual elements of a two-element 6-meter beam design. The problem he ran into was that any type of copper tubing or thick wiring tends to droop if it is over a couple of feet long. At a flea market where he was selling his antennas, a ham came by and let him in on a secret for stiffening the elements. (*Unfortunately, Ken's friend didn't catch the ham's name, so we can't give proper credit. If you recognize yourself here, let us know, and tell us how you came up with the idea.—ed.*)

"The secret was that each element could be made stiffer by twisting the wire or tubing a number of times to make it more rigid (increasing the tensile strength)."

Ken Neubeck, WB2AMU, is the "Magic Band" editor of CQ VHF.

Let's All Do the Twist

The secret was that each element could be made stiffer by twisting the wire or tubing a number of times to make it more rigid (increasing the *tensile strength*). It's a sort of hardening or crystallizing process that has been known in the materials industries for quite a long time.

You can build a real cheap antenna by buying several feet of hanging wire (the kind used for drop ceilings) from your local hardware store for a quarter or so, cutting its size for the desired VHF frequency (19 inches for a 2-meter vertical element and 56 inches for a 6-meter vertical element) and then increasing the tensile strength as follows:

- *Be sure to wear eye protection!*
- Tightly clamp one end of the wire to a vise
- Tightly clamp the other end of the wire to the chuck of a variable-speed power drill (see Figure)
- *Slowly* power the drill to turn in one direction
- Make at least five or six complete turns. Examine for stiffness; complete more turns as required.

Tips for Success

For best results, I've found that the thicker gauge copper wire is a good candidate for this tensile method. Elements for a 2-meter vertical or for a beam are easy enough to make from wire or tubing. Likewise, the same can be done for

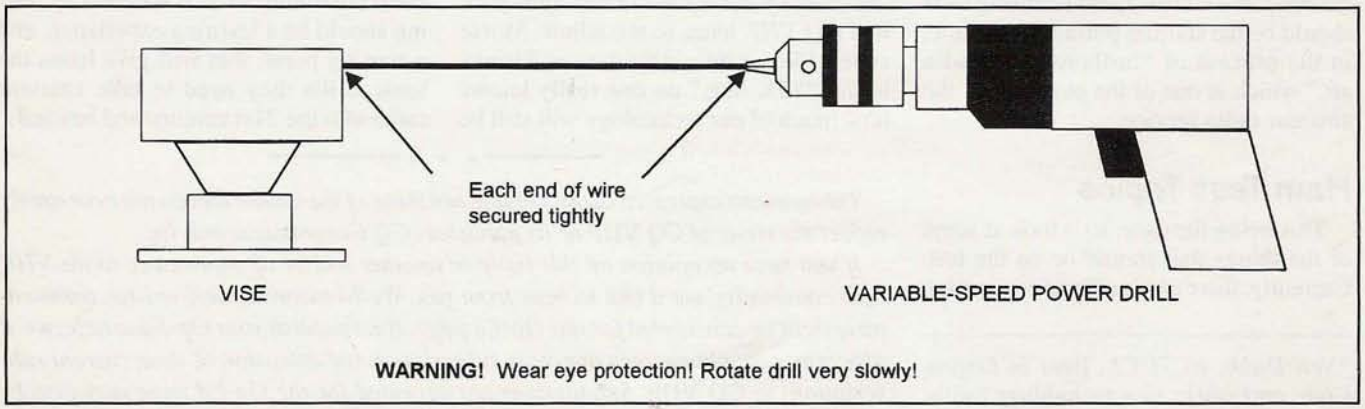


Figure. An easy method of stiffening antenna wires by increasing their tensile strength. Make sure everything is clamped in very tightly, WEAR EYE PROTECTION, and SLOWLY turn the drill five or six times. See text for details.

By Ken Neubeck, WB2AMU* (wb2amu@cq-vhf.com)

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"You can build a real cheap antenna by buying several feet of hanging wire (the kind used for drop ceilings) from your local hardware store for a quarter or so, cutting its size for the desired VHF frequency ...and then increasing the tensile strength...."

a 6-meter vertical or beam, although some more twisting will be required to counteract the "droop" factor.

Practically speaking, 6 meters may be the lowest ham frequency for constructing elements using the tensile method. As you get into the HF frequencies, like 10 meters, the elements are much longer and the droop factor becomes too severe for tensiling to counteract. At these lengths, rigid materials will have to be used.

Antennas are one of the few remaining areas in ham radio where you can still build it yourself and can still experiment. If you run into a problem while building an antenna, remember to think "outside the box" if necessary and to focus on the solution instead of the problem.

Magic Band *(from page 53)*

able in 1999 (not counting VHF rigs with plug-in options for 6 meters, or the few additional 6-meter FM-only rigs).

The low-end priced rig is the MFJ 9406, starting at $260, and a number of the radios on the list can be obtained for less than $1,200. The list keeps changing—practically every month, it seems—with the introduction of new radios. These days, it seems that 6 meters is almost a standard package for an HF rig.

The availability of more 6-meter radios underscores the growing interest in the Magic Band, not only in the U.S. but also around the world. Many of these radios, after all, are manufactured in Japan, where 6 meters is a very popular band, and offered for sale worldwide. It looks like the band will have excellent equipment representation and will be used by many hams for the upcoming solar peak.

Do *you* have a 6-meter adventure to share? If so, we'd love to hear about it. Just contact us by mail or e-mail.

Line of Sight *(from page 5)*

He gave us Mickey Mouse, Donald Duck, and a host of other characters that are now woven into the fabric of our collective psyche. It's also safe to say that he was a man of vision: Disneyland, Disney World, EPCOT, etc. By the way, Disney was fired from his first newspaper job because the editor thought that he had no imagination. Most of the banks thought that Disneyland would a big money-loser and refused financing. Disney practically invented creative financing to get the amusement park built. Since he's dead, it's now OK to publicly honor him for his creativity, vision, and daring.

Those who have studied Disney's life closely say that he went through three major stages in thinking about future plans. First there was the *dreaming stage,* during which he just let his imagination run wild. No limits. No internal critical voices. Just total reckless abandon inside the head. Sooner of later a vision would start to take form. Disney just let it evolve on its own without interference. Once the vision had taken form, he would switch into a "*realist*" mode to begin searching for ways to implement his ideas. Periodically, he would allow himself to go into the "*critic*" or "*spoiler*" mode to provide critical feedback. Then it was immediately back into the realist mode with the vision firmly before him.

Your Obedient Servant

The key is the dreaming stage and allowing it to develop the vision unhampered. How do you do that? I think it has to do with the questions we ask ourselves, particularly how we word them. Your brain is in many ways an obedient servant. Ask it a very limited question, and it will give you an answer within those constraints that are built into your question.

For instance, suppose you're having lots of problems in your life. Here are two possible questions that you might be inclined to ask yourself: "What did I ever do to deserve this?" Or, "What can I do today to help clear up these problems?" Depending on which question you ask yourself, you're going to get radically different answers from your brain. One set of answers is going to be a lot more useful than the other one, too.

So, if you want to make a major contribution to ham radio, what kinds of questions should you be asking? Very broad, very open, very positive ones! For instance, you might go with: What would be a really unusual way to use my radio? Or, if I were king of the universe, what would I do with my radio? What is the most exciting thing I could do with my radio? The possibilities are endless.

When you ask the question is also going to have an impact on the process. Trying to think about this while your boss is explaining in detail what he wants you to do for the two weeks when he's gone may not be the best timing. Nor would I suggest you do this while your spouse is giving you directions to where the car broke down. So, when *is* a good time to ask your brain your questions? How about just before you enter the most creative phase of your life: just before sleep, just before you dream? And then repeat the questions when you wake up in the morning. If you have the luxury of a few minutes, stay in bed and just let your mind run wild. Allow yourself to dream up the most fantastic things that you could do with a radio. Just let the images and ideas flow without any interference from those parts of your mind that "know better."

Be a Pioneer

Sooner or later, a vision is going to start to form. No matter how fantastic it seems, start looking around for some realistic way to implement it. If you need help, get it. Have some fun with this. In the process, you just might discover some fantastic, fun way to use ham radio that no one else has thought of before. You might do something that brings back the sizzle. Or, perhaps, you'll just be having so much fun with it that your enthusiasm becomes contagious. If you're having that much fun, those near you will want to join in. It is a no-lose situation.

Ham radio should be an adventure. It's OK to be a pioneer. It's OK to try something new or different. The future of ham radio will not come from the PTB. It will come, as it always has, from those who dare to be different, those who think "outside the box." As Henry David Thoreau said over a century ago, "If a man does not keep pace with his companions, perhaps it is because he hears a different drummer. Let him step to the music that he hears, however measured and far away."

Help Wanted

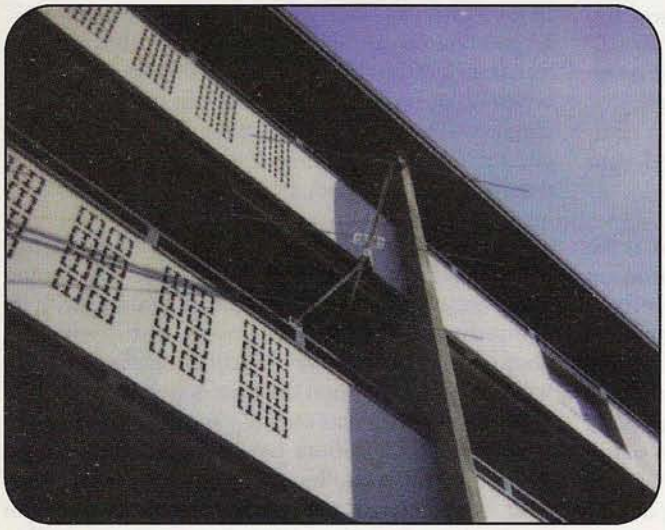
If you're involved with a project or activity that you think would be of interest to your fellow *CQ VHF* readers, we'd like to hear from you. Article submissions are welcome, as are "Op-Ed" opinion pieces if you have a point of view you'd like to share about a VHF-related topic. You can contact us by mail at 25 Newbridge Rd., Hicksville, NY 11801 (send an SASE for writers' guidelines), by e-mail to <cq-vhf@cq-vhf.com>, or via our World Wide Web page, <http://www.cq-vhf.com>. We look forward to hearing from you.

Hide-Away Antenna

Steve Jeffrey, W9ABZ, of Mountain View, California, shared some photos of his disappearing antennas with us, along with this description:

I thought some of the apartment dwelling readers might be interested in how I dealt with antenna mounting and apartment building restrictions. I call it the "Hide-A-Yagi."

My homebrew 6-meter Yagi is exactly 2/3rds the size of the "Featherweight Yagi" featured in the June, 1996, edition of *CQ VHF* (I think mine is more of a middleweight). Performance is good, considering the stucco box it sits in. Love the magazine! 73.



Now you see it...W9ABZ's 6-meter beam is mounted to his apartment balcony and is extended only when in use.

Now you don't...When Steve is off the air, there's no hint of an antenna to anyone on the ground.

Now you see it, take 2...Close-up view of W9ABZ's antenna in the "in use" position.

Now you don't, take 2...with the antenna removed, the balcony looks like any other in Steve's apartment complex.

If you've got a cool snapshot to share with us, but don't have a whole article to build around it, send it in to "Picture This," along with a brief description of who and what we're seeing. If we like it, too, and have the space, we'll print it (no pay, just glory). Send your color prints to *CQ VHF*, 25 Newbridge Road, Hicksville, NY 11801. Please don't write on the front of the photos or use ballpoint pen on the back. If you'd like your photo(s) returned, please tell us so and include an SASE (self-addressed, stamped envelope) with sufficient postage. Thanks!

Basics

VHF Propagation

If you've been told that VHF frequencies are only good for line-of-sight communications, you've been told wrong. There are many different types of propagation on VHF and UHF that can extend your range to hundreds or even thousands of miles. And much of it is available on a predictable, if not everyday, basis.

Your chances for making "DX" contacts on the VHF and UHF bands are best if you use single-sideband (SSB) or Morse code (CW), rather than FM. This is because the signals are narrower (meaning that your receiver picks up less noise to compete with the signal you want to hear) and because they're not subject to FM's "capture effect," in which the strongest signal will "capture" your receiver—even if that "signal" is actually noise. On the other hand, a good solid opening will make VHF DX possible on FM as well.

Let's take a quick look at some of the most common propagation "modes" which can extend your range on the VHF and UHF ham bands:

Tropospheric scatter—also known as *tropo*, is the most common form of enhanced propagation on VHF/UHF and is found to some extent on virtually all bands up to at least 10 GHz. The troposphere is the layer of our atmosphere that starts at the ground and extends upward to about 10 miles (depending on latitude). This is where all of our weather occurs, and variations in temperature, humidity, etc. can cause signals to be *scattered* beyond line of sight, as long as the scattering point is visible to both stations.

Tropospheric ducting—In certain locations and under certain weather conditions, especially in coastal areas during a temperature inversion (when a layer of warm air is trapped between two layers of cooler air), a *duct* may form in which VHF signals are carried from one end to another. These ducts may be hundreds or thousands of miles long. The best-known is the recurrent California-Hawaii duct, which occasionally allows handheld users in California to access VHF and UHF repeaters halfway across the Pacific in Hawaii!

Sporadic-E—Moving up to the *E*-layer of the ionosphere, about 70 miles above the Earth's surface, clouds of ionized particles periodically form and become dense enough to reflect (actually, refract) radio signals at VHF. *E*-skip, as it's also known, is most common on 10 and 6 meters, and occasionally is found on 2 meters as well. Openings may last from several minutes to several hours and are generally unpredictable, except that they occur most often around the summer and winter solstices and least often around the spring and fall equinoxes.

The cause of sporadic-*E* is still a matter of debate, although it's fairly well established that the ionized particles come from burned-up meteors and that wind-shear in the upper atmosphere plays an essential role. Some people believe there is a link between certain weather events and sporadic-*E*, but that has yet to be definitively shown. Sporadic-*E* can extend your range on 6 and 2 meters as far as 1,300 miles, and even farther with "double-hop," including the occasional transatlantic *E*-skip contact on 6 meters.

Meteor scatter—As meteors burn up in the Earth's atmosphere, they leave behind a trail of ionized particles which can briefly reflect radio signals at VHF. Depending on the size of the meteor, these reflections can last anywhere from fractions of a second to a minute or more, and can result in contacts over a distance of several hundred miles. There is a set procedure for making meteor scatter contacts. For details, see the August, 1996, issue of *CQ VHF*.

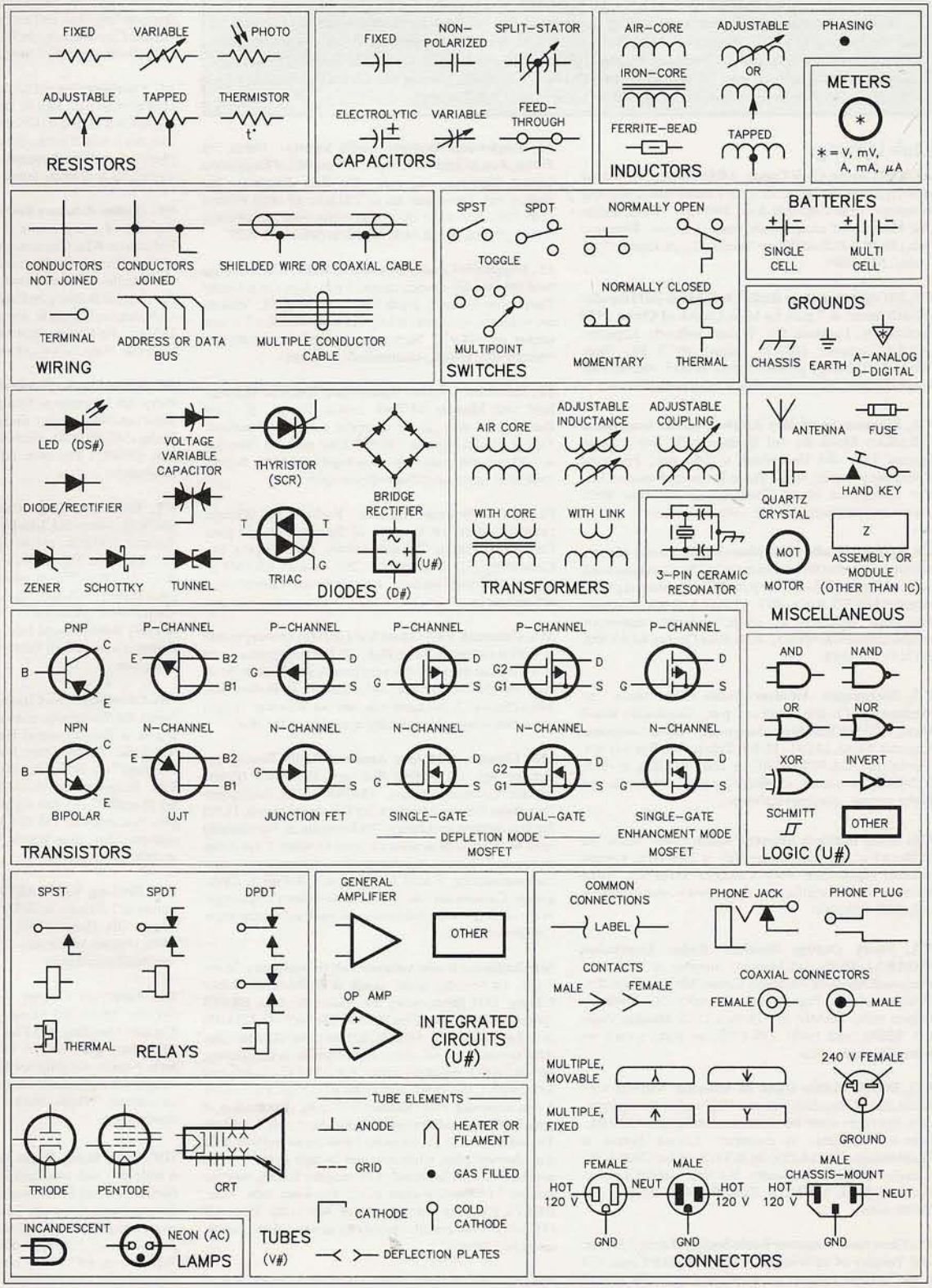
Aurora—Most people are familiar with pictures of the Aurora Borealis, the Northern Lights—wispy and wavy apparitions in the northern sky (along with its companion, the Aurora Australis, in the southern hemisphere). The auroras can reflect radio signals as well as light, and when they are active, it's possible to make VHF contacts over distances of several hundred miles. Both stations have to point at the aurora, though, so when you hear wispy, wavy signals, turn your beam toward the north (anywhere between northeast and northwest) and start listening. The auroras are influenced by energy from the solar wind, so you can expect to hear aurora (Au) propagation improve within a few days of a major solar flare. For more details on aurora and the solar wind, see the March, 1997, issue of *CQ VHF*. Your chances of making Au contacts improve as you go north, so you're far more likely to have success with this mode from Minnesota than from Texas.

Other—There are several other, less common forms of VHF propagation, including *Auroral*-E *(E*-skip caused by auroral activity), *field-aligned irregularities,* or *FAI,* which often occurs on 6 and 2 meters after the end of a strong sporadic-*E* opening on six, and *trans-equatorial propagation,* or *TEP,* in which stations in tropical or subtropical areas can contact other stations that are roughly twice their distance from the magnetic equator. To learn more, see *The VHF-UHF DX Book* from the Radio Society of Great Britain (available in the U.S. through CQ and the ARRL), and CQ's *The VHF How-To Book*, by *CQ* magazine VHF columnist Joe Lynch, N6CL. Plus, of course, keep reading *CQ VHF*.

Basics

Common Schematic Symbols Used in Circuit Diagrams

Building a project from a schematic diagram is always easier if you understand what the various symbols stand for. Here's a guide to the most common ones.



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CQ VHF Hamlink

CQ VHF "Hamlink" offers *free listings* of clubs, licensing classes, and exam sessions for up to four months at a time! *Plus*, for $1/month or $10/year, we also offer listings of **ham-related** *personal* Web sites (*commercial* **ham-related** Web listings are $5/month or $50/year).

Web site listings must be accompanied by payment in full in check or money order in U.S. dollars and mailed to *CQ VHF "Weblink,"* Attn: Bernadette Schimmel, 25 Newbridge Road, Hicksville, NY 11801. Credit card orders are accepted by mail, phone (516) 681-2922, or fax (516) 681-2926. Club, class, and exam listings may be submitted to *CQ VHF* "Clublink," or via the Web at <hamlink@cq-vhf.com>. Be sure to say what it is in the subject line (e.g., Club Listing).

Club Listings

AL, Pell City, St. Clair County ARES: Meets 1st Monday of each month at 7 p.m. St. Clair County EMA Building basement, 1610 Cogswell Ave., Pell City. ARRL testing 3rd Monday of each month, same location. Repeater: 145.130-PL 103.5. ARES net Tuesday 8 p.m. Contact Rick Yuhas, 525-4669.

CA, El Cajon, Amateur Radio Club: Meets 2nd Thursday of each month at 7 p.m. La Mesa Church of Christ, 5150 Jackson Dr., La Mesa, CA. Visitors welcome. Repeater: 147.420 (output) 146.475 (input) 107.2 PL. Nets: WAMO/YL/Young persons (<16); E-mail: <KF6ILA@hotmail.com>; Web: <http://www.eylar.com/arcec/>.

CA, Fremont, South Bay Amateur Radio Association (SBARA): Meets the 3rd Wednesday of every month (except June abd December) at 7:30 pm., Freemont Community Center, 40204 Paseo Parkway, Fremont, CA. For information about SBARA, see our club Web: <www.qsl.net/sbara>, e-mail: <sbara@qsl.net).

CA, Fullerton Radio Club: Meets 3rd Wednesday of every month at Fullerton Senior Center at 340 W. Commonwealth Ave., Fullerton, CA at 7:30 p.m. PST. Tuesday night net repeater 147.975, 8 p.m. PST. Visitors welcome. For more info, visit Web site at: <http://ourworld.compuserve.com/homepages/kc6yhm>, or call Mike Cramer, KC6YHM, at (714) 996-4510.

CA, Sacramento Amateur Radio Club: Meets 2nd Wednesday of every month at 7 p.m., Sacramento Blood Bank, 1625 Stockton Blvd., Sacramento. Visitors welcome. Repeater W6AK 146.91- PL100. Info at P.O. Box 161903, Sacramento, CA 95816-1903 or Tom, KQ6EO, at (916) 722-9358, or e-mail: <ke6eo@jps.net>; Web: <http://home.sprynet. com/sprynet/w6ak>.

CA, Santa Barbara Amateur Radio Club: Meets 3rd Friday of month September–May at 7:30 p.m., County Schools Auditorium, 4400 Cathedral Oaks Rd., Santa Barbara. For more info, see <http://www. sbarc.org>; or call (805) 569-5700.

CA, South Orange Amateur Radio Association (SOARA): Meets 3rd Monday, monthly at 7:30 p.m., Norman P. Murray Community Center, Mission Viejo, CA. Visitors welcome. Primary Repeater: 147.645(-). For information write: SOARA at P.O. Box 2545, Mission Viejo, CA 92690, call (949) 249-1373, or send e-mail to: <soara@cahaba.com>.

CO, Bicycle Mobile Hams of America: National nonprofit club of bicyclists who use VHF radios for emergencies, lost riders, route information, chatting, etc. 450 members in 46 states, 6 countries. Annual Forum at HamVention. Net: 14.253, 1st & 3rd Sundays, 2000 UTC. E-mail: <hartleyal@aol.com>. For info, sample newsletter, send SASE to BMHA, Box 4009-CV, Boulder, CO 80306-4009.

FL, Clearwater Amateur Radio Society: Meets 7:30 p.m. 2nd Tuesday of each month, Clearwater Red Cross, 624 Court St. Linked repeaters: 146.97 (103.5), 224.94, 444.15 (103.5) and 444.575 (131.8) Club net: Wednesday at 8 p.m. Web: <www.fgcarc.org/cars>; E-mail: <k2sec@amsat.org>. Paul E. Knupke, Jr., KR4YL <pk@ij.net>.

FL, Englewood Amateur Radio Society: Meets 3rd Friday of each month at 7:30 p.m., Room 400 of Englewood United Methodist Church, 700 East Dearborn St., Englewood. Two-meter net at 7:30 p.m. all other Fridays (146.700). For more info, visit <http://www.flnet.com/~crosby/ears>, or call Jack, W4JS, at (941) 475-1929.

FL, Highlands County Amateur Radio Club: Meetings held 3rd Monday of each month, 7 p.m. Agri-Civic Center Conference Room 3, South US 27, Sebring, FL. Visitors are welcome. Repeaters at 147.045 +.6, 442.350 +5.0, with packet on 144.970. Web page: <http://www.strato.net/~hamradio>; E-mail: <hamradio@strato.net>.

FL, Lakeland Amateur Radio Club, K4LKL: Meetings held first Monday of each month, 7 p.m., @ 2400 Buckingham Ave., at the Campfire Center in Lakeland. Talk-in on club repeater 146.685. Club net each Thursday at 7:30 p.m. For more info: <www.qsl.net/k4lkl>; E-mail: <aj4y@arrl.net> or <kf4dnw@juno.com>

FL, Lake Monroe Amateur Radio City (Greater Orlando): Meets 1st Thursday of the month at 7:30 p.m., Casselberry Senior Citizens' Center, Lake Triplett Dr., Casselberry, FL. Repeater 147.285. Contact KK4ND at: <wayright@magicnet.net>; Club Web site: <http://www.qsl.net/mars>.

MA, Falmouth ARA: Meets last Thursday of every month at 7:30 at Falmouth Town Hall. All levels of exams given at 9 a.m. 2nd Saturday of every month at Falmouth Town Hall. Rptr1446.655/70cm. 444.250pl141.3/. Boston link, 445.175pl.141.3. For more info, see our Web site: <http://www.falara.org>. Membership available on the Web.

MB, Canada, Winnipeg Amateur Radio Emergency Service Inc. (WARES): Callsigns VE4YWG (Public Service Communications), VE4EOC (City Emergency Operations Centre). Meetings 3rd Tuesday of month, 1930h Sir Wm Stephenson Library, 765 Keewatin St. Membership open to all licensed amateurs at least 18 years of age living in or near Winnipeg and interested in emergency amateur communications. E-mail Jeff Dovyak, VE4MBQ, Emergency Coordinator at: <ve4mbq@ve4umr.ampr.org>; Web: <http:// www.geocities.com/CapeCanaveral/Hanger/1632/wares.html>.

MD, Baltimore Radio Amateur Television Society: Meets 3 p.m. 1st Saturday of the month at the Pikesville Public Library, 1301 Reisterstown Rd., Pikesville, MD. BRATS sponsored FM repeaters are 147.030/224.960/ 447.325 MHz linked system (main), 145.130, 224.800, and 443.350 MHz. Also sponsors second oldest ATV repeater in the country, the W3WCQ repeater, input 426.250/1253.250-output 439.250/911.250. Holds nets in the 147.03 system, Sunday 8 p.m. Listening Post, Monday 7:30 p.m. Horsetraders, 9 p.m. Traffic and information, Wednesday 8 p.m. Newsline, Thursday 9 p.m. ATV, Saturday 1 p.m. News Bulletin, 1:20 p.m. Answer Men. Club activities include public service events, field day, hamfests, ATV repeater linking, amateur classes. Membership open to all. For more info, write, BRATS, P.O. Box 5915, Baltimore, MD 21282-5915, call (410) 461-0086, e-mail: <brats@smart.net>; Web: <www.smart.net/~brats>.

ME, Milo Piscataquis ARC: Meets 4th Monday of each month at Piscataquis County Emergency Operations Center (EOC) at 7 p.m. For more info, contact Piscataquis ARC, c/o George R. Dean, P.O. Box 365, Brownville Jct., ME 04415; E-mail: <parc@qsl.net>; Web: <http://www.qsl.net/parc/>. (Also participates in a number of other club events).

MO, Morely: Tri-County Amateur Radio Club, (TRICO): Callsign KBØZAW. Meetings 2nd Tuesday of every month at 7 p.m. at Scott County Emergency Management Agency in Morely, Missouri. Membership open to all licensed hams and their family members. Visitors are encouraged and welcome. ARRL exams given with prior requests. The club repeater, 146.730-. Net held every Thursday at 8 p.m. local time, on 146.730-, and every Sunday at 9 a.m. on 3.905. Contact Clay Adams at <kc5pin@ldd.net> for info. Web site: <http://www. geocities.com/capecanaveral/hall/2819>.

NC, Charlotte: 2-meter SSB net, 144.220 USB, Wednesday nites @ 9:30 p.m. est/edt. Net control stations are Wilton/WB4PCS & Bill/W4GRW, both in Charlotte area of EM95. This net is now 5 weeks old & we have been averaging 20 check-ins each week (purpose is to increase activity on 2-meter SSB & promote fellowship).

NC, Onslow Amature Radio Club, WD4FVO: Meets 1st Tuesday of every month at 7 p.m. in banquet room of Fishermans Wharf Resturant, located on Hwy 17 on the bank of New River in the heart of Jacksonville, NC. Exams are last Tuesday of every month at 7 p.m. in Onslow County Agricultural Building on College St. For more info, contact Ed Napoleon, KC4JKW, at <kc4jkw@gibralter.net>, or Rob DeVega, KF4OVM, <kf4vom@yahoo.com> or visit our Web site: <http://www.qsl.net/wd4fvo>.

NC, Stanly County Amateur Radio Club: Meetings held every 4th Thursday at Stanly Community College. Two-meter nets held at 9 p.m. (local), Wednesday (146.985), and Friday (147.390). Six- meter rag chew each Thursday at 8:30 p.m. (50.135). For more info, visit web site: <www.qsl.net/scarc>.

NY, Brooklyn, Kings County Repeater Association (KCRA): Meets 3rd Tuesday of the month (except July & August), 7:30 p.m., at Fort Hamilton Army Base, Building 213, Brooklyn, NY. Visitors welcome. Call Don, W2DON, at (718) 248-0752 for more information. Club repeater (WA2ZWP) 146.430, up 1 MHz, PL 136.5. Web: <http://www. qsl.net/kcra>. VE exam sessions last Tuesday of every month (except July, Aug., Dec.), 7 p.m. Pre-registration is a must. Call Harvey, KB2EA, at (718) 948-2290 to register.

OH, Cleveland Area, Cuyahoga Amateur Radio Society: Meets 3rd Wednesday of every month except December at 8 p.m. at Busch Funeral Home community room, 7501 Ridge Rd., Parma, Ohio. June, July, and August, "Picnic Meetings" are held at the Cuyahoga County Metropolitan Park. Re-peaters are on 146.82(-), 443.825 & 444.75 (+), 53.83 & 53.01 (+), plus digipeater at 145.07, and club simplex frequency of 146.475 MHz. For more info, contact club president, Tom Wayne, WB8N, at (440) 232-4193 or at <wb8n@en.com>.

OH, Hocking Valley ARC: Meets 1st Tuesday of every month at 7:30 p.m. in EMA building at 56 S. Market St., Logan, OH. Packet Node LOGAN: AA8BJ-2 on 145.53 MHz, club net Wednesdays at 9 p.m. on 147.345+. E-mail: <aa8bj@hotmail.com>

OH, Lawrence County, Amateur Radio Emergency Service: Meets 3rd Monday of every month at 7 p.m., EMA/911 building, 515 Park Ave., Ironton, OH. Net every Thursday night 9:30 p.m. local time on repeater 146.715. Info e-mail: <wn8f@wwd.net>, or visit web site at: <http://www.wwd.net/user/syrinix/ares.html>. Read our newsletter, "Hello Radio," at: <http://wwwwwd.net/user/wn8f>.

OH, Triple States Radio Amateur Club: Operates over a wide area with members in 50 states & 3 foreign countries. Meets 2nd Saturday of the month at 1 p.m. at Citzens Saving Bank, Colerain, OH, on Rte 250. Features Web page: http://www. qsl.net/tsrac>, major Wheeling/Martins Ferry Hamfest Aug. 8; all-mode SSB/FM/AM/CW 6-m net Wed. 9 p.m. EST/EDST on 50.150/50.151; very popular club bulletin; send for sample copy; ARRL/ VEC exam sessions, meeting room, last Monday of the month at 6 p.m. at club's meeting room, phone notice required (740) 546-3930; E-mail: <k8an@aol.com>; Fax: (740) 546-3685.

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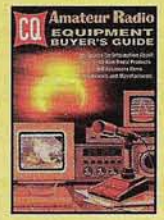

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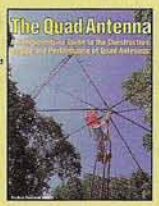

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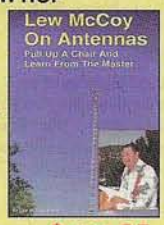

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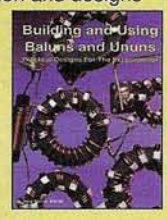

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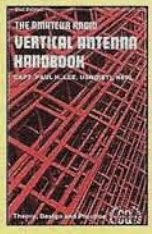

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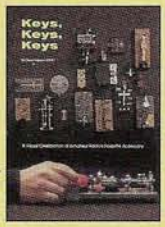

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OK, Tulsa: American Airlines Amateur Radio Club. Repeaters 145.345, 147.000+, 147.000-, 449.875, autopatches on 147.00 and 145.345. Club meetings held last Saturday of the month at 9 a.m. local time at Lil Abners Restaurant, Catoosa, OK. W5YI VE testing for all amateur radio classes held immediately following meeting. For more info on VE testing, club activities, and map on how to find Lil Abners Restaurant, see club Web page: <http:// www.webzone.net/n5jk/aaarc.htm>.

PA, Lambda Amateur Radio Club (LARC), Philadelphia: Since 1975, the only open and visible public service-oriented ham club for gay and lesbian hams. Monthly newsletter, HF skeds, Internet listserv and IRC, hamfest meetings, chapters, DXpeditions. Lambda Amateur Radio Club (ALRC), P.O. Box 56069, Philadelphia, PA 19130-6069; E-mail: lambda-arc@geocities.com.

PA, Monessen Amateur Radio Club: Meetings 3rd Monday of month at Mon Valley Community Health Center, Monessen, PA, 4th floor at 7:30 p.m. Everyone welcome. Repeaters on 147.27+, 443.8+, 224.58+. Net on Tuesday at 8 p.m. on 147.27+. For more info, contact Allan, N3UML, P.O. Box 26, Sycamore, PA 15364, (724) 852-6449 evenings.

PA, Philadelphia: Holmesburg ARC meets last Thursday of each month at NE Philadelphia Naval ASO at 8 p.m. Repeater - 146.685. General interest, classes. For more info: <www.harcnet.org>; <WA3PZO@harcnet.org>.

TX, Greater Houston area, Brazos Valley ARC: Meets 1st Thursday of each month at 7:30 p.m. at Sugar Land Community Center, 226, Matlage Way, Sugar Land, TX (across street from the Main Post Office). Talk in frequencies are 145.46 - (PL 123) and 444.55 + (PL 103). For info, contact B-VARC, Box 1630, Missouri City, TX 77459-1630; Irv Smith, KK5QQ, (281) 437-4803. <http://hal-pc.org/~bvarc>, <bvarc@hal-pc.org>.

UT, Rocky Mountain Radio Association (RMRA): Offers Utah, Wasatch Front, unique UHF to 6, UHF to 2, and UHF to HF remote gateways. Net Thursday at 9 p.m. on 447.900 PL 114.8 UHF/6-meter gateway open 24 hours on 448.700 PL 114.8. Visit Web site at <www.inconnect.com/~rmra>; or e-mail: <rmra@inconnect.com> for more info.

VA, Alexandria, Mt. Vernon ARC (K4US, MVARC): Meets 2nd Thursday of every month (except Dec.), 7:30 p.m. at Mt. Vernon Governmental Center, 2511 Parkers Ln., Alexandria, VA. Repeater frequency is 146.655. If interested, write to P.O. Box 7234, Alexandria, VA 22307, or contact Bob, KT4KS, at (703) 765-2313.

WV (Bluefield) East River Amateur Radio Club (ERARC): Meets 1st Monday of every month at Ryan's Steakhouse, 7 p.m., in the Bluefield, VA, WalMart shopping plaza. See Web <www.inetone.net/erarc/> for info on VE EXAMS, weekly breakfast meeting, club info, and weekly ARES net. Info: <w4vt@sera.org> or call KD4ZUA (540) 326-3419.

WV, Plateau Amateur Radio Association, Inc. (PARA), Oak Hill, WV: Meetings held 1st Tuesday of every month, 7:30 p.m. New River Pawn Shop basement, 328 Main Street, Oak Hill, WV. Mailing address: PARA, P.O. Box 96, Fayetteville, WV 25840. Repeaters are 146.790-; 147.075- and 443.300+. For more info, contact Juddie Burgess, KC8CON, Secretary, at <kc8con@usa.net>.

Exam Sessions

FL, Casselberry, Lake Monroe Amateur Radio Society (Greater Orlando): 4th Saturday of every odd month at Casselberry Public Library on Oxford Rd., Casselberry, FL. For information, contact Al LaPetrer, W2IL, at (407) 671-1056.

FL, Clearwater: Exams held 2nd Monday of each month (except December) at 7 p.m. at the Salvation Army at 1625 North Belcher Rd. For more info, contact John Townsley, AE4GB, at (727) 376-6705, e-mail: <ae4gb@gte.net>, or Mike Branda, K4HN, e-mail: <k4hn@amsat.org>. Paul E. Knupke, Jr., KR4YL <pk@ij.net>.

FL, Englewood: ARRL exams held 3rd Saturday of each month, 9:30 a.m., Englewood Chamber of Commerce Building, 601 South Indiana Ave., Englewood. Two-day advance reservation required. For info and reservations, call Jack, W4JS, at (941) 475-1929.

FL, Highlands County: Exams held 4th Monday of each month, 7 p.m. Agri-Civic Center Conference Room 1, South US 27, Sebring, FL. Walk-ins welcome. Web page: <http://www.strato.net/~hamradio>; E-mail: <hamradio @strato.net>.

IN, Evansville: Exams held once a month on a Saturday morning starting at 9 a.m., local time at Evansville Red Cross, 111 Diamond Ave., Evansville, IN. No pre-registration for sessions. For more info, call Terry Brooks, AA9MM, at (812) 421-9135. (Exam dates: 4/24 (ARRL Nat'l Exam Day), 5/22, 6/19, 7/31, 8/28, 9/25 (ARRL Nat'l Exam Day), 10/30, and 12/04).

NC, Wilmington: Azalea Coast Amateur Radio Club, VE testing sessions 2nd Saturday of even numbered months at UNCW Morton Hall at 10 a.m. All persons wishing to take amateur radio tests, please arrive before 10 a.m. Test candidates only. For further info, call (910) 791-1566.

OH, Cincinnati: OH-KY-IN Amateur Radio Society will offer exams in Cincinnati, OH, on Saturday, May 8th, at Salem Presbyterian Church in Western Hills. The church is located at intersection of Mozart and Higbee, just behind the White Castle restaurant at Harrison and Boudinot. Novice through Extra exams will be offered and will start promptly at noon. Walk-ins accepted, but pre-registration is appreciated as it speeds up registration process. For advance registration, send completed FCC 610 form and a check or money order payable to OH-KY-IN A.R.S. in the amount of $6.45, along with a copy of all certificates of successful completion and your current license (if any) to: Bill Simpson, KI4QJ, 10743 Palestine Dr., Union, KY 41097. For more info, call Carol Hugentober, K8DHK, at (513) 661-5323; E-mail <k8dhk@juno.com>; Web site: <www.qsl.net/k8sch>.

OH, Cleveland Area: Cuyahoga Amateur Radio Club holds exam sessions on 2nd Sunday of each odd-numbered month (except May), at the Olde Independence Town Hall, 6652 Brecksville Rd. (Rte 21), Independence, OH. Sessions start 9 a.m. Fee is $6.95 and a valid ID and copy of your FCC license is required (if you are already licensed). For more info, contact Gary Dewey, NI8Z, at (216) 642-1399 or at <gdewey@en.com>.

PA, Monessen Amateur Radio Club: Test session 1st Sat. of even months (Feb, Apr, Jun, etc.) 10 a.m. at New Eagle Boro Bldg. Main St., New Eagle, PA. Walk-ins welcome but pre-registration preferred. For more info, contact Allan, N3UML, at (724) 852-6449, P.O. Box 26, Sycamore, PA 15364.

PA, Philadelphia: The Philmont Mobile Radio Club sponsors exams on 1st non-holiday Thursday of each month at Franklin Institute, 20th and Ben Franklin Pkwy, Philadelphia, PA. Walk-ins welcome. Exams start at 6:30 p.m. For more info, contact, Dusty Rhoades, ND3Q, at (215) 879-0505.

TX, Garland Area: Test sessions 4th Thursday each month except November. Exams begin promptly at 7:30 p.m. at Austin Street Church of Christ, 800 Austin St., Garland, TX. Contact W. H. (Bill) Reynolds, K8DNE, at (972) 475-9407 for recorded session information, or send e-mail to <k8dne@arrl.net>.

TX, Houston: Meets 2nd Tuesday of each month, 6:30 p.m. Strake Jesuit High School. Bellair @ S. Gessner (SW Houston) Pre-registration requested, walk-ins accepted. Sponsored by Brazos Valley ARC (B-VARC). Call Cass Germany, KG5IT, at (713) 682-6897; E-mail: <cassg@hal-pc.org>.

Personal Web Site Listings

"The Radio Picture Archive," URL: <http:// www.e-etc.com/rpa> (corrected). Speciality collection of pictures of radios.

"Telegraph Key/Museum/Collector's Guide" URL: <http://w1tp.com>. Collector of telegraph keys, old radios, microphones & apparatus history, appraisals, buying, trading.

Commercial Web Site Listings

Byers Chassis Kits: Aluminum chassis and cabinets kits, VHF & UHF antennas and parts. Catalog: Callbook address. E-mail: <k3iwk@herd.net>; <http://herd.net/byerschassiskits>.

CCT®, Inc.: Antennas—High Efficiency Unique Designs HF to UHF. Computer Systems, Sub-Systems, CPU & Motherboard Upgrades, Components. High Voltage Capacitors, Parts. Contact CCT® Radio: <http://www.cctnetwork.com>.

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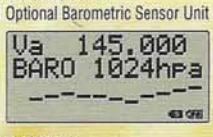

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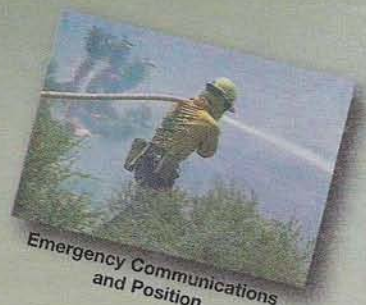
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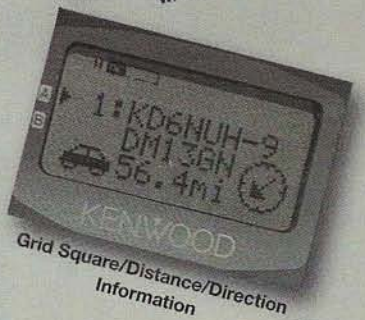

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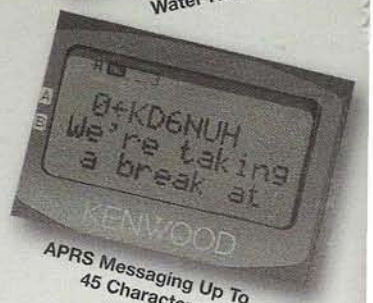

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