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CQ VHF

Ham Radio Above 50 MHz

December 1997

- Is Your HT Too Hot to Handle?
- Rocket Research and Sporadic-*E*
- Spot Band Openings on Your TV!
- You Don't Have to Be Einstein...

Plus Two CQ VHF Reviews:

- Maha MH-A302 HT Docking Booster
- MFJ-1762 6-Meter Beam Antenna

... and the 1997 Annual Index

On the Cover: Ray Rector, WA4NJP, of Gillsville, Georgia, with some of his many VHF+ ham antennas. Details on page 57.

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Dual Band 144/440 MHz Amp

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Power Curve -- typical BD-35 output power							
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Watts In	1	2	3	4	5	6	7

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- ***Includes mobile bracket***
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- ***Custom heatsink, runs cool***
- ***Works with handhelds up to 8 watts***
- ***One year MIRAGE warranty***

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B-34, $69.95. 35 watts out for 2 watts in. Like B-34-G, FM only, less preamp, mobile bracket. 3⅛x1¾x4¼ inches.

160 Watts on 2 Meters!

B-5016-G

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CQ VHF Ham Radio Above 50 MHz

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COLUMNS

BASICS

DEPARTMENTS

Next Month: "The Soldering Gear Every Ham Needs," by Jim Aguirre, WB7DHC

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Through a Cornfield...Quickly

It was a dark (but not yet stormy) night as we raced down the one-lane road through a cornfield to...a ham station in a clearing! Welcome to Weinheim!

Speed is big in Germany. That was one of the first lessons I learned as I began my first visit there this past September.

The goal: find out how the annual Weinheim VHF Conference regularly draws crowds in the range of 10,000 people, when the biggest VHF conferences in the U.S. pull 200 to 300.

I was lucky enough to be joined for this visit by *CQ VHF*'s "Digital Data Link" editor, Don Rotolo, N2IRZ. Don works for a German-based company, makes regular visits there, and is fluent enough in the language to have served as a top-notch translator and tour guide (not to mention chauffeur). Thanks, Don.

My introduction to speed began on the autobahn, as we headed to Weinheim from the airport in Frankfurt. "See that sign?" Don said, pointing to a speed limit sign with a slash through it. "That means there's no more speed limit. But don't worry. These roads are built for high speed." Funny, the autobahns that I saw didn't look much different from any of our 55-mph Interstates.

Cut to that evening, after a delightful barbecue with our hosts, Wolfgang Mahlke, DF1GW, his family, and other members of the Weinheim radio club. "We'd love to show you the club station," Wolfgang said. "We'll take my car, there's plenty of room." So several of us climbed into Wolfgang's VW microbus (they still make them over there) and headed for the station, which is out of town a ways.

After following a few main roads, we turned at a sign which, according to Don, means "Don't come in here unless you belong here." The road narrowed to just more than one car width and dove into some fields, twisting and climbing and generally being a back road. "Don't worry. These roads are built for high speed." Yeah, right. Not this one. It was probably a good thing that I couldn't see the speedometer as we hurtled through the cornfields on either side of the road and finally emerged outside the clubhouse and station building. It was an impressive sight (which I'll share with you in a future article on the club and the conference), but, to me, the most impressive thing was that we arrived alive!

Through a cornfield...quickly. This is the narrow road leading to the Weinheim radio club's station (note the towers in the background, and ignore the power lines). In front of the club station is a camping area where people with tents and RVs could stay before and during the Weinheim VHF Conference.

The Secrets of Weinheim

I saw and learned too much on my brief visit to cover in one short editorial, so I'll put off some of the details for later, and I'll concentrate here on the intangible differences between hams the U.S. and in Europe (or at least, Germany).

First of all, how *do* they get 10,000 people to come to a VHF conference? They do it by linking it with a major hamfest and taking the reverse approach to what we sometimes see here. Imagine taking one of our larger hamfests—not Dayton, but something on the scale of Miami, Dallas, or Rochester—and scheduling a full two days' worth of VHF/UHF technical forums along with it. Kind of like holding the Central States conference at the Dallas Ham-Com.

Now, here's where the numbers come from. Here in the U.S., the PackRats, which sponsor the Mid-Atlantic VHF Conference each year outside Philadelphia, also hold a good-sized hamfest the day after the conference. If you attend the conference on Saturday, you get into the flea market for free on Sunday. In Weinheim, the hamfest runs both

By Rich Moseson, W2VU, Editor

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Hellmuth Fischer, DF7VX, head of the DARC's VHF division, holds a 411-GHz transverter designed and built by DB6NT. It's one of several examples of ham radio technological leadership evident at the Weinheim conference. DARC is Germany's equivalent of the ARRL.

Saturday and Sunday, and, if you pay your 12 marks (roughly $7 at current exchange rates) to get into the flea market, you get to attend the conference sessions for free (the Proceedings book is extra). So they get their 10,000 people coming to the hamfest and each one gets a program listing all the technical forums.

Do all 10,000 hams attend the forums? Of course not. By my guesstimate, there were probably about 600 individuals who attended one or more forums. Not much, huh? But wait...that's still *double* the number of people who show up at Central States in a good year. Maybe they've got something there: bring lots and lots of hams out to the general-interest hamfest, expose them all to what's happening in the world of VHF, and provide the heavy-duty technical forums (along with beginners' forums) for those who are interested. Maybe it's an approach we ought to try here. Oh, and one other thing—keep doing it year after year. This was the 42nd "Weinheimer UKW Tagung" (Tagung is conference and UKW is short for Ultra Kurtz Welle, or ultra short waves, what we call VHF).

A Difference in Attitude

What impressed me much more than the mechanics of putting on the hamfest and conference, though, was the extreme difference in attitudes toward VHF in Europe. VHF is considered just one more part of ham radio, and those who choose to concentrate their activities on VHF and UHF receive just as much respect as those who prefer working 20 or 40, or the "top band," 160 meters.

There was none of the "us versus them" mentality evident, either between repeater users and other VHF ops, digital and weak-signal, HF and VHF, or between hams with and without code knowledge. In fact, it seems that all the segments of the broader radio hobby get along better there than here. The ham magazines include columns on shortwave listening, scanning and, yes, even CB. European hams appear to treat CB as just another part of the radio hobby, not as a pariah, like we do here.

At the same time, there is recognition that VHF and UHF are *different* from HF, and the DARC (Germany's equivalent of the ARRL) has a special VHF division which encourages activity and experimentation on the bands above 50 MHz.

Advancing the State of the Art

If you look over the Proceedings books for the last two conferences, you'll see many topics similar to those you'll find at American VHF conferences, but you'll also find papers on 1.2 *Mega*bit/second packet links and an experiment with sending digital voice on a 25-kHz bandwidth. Beyond the theoretical, you can walk into the exhibit hall and see a broadband (200-kHz bandwidth) 70-centimeter transceiver capable of 76.8-kilobaud packet (twice the speed of your brand-new 33.6 phone modem), available now from ADACOM,

sort of a German equivalent of TAPR. Or you can go to the DARC booth and see a 411-*GHz* transverter. The list goes on.

The hams in Europe seem to still be able to do what we've forgotten how to do—*lead* in the development of new technology and in advancing the state of the art. They're pushing packet speeds to 1.2 *mega*bits while we're still stuck at 1.2 *kilo*bits; experimenting on 411 GHz while we have trouble getting people to use 430 MHz. Not only that, but we have much greater access to parts and materials, at much lower prices. There's something fundamentally wrong with this picture, and we're the ones who have lost our focus.

Let's Use Our Resources

The results of September's reader survey showed that 75% of you have a computer in your ham shack, and that 55% of that group uses their computers for ham-related Internet e-mail. The Internet can be a wonderful tool for us, as it lets us contact other hams—such as our colleagues in Europe—who are beyond normal VHF radio range. Let's take advantage of this ability, seek out hams in other places with common interests, compare notes and begin to work together on advancing the radio art both here and abroad. And in line with last month's editorial, let's start the new year by trying to forge closer links with our fellow enthusiasts in other aspects of this great hobby we call *radio*.

Staff Notes

You may notice that a few of our regular columns are missing this month, or may have been appearing only sporadically over the past few months. Unfortunately, real life has a habit of sometimes getting in the way of things we like to do, and that's been the case recently with two of our columnists.

Don Stoner, W6TNS, has decided to step down from his "In Theory" column due to health problems. We thank Don for his valuable input and contribution to the early success of *CQ VHF*, and we hope to still receive an occasional feature article from him, as his health permits. The "In Theory" column will resume as soon as we find a qualified successor to fill Don's shoes.

Like many of us, Gould Smith, WA4SXM, has found himself needing to do more at work with fewer people, and his job demands have significantly cut into the time he needs to prepare his "Orbital Elements" column. We will either be finding someone to share the role with Gould, or to take over the column on a monthly basis.

Since Ken Neubeck, WB2AMU, seems to have an article in nearly every issue anyway (he's got two in this issue), we figured we'd make it official and add him to our staff of Contributing Editors. Starting next month, Ken will introduce "The Magic Band Chronicles," a series of mini-columns about exciting things that happen on 6 meters. If you've got a great 6-meter story to tell, particularly one that showcases a particular propagation mode, Ken would love to hear from you.

In fact, *all* of our columnists are always interested in different and innovative activities in the fields they cover. Please don't hesitate to contact them, either directly or c/o *CQ VHF*.

Finally, this issue contains our 1997 Annual Index of *CQ VHF* articles. A special thank you to Lew Ozimek, N2OZ, for compiling and organizing the data.

Happy Holidays

Well, it's that time of year again...cold days, long nights, bright lights, maybe a bit of Aurora or winter *e*-skip, and, if you've been really good, a duct straight to the North Pole! If you've been like most of us, though, and have to do your own shopping, please try to patronize the advertisers without whom this magazine could not exist. And when you *do* order something from them, be sure to tell them you read about it in *CQ VHF!*

Whatever winter holidays you celebrate, we hope that they're happy, and that each and every one of you has a happy, healthy and prosperous new year.

73 de W2VU

Help Wanted

If you're involved with a project or activity that you think would be of interest to your fellow *CQ VHF* readers, we'd like to hear from you. Article submissions are welcome, as are "Op-Ed" opinion pieces if you have a point of view you'd like to share about a VHF-related topic. You can contact us by mail at 76 N. Broadway, Hicksville, NY 11801 (send an SASE for writers' guidelines), by e-mail to <CQVHF@aol.com>, or via our World Wide Web page, <http://members. aol.com/cqvhf/>. We look forward to hearing from you.

VHF News

Ham Radio "Official" Part of Space Station

Amateur radio is now an official payload of the International Space Station, according to Frank Bauer, KA3HDO, AMSAT-NA Vice President for Manned Space Flight. In an October letter to the ARISS (Amateur Radio on the International Space Station) planning team, quoted by the AMSAT News Service (ANS), Bauer said "NASA has given us a commitment" to having a ham station aboard the space station. Construction is scheduled to begin next year.

Bauer called the NASA commitment "a monumental decision which will solidify the future of amateur radio on manned space vehicles," adding that, "as our space explorers occupy the international space station and eventually venture to worlds beyond, amateur radio will continue to provide the adventures of space flight directly to radio amateurs, students and the general public on Earth."

KC5VPF Active on Mir

Astronaut David Wolf, KC5VPF, is getting his feet wet in amateur radio via the ham station aboard the Russian Mir space station. Wolf replaced Astronaut Mike Foale, KB5UAC, aboard the craft in early October. Several reports note that Wolf doesn't have much ham radio experience, but he's been heard at least once calling CQ on voice and has managed to send at least one packet message.

According to the AMSAT News Service, MIREX (Mir Amateur Radio Experiment) Education Director Miles Mann, WF1F, asks that messages to the Mir packet mailbox be kept short, that you don't ask questions requiring replies, and that attempts at voice contacts be made only when you hear a crew member calling CQ or QRZ.

Phase 3-D Update

There's still no launch date set for the Phase 3-D (P3D) satellite, which was bumped from the Ariane 502 flight when structural changes required by the European Space Agency (ESA) made it impossible to have the satellite ready in time for the scheduled launch date (which has now slipped several times and still hasn't occurred at press time). However, AMSAT officials are confident that the satellite will be launched sometime in 1998, and they report several positive developments in recent weeks.

They say ESA has dropped its original requirement that AMSAT provide a "dummy" substitute of the same weight to fly in place of P3D (a substantial savings for hams) and has paid AMSAT for the "Specific Bearing Structure"—which was supposed to hold P3D in place and which remains part of the launch vehicle—in accordance with the original agreement between the two groups.

AMSAT officials have issued several statements praising ESA's long record of cooperation with the amateur satellite program (16 launches, more than any other launch agency), and urging hams not to unfairly criticize ESA or the decision to drop P3D from the AR-502 launch. They fear that widely distributed e-mail messages critical of ESA may harm AMSAT's long-term relationship with the agency.

Single-Yagi EME Feat

The first single-Yagi-to-single-Yagi EME (earth-moon-earth) contact ever was made in September by Dave Blaschke, W5UN, and Graham Daubney, F/G8MBI. According to a report in *SpaceNews*, both stations used full legal power and had *no* benefit from ground gain (*signal enhancement when the moon is near the horizon—ed.)* They made the QSO on their third attempt.

Hams Praised by Big-City Mayors

The mayors of New York and San Francisco have both issued statements praising amateur radio operators. In San Francisco, Mayor Willie Brown said in a statement provided by Dave Larton, N6JQJ, that the hams of the city's Auxiliary Communications Service "may be the most active of all the volunteers" he's dealt with. He described the hams' emergency communications network as "a wireless system that seldom if ever can be totally disrupted by a disaster....Obviously the cell phones play a role in that now, but the ham radio operators are the heart and the soul and the lifeblood of that system."

New York Mayor Rudolph Giuliani issued a proclamation declaring Amateur Radio Awareness Day at a ceremony attended by several Big Apple hams.

Coordination Confusion in New York

The New York City metro area may have a new repeater coordination group... or it may not. A last-ditch effort to revitalize the Tri-State Amateur Repeater Council (TSARC), which had become dysfunctional in recent years, instead turned into the organization of a new group, the "Three States Amateur Repeater Council." But there's considerable doubt as to whether the new group will be accepted by the 300+ repeater owners in southeastern New York, northern New Jersey, and Connecticut.

There had been confusion up until the last minute about where and whether the September 20 meeting would be held. There was a last-minute change of location and only 15 people attended. According to Newsline, some repeater operators claim they weren't properly informed of the meeting. For now, at least, repeater coordination remains in limbo for the nation's second-largest concentration of repeaters and users.

FCC Assigns "Little LEO" Frequencies Outside Ham Bands

The FCC has assigned spectrum space for "Little LEO" satellites in frequencies currently assigned to the U.S. Air Force and NOAA, the National Oceanic and Atmospheric Administration. The frequencies will be shared among the various users and will not be auctioned, according to an October 9 FCC news release, which did not list the specific frequencies involved.

Last year, companies planning to launch these small low-earth-orbit (hence the name, Little LEO) satellites requested sharing studies for a variety of fre-

Compiled by the CQ VHF Staff

quencies below 1 GHz, including the 2-meter and 70-centimeter amateur radio bands. A mass outpouring of protests from hams forced the FCC to change the way public comments on these proposals were handled.

Next question: Will the Little LEO companies be satisfied with what they've gotten, or will they come back for more in the future?

ARRL Launches Web-based Audio News Service

A new ham radio news service has taken to the air...sort of. ARRL Audio News, which was scheduled to debut on October 17, features weekly reports of 10 minutes or less, based on articles published in the *ARRL Letter*. The reports are narrated by *ARRL Letter* Editor Rick Lindquist, N1RL.

Distribution will at first be only via the World Wide Web <http://www.arrl.org/> in RealAudio format, with possible dial-up telephone access planned for the future. TAPR (Tucson Amateur Packet Radio) is providing space for the reports on its Web server. According to Lindquist, anyone with a RealAudio Plus player should be able to download the reports to their hard drives. They may then be transmitted on amateur frequencies as bulletins, provided ARRL Audio News is credited as the source.

Online License Renewals

You can now renew your ham license online. The FCC's new Form 900—for renewing a variety of licenses issued by the Wireless Telecommunications Bureau (WTB), including amateur—is available only for timely renewals and may be used only for online applications. According to an ARRL bulletin, Form 900 may be found by going to the WTB's Electronic Commerce page, <http://www.fcc.gov/wtb/electcom.html>, then clicking on "Production Page for Electronic Commerce Applications." Then follow the instructions and be sure to go to the fee information page after you've filled in everything (even though there's no fee for renewing a non-vanity amateur license).

If you have problems, call the FCC Technical Support Group at (202) 414-1250. Other questions should be directed to the FCC's National Call Center at (888) 225-5322.

RS-12 in Mode A

Satellite operators are reporting that the Russian RS-12 satellite has switched to Mode A (2-meter uplink, 10 meter downlink), after a long period of operating in Mode K (15-meter uplink, 10-meter downlink). The change was reportedly due to interference caused by improving propagation on 15 meters.

Sputnik Scale Model Launch Delayed

Plans to launch a 1/3-scale-model of the original Sputnik satellite with a ham transmitter aboard (see "VHF News," October, 1997) were delayed at least until November 3, according to the AMSAT News Service. The launch-by-hand during a Mir spacewalk was originally planned for October 4, the 40th anniversary of Sputnik's launch. The report also said the satellite would identify as RS-17 when active.

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, *76 N. Broadway, Hicksville, NY 11801; or via e-mail to <CQVHF @aol.com>; <cqcomm@delphi.com> or <72127.745@compuserve.com>. Please specify that it is a letter for* CQ VHF *magazine.*

Dear *CQ VHF*:

Since we expect to be entering a period of increased 6-meter activity now that the sunspots are rising again, why don't you review some of the 6-meter radios on the market? Kenwood has what sounds like a super unit in its TS-60S 50-MHz all-mode transceiver. They also have model TM-742AD, 2 meters and 440. You can add a 6-meter module and have a tri-band unit. I am sure there are others out there that would be of interest to your readers. You might also cover the advantages of sideband. Your consideration of this request would be much appreciated.

Ralph Amtsberg, KC5NAA
Apache Junction, Arizona

Ralph—Normal practice for ham magazines is to review equipment soon after it comes on the market. But 6 meters is kind of a unique case in that much of the equipment currently on the market has been available for quite some time—longer, in fact, than many of the newer 6-meter operators have been interested in the band. Your request is one of several we've received, and we do plan to start reviewing 6-meter radios that are popular though no longer new. First up should be a look by Ken Neubeck, WB2AMU, at his Yaesu FT-690 on the 10th anniversary of its introduction.

Dear *CQ VHF*:

In reading the August copy of your mag, I noticed on page 25 you talk about keeping mobile antennas away from overhead power lines and I have a small story to share.

I'm an EMT (Emergency Medical Technician) for a local EMS and took one of our ambulances to a call for a car crash. I was directed to park next to a police car.

Well, what neither the officer nor I noticed was a low-hanging power line that contacted our Low-Band (33-MHz) antenna and melted it to the roof! We were lucky that all the power wire did was melt the antenna.

Jon Awalt
(via e-mail)

Jon—You are lucky indeed. As an EMT, I'm sure you're well-aware of the deadly danger posed by contact—or even near-contact—with power lines. Thanks for the reminder that it's always good to look up as well as left and right!

More Licensing Comments

Dear *CQ VHF*:

First of all, I would like to thank you for such a wonderful magazine! It sure has filled a void in my few years as a ham, especially since there aren't many other hams in my community. I have to drive 110 miles to club meetings and other acvities.

Regarding the (July '97) "Op-Ed" entitled, "A Mode of Operation Should Be a Choice, Not a Barrier," I have to agree with WB9OMC. We don't have a qualification system for packet, AMTOR, Pactor, ATV, or the like. Why then code? In my opinion, we as the amateur community should concentrate on teaching and making sure we know the fundamentals of amateur radio, such as electronics, spectrum allocations, etc.

I spent eight years studying after high school and became a dentist. Four years ago, I got my Technician license. I passed the written portion of the General exam without a problem. I'm RACES coordinator for my county and participate in other activities. But I guess I'm not good enough to experience the pleasure of upgrading because I can't learn the code.

Let's tie frequency privileges to educational proficiency in amateur radio, not code proficiency. If we don't, we will all stagnate and our frequencies will be lost due to lack of use—all because a mode of communications holds back our progress into the future.

Jose Rodriguez, DDS, NØZXB
Belcourt, North Dakota

Dear *CQ VHF*:

I have been reading everything printed concerning the problem of code and its value/merit to the amateur radio field. I find most every argument, mostly against retaining the requirements, very amusing, and, undoubtedly, self serving.

The arguments against say, "No one else uses it," "Plots have a shorter test and it is easier," "It's antiquated," "I came aboard as a No-Code Tech, and have no desire to learn it or I'm not going to use it anyway," etc. I've heard that we will keep out the riff raff that come in. So far, I haven't heard a reason for doing away with the requirements that I would consider valid.

Trying to compare amateur radio licenses with a pilot's license is one of the most ridiculous arguments I've heard. That test is less than 50 questions I'll agree. However, in addition to that test, you have to get the weather, plot a course, making necessary corrections for winds, file flight plans, operate radios to get clearances to do almost everything he tries to do and then demonstrate his ability to preflight the aircraft, that he is capable to take off, perform many of the required maneuvers, in regular and slow flight and land, frequently in other than ideal circumstances. In addition, to get higher ratings, each is attained by passing further tests, and another flight test including more and more intricate flying. Also, depending on the ratings held, a pilot must go through briefings and flight exams every two years to maintain his license in a current status or it is cause for grounding. When is a ham caused to demonstrate his ability to maintain a current license? There were things that I was required to learn and demonstrate my ability to do them that I have never used since learning them but I'm glad I know what to do and how to do it should the occasion ever arise.

Doing away with the code requirement is just another way of saying, "Hey, I don't like that requirement, or I won't learn the code to get to use the other part of amateur radio that I would like to have." Some say, I can't learn the code. My answer to you is, just look in the ads in all of the amateur related magazines. Every one of them have ads for code courses that guarantee success in a short period of time or a full refund of the cost

of the course. I think with a promise like that, the ones balking at the code would have been much easier with a proven course to help. I think it's much more a won't and not a can't to those who are so vehemently against the requirement.

73,

Charles J. Devett, N3XVV
Revloc, Pennsylvania

Charles—Your argument is exactly why we were comparing ham licensing with pilots' licensing. The comparison originated in an editorial (May, 1997) in which we proposed adding some practical requirements to upgrade exams. Goal: Make ham radio license requirements more like pilots' exams.

Update on DAREN

Dear *CQ VHF*:

I was thrilled to read about the DAREN packet system in the (July '97) article, "Ham Radio Public Service: A Sales Guide." This is a noteworthy system conceived by Ken Harris, WA8LLM, of Parkerburg, West Virginia, and implemented by Wood County Emergency Communications, a local group of hams dedicated to helping public service agencies and similar worthy causes with communication needs. The systems in each county associated with DAREN are generally supported by a local communications agency, usually the county Emergency Operations Center or affiliated hams. Additional information on the DAREN system is available by contacting Wood County Emergency Communications, P.O. Box 3328, Parkersburg, WV 26103.

John Hatfield, WS8C
Harrisville, West Virginia

John—Thank you for that update. Emergency communications managers interested in developing wide-area packet networks will probably benefit from learning more about the DAREN system.

Re-inventing Packet

Dear *CQ VHF*:

The article by Greg Jones, WD5IVD, President of Tucson Amateur Packet Radio (TAPR) "Time for a New Packet Revolution" ("Op-Ed," September, 1997 *CQ VHF*) was wonderful.

After attending the TAPR forums at the Dayton Hamvention this year, I came away with the feeling that TAPR will be the salvation of amateur radio. This was evident to me by the quality of TAPR's forum speakers. They are an upbeat and inventive group of amateur radio movers and shakers. Keeping up with all that TAPR is doing is challenging, and using their new technologies gives me a feeling of accomplishment. I am envious of the "high" the designers must receive from developing such imaginative software and hardware.

TAPR has not only helped many amateur radio operators through the doldrums of the recent sunspot cycle. It is leading us out of the 20th century and will lead us creatively into the 21st.

John Hartman, WA3Z
Baltimore, Maryland

Product Update

Synthesized FM Repeater Modules from Hamtronics

Hamtronics has a new line of VHF FM transmitters and receivers: the T301 exciter and R301 receiver. Intended primarily for repeater use, these units provide high-quality NBFM and FSK operation on 144 to 148 MHz (and 148 to 174 MHz for export and government services). Features include DIP switch frequency selection, low noise synthesizer for repeater service, commercial grade TCXO for tight frequency accuracy in wide range of environmental conditions, and fast delivery with no wait for channel crystals.

The T301 exciter uses direct FM modulation, which allows FSK transmission of data up to 9600 baud. Power output is 2 to 3 watts and it is rated for continuous duty in demanding applications, such as repeater service. The R301 receiver has the same sensitivity, selectivity, and squelch as other Hamtronics receivers.

The T301 and R301 are available either in kit form or factory wired and tested. The T301 exciter is $109 (kit) or $189 (wired/tested); the R301 receiver is $139 (kit) or $209 (wired/tested). Kits use a crystal (supplied) to generate the reference frequency, and a TCXO is optional at $40. Factory built units include a TCXO as standard equipment. Two-meter repeaters built from these units are available for next day shipment, as there is no delay waiting for channel crystals.

For additional information, contact Hamtronics, Inc., 65-V Moul Rd., Hilton, NY 14468-9535; Phone: (716) 392-9430; Fax: (716) 392-9420; e-mail: <jv@hamtronics.com> (mention this writeup in *CQ VHF*). A complete catalog can be viewed at their Web site: <http://www.hamtronics.com>.

ICOM offers High Power Option for IC-T7A

The HP model of ICOM's IC-T7A dual-band (144/440 MHz) handheld transceiver now comes standard with a BP-173 battery pack, giving it up to 4 watts of output power. With a height of approximately four inches, the palm-sized IC-T7AHP offers all the features of the original IC-T7A plus increased output power. The radio stores up to 70 channels in any combination of VHF or UHF frequencies and has nine DTMF (dual-tone multi-frequency) memories for auto dialing, as well as 50 separate encode and decode frequencies and a tone scan function for easy subaudible tone selection.

For more information, contact your local amateur radio dealer, or ICOM America, Inc., 2380 116th Avenue NE, Bellevue, WA 98004; Phone: (425) 454-8155; World Wide Web: <http://www.icomamerica.com>.

Circle 100 on reader service card

Philips ECG U-105 Antenna Rotator

Philips ECG, a division of Philips Consumer Electronics Company, has introduced its new U-105 Antenna Rotator. The package includes automatic controller, rotator drive unit, and mounting hardware. An optional TB-105 support bearing is available for installations requiring extra rigidity.

According to the manufacturer, the rotator is durable, precision-built and designed to turn and accurately position even the largest flat wedge type TV-FM antenna for the best possible TV picture and FM reception. It will also handle small VHF/UHF amateur antennas.

Features of the U-105 include precision cut steel gears hardened for long service life; rugged, one-piece cast aluminum housing for greatest strength in high stress areas; large bearing surfaces and strong reinforced mast for lateral load support (vertical load 45 Kg, or 99 lb, maximum); ball bearing provided for thrust load (160 lb-inches of motor torque); high torque easily handles largest TV/FM antenna arrays; durability in high winds and harsh weather extremes, watertight seal, fully lubricated drive train; and complete automatic control indicator, accurately shows orientation of antenna.

For the name and location of the nearest ECG distributor, call toll-free at (800) 526-9354.

Circle 102 on reader service card

JPS Communications Spectrum Display Kit

JPS Communications, Inc., has announced the availability of its new Spectrum Display Kit, SPEC-12, for the NIR-12 Noise/Interference Reduction and Filter Unit. The SPEC-12 is a software and hardware kit that adds an audio spectrum analyzer function to the NIR-

(Continued on page 52)

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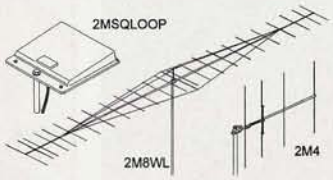

2M7, 2m 7 element
2M12, 2m 12 element
2M18XXX, 2m 18 element
2M5WL, 2m 5 wave
2M8WL, 2m 8 wave
2MCP14, circular
2MCP22, circular
440-18, 70cm 18 elements
432-9WL, 70cm 9 wave
432-13WLA, 70cm 13 wave
436CP30, circular

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2M (20W)

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35W/UHF Advanced Features
IC-2000H 2 Meter Mobile
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IC-821H 2M/440 MHz, All Mode
Satellite Transceiver
IC- Δ100H 2 Meter/440MHz/1.2GHz
50W/35W/10W, 600 Memories
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Picture This!

Travels with CQ VHF

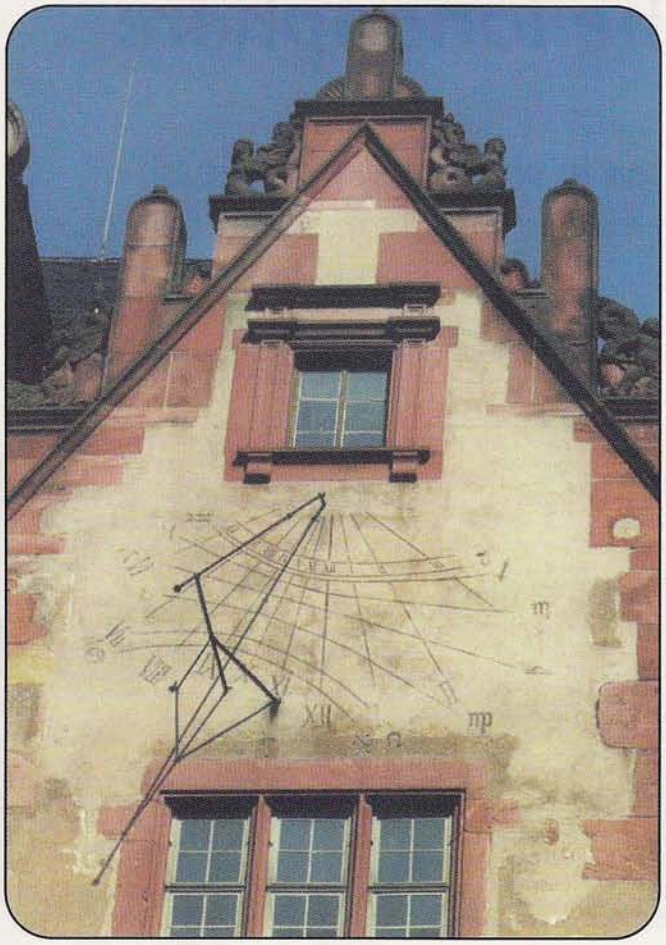
Over the next few issues, we'll be reporting on highlights of W2VU and N2IRZ's trip to the 1997 Weinheim VHF Conference in Germany. This month, though, we thought we'd get started by sharing some interesting photos that probably won't make it into any of the main articles.

The hotel room was kind of drafty, but the view was great! Actually, this is the Scholss Heidelberg, or Heidelberg Castle, in the city of the same name about a half hour south of Weinheim on the Bergstrasse, the "mountain road."

Authentic German food. You'll have to look closely to see what's familiar about this lovely restaurant in downtown Heidelberg. Hint: It's a good place to order a ground beef pattie that originated in Hamburg.

Thirsty? This huge wine cask, known as "the big vat," is in the basement (dungeon?) of the Heidelberg Castle. Look at the people at the bottom of the photo to get an idea of its size. Built in 1751 and holding 221,726 liters (58,580 gallons) of wine, it must have made long sieges easier to bear!

Weinheim is on the eastern edge of the Rhine River valley. A feature of the Rhine that might be of interest to VHF hams is the semi-permanent temperature inversion over the river (see "Tracking an Inversion").



Does anybody really know what time it is? This very old sundial at the Schloss Heidelberg apparently tells not only the time of day, but—as far as we could figure out—the time of year as well. And yes, that's a radio antenna on the roof.

And finally, the trip offered W2VU an introduction to German (N2IRZ is fluent), including such important words as toiletten *(rest rooms),* cola light *(Diet Coke),* credit carden *(what else?), and the kids' favorite,* ausfahrt, *which means "exit."*

Tracking an Inversion

When there wasn't anything else on my plane's video system, the screens in the cabin displayed a map of the 747's location and route, plus altitude, ground speed and outside temperature (all but the temperature, courtesy of the plane's GPS navigation system). At our cruising altitude of 37,000 feet, the outside temperature varied between -65° and -70° F. As the plane descended, the temperature rose steadily, climbing to +41° F as we passed through 10,000 feet, and 53° F at 4,900 feet. But by 4,000 feet, as we passed over the Rhine River, the temperature had dropped back to 42°, then steadily climbed again as we continued to descend, finally reaching the ground temperature of 50° F.

A few days later, I noticed a similar temperature pattern in tracking data from a balloon launched from the Weinheim convention, and I learned from Project Engineer August Gihr, DK5UG/AC6SP, that this inversion is a semi-permanent feature of the Rhine Valley. It would be interesting to know if this inversion reaches ground level at any points, and, if so, whether any significant tropospheric ducting has been accomplished on VHF.

—W2VU

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*, 76 N. Broadway, 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 to you, please tell us so and include an SASE (self-addressed, stamped envelope) with sufficient postage. Thanks!

Rockets into the Ionosphere

Hams aren't the only people interested in the ionosphere. Much of what we've learned about its composition comes from data collected by NASA sounding rockets.

By Ken Neubeck, WB2AMU*

How do we know exactly what the ionosphere is made of? Or how it produces the various propagation modes that hams often experience on the VHF bands?

Much of our understanding of the ionosphere has been gained through the launching of *sounding rockets*. These suborbital launches carry payloads containing scientific equipment that makes measurements in the ionosphere and sends its readings back to the ground, where scientists can analyze it. The sounding rocket program has helped scientists get a better handle on the phenomena that occur in this region of our atmosphere. Launches by both the U.S. and Russian space agencies were quite common during the 1960s and 1970s, and there continue to be occasional NASA launches today, despite funding cutbacks.

The data collected by sounding rockets are highly relevant to amateur radio operators. Understanding the *E*-region ion composition helps significantly in our understanding of some of the major propagation modes that are heard on HF and VHF bands, including sporadic-*E*, aurora, and meteor scatter.

There are many reasons why NASA uses sounding rockets to probe the ionosphere. The rockets themselves are low cost and a payload can be developed in as little as six months. But the most important reason that the rockets can collect data at altitudes that are too high for balloons (which have a maximum height range of about 30 miles) and too low for satellites (which have a minimum altitude of 100 miles). As many of us know, sporadic-*E*, meteor, and aurora activity takes place in the area of 70 to 80 miles above the Earth's surface.

This is one of the most successful ionospheric sounding rockets in history, the Nike-Cajun, which stands over 25 feet long. It was first launched for this purpose in 1956 from Wallops Island, Virginia. (NASA photos)

How the Rockets Work

The photos show a NASA sounding rocket being readied for launch in the 1960s. These were typically Nike Cajun (pictured) or Aerobee rockets, with the Cajun being the most popular. Launch sites used in North America included Wallops Island, Virginia; White Sands, New Mexico; Eglin Air Force Base in Florida; and Fort Churchill, Manitoba. (Many of the launches from Fort Churchill were aimed at auroral formations. I have been told that it is almost like a religious experience to be in a remote outpost where there is just you and an intense aurora formation that may be in a shade of green or red. A few people who have been stationed there claim that the aurora can actually be *heard* in the quiet of such a surrounding and that it comes across as a high-pitched sound.)

From conversations I had with a person who was stationed at some of the rocket sites, a typical sequence actually involved three launches: a preliminary rocket before the main launch and a final

"...the rockets can collect data at altitudes that are too high for balloons (which have a maximum height range of about 30 miles) and too low for satellites (which have a minimum altitude of 100 miles)."

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

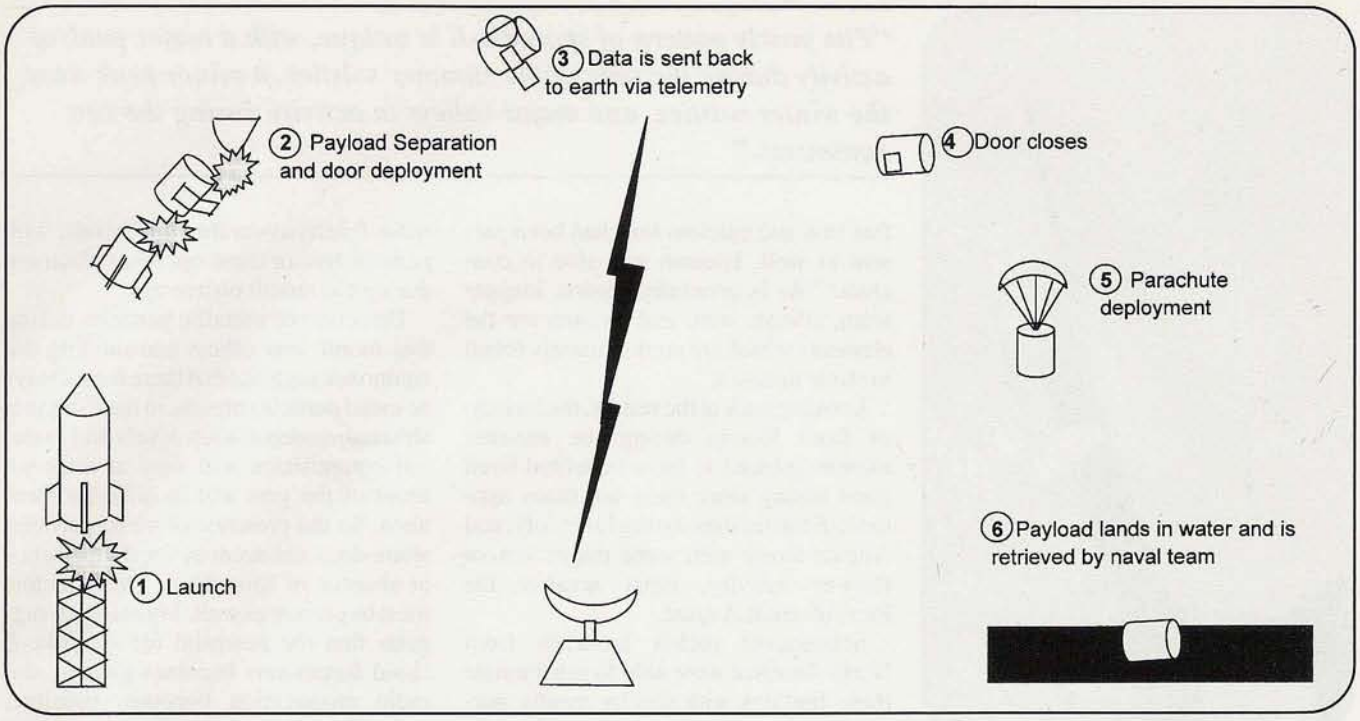


Figure. Typical sequence of a NASA sounding rocket launch. At a preset altitude, the payload separates from the booster rocket and a door opens, lowering sensors into the ionosphere. Readings are radioed to the ground via telemetry. Recovered payloads may be reused.

rocket afterward for the purpose of collecting before-and-after telemetry reference data. In the main launch, the container with the scientific equipment is ejected from the rocket at an altitude of about 70 kilometers (see Figure). The payload continues to ascend at a high rate of speed until it reaches an altitude of 100 kilometers. This helps it maintain enough separation from the rocket to prevent the test instruments from picking up traces of rocket fuel, which would contaminate the results. The upper section of the rocket typically has a metallic parachute so that ground retrieval of the spectrometer equipment is generally possible. For launches conducted from Wallops, the payload section would land in the ocean and be recovered by a naval retrieval team. The payload section can be reused if recovered intact.

In launches made for the purpose of identifying elements in the *E*-layer, the payload equipment measures *ionic current* as it passes through this part of the ionosphere. Each ion has a unique ionic current in an electric field, so scientists can use the readings to determine what elements were present in the ionosphere at the time of the launch.

To gather this data, the rocket's payload section consists of a container that houses a radio frequency mass-spectrometer and a probe. The probe is a tube that is opened at one end with a set of flat parallel grids inside that measures ionic current. The probe operates according to the principle of the separation of ions in electric fields through the use of grids set at fixed and alternating current potentials. The signal from the probe is sent to the mass-spectrometer, which amplifies it and sends the information to the ground via telemetry using a multi-channel and high-speed sampling rate system. This is the same basic methodology that was used in the first truly successful sounding rocket launch, from Russia, in 1960. So let's take a look now at some of these early launches.

40 Years of Rocket Research

Before there were sounding rockets, scientists could only speculate as to what type of ions made up sporadic-*E* clouds and auroral formations. In 1955, a researcher, M. Nicolet, hypothesized that meteors played a major role in nighttime ionization in the *E*-region, and eventually the data collected by sounding rockets proved his hypothesis.

The first sounding rockets were launched from the U.S. in 1956, and an intense schedule of launches took place during the International Geophysical Year (IGY) in 1957 to 1958. A few of the 1958 launches were partially successful in detecting the presence of positive ions in the *E*-region, but it was not until a launch from Russia on June 15, 1960, using the data collection method outlined above, that things became clear (see Table for results of significant launches). The results of this launch were documented in a major paper by V. Istomin ("Ions of Extra-Terrestrial Origin in the Earth Ionosphere," *Space Research,* Volume 3, 1963, North-Holland Publishing).

Data from this Russian launch showed the detection of ions with mass numbers of 24 and 26 AMUs (Atomic Mass Units) at approximately 105 kilometers above the Earth. These ions were identified as isotopes of magnesium. Istomin was able to calculate the peak concentration of

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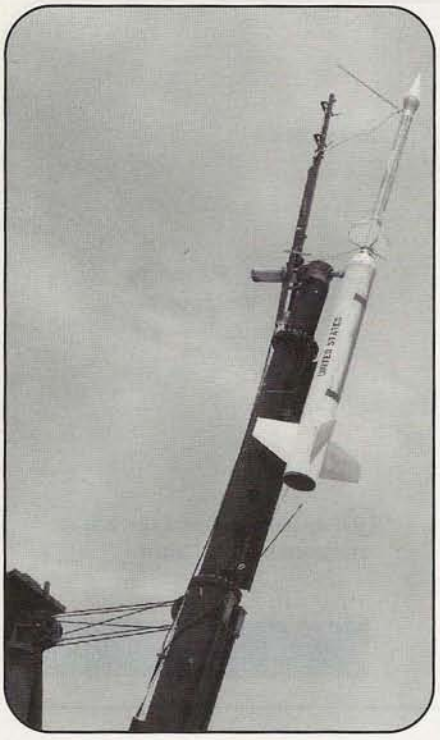


Another view of a Nike Cajun sounding rocket. These were used extensively for research during the International Geophysical Year (IGY) in 1957/1958. Plus, NASA launched over 300 in the 1960s and 1970s during numerous studies of the ionosphere.

these magnesium ions at 13,600 per cubic centimeter, representing about 17% of all ions in that particular area of the ionosphere (this area is typically composed of a very low density of nitrogen oxygen and oxygen ions). Istomin also determined that a layer of iron ions at 56 AMUs might also have been present during this flight. Plus, by examining the partial data from two previous launches from the USSR in August of 1958, he was able to determine that iron and calcium ions had been present as well. Istomin was able to conclude: "As is generally known, magnesium, silicon, iron, and oxygen are the elements which are predominantly found in stone meteors."

"The yearly pattern of sporadic-E is unique, with a major peak of activity during the time of the summer solstice, a minor peak near the winter solstice, and major valleys in activity during the two equinoxes."

Looking back at the results, the launches from Russia during the summer months seemed to have benefited from good timing since there are many sporadic-*E* formations during June, July, and August along with some major meteor shower activity, most notably the Perseids each August.

Subsequent rocket launches from North America were able to substantiate these findings with similar results, particularly those launched during the sporadic-*E* summer season and during meteor showers.

Correlations to Sporadic-E

Take another look at the Table. Along with a summary of results from major launches, you can also see that metallic ions have been detected by sounding rockets throughout the different months of the year. In certain months, particles were detected that seemed tied to events such as aurora and meteor shower activity. However, it's interesting to see detection of these particles during the launch of April 12, 1966, that appears to correspond to a probable sporadic-*E* cloud. Typically, April is a quiet month for sporadic-*E* activity on the VHF bands, with perhaps two or three openings observed during the month on average.

Detection of metallic particles during this month and others surrounding the equinoxes suggests that there may always be metal particles present in the *E*-region, although concentration levels and material composition will vary at different times of the year and in different locations. So the presence of metal particles alone does not account for the presence or absence of sporadic-*E*. Other factors must be present as well. My research suggests that the potential for sporadic-*E* cloud formations becomes greater, and radio propagation becomes possible, when the right environmental conditions associated with wind shear exist, along with the presence of solar radiation.

Seasonal variations in solar radiation appear to play a major role in sporadic-*E* cloud formation. As discussed in previous *CQ VHF* articles on sporadic-*E*, there is a consistent yearly pattern with minor variations over the course of the 11-year sunspot cycle (this is borne out by the consistency of sounding rocket results at various points in the sunspot cycle, as seen in the Table). The yearly pattern of sporadic-*E* is unique, with a major peak of activity during the time of the summer solstice, a minor peak near the winter solstice, and major valleys in activity during the two equinoxes. If metal particles are generally present in the *E*-layer at all times of the year, one would have to

Table. Summary of Major Rocket Launches into the Ionospheric E-region.

					METAL IONS DETECTED									
DATE	TIME	LAUNCH SITE	HEIGHT (km)	FORMATION TYPE	Fe	Mg	Ca	Si	Na	Al	K	Ti	Mn	Ni	Cu
6/15/60	0800 MST	European USSR	105	Sporadic-E	X	X		X							
10/31/63	1200 CST	Eglin AFB, Florida	85	Sporadic-E		X	X		X						
3/6/65	0132 CST	Fort Churchill, Manitoba	100	Aurora		X									
11/16/65	1222 CST	Eglin AFB, Florida	1) 94	Meteor (Leonids)	X	X	X		X	X					
			2) 111	Meteor (Leonids)	X	X		X							
11/17/65	2320 CST	Eglin AFB, Florida	89 and 93	Sporadic-E/Meteor (Leonids)	X	X	X							X	
1/26/66	-	White Sands, New Mexico	106	Sporadic-E	X	X	X	X		X					
4/12/66	1849 CST	Eglin AFB, Florida	1) 93	Sporadic-E	X	X									
			2) 105	Sporadic-E	X										
			3) 115	Sporadic-E	X			X							
8/12/76	1054 EST	Wallops Island, Virginia	101	Meteor (Perseids)	X	X	X	X	X	X	X	X	X	X	X

"The major determination that the particles that make up these formations are metal ions, and that these ions are typically the same type as found in meteors, has allowed scientists to gain a better focus in the investigation of these phenomena."

examine what else is happening to preclude the formation of sporadic-*E* events. At this point, we need to examine the Earth's positioning relative to the sun during the course of the year to see what physical forces are inhibiting the formation of sporadic-*E* clouds.

Summing Up

Sounding rocket launches from a NASA base during the 1960s and 1970s numbered between 50 and 100 launches a year. With the cutback of government money in this area, the current number of launches from each NASA facility numbers around 5 to 20 a year. In addition, the type of ionospheric research has shifted from the *E*-region to the *F*-region. The latter type of research requires larger rockets as the distances to reach the *F*-region are greater (200 miles up as opposed to 70 miles for the middle of the *E*-region). So, while sounding rockets continue to be launched, they are no longer providing much new data on the *E*-region. Still, they have provided us with vital information.

Sounding rocket research has been instrumental in determining some of important facts about sporadic-*E*, aurora, and meteor phenomena. The major determination that the particles that make up these formations are metal ions, and that these ions are typically the same type as found in meteors, has allowed scientists to gain a better focus in the investigation of these phenomena. It also explains a number of facts for us as radio amateurs with regard to the different phenomena that affect our VHF propagation.

The fact that sporadic-*E* formations consist of metal ions may explain why this mode of propagation is exceptionally efficient, especially for low-power operation. Also, it's known that metallic ions have a lower ionization potential than the oxygen and nitrogen ions that are normally found in the ionosphere, and this fact will help scientists to understand why sporadic-*E* and related phenomena behave in the way that they do.

I hope I've helped clear up some of the misunderstandings that hams may have about sporadic-*E* and aurora by sharing some of the facts that have been discovered about them through the sounding rocket program. It may be some time before we completely understand everything about these phenomena, but ongoing scientific research will help us improve our knowledge in this area. Obtaining hard data and facts will help researchers to come up with reasonable theories that can be supported by physical evidence, rather than by speculation. However, I would like to emphasize that hams can still contribute to a better understanding of propagation associated with the *E*-region by continuing to make careful observations of what they hear on the amateur radio bands.

I wish to thank Keith Koehler of NASA's Wallops Island facility for providing me with photographs and information for this article. A number of the NASA bases have a Web page on the Internet with further information on sounding rockets. One good Web site to start with is <http://www.wff.nasa.gov/~web/sndroc.html>.

References

The following is a list of the scientific papers in which much of the results of rocket studies are documented. You can see that extensive work has been done in this area. I was able to find these papers in the volume of journals in the Earth Space Science library of my Alma Mater, SUNY at Stony Brook. They should be available at most university libraries, but I will make copies upon request. Please include an SASE.

"Ion and Neutral Composition of the Ionosphere" (1967) C.Y Johnson, *Annals of the ISQY*.

"Abundance of Metallic Atoms in the Atmosphere" (1965) A. Vallance Jones, *Annales de Geophysique*.

"Ion Composition Measurements and Related Ionospheric Processes in the D and Lower E Regions" (1965) R.S. Narcisi, *Annales de Geophysique*.

"Processes Associated With Metal-Ion Layers in the E region of the Ionosphere" (1966) R.S. Narcisi, *Space Research VIII*.

"Ions of Extra-Terrestrial Origin in the Earth Ionosphere" (1963) V.G. Istomin, *Space Research III*.

"Ionic Reactions for Meteoric Elements" (1970) W. Swider, *Annales de Geophysique*.

"Composition Measurements of Sporadic E in the Nighttime Lower Ionosphere" (1967) R.S. Narcisi, A.D. Bailey and L. Della Lucia, *Space Research VII*.

"Metal Ions and Isotopes in Sporadic *E*-Layers during the Perseid Meteor Shower" (176) U. Hermann et al., *Space Research XV*.

A Network of High-Power Beacons

Using FM and TV broadcast bands to spot openings and help you get the most from the VHF ham bands.

By Philip Gebhardt, VA3ACK*

If you're like many hams, your interest in radio began with listening... perhaps to faraway stations on the AM broadcast band, or perhaps to international shortwave broadcasts. However, it seems that the commercial FM broadcast band and the TV bands got left out of the picture (no pun intended). Few hams seem to have had their interest in radio sparked because they heard a distant FM station or saw a distant TV station on the living room TV set. This is unfortunate, since DXing on these bands is not only possible and lots of fun, but it's also a valuable tool for ham radio DXing.

Maybe we need to reverse the process that got many of us started. Perhaps now that we have our licenses, we should take a closer look at these generally neglected broadcast bands. What we hear (and see) may spark an interest in the VHF and UHF amateur bands the same way mediumwave and shortwave stations may have once piqued our interest in exploring the lower frequencies.

You don't need to invest in a high-cost FM receiver for DXing the broadcast bands. Whatever you have available will get you started. This is a photo of the author using a Realistic DX-440. With this receiver and a five-element commercial beam, he's heard WKGC-FM in Panama City, Florida from Canada via sproadic-E. He has also used the same setup for meteor scatter. (Photos by the author)

The Ham Connection

The low VHF TV band that includes channels 2 through 6 (54 to 72 and 76 to 88 MHz) is right next to the 6-meter ham band. The high TV band (174 to 216 MHz) covers channels 7 through 13 and is next to the 220 MHz (1.25-meter) ham band. These TV bands experience the same types of propagation as the adjacent ham bands, meaning that they can be used as indicators to tell us what signal characteristics to expect on 6, 2 and 1.25 meters. They're also excellent for alerting us to band openings. All of this, by the way, assumes that your TV or FM set is connected to an antenna and not to cable. (See Figure 1 for the relationship between the TV and FM bands and various amateur bands.)

High-Power Beacons

Just think about it: There are hundreds of TV stations located throughout continental North America. Add to these, stations in Hawaii, Bermuda, Central America, and the Caribbean. You now have a network of high-power beacons, many of which are in operation 24 hours a day. If you see WESH-TV (Daytona Beach) on channel 2, you'll know that there is propagation between your QTH and Florida. That's the time to turn your 6-meter beam towards Florida and start calling CQ. But what if there is a local station on channel 2? Try channel 3 instead. Maybe you'll see WEDU in Tampa. You'll get the same indication of a band opening to Florida.

Is this really possible? It sure is. Robert Ross, VE3SW, saw both of these Florida stations from his QTH in London, Ontario (see photo of his QSL cards).

"These TV bands experience the same types of propagation as the adjacent ham bands, meaning that they can be used as indicators to tell us what signal characteristics to expect on 6, 2 and 1.25 meters."

Philip Gephardt, VA3ACK, is a teacher from Greenbank, Ontario, about 40 miles northeast of Toronto. He uses FM and TV broadcast DXing to augment his VHF hamming.

There is yet another possibility. QSOs between VE3s in Ontario and W4s in Florida are common, probably because there are many hams in both areas.

But what if you want to work an area where there aren't many hams active on the VHF bands? Is *that* possible? To find out, check your TV set. If you can see a channel 2 (or channel 3) TV station from the area of interest, then a QSO on 6 meters should be possible. In this case, it's worth looking for a ham with whom to set up a sked.

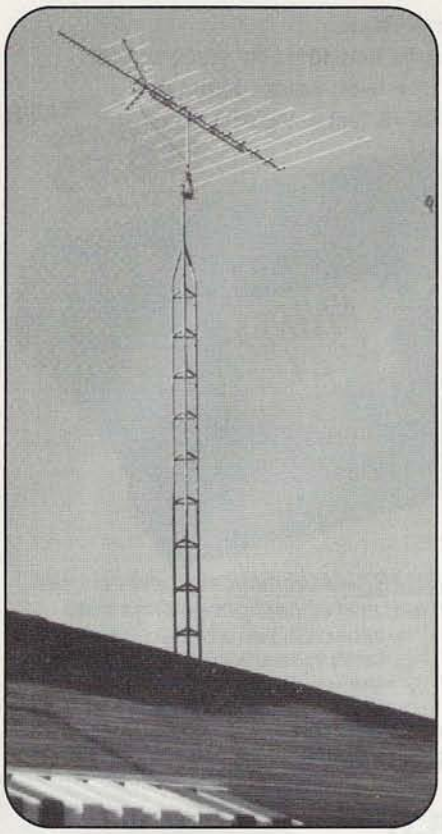
TV DX signals can vary from a weak, snowy picture to a perfectly clear one. In the presence of a strong, semi-local station, a DX station may show up as a weak background signal. The signal will affect the quality of the semi-local station and you'll likely see the horizontal and vertical blanking bars of the DX station move across the screen. While watching TV DX, you may see only the video portion of the signal, or perhaps hear only the audio portion. Occasionally, you'll see the video signal from one station and hear the audio signal from another station.

By the way, there are areas where you *can't* work hams. For example, the band allocations in the Bahamas leapfrog the 220-MHz band. Hams there can use 2 meters and 70 centimeters, but not the 1.25-meter band. Nonetheless, you might wonder if it would even be possible to work the Bahamas on 220 from your QTH. Why not check out ZNS (channel 13 on 210 to 216 MHz)? Although there are no hams on 220 MHz in the Bahamas, you'll at least have the satisfaction of knowing whether a contact was even possible. (Maybe this is a possibility for a future DXpedition. Perhaps a special license would allow a short-term operation to put C6A on the 1.25-meter band.)

In any case, the TV bands can be used to great advantage by hams to determine DX possibilities.

Propagation Spotting

But there are other uses as well, and many propagation modes on the VHF bands that can be exploited by radio amateurs. Among them are *tropospheric scatter, sporadic*-E, *meteor scatter*, and *auroral* propagation. To use these modes, you will need to know when to listen and just what it is that you're listening for. *(If the preceding paragraph was Greek to you, see this month's "Basics" article on VHF propagation for a brief introduction.—ed.)*



A large beam is an advantage when receiving weak FM and TV broadcast signals, just as it is with ham radio communications. For most FM/TV work, a rotatable beam on a high tower works best, but any antenna, including a folded dipole, will provide some results (see Figure 3 for examples).

The commercial TV and FM broadcast bands are ideal for learning about propagation modes. Again, the advantage is that there are thousands of FM and TV stations scattered across the continent. They are, for the most part, high-power (25, 50, and 100 kW) stations. You can check out VHF propagation modes using these stations without setting up skeds with other hams and hoping for the right conditions. And here's where your FM broadcast radio will also come in handy.

Although the FM broadcast band is removed from both the 6- and 2-meter amateur bands, many of the propagation modes found on the ham bands will also be heard on the FM band. Again, their presence on the broadcast band can be a tip-off to turn on your ham rig. Let's take a closer look at the most common propagation modes, starting with *tropo*, or *tropospheric* propagation.

For starters, if you think that VHF bands are mainly useful for line-of-sight communications, all you need to do to find out how wrong you are is to sit down one evening with your FM broadcast receiver. Tune around the band (88 to 108 MHz). You'll hear plenty of stations that are over the horizon, even without any real "band openings." This is due to tropospheric propagation, which is a mainstay of VHF communications and can be used almost daily by hams.

If you live near a large body of water, you can easily detect the effects of enhanced propagation. You'll notice that you can hear stations farther away if you aim your antenna along the shoreline or across the water. Stations the same distance away across land may not only be weaker, they may be impossible to hear. At my home near Toronto, Ontario, WKLX (98.9 MHz), across Lake Ontario in Rochester, New York, sounds like a local station. Rochester is about 90 miles (150 kilometers) away. For my five-element FM/TV antenna up about 20 feet (6 meters), the horizon is 6.3 miles (10 kilometers) away; WKLX's horizon is 33.5 miles (54 kilometers) from the station. Clearly, the two antennas cannot "see" each other, so direct, line-of-sight reception is impossible. Yet WKLX can be heard here any time of the day or night.

The same approach can be used with other propagation modes. The only difference is the distance. While tropo signals may extend for 500 miles (800 kilometers), sporadic-*E*, meteor scatter and auroral signals may come from as far away as 1300 miles (2000 kilometers). Both sporadic-*E* and meteor signals can often be heard (and seen) in the FM and TV bands. Among the stations I've heard from Toronto via sporadic-*E* are WKGC-FM (90.7 MHz) in Panama City, Florida, and WVAS (90.7 MHz) in Montgomery, Alabama. (See Figure 2 for a look at various VHF propagation modes.)

What Sort of Opening?

Using FM stations as beacons, you can quickly learn to recognize the different propagation modes. Tropo is often weak with fading, but it may last for hours. Sporadic-*E* produces strong signals and it, too, can last for many hours. As the sporadic-*E* cloud moves, you may hear one station quickly replaced by another equally strong station. Meteor scatter can also produce strong signals (comparable to local stations). These signals are characterized by a rapid rise out of the noise and then a quick decline. Some meteor signal bursts last only a fraction of a second, while others may last up to a minute. Longer bursts are often subject to fading.

While there isn't much *F*-layer propagation at this point in the sunspot cycle, there will come a time in the not-too-distant future when 6 meters can be reliably used for transatlantic QSOs. In this case, you need to know when there is propagation between Europe and North America. How do you tell? You look for European TV signals. North American hams listen for TV signals between 48.240 and 48.260 MHz. (In the West European "E" channel system, the video carrier for channel 2 is on 48.250 MHz.) In July 1995, WB4WTC heard strong 48.250-MHz video signals (lots of buzzing) from Spain and Portugal. In that case. it wasn't *F*-layer propagation, but a sporadic-*E* opening.

There's also a link between VHF propagation and weather. It's easier to see the effect weather has when you have access to many stations simultaneously, so try

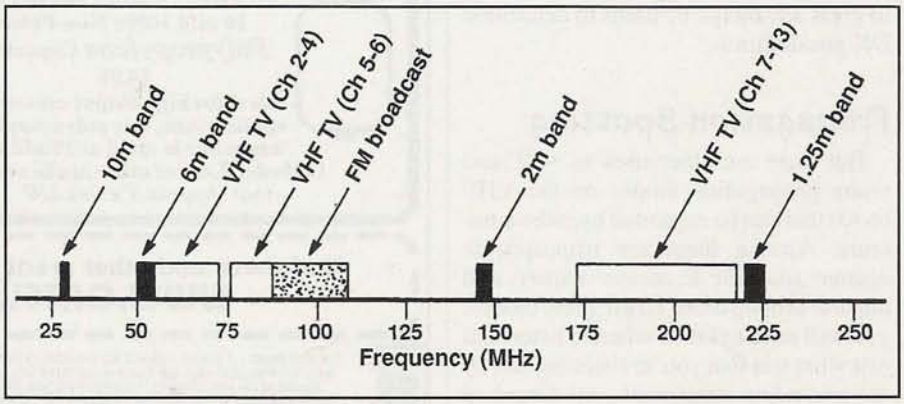


Figure 1. The commercial TV and FM broadcast bands are well situated to benefit hams. Their proximity to amateur bands allows TV and FM stations to be used as beacons to indicate propagation openings and to help hams study VHF propagation.

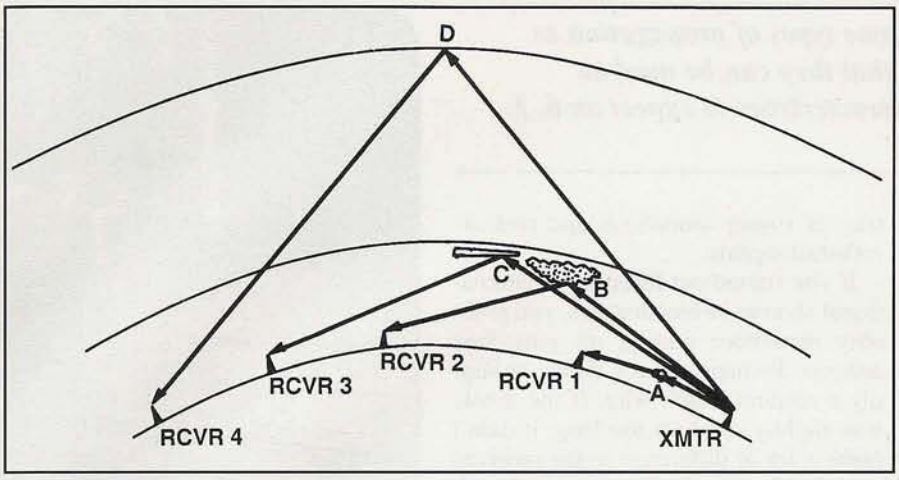


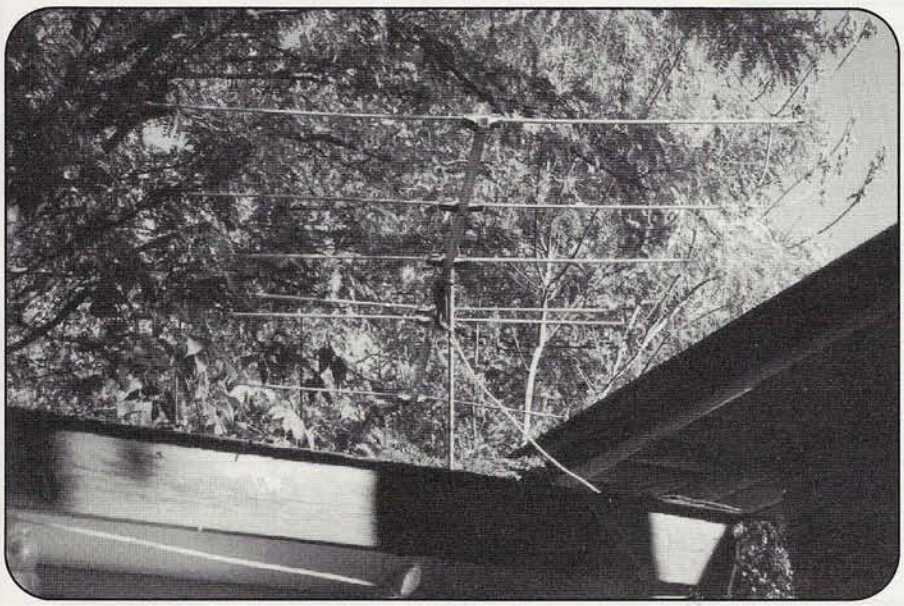
Figure 2. When the Earth blocks the path between the transmitting antenna and the receiving antenna, no direct, line-of-sight path exists for the signal. However, several other signal paths exist, including tropospheric scatter from a common area "seen" by both antennas (A), sporadic-E propagation from ionized clouds in the ionosphere's E-layer (B), and meteor scatter from the ionized column produced by a meteoroid (C). During the peak sunspot years, VHF propagation is also possible via the F-layer (D).

comparing your results under different weather conditions. Once you know the signs to look for, it's much easier to apply this knowledge to ham radio QSOs.

Follow the Propagation

Watching for such propagation signs is an important aspect of successful VHF DXing. Propagation generally moves from low frequencies up through higher frequencies. The signs of auroral propagation, for example, appear initially as "watery" signals in the AM broadcast band, and propagation eventually works up through 10, 6, 2, and 1.25 meters. Aurora contacts have also been made on the 70-centimeter (432-MHz) band. Similarly, sporadic-*E* propagation can be followed from 10 meters up through the 1.25-meter band.

Knowing this, both the FM band and the TV bands can be used to follow the propagation. Notice that the 10-meter band is included in Figure 1. That's because you can use this band to explore many of the propagation modes used by VHF DXers. While we're still well below



If you don't currently have a large FM/TV beam and don't want to commit the money or space to one, a simple beam on a wooden mast will do the trick for you.

"These TV bands experience the same types of propagation as the adjacent ham bands, meaning that they can be used as indicators to tell us what signal characteristics to expect on 6, 2 and 1.25 meters."

the sunspot peak, this would be an excellent time to check out sporadic-*E* and meteor scatter on 10 meters. (*See "10 Meters: Is it HF or VHF?" in November, 1997,* CQ VHF.—*ed.*) Once you've heard sporadic-*E*, for example, on 10, you might start listening on 6 meters. You can then watch for it on the lower VHF TV band and later listen for it in the FM broadcast band. It may eventually appear on 2 meters and then on the high VHF TV band, and perhaps even up on 220!.

It's important to understand that hearing signals on 10 meters doesn't necessarily mean that you'll eventually hear signals all the way up to 1.25 meters. And if there is no evidence of sporadic-*E* in the FM band, then there will not be any in the 2-meter band, the high VHF TV band, or on 1.25 meters; the cloud may not develop to the extent that it can reflect the shorter wavelengths.

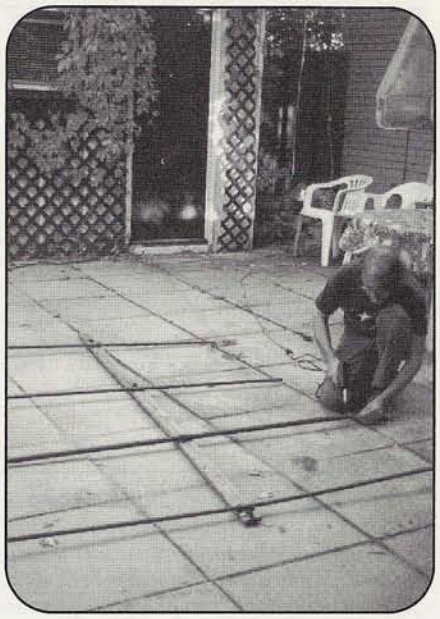
Antenna Needs

While a rotatable FM/TV beam antenna on a tower is certainly an advantage, you can also receive FM and TV signals with simpler antennas. This is especially true of strong sporadic-*E* and meteor-reflected signals.

If you started out listening to international shortwave broadcasters, you probably remember putting up your first antenna. Perhaps it was a dipole or simply a random-length wire. If the dipole was slightly short, or too long, it didn't make a lot of difference to the received signal. When receiving, antenna length and impedance matching are not the critical issues they are when transmitting.

You can use this to your advantage in learning about VHF antennas. You can try dipoles, folded dipoles, collinear antennas, or Yagis (Figure 3 shows a few possibilities). You can practice constructing impedance matching baluns. Or, for 300-ohm antennas, such as the folded dipole or the three-element collinear, you can use commercially manufactured baluns made for TV applications. In fact, you could buy a TV balun, take it apart, and use the parts for your custom-designed impedance transformer. Just about anything goes in receiving applications.

By the way, don't be too quick to dismiss the dipole as a practical antenna in the VHF range. Oswald G. Villard, Jr., W6QYT, used dipoles as both transmitting and receiving antennas in his meteor research at Stanford University. Like hams, he was using a 1-kW CW signal. This was 50 years ago, when receivers weren't nearly as sensitive as they are



A small homemade beam will outperform a similar size commercial FM/TV antenna. Commercial antennas sacrifice gain for a large bandwidth. Dimensions for 6-meter beams can be scaled down to work on the lower VHF TV channels or on a portion of the FM broadcast band.

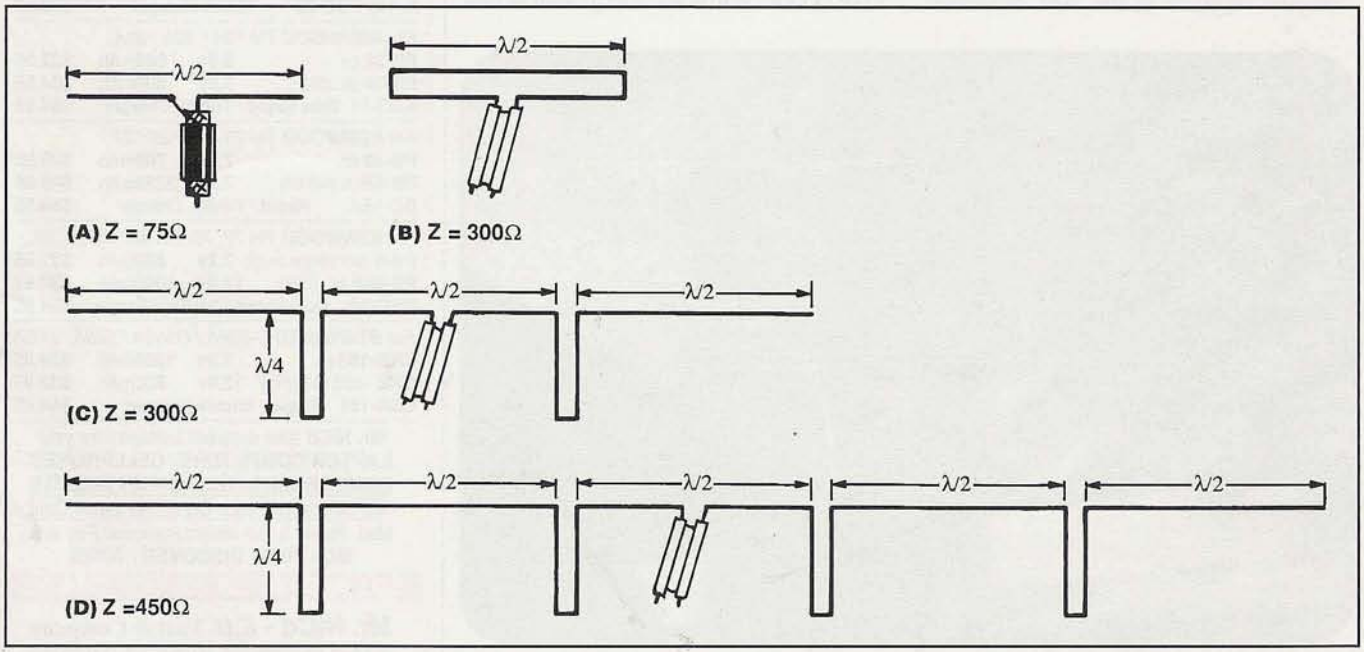
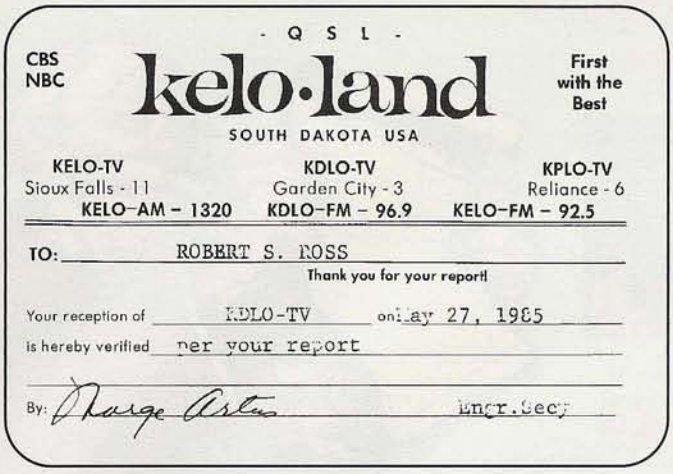
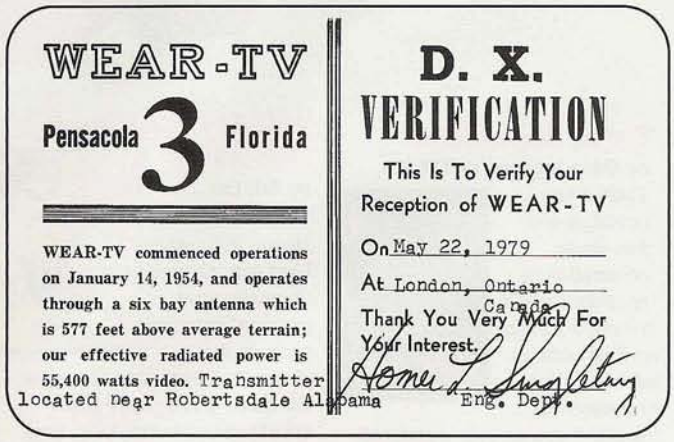
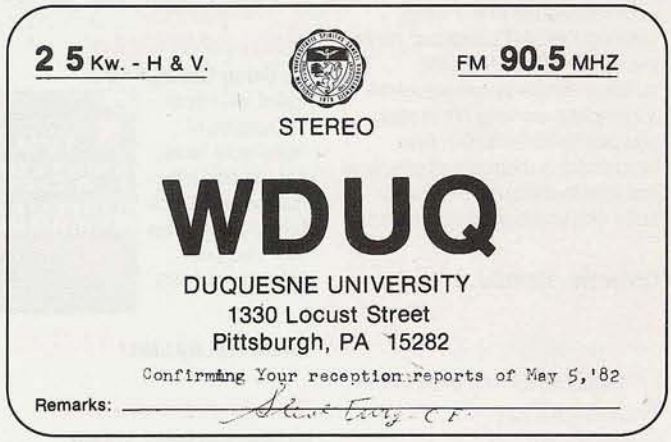


Figure 3. A variety of antennas can be constructed for VHF DX work on the FM and TV bands. A half-wave dipole (a) or a folded dipole (b) will work for strong-signal modes such as sporadic-E or meteor scatter. Antennas with gain include the three-element (c) and the five-element (d) collinear. Impedance values (Z) are for the feedlines.







These are a few broadcast QSL cards from the collection of Robert Ross, VA3SW. From his London, Ontario, QTH, he's heard 1025 FM broadcasters, with 600 verified by QSL. He's also seen 358 TV stations (275 verified). His best FM DX is to Belize (88.9 MHz) and Bermuda (89.1 MHz). On TV, he's logged channel 3 in Cuba.

today. Even today, amateur radio astronomers use four- to seven-element Yagis in meteor detection activities.

Where's That Station?

Once you've tuned in a distant FM or TV station, you need to figure out where it is. Obviously, the station's callsign is a good start, but you can also use weather reports and even commercials to help you get a fix on the station's general location.

The quickest way to determine an FM station's location is to use a reference such as the *FM Atlas* [1]. This annual publication lists stations by geographical area as well as by frequency. TV stations may be trickier unless you're fortunate enough to tune into a local weather forecast or you see the location during a station ID. Several years ago, the Worldwide TV-FM DX Association[2] produced a series of maps showing station location by channel. Copies of the series may still be available through the Worldwide TV-FM DX Association (WTFDA) or from individual members. The *World Radio TV Handbook* (WRTH)[3] lists FM stations outside of the U.S. and Canada and used to list TV stations outside North America as well. However, as of 1997, those listings were shifted to WRTH's *Satellite and TV Guide*, a separate publication.

Taking It a Step Further

Basic information related to VHF propagation modes is available in many amateur radio periodicals (again, refer to "Basics: VHF Propagation," elsewhere in this issue, and to "A Beginner's Guide to Sporadic-*E* on 6 Meters," *CQ VHF*, January/February 1996.). Books, including the ARRL's *The ARRL Handbook*, *The ARRL Operating Manual*, *Beyond Line of Sight*, and *The Radio Amateur's V.H.F. Manual* (out of print but sometimes available at flea markets), are also good references.

To see what's possible in FM broadcast DXing, check out Pat Dyer, WA5IYX's Web page at <http://home.swbell.net/pjdyer/index.html>. It summarizes Pat's FM DX accomplishments over the course of two decades.

Whether you use the FM and TV broadcast bands to predict openings on the VHF ham bands or to more fully explore and understand the various VHF propagation modes, you're bound to find they have a major impact on your ability to take advantage of everything the VHF ham bands have to offer. ■

Notes

1. Elving, Bruce F., *FM Atlas*, FM Atlas Publishing, P.O. Box 336, Esko, MN 55733-0336
2. Worldwide TV-FM DX Association (WTFDA), Box 514, Buffalo, NY 14205
3. Sennitt, Andrew G., Editor, *World Radio-TV Handbook*, BPI Communications, P.O. Box 9027, 1006 AA Amsterdam, The Netherlands; U.S. Office: Watson-Guptill Publications, 1695 Oak St., Lakehurst, NJ 08701.

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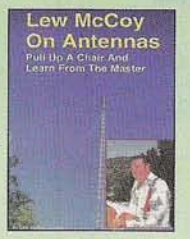

This is truly a unique antenna book that's a must read for every amateur. Unlike many technical publications, Lew presents his invaluable antenna information in a casual, non-intimidating way for anyone!

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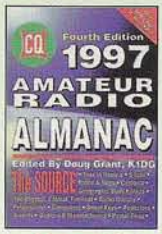
by Doug Grant, K1DG



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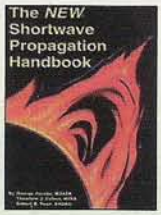

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by Martti Laine, OH2BH

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by Bob Haviland, W4MB

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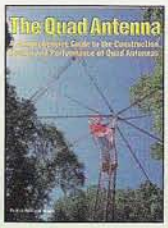

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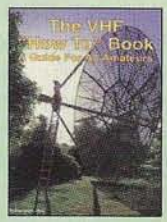
by Joe Lynch, N6CL



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

Order No. BVHF..... $15.95

Keys, Keys, Keys

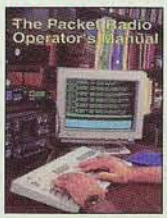
by Dave Ingram, K4TWJ

You'll enjoy nostalgia with this visual celebration of amateur radio's favorite accessory. This book is full of pictures and historical insight. If you've ever wondered about the old days of Morse, this book's for you.

Order No. KEYS $9.95

The Packet Radio Operator's Manual

by Buck Rogers, K4ABT

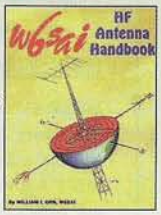


CQ has published an excellent introduction and guide to packet operation. It's the perfect single source, whether you're an advanced user or just starting out.

Order No. PROM. $15.95

W6SAI HF Antenna Handbook

by Bill Orr, W6SAI



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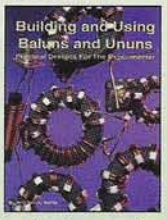

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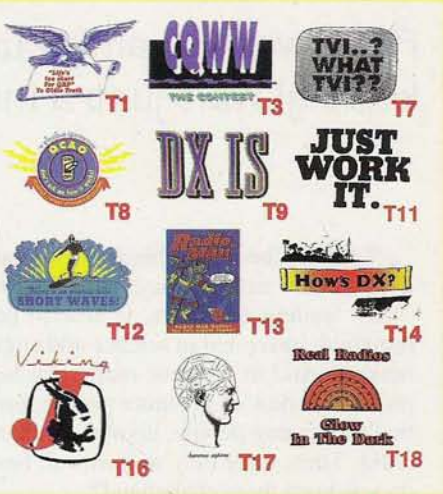

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A State-of-the-Art Ham Station—in a Museum

Put a working amateur radio station in a museum? You've got to be kidding! Wait just a minute...our group did it. Perhaps yours can, too!

By Ken Pierpont, KF4OW*

One of the big problems facing our entire nation today, according to leading educators, is how to get our youth interested in science and engineering. And in amateur radio, one big problem is how to get more people, particularly young people, involved in ham radio. Then, once they're licensed, how do you keep them challenged?

Maybe you know the solutions to those problems. I know I don't. But clearly, the two are interrelated, and perhaps, by changing our thinking and trying some different ideas, we can make a dent in both at once.

One way to find potential hams is to go where a young group might congregate. One such place is the Virginia Air & Space Center (VASC) in Hampton, Virginia, visited by over a quarter million visitors each year, including well over 30,000 school children who go through in April and May alone. Our ham station at VASC tries to show them and tell them about amateur radio so as to leave a lasting impression and a challenge! Is it worth the effort? Let me tell you the story of KE4ZXW...and you decide.

Photo A. The amateur radio exhibit at the Virginia Air & Space Center. The cabinet on the left contains a display of antique radio equipment, while the one against the wall is outfitted with a state-of-the-art amateur satellite station as well as HF gear. The box in front is the "Visitor Interface," which includes interactive display.

Beginnings

As a gray-headed research scientist-engineer, I learned long ago that the best solution to any problem most often simply "grows."

It all started with just an idea—an idea which blossomed into a truly fine permanent exhibit telling the story of amateur radio and focusing on the high technology we hams "play" with: a fully automatic, 9600-baud, digital amateur radio station—KE4ZXW (see Photo A).

Our "growth" process began when a local amateur radio club sponsored a special event HF radio station during the center's opening in April, 1992. It was kind of off the main track for visitors; nevertheless, some people saw it and learned something about ham radio. Also, a number of brand new hams got their feet wet and "took off."

Later in the year, one of our new YL hams, Cathy Watson, KD4SWF, came up

*Ken Pierpont, KF4OW, is retired from NASA's Langley Research Center, where he was Chief Engineer of the Sub/Transonic Research Division. Ken has been licensed since 1982 and holds an Extra class license.

"It all started with just an idea...which blossomed into a truly fine permanent exhibit telling the story of amateur radio and focusing on the high technology we hams 'play' with: a fully automatic, 9600-baud, digital amateur radio station—KE4ZXW."

with a fresh idea: "Why not ask the Space Center management if we could put up a "demonstration" satellite station on the center's first anniversary?" With a little encouragement, she went right after that goal, received permission, and proceeded to head up the whole thing.

The anniversary weekend demonstrated amateur radio satellite technology to many visitors. The focus was on youth, providing young people with hand-outs and even teaching them how to send their names in Morse code. The station location was at the entrance to the Space Science area (also near the rest rooms!). Many people stopped, looked, listened, and asked questions.

Proposal: Making It Permanent

What was the next step? Well, that first public demonstration by the local ham club was so successful that, in the fall of '93, with technical help from Chaz Richard, now W4HFZ, and Jim Sanford, WB4GCS, Cathy Watson made a formal proposal to the center staff for a permanent amateur radio exhibit focusing on an amateur radio satellite station. At that point, Cathy had little idea how that small beginning would ultimately lead to a major permanent working exhibit at the Center. Neither did the rest of us!

By this time, word of such a possibility had spread, and interest in the project was beginning to grow in the nearby ham community. The group of volunteers who make up the Steering Committee that puts on the well-known Virginia Beach Ham & Computer Fest each September took a leading role by setting aside some funds that needed to "be plowed back into the ham community." Also, Lew Steingold, W4BLO, who deals with the commercial exhibitors at the hamfest, offered to help obtain the needed equipment.

First Steps

By late winter '93–94, the Southern Peninsula Amateur Radio Klub decided to get something started. Letters were sent to all the amateur radio clubs surrounding the port of Hampton Roads, inviting each to send a representative to become a part of the "Oversight Committee" for this project. Never before had such a broad level of participation by amateur radio clubs been attempted in our area. In March, after waiting over six months, tentative approval was received from the Air & Space Center for a permanent exhibit about amateur radio.

The first meeting of the Oversight Committee in early July was chaired by Dick Stetson, K4DHO, with three clubs represented. By early fall, 10 clubs would be full participants (see Table 1). In November, the VASC Amateur Radio Group, Inc. was chartered as a not-for-profit corporation. All equipment would be owned by this group, rather than any one or more of the participating clubs.

Meanwhile, several subcommittees were hard at work. The prime goal was an attractive exhibit with focus on a satellite station. Our technical talent, comprised mainly of W4HFZ and WB4GCS, persuaded the Oversight Committee to attempt to pull off a fully automatic, 9600-baud digital satellite station. Everyone was awed, but not daunted, by the magnitude of the task. At this point, fewer than a dozen such stations existed anywhere in the world.

Table 1. Participating Amateur Radio Clubs

Chesapeake Amateur Radio Services
DX Century Club
Middle Peninsula Amateur Radio Club
Hampton Roads Radio Association
Peninsula Amateur Radio Club
Portsmouth Amateur Radio Club
Quarter Century Wireless Association
Southern Peninsula Amateur Radio Klub
Tidewater Amateur Radio Club
Virginia Beach Amateur Radio Club
Williamsburg Amateur Radio Club

The Space Center representative, Bert Smith, offered a couple of sites that might be used for this as-yet-nearly-undefined project. The committee chose one situated between a large historical display area and a modern Air Force jet engine, with a view toward the Space Science area. The site measured 11 feet long by 8 feet deep, and it was decided to include a display of antique ham radio equipment alongside the satellite station.

First Hard Concept

At the annual hamfest in late September, 1994, an artist's sketch of a possible exhibit was shown to the amateur radio community (see Figure). By early January of 1995, a committee of three hams and the Center representative reached an agreement for the entire

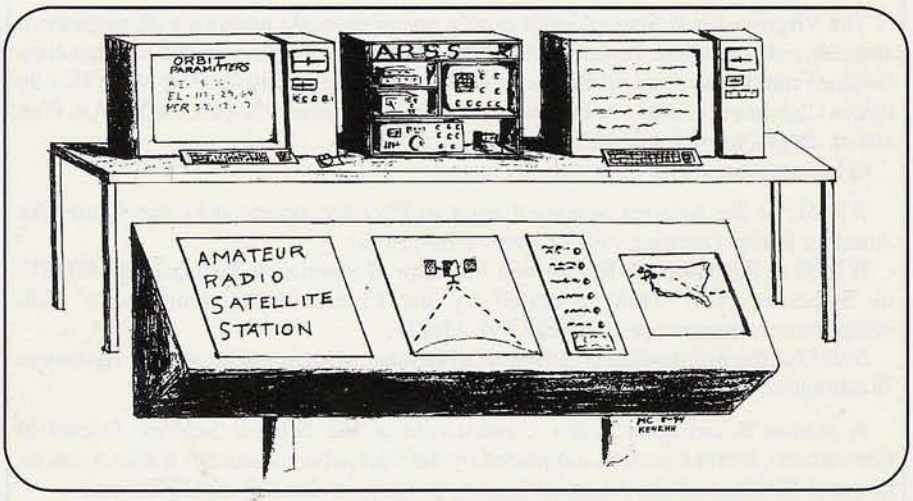


Figure. Artist's sketch of preliminary plans for the amateur radio exhibit at the Air and Space Center. Contrast this to the final product in Photo A. (Drawing by Matthew Currie, KE4KHH)

"For his efforts, Wally Carter, K4OGT, was declared Volunteer of the Year for 1996 by the Virginia Air & Space Center."

Photo B. Amateur satellite antennas on the roof of the Virginia Air and Space Center.

exhibit, including how visitors would interface with it. It would consist of two large cabinets, each 8 feet long and 7 feet high, arranged as an "ell." One would be a display case and the other would be the radio console. A "Visitor Interface Console" in front and a 1/4-scale model of the Phase 3D satellite overhead would complete the exhibit.

The display case was to have three large illuminated glass shelves to exhibit antique radio gear. The radio console would have two complete working station positions, computer displays, backlighted pictures, electronic controls, computer systems, and storage. Security would be provided by clear plastic drop-down doors in front of the radio equipment, cabinet locks on access panels, and attractive barrier railings.

Making Progress

With working drawings completed, just a little less than a year after tentative approval, offers of help came out of the woodwork. One of those critical to the project was Bill Anderson, KE4IPS, who constructed all the cabinet work, assembling it in his living room. The radio console unit stood ready for final painting at the Center the first week of May. The second unit, the large display case, was ready for final painting later that month. They were both installed on the floor of the museum in early August.

In late May, an antenna location problem surfaced as the city refused permission for the proposed site, based on what seemed to be esthetic reasons. A month later, an alternate site was approved, but this now required an entirely different and much more difficult installation procedure. While the initial location required only a short mast mounted on a wall, we would now need to penetrate the special rubber roof to install the antenna supports. This involved the insurance company, the roofing manufacturer, and the contractor who had put it on the roof. (Initial satellite station operations began in September with a temporary Field Day-type antenna on the roof, but the permanent installation wasn't completed until late November. The final tower and antennas are shown in Photo B.)

By early June, most of the radio system components were in hand. Initial check-out followed bench testing by Chaz Richard, who was among the first half-dozen amateurs to have a working fully automatic digital station at home.

The Visitor Interface Console

While the station itself was coming together smoothly, the Visitor Interface Console was turning into a major problem. By mid-July, the console not only was incomplete, but no criteria or detailed electronic designs had yet been established. A small ad hoc committee tackled this problem head-on.

Steve Finkle, W4AHV, stepped forward and offered a workable plan which involved controlling three different visitor-selected systems through a single programmable chip with which he'd been experimenting. One system consisted of a series of eight large back-lighted color pictures with lamps sequenced and timed with an audio message. Another was a VCR/TV, stepped forward with each button press and then rewound after the full tape had been used. Finally, there was a computer which displayed several amateur radio satellites on a global map, along with recent message downloads from the satellites.

One key requirement was that all these visitor interface systems be "safed" so only one could be shown and heard at a time. Everything had to be child/adult proofed, and all systems had to self-start following nightly power shutdowns, or

We're Not Alone— Other Museums with Ham Stations

The Virginia Air & Space Center is only one of several museums with permanent amateur radio stations. Perhaps one of the oldest museum/ham radio relationships is at the Franklin Institute in Philadelphia, Pennsylvania, where the Phil-Mont Mobile Radio Club has operated a ham radio station/exhibit since 1952 (see the W3AA Web site at <http://www.fi.edu/tfi/exhibits/w3aa.html>).

Other museums with ham stations include:

W7ASC at the Arizona Science Center in Phoenix, operated by the Center for Amateur Radio Learning <http://www.w7asc.org>;

W2CM at the Milton J. Rubenstein Museum of Science & Technology (MOST) in Syracuse, New York, operated by the Liverpool Amateur Radio Club <http://www.dreamscape.com/tek438/LARC/>;

NN3SI at the Smithsonian Institution's National Museum of American History in Washington, D.C.; and

A station is currently under construction at the Natural Science Center of Greensboro, North Carolina, supported by the Greensboro Amateur Radio Association and the Greensboro Amateur Society (e-mail: <science@mci2000.com>).

Thanks to the Kenwood Report *newsletter for much of the above information.*

Table 2. Principal Participants

The following individual amateur radio operators were instrumental in the success of the project:

Bill Anderson, KE4IPS
Brit Belyea, W4GSF
Ed Brummer, W4RTZ
Bus Etheridge, K4IX
Earl Evans, KE4BNX
Steve Finkle, WA8AHV
George Hartsell, W4GEO (ex-KO4YV)
Charlie Keil, AA4CK
Dwight McSmith, K4KTR
Dick McNutt, W4NTG
Russ Murphy, KC4YIU
Ken Pierpont, KF4OW
Chaz Richard, W4HFZ (ex-KM4EM)
Tim Rogers, N4XND
Jim Sanford, WB4GCS
Richard Siff, WA4BUE
Lew Steingold, W4BLO
Dick Stetson, K4DHO
Ed Williams, KN4KL

The help of the following corporations and organizations was likewise indispensable:

Advanced Electronic Applications, Inc., Lynnwood, WA
Cushcraft Corp., Manchester, NH
Electronic Distributors Corporation, Vienna, VA
NASA Langley Research Center, Hampton, VA
RMSI Computers, Inc., Newport News, VA
Telex Communications, Inc., Lincoln, NE
The Radio Works, Portsmouth, VA
Tidewater Radio Conventions, Inc. (Hamfest), Va Beach, VA
Yaesu USA, Cerritos, CA

storm-related outages. With the generous help of everyone who jumped in, everything was operational by formal opening, although a number of last-minute details were completed just minutes before "ribbon cutting."

Exhibit Opening

The original timetable called for initial station operation in April or early May of 1995. This turned out to be impossible! One date was firm, though: we had to be on the air by September 21, 1995, the day before the annual Virginia Beach Ham and Computer Fest.

Finally, on September 16th, everything was ready. Station KE4ZXW contacted the satellite right on time and received lots of good data. Yours truly had the excitement of viewing this milestone!

On September 21, right on schedule, a small grand opening ceremony was held. Those present included members of the Oversight Committee, the hams who worked on the project, representatives of organizations that had helped make the exhibit possible, ham radio magazine editors, and colorful visiting personages such as Gordon West, WB6NOA. And Cathy Watson, KD4SWF, who made the proposal to the center, was on hand to cut the ribbon. (Table 2 lists the many individuals and organizations who participated and without whose help this project would never have been possible.)

Kim Maher, the very recently appointed Director/CEO of the Virginia Air & Space Center, noted at the ceremony: "I have seen lots of 'volunteer' projects. Never before this have I seen such a complex one. It has been done so well, and it blends in so nicely with the nearby exhibits. You are to be congratulated on a job well done." At that point, we knew we had been accepted.

Since that opening, station KE4ZXW has been in continuous 24-hour operation with only brief shutdowns of just a few hours for maintenance, repair, or upgrading. The electronic displays have all performed well every day with only a few replacements or repairs needed.

Trained Station Operators Needed

Building and installing the station was one thing. Staffing it for ongoing operation was another. It's probably safe to say that no one person knew all that was needed about every part of the exhibit and the station operations. A training plan for operators was needed, and it had to be put together quickly because one of our principals, Chaz Richard, was about to be transferred. The training schedule initially included two hours of classroom work followed by two hours of hands-on training. Chaz taught two groups of trainees, totaling about 16 certified Station Operators, before leaving. Another group, led by Jim Sanford, increased the total to 20 Station Operators by late January, 1996. The Jim was shipped out, too, a hazard of being in the Navy.

"The display case was to have three large illuminated glass shelves to exhibit antique radio gear. The radio console would have two complete working station positions, computer displays, back-lighted pictures, electronic controls, computer systems, and storage."

One of those who went through the early training was Wally Carter, K4OGT. He had been pretty dormant in ham radio for a couple of years, but the satellite station intrigue took hold. Wally, needing something to sink his teeth into at the time, soon took on the task of individually training several more new operators. He also became Chief Control Operator with responsibility for all the software.

As 1996 began, Station Operators were assigned in pairs for two-hour shifts, and then, as confidence developed, they were separated to cover a total of four hours on both Saturdays and Sundays. Now, as some retirees have become interested and trained, every day of the week is covered for at least a couple of hours during peak visitor periods. For his efforts, Wally Carter, K4OGT, was declared Volunteer of the Year for 1996 by the Virginia Air & Space Center.

Reaching Out

During the first month of KE4ZXW's operation, a photograph of the entire exhibit had been digitized and put up on three amateur satellites: UO-22, KO-23, and KO-25. The picture was downloaded from one of the birds a few days later and printed out on an ordinary color printer so visitors could see the quality of picture that any amateur radio operator in the world could see of this exhibit.

KE4XZW was soon recognized as a world-class station, at that time one of barely a dozen fully automatic, 9600-baud digital amateur radio satellite stations in the world. It is the featured part of a beautiful amateur radio exhibit, and a tribute to the many hearts, hands, minds, pocketbooks, individuals, clubs, and corporations that made this project possible.

One day, one of our non-club hams approached with this question: "Would you be interested in letting me develop a homepage on the World Wide Web for you at no cost?" Who wouldn't? We jumped at the offer by Jim Byrd, WB5POJ. The homepage can be found on the Internet at: <http://www.seva.net/vascarg>. A number of visitors from other countries have made special trips to the center just because they found that Web site!

Thousands of visitors have stopped to learn about ham radio, and, as they approach, they're sometimes heard to say under their breaths, "Isn't that a live mannequin?" That gives the very-much-alive Station Operator on duty a fine opening to introduce the exhibit and ham radio.

Special Activities and Future Plans

That first spring surprised us by the large number of youths from school groups who stopped for a five-minute "tour" of the exhibit and often took some of the brochures on amateur radio. Now, nearly every Docent (volunteer guide) at the Center stops with their groups when an operator is on duty. Even when none is present, many visitors stop because this is listed as a major exhibit on the self-guided tour folder.

We have already had a couple of feature events, the biggest of which was when students from Norfolk's Granby High School and Mary Calcutt Elementary School talked live with astronaut John Blaha on the Russian Mir space station last December. Other MIREX and SAREX plans are in the works (*MIREX and SAREX are the formal programs for ham radio contacts with Mir and the U.S. space shuttle, respectively—ed.*).

Also, KE4ZXW served as a special event station this past April, on the Center's fifth anniversary, and again on September 27 to 28, to celebrate two years of continuous operation.

That second operating position, originally designed into the radio console, is now full of HF radio equipment. Some of our Station Operators enjoy just "working the traffic" on HF when they have time, or when they want to demonstrate that part of ham radio. Now, plans are under way to provide remote access by control operators for system checks and for local hams to be able to read the incoming messages. Later, area hams will be able to send and receive individual messages while safeguarding critical software. A major equipment upgrade is planned for sometime after the Phase 3D satellite is operational.

Afterthoughts

Does anything ever go wrong? Sure, and sometimes too often. Military radar that sweeps the 70-centimeter band often knocks out reception. A power amplifier was cooked by a freak transmitter hang-up; a mast-mounted pre-amp turned into a cinder when the building took a direct lightning strike. Another time, saltwater intruded onto a circuit board in one of the antenna assemblies (we're right on the coast). And, of course, there have been bad solder joints at cable connectors. We've had people gremlins and unknown gremlins at work. But, a small group of highly talented and motivated hams has patiently sought out and solved these many gremlin problems along the way, keeping the station on the air and accessible to the center's many visitors.

Is it worthwhile to have an amateur radio exhibit in a museum, even if it is a space science center as well? In retrospect, that question almost seems silly. I hope you agree that the answer is a resounding "yes." Despite the difficulties encountered, as stated at the outset, sometimes the best solution is just to let the answer grow and mature by guiding its course very gently.

Now, what about you? Is there a museum or science center near you that could benefit from an on-site amateur station? Can the radio clubs in your area pull together to provide the resources and staffing necessary to put such a station together and keep it on the air? We did it. Hams in other places have, too (see "We're Not Alone").

Are you up to the challenge? ■

Resources

The Virginia Air & Space Center is the official visitor center for the NASA Langley Research Center. For more information on the center itself, contact VASC, 600 Settlers Landing Rd., Hampton, VA 23669; Phone: (800) 296-0800 or (804) 727-0900; e-mail: <khinson@vasc.mus.va.us>.

For more information on the VASC ham station, see the group's World Wide Web homepage at <http://www.seva.net/vascarg>.

Hot Topic: Heat and Your HT

Heat and small handheld radios. Will yours be a hot item? If so, how hot? Will it scorch your hand? Here's what you should know before you invest $300 or more in a new radio.

By Jim Goralski, AC6PD*

"OK" ...Beep. "QSL Jim. Well I'm using a three-element quad up about 20 feet above the roof. And I'm running about 40 feet of coax into the ham shack. Wait a minute Jim! I think there is something terribly wrong here!" ...Beep

After a long pause, at least a minute: "Are you still there Jim?...Beep"

"Yeah Nick, I am still here. What type of radio are you using? Is it a handheld?" ...Beep

"Yes! The SWR must have gone sky high or something! I couldn't hold it! I had to put it down! You'd better talk for a few minutes while this thing cools down. Maybe I'd better not transmit until I find out what is wrong." ...Beep

And that was the last we heard from Nick for a while.

This fictional QSO—a composite of several in which I've been involved—is typical of what I like to call "Overheated Handheld Syndrome." Nick's radio is becoming very hot with extended use. There's nothing wrong with his radio. It's just the nature of the beast, and it has to do with smaller packaging and higher power. In recent years, the trend in HTs has been toward tiny packaging and increased power, reflecting a general trend toward smaller packaging throughout the electronics industry. The catch phrase out there is, the smaller the better.

Now, let's look at the cause and effect in detail:

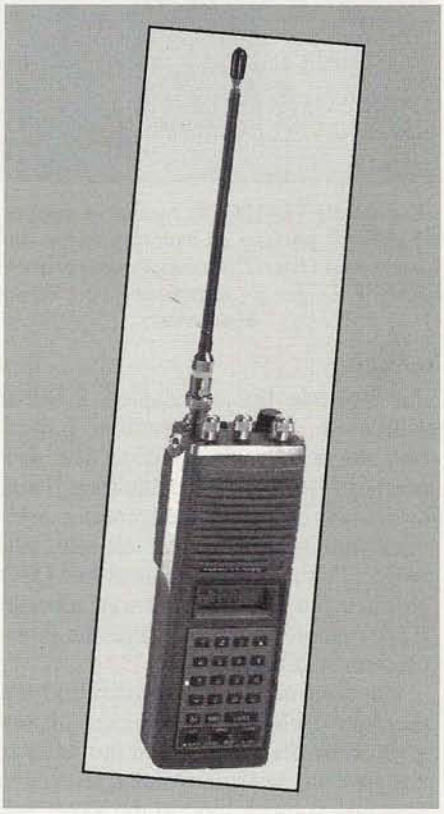
Handhelds of say, 16 years ago, were fairly large compared to today's. I have a Yaesu FT-708R (70 centimeters) HT of about that vintage. Maximum power out is 1 watt. This radio has no undesirable heat. The large case nicely dissipates what little heat there is from the radio. Long ago, when this radio was made, the RF engineers thought 1 watt was enough power for this band. That's where the radio falls short. By today's standards, its power is anemic, to say the very least.

Manufacturers and amateurs alike could easily see the need to add more power for greater signal strength. Remember, though, that at the same time, the trend has been to smaller packaging. This means there's less surface area to dissipate the extra heat caused by higher output power. Many newer radios, such as my Kenwood TH-22AT are going to get *hot*, and I mean very hot, while operating on high power (5 watts) for an extended period. And high power for an HT can be as much as 7 watts. Let's look at how I fared with 5 watts.

My 5-Watt Hot Ticket

I bought the latest model handheld within my budget. It came with stock accessories, including a 600 mAh (milliamp hour) @ 6-volt battery. Using this battery, with a 3-watt maximum output power, I felt little heat, even on the high setting. But I generally needed at least the 3 watts, and usually more. After all, my favorite repeater was on Catalina Island, California, about 46 miles away from my home in Anaheim.

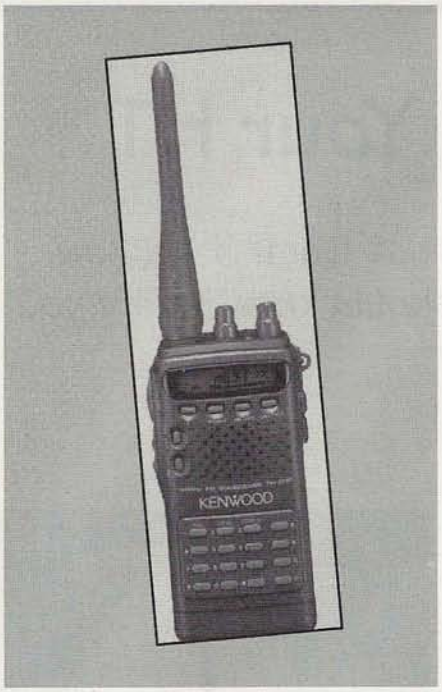
When I took this HT mobile, I added a magnet mount antenna to my car. While mobile, the battery pack died in the middle of a QSO. About 15 hours later, with a full charge from the wall charger, I was ready to go again. Next, I bought a cigarette lighter adapter plug to correct this problem. But with a steady source of power, I talked longer...and got my first taste of heat, hot enough to scorch my hand—to say nothing of charging my nickel-cadmium (NiCd) battery pack.



No heat problems here. The decade-plus old Yaesu FT-708R put out only 1 watt and had a case big enough (massive, by today's standards) to handle any heat it generated.

The problem was even worse at home. When my base radio, which I'd been using with an Astron 20-amp power supply, broke down, I switched to the handheld as a substitute. I began using my power supply with the handheld. Because of my antenna location, I needed 5 watts minimum all the time. With my radio plugged into a 12-volt external supply via

**Jim Goralski, AC6PD, writes a technical column for the Catalina Amateur Radio Association's newsletter, "The Ragchewer."*



Kenwood's TH-22AT is typical of modern handhelds, packing a 5-watt transmitter into a very small case. The manual warns of overheating danger if you transmit too long on high power.

the cigarette lighter adapter, I had a source of seemingly endless power. But...the radio got hot, with as little as a couple of 90-second transmissions. It was even worse on other distant repeaters with three-minute timers that let me talk longer. I couldn't go two turns in a QSO before it felt like my hand was burning. It had become a contest to make the shortest transmissions possible.

It became radio versus hand. Why? It's the duty cycle—the percentage of any given time period in which the radio is designed to transmit without problems. Lets take a quick look in the TH-22AT owner's manual.

Under the "Precautions" section, the manual states: "Do not transmit on high power for extended periods. The transmitter may overheat." They could leave out the "may." This radio is *gonna*! Worse yet, the next paragraph speaks of avoiding fire, personal injury, and transceiver damage. It's only natural the radio is going to become too hot to hold. It's supposed to.

Surface Mount = Surface Heat

The smaller packaging at the bottom of all this is primarily due to the development of SMT (Surface Mount Technology) circuit boards. The tiny space-age components are wafer thin. A standard IC (Integrated Circuit) chip has leads and is plugged into an IC socket for easy replacement. The major difference between a standard chip and an SMT component is the lack of any of these leads. The SMT IC chip only has enough lead to reach the surface of the pc board to which it is being soldered. The height of the chip itself has been more than cut in half and the socket has been eliminated altogether.

SMT resistors, capacitors, etc. are even more compact. These devices differ from standard components in that they have no axial leads at all. They are tiny, usually oblong devices that have metal caps at both ends instead of leads and are soldered directly to the pads on the board. (Another bit of advice: Having worked with many circuit boards including SMT technology, I'd suggest that, unless you're a qualified service repair technician, DO NOT work on one of these boards yourself. Get experienced help.)

What about YOUR Radio?

Some hams will use a speaker mic so they won't feel the heat from the radio. Others try a home remedy which involves adding additional heat sinking by clipping some form of metal to the radio belt clip, such as a strip of flat aluminum at least 6 inches long. The belt clip screws to the radio rear panel or heat sink and serves as part the cooling system, removing some of the heat. But as we'll learn in a moment, at least some of the manufacturers frown on this.

Kenwood is up-front with heat information in its manual. However, Kenwood is not the only manufacturer that makes small radios which become very hot. My Yaesu FT-33R becomes just as hot in the 5-watt mode, and so do other radios. Do all manuals provide duty cycle information? We contacted several manufacturers to see what they say about heat and their HTs:

Clifford Uyeda of Kenwood customer service advised: "I believe all of our manuals carry duty cycle information, this also includes mobile rigs and others, not just our handhelds."

To avoid heat problems, Uyeda says,

"Make sure that you have good air circulation around the radio and use a speaker microphone. Try not to hold the radio in your hand. I do not recommend clipping on any additional heat sinking because you are now adding something to the radio system. Avoid very long transmission times, such as one half hour at a time. If done repeatedly, as little as twice, with only short listening periods, especially the TH-22AT or 79A will become hot enough to destroy the final power transistors. In fact, we have many radios in for repair every year for this reason."

Premier/ADI Marketing Manager Ken Collier, KO6UX, states: "Our radios don't get hot. This is because they have heat protection built into the CPU [central processing unit—yes, these and other modern radios are computer-controlled]. Our radios shut down completely when they become hot, and will not transmit again until the radio cools."

Ken adds, "The heat problems have become more severe as radios became smaller. Thus we have built this feature into our radios."

Over at ICOM America, Orien B. Jeans, KJ7ZT, wrote that

"The duty cycle of our handheld radios is about 25%. As far as being a problem, we do not consider it a problem. The customer should use low power to operate the radio. Most repeaters can be accessed using low power. High power should be used only when necessary. On high power, the radio is generating about 10–12 watts, of which 5 watts reaches the antenna and the remaining power is dissipated by the heat sink which in ICOM radios is the whole case, front and back. The radio will start to shut down once a thermistor in the circuit is activated."

Unfortunately the shutdown temperature is not specified.

Sid Wolen, K2LJH, formerly of Azden, wrote this:

"With regard to heat in handhelds, there isn't much that can be done except use it less on transmit and use low power as much as possible. In my opinion, even new designs with higher efficiency in the output stages will not help much, as modern radios are quite efficient already. There is no substitute for heat sink area."

He went on to say, "No, we do not include duty cycle information in our manuals because the radio will take key down indefinitely." (*Editor's note: While Azden recently announced it was leaving the amateur market, it plans to continue servicing existing radios indefinitely.*)

A spokesman at Yaesu USA wrote that,

"in general, the duty cycle for amateur equipment is about 50%, although several HF transceivers [like the FT-900 etc.] are rated for 100 watts output for up to 30 minutes. I would say the manufacturers generally only

Yaesu suggests using a soft leather case—and common sense—when operating a handheld like their FT-23R (pictured here) or its 222-MHz cousin, the FT-33R. A spokesman says "don't pretend it's a repeater."

specify duty cycle when they are interested in promoting their construction and/or design accomplishments [heat sink, chassis, fans, etc.], and because most amateur radio modes such as SSB and CW are intermittent duty, there seldom is an issue worth raising.

On FM, this is also the case because most repeaters have a 'time out' feature that prevents users from monopolizing a channel. But as you suggest, the rear panels of some radios can become quite warm when all-metal construction is being used [as on the FT-33R]. We have no particular recommendations in this regard, other than to use a 'soft' leather case if the heat is uncomfortable to you. We would, however, expect that amateurs would use the kind of common sense expected of us by not trying to use an HT as a repeater in a high-power mode, as 'real' repeaters are large boxes, mounted in a rack, with fans and/or air conditioning in the building in which they are housed."

Cautions for Beginners

Most newly licensed hams buy handhelds as their first radios. But if you're looking for something to use as a home station, a base unit or a mobile with a power supply is a much better choice. It sure beats attaching your hand to a hot heat sink (thus becoming part of the cooling system) or losing your ability to transmit because of thermal shut down. Plus, you can usually run 5 to 50 watts of power on 2 meters if the need arises, and the large heat sinks and big metal cases will handle heat nicely. (*Be careful even with mobile rigs. The one I'm using now gets* real *hot after about a half hour of regular use at 50 watts.—ed.*)

Be an Educated Consumer

Despite their limitations, handhelds are wonderful devices and I own several for different bands. I use them for portable and mobile operation; they're really handy hanging from your belt clip while walking around and are well suited for short transmissions. I'm sure they will stay a favorite of hams for many years to come.

Just remember, SMT technology equals less surface area. This, coupled with higher output power, equals more heat to be dissipated by this tiny surface area. Five watts or more equals high power for an HT. Some radios have heat protection circuits built in. Others may get uncomfortably—even dangerously—hot with long-winded transmissions.

And remember, too, whether or not you buy a radio with heat protection—when the HT becomes too hot, you'll be off the air. At least until it cools. ■

Results of the Second Annual WSWSS VHF and Above Sprint

Here are the results of the Western States Weak Signal Society's 1997 VHF and Above Sprint contest, held for four hours on September 3, 1997. There were 23 stations submitting logs from 10 ARRL sections in four states. NEØP's entry from Iowa shows you don't have to be on the west coast to take part! (An asterisk * denotes a certificate winner; categories include L = multiop, Q = QRP, S = singleop and R = rover; bands are: A = 50 MHz, B = 144 MHz, C = 222 MHz, D = 432 MHz, E = 1296 MHz). Scores courtesy of Erik Dean, NI6G.

Section/ Callsign	Total Points	# of QSOs	# of Mults	Category	Bands worked
Arizona/					
*NU8I	504	23	14	S	ABCDE
Iowa/					
*NEØP	36	6	6	Q	B
East Bay/					
*WB5OMF	2079	51	27	S	ABCDE
Los Angeles/					
*KF6FJG	128	16	8	Q	AB
*N6RMJ	7380	120	45	S	ABCD
W3SE	2040	72	20	S	ABCD
W6IST	1020	40	17	S	ABCD
N6ZE	192	24	8	S	B
Orange/					
*KE6GFF	416	26	8	Q	D
*N6HKF	4416	101	32	S	ABCD
KD6UIH	1860	62	20	S	BCD
Sacramento Valley/					
*WA5YWC	555	37	15	Q	ABD
*KC6ZWT	1892	59	22	S	BCD
N6DHN	416	28	13	S	ABD
K6AAW	276	23	12	S	B
Santa Clara Valley/					
*WB9AJZ	846	40	18	S	ABD
San Diego/					
*K6IAH	90	15	6	Q	ABD
*KF6JBB	1120	58	16	S	ABD
San Joaquin Valley/					
*N6AJ	4264	68	41	S	ABCDE
N7STU	1650	54	25	S	ABE
K6YK	645	38	15	S	BCD
*KY6M	615	30	15	L	BCDE
(ops: KB6HRB, KB6QNP, KC6UCN)					
Nevada/					
*N7LQ	8	4	2	S	B

What You've Told Us...

In our September survey, we looked at your computer usage and your attitudes toward ham radio/computer "convergence." Fully 75% of readers who responded have a computer in their ham shacks. But there is little agreement within that group on the computer's importance. Just under 1/4 of you (23%) believe your computer is "an integral part" of your station, and 30% say it's "an important station accessory." On the other hand, just *over* 1/4 (26%) believe the computer is "useful but not really important," and 1/5 (21%) says it "does not play a significant role in my station."

The most common ham radio applications for computers are are "radio communication (e.g., packet)" and "ham-related Internet e-mail," with 55% each; followed by "other" with 44% (what are some of those "other" uses? We'd like to hear from you); tracking amateur satellites (37%), logging/ QSLing (34%), antenna design/ modeling (24%), tracking other objects (e.g., APRS, the moon) at 23%, radio control/programming (17%), and antenna control (4%). Plus, 20% reported "no ham radio-related uses."

Finally, we asked how willing you'd be, if buying a new rig in the next five years, to get one that operates *only* through a personal computer. The largest single group (26%) said "no way, no how, that's not radio"; the next largest group (21%) said "I don't think so." They were followed closely by "you'd *really* have to talk me into it (19%); "somewhat willing to consider it" (19%), and "very willing to consider it" (15%).

This month's winner of a free one-year *CQ VHF* subscription is G. Clark of Grandy, North Carolina. As always, thanks for sharing your views. And happy holidays.

Reader Survey—December, 1997

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

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

As an incentive, we'll pick one respondent every month and give that person a complimentary one-year subscription (or subscription extension) to CQ VHF. *This month, with the holidays approaching, we'd like to ask about your ham radio purchasing plans and preferences.*

1. Please indicate whether you have made an amateur radio purchase of any kind in the past 12 months. **Circle Reader Service #**

Yes	1
No	2

2. Please indicate whether you are *planning* an amateur radio purchase of any kind...

...during the next 3 months	3
...during the next 6 months	4
...during the next 12 months	5
No purchases planned in the next year	6

3. If you have made an amateur radio purchase in the past 12 months or plan to in the next 12 months, please indicate what you bought or are planning to buy (circle all that apply)...

...Single-band FM handheld	7
...Dual/multi-band FM handheld	8
...Single-band FM mobile/base rig	9
...Dual/multi-band FM mobile/base rig	10
...Multimode (FM/SSB/CW) VHF or UHF mobile/base transceiver	11
...HF/VHF mobile/base transceiver	12
...HF-only mobile/base transceiver	13

4. Please indicate the *most* important consideration in choosing a new radio

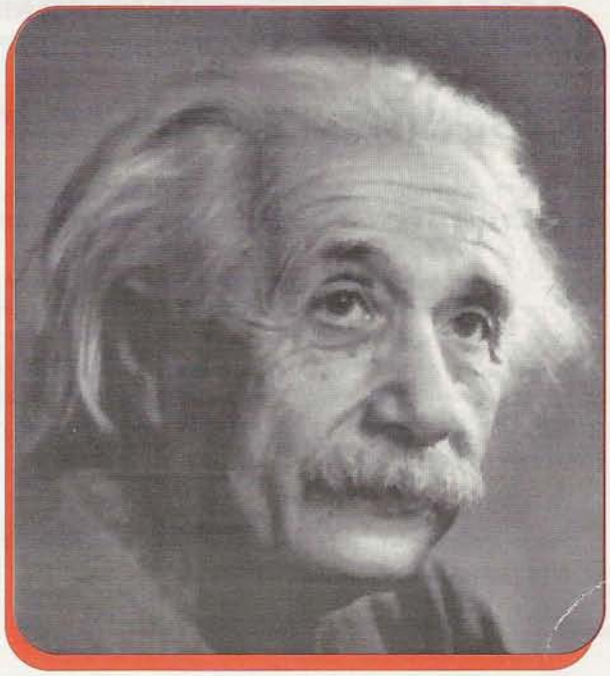
Price	14
Features	15
Ease of purchasing (e.g., 800 #)	16
Reputation of specific model	17
Reputation of manufacturer	18
Reputation of dealer	19
Personal service	20

5. Please indicate whether you prefer to purchase your ham gear...

...from a dealer at a store	21
...from a dealer via mail-order	22
...directly from the manufacturer	23
...via the Internet	24

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

You Don't Have to Be Einstein... to Understand Decibels



Decibels are handy for measuring and comparing all sort of things, from antenna gain to RF power. Here's how to make all the numbers add up (using a scientific calculator).

By Ron Hranac, NØIVN*

Editor's Note: If you flunked high school math, this article may be hazardous to your health. But if you passed, it should help you learn how to make use of the various variations on the decibel, such as dBd, dBi, dBm and dBW, in real-life calculations.

We hams use a wide variety of measurement units, from farads and henrys to ohms and volts. Transmitter power, for example, is usually measured in watts, while receiver sensitivity is generally measured in microvolts (μV), and any mismatch between your transmitter and your antenna is expressed in SWR.

Using different units makes it difficult to combine and compare the different elements that go into how well a signal will be heard over a given path. Wouldn't it be handy to have a single unit of measurement with which you could calculate the performance of all these elements and work out your overall system performance? Well, there is such a unit—the ubiquitous decibel (dB).

You're probably aware already that gain and loss in your antenna system is often expressed in dB. But it's also possible to measure transmitter power and receiver gain in terms of dBm, or decibel-milliwatts. When everything's measured in dB, it then becomes easier to add and subtract values—adding apples and apples instead of apples and oranges.

This article is about the mathematics of the decibel as it's used in amateur radio and is adapted from articles I've previously written for *Communications Technology*, *International Cable* and *SPEC-COM* magazines, and the *Rocky Mountain VHF+* newsletter. Don't let your eyes glaze over just yet, though. I promise I'll try to keep this at a reasonably down-to-earth level, and provide some useful information while I'm at it. Grab a fresh cup of coffee and your scientific calculator, and tag along for some fun with the decibel.

A Little History

It's best to think of the decibel as a shorthand method of dealing with numbers. By itself, the decibel can only express a ratio between two values, although when coupled to a reference, it can express absolute values. Even in the latter case, the expression is actually a ratio of some value to a reference.

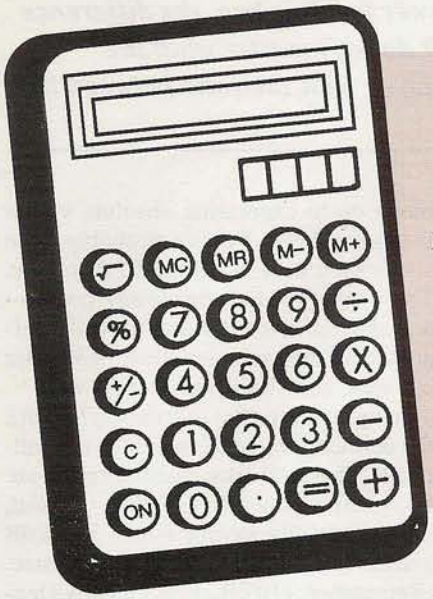
"To fully understand decibels, it helps to also know a little about logarithms....In this case, think of logarithms as the building blocks of the decibel."

The decibel had its origins in the telephone industry. In the early part of the century, telephone engineers discovered that a 10-mile length of a certain type of telephone cable attenuated the power of a signal by a fixed amount. They named that amount of power loss the *Bel*, in honor of Alexander Graham Bell. Mathematically, the loss was determined to be the base 10 logarithm of the ratio of the telephone cable's output power to its input power:

$$\text{bel} = \log (P_1/P_2)$$

where P_1 was the signal power at the input of the telephone cable and P_2 was the signal power at the cable's output. But like the Farad, which measures capacitance, the Bel is very cumbersome to deal

**Ron Hranac, NØIVN, is a VHF contester from Colorado...and that extreme rarity—someone who actually understands, and can explain, decibels!*



$$\text{decibel} = 10 \times \log (P_1/P_2)$$

$$\text{bel} = \log (P_1/P_2)$$

$$L_{FS} = 36.6 + [20 \times \log (F)] + [20 \times \log (D)]$$

$$\text{dBW} = 10 \times \log (\text{watt})$$

$$\text{dBm} = 10 \times \log (\text{milliwatts})$$

with—especially on shorter lengths of cable—so the telephone folks divided everything by 10 and came up with the *decibel*, which is $^1/_{10}$ of a Bel. The decibel could then be described mathematically as:

$$\text{decibel} = 10 \times \log (P_1/P_2)$$

Some Basics First

I need to backtrack for just a moment. To fully understand decibels, it helps to also know a little about logarithms. Like the decibel, logarithms are a fundamental part of the mathematics of amateur radio. In this case, think of logarithms as the building blocks of the decibel. Logarithms also can be thought of as a type of mathematical shorthand that can be used to deal with numbers, especially very small or very large numbers. Furthermore, they can be used to reduce multiplication and division to much simpler addition and subtraction.

Consider the following representations of the numbers 0.001, 100 and 10,000:

$0.001 = 1/(10 \times 10 \times 10) = 10^{-3}$
$100 = 10 \times 10 = 10^2$
$10{,}000 = 10 \times 10 \times 10 \times 10 = 10^4$

These three numbers have something in common. Each can be represented as 10 raised to some power. The power to which 10 is raised in each case is called an exponent or logarithm. Since the number 10 is being raised to some power in the previous examples, we can say that the exponents or logarithms are all base 10 logarithms, or simply $\log_{10}$. Base 10 logarithms are often abbreviated as *log*.

In the world of base 10 logarithms, we can simplify even more by dropping the base 10 and working with only the exponents (logarithms). Thus, the base 10 logarithm, or log, of 0.001 is –3; the log of 100 is 2; and the log of 10,000 is 4. Each of these also could be written as

log (0.001) = -3
log (100) = 2
log (10,000) = 4

From this, it should be apparent that log (1,000) = 3 and log (100,000) = 5, since $1{,}000 = 10^3$ and $100{,}000 = 10^5$.

But what is, say, log (495)? Well, it should be some number between 2 and 3, because log (100) = 2 and log (1,000) = 3. Using either a logarithm table (if you remember those, you're dating yourself) or a much more convenient scientific calculator, you'll find that log (495) = 2.6946. That is, $495 = 10^{2.6946}$.

I mentioned that logarithms can be used to reduce multiplication and division to addition and subtraction. Here's how. If you were to multiply 100,000 x 1,000, your first choice is to do it the old-fashioned way:

```
  100,000
    1,000
   000000
  000000
 000000
100000
100000000
```

Or, you can do it a much easier way: Add the logarithms of the two original numbers! The sum of the two logarithms will be the exponent (logarithm) of the answer. We know that log (1,000) = 3 and log (100,000) = 5, so just add 3 + 5. We get 8, so the answer to the multiplication problem doing it this way is 10^8, or 100,000,000. If you want to divide numbers, just subtract their logarithms. Pretty simple, huh?

"Since the decibel expresses a ratio between two power levels, it's ideal for describing gain and loss. In fact, comparing a device's output power to its input power is one common use for the decibel."

Decibels and Power Levels

Now, let's go over some practical examples of using decibels to compare different RF power levels. Earlier I showed you the formula that mathematically describes the decibel:

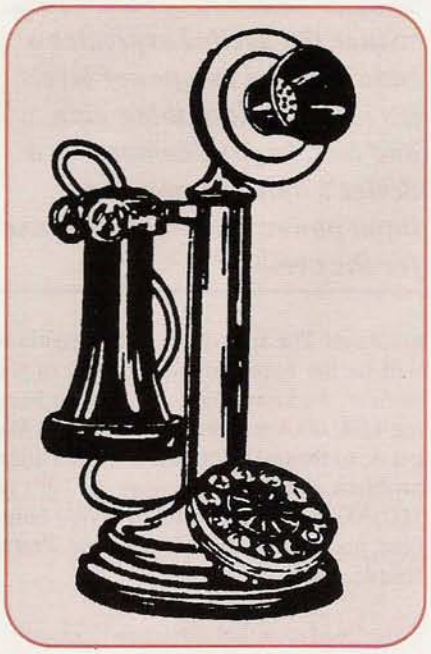
$$\text{dB} = 10 \times \log (P_1/P_2)$$

Since the decibel expresses a ratio between two power levels, it's ideal for describing gain and loss. In fact, comparing a device's output power to its input power is one common use for the decibel. For example, it's a whole lot easier to say something like "the loss through a 50-foot piece of coax is 3 dB" instead of "the loss through a 50-foot piece of coax is 50 watts if the input is 100 watts", or "...1 watt if the input is 2 watts," etc.

Let's work through an example: Suppose your VHF "brick" amplifier has an output of 100 watts, and your friend's barefoot rig has an output of 50 watts. How much more power does your amplifier produce, in decibels, than your friend's rig? Here's the solution, using the previous formula:

$\text{dB} = 10 \times \log (P_1/P_2)$
$\text{dB} = 10 \times \log (100/50)$
$\text{dB} = 10 \times \log (2)$
dB = 10 x 0.3010 (using a scientific calculator or log table)
dB = 3.01

Your amp has 3 dB more output power than your friend's rig (well, OK, 3.01 dB). The important thing to understand from this example is that whenever the ratio of any two power levels is *two*, the difference between them will always be 3 dB.



The decibel is one-tenth of a Bel, a unit of measurement named after telephone pioneer Alexander Graham Bell. It was first used by telephone engineers to calculate loss in telephone cables.

"...whenever the ratio of any two power levels is two, the difference between them will always be 3 dB. It doesn't matter what the original power levels are; we are dealing with the ratio between the two levels."

It doesn't matter what the original power levels are; we're dealing with the *ratio* between the two levels. If one station's output power is 1,500 watts and another's is 750 watts, if one is 10 watts and the other is five watts, or if one is 20 milliwatts and the other is 10 milliwatts, the difference will always be 3 dB.

Look at it another way: If you have a 100-foot piece of coax with 3 dB of loss at 144.220 MHz, the power at the cable's output end will always be half as much as the power at the cable's input end (assuming no impedance mismatches or VSWR problems). If the input to the coax is 100 watts, the output at the other end will be 50 watts; if the input is 10 watts, the output will be 5 watts, and so on.

Here are a couple rules of thumb to remember: A 3-dB change (actually 3.01 dB) means that the power level has either doubled or been reduced by half. A change of 10 dB means that the power level has increased 10 times or has been reduced to $^1/_{10}$ of its original value. You can use these two rules to "guesstimate" simple power gains and losses.

Making Guesstimates

For example, if you have a brick with 10 dB of gain, what will the output power be if the input is 10 watts? Simple: 100 watts (10 dB means the power level will change by a factor of 10. Thus, 10 watts x 10 = 100 watts). What if the amplifier has 13 dB of gain? Still simple: 200 watts. How do we get that figure? The first 10 dB will boost your 10 watts to 100 watts, and another 3 dB will double that to 200 watts (10 dB + 3 dB = 13 dB).

What if the amplifier's gain is 7 dB? That's right: 50 watts! Here's how to figure this one in your head: 10 dB will increase 10 watts to 100 watts; *subtracting* 3 dB from the 10 dB (10 dB - 3 dB = 7 dB) means the 100 watts will then be reduced by half to 50 watts. Keep in mind that I'm taking some journalistic liberties here and anytime I refer to 3 dB or increments of 3 dB, I actually mean 3.01 dB.

Let's go through a couple more examples. What is the gain of a linear amplifier that requires 75 watts of drive to produce 1500 watts output?

$dB = 10 \times \log (P_1/P_2)$
$dB = 10 \times \log (1{,}500/75)$
$dB = 10 \times \log (20)$
$dB = 10 \times 1.3010$
$dB = 13.01$

If you measure 150 watts at the output of your VHF brick amplifier in the shack and 110 watts at the other end of the coax feeding the antenna, what is the loss through the coax?

$dB = 10 \times \log (P_1/P_2)$
$dB = 10 \times \log (150/110)$
$dB = 10 \times \log (1.36)$
$dB = 10 \times 0.1347$
$dB = 1.35$

Most S meters are calibrated such that each S unit is about 6 dB, so a loss of 1.35 dB between your shack and antenna will barely be noticeable—if at all—to the station at the other end of your QSO. That amount of loss represents less than $^1/_4$ of an S unit. Unless you're doing very weak signal EME or something similar, this is a negligible amount.

Decibels and Absolute Values

Now that we've covered power ratios and their relationship to decibels, let's move on to expressing absolute values using decibels. You've probably seen terms such as +30 dBm, -10 dBm, etc. They refer to discrete power levels—actually, ratios to a defined "zero dB" reference. In the examples above, +30 dBm = 1 watt, and -10 dBm = 0.0001 watt.

In the case of *dBm (decibel-milliwatt)*, the defined "zero dB" reference is 1 milliwatt. That is, 0 dBm equals 1 milliwatt. So, when we say that +30 dBm = 1 watt, we are actually saying 1 watt is 30 dB *greater* than the 1 milliwatt reference. (Remember, +10 dB always means a tenfold increase, so +30 dB = 10+10+10, or 1,000 times the original value.) Likewise, -10 dBm means that 0.0001 watt is 10 dB *less* than the 1 milliwatt reference. See? Even when dealing with absolute values, decibels are still nothing more than ratios between two values!

You can convert from milliwatts to dBm using the formula:

dBm = 10 x log (milliwatts)

Here's an example. Your 10 GHz transverter's output is 100 milliwatts. What is that level in dBm?

$dBm = 10 \times \log (\text{milliwatts})$
$dBm = 10 \times \log (100)$
$dBm = 10 \times 2$
$dBm = 2$

In this case, the answer is +20 dBm. Technically, this means 100 milliwatts is 20 dB greater than the 1 milliwatt reference. Another way to figure this is with the rules of thumb I showed you previously (a 3 dB change means we change the original amount by a factor of two; a 10 dB change means we change the original amount by a factor of 10). If 0 dBm = 1 milliwatt, then increasing 1 milliwatt by 10 dB would give us 10 milliwatts (1 milliwatt x 10 = 10 milliwatts). Another 10-dB increase would change the 10 milliwatts to 100 milliwatts (10 milliwatts x 10 = 100 milliwatts). Or, 0 dBm + 10 dB + 10 dB = 20 dBm.

What if the original power level is in watts instead of milliwatts? Well, you can use the same formula if you first convert

the amount in watts to milliwatts. You do this by multiplying the amount in watts by 1,000. For instance, 3 watts is 3,000 milliwatts (3 x 1,000 = 3000 milliwatts).

Now, let's assume your 2-meter rig's output power is 25 watts. What is its output in dBm? First, convert 25 watts to milliwatts by multiplying by 1,000 (25 x 1,000 = 25000 milliwatts). Then use the previous formula to determine the power in dBm.

dBm = 10 x log (milliwatts)
dBm = 10 x log (25,000)
dBm = 10 x 4.3979
dBm = 43.98

About Face!

To go the other direction and convert from dBm to milliwatts, use one of the following formulas (they actually are the same formula; one is just written a little differently than the other). I'm showing both, because some calculators have an <INV LOG> key, and others perform the same function using a <10^X> key.

milliwatts = <INV LOG>(dBm/10)
or
milliwatts = $10^{(dBm/10)}$

Let's suppose that you just bought a 1296-MHz transverter, and the instructions say the required drive from a 432.100 MHz IF rig is +13 dBm. What is that drive level in milliwatts? Here's how to find the answer:

mW = $10^{(dBm/10)}$
mW = $10^{(13/10)}$
mW = $10^{(1.3)}$
mW = 19.95

If you want to convert milliwatts to watts, just divide the amount in milliwatts by 1,000. For the previous example, 19.95 mW = 0.02 watt (19.95/1,000 = 0.0195, rounded to 0.02 watt).

And Now, the dBW

Before moving on, I'd like to review one other decibel conversion. It's the *dBW*, or *decibel-watt*. Here, the "zero dB" reference is 1 watt. That is, 0 dBW = 1 watt. While not as common as the previously discussed conversions, the dBW does occasionally show up in amateur radio. Here's the formula to convert from watts to dBW:

dBW = 10 x log (watt)

A quick example: Most HF rigs have a nominal maximum power output of 100 watts. What is that output power expressed in dBW?

dBW = 10 x log (watt)
dBW = 10 x log (100)
dBW = 10 x 2
dBW = 20

That's pretty straightforward. To convert from dBW to watts, use one of the following formulas:

watts = <INV LOG>(dBW/10)
or
watts = $10^{(dBW/10)}$

Try an example on your own using one of these last formulas. The process is similar to converting from dBm to milliwatts.

Putting It All Together

Now let's work through a real-life situation that puts together everything that's been discussed so far. Our task is going to be to calculate the received signal strength at the input to a friend's transceiver in both dBm and microvolts μV, given some assumptions about the transmitting and receiving stations.

Let's say you're having a CW QSO with a friend who lives 110 miles away. Your 432.100-MHz transceiver output is 25 watts, and you've got 60 feet of RG-213 cable (4.8-dB loss per 100 feet at 432.1 MHz) between the output of your rig and the antenna. Your antenna is a 16-element Yagi, which has a published gain of 14.0 dBd (16.14 dBi)†. Your friend has a similar setup, except his antenna is a 10-element Yagi with 11.5 dBd (13.64 dBi) of gain. He, too, has 60 feet of feedline, but he recently upgraded to Belden 9913 coax (2.9-dB loss per 100 feet at 432.1 MHz). Assuming an unobstructed line-of-sight path between the two stations and no unusual propagation conditions, what is the received signal strength—both in dBm and in μV—at the input to your friend's rig?

Here's the formula we're going to use to calculate the receiver input in dBm:

$$P_R = P_T - F_T + A_T - L_{FS} + A_R - F_R$$

where
P_R = receiver input, dBm
P_T = transmitter output power, dBm
F_T = transmit feedline loss, dB
A_T = transmit antenna gain, dBi
L_{FS} = free space path loss between the two stations, dB
A_R = receive antenna gain, dBi, and
F_R = receive feedline loss, dB.

One of the first things you'll notice is that all of this formula's units are in some variation of the decibel. This makes things a whole lot easier! However, before using the formula we have to convert the transmitter output power, which is in watts, to dBm.

To do this, as we explained a few paragraphs back, we'll use the formula:

dBm = 10 x log (milliwatts)

Milliwatts? But the transmitter output is shown in watts! No problem, just remember to multiply the transmitter's output power in watts by 1,000; so 25 watts x 1,000 = 25000 milliwatts. Let's start plugging in numbers.

dBm = 10 x log (25000)
dBm = 10 x 4.3979
dBm = +43.98

Looking back at the formula to calculate receiver input, there's one other term that must be dealt with. It's L_{FS}, or free space path loss. This is the amount of signal attenuation that will occur "through the air" between two locations. The next formula can be used to calculate L_{FS}, but it won't take into account additional loss that is the result of blockage by trees, buildings, local terrain, and other obstructions. It also doesn't account for signal enhancement due to unusual propagation conditions, or signal variations caused by reflection or refraction. In real-world situations, one or more of these would likely have some effect on the transmitted signal, possibly making the actual received signal level quite a bit different from what we calculate. That said, here's the formula for calculating free space path loss:

$$L_{FS} = 36.6 + [20 \times \log (F)] + [20 \times \log (D)]$$

where
L_{FS} = free space path loss, dB
F = frequency, MHz
D = distance, statute miles

So, how much will the signal be attenuated over the 110-mile path between

† A dipole antenna has 2.14-dB gain over a theoretical *isotropic* antenna, which radiates equally in all directions. Therefore, 0 dBd, the gain of a dipole in free space, equals +2.14 dBi, and any real-life antenna will always have its gain in dBi appear 2.14 dB greater (sometimes 2.15) than its gain in dBd. The important thing is to compare dBd to dBd and dBi to dBi.

your transmit antenna and your friend's receive antenna?

L_{FS} = 36.6 + [20 x log (432.1)] + [20 x log (110)]
L_{FS} = 36.6 + [20 x 2.6356] + [20 x 2.0414]
L_{FS} = 36.6 + 52.7117 + 40.8279
L_{FS} = 130.14 dB

Now, we need to figure out coax attenuation for both stations. The RG-213 at your station has 4.8 dB of loss per 100 feet at 432.1 MHz, but you have only 60 feet of it. Therefore, your feedline's loss is 4.8 x 0.60 = 2.88 dB. Your friend is using 9913, which has 2.9 dB of loss per 100 feet at 432.1 MHz. He, too, has only 60 feet of feedline, so his coax attenuation is 2.9 x 0.60 = 1.74 dB. (As a side note, if he had 150 feet of 9913 feedline, the loss would be 2.9 x 1.50, or 4.35 dB.)

Now we're ready to plug everything in:

$P_R = P_T - F_T + A_T - L_{FS} + A_R - F_R$
P_R = 43.98 - 2.88 + 16.14 - 130.14 + 13.64 - 1.74
P_R = -61.0 dBm

"In the case of dBm (decibel-milliwatt), the defined 'zero dB' reference is 1 milliwatt. That is, 0 dBm equals 1 milliwatt."

The signal strength at the input to your friend's receiver is -61 dBm. That's quite a bit weaker than the +43.98 dBm (25 watts) at the output of your transmitter—in fact, it's nearly 105 dB less!

Moving on to Microvolts

We've figured out one answer: the receiver input in dBm. The next step is to figure out the receiver input in µV. To do this, we first have to convert the receiver's dBm input to milliwatts, using the following formula:

$mW = 10^{(dBm/10)}$
$mW = 10^{(-61/10)}$
$mW = 10^{(-6.1)}$
mW = 0.000000794328

Next, change from milliwatts to watts by dividing by 1,000: 0.000000794328/1,000 = 0.000000000794328 watt. Pretty small signal, huh? Now, using a variation on Ohm's Law ($E = \sqrt{PR}$), we can change the signal level from watts to volts, and then to microvolts. When doing this, we assume that the entire receive system impedance ("R" in the Ohm's Law formula) is 50 ohms.

$E = (\sqrt{0.000000000794328 \times 50})$
$E = \sqrt{0.0000000397164}$
E = 0.0001993 volt

Still a pretty small signal, huh? Well, maybe not as small as it seems. To convert volts to microvolts, just multiply the amount in volts by 1,000,000: 0.0001993 x 1,000,000 = 199.29 µV. Considering that most contemporary amateur transceivers have a receive sensitivity spec better than 1 µV (less than 0.2 µV is typical), this calculated received signal strength is actually pretty decent.

To put it in perspective, when the ARRL published its test results of the Yaesu FT-736R back in the May 1990 issue of *QST*, the '736 had a 432-MHz S-meter sensitivity of 5.2 µV for S9. Our 199.29-µV signal would be about 30 dB over S9.

Remember, this calculated signal level assumes ideal conditions and no obstructions (including the good ol' Earth) between you and your friend.

Class dismissed! ■

6-Meter Internet Contest Results

Following are the top scorers in the first Internet 6-Meter Contest, as reported by contest originator Ken Ramirez, N4UK. The contest coincided with the ARRL June VHF Contest.

USA/VE
Single Operator/High Power

1st	K5AM	13,575	Plaque winner
2nd	VE1ASJ	9,639	Certificate winner
3rd	WZ8D	5,625	Certificate winner
4th	KB5IUA	5,508	Certificate winner
5th	KØFF	3,267	Certificate winner

QRP

1st	CG2PIJ	5,289	Plaque winner
2nd	AA4S	884	Certificate winner

Multi-operator

1st	W2DRZ	31,195	Plaque winner
2nd	WS4F	20,732	Certificate winner
3rd	KØYO	4,050	Certificate winner

Rover

1st	K8WW	9,360	Plaque and KB6KQ miniloop winner
2nd	AA4R/8	1,896	Certificate winner

DX
Single operator

1st	GØAEV	28,130	Plaque winner
2nd	G1IOV	8,845	Certificate winner
3rd	CO2OJ	120	Certificate winner

Highest Multiplier Total	GØAEV	24 DXCC countries + 73 Grids = 97 mults.
Most Grids worked	W2DRZ	83 Grids
Most Grids worked by single op.	K5AM	73 grids
Most Grid fields worked	GØAEV and K5AM	8 Grid Fields

K7XC will be keeping the 6-Meter Internet DX Contest records. There were plenty of certificates and plaques that went unclaimed this year. Keep the contest in mind next year!

—N4UK

Mini-Review: Maha MH-A302 Docking Booster

In a somewhat different sort of review, WB6NOA shows us how some equipment he was checking out solved a real-life ham radio mystery.

By Gordon West, WB6NOA*

Every now and then, new amateur operators will set up their stations and run into a problem that baffles everyone—sometimes even the manufacturers of the equipment. This review took an unanticipated turn when a problem cropped up and it appeared that the piece of gear I was reviewing could become part of the solution.

The Case of the Disappearing Signal

I enjoy problem-solving, so decided to take on the job of figuring out why a new ham near me could not reliably access the local repeater.

The repeater itself was quite straightforward: a regular 600-kHz offset, with CTCSS required for access (82.5 Hz, in this case). The radio the ham was using was also straight-forward: a dual-band handheld with a measured deviation of 3.7 kHz and tone encode deviation of 550 Hz. This particular repeater would "open up" with as little as 200 Hz of tone deviation, so 550 was plenty.

The new operator, who's active in the local RACES group, is visually impaired, and so does most of her operating in her living room. She powers her equipment with a gelled battery system placed in a well-ventilated area about eight feet away from her operating table. The battery was kept charged by a small automotive-type 2-amp trickle charger, more than enough to keep the battery up even during prolonged transmission periods.

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The problem? Everything would work fine until about 10 or 15 minutes into a conversation. Then she would mysteriously drop out and not come back up on the air until she let her handheld "rest." Adding to the mystery was the fact that other hams could hear her signal—including the required tone—quite nicely on the input frequency, but still she was not able to trigger the repeater. It was a case for "Sherlock West."

Troubleshooting the Mystery

At first, I figured the HT was getting hot and that the heat was causing the final amplifier to shut down. But she told me she operated only on medium power, and, after several tests with a wattmeter, it was apparent that the problem was not final amplifier cut-out. The VSWR was also good, so there was no problem with the radio shutting down (*Many radios have SWR protection circuits that reduce power, sometimes to nothing, to prevent damage from excessive reflected power.—ed.*).

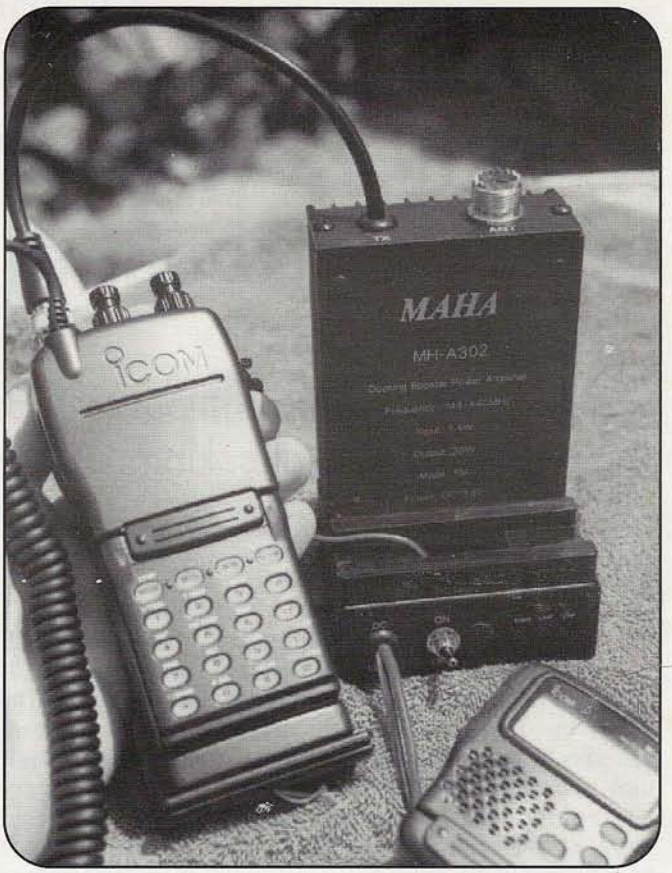
I next took a look at the CTCSS level, and it was right on the nose. I then brought out the oscilloscope, and found that the 82.5-Hz frequency was right on as well. I left the scope hooked up and had her transmit for a few minutes into a dummy load. Then I discovered the problem. Have you figured it out yet?

This is what I found: As her handheld drew current from the battery, the battery voltage dropped slightly, and the charger began to deliver more current. Automobile chargers are typically under-filtered, and the more she talked, the more current the charger was putting out to try to bring the battery voltage back up. And the more current the charger put out, the more AC hum there was coming into her handheld and ultimately out on the air.

Maha's HT docking booster, model MH-A302, provides a combination HT support stand and dual-band power amplifier.

How did that keep her from being heard at all? Well, because the hum was so low in frequency (60 Hz), and because so many modern ham sets have de-emphasis circuits which filter out low tones (including CTCSS), the AC hum *and the CTCSS tone* were both being fil-

Make sure you order the battery adapter that will fit your handheld. There are nearly a dozen choices.



Connections are simple: slide the HT onto the battery adapter and the battery adapter onto the docking booster. The coax cable on the booster connects to your HT antenna jack, and the feedline from your external antenna connects to the SO-239 on top. You need at least 6 amps of 12-volt DC power.

tered out! The repeater receiver didn't "hear" her tone, so she wasn't able to trigger the repeater.

Solving the Problem

The obvious cure would have been to drop the charger out of line on transmit, or find a better low-noise battery charger module. I had another idea. Maha Communications President Charles Chueh had recently loaned me one of his company's dual-band VHF/UHF docking booster/power amplifier, along with a battery adapter that the handheld will snap onto for a nice tight fit. My new ham friend and I decided to give it a try, not only to improve how her handheld would stand on the table, but also to increase her VHF and UHF power output to the 40-watt level. The booster alone wouldn't solve the problem, but it would be part of the solution.

We still needed to change that noisy automotive-style battery charger, so we went down to a local electronics store and picked up a 2-amp battery charger specifically designed for low-noise applications on gelled cells. This charger also featured a sensing circuit in order to prevent the battery from overcharging.

What Is the MH-A302?

The Maha docking amplifier is really a combination of three things: a stand to hold an HT steady on a table, an easy way to hook up to an external antenna, and a 40-plus-watt amplifier for both 2 meters and 70 centimeters (with an input between 1 and 5 watts). Individual VHF and UHF transmit indicators light up when you transmit on each band.

During our tests, we discovered that a medium-power setting on the HT (3 watts output) would let the handheld run relatively cool during long transmission periods, yet still allow for almost the maximum output power of 45 watts on VHF and 42 watts on UHF. (You should always try to run your handheld on the least amount of power output to have it run cool, and also to let the big heat sink on the power amplifier do the job of dissipating the heat when the power amp is turned on. If you don't need 40 watts output, simply switch off the amplifier and run "barefoot.")

"The Maha docking amplifier is...a stand to hold an HT steady on a table, an easy way to hook up to an external antenna, and a 40-plus-watt amplifier for both 2 meters and 70 centimeters."

Good News: No Preamp

The Maha power amplifier purposely leaves out of the circuit something that I wish everyone would leave out: the receive pre-amplifier. Remember, this is designed for an FM handheld. If there's any pre-amplification to a received signal, most handhelds will immediately start sucking in strong signals on adjacent frequencies and all you'll hear is intermodulation (intermod), and even the strongest of nearby signals will have trouble getting through. A handheld just can't take any type of preamp in most metropolitan and urban regions. Maybe way out in the country it's useful and needed, but most of the time, handhelds have plenty of receiver capabilities without the external preamp.

This amplifier also protects itself under high VSWR conditions. We noticed that

"The Maha power amplifier purposely leaves out of the circuit something that I wish everyone would leave out: the receive pre-amplifier."

the relay would chatter when we accidentally forgot to hook up the UHF antenna and tried to transmit.

Power and Antenna Connections

In our case, we measured 6 amps of current with the handheld on medium power and the amplifier putting out 45 watts. If you plan to run this unit in your vehicle, this type of current would require you to wire directly to a fuse block, or, better yet, directly to your vehicle battery. A direct connection to the vehicle battery also minimizes alternator whine. For home use, a suitable DC power supply or gelled cell battery system is all you need.

A mobile or base station antenna connects with a regular PL-259 connector to the SO-239 input on the booster. If you plan to run the booster mobile, there's a supplied mounting bracket as standard equipment. You connect the docking booster's coax cable with the BNC connector to your handheld antenna jack.

The unit doesn't require a duplexer when used with a dual-band roof-mount or mobile antenna. In fact, the amplifier allows for full duplex cross-band operation when transmitting on one band and listening on another.

HT Connections

The Maha docking booster gives you a choice of over 10 individual battery adapters that will slide onto your radio and serve as the power source and anchor to the docking unit. Radio equipment from Kenwood, Standard, Heath, Yaesu, ICOM, and RadioShack will probably have a customized battery tray available to securely hold your unit onto the booster assembly (hence the term "docking").

As it happened, my review unit came with the exact battery tray our new ham needed to match her new dual-band transceiver. To hook it up, I just had to slide off the HT's regular battery and slide on the docking booster's battery adapter (see photos). This adapter is connected to red and black wires that exit the docking amplifier and go down to the outside battery or other 12-volt power supply.

The unit is small enough and light enough to hold in one hand, but be careful about picking it up when you've been using it for a while. The amplifier may be hot.

Elementary, My Dear Watson...

Our new radio operator is now on the air with the docking booster, and, thanks to the addition of a better battery charger, the small amount of hum on her signal that was disrupting the repeater's ability to hear CTCSS has been all but eliminated. She can now get onto her local RACES repeater with a good, clean signal, and, better yet, the docking booster allows her to access more distant repeaters that were previously out of range for her little handheld. ■

Resources

The list price of the MH-A302 is $165.95. It's available from Maha dealers or direct from Maha Communications, 2841-B Saturn St., Brea, California 92821; Phone: (800) 376-9992 or (714) 985-9132; Fax: (714) 985-9221; Internet: <http://www.maha-comm.com>.

Build an Efficient HT Power Supply

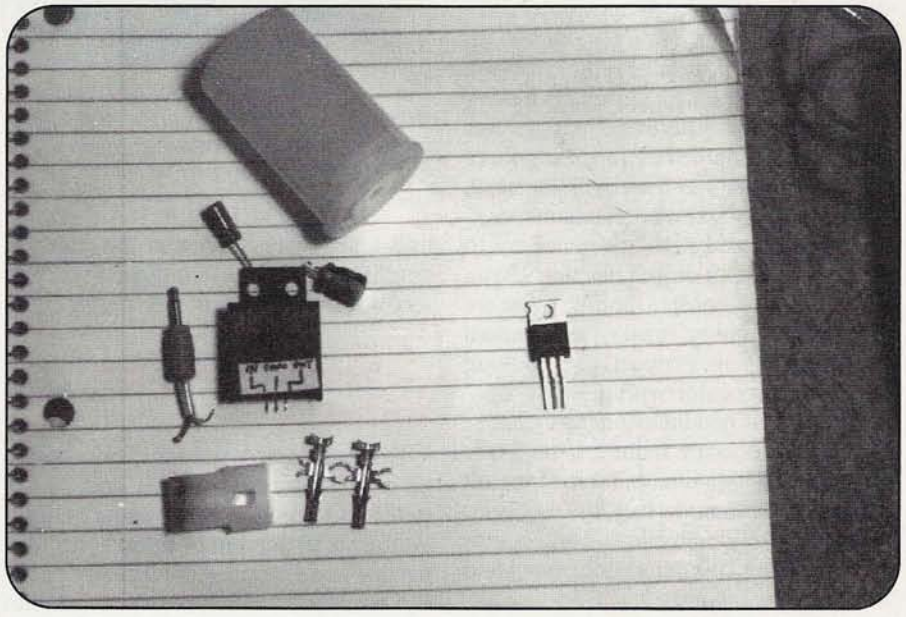
Here's a simple project to provide all-day power for your low-voltage handheld...efficiently.

By Phil Salas, AD5X*

When you need to use your HT for a day-long event, such as a ham-fest, walk-a-thon, or campout, battery power can become a problem. If you'll be doing an appreciable amount of transmitting, then the standard nickel cadmium (NiCd) battery pack that comes with most HTs simply won't last more than a few hours. If you need your radio to keep going and going and going, you'll need to pack some extra talk power.

Your choices include multiple NiCd packs, which can be expensive and are difficult to recharge in the field; refillable battery holders and a pocket full of alkaline cells; or a high-capacity gel-cell battery that can be hooked up as an external power source. I chose the latter option, preferring a single, day-long power source.

Surplus 12-volt, 2.3 Ah (amp-hour), gel-cell batteries and chargers are available very inexpensively from All Electronics, Hosfelt Electronics, and others. But most of the handie-talkies on the market today operate from voltages much lower than +12 volts. As an example, my Yaesu FT-51R typically runs on four AA batteries (5 volts with NiCds and 6 volts with alkaline batteries). I wanted to build an adapter to let me run my FT-51R from one of these larger external batteries that I could wear on my belt during day-long events (it is easy to epoxy a belt loop to the side of one of these batteries). An easy way to do this would be to build a small adapter box that contains a 5- or 6-volt, three-terminal regulator. But this approach is extremely inefficient.



The 7805 linear regulator on the right is small and simple, but far less efficient than the PT-5101 switching regulator, in the center on the left. This entire project can be built from the parts on the left. (Photos by the author)

Why Worry About Efficiency?

What do I mean by inefficient? Well, let's assume that I want to run my HT from a 12-volt battery and that I use a 5-volt, three-terminal, regulator, such as a 7805, to give me the HT operating voltage. Also, assume I draw 500 milliamps when I transmit. Using Ohm's Law, you can calculate that the power required by the HT is *5 volts X 0.5 amps* or *2.5 watts*. However, the power dissipated in the three-terminal regulator is *(12-5) volts X 0.5 amps* or *3.5 watts*.

"[With a standard regulator], I'm dissipating more power in the regulator than I'm using for the HT! So, the total power I'm drawing from the battery is 6 watts, even though only 2.5 watts are doing what I need."

Phil Salas, AD5X, is the Senior Director of Radio Product Development at Alcatel Network Systems in Richardson, Texas. He's been an active ham since 1964.

"...your external battery will last over twice as long if you use the PT5101. And this regulator will run cool since it only dissipates 0.44 watts, compared with 3.5 watts of heat dissipation on the linear regulator!"

In other words, I'm dissipating more power in the regulator than I'm using for the HT! So, the total power I'm drawing from the battery is 6 watts, even though only 2.5 watts are doing what I need. The other 3.5 watts get turned into heat, which needs to be somehow dissipated. How do we get around this? Well, how about a switching regulator?

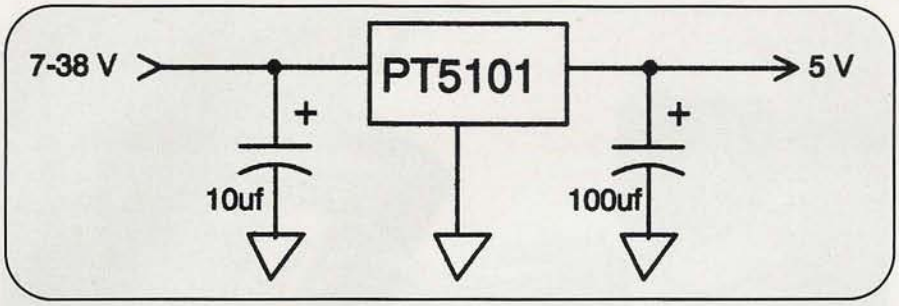
The whole switching regulator circuit—the PT-5101 plus two capacitors—can be built into an empty film can, which goes between a long-life battery and the HT power pack.

Isn't That Overkill?

Normally, tackling a switching regulator design for an application this simple *is* a bit of an overkill. However, there are some commercially available switching regulators that are relatively inexpensive and that do what we need. So why not?

One such switching regulator is the PT5101 switching regulator made by Power Trends, Inc. You can purchase this unit from Digi-Key for around $14 (Part No. PT5101A-ND). This 5-volt, three-terminal regulator has the same pin-outs as the 7805 linear regulator, but is bigger and has a few other important differences.

This simple switching regulator operates over a DC input voltage range of 7 to 38 VDC, with an operating temperature range of -20 to +70 degrees C. The switch-



The simple circuit consists of only three components: a 5-volt, three-terminal switching regulator (the PT-5101), plus a 10-µf capacitor on the input side and a 100-µf cap on the output.

ing frequency varies over the range of 500 to 800 KHz, which means that it's very easy to filter out any switching noise. The only external components needed are a 10-µf electrolytic capacitor placed on the regulator input and a 100-µf electrolytic capacitor on the regulator output (see Figure). Like the 7805, the PT5101 puts out 1 amp at 5 volts. But *unlike* the 7805, the PT5101 is 85% efficient.

What does this mean? It means that to provide 2.5 watts to the HT (*5 volts X 0.5 amps*), you will only need to draw 2.94 watts from the 12-volt battery (*2.5 watts/0.85*). This is *less than half the battery power required* when a linear regulator is used! So your external battery will last over twice as long if you use the PT5101. And this regulator will run cool since it only dissipates 0.44 watts, compared with 3.5 watts of heat dissipation on the linear regulator!

Building the Regulator

The simple schematic for this switching regulator is shown in the Figure. You can easily build it into most anything, including an empty battery pack. Just put a connector of your choice on the battery pack to connect with the external battery and snap it onto your HT. In my case, I built the circuit (such as it is) into a plastic 35-mm film can and hooked it up to an empty alkaline battery pack with a subminiature phone plug.

That's all there is to it. This is a very simple and inexpensive project, yet it can be very worthwhile for long operating events. So, whether you're a first-time builder or a grizzled veteran, get out the soldering iron...and get efficient! ■

Resources

Most of the parts listed in this article are available from one or more of the following sources:

All Electronics Corporation, P.O. Box 567, Van Nuys, CA 91408, 1-800-826-5432

Digi-Key Corporation, 701 Brooks Ave. South, Thief River Falls, MN 56701-0677, 1-800-344-4539

Hosfelt Electronics, 2700 Sunset Blvd., Steubenville, OH 43952-1158, 1-800-6464

Product Update *(from page 12)*

12. The complete product consists of a SPEC-12 SPL kit, which includes a 3.5-inch disk of PC software, a new PROM for the NIR-12, and the SDK-12 kit for the NIR-12. The SDK-12 provides a hardware serial port with which to send spectrum data to an unused serial data port on the PC for display. The PC software will run on either DOS or Windows on a 486 or faster PC. A 386 PC may be used if it has a math co-processor.

Using the Fast Fourier Transform built into the NIR-12, the SPEC-12 turns a PC into an audio spectrum analyzer, capable of displaying a receiver's audio spectrum from 100 Hz to 3450 Hz. While the SPEC-12 is running, the full functionality of the NIR-12 is retained, so the displayed spectrum shows the effects of the NIR-12's noise reduction, tone removal, and bandwidth filter controls on the received signals.

The SPEC-12 is controlled via the function keys on the PC keyboard. Resolution may be toggled between 15 and 30 Hz; display may be linear or logarithmic; display may be frozen; displayed signal may be displayed raw or smoothed. The display rate is three or six frames per second, as determined by the resolution key. The display dynamic range is 50 dB.

The SPEC-12 is available from the factory for $75.00, including shipping within the continental U.S. For those users who already have the SDK-12 kit, the SPEC-12 SPL portion is available for only $40.00, including shipping.

For more information, contact JPS Communications, Inc., P.O. Box 97757, Raleigh, NC 27624-7757; Phone: (919) 790-1011.

Circle 103 on reader service card

Motorola Antenna Adapter

Nemal Electronics International has introduced a coaxial adapter for use with Motorola P110 and GP300 handheld radios. The adapter, part number NE9395, accepts a BNC plug and adapts to the Motorola miniature 3.5-millimeter-type antenna connector. The adapter features a gold plated center contact and Teflon insulation, for optimum performance throughout the VHF and UHF spectrum, and a knurled body for ease of connection. Part number NE9395 is a direct replacement for Motorola part number HLN9756A.

Pricing (100 piece quantity) is $4.95. For more information, contact Nemal Electronics at (305) 899-0900, fax (305) 895-8178, e-mail: <info@nemal.com>.

Circle 104 on reader service card

Elenco Electronics Catalog

Elenco Electronics is offering the 25th anniversary issue of its full line 48-page color catalog. It features trainers, tool kits, hand tools, educational kits, solder kits, oscilloscopes, power supplies, counters, generators, breadboard aids, multimeters, and more.

For a free copy of the catalog, contact Elenco Electronics, 150 West Carpenter Ave., Wheeling, IL 60090; Phone: (847) 541-3800; Fax: (847) 520-0085.

Circle 105 on reader service card.

Q & A

Questions and Answers About Ham Radio Above 50 MHz

Q: As a sideline to the hobby, I picked up a few old Heathkit "Lunchboxes" at the Dayton Hamvention. What is, or would be, the frequency used on 2 meters for local AM? And, are there frequencies other than 50.400 MHz available on 6 meters for AM? I would like to get a Twoer and a Sixer on the air and generate some interest in old radios.

Martin Cvitkovich, KB8TPT
Dayton, Ohio

A: First of all, for the uninitiated, the Heathkit "Sixer" and "Twoer," matching 6-meter and 2-meter AM transceivers from the 1960s/70s, were known as "Benton Harbor Lunchboxes" because Heath was headquarted in Benton Harbor, Michigan, and these 5-watt radios were about the size and shape of a lunchbox, and even included a handle on the top!

As for frequencies, there are no formally or informally designated AM frequencies on 2 meters, due both to a lack of AM activity and crowding by other modes. There are a few "holes" in the ARRL's (very outdated) band plan, such as the "New OSCAR subband" from 144.30 to 144.50—no current or planned satellites use that segment—and the "linear translator" inputs and outputs at 144.50 to 144.60 and 145.10 to 145.20—there are no linear translators on 2 meters in the U.S., as far as we know. (In some places, though, these frequencies have been reassigned for repeaters or other uses, so check with your frequency coordinator or a knowledgeable club official before picking a frequency.) The bandplan does designate 145.50 to 145.80 for "miscellaneous and experimental modes," and you'd probably be OK there, as long as you avoid the space shuttle's ham frequency of 145.550 MHz and the informal-but-generally-accepted APRS frequency at 145.790 MHz. Again, check first with someone knowledgeable about local frequency allocations on 2 meters.

As for 6 meters, there generally aren't enough AM ops on the air at any given time to overload 50.400, but if it did get overcrowded, folks would probably just move up the band a little bit, to 50.410 or 50.425.

Perhaps some AM afficionados among our readers can offer additional suggestions.

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

You're Invited...to Write for CQ VHF!

"When are you going to run an article about (insert your favorite ham radio topic here)?" This is a question we hear regularly—and our usual response is: "When are you going to *write* an article about (same inserted favorite ham radio topic)?"

This is your formal invitation to become a *CQ VHF* writer as well as a reader.

Yes, we have our regular columnists, but we reserve the biggest chunk of editorial space each month for feature stories, generally written by readers like you. The results of our March, 1997, reader survey show that over 25% of our readers have been licensed for more than 25 years. One-third of you, according to the same survey results, hold Advanced or Extra class licenses. Clearly, a lot of you are active, experienced hams with knowledge and ideas you can share with the rest of us. We invite you to do so.

What Are We Looking for?

Here's a basic rundown of the types of articles we're generally looking for, along with some examples from recent issues:

Operating

• Beginner articles on all aspects of VHF/UHF operation, not only for the new ham, but also for the ham who's been around but is new to that particular operating activity. Examples from previous issues include:

"Moving Off Repeaters When You're on the Move," April, 1997
"Foxes, Hounds and Hams—An Intro to Foxhunting," September, 1996
"EME Operating Techniques for the Beginner," November, 1996

• More advanced articles on all aspects of VHF/UHF operation. Examples:

"OSCAR-13's Last Picture Show," February, 1997
"Secrets of Successful Rover Operating" April, 1997
"VHF DXpeditions to Cyprus and Tunisia," April, 1997

Public Service/Emergency

"The General Clinton Canoe Regatta," November, 1996
"Hams Just Do That" (A Report from the Blizzard of '96), March, 1997

Technical/Projects

• As above, both beginner's articles and more advanced projects. Examples:

"Build a Headset Mic for $5," January, 1997
"The Duplexer & Triplexer Connection," November, 1996
"Build a 6-Meter Beacon Transmitter," March, 1997
"2-Meter Moonbounce Basics," October, 1996

Ham Radio Science

• Reports on the science of radio communication, particularly as it applies to hams. Examples:

"Aurora: A New View," March, 1997
"The Great Sporadic-E Debate," two parts, April and May, 1997

First-Person/Ham Profiles

• Articles on notable hams and first-person stories about ham radio events with particular personal impact.

Let's Hear from You!

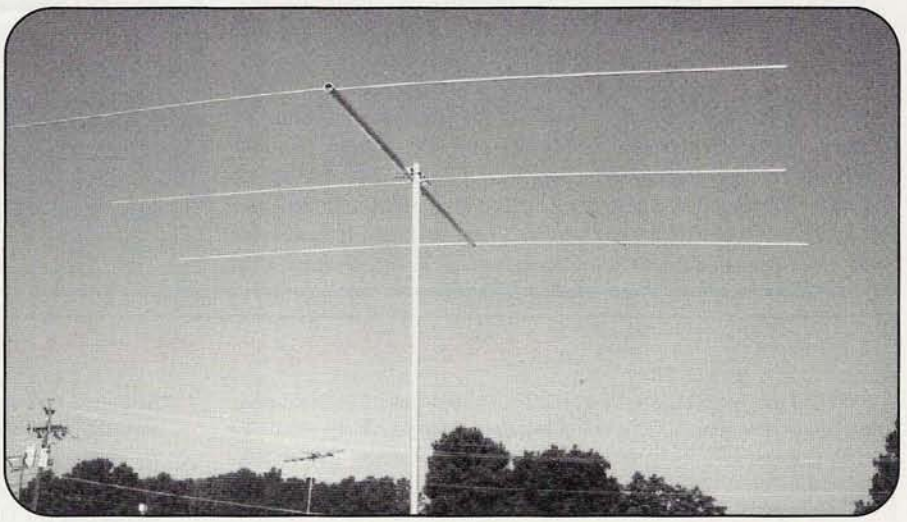
All of these are just examples. If you've got a story to tell, information to share, advice to offer, we'd like to hear from you. We recommend that you get a copy of our writers' guidelines before submitting your article. They're available on the World Wide Web at <http://members.aol.com/cqvhf/>, or by mail request (with an SASE) to *CQ VHF*, 76 N. Broadway, Hicksville, NY 11801. We look forward to hearing from you!

The MFJ-1762 Three-Element, 6-Meter Yagi

This lightweight beam is easy to assemble and can be a real workhorse for contesting and other portable operating, as well as for home use.

By Ken Neubeck, WB2AMU*

With the recent increase in popularity of 6 meters, there's also been an increase in availability of both rigs and commercially made antennas for the band. MFJ has been one of the manufacturers involved in 6-meter gear, beginning with its MFJ-9406 6-meter SSB transceiver, designed by Rick Littlefield, K1BQT, that was introduced last year. Now, MFJ is offering a lightweight, three-element Yagi for six, also designed by K1BQT. I evaluated not only its design and construction, but also its on-air performance during a contest.



The MFJ-1762 is a lightweight, portable, three-element beam for 6 meters. It performed well for the author in a variety of settings. (Photo courtesy MFJ)

A Unique Design

The things that I look for in an antenna for potential portable operation are light weight, durability, and ease of transport. The MFJ-1762 antenna meets all of these requirements.

Thanks to some clever design work, this antenna has an astonishing assembled weight of just 2.5 pounds, accomplished through the use of aluminum rods and tubing. The antenna uses split elements arranged in a staggered pattern for all three elements: reflector, director, and driven. Each half-element consists of a 1/4-inch aluminum rod with internal threading on one end. That threaded end is inserted into a hole in the 6-foot aluminum tubing boom and is held in place by a Phillips head screw which goes through the boom and into the rod (see Figure 1). The driven elements are insulated from the boom by plastic grommets that are inserted on each side. The driven elements are then connected to a hairpin inductor by an "L" bracket. Figure 2 shows the matching network and feedline connection details.

The staggering of elements has a minimal effect on the pattern because of the low frequency involved. The use of rods instead of larger diameter poles is not a major problem with regard to bandwidth, and even the fact that the driven elements are inserted into the boom does not significantly alter the pattern.

Feedline Connection

Coax is connected to the feedpoints at the bottom of the hairpin inductor. The manual for the MFJ-1762 recommends RG-8M 1/4-inch diameter coax for feeding this antenna. You'll have to strip one end of coax and attach lugs to the two conductors to connect the cable to the feed points (see Figure 2 for matching network and feedline connection details).

Since the driven element is balanced, MFJ also recommends using some sort of balun to prevent unwanted radiation from the feedline. A simple suggestion in the manual is to arrange about 6 feet of the feedline into a five-turn coil. MFJ also recommends securing the feedline to the mast with electrical tape to provide stress relief at the feedpoint.

MFJ includes some Locktite® with the antenna. This should be used on the screws if you're planning to install the antenna permanently. However, you should *not* use Locktite to secure the screws if you're planning to use the antenna for portable operation.

**Ken Neubeck, WB2AMU, is a regular contributor to CQ VHF. Next month, he'll be premiering a new mini-column on 6 meters, called "The Magic Band Chronicles." Watch for it.*

The antenna is set for a resonant frequency of 50.3 MHz. The manual states that a resonant frequency 200 kHz higher than 50.1 was used to accommodate the effects of rain, ice, or snow, since water on an aluminum element tends to lower an antenna's resonant frequency. If you want to use this antenna for FM work, the manual provides details on how much of the elements to cut.

MFJ states that the antenna has a forward gain of 6 dBd (gain over a dipole antenna) and a front-to-back ratio of 18 dB (measured). This is consistent with what the equations in the antenna handbooks say it should be and the beamwidth pattern and front-to-back pattern characteristics were noticeable during use on the air.

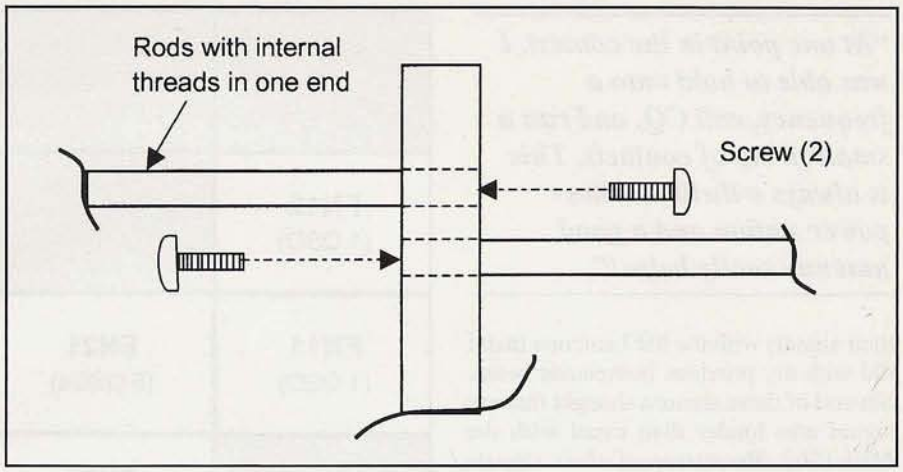


Figure 1. The elements of the MFJ-1762 are slightly staggered so that each half is attached separately to the mast, using screws. The driven element is insulated from the mast with plastic sleeves.

Putting It Together

First-time assembly of the antenna takes less than a half hour. If you're planning to use this antenna primarily for portable operating, it's probably a good idea to leave the tuning network and the mounting hardware on the mast and just remove the six half-elements when transporting. Assembly of just the six half-elements takes about five minutes using a Phillips head screwdriver. One suggestion I have about disassembling the elements is to put the screws back into the threaded end of each element so you can find them quickly when reassembling the antenna! (The manual recommends doing this as well!)

The manual also provides directions for stacking two MFJ-1762 antennas. Detailed instructions are given on how to figure out the correct cable lengths for connecting the two antennas with the correct phasing.

On-Air Testing

What better way to test any antenna than in a contest? I received the MFJ antenna just before this year's ARRL September VHF contest. The good thing about the September contest is that it's primarily a "no-skip" contest, in which the majority of the contacts are made via ground wave with occasional tropo enhancements. This is an ideal way to check out the performance of the antenna and to judge its capabilities since you're without the benefit of strong propagation modes, such as sporadic-*E*, when even simple antennas can do very well. And since I planned to operate in the QRP portable category from the same location from which I'd operated previously (a 300-foot hill on Long Island in Grid Square FN30) and using the same transmitter (a Yaesu FT 690) and a homemade two-element Yagi, I'd have plenty of data for comparison. (See "Six Meter QRP: How Far Can You Go?" November, 1996, *CQ VHF*.)

The beauty of QRP operation is that the antenna is of major importance. High power can compensate for some signal losses, but when you're dealing with 10 watts, any loading problems or mismatches will hurt your ability to make contacts, especially if you're relying on ground wave contacts.

After working the three major ARRL VHF contests from the same location and with the same basic setup during the past three years, I've found a basic core of "local" hams whom I work during all of these contests. They know my signal well enough that I can ask if they notice any differences. Plus, I could determine whether I had an easier time receiving

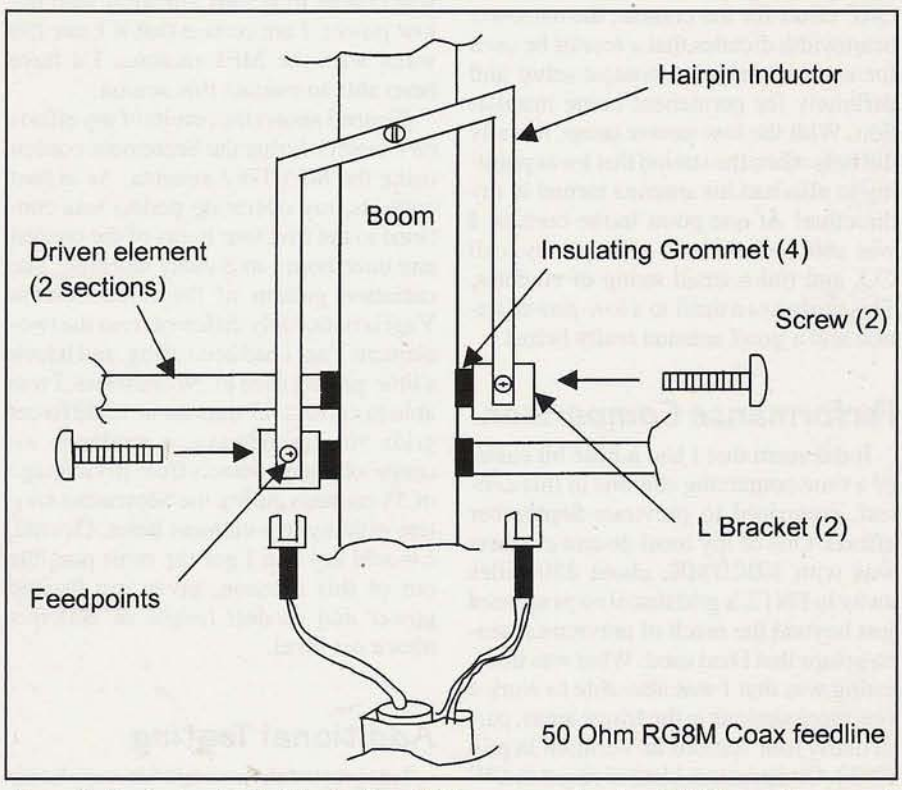


Figure 2. Feedpoint details. The feedline (MFJ recommends using RG-8M coax) is connected to the driven element ac the connection points of the hairpin match.

"At one point in the contest, I was able to hold onto a frequency, call CQ, and run a small string of contacts. This is always a thrill to a low-power station and a good antenna really helps!"

their signals with the MFJ antenna than I did with my previous homemade beam. Several of these stations thought that my signal was louder than usual with the MFJ-1762. Reception of *their* signals seemed better, too, particularly when the beam was pointed right at them. These observations may seem subjective but you have to feel good when several stations say that there is an improvement in your signal.

The nulls on the sides of the antenna's radiation pattern were noticeable during the contest, and I was able to tune out loud stations in one direction while listening for stations in another direction. The antenna has about 60 degrees of beamwidth, a fairly narrow pattern for trying to get in line with stations being worked, particularly those in fringe areas. While I used the "armstrong" (manual) technique for rotating the antenna during my QRP effort for the contest, the narrower beamwidth dictates that a rotator be used for a more elaborate contest setup and definitely for permanent home installation. With the low-power setup, it really did help when the station that I was pointing at also had his antenna turned in my direction! At one point in the contest, I was able to hold onto a frequency, call CQ, and run a small string of contacts. This is always a thrill to a low-power station and a good antenna really helps!

		FN33 (4 QSOs)	**FN43** (1 QSO)
FN12 (1 QSO)		**FN32** (5 QSOs)	**FN42** (2 QSOs)
FN11 (1 QSO)	**FN21** (5 QSOs)	**FN31** (12 QSOs)	**FN41** (1 QSO)
	FN20 (1 QSO)	**FN30** (9 QSOs)	
FM19 (1 QSO)			

Figure 3. WB2AMU's results, by grid square, using 10 watts and the MFJ-1762 during the 1997 September ARRL VHF contest. He did better than in past efforts using only a two-element Yagi and operating from the same location in FN30. Ken notes that he also heard, but did not work, stations in FM08, FM29 and FN02.

Performance Comparison

It did seem that I had a little bit easier of a time contacting stations in this contest, compared to previous September efforts. One of my most distant contacts was with KB2DMK, about 250 miles away in FN12, a grid that always seemed just beyond the reach of previous antenna setups that I had used. What was interesting was that I was also able to work a few more stations in the fringe areas, particularly four stations in Vermont in grid FN33. On occasion, I had to resort to CW for fringe stations like K3MQH in FM19 to hear me. Several times during the contest, I was able to copy K8GP on Spruce Knob, West Virginia in grid FM08, but was unable to get his attention with my low power. I am certain that if I ran 150 watts with the MFJ antenna, I'd have been able to contact this station.

Figure 3 shows the results of my efforts on 6 meters during the September contest using the MFJ-1762 antenna. As in past contests, my operating period was confined to the first four hours of the contest and three hours on Sunday morning. The radiation pattern of the three-element Yagi is noticeably different from the two-element Yagi I had been using, and it took a little getting used to. Nonetheless, I was able to contact 43 stations in 12 different grids via groundwave, a moderate increase of eight contacts from my average of 35 contacts during the September contest with my two-element beam. Overall, I would say that I got the most possible out of this antenna, given my limited power and modest height of 300 feet above sea level.

Additional Testing

I also tested the antenna from my home QTH (which is not on any hill) and found the antenna worked well there, too. There was no skip activity, but I was able to work a few local stations and get the hang of pointing the beam right at the stations for maximum signal strength. Then I took it portable again, setting up at a special event station run by the Peconic Amateur Radio Club. Using 150 watts this time, with *no* contest and so little activity on the band, I was impressed at being able to make contacts in three different grid squares in Connecticut, Massachusetts, and Rhode Island. These contacts, as well as tests with beacons, also demonstrated the antenna's excellent front-to-back ratio, which generally seemed to be on the order of two or three S-units.

Final Comments

There were a few minor items that I noticed with this antenna that I believe could be improved upon to make it even better for hilltopping use. First of all, the driven elements and the directors are only 1/2-inch different in length, and it would be rather easy to make a mistake during assembly. I would suggest that for hilltopping use, you mark each element with strips of different colored tape. You also need to make a mental note as to where the front of the anten-

"One of my most distant contacts was with KB2DMK, about 250 miles away in FN12, a grid that always seemed to be just beyond the reach of previous antenna setups...."

na (director end) is. In the case of this antenna, the tuning network is on the side of the mast in between the driven element and the director, while the mounting U-bolt is on the side of the mast between the driven element and the reflector. Keep this in mind and you'll be fine, or just mark the mast with an arrow pointing toward the front.

Also, close attention must be paid when assembling the metal bracket used to connect the tuning fork to the driven element. This bracket is a little bit oversized and should be carefully installed so it doesn't inadvertently short out against the mast. This can be a concern for a permanent installation where wind will stress the antenna and may cause this bracket to move. Electrical tape on the mast is a good and simple precaution against inadvertent shorting if high winds should flex the antenna. (I have discussed these concerns with the designer for a possible update by MFJ in the future.)

Overall, I was very impressed with the rugged and lightweight design of this antenna. It's ideal for a QRP effort in VHF contests, Field Day, and other portable operations. This antenna would be suitable for a rover effort in a VHF contest, but time has to be set aside for assembly at each stop as it takes about five minutes to put all of the screws into the elements. For a permanent installation, though, this antenna will more than meet the demands of a rigorous environment. And, the MFJ-1762 is reasonably priced at $69.95.

My thanks to Al, K2BPQ; Emil, W3EP; Sam, N1NOL, and Frank, N8WXQ, who took a little extra time during the VHF contest to give me signal reports. ■

Resources

For more information, or to order the MFJ-1762 6-meter Yagi, call or visit your favorite MFJ dealer, or contact MFJ Enterprises, P.O. Box 494, Mississippi State, MS 39762; Phone: (601) 323-0549; Internet: <http://www.mfjenterprises.com>.

VHF Worldwide

5A28: 6 Meters from Libya

The 6-meter portion of last summer's 5A28 DXpedition to Libya netted 51 contacts in 11 countries, according to information provided by Gunter Dilsky, OE6DGG (one of the participants), and forwarded by Chris Gare, G3WOS, of the UK Six Metre Group (UKSMG). The DXpedition group was active on 160 through 2 meters, so the 6-meter operation was only a small part of the total.

Gunter reports that the station first went on the air August 30 as 5A1A, the callsign of a Libyan club station which has been on the air on six for two years, but which had made only a few contacts on the band. That first day of operating netted only one 6-meter contact, with 9H5EE in Malta.

The first operation as 5A28 came on August 31, with a sporadic-*E* opening providing contacts in France, Germany, Belgium, and the Netherlands. A second *E*-skip opening on September 1 added Poland to the list, with additional contacts in France, Germany, and the Netherlands.

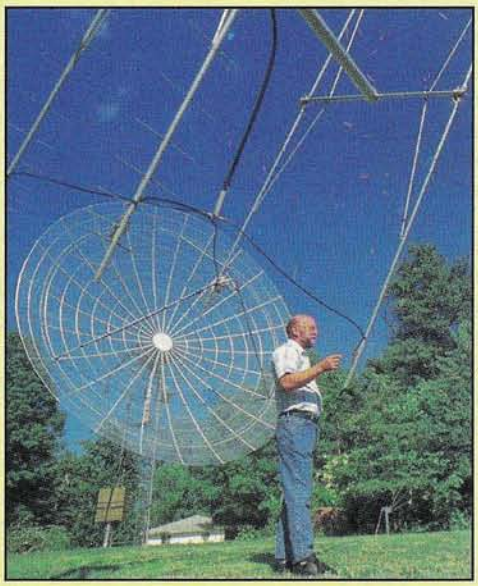
Conditions worsened on the 2nd, with only two contacts made on six, both "locals" to Malta. Then, Gunter says, several days of heavy rain and lightning kept the station off the air until September 7—the final day of the operation. But the wait paid off, with the biggest band opening of the trip: 33 QSOs to eight DXCC countries, including several stations in England, Jersey, Wales, and Italy, none of which had been worked earlier.

Final comment from Gunter: "Many thanks to all of you who worked 5A28. It was a very nice feeling to be on the other side of the pile-up."

On the Cover

"I'm just a ham at heart," says Ray Rector, WA4NJP, of Gillsville, Georgia, approximately 60 miles northeast of Atlanta. In this photo, Ray is standing among his six towers and dozens of antennas, including the 6-meter EME array that snagged him the world record for a moonbounce contact on that band, from Georgia to New Zealand.

Ray is active on EME and other weak-signal modes on 50, 144, 222, 432, and 1296 MHz and has earned Worked All States and Worked All Continents on 2 meters. Ray says he's operated VHF "from the get-go" in 1962 and has been on EME since 1975. As far as he's concerned, "the main use of HF is to make skeds for VHF!"



Ray's 6-meter EME array consists of four 36-foot, eight-element Yagis centered at 80 feet. Six meters, says Ray, is "the most difficult band there is" for working stations off the moon, noting that he's worked about 30 different stations on 6-meter EME, another record. All told, Ray says he's worked just under 1,000 different hams via EME, including some 500 to 600 on 2 meters alone.

His 2-meter moonbounce array consists of 16 3-wavelength Yagis (not visible in the photo), and, on 432, he uses eight 24-element beams. The 36-foot homebrew dish can be used on 222, 432, and 1296 MHz and was set up for 1296 when this photo was taken. A new addition (not pictured and not yet on the air) is a 5-meter dish for 2304-MHz EME. Plus, there's a 100-foot tower with beams for all five bands so Ray can make terrestrial contacts without having to rearrange his EME antennas!

(Cover photo by Larry Mulvehill, WB2ZPI)

How to Buy a New Radio

When it comes time to buy a radio, how should you choose between the multitude of available models? WB2D has some tried-and-true tips for getting the most for your money.

Sooner or later you're going to decide to buy a new piece of equipment. There are a number of ways and means for deciding which particular model to buy. You could pick out the mobile that has the prettiest lights on the panel. Or you could buy the handheld that has the silkiest keypad. Perhaps you will buy the amplifier that has the relays that make the loudest "kerchunk" when they close and open. Of course, you could opt for a vertical antenna that resembles a pelican diving for a fish—I saw one once in an ad in another magazine.

There is, I suppose, some merit to these criteria, but wouldn't it make more sense to simply examine the *specifications* of the various contenders and factor that information into your decision? But which specifications are really important? And what do they mean? It's easier than it sounds, and you definitely don't have to be a rocket scientist to make an informed decision. (You may, however, need a degree in computer science to be able to figure out some of the programming of some of the more exotic transceivers on the market.)

For any given class of equipment, there are only a handful of specifications that are truly significant. What follows is my own personal list. Other operators with different experiences will probably have a slightly different list. The more experienced hams that you can talk to before you buy, the better off you will be.

Transceivers

FM base/mobile rigs for the VHF/UHF bands pack phenomenal features into a very small space. Digital circuitry (microprocessors) and advanced design techniques allow the manufacturers to package dual-band transceivers capable of 50-watt output in a package often smaller than a typical hardback novel.

Most VHF mobile rigs today have the same major features, such as lots of memories and power output in the 50-watt range. The differences lie in minor features and how easy they are to program and use. If possible, try out a rig before you buy.

With such capability, one of the biggest challenges becomes designing a control interface that is intuitive and convenient for the user. What's the point of having super features if the operator can't figure out how to turn the rig on and make a contact on the local repeater? It's wise to try out a model before purchasing, if possible. If not, try to find another ham who has one and get the rundown from him or her. Or you can wait for one of the major magazines, such as *CQ* or *CQVHF*, to do a full review of the unit.

There are some features that are virtually universal at this point, but the exact method needed to activate or control these features varies from model to model and manufacturer to manufacturer. Virtually all models on the market now offer at least a few memory channels. How many memory channels do you need? If you live in a rural area or habitually hang out on the same repeater, 10 channels is probably sufficient. On the other hand, if you travel for a living and visit the same areas every few days or weeks, 100 channels might be more to your liking. This would be particularly true if the rig offers the capability of organizing and grouping the channels so that the operator can activate only one group at a time.

The trend now is for each memory channel to store more information than just the operating frequency. For instance, if CTCSS (Continuous Tone Coded Squelch System, often referred to by the Motorola trademark of "PL") is used on the repeater, it's very handy to have the CTCSS encoder/decoder automatically select the right tone each time the memory channel is activated. For dual-band or multi-band models, each band often has its own set of memories.

Another useful memory function for some operators is storage of DTMF (Dual Tone Multi Frequency or AT&T's trademark, "Touch Tone") strings. A typical use would be a telephone number frequently called via the autopatch. Or, perhaps, the repeater offers numerous "bells and whistles" that can be activated via a DTMF string. Some models now offer built-in paging and DTMF coded squelch. This is useful for operators who want to be available to receive a call directed to them but who do not wish to monitor a busy frequency all day, such as

"It's easier than it sounds, and you definitely don't have to be a rocket scientist to make an informed decision."

By Peter O'Dell, WB2D

" ...one of the biggest challenges [for manufacturers] becomes designing a control interface that is intuitive and convenient for the user."

those involved in emergency preparedness communications.

Priority Calling

Other universals (or almost universals) are "call" and "priority" memory channels. A call channel can usually be activated by touching a single button. This feature is quite useful to get you onto your "home" frequency very rapidly. A priority channel, though, usually refers to the rig's ability to momentarily check for activity on the frequency programmed into the "priority" channel while the receiver is tuned to another frequency. With most rigs, the operator can choose to program the same frequency into the call and priority channels.

A cross-band repeater function (in dual- or multi-band units) can be very useful for some operators. A typical application here might be for a ham on an outing at a remote site too far away from the local repeater for a 144-MHz handheld to be useful. The mobile rig could be set up to repeat between 144 and 440 MHz, and the ham could stay in contact with other operators on 144 MHz via a 440 handheld. (*Beware, though, of running down your car's battery with extended use.—ed.*)

One extremely useful feature that's available on some upscale models (and will probably become universal within the next few years) is the ability to program the radio via a cable connected to a computer. It would be difficult to overestimate the usefulness of this feature for a rig with a lot of memories and programmable features. A variation on this theme is "cloning," in which all the memory information from one radio may be transferred into the memory of another radio, either via a cable or over the air. Generally, both radios must be the identical models for cloning to work.

Some top-of-the-line models also offer a detachable front panel, which can be very useful for smaller cars with little room for mounting a unit under the dash. This feature is also desirable when the vehicle will be left unattended and there is danger of a thief breaking in and making off with the radio.

Extended Receive Tuning

Many, if not most, of the units offer extended receiver tuning ranges. On the positive side, this reduces the need for a scanner if the operator is inclined to do some listening outside the ham bands. The downside of this is that some models suffer from severe intermod (interference usually caused by the mixing of strong out of band signals) when located in urban areas. (See the *ARRL Handbook* for a discussion of intermod and its cures.) This is because filtering that normally would block strong out-of-band signals from entering the front end of the receiver must be removed in order for the unit to be able to receive out-of-band signals. A few top-of-the-line models offer a separate out-of-band receiver. There is no standard specification for intermod susceptibility. If you live in an area with a lot of RF "pollution," you probably will want to listen closely as other nearby operators tell of their experiences.

Handhelds

Many of the handhelds could be described as simply low-powered, battery-operated, miniaturized versions of base/mobile models. Often the features and capabilities are quite similar, obviously excluding size and output power. There are some issues, though, that are unique to the handheld. For instance, a ham is much more likely to inadvertently bump the control pad of a handheld being carried on the belt or in a purse than one on the mobile unit mounted under the dash. The ability to quickly and easily lock and unlock the control pad is a significant feature.

NiCd battery packs have been the undisputed power source of choice for portable radios for years. They are not without problems, though. Considerable care must be observed in charging them, making sure to avoid cell "memory" among other things. If a cell is totally discharged, there is the danger of inadvertently "reversing" it. In the cellular telephone market, NiCds are being edged out by Nickel Metal Hydride (NiMH) packs. Besides offering somewhat better power capacity, these batteries are not a threat to the environment as NiCd cells are. As the market for NiMH cells increases, we should see a decrease in price and more

manufacturers should begin to offer them as an option. (*NiMH packs require "smart chargers" to avoid overcharging/overheating, and some manufacturers warn that their fast-chargers aren't NiMH capable. See July, 1997,* CQ VHF *for more information.—ed.*)

Although Automatic Power Off (APO) circuits are included in some base/mobile models, these features come into their own with handhelds. It's a simple timer circuit that shuts the radio off if the transmitter is not activated or no signal breaks the squelch for a certain amount of time, usually an hour. Such a circuit can save you the annoyance of finding that you unintentionally have left the unit on and run the battery down.

There are some features, however, that are equally important in handhelds and base/mobile units. Among these are flexibility in repeater offsets, or splits, and in frequency tuning steps. Adherence to the ARRL's bandplans for repeaters is spotty at best, so any radio on the market now should be able to handle odd-ball splits with some degree of elegance. Likewise, good design calls for the ability to easily change tuning steps (channel spacing). This is because 2-meter repeaters are spaced every 20 kHz in some parts of the U.S., and every 15 kHz in others —and sometimes both at once (see below).

Another useful feature is having the ability to instantly switch transmit and receive frequencies (T/R Reverse). This enables you to monitor a repeater's input frequency to quickly tell whether you are in simplex range of the person to whom you're talking.

Scanning Abilities

A scanning feature is useful, but because of the vagaries of the bands, particularly 144 MHz, it's highly desirable to have several different scanning schemes available or the ability to tailor the scanning to your needs. For instance, in most areas of the country, you might want to scan 146.61 to 147.39 MHz in 15-kHz steps, but you would probably want to scan 145.20 to 145.50 in 20-kHz steps. Obviously, being able to scan only certain band segments is useful, too, as well as the ability to "lock out" certain memory frequencies (so you don't get "stuck," for example, on NOAA Weather Radio, which is always transmitting, if you've programmed that frequency into one of your memory channels).

Both MARS (Military Affiliate Radio System) and CAP (Civil Air Patrol) have frequencies just outside the ham bands. For the ham who is also a member of one of these groups, it's most useful to be able to use his regular ham equipment on these frequencies. Some designs lock out the transmitter when the unit is tuned outside the standard ham frequencies. The ability to easily disable this feature is of significance to MARS/CAP operators. (*Some manufacturers require you to bring the radio to an authorized dealer or service center and provide proof of authority to operate on these frequencies before "unlocking" them for you.—ed.*)

On to the Nitty Gritty

In terms of rating, receiver sensitivity is typically measured in (X) mV for 12 dB SINAD. The lower the value of X, the more sensitive the receiver is. Selectivity is usually measured at the 6 and 60 dB points. The closer these numbers are to each other, the better the selectivity of the receiver. (For more detailed information on what these numbers and abbreviations mean, see Don Stoner's three-part series on "Getting to Know Your Handheld" in his "In Theory" column in the September, October, and November, 1996, issues of *CQ VHF*.)

Amplifiers

A typical VHF/UHF FM power amplifier is the simplest active piece of equipment in a ham station. Units designed to work with handhelds and mobile equipment commonly have no more than two switches: power on and off, and preamp on and off. That, of course, assumes that it has a receive preamp built in. Also, you'll have an input connector, an output connector and a power cord. Nothing to set, nothing to adjust. Just plug it in and use it. It senses that the transmitter has been activated and goes into transmit mode automatically.

"One extremely useful feature that is available on some upscale models (and will probably become universal within the next few years) is the ability to program the radio via a cable connected to a computer."

Important features to look for on handhelds are such things as protection from accidental reprogramming while on a belt or in a purse, and power-saving circuitry to prolong battery life.

Although many manufacturers refer to their products as being "linear" amplifiers, that may not always be the case for VHF/UHF power amplifiers. A Class C (nonlinear) amplifier is just fine for FM work. It would not work well, however, for SSB. If you only intend to operate on FM, then it does not matter whether or not your amplifier is truly "linear." But, if you plan to operate SSB, it is of paramount importance to make sure that the amplifier does, in fact, operate as a true linear amp. If in doubt, contact the manufacturer before purchase.

A built-in receiver preamp is useful, particularly if your station has a "hearing" problem. Having the preamp built into the amplifier makes life simple for the user. For a preamp to survive in a circuit with a transmitter (not to mention an outboard amplifier), the switching circuit must be fast and fail-safe. With these models, the design engineers have worked out the bugs. The only significant disadvantage to this scheme is that the preamp is housed inside the amplifier housing, making it impossible to "remote" the preamp without also remoting the amplifier. Usually, that is not practical. Among other things, that would make

Most VHF linear amplifiers for FM use aren't really linear, but they generally don't have to be (for SSB and CW work, they do, though, so be careful). Operation is generally quite simple: just an on/off switch for the amp and, if there's a receive preamp built in, a switch for that, too.

necessary a long run of power cable. Another drawback to preamps is that they tend to amplify out-of-band signals as well as in-band signals, and, in urban areas, this can result in unnecessary intermod and interference.

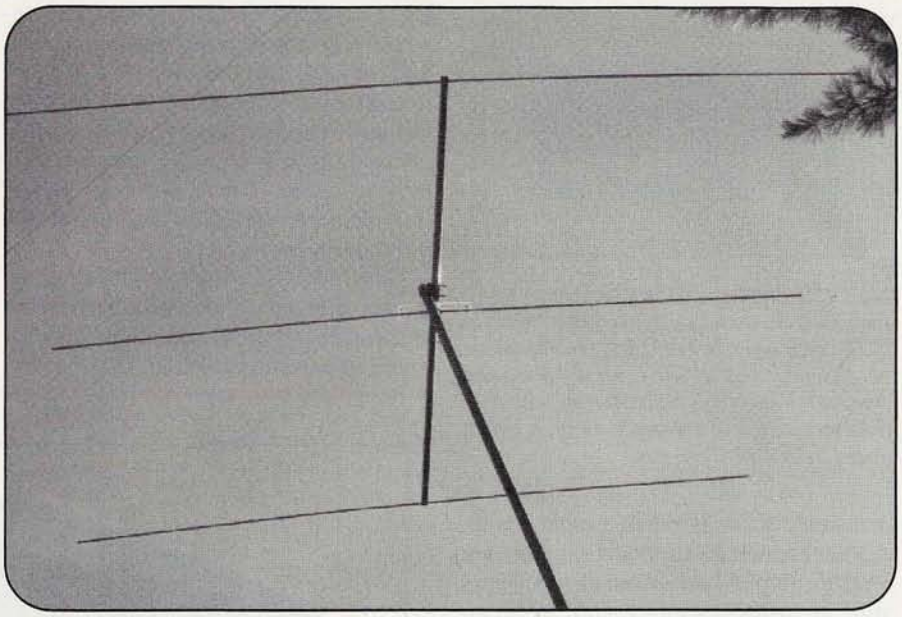
Virtually all units have protective circuitry built in that limits output power in face of a high SWR. Such circuits prevent the amplifier from being damaged by high SWR conditions. It's probably well worth paying a little more for such a circuit if the amplifier happens to be offered in both flavors, with and without. Finally, there's the matter of feedline connectors. Most 2-meter amplifiers will use so-called (and misnamed) UHF or SO-239 connectors, while on 440 MHz and higher, you'll find (and most experienced operators prefer) Type N connectors instead. Make sure the connector on your coax matches that of the amplifier. (Amps intended for use with HTs will often have a cable with a BNC connector on the input side.)

Antennas

Antennas for VHF/UHF can be divided into several different categories. One of the most meaningful is directional versus omnidirectional. For the casual FM operator, the omnidirectional antenna is usually the better choice for a first antenna. These vertical radiators are comparatively inexpensive, easy to install, and require no rotator. They allow you to access repeaters in all directions without having to turn the antenna.

The gain of an antenna has to do with "shaping" the pattern of the transmitted signal (and received, too, but it is usually easier to visualize what is going on while thinking about the transmitted signal). A true omnidirectional antenna would radiate equally in every direction (X, Y and Z coordinates, or for the mathematically-impaired, left-right, up-down and forward-back). Such a radiator does not exist, but if it did it would simply be a point in space. The radiation pattern coming off it is typically depicted as a perfect sphere. This is the definition of the *isotropic* radiator—the imaginary point in space.

Gain has to do with taking some of the energy going in a non-useful direction and moving it around and adding it to that going in a useful direction. Graphically, it is like taking the imaginary ball and squishing it around into something closer to a bean-bag chair than a tennis ball. For regular terrestrial communications, we basically want our signal to mostly go toward the horizon. Any signal going up toward the sky at some steep angle is wasted. So, when we talk about a real "omnidirectional" antenna, we are thinking of one that radiates equally well in the full 360 degrees toward the horizon. Gain for these antennas is accomplished by squeezing some of the high-angle radia-



Directional antennas are useful on VHF for long-distance contacts. Use an antenna with vertical elements for FM work, and with horizontal elements for SSB/CW operating.

tion down toward the horizon—sort of like flattening out a doughnut.

Beam (directional) antennas also take some of their gain from high-angle radiation. But they mainly take signal from the sides and back of the antenna and aim it toward the front. Graphically, these "lobes" are often depicted from an overhead view and look a bit like the silhouette of an ice-cream cone with the tip of the cone at the center of the antenna.

Traditionally, antenna gain is measured with respect to either an isotropic radiator (dBi) or a dipole (dBd). The same antenna will show about 2 dB higher gain when referenced to the isotropic radiator instead of a dipole (because a dipole typically has a gain of slightly more than 2 dB over isotropic). For omnidirectional antennas, the measurement procedures are fairly standard, so you should feel confident comparing apples to apples where these antennas are concerned—as long as you know the reference antenna. Bandwidth is usually not an issue for these antennas, either. Most will perform with acceptable SWR (generally less than 2:1) across the entire band for which they're designed.

Getting Directional

With directional antennas, the figuring becomes a bit more complicated. Gain can be thrown off by a number of different factors, including height above ground and the proximity of other metallic objects. Furthermore, gain can be measured in a number of different ways. For instance, the manufacturer might take several readings across the band and average them. Or he might simply provide the highest gain figure found across the operating band.

Bandwidth also becomes an issue with directional antennas (it goes down as gain goes up). For this reason, manufacturers often "cut" their beams for a specific portion of an amateur band. For example, a vertical beam for 2 meters will generally be used for FM work, so most will be centered on 147 MHz, the middle of the "traditional" repeater subband of 146–148 MHz. Horizontal beams, on the other hand, are most often used for SSB and CW operation, which is found mostly at the low end of the band, or for satellites, which have a 200-kHz chunk of space between 145.800 and 146.000 MHz. In these cases, the beams will either be cut for 145 MHz (halfway between 144 and 146), or specifically designed either for weak-signal (144 MHz) or satellite (146 MHz) use.

RTFP, Then RTFM

Computer jocks have a saying that is the universal comeback to a stupid question—"RTFM"—Read The Fine Manual (that came with your software or whatever). When it comes to buying a new piece of ham gear, my advice to you is to RTFP—Read The Fine Print. Then RTFM. And have a happy holiday season, too. ■

Public Service Around the World

Amateur radio emergency communications is a worldwide activity. Here's a glimpse of hams in action all over the world, helping their neighbors...in the public interest.

Serving in the public interest. Is this a tradition just among hams in North America? The answer is no! Other nations have public-service-minded hams with organizations similar to the Amateur Radio Emergency Service (ARES) and the Radio Amateur Civil Emergency Service (RACES). This month, we'll take a look at how amateurs around the world are helping others.

Australia

When an avalanche hit the Australian town of Thredbo a few months ago, amateur radio operators were called to assist with communications and other duties. They helped the police with their Disaster Victim Registration (DVR) procedures, in both the registration and public inquiry aspects. Tasks included computer entry of information from Thredbo, the taking of calls from the public regarding the victims, training of police officers for these tasks, supervision of the DVR Coordination Centre, and liaison between the Volunteer Resource Association operators and the Police Service. The hams provided day and night assistance for the first three days of the operation.

These amateurs are part of WICEN, the Wireless Institute Civil Emergency Network. WICEN is sponsored by the Wireless Institute of Australia, which claims to be the oldest radio organization in the world. WICEN members provide communications during emergencies and disasters such as cyclones (hurricanes), bush fires, floods, earthquakes, and weather watches, as well as at public service events like fun runs, horse endurance races, car rallies, bicycle races, and boating events.

"Trained volunteers linking the community in times of need"—motto of Australia's Wireless Institute Civil Emergency Network, or WICEN, the VK version of ARES.

According to Leigh Baker, VK3TP, WICEN's National Coordinator, the police force has the primary responsibility for coordinating agency responses to emergencies. Communication support is provided by Telecom Australia and WICEN. Telecom Australia must provide alternative communications that can bypass the telephone network. WICEN's responsibilities under Australia's disaster plan (DISPLAN) include:

- responding to the Police DISPLAN Coordinator or the various state emergency services;
- radio communications for and between support agencies;
- supplementary and support communication to combat agencies; and
- service to the community where conventional communication facilities are not available.

"WICEN's objective is to make the resources of the Amateur Radio Service most effectively available to the community in times of disaster or sudden need."

WICEN members may be called upon to provide communications for police coordinators, state and territory emergency services, the Victorian Institute of Forensic Pathology, Victorian State Coroner's Services Centre, the Departments of Community Services, Agriculture, Health, and Education, the Red Cross Society, St. John Ambulance Brigade, and local municipalities.

"WICEN members are prepared to have a continuing involvement in community service," says Baker. "The trained operator core of WICEN is available on request by the appropriate authorities and in the case of a larger emergency, would act as a nucleus to enable volunteers from the amateur radio population to be put to use in a coordinated manner."

WICEN's objective is to make the resources of the Amateur Radio Service most effectively available to the community in times of disaster or sudden need. WICEN has a federal coordinator who assists each of the state coordinators. Each state structure varies across Australia. In some states, WICEN works as a subunit of the State Emergency Service; in another it works as a subunit of the Volunteer Rescue Association; and in other states, WICEN is recognized as a separate entity under the state disaster

By Bob Josuweit, WA3PZO

"AREC's mission is 'to be the preferred provider for emergency communications to New Zealand emergency services' by training and providing competent radio communications personnel who are suitably skilled in assisting organizations during emergencies."

plan and is on equal standing with the fire brigades or Red Cross.

Within each state or division, WICEN is organized into regions which usually correspond to those of the Police Force and State Emergency Service. If there is a shortage of WICEN members available to assist, the Police or SES officer decides which communications tasks have the greater priority. WICEN members may also be called upon to assist in neighboring states.

Each WICEN member is issued an identification card and a handbook of information and procedures for response to various types of emergencies. Members also receive an information letter to be given to their employers explaining WICEN's operation and seeking each employer's cooperation if an activation occurs during working hours. Training exercises can last for a few hours or could be a week long.

In some WICEN groups, there's a small charge for a membership card and, in three divisions, there is a charge to join (up to $10 Australian). In four divisions, uniforms are encouraged, but not required. The uniforms in New South Wales, Victoria, and Queensland are similar. The uniforms in the Northern Territory are different because of the warmer temperatures (remember, in the southern hemisphere, temperatures are warmer in the north than in the south).

There are two requirements for belonging to WICEN. The first is that the member must participate in at least one, and preferably two, field exercises per year. Secondly, WICEN members should be familiar with voice procedure and message handling techniques. Upon being activated, WICEN suggests to its members that they have a meal before they leave home since it may be hours before they are able to eat. Taking along some high energy snack food and something to drink is also recommended.

Following every activation, each WICEN member participates in two debriefing sessions. The first is to make sure there are no claims for damage to equipment and to determine if the operator needs any counseling or other support. The second is an event debriefing to review and evaluate WICEN's participation in the disaster.

New Zealand

If you've been involved with amateur radio public service activities in the U.S. for 20 years or longer, you probably remember the name Amateur Radio Emergency Corps (AREC). In an effort to update the name, the American Radio Relay League changed AREC's name in 1980 to the Amateur Radio Emergency Service, ARES.

Well, if you were a New Zealand amateur 20 years ago, and a member of the New Zealand Amateur Radio Transmitting Society (NZART), you might have participated in their Amateur Radio Emergency Service. But then the name was changed to the Amateur Radio Emergency Corps and is now simply Amateur Radio Emergency Communications (AREC). AREC's mission is "to be the preferred provider for emergency communications to New Zealand emergency services" by training and providing competent radio communications personnel who are suitably skilled in assisting organizations during emergencies. AREC maintains a close liaison with the New Zealand Police for Search and Rescue, the civil defense agency, and other community organizations. This liaison involves all members in active operations and training to enable them to be fully conversant with all modes of communications and to be flexible in adapting to changing situations.

"To be the preferred provider for emergency communications to New Zealand's Emergency Service"—Mission statement of New Zealand's amateur radio emergency communications group.

At the Section level, leaders maintain contact with emergency agencies, such as the police, St. John Ambulance, Red Cross, Civil Defense, and Search and Rescue. Regional coordination is done by the area manager; at a national level, coordination with similar organizations

Communication Lessons from Guam

Jayson Kohama, WH6BXK, Communications Officer for the HI-1 NDMS DMAT team, spent almost two weeks on Guam following the crash of Korean Airlines flight 801 there last August. Below, he offers a few tips based on the Hawaiian DMAT's August deployment to the crash site. (NDMS is the National Disaster Medical System, and DMAT is a Disaster Medical Assistance Team.)

Before going into a new area, you should try to find a topographic map so you can familiarize yourself with the terrain and try to see what kinds of problems you will encounter with radio communications. Make sure that everything is tested often. We had the fax set up for a few hours before we realized that it would only receive. And even if everything is working OK when you start, it's a mistake to assume that there will be no problems. Even the simplest of items will be hard to find. I could not find a pair of wire crimpers on the island until I found a pair at a local NAPA auto parts store.

A complete telecommunications tool set would be real handy. Sometimes it takes too long for the phone people to get to you with their tools. The problems we had with the system were minor, like loose connections and broken jacks and connectors. Make sure you have duct tape, super glue, chewing gum, and zip ties. You will need them.

Britain's ham radio emergency organization, Raynet, provides a 24-hour per day duty officer to assist when necessary.

"Raynet's biggest incident ever was its participation in the widespread search following the 1988 crash of Pan Am flight 103 over Lockerbie, Scotland. Raynet provided a minimum of 80 operators during each of the first ten days after the disaster."

and government agencies is handled by the National Director, who is appointed by the NZART Council.

During search-and-rescue missions, AREC members are required to provide communications between the search teams and the search headquarters. They may also be required to provide communications back to a town base if the search is in a very remote area, or communications to air support. In most parts of the country, high frequency communication is needed, but the use of VHF handheld equipment in conjunction with portable repeaters is becoming more common.

AREC provides operators and specialized equipment on a volunteer, non-profit basis. The police provide some financial assistance, but most of AREC's funding comes from private donations and fund raising activities.

Great Britain

Since 1954, British amateur radio operators have participated in Raynet, the Radio Amateurs' Emergency Network. Raynet provides emergency communications services, almost exclusively by radio, to a wide range of organizations. Raynet groups are organized at the county or local level, and these groups are organized into zones with Zone Coordinators. At the national level, Raynet is managed by the Zone Coordinators, the Chairman, Secretary, and Treasurer. Besides working in their respective zones, the Zone Coordinators also chair specialist groups, which include emergency planning, training, and technical.

One unique feature Raynet offers at the national level is a Duty Officer who can be called 24 hours a day. The various served agencies can call a single phone number which will switch them to the Raynet Duty Officer, who may be located anywhere in the country. This contact point is a backup to local points of contact. Some groups have only a few members, but they all work closely with neighboring amateurs in times of need.

Here in the U.S., we take for granted the freedom to pass messages on behalf of a third party, whether or not it's in an emergency situation. In Great Britain amateurs may not routinely pass third party messages, but agreements have been worked out with the licensing authorities to allow them to pass messages to specified "User Services." The list includes the British Red Cross, St. John Ambulance, St. Andrews Ambulance, Local Authority Emergency Planning Officers, any of the United Kingdom's police, fire, or ambulance services, the Coast Guard, health authorities, government departments, and public utilities.

As part of their training and to keep in practice, Raynet members provide radio communications at public events, assisting one or another of the voluntary ambulance organizations and, by so doing, widening the coverage which they can provide. Typically, for example, at a half-marathon road race, there may be an ambulance with a crew plus a first aid team and as many as a dozen Raynet stations at points around the course, ready to report casualties or people in need of medical assistance.

For example, the 25 active members of the Cambridge Raynet provide communications for various events every other weekend during the spring and fall (Cambridge is a small city in eastern England). During these events, the Raynet group provides communications for one of the voluntary medical services, such as the St. John Ambulance Brigade or the Red Cross. They may also help the local government or police department.

Several Raynet groups have not been activated for actual emergencies since the regular emergency services are quite large and can handle most situations. However that does not stop the training and public service work. The Surrey Raynet group, covering an area south of London, is one example. They keep up their training even though they've never been called up "for real," aware of the risks associated with living between two of the world's busiest airports (Heathrow and Gatwick).

Between 1993 and 1996, Raynet groups were called upon to provide radio communications on 17 occasions for emergencies that included fires, floods, chemical incidents, and an air crash. Raynet's biggest incident ever was its participation in the widespread search following the 1988 crash of Pan Am flight 103 over Lockerbie, Scotland. Raynet provided a minimum of 80 operators during each of the first 10 days after the disaster, with up to 130 on duty on the busier days.

Raynet has also had its fair share of maritime incidents. The more recent ones have included the Piper Alpha Oil Rig, Zeebrugge Ferry, Shetlands, Rose Bay, and Sea Empress oil spills. Overseas work involves Raynet providing emergency communications, usually for the International Red Cross or the International Rescue Brigade. Some notable examples were the earthquakes in Mexico and El Salvador and Caribbean hurricanes. News of emergency medical, clothing, food and shelter requirements can be passed to authorities in Great Britain along with news of relatives.

Japan

On the other side of the world, the Japan Amateur Radio League (JARL) participates in the Council of Emergency Radio Communications (organized by the Ministry of Posts and Telecommunications) and other organizations. In the event of an emergency, amateur radio operators work with each other to facilitate rescue operations and other emergency activities. JARL also conducts training courses for emergency communications at locations around Japan.

Separately, Brent Bossom, 7J1ANN, has led an effort to get the Tokyo International Amateur Radio Association

"This winter will show the effects of El Niño. For some it may be a mild winter. For others, though, there may be blizzards or flooding or both. Be prepared."

(TIARA) Emergency Communications Plan more organized. The plan coordinates the efforts of TIARA with those of the amateur radio clubs at two of the large U.S. military bases on the Kanto Plain.

The JAARAY club at Yokota AFB and the Yokosuka Navy Base club provide outlying link points to provide better coverage throughout the area. In the event of an emergency, TIARA members are encouraged to appear on specific HF, VHF, and UHF frequencies. Here, they should be able to get health and welfare information messages out to an unaffected site for relay to relatives abroad.

Ham Radio: A Worldwide Resource

This month, we've taken a look at amateurs around the world serving in the public interest. This is only a sampling of the work being done by hams in times of need. In our examples, amateurs provide routine public service communications for runs, cycling, boating, and other events. In times of emergency, they are there to assist government and other agencies—not only with their communication skills, but with other technical and relief skills that they have learned. We can easily see that these amateurs take as much pride as we do in being trained communicators. At all times, they are working towards a common goal of helping their fellow citizens when the chips are down.

In this holiday season of promoting international goodwill, it's appropriate to acknowledge the public service work of your fellow hams. Winter will show the effects of El Niño. For some it may be a mild winter. For others, though, there may be blizzards or flooding or both. As hams, we need to be prepared.

I'm sure you have a public service experience to tell. Please let us know about it at *CQ VHF* so we can share your experience with others. You can write me at <bjosuweit@aol.com> or <CQVHF @aol.com>.

73 and happy holidays

TIARA, the Tokyo International Amateur Radio Association, works with hams at U.S. bases in Japan to provide emergency communications. TIARA is not associated with JARL, the Japan Amateur Radio League.

Oops...

Looks like we still have a little ways to go in the perfection department. A few little errors managed to slip into last month's issue (if there are more, we're confident you'll tell us about them):

• In "Who Can Build a Better Beam?" we put the wrong picture with the right caption. What was supposed to be the Ron Maroskos (Sr., K5LLL, and Jr., KK5DK) working on their homebrew 70-centimeter beam, ended up as a shot of George Carsner, WØPPF, holding up his team's finished antenna for gain measurement. Here's the photo that was supposed to be there. Ron, Jr., is on the left in the Hard Rock Café T-shirt, and Ron, Sr., is on the right in the straw hat.

• In the table accompanying CO2KK's article on treating 10 meters as a VHF band (p. 34), we put the wrong frequency in the right place for the U.S. FM simplex calling frequency. **The correct calling frequency is 29.600 MHz,** not 28.500. Fortunately, it was in the correct part of the frequency chart, up near the very top of the band, so it's unlikely it'll result in anyone operating FM at 28.500.

• Finally, we had one letter wrong in the address for our contest calendar Web page (and you know how easily computers get confused). The correct URL is: **<http://members.aol.com/cqvhf/ navhfcon.htm>**.

Gift Box

If you're still searching for a holiday gift, you might want to look for the new NOAA weather radios that are capable of receiving weather alerts at the county level. These radios use NWS technology called *SAME* for Specific Area Message Encoding. According to the National Weather Service, older radios will still work, but the new radios will allow you to stay asleep when the alert is for an area far away!

Hamfest Calendar

The following hamfests are scheduled for December, 1997, and early January, 1998:

Dec. 6, Fourth Annual Central Illinois Winter Superfest, Tunrner Junior High School, **Jacksonville, IL.** Talk-in: 146.775-and 444.675+. For more information, write to ARS c/o Kaye Green KBØKHQ, 27 Ivywood Drive, Jacksonville, IL 62650 or call (217) 245-6778. (exams)

Dec. 7, 32nd Annual Swap and Shop, Hazel Park High School, **Hazel Park, MI.** Talk-in: 146.64-(DART). For more information, write to HPARC, Box 368, Hazel Park, MI 48030.

Dec. 13, Third Annual Columbia County Hamfest and Computer Show, National Guard Armory, **Lake City, FL.** For more information, write to P.O. Box 1649, Lake City, FL 32056 or call Colin Boutwell, WA5RKR, (904) 755-7969, (800) 752-7969; or e-mail: <wa5rkr@isgroup.net>.

Jan. 3, 1998 Hamfest and Computer Show, Talley Ward Recreation Center, **Morristown, TN.** Talk-in: 147.03+. For more information, write to LAKEWAY ARC, P.O Box 895, Talbott, TN 37877-0895, or call Kemp Lawson, KF4AGB, (423) 587-3320.

Operating Notes

For December, 1997, and January, 1998:

December

7	Good EME conditions
13	Geminids meteor shower peak
15–19	BCC Meteor Scatter Contest (Europe)
22	Ursids meteor shower peak

January, 1998

4	Good EME Conditions
4	Quadrantids meteor shower peak
24–25	ARRL January VHF Sweepstakes *(Note: the ARRL contest is later than usual this year because January has five weekends in 1998.)*

EME data courtesy W5LUU. More contest info is available on the CQ VHF *Web page at:* <http://members.aol.com/cqvhf/navhfcon.htm>.

Being "Competitive"

What does it take to "be competitive" in a VHF contest? K7XC looks at how top stations plan their strategy.

Happy holidays from the wilds of northern Nevada! I love this time of year, when we take time to cherish what's important to us—our family and friends, our jobs and our hobbies.

Amateur radio is unique in that it involves daily contact with more people in more places than any other pastime I know of, so our circle of friends grows not only in number, but it grows to cover vast distances as well. I have friends all over the planet whom I have never met but who are just as close as someone standing right next to me. It's this art of meaningful communication over the long haul that makes us who we are.

December is also the time to begin planning for next year's June VHF QSO Party (yes, *June*), *the* VHF contesting event of the coming year. Get out those maps, start making "To Do" lists, and get busy...it will be here before you know it!

"Being competitive" with a multi-op station requires months of planning and preparation, plus the ability to put out good signals on as many bands as possible. Here, Bill Dawson, W7TVF, and Jim Frye, NW7O, prepare to operate. (Photos by the author)

Contesting Philosophy

To be "competitive"...what does that mean? To me, it's doing everything in your power to ensure your final score is all that it can be. Through these pages in previous issues, we've discussed the various aspects of VHF contesting—rover, multi-op, single-op, etc.—and some of the mechanics of setting up an effective contest station, but very little of the *philosophy* of a competitive contest effort. So this month, let's review some winning tactics employed by stations in the different categories.

Multi-Op

A multi-op station is a group of two or more amateurs who pool their resources and operate as one large station (*multi-op stands for "multiple operators"—ed.).* Top teams gather together a group of competent operators atop a tall mountain strategically located near a large metropolitan area, or in between two of them. Most of their contacts come from these highly populated areas. They bring plenty of equipment for as many bands as possible, including spares if they can. Kilowatt (kW) amplifiers are a must if you're to work to the outer fringes of the various propagation modes (tropo, meteor scatter, *Es*, F_2, etc.). Most also use large antenna arrays for each band, with spares in case the unmentionable happens and the primary array for a band gets damaged or destroyed.

But having the right equipment is not only what wins contests. It's also attention to detail, making sure the little things get done. Before each contest, multi-op team members inspect, repair, or replace all coax cables and connectors, double-check all the rotors and controllers, replenish their spare hardware buckets, put all coax connector adapters back in their storage case so they're ready if needed, and build new coax jumper cables (you can never have too many), etc. And as a multi-op team, the duties of preparing can be divided among the group members so as not to overwhelm one person.

Once on site, what would take a single-op an hour to do alone, a two-man crew

"...having the right equipment is not only what wins contests. It's also attention to detail, making sure the little things get done."

By Tim Mare'k, K7XC

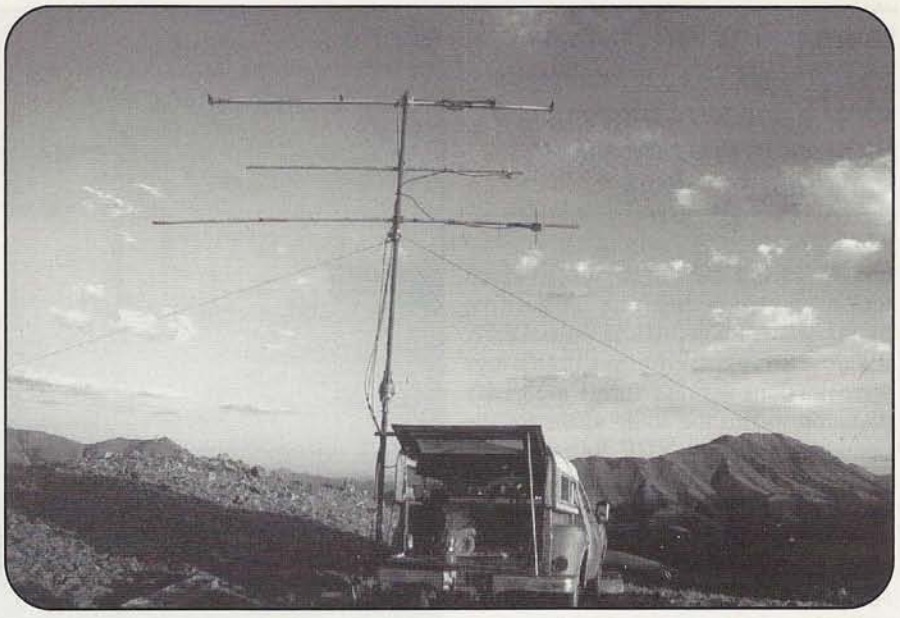
can accomplish in less than half the time. The whole is always greater than the sum of the parts, and, if your crew has been together for a while, very little supervision is necessary as each person knows what's needed and just does it. It's a wonderful thing to watch and be a part of. Of course, this doesn't all come together by itself. Each contest team spends months preparing, meeting, going over what has to get done, reviewing goals and strategies, and reassessing their needs.

Goin' It Alone

The single-ops have a tougher row to hoe, but their challenges can be just as rewarding as any others. Planning is simpler: it's all based on what you can put up on Friday before running out of steam. Here, creativity becomes your biggest weapon, and "less is more" rings true. What can you do to decrease your setup time and yet field as large an effective a station as possible?

Luckily, single Op antenna arrays are not as complicated or diverse as a multi's. Everything has to fit in one vehicle, not several, and this alone will make for some hard choices (I'm assuming you're operating from a remote location, as the top-scoring single-ops generally do). Wrestling a 5000-watt generator by yourself atop a tall mountain 100 miles from anywhere isn't fun. And if you injure yourself, help can be quite a while away, not to mention blowing all the hard work getting ready for the event. So, as a single-op, you must be that much more cautious and deliberate in your actions. Your attention to detail, to the little things, is even more important as no one else is there to draw from if you forget something important. Single-op mountaintopping in a contest teaches you an awful lot about self reliance, prior planning, and developing the ability to "adapt, overcome, and succeed!"

Some of my most memorable trips stem from finding creative solutions to problems in the field using only what was on hand. One time, early on in my weak signal days, a friend and I took his brand new 432-MHz rig up to a mountaintop to make our very first contacts on the band. We were excited about doing something we'd never done before and took everything needed for a quick mountaintop operation...except a U-bolt to mount the Yagi to the mast! There was no suitable replacement to be found. So, in a moment of inspiration, I taped the antenna to the mast using a whole roll of 49-cent electrical tape. It wasn't pretty, but we were on the air and made our first QSO ever on 432-MHz CW with Larry, K6AAW, 180 miles away in CN80, using just 10 watts and no preamp. The three of us jumped around celebrating because we had overcome adversity and still got the job done. It's that creative approach to problems in the field that makes or breaks the best of the single operators.



If you're going out to a remote location as a single-op, the challenge is to put together as big a station as possible within the limits of available space and setup time.

The Rover—A Breed Apart

This is by far *the* most demanding category to operate...*period*! In what other contest setting do you have to deal with the combination of extremely diverse strategy, demanding operating, well thought-out station design and installation, cross-country driving, traffic, the elements, fatigue, navigation, vehicle maintenance, mobile operating and logging, multiplier chasing (mults are hard to come by as a rover now), keeping your wits and being able to think on your feet? It's a "GO GO GO" kind of life and it takes a lot out of you, but the rewards are many. The rover is more important to the stationary station than the other way around. A rover is a constant source of new points and mults and so is highly sought after during a contest. Each time he changes grids, things can get so intense it's as if you were listening to a ham on a DXpedition to a rare country running a raucous pileup.

For a rover to be competitive, he must carry as many bands as possible, each optimized for use while mobile and parked. His route must be highly publicized so everyone in his "flightpath" knows approximately when and where to expect him. If he can recruit a driver, leaving him only the radio duties, so much the better! And recruiting a second op...Heaven! A West Coast rover has a completely different strategy then a Midwest or eastern one. We each have our population centers from which to draw contacts and we plan our routes accordingly. Planning is also based on available equipment.

In my case, to make up for having fewer bands than other rovers, I do more grids. I have Yagis fixed towards the front of the truck and omnidirectional loops for stations to the sides or rear, and I switch between them as needed. I've made several 500-mile contacts while flying down the highway. Jack, AB4CR/R, and his crew visit fewer grids than I do, but they carry 10 bands!

As you go higher in frequency, each contact is worth more points, not to mention the all-important multipliers that are available. I have squeezed as much as I can out of a three-band rover station, placing third two years in a row, while Jack has placed first twice. So, this past September, I borrowed some HTs for 222 and 1296 and extended my route to attempt 32 grids from Los Angeles to Seattle/Vancouver. The additional bands

"Each time [a rover] changes grids, things can get so intense it's as if you were listening to a DXpedition to a rare country run a raucous pileup."

helped, as did the longer route, which took me past more amateurs and gave me more chances for points and mults. I think it's close to my best effort yet, but the logs were not done at press time. I'm already planning to run the route again for the upcoming January VHF Sweepstakes, this time with a greater understanding of each end. More on that next month.

So as you can see, each category has its own problems, strategies, and rewards. And I have yet to discuss QRP-Portable, as that's one category in which I have no experience...yet. But I'm thinking about it. (*How about it, QRP-Portable ops? Want to share your secrets? Let's hear from you.—ed.*)

Regardless of which category you choose, be sure to stay focused, be confident, and compete to the best of your ability. It's not necessary to have the biggest station to have fun or even to win. The average 2-meter station running 100 watts into a modest Yagi will have plenty of action to keep going all weekend. Take that same station to a mountaintop and it will perform like a kW from the valley floor. Take that same station to a mountaintop in a rare grid, and be prepared to deal with the attention normally reserved for a DXpedition to a rare country. You will be *busy*. And remember above all else to *have fun!* After all, that's what hobbies are for....Enjoy!

Speed is of the essence when you're operating as a rover. Setup and tear-down time at each stop must be minimized if you're going to "be competitive."

Activity Reports

This month's activity reports fall mostly into two categories, the Perseids meteor shower in August, and 2-meter tropo and EME (moonbounce) in August and September. Let's start with the "rocks."

From Dave, NØIT:

8/14/97 Perseids—During five skeds prior to Monday evening, I heard absolutely nothing. As the peak approached, conditions improved dramatically. On the 12th, I had 10 schedules. Of these, I was asleep at my operating table during two, and worked four of the remaining eight stations for 50% efficiency. Also had a random contact with VE3AX.

Results on 8/12: 0600 W1XE DM79, 0630 WA4PGM FM07, 0830 KØGU DN70, 0918 VE3AX FN02,1430 W4NF FM18, 1600 WB5IGF EM45 (*W5ZN?—ed.*), and 1730 K1BWT FN42. Overall, I worked six new grids, two new states, and a new country (VE), all using 180 watts to an Eggbeater antenna up 20 feet. While bigger is better, meteor scatter (MS) can be done with modest equipment if an operator is willing to invest the time and give up some sleep (HI). Those of you out there that haven't tried MS because you don't have the station, give it a try. You may be positively surprised.

From Oscar, CO2OJ EL83:

8/14/97—I don't know what happened in other places, but I didn't hear too many rocks. I had six skeds, but only finished one with Steve, WS4F, in EM84, just two minutes before the end time (1328 UTC). Hope that things were better for the rest. CU on the next meteor shower.

From Robert, N7STU DM07aa:

8/14/97—Very unproductive shower this year. 10 Aug, 4 skeds 1(?) completion, nothing heard from 3 skeds VE3GBA CN78 1341km 22 pings, max 2s./11 Aug, 9 skeds 1 completion, nothing heard from 6 skeds 0700 Z KØYO DN60 1400 km 17 pings max 2s, 0830 Z N5WS EL09ru 2134 km 1 ping, 1630 Z KE7NS DN41 921 km 1 ping—10s complete-3 minutes. /12 Aug, 10 skeds, 3 completions, 4 randoms, nothing heard from 2 skeds. 0700 Z KØYO DN60 1400 km 6 pings—max 20s complete-5 minutes, 0830 Z N5WS EL09ru 2134 km 7 pings—max 20+s five 10+s burns complete-19 minutes, 0951 Z KØGU DN70 1355 km random 30+s, S9+20, 1015 Z N5TML EM14 2078 km random 10s, 1830 Z W7XU EN13 2072 km 2 pings—max 90s complete-58 minutes and a NEW STATE.

Primary peak 8000–1000 Z, secondary peak 1500–1530 Z 12 August. Total completions: Skeds— (maybe 5), three new grids, one new state! Random—4 Tropo—three new grids in NV. Ran a lot of longish and duplicate schedules with not much luck. Very

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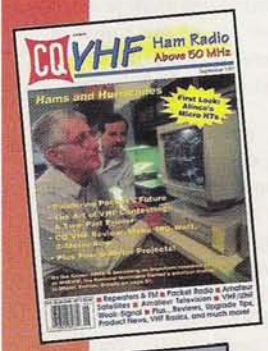

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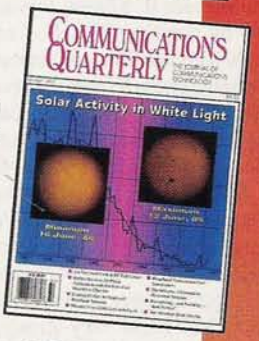

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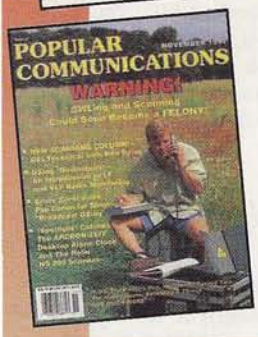

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poor on the 10th/11th. Best DX: N5WS, 2134 km. New personal best MS DX completion! All in favor of a 2-m SSB random MS frequency, maybe 144.150?

From Carl, KM1H:

8/16/97—There was a brief 6-meter opening to Germany from 2030 to 2120 UTC. Lefty, K1TOL, reported DF5LQ, and I had a few stations call me but I could not get complete calls due to QRN. Lefty said there were two Germans that he could hear calling me. At 2116, I copied a partial from a DL9 but no QSO. So there is still some life in the band.

On to the Moon...

From Peter, SM2CEW:

8/23/97—I was active during the morning hours on 144 MHz EME, conditions were pretty good, echoes were very loud at times. This weekend, I wanted to try my 7-element Yagi, (1.5 lambda boom, 11 dBd gain) on the moon, as I have mounted it on a KR500 so I can elevate it. Started this morning's activities by working W5UN, I called for 30 seconds with the little antenna and he came back straight away. Good receiver, Dave! Same thing with Gary, KB8RQ, came right back to my 1st call. Both stations were solid copy on the little beam. My power was about 1 kW.

Stations heard this morning on my small 7-el antenna were 0530 W7HAH, 0550 W5UN very strong, 0556 WØHP good copy, 0629 DK9ZY, 0649 W7HAH again, 0655 W7GJ very good copy, 0720 KB8RQ very strong, 0800 VE7BQH very strong, 0840 K6MYC good copy, 0846 I3DLI good copy, 0940 G4ZHI weak but peaking fully readable, 0950 WA6PEV good copy.

All stations except G4ZHI and WA6PEV were heard with >10 deg elevation so no ground gain at this end to help signals. My compliments to these stations for putting out excellent signals via the moon this morning! My experiments with the small antenna are lots of fun for me as they show that EME can be done with a very modest setup. Just like someone pointed out the other day here on Moon-Net (*the Internet EME reflector—ed.*), all you well equipped meteor-scatter/tropo stations should turn your antennas to the rising or setting moon and join the fun.

From Doug, WØAH DM78:

8/23/97—First time on 144 EME since spring! Worked DF6NA, WØHP, DL9YEY, LX1EC/P, PE1LCH, DJ7OF, WA2GSX, and DK3WG—the last 4 on CQs. Thanks to the LX/P boys for a new country. I believe 6NA and 9YEY are initials.

From Szigy, YO2IS:

8/23/97—QRV on my small 2-m EME window, not too many signals at the beginning at 02.30 UTC, at 04.40 heard the QSO of OE5JFL with F3VS, both 549, on .019. Pity that I was unable to find Hannes on another QRG. At 05.00 got a fast QSO with W5UN on .028, and at 05.19 F3VS on .019. Then at 05.12 hrd IV3CER in QSO with W5UN who was much stronger than in our QSO. So around 05.30 my XYL, YO2DM, decided to answer the CQ from W5UN—he was a solid 559 at the time. Maybe Dave was surprised to hear another YO showing up on the EME scene. No problem in completing the QSO with YO2DM, she helped me a lot in getting together my EME equipment and has enjoyed the debut. Just before my window's end at 05.40 heard KØGU w.439 on .022 in a QSO.

Back to Earth

From Jason Baack, N1RWY FN54no:

8/28/97, 0200–0600 UTC—Tropo worked list: 144 MHz. W1GRW FN31, NG4C FM16, W3OR FM28, KN4SM FM16, WD4KPD FM15, K2SMN FN20, K1WW FM15, KOØU FN42, W4TNV FM05, WF4R FM16, and N1JOY FN41. Great conditions up and down the East Coast!

From Mike, VE9AA FN65rr:

Aug 28, 0220 Z—144.240 MHz SSB, then CW, I worked Connie, NG4C in FM16. Heard him running 1's on 144.200, then with a little liaison help from K1ZZ (and maybe others) via Internet, etc. we got Connie up on 144.240 for a solid QSO. Thanks Connie, Dave, and others. I make it at approx. 1300 kms, depending on his *exact* grid locator. Best Tropo for me in about 4 years. I heard Connie for about 1/2 hour, but not another soul on the band, except Clint, W1LP, in FN41 off the back of his beam. Weird!

From Dave, N7DB, CN85:

8/30/97—Here in the Pacific Northwest, we are now past our summer *E* season. From this perspective, I wish to pass along my observations of this past season. Was this *the* worst summer *E* season? No, but it was one of the poorest in my memory (quarter-century on 6). Although I did not expect any exotic multi-hop openings, I certainly expected the quantity of openings to be much higher. MUF (Maximum Usable Frequency) was not that exciting this year. Usually expect to catch at least *one* 2-m opening, none this summer. Certainly disappointed in not seeing an "all-nighter" of transcontinental 6-m sporadic-*E* this summer.

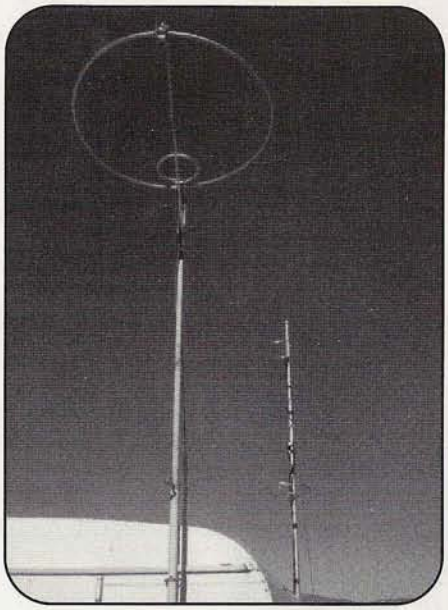
Some of the highlights I would like to point out included the first encounter by this operator of FAI (*Field Aligned Irregularities — ed.*) on 6. Also, there seemed to be a few more high latitude openings observed this season (i.e., VE8 beacons). Looking forward, I note the solar activity has been showing signs of life this month. Will we have a good F_2 cycle this time around? Not sure yet, but we should have a better idea by the end of this year.

From Kevin Bishop, N8ZJN EM79xk:

9/4/97—2-m opening, Had a nice opening tonight working W4, 5, 9, and 0's. About 0225 Z I began working SD, IA, MO, KS, IL, AR, and TN. At 0538 Z, I was still hearing stations to the west.

From Ed, WØOHU EN34oa:

9/4/97—2-m was open Wed night in Midwest—really *big opening*. It's tough being in middle of big opening and listening to those all around you work each other 59! There was also a little Au sprinkled in every few hours to keep things interesting. Around 0150 Z, I worked EN66, EN58, and EN82 on Au. It lasted from 0130 Z to well past 0600 Z. Heard VE4 - EN19 and VE3 - EN29 work AR - EM35. ND and MN worked MO, TN, and KY. SD worked TN, MI, etc. Looking SE, I heard QRM from EN66 and EM66 at same time!, That has to be rare on 144! Stations refused to spread out off of 144.2, so QRM there was deep!



Omnidirectional antennas, such as these loops on my rover truck, don't have the range of Yagis, but require no setup time and allow you to keep operating, even while on the move.

Tnx and Happy Holidays

As 1997 rolls to a close, I would like to thank all those who have helped me throughout the year: Melissa, KC4QBU; Bryan, K1CD; Dave, KA7VLL; Pat, N6RMJ; Dave, W7KK; Russ, K6KLY; Larry, WB5OMF; Al, WB6YIY; Jim, WB2ODH; Jeff, KE6ILX; Kris, KC7ICH; Rod, KA7YOU; Greg, KB7ZNT; George, KØFF; Al, K7CA; Jim, NW7O; Larry, K6AAW; Rich, W2VU; Emil, W3EP; Kurt, K9AKS/6; my brother Scott and his wife, Melody; Mom, Dad, and countless others that have in one way or another touched my life and made it better. Without their help, guidance, encouragement, friendship, companionship, and trust, I would be much less of a person. My profound thanks and Happy Holidays!

73 from DM09bp
de Tim, K7XC/R...sk

Starting at the Beginning: A Buyer's Guide to TNCs

We've gotten pretty esoteric in recent months, so now it's time to go back to basics with a look at that most basic piece of packet radio equipment—the TNC.

I was reading through some statistics about amateur radio the other day, and came across something shocking: There's actually one ham out there who doesn't own a Terminal Node Controller (TNC) yet! I really couldn't believe it, so I double-checked the source, but there it was, in black and white.

So for that one ham (the statistics didn't mention the callsign, or I'd have written a letter instead), I decided to help him or her sort though the nearly overwhelming number of choices for TNCs by taking a look at what's available right now. First, we'll look at what a TNC is, and how it fits into the whole scheme of packet and digital modes. Then, we'll look at specific makes and models.

Doin' It Digitally

Hams have communicated for years using signals they made themselves—voice, CW, and so on. Then somebody got the idea of connecting typewriters by radio, inventing RTTY (Radio TeleTYpe) in the process. Moving ahead, we can now use our computers to talk to each other, saving ourselves considerable time and effort.

No, seriously, we can use the so-called *digital modes* to move computer information over radio. You probably have to type it in yourself, but whatever the source, you can use your computer to communicate just as easily as you do with your voice, only faster. The TNC provides the computer-radio link and handles the details of the radio communication—keying the radio, error-correction, timing and the like.

Your TNC also contains a modem, which converts the voltages from your computer to audio tones that your radio can handle. So, the TNC can be thought of as a radio modem, allowing your computer's signals to be transferred over the air. Its functions are similar to those of a telephone modem, but they're conducted in a very different way since you're communicating over the radio and not via a phone line.

There are many different types of radio modems, but, except for some specialized items, they're mostly compatible with each other, as long as they're rated for the same speed.

The speed, measured in *baud*, is a count of how many 1s and 0s are sent each second. (OK, not exactly; in some cases, baud does not equal bits per second; but for the most common cases, it does). The two most common speeds we see on VHF and above are 1200 and 9600 baud.

Using Your TNC

Once you connect your computer, TNC, and radio together, you can begin a packet "session" by connecting to another TNC somewhere. This is kind of like dialing a telephone to connect to another telephone somewhere. The other TNC you connect to is most likely going to be part of the local packet network, and from there you can "surf" the network to accomplish whatever task you need or want, such as e-mail, weather info, chatting with other folks, and checking out DX spots.

OK, now you know what a TNC does, and it should be fairly clear that, in order to work the digital modes, you need to have one, or at least something that performs the same function. By the way, I keep referring to packet, but AMTOR, RTTY, ASCII, Baudot, and the like are also digital modes and also need some kind of radio modem to work. Some TNCs, but not all, support these other digital modes. In fact, whether or not an individual TNC offers this support determines which of two broad categories it falls into.

Two Types of TNCs

The first type is what I call the *plain-vanilla TNC*. These operate only on packet and not other digital modes. Available in many forms, some may have enhancements, such as dual-channel capabilities or small "mailbox" functions. They range in price from a little over $50 for the simplest to nearly $300 for the bells & whistles models.

The second type is the *Multi-Mode Data Controller*, or *MMDC*. These generally operate in many different digital modes. While they're versatile machines, the other digital modes are generally used only below 30 MHz, and so may have only limited appeal to hams using primarily VHF. These are also more expensive, starting at over $300.

There are also some highly specialized TNC-like devices on the market, generally used for networking operations, which I feel are beyond the scope of this month's column. Just because something isn't mentioned here doesn't mean it isn't good: it either means I haven't heard of it or it's not really meant as a "user" TNC.

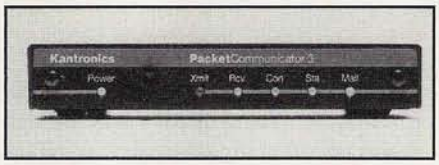
By Don Rotolo, N2IRZ

In the Marketplace

Let's look at each TNC manufacturer (in alphabetical order) and see what they offer in each category. Because I simply don't have the space to offer a complete review of each product, I've included sources for more detailed information in the Resources section.

Kantronics

Kantronics offers packet equipment in three basic price/feature segments, enough to satisfy any budget and operational level. Their basic entry-level TNC is the *KPC-3 Plus*, with a list price of $140. The Plus refers to the built-in Personal Bulletin Board System (PBBS), which can connect by itself to your full-service BBS and have your mail waiting for you whenever you're ready. The KPC-3 Plus also has support for APRS (Automatic Position Reporting System) and GPS (Global Positioning System), and can be modified to become a part of the local packet network. This modification is done with a simple swap of an EPROM memory chip. As with all plain-vanilla TNCs, it's supplied with a 1200-baud modem, and doesn't appear to be upgradeable to a faster modem.



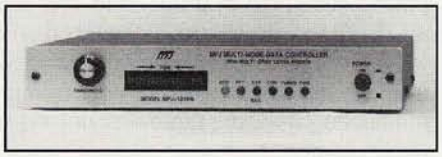
Kantronics KPC-3 Plus

The *KPC-9612 Plus* is similar to the KPC-3, with the addition of a 9600-baud modem and a second radio port, allowing both to be used at the same time. The KPC-9612 also has numeric and alphanumeric paging capabilities, using the common POCSAG protocol (*see "Ham Radio Paging: Putting 'POCSAG' on Packet," July, 1996,* CQ VHF—*ed.*). At a list price of $290, it's a jump up in price, but a good value for its capabilities.

The *KAM Plus* is Kantronics' all mode MMDC, offering just about every digital protocol there is (even CW!), along with the company's *G-TOR* protocol which automatically adjusts the HF baud rate for channel conditions. Because it's also a true dual-port unit, you can operate the HF digital modes while staying connected to a DX Cluster on VHF. Of course, all the features of Kantronics' other TNCs are included (PBBS, APRS, GPS) and there's even an optional ($50) WEFAX (weather fax) decoding program. At $350, it is the costliest of Kantronics' digital offerings, but again, a good value.

MFJ

MFJ has a wide line of packet accessories and TNCs, starting with the venerable *MFJ-1270C*. This TNC has been around in one form or another for as long as I can remember, and, at a list price of $120, it's one of the best values on the market. A true TNC-2 compatible, it uses all the standard modems and firmware developed for the TAPR TNC-2. The "C" model features PBBS and WEFAX capabilities as well as the ability to upgrade from the standard 1200-baud modem. A version with a 9600-baud modem installed lists for $230. Because of the low price of the basic unit, these are often used in packet networks. A similar version, the *MFJ-1271 Packet Card*, is offered for Commodore C64/C128 computer users.



MFJ-1278B

The next step up is more than a plain-vanilla TNC, but not quite a full MMDC. The *MFJ 1276* offers packet and PACTOR in the same box, for only $160. All the standard features are included, and the modem can be upgraded.

The *MFJ-1278B* is their MMDC offering, with a list price of $300. As with other MMDCs, it offers most of the HF digital modes and CW, as well as the usual VHF packet. A Digital Signal Processor (DSP) HF filter is an option, bringing the list price up to $380.

In addition to having some of the lowest prices in the industry, MFJ also has a fairly complete offering of accessories. This includes accessory modems, real-time clocks, a deviation and temperature meter daughterboard (used with TheNET X1J networking firmware), and even a true 9600 baud-capable radio (the MFJ 8621, about $120).

PacComm

PacComm, the Cadillac of packet suppliers, offers a broad range of TNCs and accessories. Its plain-vanilla entry, the *TINY-2 Mark II*, offers a higher-speed CPU (10 MHz) as standard equipment, allowing this true TNC-2 compatible to offer some of the fastest throughput of any TNC. The basic unit, with a list price of $150, includes all the usual TNC features (PBBS, GPS and APRS support, etc.), and can be customized with a dizzying array of accessories and options.

PacComm TINY-2 Mark II

Other PacComm TNCs that are plain-vanilla in their features, but exceptional for their size, are the *HandiPacket* ($230) and the *PicoPacket* ($150). The HandiPacket is small (1.28 x 2.55 x 4.15 inches), light, and has every feature that any plain-vanilla TNC could have. The PicoPacket is smaller, lighter, and even offers a dual serial port option! As with all PacComm products, it would take a page just to list the many options available.

The real high performance TNC from PacComm is the *Spirit-2*. The standard model ($240) is equipped with a 9600-baud modem, and the options reach up to an installed 70-centimeter data radio and modem for 19200-baud operation—complete package, ready to run, $500. For high-performance networking, the various *NODE* models are the best you can get.

For dual-port operation, PacComm offers the *TNC-320* and *PC-320*, the latter being a PC ISA-Bus card that fits inside your computer. Each is just over $200, and both accept standard modems. The *TNC-NB96* is a dual-port, 1200/9600 baud TNC ($290) with all the usual features included.

Finally, PacComm's *MMDC*, at $950, is not for the faint-hearted. It features a full DSP processor, three ports, and 32 MEGAbytes of mailbox storage. As a full DSP unit, all the modems are in software, and upgrades to new protocols are as simple as a floppy disk. Skilled programmers can even write their own!

PacComm offers many more products and accessories, but you should get a pretty good idea from even this abbreviated list of its products. The variety can be

overwhelming, but, for advanced packeteers, this is the place. GPS features quite heavily in PacComm's products, as does packet networking.

TigerTronics (BayCom)

TigerTronics is the North American distributor for products made by BayCom, the innovative packet company from Germany. In the BayCom system, all the usual TNC functions are built into software, and only a tiny piece of hardware—the size of a DB-25 connector hood—is attached to, and powered by, your computer's RS-232 port (or parallel port, for the BP-96A).

BayCom's basic hardware/software package, the *Model BP-2*, is only $50, making it the most basic, and lowest cost, method of getting onto packet. Plus, the basic software is shareware. It's provided with the modem and is also available for downloading from TigerTronics.

Another BayCom model, the *BP-2M* ($70), adds multimode capabilities to the basic modem, with most of the usual HF modes available. Also offered is the *BP-96A* ($96), a 9600-baud version.

All of these modems require the use of the BayCom software, which is only available for IBM-PC compatibles. However, the software will run with good results even on a 4.77-MHz IBM 5150, the most basic PC there is. And with 286 computers on sale at hamfests for next to nothing (or less), finding a computer to use shouldn't be a financial burden.

Aside from their very low cost, the greatest advantage of these BayCom units is their very small size. I carry the basic BP-2 modem (for 1200 baud) with me when I travel, running the software on my laptop and using my HT with a folding beam for packet fun from my hotel room.

Timewave/AEA

Timewave recently completed its acquisition of AEA, which manufactured a wide variety of digital equipment. Most of AEA's product line is already back on the market, and the remainder is expected to become available as soon as Timewave can ensure the availability of proper support and service.

The plain-vanilla TNC offered by AEA/Timewave is the *PK-12* at $100, along with its upgraded sister, the *PK-96*, at $170. Both are the lowest-priced TNCs available in their class. They offer all the expected features, including a PBBS and GPS/APRS support, as well as conve-

Timewave/AEA PK-96

nient controlling software for both Windows and Macintosh platforms. The included Gateway feature is an advantage over digipeating, but it falls short as a full network facility. Overall, though, their an excellent value as a first or spare TNC.

Timewave's MMDC, the DSP-232 ($400) and its dual-port sister, the DSP-2232 ($500), essentially define the class of DSP-powered MMDCs. Designed by AEA to bring the technology of the venerable PK-232 (alas, no longer available) into the next century, it's one of the most powerful and flexible MMDCs on the market. The great advantage of a DSP system is that protocols, operating modes, and modems can all be changed on the fly as technology advances. If someone were to invent a new digital mode tomorrow, you'd only need to download the right software and go, no hardware required. (I wish I could update my kitchen that easily).

So, What's the Best?

I often hear that question, and my answer is invariably, "what do you want to do?" If you're just getting started and don't plan (or have the budget) to get really deeply into packet, then the BayCom modems from TigerTronics are the way to go. It isn't a huge investment and you can always sell it to upgrade to a TNC.

If you have the extra money, expect to operate packet fairly often, or want to get involved in networking, then look for a plain-vanilla TNC. Some of the features might lead you to one brand or another, but they're all very similar in operation, features, and reliability. They do vary in size, though.

For mobile, GPS or APRS operation, the preferred standard is the PacComm PicoPacket because of its ruggedness, power options, size, and price. Great for balloon launches, too, especially with the integrated GPS receiver.

If you also operate on HF, then one of the MMDCs might have a place in your shack. From the low-end BayCom to the ultra-cool PacComm, there's something for everyone. Features and capabilities vary considerably, so do your homework before spending all that money. If you're just starting out, and figure you might as well go for the whole farm, I would suggest that you reconsider and get a cheap TNC first. TNCs are a commodity and you can always sell one at a hamfest to finance an upgrade. However, if RTTY and AMTOR are frequent operating modes, then an MMDC might be just what the doctor ordered.

Happy Holidays

I hope that this overview of this year's product offerings has been helpful. Be generous to yourself this holiday season, and get yourself something nice.

In closing, I'd like to offer my usual wishes for a joyous holiday season, as well as a healthy and prosperous new year. We should all remember to be a little bit kinder throughout the year, and leave the world a better place for our being here.

Vy 73, Don, N2IRZ

Resources

For all products, contact the manufacturer for detailed specifications, pricing, and availability. In many cases, only a portion of the complete product offering was described.

Kantronics, 1202 E. 23rd St., Lawrence, KS 66046-5099; Phone: (913) 842-7745; Internet: <http://www.kantronics.com>.

MFJ Enterprises, PO Box 494, Mississippi State, MS 39762; Phone: (601) 323-0549; Internet: <http://www.mfjenterprises.com>.

PacComm Packet Radio Systems, 4413 N. Hesperides St., Tampa, FL 33614; Phone: (813) 874-2980; Internet: <http://www.paccomm.com>.

TigerTronics, 400 Daily Lane, Grants Pass, OR 97527; Phone: (541) 474-6700; Internet: <http://www.tigertronics.com>.

TimeWave Technology/AEA, 2401 Pilot Knob Rd, Suite 134, St. Paul, MN 55120; Phone: (612) 452-5939; Inter-net: <http://www.timewave.com>.

Does the Code Requirement Help or Hurt Ham Radio?

Hams have gotten so emotionally wrapped up in the code issue, says KW5D, that they're not even talking anymore about the really important questions.

The "Op-Ed" column in the October issue of *CQ VHF*, commenting on an earlier article about the code requirement, really jerked my knee. I think it is inappropriate to print personalized "reviews" critical of someone else's ideas where one author refers to another by name. It almost always results in the real issues being submerged in sarcasm sprinkled with cute arguments.

As an example, the October "Op-Ed" tried to put down those who oppose the code requirement by citing some youngster's ability to pick it up rapidly (implying that anybody should be able to do it, if they only tried). This argument is so time-worn (and irrelevant) that it really doesn't deserve space in your magazine. But there it is—again. Of course kids can learn mechanical skills, language, video games, and a whole lot of things much faster and better than older folks. But that's nothing new.

Such specious arguments totally evade any consideration of the real issue as to just how the code requirement contributes to ham radio. Does the code requirement help the hobby to grow? Does it stimulate experimentation and technology advancement? Does it contribute to interpersonal communication development? To what extent does code *really* contribute to our emergency communications capabilities?

And do code proponents pause to consider the apparent downsides of the requirement, such as decreasing the number of hams and the demand for ham equipment, along with the effect on our domestic equipment manufacturers and suppliers? And how about the constant grabs for our frequency allocations by commercial interests that grow more powerful as we seem to stagnate?

Where's the Logic?

My sense is that the logic behind the code requirement would score less than zero on most any scale if, that is, it were possible to somehow objectively evaluate it that way. The problem is that we all seem to have chosen up sides and are way beyond listening to the other guy who might disagree with us.

I would agree that code is a "..part of communications history." But so are spark-gap transmitters and a lot of other outdated technology that has been surpassed and is largely irrelevant in today's world, except insofar as it provided a stepping stone to getting where we are. And code is not really even a technology; it is simply a psycho-motor skill like typing on a keyboard, or, on a much higher level, playing a piano—neither of which has much to do with intelligence. In short, it is ridiculous to try to justify the code requirement by making an analogy to learning history.

I also agree that, "..if Morse code is so de-emphasized, no one will learn it," but it probably wouldn't disappear anytime soon. After all, it's "..so much fun...," right? Seriously, code will likely continue to be the mode preferred by some operators for a long time to come. But their fear of extinction of a favorite bit of nostalgia is certainly not a justifiable reason to use code as a bar to otherwise deserving newcomers to the hobby. Code does serve a purpose as one of many means of impressing intelligence on an RF carrier, but let's not anoint it with special treatment at the expense of other methods and improved technologies.

The ARRL Roadblock

The notion that the ARRL should be viewed as the authority through which the code issue must be negotiated is a dangerous one. Through its past actions, the ARRL has exhibited a deaf ear to those hams who oppose the code requirement and clearly has opted to forge ahead with its pro-code agenda.

Now, the ARRL does great technical stuff and deserves a lot of credit for it. But its one-sidedness on the code issue has turned off so many hams and ham-wannabes that it seems the only way an objective position on code can be reached at the ARRL is through a complete culture transplant at the top. Otherwise, a competing organization may be the only way the vast majority of hams who have chosen not to belong to the ARRL can get their message across to the FCC.

So what can we look forward to on the code issue? Probably not much, as long as the ARRL continues to dig in its heels and refuse to consider the real issues. We will continue to hear nonsensical arguments like, "..my kid learned code and if you were not so lazy, you could, too..."; "..it's a part of history..."; and ".. it's fun." All of which are irrelevant and none of which makes

By Alex Haynes, KW5D*

*Alex Haynes, KW5D, holds an Extra class license. He lives in Eureka Springs, Arkansas.

any sense, but it has been the ARRL mantra for so many years now, many hams just numbly accept it. The ARRL will continue presenting to the FCC the results of its cooked surveys as the wishes of the ham community, and the FCC will probably continue with its policy of benign neglect of amateur radio.

But it is not so "benign" as we might hope. As the average age of hams continues to increase, and as we fail to attract younger and highly qualified technical talent, our claim for radio spectrum will weaken and our hobby will suffer.

Amateur radio in this country is dying a slow death, helped along by the wrong headed ARRL policy on code. Our attitudes as well as our technology must keep up with the times, or we simply will be bypassed by the new world of global communications technology.

Finally, I'm fully aware that by sharing my thoughts with you, I'll probably be vilified by some pro-coders as a lazy, mentally defective lout with no sense of history—all of which is probably true to some extent. But none of which is relevant to the real issue we should be discussing: Does the code requirement really help or hinder amateur radio?

Until the ARRL comes up with a logical explanation for its position on the code requirement and is willing to defend it in open forums, most hams who think it's a dumb idea will continue to reject the League and its claim to representing the consensus of ham opinion.

A Debate in Print?

So how about it *CQ VHF*? Would you be willing to open your pages to a properly conducted "debate-in-print" and be the sponsor and moderator? There are plenty of us who would like to try to convince the ARRL they are headed down the wrong path, but it's like talking to a brick wall—I know, I've tried. And who knows? If we get lucky, and if logic and fact triumph, then maybe we can put this issue to rest and move on to a bigger and better hobby.

Editor's Response: The issue of the code requirement has been debated endlessly in the pages of CQ VHF, *and probably will continue to be as long as so many readers feel it is so important to them. (My personal preference is to, as you suggest, put this issue to rest and move on. But the volume of reader mail suggests it is a topic that must continue to be discussed). It is our hope that an ongoing dialogue will help bring about an early resolution to this extremely divisive issue. With regard to a formal "debate," I'm not sure this is the proper forum for it. However, if an ARRL spokesperson wishes to explain the League's position to our readers, we will be most happy to print that explanation in this column.*

• • •

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.*

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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*.

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Looking Ahead in

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Here are some of the articles that we're working on for upcoming issues of *CQ VHF*:

- "Soldering Equipment for the Ham Shack," by Jim Aguirre, WB7DHC
- "'Roving' in Scotland," by Simon Lewis, GM4PLM
- "No Code to Know Code," by Jeffrey Lih, N2VHV
- "Heart-Healthy Hamming," by Richard Benda, M.D., WB2QJA

Plus...

- "Riding the Airwaves," by Scott Farrell, KE4WMF
- "Microwave Hamming in Europe," by Simon Lewis, GM4PLM
- "The Magic Band Chronicles," a new monthly mini-column by Ken Neubeck, WB2AMU

If you'd like to write for *CQ VHF*, you may download our writers' guidelines from the *CQ VHF* World Wide Web site at <http://members.aol.com/cqvhf/> or FTP to <ftp://members.aol.com/cqvhf/General> and look for the file, "writguid.txt." Or, you may send a written request with an SASE (self-addressed stamped envelope) to *CQ VHF* Writers' Guidelines, 76 N. Broadway, Hicksville, NY 11801.

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TM-V7A Dual Band Transceiver

If the TM-V7A could do any more for you as a mobile radio, it would be holding a conversation with you. From the **blue positive/negative display modes** that optimize lighting conditions, to the multi-dimensional **Five-in-one programmable memory system** that stores five different operating profiles, the TM-V7A incorporates a comprehensive intelligence that will bring you an entirely new mobile operating experience.

A world first **blue LCD front panel** utilizes a dot-matrix format for crisp, high-resolution information display in either positive (white background/blue characters) or negative (blue background/white characters) modes to suit ambient lighting conditions.

The 'Five-in-one' user interface memory system allows you to configure five unique 'personalities' into the TM-V7A to suit various operating requirements, and access them at the push of a button. Each 'personality' program includes positive/negative display mode, dimmer level, frequency range and memory mode– great for families who use the same radio.

This user interface provides access to a set of features with extraordinary range and depth. You have up to **280 multi-function memory positions** that each store TX/RX frequencies, frequency step, and DTSS (Dual-Tone Squelch System) or CTCSS (Continuous Tone Coded Squelch System) tone frequency. If you use the **Memory Name function** to store each memory with a full alphanumeric identifier, there are up to 180 channels available. You can receive two frequencies simultaneously on the same band (VxV or UxU) or split across both bands, and cruise the frequencies with a powerful new scanning system that provides a **visual graph** of the frequency band activity. The **Auto-simplex checker** (ASC) function can also automatically sense if you can switch from a repeater to simplex operation.

All of these advanced features are combined with Kenwood's unmatched **AIP (Advanced Intercept Point)** circuitry for excellent selectivity and sensitivity. The **mini-DIN plug** for 1200/9600 bps data transmission will allow you to operate voice and data at the same time, a Kenwood exclusive. The compact, **quick-release front panel** for remote positioning and **commercial-grade design with heavy duty heatsink and rugged construction** make the TM-V7A the ultimate choice for mobile communication.

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- **Automatic band change**
- **Selectable frequency step (5, 6.25, 10, 12.5, 15, 20, 25 or 50 kHz)**
- **Wireless remote control function**
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- **Separate speaker terminals for each band**
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