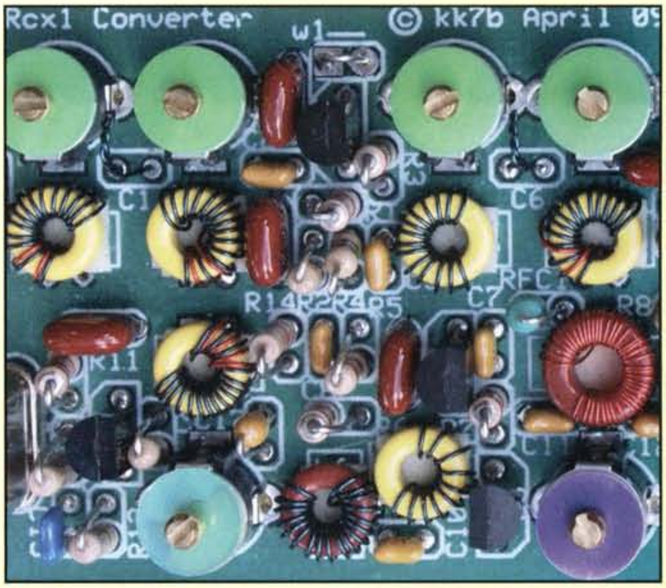
CQ VHF

ISSN 1085-0708

Ham Radio Above 50 MHz

www.cq-vhf.com
Spring 2010
$7.50



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Richard S. Moseson, W2VU, Editorial Director
Carol Lynch, W6CL, Editorial Consultant

CONTRIBUTING EDITORS

Rich Arland, K7SZ, Beginner's Guide
Kent Britain, WA5VJB, Antennas
Bill Brown, WB8ELK, Up in the Air
John Champa, K8OCL, HSMM
Thomas Dean, KB1JIJ, ATV
Miguel Enriquez, KD7RPP, The VHF+ Classroom
Mitch Gill, NA7US, EmComm
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Hal Keith, Illustrator
Larry Mulvehill, WB2ZPI, Staff Photographer
Doug Bailey, KØFO, Webmaster

A publication of

CQ Communications, Inc.
25 Newbridge Road
Hicksville, NY 11801 USA.

Offices: 25 Newbridge Road, Hicksville, New York 11801. Telephone: (516) 681-2922. FAX: (516) 681-2926. E-mail: cq-vhf@cq-vhf.com. Website: http://www.cq-vhf.com. CQ VHF (ISSN 1085-0708) is published quarterly (4 times a year) by CQ Communications, Inc. Periodical postage paid at Hicksville, NY and additional offices. Subscription prices (all in U.S. dollars): Domestic—one year $25.00, two years $50.00, three years 75.00; Canada/Mexico—one year $37.00, two years $74.00, three years 111.00; Foreign—one year $48.00, two years $96.00, three years 144.00. Government Agencies: Subscriptions to CQ VHF are available to agencies of the United States government, including military services, only on a cash with order basis. Requests for quotations, bids, contracts, etc., will be refused and will not be returned or processed.

Allow six weeks for change of address.

Printed in the United States of America.
Postmaster: Please send change of address to CQ VHF, 25 Newbridge Road, Hicksville, NY 11801.

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Spring 2010
Vol. 14 No. 1

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COLUMNS

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CQ VHF Ham Radio Above 50 MHz

LINE OF SIGHT

A Message from the Editor

Facing Facebook and Other Social Media

My thanks go to Propagation columnist Tomas Hood, NW7US, for bringing the CQ Communications family into the new age of social media. Tomas took the first initiative to develop fan pages on Facebook for each of CQ Communications' magazines, which, along with this publication, include the flagship, *CQ* magazine, *Popular Communications*, and *WorldRadio Online*.

Each of the publications has developed a growing fan base, with *CQ* magazine naturally leading the way. As of this writing *CQ* magazine has nearly 2500 fans; *Popular Communications* has over 300 fans;. *WorldRadio Online* has nearly 500 fans; and *CQ VHF* brings up the rear with nearly 300 fans. In addition to *CQ* magazine's fan base, other independent CQ-related fan bases have started. They include the CQ WPX and CQ World-Wide DX Contests, which have nearly 700 and nearly 500 fans, respectively.

One of the ongoing complaints I hear about *CQ VHF* magazine is that it is published only four times a year. I feel that constraint every time I work on the next issue. I have to gauge what we publish relative to the piece's time value. Often I am presented with an item that, because of its relatively urgent time value being between publication dates, I cannot do anything with.

Here is an example: In early April I learned of the dates for the Spring Sprints. Unfortunately for the sponsors, the events were receiving little publication because news of the sprints was released well after all of the print media deadlines.

Enter Facebook: As soon as I learned of the dates I immediately created a post on the *CQ VHF* Quarterly Magazine fan page in which I made a brief announcement and created a link to the Southeast VHF Society's website. Facebook has now solved my problem for certain time-sensitive items such as a forthcoming contest, conference, grid-square activation, and/or band opening. Therefore, if you have a time-sensitive item that you want publicized to the world, post it on Facebook. If you have something that is related to our niche in the ham radio hobby, then post it on the *CQ VHF* Quarterly Magazine fan page. It will get instant dissemination to the nearly 300 fans who follow the magazine's posts.

The name of the game, however, is numbers. Rich Moseson, W2VU, the editor of *CQ* magazine, mentioned in his April 2010 editorial that *CQ* magazine had a presence on Facebook. Almost overnight the fan base jumped from 1500 to over 2300. For *CQ VHF* magazine, every time I gain a new amateur radio friend I recommend to that person the CQ VHF Quarterly Magazine Facebook site. While *CQ VHF* is bringing up the rear in the count at this time, I expect that the publicity I am giving Facebook in this editorial will also give us a positive bounce in our number of fans. Are you a fan?

There are other social media outlets as well. Among them are Twitter and Skype. Thanks to the versatility of Facebook, when an administrator post is made to a fan page, it can be linked to automatically reflect on one's Twitter page. For me, this means that the nearly 300 fans on Facebook and my 60 or so followers on Twitter are getting the same message instantaneously. With the built-in link back tiny URL feature on Twitter my followers are linked to the full announcement on Facebook.

Skype is another source of social networking that is finding increasing use among ham radio operators. For example, for my May 2010 "VHF-Plus" column in *CQ* magazine I used both Facebook and Skype to interview Vu Trong Thu, XV9AA, in Hanoi, Vietnam. After Thu and I became friends on Facebook, I asked him for an interview via Skype, to which he readily agreed. Thu and I spent more than 40 minutes in a video conversation, covering a number of subjects. Be sure to take a look at the interview in my column.

As a late adopter, I am continuing to find so many of my ham radio friends have been using these social media tools for quite some time. For example, last fall one of the presentations made at the TAPR/DCC conference was done via Skype. Skype has so many potential applications. For example, someone's live balloon sat camera could be hooked to Skype so that people all over the internet could watch a live balloon launch.

Additionally, someone could conduct ham radio licensing classes in two or more locations—one live and the others via Skype. On a one-to-one basis, ham radio operators can collaborate with one another when designing or troubleshooting equipment.

While we at CQ Communications are in our infancy of adopting these social media tools, our universal initial reaction is: "Why haven't we been using these tools before now?" It seems that far from leading ham radio to its demise, the social media tools are starting to contribute to the ongoing growth of the amateur radio hobby. Such growth caught the attention of Matt Sepic at NPR (National Public Radio). Matt wrote a very positive piece about amateur radio that elicited more than two dozen—almost universally positive—responses. Please see: <http://www.npr.org/templates/story/story.php?storyId=125586086> for the NPR story.

In his article, Sepic comments on the universal appeal of amateur radio, quoting a senior citizen and a high school youth. The senior, Helen Schlarman, WØAKI, commented: "[Ham radio is] a different community. There [are] no stereotypes of age; it's just talking and sharing and enjoying." Fifteen-year-old Jonathan Dunn, KDØHSL, stated that "Facebook and texting are fun, but making friends using a $200 radio that doesn't come with monthly fees is more rewarding.

He added, "With ham radio you can talk to new people, all kinds of ages, races, and it's just amazing what a little radio can do. Because no matter where you are, if you have the right stuff and the right power you can talk to anyone."

CQ magazine Editor Moseson agrees with Schlarman and Dunn concerning the universal appeal of our hobby. In a comment to Dan Brown, a sociology student, concerning the social media's usefulness to the amateur radio hobby, Moseson wrote: "Online social media like Facebook help the traditional ham radio establishment reach out to younger hams (and potential hams) 'on their turf'."

No matter whose turf we are on, we hams are capable of benefiting from the new social media—if we use it right. There is one caveat, however, with social media: The bad guys are also reading our posts. Therefore, before you put down this editorial, get online with Facebook, and post, "I'll see you at Dayton," think twice about your vulnerable home and radios while you are away. Don't let those bad guys know that your new radio is now available for the taking while you're gone.

If you have some creative ideas for using the social media to further our niche of this, our wonderful hobby, please let me know. Thank you.

Out of respect for the social media outlets, I end my editorial with this salutation: Whether it's on Facebook, Twitter, or Skype, or here in the pages of this magazine—

Until next time . . .

73 de Joe, N6CL

QUARTERLY CALENDAR OF EVENTS

Current Contests

June: ARRL June VHF QSO Party. The dates for this contest are 12–14 June. Complete rules are in the May issue of *QST*. Rules can also be found on the ARRL website (http://www.arrl.org). Many are making plans to activate rare grids. For the latest information on grid expeditions, check the VHF reflector (vhf@w6yx.stanford.edu) on the internet. For weeks in the run up to the contest postings are made on the VHF reflector announcing Rover operations and grid expeditions. It is a contest that will create for you plenty of opportunities to introduce the hobby to your friends who are not presently working the VHF-plus bands or are not hams.

SMIRK Contest: While no formal announcement exists on the SMIRK website (see below), it is assumed that because of prior years' announcements, the SMIRK 2010 QSO Party, sponsored by the Six Meter International Radio Klub, will be held from 0000 UTC June 19 until 2400 UTC June 20. This is a 6-meter-only contest. Exchange SMIRK number and grid square. Score 2 points per QSO with SMIRK members and 1 point per QSO with non-members. Multiply points times grid squares for final score. Awards are given for the top scorer in each ARRL section and country. For more information on filing logs, please see the club's URL at <http://www.smirk.org> and click on the SMIRK Contest link at the top of the page.

Field Day: ARRL's classic, Field Day, will be held on June 26–27. Complete rules for this contest can also be found in *QST* and at: <http://www.arrl.org>. In years past tremendous European openings have occurred on 6 meters. Also, as happened in 1998, tremendous sporadic-*E* openings can occur. This is one of the best club-related events to involve new people in the hobby.

CQWW VHF Contest: This year's CQ WW VHF Contest will be held between 1800 UTC July 17 and 2100 UTC July 18. A summary of rules is on page 67 in this issue, with complete rules in the June issue of *CQ* magazine and on the CQ website: <www.cq-amateur-radio.com>.

August: There are two important contests this month. The **ARRL UHF and Above Contest** is scheduled for August 7–8. Complete rules can be found in the July issue of *QST*. The first weekend of the **ARRL 10 GHz** and above cumulative contest is scheduled for August 21–22. The second weekend is September 18–19. Complete rules for this contest also can be found in the July issue of *QST* and on the ARRL's website.

Current Conferences and Conventions

May: Dayton HamVention®. The Dayton Hamvention® will be held as usual at the Hara Arena in Dayton, Ohio, May 14-16. For details, go to: <http://www.hamvention.org>.

June: The annual **Ham-Com Hamfest** will be held June 11–12, in Plano, Texas. As always, the North Texas Microwave Society will present a microwave forum. For details, see the Ham-Com website: <http://www.hamcom.org/>.

July: This year's **Central States VHF Society Conference** will be held July 22–24, in Bridgeton, Missouri, at the Doubletree Hotel. For information go to: <http://www.csvhfs.org/>.

Quarterly Calendar

The following is a list of important dates for EME enthusiasts:

May 6	Last quarter Moon and Moon apogee
May 14	New Moon
May 20	First quarter Moon
May 20	Moon perigee
May 27	Full Moon
June 3	Moon apogee
June 4	Last quarter Moon
June 12	New Moon
June 15	Moon perigee
June 19	First quarter Moon
June 26	Full Moon
July 1	Moon apogee
July 4	Last quarter Moon
July 11	New Moon; total eclipse of the sun
July 13	Moon perigee
July 18	First quarter Moon
July 26	Full Moon
July 28	Moon apogee
July 28	*Southern Delta Aquarids* meteor shower
August 3	Last quarter Moon
August 10	New Moon
August 10	Moon perigee
August 12	*Perseids* meteor shower
August 16	First quarter Moon
August 24	Full Moon
August 25	Moon apogee

—EME conditions courtesy W5LUU

Calls for Papers

Calls for papers are issued in advance of forthcoming conferences either for presenters to be speakers, or for papers to be published in the conferences' *Proceedings*, or both. For more information, questions about format, media, hardcopy, e-mail, etc., please contact the person listed with the announcement. The following organizations or conference organizers have announced a call for papers for forthcoming conferences:

Central States VHF Society Conference: Technical papers are solicited for the 44th annual Central States VHF Society Conference to be held July 22–24 in Bridgeton, Missouri. Papers, presentations, and posters on all aspects of weak-signal VHF and above amateur radio are requested. You do not need to attend the conference, nor present your paper, to have it published in the *Proceedings*. Posters will be displayed during the two days of the conference. Please contact the folks below if you have any questions about the suitability of a topic. Strong editorial preference will be given to those papers that are written and formatted specifically for publication, rather than as visual presentation aids. Submissions may be made via the following: electronic formats (preferred); via e-mail; uploaded to a website for subsequent downloading; on media (3.5" floppy, CD, USB stick/thumb drive). Deadline for submissions: For the *Proceedings,* May 25; for presentations to be delivered at the conference, June 28; and for notifying them that you will have a poster to be displayed at the conference, June 28. Bring your poster with you on July 22 or 23. Contact information: Ron Ochu, KOØZ@arrl.net.

Technical papers are solicited for presentation at the **29th Annual ARRL and TAPR Digital Communications Conference** to be held September 24– 26 in Portland, Oregon and publication in the conference *Proceedings*. Presentation at the conference is not required for publication. Submission of papers is due by July 31 and should be submitted to: Maty Weinberg, KB1EIB, ARRL, 225 Main St., Newington, CT 06111, or via the internet to <maty@arrl.org>. For suitable topics and submission guidelines also contact Maty via e-mail and check <http://www.arrl.org>.

Meteor Showers

May minor showers include the following and their possible radio peaks: *η-Aquariids*, May 6; *ε-Arietids*, May 9, 0815 UTC; May *Arietids*, May 16, 0815 UTC; and *o-Cetids*, May 20, 0713 UTC.

June: Between June 3 and 11, the *Arietids* meteor shower will once again be evident. This is a daytime shower with the peak predicted to occur on June 7, around 1700 UTC. Activity from this shower will be evident for around eight days, centered on the peak. At its peak, you can expect around 60 meteors per hour traveling at a velocity of around 37 km/sec (23 miles per second).

On June 9 the *Zeta Perseids* is expected to peak around 1700 UTC. At its maximum, it produces around 40 meteors per hour. The *Boötids* is expected to make a showing between June 27 and July 2, with a predicted peak on June 27. On June 28 the *Beta Taurids* is expected to peak around 1600 UTC. Because it is a daytime shower, not much is known about the stream of activity. However, according to the book *Meteors* by Neil Bone, this and the *Arietids* are two of the more active *radio* showers of the year. Peak activity for this shower seems to favor a north-south path.

July: This month there are a number of minor showers. The *Piscis Austrinids* is expected to peak July 28. The *δ-Aquariids* is a southern latitude shower. It has produced in excess of 20 meteors per hour in the past. Its predicted peak is also around July 28. The *α-Capricornids* are expected to peak on July 30.

August: Beginning around July 17 and lasting until approximately August 24, you will see activity tied to the *Perseids* meteor shower. Its predicted peak is between August 12 at 2330 UTC and August 13 at 0200 UTC. The *κ-Cygnids* meteor shower is expected to peak on August 18. The visually-impossible *γ-Leonids* is expected to peak August 25, around 1600 UTC. However, this shower may have gone dormant. The *α-Aurigids* is expected to peak around September 1.

For more information on the above meteor shower predictions see Tomas Hood, NW7US's propagation column beginning on page 74. Also visit the International Meteor Organization's website: <http://www.imo.net/calendar/2010>. A pdf document of the year's meteor showers is available from the IMO at: <http://www.imo.net/docs/cal2010.pdf>.

Activation of Elusive Grid EL58

This little elusive island that has one paw in the Gulf of Mexico and the other in the Mississippi River is almost nowhere to be found—except that it lies within a very rare grid square. If it's rare, then hams have to go there. Here WA4EWV tells the K5N EL58 activation story.

By Al Lee,* WA4EWV

The Fred Fish Memorial Award (FFMA) is given to any amateur radio operator who has worked all 488 Maidenhead grid squares in the 48 contiguous United States on 6 meters. (For details on the award go to: <http://www.arrl.org/awards/ffma/>.) One of the most wanted grids is EL58, which is located on an island on the very southeast tip of Louisiana with the Mississippi River on one side and the Gulf of Mexico on the other.

Bruce Brackin, N5SIX, getting ready to transport equipment to the K5N location.

A Little History

There had only been one DXpedition to EL58, and that was in 1985. Various hams had talked about going there, but it wasn't until November 2008 when some serious discussions began to take place. Bill Musa, K5YG, and Marshall Williams, K5QE, started a series of discussions on the FFMA Yahoo Groups reflector. During that time frame, Danny Cristina, N5OMG, his son Daniel, KE5KDM, plus Bruce Brackin, N5SIX, and Al Lee, WA4EWV, joined the effort.

In December 2008 or January 2009, it was decided that a trip should be made to the area to scout it out. Obviously, winter was not the time to go. Many e-mails later and a two-hour Skype QSO laid out some very important plans.

The Planning

An operation of this type is not an easy task. It consisted of seven hams from four different states, so coordination was relatively difficult. Then there was the matter of getting a guide to help identify the best place to land. Danny, N5OMG, approached several guides before Capt. Shawn Lanier agreed to help with our project.

Bill, K5YG, took the leadership role, as he had been on many island expeditions. He would provide a spreadsheet in which all of the equipment could be listed and each member would know what he was to bring. Bill's leadership and past experience was invaluable. The use of the spreadsheet was an absolute necessity.

Danny, N5OMG, would man the 75-meter link to our pilot (land based) stations. He would also be the treasurer.

Bruce, N5SIX, was given the task of coordinating the station's radio equipment. I had had a lot of RV and traveling boat experiences, so I volunteered to prepare the menu and purchase the food.

Marshall, K5QE, would provide two 6-meter TE Systems amplifiers and power supplies for the stations.

In April, Danny, N5OMG, his son Daniel, KE5KDM, and Bill, K5YG, made the scouting trip. Pictures and videos were taken.

The special call, K5N, was applied for and approved. Joey, W5TFW (one of our pilot stations), offered to pay for the QSL cards via the "Six Club."

We also welcomed aboard our pilot stations: Joey Fiero, W5TFW, Tip Tipton, WA5UFH, and Tom Miller, AC5TM. Since there would be no internet service, they would monitor our operations using HF.

Bob Delaney, WN2E, then joined the group. Since he is a pharmacist, he

*7137 Dolphin Bay Blvd., Panama City Beach, FL 32407
e-mail: <wa4ewv@wa4ewv.net>

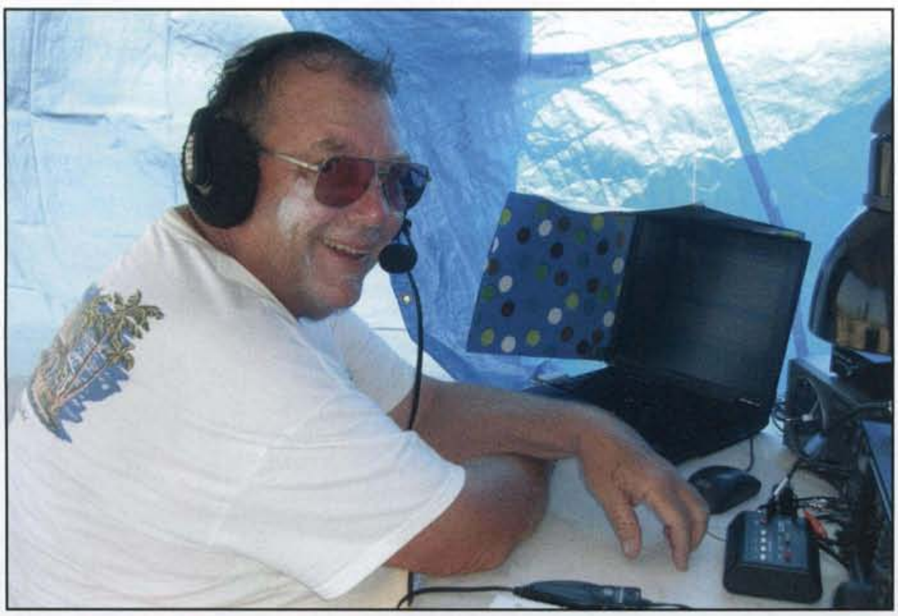
Some of the equipment laid out on the grass prior to setting up the stations.

became the group medic. We each filled out medical record cards along with emergency contact information. The contact information was left with each spouse—just in case. Danny, N5OMG, provided us with his SatPhone number—again for emergency use only.

Tip, WA5UFH, who is an avid HSMS (high-speed meteor scatter) ham and hosts the WSJT group site, volunteered to post anything necessary for the expedition; see <http://www.ykc.com/wa5ufh/>. "JD" Dupuy, NØIRS, set up a section on his web page for us: <http://www.kcvhfgridbandits.com/kc_vhf_grid_bandits_018.htm>.

Daniel, KE5KDM (17 yrs old), volunteered to be the "camp fisherman." He turned out to be a great fisherman, providing the camp with flounder, trout, and other treats from the sea.

Because of the large number of hams asking to donate to our trip, Danny set up a PayPal account for us. Originally, we had decided not to solicit donations. Expenses kept mounting, but we still didn't solicit. We just said, "Let your conscience be your guide."



The author operating from one of the stations.

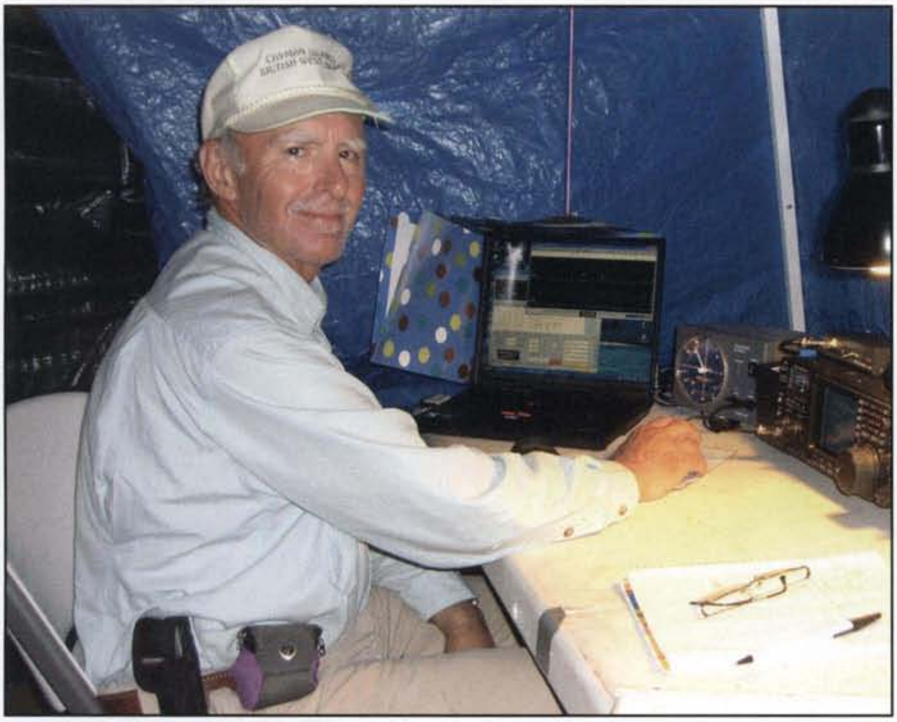
The Trip to Venice, Louisiana

May 28, 2009: The day finally arrived when we all headed for Venice, Louisiana, 65 miles south of New Orleans, and Capt. Lanier's camp (see: <http://www.fishon-guideservice.com>). Al drove from Panama City Beach, Florida, pulling a Boston Whaler. He rendezvoused with Bill and Bob in Ocean Springs, Mississippi. Marshall drove from Hemphill, Texas, Bruce from Brandon, Mississippi, and finally Danny and Daniel from Harahan, Louisiana, towing their boat.

After our arriving and loading Capt. Lanier's boat, he provided dinner of charcoal-grilled fish. The bunk room was a welcome sight after the long drives and loading the boat.

Getting to the Island

On Friday, May 29, 2009, before sunrise, we launched the three boats, and loaded Al's and Danny's with the remaining gear. The first part of the trip was down West Bay. The water was smooth and we were able to run at about 20 knots. Capt. Lanier knew the entire bay like the back of his hand, and we had no trouble with shallow areas. We saw several well



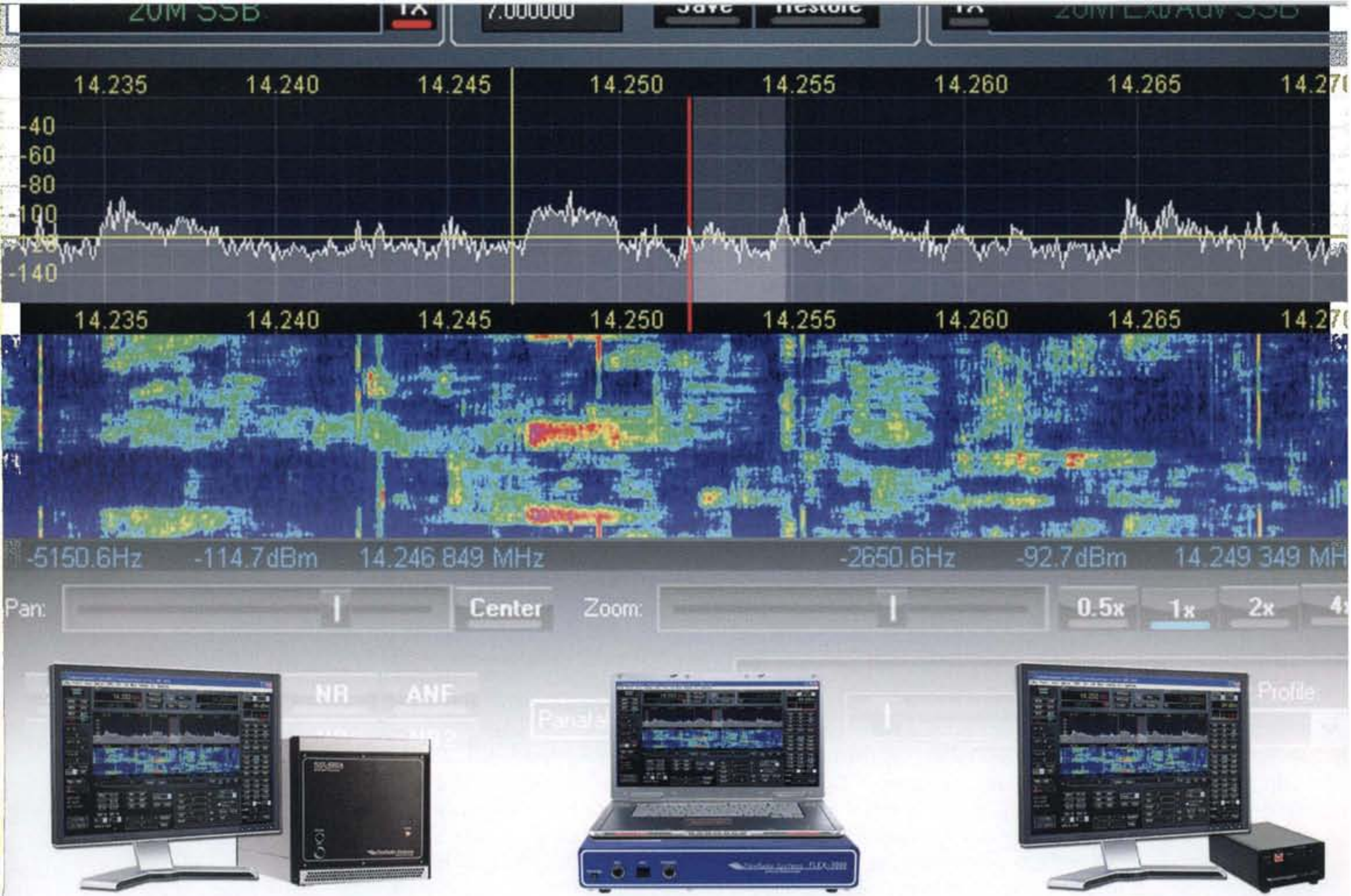
Bill Musa, K5YG, operating from one of the stations.

heads along the way. We then cut into the Mississippi River for five miles. This part of the trip was uneventful. However, we did pass one inbound ship. Capt. Lanier had already briefed us on the dangers of not only the stern wake, but the bow wake as well. We gave each of these as wide a berth as possible, and cut the wake at 90 degrees and slow speed. We then turned east into the cut toward the island.

The first order of business was Daniel and his weed whacker cutting a path through the thigh-high marsh grass over to the beach site. After we made our landing, each passing ship would "suck" a little water away from us, and then push it back with its wake. Since we were at least a mile away from the water, however, it presented no problem. It just sloshed water up into the path Daniel had cut through the tall grass. Ankle-deep muck is a good way to describe it.

The most grueling part of the morning was bringing all of the equipment from the landing area to the beach. The first tent erected was the common area where

All seven of the operators at K5N.


14.235 14.240 14.245 14.250 14.255 14.260 14.265
-40
-60
-80
-140
-5150.6Hz -114.7dBm 14.246 849 MHz
-2650.6Hz -92.7dBm
Pan:
Center
Zoom:
0.5x 1x 2x
NR ANF

An aerial photo of the EL58 site.

the food, cooking equipment, and chairs for relaxing were kept. This was followed by the installation of the generator and the power cords from it to where the operating tents would be set up. Erection of the two M^2 6M5X Yagis, the Cushcraft R7 (on loan from K2FF), and the fan dipole inverted-V followed. The three operating stations were SSB/CW for 6 meters, meteor scatter for 6 meters, and HF for communications with our pilot stations. Sleeping tents and the toilet tent were the last to be set up. During the erection of the meteor-scatter Yagi it fell over, bending several elements and breaking off one completely. The bent ones were straightened as best we could, and the broken reflector element was taped on with electrical tape!

Environment

The only traces of any animals were deer tracks. We had prepared for the worst concerning bugs. We each had brought a ThemaCell and lots of spray repellent. Fortunately, the only bugs that came out were the ones that liked the Coleman lanterns we used in the common-area tent. No flies, no mosquitoes, no horse flies.

The weather was hot with not a cloud in the sky during the entire trip. We used plenty of SPF 50 on all exposed parts of our body. We also brought fans, which were a great help keeping us cool inside the operating tents.

On Saturday, Mike, WB5LLI, Keith, W5KB, and Charlie, WD5BJT did a fly-by and took photos from the aircraft.

Operating

With everything up and operating, the first 6-meter SSB QSO was made by Bill with K1WHS (2010 UTC on 50.150 MHz. Operations continued non-stop through Friday night, all day and all night Saturday, and ending just before 1700Z on Sunday with Al at the mic of the SSB station. At some point Daniel, who had been doing a lot of fishing and scouting the area, said that there was about 3 feet of water behind the spillway where we could bring our boats to load from a sandy beach area. This was a welcome revelation, as the thought of dragging everything back through the bush was not appealing! Those of us not operating started taking the camp apart and putting the equipment on the beach for loading.

Not only did the group work 6 meters, but many QSOs on HF were made, activating ARLHS USA 1101 under the "Visual Sight Rule" and a New Island—USi LA105S (Burwood Island, LA; South West Pass).

One of the highlights of the operation was the two EME contacts made by Al with Lance, W7GJ, and Mike, K6MYC. Those two were the first ever EME contacts from EL58! This was done with the damaged beam, too!

Problems Encountered

The erection of the meteor-scatter beam presented a problem when it fell over as were putting it up. The solution to prevent this from happening again is to use more manpower to erect one.

Another problem was the fact that the manufacturer of the generator had not connected the ground to the common. This could have presented a problem with switching power supplies. After removing the control panel and connecting the two together, all was well.

We had rotor failure on the meteor-scatter antenna. It was an old Radio Shack TV rotor that gave up the ghost after about 20 hours. Recommendation for future DXpeditions is a little higher quality rotor.

A note about the toilet: The one we purchased was okay, but not for use in the sand. One or more of the three legs would sink. Al found some small blocks of wood to put under the legs, but it didn't help that much. If the toilet has to be on sand, bring a piece of plywood at least a foot larger than the area of the three legs.

Operating Notes

During the QSOs most stations thanked us and said 73. There were a lot of stations on SSB that wanted to rag-chew. It was quite tempting, but good operating practice by our operators kept that to a minimum, giving other stations a chance.

Summary of our QSOs:

6 meters SSB and CW = 424
6 meters HSMS = 56
6 meters EME = 2
Total 6 meters = 482

HF:
17 meters = 35
20 meters = 45
40 meters = 36
75 meters = 43
Total HF = 159

States worked = 40
Unique grids worked = 118

Sights and Things to Remember

The fishing camp at Capt. Lanier's was very nice. There were two simple bunk rooms with four bunks each. They were air-conditioned and comfortable. His fish dinner was one to remember!

The marina in Venice has made what looks like a 100% comeback after Hurricane Katrina. That was a pleasure to see.

We had three boats—those of Capt. Lanier, Danny, and Al. Each was loaded to its maximum weight capacity. We had to be careful in that regard to not overload any of them. Part of the spreadsheet planning was to weigh everything we were bringing and eliminate things that were either duplicated or just too heavy.

As can be imagined, food and fluid intake were an important part of the trip. We cooked hamburgers on the grill, fried fish that Daniel caught, and had sandwich meat, peanut butter and jelly, cheese crackers, and cookies. Last of all, we consumed several Meals-Ready-to-Eat (MREs). One of the things that Danny did was bring a large cooler with block ice topped with dry ice. It lasted all weekend, resupplying the drink and food coolers with ice. Water and Gatorade sustained us. Cola drinks just don't hack it, although many were consumed.

Summary

The six "P"s come into play when an adventure such as this: "Prior Planning Prevents Pee Poor Performance." Knowing every aspect of the operation is the key to success. Every contingency should be taken into consideration. Everything from tool boxes, to equipment, to health considerations must be taken into account. Fuel and oil for the generators was a major weight consideration. (We even had a spare generator.) In our particular case, if someone had been seriously injured, either a one-hour trip back to Venice (then 65 miles to New Orleans) or helicopter evacuation would have been necessary.

It can be said that the seven of us worked well together as a team, and we made new friends to boot.

Amateur Radio and the Cosmos
Part 4 – Never a Dull Moment

Nowadays we take satellites for granted. Yet how far have we come? At the beginning of satellite development, hams played significant roles. Here WA2VVA details some of the hams and their roles during those early days.

By Mark Morrison,* WA2VVA

The signs around campus said it all. On April 22, 1975 the world's leading rocket scientist would visit this town in upstate New York to present a lecture on the uses of space—not just any scientist, mind you, but Wernher von Braun! The man whose Saturn V rocket took man to the moon in 1969 and whose Redstone rocket put America's first satellite into orbit in 1958. The man whose visions of space travel were captured on the pages of *Collier's* magazine, the films of Walt Disney, and even Disneyland itself, leaving lasting impressions for generations of future scientists.

In his lecture "The Uses of Space, A $100 Billion Dollar Gamble; Is the Earth Winning?" (see figure 1) von Braun described his newest vision for space—the use of satellites to provide television programming to remote areas of the world, not for entertainment, but for medical and educational purposes. This was something with real merit, as it would benefit those intended to receive such broadcasts as well as the men and women to follow in von Braun's footsteps. After all, putting rockets into space wasn't something you learned in college. You learned it from those who came before you. However, for me, what followed the lecture was of greater significance.

A reception was held for von Braun at a prominent fraternity where perhaps twelve of us were waiting for him to make his way over from the lecture hall. I don't think anyone knew what to expect. After all, we were about to meet Wernher von Braun, a legend in his own time. When the time finally arrived, we were immediately impressed by the friendly persona of this big man as *he* greeted *us*!

*5 Mount Airy Rd., Basking Ridge, NJ 07920
e-mail: <mark1home@aol.com>

Figure 1. The promotional piece for Wernher von Braun's 1975 lecture describing his newest vision for space.

At that time von Braun was something of an ambassador for the space program and perhaps a bit worried about it all. The great achievements in space had already been recorded in the history books. Man had walked on the moon several times, satellites were parked in geostationary orbits, and space probes were on their way to the planets and beyond. What would happen in the future depended on the U.S. government, and with support for future moon missions waning, something had to be done.

Curiously, von Braun wasn't the only space ambassador of the 20th century. Concerned about the future of aeronautics, in 1930 aviator Charles Lindbergh took interest in the rocket work of Clark University professor Robert H. Goddard. Impressed by what he saw, Lindbergh recommended Goddard to financier Daniel Guggenheim, who awarded him a $50,000 grant and convinced him to move to Mescalera Ranch, near Roswell, New Mexico. This allowed Goddard to experiment with much larger rockets, without the prying eyes of the local fire marshall or even the press.

It is interesting to note that Goddard was a radio amateur of sorts, having organized the Wireless Club at Clark University in 1927, the same year that Lindbergh crossed the Atlantic solo and, coincidentally, von Braun's German Rocket Society was formed. Goddard held several radio-related patents, many

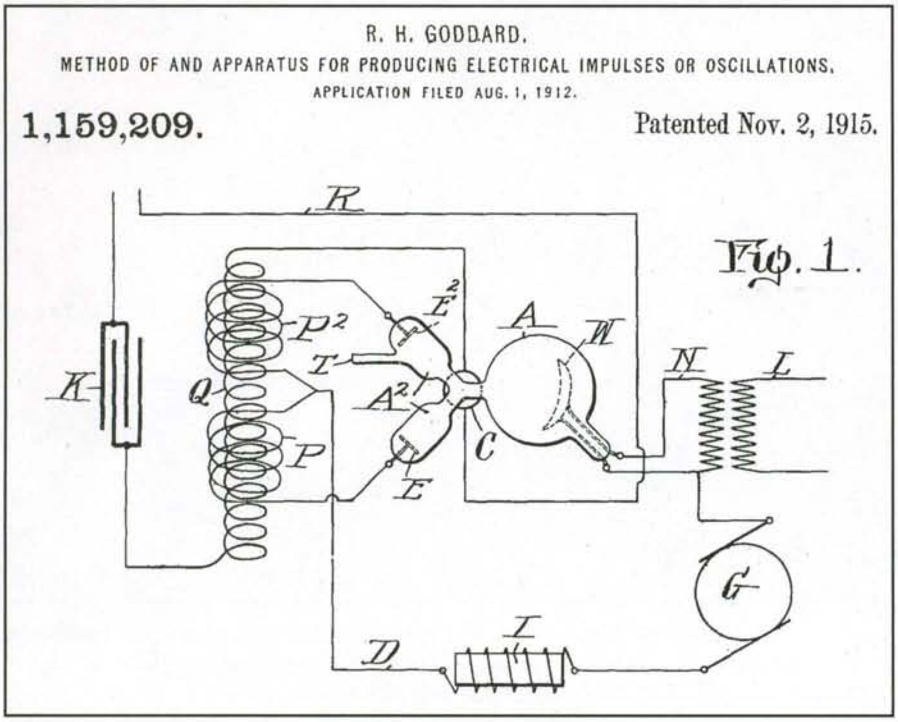


Figure 2. One of Robert H. Goddard's patents, issued in 1912, was for a vacuum-tube oscillator.

of which he sold to Westinghouse in these, the earliest days of radio broadcasting. One of Goddard's patents was a vacuum-tube oscillator for which he filed a patent application in 1912 as shown in figure 2. Note that this work actually preceded similar work by radio pioneers de Forest and Armstrong!

This particular patent, which was used in the Collins 45A transmitter, would later involve Goddard in a patent infringement lawsuit between RCA and Collins Radio. Art Collins (WØCXX, ex-9CXX) personally contacted Goddard for assistance in defending his design. Although Collins would lose the suit, a subsequent appeal would lead to a generous licensing agreement with RCA that allowed his young company to flourish.

Goddard's move to New Mexico was preceded by that of an older cousin, Ralph W. Goddard, who held the call 5ZJ. Ralph moved to New Mexico in 1914, where he became Dean of Engineering at New Mexico College of Agriculture and Mechanical Arts. Sadly, Ralph died shortly before Robert's arrival.

The financing of Daniel Guggenheim, coupled with the wide-open spaces of New Mexico, gave Robert Goddard unparalleled opportunity to follow his elusive dream of building rockets to probe the edge of space. That dream would be cut short, however, when the Navy asked for Goddard's assistance in developing Jet Assisted Take Off rockets, otherwise known as JATO, in Maryland. Curiously, parallel work would be done by Reaction Motors in New Jersey, and another Guggenheim beneficiary, the Guggenheim Aeronautic Laboratory of the California Institute of Technology, also known as Caltech. The Caltech effort would result in the first commercial JATO units, as well as the now famous Jet Propulsion Laboratory (JPL).

A New Era in Rockets

Following Goddard's departure from New Mexico, a new era in rocket development would begin just 100 miles to the west of Roswell. This barren stretch of desert, bordered on two sides by mountain ranges, rail facilities to the south, and a lone highway that separated the firing area from the impact area, would become the White Sands Proving Grounds. At the end of World War II, the United States had acquired a large stock of V-2 missile components from Germany. These parts were shipped by rail to Las Cruces, New Mexico and then transferred to White Sands for use in high-altitude research. Also transferred were Wernher von Braun and several of his top scientists. Over the next few years General Electric, Johns Hopkins, the Naval Research Laboratory (NRL), Caltech, Douglas Aircraft, and Bell Laboratories all would be involved in rocket programs here. While most concerned high-altitude research, some were military projects.

As might be expected with so many technical people all in one place, a large number of amateur radio operators would also live here. One was Philip H. Smith, 1ANB, who worked on radar antennas for Bell Laboratories. Smith is perhaps best recognized for his "Smith Chart" known to engineers and radio amateurs the world over.

Another was Richard Tousey, of the NRL, who scored one of the first scientific successes at White Sands. By loading 35-mm film into the nose cone of a V-2 rocket, along with a special type of spectroscope, Tousey recorded the first spectrographs of the sun in the ultraviolet. Tousey's involvement with amateur radio dates back to 1920, when at the age of 12 he was thought to be the youngest ham in the city of Boston.

Yet another ham was Curtis LeMay (DL4AFE, and later, KØGRL, K4FRA, K3JUY, W6EZV), then Deputy Chief of the Air Staff for Research and Development. Following World War II, LeMay commissioned Douglas Aircraft to study the problem of putting a satellite into orbit as part of Project RAND and gave them just three weeks to do it. Amazingly, the official RAND report, entitled "Preliminary Design of an Experimental World-Circling Spaceship," was released just two days before the deadline. This classic text is available as a free download from the RAND website (http://www.rand.org).

Figure 3 shows three other hams, all working at White Sands in 1947. From left to right are Dick Mockbee, W6FZD, Tom Bohnsack, W2RVC, and Marv Olson, W6VRI. This QSL card, supplied through the courtesy of Steve Durst, documents a QSO between W6VRI and W8RM on September 23, 1947. As Steve points out, the postage for this QSL card was cancelled the same day that Johns Hopkins launched the first Aerobee rocket. An interesting account of the Aerobee rocket can be found at Steve's website at <http://www.collectspace.com/ubb/Forum20/HTML/000588.html>.

When this photo was taken, Mockbee was involved with field testing of the NIKE missile for Douglas Aircraft, a major sub-contractor to Bell Labs at the

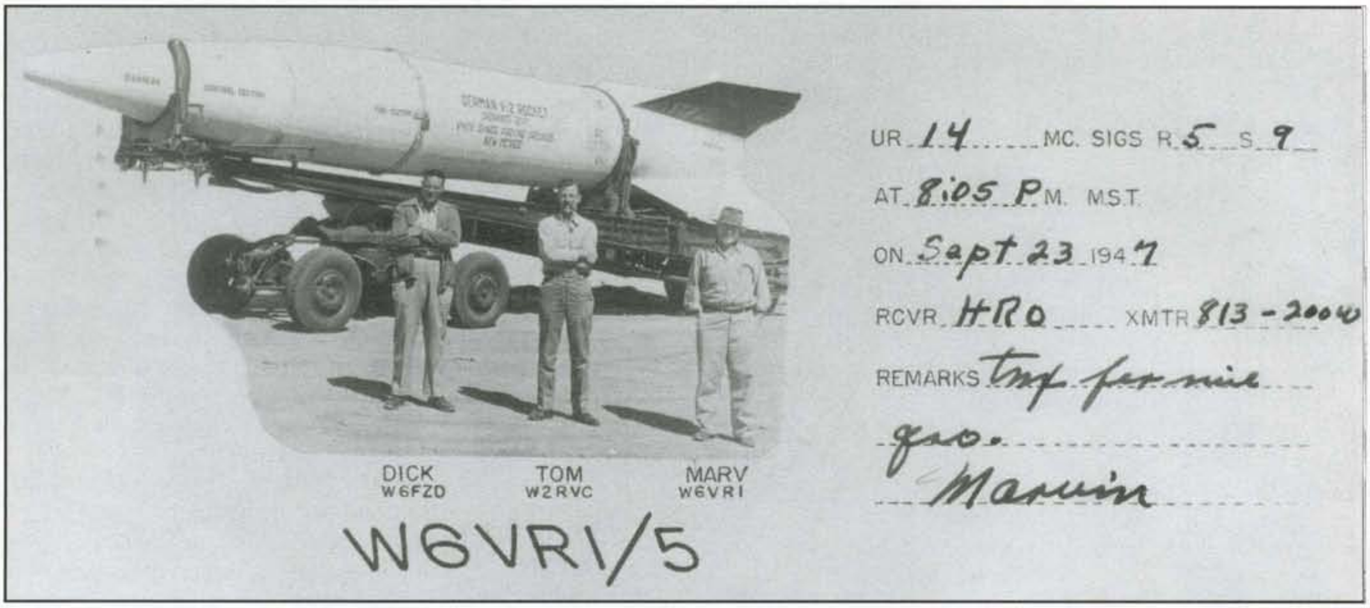


Figure 3. The White Sands Proving Grounds in New Mexico was the site of a new era in rocket development. A large number of amateur radio operators worked there in 1947, including the three shown on this QSL card (from left to right): Dick Mockbee, W6FZD, Tom Bohnsack, W2RVC, and Marv Olson, W6VRI. This QSL card, supplied through the courtesy of Steve Durst, documents a QSO between W6VRI and W8RM on September 23, 1947.

time. In 1948 he officially moved over to Project RAND, becoming one of the earliest technical people in what would later become the RAND Corporation. It is interesting to note that although much of Mockbee's work involved early computers, in 1964 he worked on a technical feasibility paper for the construction of an all digital, microwave relay system for use in the distributed network proposal of Paul Baran. This work, elements of which would later appear in the modern internet, is perhaps the first reference to a wireless internet node. A full description of this microwave design can be found at the RAND website (http://www.rand. org/pubs/research_memoranda/RM3762/RM3762.chap6.html), including the article "Experimental Transceiver for 5650 Mc," by C. J., Prechtel, W8DRR, which appeared in the August 1960 issue of *QST* (Vol. 44) on pages 11–15. *(Editor's note: A copy of Prechtel's article is available to ARRL members under the "Members Only" section of the League's website: <http://www.arrl.org/members-only/>.)*

The Aerobee rocket was the high-altitude research project of Johns Hopkins and involved Dr. James Van Allen, who himself had pioneered one of the biggest issues with high-altitude research—getting instruments to higher altitudes for longer periods of time. His solution was something called the Rockoon, a combination of rocket and balloon. By lifting the rocket to a higher altitude before igniting it, the rocket would not waste valuable fuel pushing through the lower and denser parts of the atmosphere.

One problem with high-altitude rocket research was that several launches were often necessary in order to collect any meaningful amount of data, not to mention the fact that prior to the use of telemetry, instrumentation packages would simply crash into the impact area, where they had to be located before any data could be retrieved. Much better would be a platform that stayed aloft, such as an orbiting satellite. According to Space writer Willey Ley (in his classic book *Rockets, Missiles, & Space Travel,* ca. 1953), it was the development of telemetry in the general timeframe of the late 1950s that actually made the idea of an orbiting satellite a practical possibility. All that was needed was a means of putting one into space. Although Goddard did not live to see it, in 1949 a modified V-2 would boost a Caltech WAC Corporal to the edge of space, setting a new world altitude record. However, there were other rockets, too. A Navy research rocket named Viking would set a world altitude record for a single stage of 210 km on August 7, 1951. Furthermore, years later Viking would be favored to launch America's first satellite.

Rocket Launches

When America first proposed putting a satellite into orbit as part of the International Geophysical Year (IGY) of 1957–1958, there were several rocket candidates: the Army's Redstone, a direct descendent of von Braun's V-2; the Air Force's Atlas; and the Navy's Viking. The first two were ballistic missiles, whereas the Viking was a true research rocket. Since the IGY was to be a peaceful mission, President Eisenhower gave the job of launching America's first satellite to the Viking team and their Vanguard satellite.

Not being a military project, progress of the Viking rocket and its Vanguard satellite became regular news items. During the IGY the American Museum-Hayden Planetarium in New York City dedicated Viking Hall and published regular accounts of Vanguard's progress in its official monthly bulletin called "The Sky Reporter." The January 1957 issue showed a see-through picture of the Vanguard satellite on its cover and continued to report on it in subsequent issues.

When the Soviet Union launched Sputnik I in October of 1957 "The Sky Reporter" held fast, continuing to publish reports of the Vanguard program even though by this time von Braun had been authorized to launch a different satellite,

Explorer I, using a Redstone variant know as the Jupiter-C. It is interesting to note that Dr. James Van Allen, the same man who oversaw many rocket launches from White Sands, equipped Explorer I with instruments that would make the greatest discovery of the IGY—the radiation belts later named in his honor. On January 31, 1958 Explorer I was launched from Patrick Air Force Base into a polar orbit, thus becoming the first orbiting satellite launched by the United States.

Later that same year amateur radio operators would be called back to White Sands, this time as part of Operation Smoke Puff. The idea was to launch a rocket into the upper atmosphere and release a cloud of potassium ions known to reflect radio signals. Amateurs would then attempt to communicate by bouncing their signals off this cloud. By studying amateurs' reports it would then be possible to study the upper atmosphere in a uniquely different way. Michael Gladych authored an interesting account of this event, complete with illustrations, his article was published in the October 1958 issue of *Popular Mechanics*.

Advances in Technology

The early satellites may have solved the time-aloft problem, but they brought a new limitation—limited battery power. Fortunately, the rise of rocket power in the late 1950s was paralleled by advances that were beneficial to spacecraft, including the transistor, the silicon solar cell, and the traveling wave tube amplifier (TWT), all inventions associated with Bell Labs in Murray Hill, New Jersey. It is interesting to note that Vanguard was the first satellite to be powered using silicon solar cells.

The TWT was actually invented by Austrian-born radio experimenter Rudolph Kompfner, who first wrote of his invention in the same British magazine that Arthur C. Clarke proposed the synchronous satellite orbit—*Wireless World*. Recognizing the potential of Kompfner's invention, J. R. Pierce, then Executive Director of Electronics Research at Bell Labs, recruited Kompfner to serve as his Director. Kompfner accepted this position, and another engineer, C. Chapin Cutler, W1TX, would serve as Assistant Director. Cutler was an early member of the wireless club at Worcester Polytechnic Institute, which claims to be the first operational radio club. Together, Pierce, Kompfner, and Cutler would exert great influence on the development of communications satellites and the concept of radio repeaters in space.

Project Echo and Telstar

Kompfner later would be responsible for building the East Coast station for Project Echo at Crawford Hill, which involved many other amateur radio enthusiasts. One was Bill Legg, W2VE (ex-W2IPJ), who worked at Crawford Hill with Dick Turrin, W2IMU, during the early days of Echo and Telstar. In a recent e-mail to this author, Bill mentioned how he operated the tracking part of the program. Dick worked on the phase-lock tracking receiver.

In a 1963 lecture at Oxford, Pierce described how orbital elements were computed at NASA's Goddard facility in Greenbelt, Maryland and then transmitted to Crawford Hill and Goldstone via teletype. The punched tapes were then loaded into digital to analog converters that, at the appointed time, would keep the antennas pointed at the satellites passing overhead.

For an interesting look at the many other amateurs involved with this project, refer to a photo collection entitled "Hams in the Telstar Project" that appeared on page 64 in the May 1963 issue of *QST*. *(Editor's note: This article is also available to ARRL members at: <http://www.arrl.org/members-only/>.)* Among the hams pictured in the piece are: Joseph Oleckniche, WB2EYM; Lewis Lowry, ex-KN2KEK; Bill Schober, W2JIM; Bruce McLeod, K2QXW; Frank Witt, K2TOP; John Galney, W2LCO; Ronald Wells, W1WSV; Leonard Dryer, W1DCC; Eddie Snyder, K1YFA; Kenneth Field, K1LSC; Rodney Rouse, K2LVE; John Jacobsen, W1VXD; Gerald DeBonis, W1YWF; and Robert Brandt, W2CQB. The photos were supplied to the League by W2NJR.

With the success of Project Echo, all manner of spacecraft would quickly follow. There would be communications satellites that transmitted messages from one part of the Earth to another. There would be meteorological satellites that monitored the Earth's weather. There would be satellites filled with instrumentation to monitor various properties of the Earth. Additionally, there would be general-purpose satellites, known as Application Technology Satellites (ATS), which served as platforms for many different applications. JPL, already well established with its Earth and lunar probes, would develop new probes to explore the solar system, with names such as Ranger, Mariner, and Viking. Not to be outdone, a group of California radio amateurs would develop their own satellite known as Orbiting Satellite Carrying Amateur Radio, or simply OSCAR.

Amateur Satellites: Project OSCAR

The story of the first amateur satellite started in April 1959 when Don Stoner, W6TNS, then Semiconductor Editor for *CQ* magazine, published his design for a 50-mW, 2-meter transmitter he had successfully tested across the San Bernardino Mountains of California. Covering a distance of 120 miles with such a "tiny transmitter," Don realized it should work just as well 120 miles in a vertical direction, as in a satellite. In his article he joked, "Does anyone have a spare rocket for orbiting purposes?" *(Editor's note: This article is available for download for a fee from <http://www.hamcall.net>.)* As it turns out, an employee at Lockheed named Fred Hicks, W6EJU, read the article and believed it might be possible to find a launch vehicle through his association with the Air Force. After discussing this with Don, Project OSCAR was formed by a group of amateurs living in the San Francisco Bay area. After meeting with ARRL Southwest Division Director Ray Meyers, W6MLZ, and the head of JPL's Space Instrumentation System, Dr. Henry L. Richter, W6VZA, a plan was developed for the first amateur satellite.

Project OSCAR would eventually develop into a real group effort including not only Don and Fred, but other well-known hams, too. Included in the early OSCARs were Hank Brown, W6HB; Bill Orr, W6SAI; George Jacobs, W3ASK; Nick Marshall, W6OLO; Chuck Townes, K6LFH; Lance Ginner, K6GSJ; and many others, including our very own Dr. SETI, Dr. Paul Shuch, N6TX. Taking OSCAR from concept to reality also involved help from the ARRL and permission from the FCC, but in December of 1961 it finally did happen. This was followed by another beacon satellite (OSCAR 2) on June 2, 1962, and the first two-way amateur communications satellite (OSCAR 3) in March of 1965.

When AMSAT was formed to continue the work of Project OSCAR, Leonard Jaffe, K3NVS, formally announced to the world that OSCAR 5 would indeed be launched. Jaffe was NASA's Director of Communications, already experienced with projects such as Echo, Telstar, ATS, and CTS, to name just a few. Obviously, OSCAR involved many people, in fact too many to mention, and the story has since evolved into an international affair that continues to this day.

The Satellites An Overview

To put things into perspective, the first six active communications satellites were Score, Courier, OSCAR, Telstar, Relay, and Syncom, in that order. Score was put into orbit on December 18, 1958 by the Advance Research Projects Agency (ARPA) and is remembered for transmitting a taped holiday greeting from President Eisenhower. Score was a delayed repeater-type satellite, allowing messages to be uploaded from one ground station and downloaded later to another. Courier was launched by the U.S. Army in September of 1960, and it too was a delayed repeater type. A major communications obstacle for this type satellite was the communications delay, which could be as long as two hours. Oscar was launched on December 12, 1961. It transmitted the word "HI" using Morse code on the 2-meter band. The repetition rate of this message was proportional to the satellite temperature, perhaps qualifying it as one of the earliest space probes. Telstar, the creation of AT&T and Bell Labs, was launched on July 10, 1962 and is probably the best known of the early satellites. AT&T funded its entire development and even refunded NASA for putting it into orbit. Relay, a NASA satellite, was launched on December 13, 1962 and is known for carrying the news of President Kennedy's death to the world. Syncom, another NASA satellite, was launched on February 14, 1963. Syncom 3 would become the first satellite to truly follow a synchronous orbit, and in 1964 was used to relay the first live TV pictures, of the Tokyo Olympic Games.

As it turns out, two radio amateurs working for Hughes Aircraft, Harold Rosen (call unknown) and Tom Hudspeth, W6LHN, played a major role in Syncom 3. Rosen and Hudspeth visited the Bell Labs Holmdel facility in 1960, apparently trying to sell their idea of a geostationary satellite. Pierce didn't think much of it at first, because at such a distance (22,300 miles) the communications delay would be objectionable to users of the phone system. However, Bell's concept of maintaining a fleet of orbiting satellites brought the unwieldy task of accurately tracking all those satellites. This would not be a problem for a synchronous satellite, and Pierce later commented about Rosen's genius. Of course, the Syncom satellite was the precursor to the vast majority of satellites in use today.

Another Hughes satellite with connections to amateur radio was ATS-1, an Application Technology Satellite. This satellite was launched in 1966 and used for geosynchronous and spin stabilization experiments until 1969, when NASA made it available for other uses. One use was proposed by Dr. John Bystrom of the University of Hawaii. He proposed the satellite be used as a relay for voice and data communications in the remote islands of the South Pacific. Well-known amateur Katashi Nose, KH6IJ, would take on the responsibility of developing the low-cost ground stations for use with this so called "Peacesat."

When Wernher von Braun retired from NASA in 1972, the year of the last moon landing, he went to work for Fairchild Industries. While at Fairchild he pursued a new vision for space—not the space stations and interplanetary travel of the 1950s, but the use of satellites for the good of mankind. The idea was to adapt ATS satellites to provide direct television programming to remote areas of the world, not for entertainment, but for medical and educational purposes. Places such as India, Alaska, and the Appalachian Mountains all would benefit from this endeavor. The satellite of choice would be the Fairchild built AT-6, which von Braun promoted on campuses across the United States in the mid-1970s, which brings us back to where we started in this article.

Conclusion

As we sat down with Dr. von Braun, someone brought out a plate full of donuts, not the neat kind, but those of the messy white-powdered variety. As von Braun reached out for one, someone began the questioning by saying something like "Dr. von Braun, you've pretty much seen it all, from the early days of rocket development, to White Sands, all the way to landing a man on the moon. Looking back, how would you summarize your experience?"

As the white powder fell from his doughnut, landing gently on his finely woven slacks, von Braun paused for a moment and said, "Well, there was never a dull moment!" All at once we felt at ease with this man, no longer worried what to say or how to act. We just sat there enjoying his company, as well as the donuts!

"Ham-Tested" at Quartzfest

It's the primitive location. It's the fun and camaraderie. If you're a ham and own an RV, then it's the place to be—Quartzfest. Maybe it's the ruggedness that brings out the aspiring ham radio product developers to have their latest goodies field tested. Here WB6NOA describes several new products for the rugged ham radio operator.

By Gordon West,* WB6NOA

Plenty of weak-signal operators can be found at Quartzfest. This is the gathering of ham radio RVers five miles south of Quartzsite, Arizona during the annual Quartzsite RV show. Hams at Quartzfest join up at mile marker 99 and spend a week boon-docking on the desert floor. As hams, we are self-sufficient, and we don't need the customary campground hookups. After all, we have our own! (See: <http://www.Quartzfest.org>.)

Solar Charger with a Spike

Before the big rain storm moved in near the end of the encampment we had great sunny weather—perfect for "ham testing" solar panels. However, for those campers who hadn't "exercised" their on-board battery systems, many found that their house batteries just wouldn't hold a sun-charge as when they were new. It was a common problem, likely plate sulfation when hooked in to winter months of shore power at the RV storage facility.

After a year of testing PulseTech Products Corporation battery charging systems (photo 1), I was surprised that their pulse charging waveform could actually make a difference for several five-year old lead-acid batteries. (See the PulseTech Extreme Charge at: <http://www.XtremeCharge.com>.)

"We use pulse current as an effective conditioning and breakdown of sulfation into active electrolyte, with this activity resulting in availability of active plate material and renewed performance and rechargeability in lead acid batteries," comments John Wise, the engineer for PulseTech products.

Photo 1. PulseTech Xtreme Charge Marine version.

"Our products deliver a 1-microsecond rise-time pulse, with a width of 12 microseconds, at a pulse frequency of 26 kHz to 34 kHz, with some products having a pulse current amplitude of 200 mA," adds Wise. Therefore, besides charging a battery from the company's AC pulse charger, or several models of solar-panel pulse chargers, these pulses help to desulfate battery plates.

"Battery resistance is three to four orders of magnitude higher than the source resistance of the solar panel. Therefore, desulfating pulse performance is easier to measure as a current pulse, rather than a voltage pulse. The charge of the battery is *not* a pulse charge. Our unique technology is a desulfating high-frequency pulse combined with smart charging," adds Wise, describing how the product technically works. See the oscilloscope plot measured using a Fluke 199C scope meter and a Fluke I30s AC/DC current clamp. I used .1- to .5-ohm resistors for this measurement.

In the Dune Buggy that was towed to Quartzfest, a relatively old battery continued to function well on starting, likely due to this pulse technology. although the Buggy's solar panel could only generate a couple of hundred milliamps, evidently the pulse technology helped clean up a relatively sluggish battery.

In a marine installation, we ran the five-stage maintenance charger from PulseTech Products Corporation, model XC-100-W, and besides five stages of bat-

*CQ VHF Features Editor, 2414 College Dr., Costa Mesa, CA 92626
e-mail: <wb6noa@cq-vhf.com>

Photo 2. PulseTech SP-25 solar-panel system.

tery charging, the constant pulses remained strong, even though the charger was in the "float charger" mode. We couldn't see the pulses on a volt meter, but could detect them with the Fluke and see them on an oscilloscope. The marine battery didn't seem to age with sulfation with this new pulse charging, as it did with a regular marine trickle charging circuit.

At Quartzfest, we ran the PulseTech Products Corporation SP-25 solar panel system (see photo 2). Fellow RVers all wanted to know where that thin, sturdy 1.5-amp clear lexan-covered solar panel came from and what it did beyond just charging up the battery. The potted controller features three LEDs, one for power on, one flashing to show charge and pulse, and steady-on for the pulse maintenance mode. There is also also a red LED in case you get the panel hooked up backwards.

Therefore, beyond straight battery charging and automatic over-voltage regulation, the little black box with the LEDs also delivers the pulse waveforms to keep a battery desulfated.

I still needed convincing on the actual desulfate process, so I sat with one of the Quartzsite RV distributors, WCS Distributing, and saw many customers coming back to buy a second and third panel. One was a ham, who said he was totally skeptical about the product's claims, but

Photo 3. Ant-0865 Super-M Classic Mobile whip antenna.

after a year a relatively older battery was now behaving like a youngster!

Your contact at PulseTech Products Corporation for more information is Smokey White at <SWhite@PulseTech.net>, or you can look up the company's claims and some technical details at <http://www.XTREMECharge.com>. You can also get pricing plus availability from dealers at this same website. To contact the head engineer, call 800-580-7554, ext. 159, for John Wise, who really knows his stuff. The general toll free-phone number is 800-580-7554, ext. 170.

MP Antenna Test

Another product we "ham-tested" at Quartzfest was a strange antenna system from MP Antenna Ltd. (see: <http://www.MPAntenna.com>). Several years ago I purchased one from Fred at Universal Radio that covers 25 MHz to 1.3 GHz receive, and 144, 222, and 440 MHz for transmit. Back then it was called the NilJon, but today it is model Ant-0865 Super-M Classic Mobile (photo 3). It terminates to an NMO connection and features three whips, different lengths, coming out at different angles for MultiPolarized radiation. Say what?

Dr. Nilsson, MP Antenna's inventor and research scientist, explained that patented MultiPolarized antenna technology improves weak-signal reception by its special phasing of the antenna elements. I could see an improvement over picket fencing, as he tells me one element will hold the signal as the other element may be in a momentary 3-dB fade. He indicated that MultiPolarized technology is very useful in downtown areas where multipath is always a problem for VHF/UHF mobile operation. The polarization, for us weak-signal users, is horizontal, but the capability of capturing vertically polarized signals that might otherwise be out of phase is dramatically improved by the multiple antenna elements.

At Quartzsite, we wanted to see how much better MP Antenna's 2.4-GHz antennas might do over a conventional 2.4-GHz WiFi Yagi (see photo 4). The Trident 2.4-GHz WiFi antenna, model Ant 0874, can operate omni, but add the Sector 60, 2.4-GHz directional 60-degree corner reflector (photo 5) with Ant 0868 for a substantial boost in gain over the omni—12 dBi as plotted, about the same as our cumbersome 2.4-GHz Yagi.

Side by side, the MP Sector 60, 2.4-GHz multi-polarized high-gain corner reflector directional antenna beat the daylights out of the conventional 2.4-GHz fiberglass-enclosed Yagi! I was able to land distant WiFi hotspots out in the desert, thanks to fellow hams allowing us to link aboard their satellite system and WiFi router.

Photo 4. How will a conventional 2.4-GHz WiFi antenna compare with MP Antenna's Sector 60, 2.4-GHz antenna?

MP Antenna also produces some base-station antennas, offering wide-band coverage from 25 MHz to 6 GHz, great for scanners or clandestine radio applications on nearly any frequency.

"When tested in non-line-of-sight obstructed environments, the 6-element M-Pole certified MultiPolarized antenna can outperform a single whip by at least 8 dBi," comments Brian Gaul, sales manager for MP Antennas.

I even squeaked out some decent VHF/UHF contacts on the drive home in the rain from Quartzsite that weekend. Therefore, while it is not designed as an omni-directional *horizontal* antenna, it still does an okay job for weak-signal SSB and CW signals.

Fred at Universal Radio says he has many satisfied ham customers, who, not

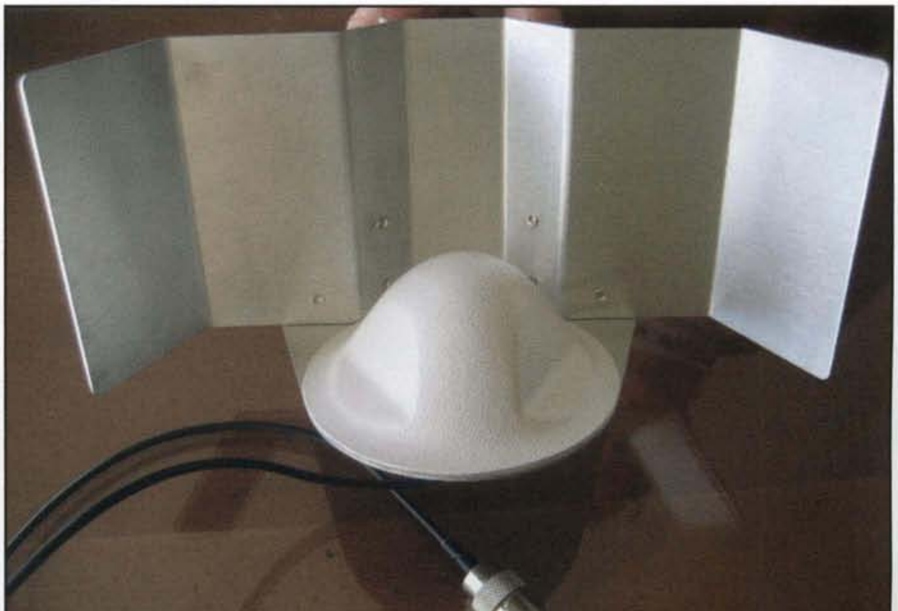


Photo 5. MP Antenna's Sector 60, 2.4-GHz antenna.

Photo 6. Jetstream JTPS 30M switching power supply.

fully understanding the technology, agree it seems to make a difference. I like it because it looks strange on the comm van, and does just as well as a conventional VHF/UHF multiband whip, but without quite the height.

Contact MP Antenna for suggested pricing and spend some time with your laptop figuring out how you are going to take the antenna coax TNC and tie it in with your 2.4-GHz WiFi card. If you have a router, one with removable antennas, this will certainly give the router a big boost in range.

"Yes, our Trident 2.4 Antenna easily connects to many wireless WiFi routers such as D-Link, Linksys, Netgear, etc. It also connects to many USB WiFi cards as well, such as Hawking Technology, Alpha, etc.

"Our soon-to-be acquired resellers in the 2.4-GHz/WiFi commercial arena will be happy to help customers with interconnect coaxial cables between our antennas such as the MP Antenna Sector 2.4–60/120 and Access Points, Mesh Radios, and CPE (Customer Premise Equipment) including POE (Power over Ethernet) types," comments Dr. Nilsson.

DC Switching Power Supply

At the fun R&L Electronics open house I had a chance to peek at the inside of the new Jetstream JTPS 30M switching power supply (see photo 6 and <http:// www. Jetstream-usa.com>, sales at <sales@ Jetstream-usa.com>). Quite nice! The switcher supply is small, lightweight, and efficient with no found radio birdies. An analog meter with a cool blue LED backlight can measure voltage or current, and voltage is variable from 9 volts to 15 volts by a front-panel control. An accessory socket on the front offers cigarette-plug 12 volts DC output at 10 amps. A front-panel, 12-volt DC output is also available at 3 amps. The big power DC output is on the back of the equipment, rated at 30 amps. A cooling fan keeps the unit happy during prolonged transmission.

The four-page instruction sheet indicates: "Don't put any fraise in front of the cooling fan within 30 cm." I'm not sure I have any fraise hanging around my shack, but I'll keep the cats clear of the spinning fan.

I tried to short it out, and it instantly cycled down, and then reset after the short was removed. No spark; very smart. I ran it on some FM long-winded nets, and it barely got warm.

I like the nice rounded corners, and especially like the included DC current and DC voltage dual-function meter, which toggles between both on the front panel.

Just remember, if you want variable DC voltage via the front-panel knob, make sure the switch on the rear is set to "adjust." It took me a few minutes to figure out that one.

However, it took me only seconds to like this great, quiet power supply from Jetstream available at local ham radio dealers and R&L Electronics. See you at the next R&L bash!

With summertime approaching, tropo time is growing near, and the next issue of *CQ VHF* takes a look inside the tropo duct.

Twenty Years of ARRL VHF Contesting: With Emphasis on Portable Operations

Nearly 400 years ago Thomas Taylor once exclaimed, "Experience is the best teacher." A hundred years before Taylor, someone else declared, "Time will tell." Here WB2AMU tells of the lessons he has learned over 20 years of portable VHF contesting.

By Ken Neubeck,* WB2AMU

By the summer of 1990 I had accrued over 20 years of hamming on the HF bands. I was looking for something different to try in the hobby. Six meters and weak-signal VHF always seemed to be out there for me to explore, and I got my start in this realm when I bought a Swan 250 6-meter transceiver at a flea market in Long Island, NY.

By August I had rigged up a crude-looking 6-meter beam using an old TV antenna and actually made a contact with a local ham. I used a somewhat portable setup with this TV antenna and my Swan 250 sitting on a picnic table with AC power from the house in my backyard for the September 1990 ARRL VHF Contest. I had fun, as there was a good amount of line-of-sight activity during this contest. However, I had to shut down the station when the next-door neighbor complained of TVI, a situation that I found to be inherent with the band and particularly with the RF-leaky Swan 250.

Over the next six months, I did participate in the January 1991 ARRL VHF Contest from my basement station setup with a few line-of-sight contacts being made, but still nothing to show me anything special about 6 meters. It was not until the morning before the start of June 1991 ARRL VHF Contest that I finally experienced sporadic-*E* on the 6-meter band that carried forward into the contest. Then that I saw what was so special about the 6-meter band and this led to a renewal of my interest in ham radio.

*CQ VHF Features Editor, 1 Valley Road, Patchogue, NY 11772
e-mail: <wb2amu@cq-vhf.com>*

Photo 1. The author, Ken, WB2AMU, using a Swan 250 hooked up to a modified TV antenna on a mast mounted in the picnic table for his first-ever VHF contest effort that took place in September 1990 in the back yard of his house in Patchogue, New York. (Photo by Fran Neubeck)

For the next few years I made some station improvements, finding a TS-670 that was lower power and less TVI-prone than the Swan 250, along with setting up a permanent vertical antenna for the band. The additional benefit of the TS-670 was that it is a 12-volt radio and this led to some earlier experimentation with portable operation from my car. Again, this led to more refinements, such as a mag-mounted vertical quarter-wave 6-meter antenna and the construction of a portable 2-element 6-meter Yagi, as well as the purchase of the FT-690 portable radio, which could run at 2 watts in battery mode or 10 watts with the amplifier attachment.

I was also finding out that my modest station at home was simply not going to be competitive for any of the three ARRL VHF contests with the better equipped and designed VHF stations that are located on Long Island. This is true when you examine my street name, Valley Road, which is actually down a hill but still at about 30 feet ASL or so. Therefore, I started exploring the option of improving my portable setup in my car at that time, a 1993 Plymouth Sundance, and finding optimal hilltop locations on Long Island from where I could operate. This resulted in an interesting trial-and-error period, when I operated from both the south and north shores of Long Island, typically running a 2-element beam and about 60 watts of power using a Mirage 1015A 6-meter amplifier with my FT-690 in the 2-watt output mode.

Eventually, I picked up the FT-290, which is the 2-meter version of the FT-690, and this led to a better contest effort so that I could go between two bands when conditions changed. The move to 2 meters brought up the need that hilltop locations were going to be required for best results for me. Thus, by 1995 I also realized that by operating at one of the highest points on Long Island during the three annual ARRL VHF contests I could efficiently operate a QRP setup with good results, although with some challenges.

Portable Operations

By 1995 portable and rover operations became the focus of my efforts from that point forward. At first I only had 6 meters and a simple two-element beam, but over the years I added additional bands and used different antennas to improve my overall score.

My initial effort in portable operations during the VHF contest was strictly on 6 meters. However, after a few years it became obvious that I needed to add some 2-meter capabilities for when the 6-meter band was quiet. I added an FT-290 to my arsenal in June 1995. This helped me become more competitive, and it led me to adding 432 MHz in June 1999 with an FT-100 radio and some limited 220-MHz capabilities with an ICOM FM HT in January 2003. Also, over the years I eventually migrated to three-element Yagi antennas for the 6- and 2-meter bands. It is important to realize that it sometimes may not be possible to get all of the equipment that you need at once, and gradual additions and improvements are a good way to go.

In June 1996 I made a long-desired trip to Wyoming and Colorado, where I did a rover operation during the June VHF contest. I had kept strictly to one band, 6 meters, as I did not expect a lot of activity on the other bands in the area I was

Photo 2. WB2AMU's QRP portable setup of a two-element 6-meter Yagi for the ARRL September 1996 VHF contest using his 1992 Plymouth Sundance. (This and remaining photos by WB2AMU)

Photo 3. A January 2003 VHF contest QRP effort with a 1998 Chevy Cavalier using a three-element 6-meter Yagi.

in. I was able to rig up the rental car to put out 150 watts to a mag-mount vertical, and I was very grateful when sporadic-*E* appeared at the beginning of the contest on Saturday and during Sunday morning. I think that going to rare grids during the June contest can be one of the most fun activities in which a VHF ham can participate.

There are challenges regarding portable operations. With portable operations, the ideal location for operating traditionally has been a hilltop or mountaintop location to get improved line-of-sight conditions for the VHF and UHF bands. Since I live on Long Island, where there are no mountains (don't believe what you saw in the opening scenes of the movie *Pearl Harbor*), the choice is confined to hills. Long Island has a limited number of hills, some in central Long Island, where the glaciers stopped years ago, and some on the north shore. Most of them are in the 200-foot ASL range, which may not seem like much, but it does help a lot in the moderately busy VHF activity found in the Northeast U.S.

I thought that merely securing a high point on Long Island would be easy and present no issue when I operated from a public park. However, I would soon find out that operating in a public area presents additional challenges compared to the safety of one's ham shack.

In January 1995, it was cold but no snow on the hill I chose. I was located at the far end and making contacts in the afternoon, after the contest had started at 2 PM. The parking lot was about 60 percent filled with cars, mostly with men just sitting in the front seat. At about three PM, two police cars entered the parking lot, followed by undercover police who were already there. I was in the midst of a full-fledged police raid. The police saw my portable antenna setup and left me alone while clearing the park of cars, enforcing a no-loitering rule. They came to me at the end, when I was the only car left, and told me that they understood my amateur radio activity but suggested that I secure permission from the county parks department in order to avoid any problems in the future. Indeed, I found that I would need paperwork from the county, after being asked to leave during another January contest in 1997 because of the no-loitering rule for the park.

If I had never gone to the hill in the first place, I would never have known about the weird situation that was going on up there involving the exchange of drugs, etc. But because of the excellent height of the hill and it also being one of the few spots on Long Island where there is good line-of-sight in all directions, I became aware of the other situation going on. Likewise, parking lots in other locations in the U.S. could have activity that the average person may not be aware of. Thus, use caution when seleting an operating site.

However, I was determined not to be deterred. The way that I saw it was that ham radio was a legitimate and "good" activity that should be allowed in a a public park. I thought that by shining a light on the darkness with the participation of ham radio in a public place, it would be a step in the right direction to correct the situation.

The situation did get better after several police actions during the early part of the new century when several dozen arrests were made. However, now I was the odd ball with regard to appearing "different." It was not be unusual for a police car to pull up next to me on a Sunday morning to check me out in response to a call of suspicious activity. I knew the drill by now. I would stop operating, get my documentation, and get out of the car to talk to the police when they arrived. It seems ironic in the current climate that ham radio is not very well known by the public and can be "suspicious activity." I think that hams as a whole have their work cut out for them in the future to define ourselves to the public.

Therefore, I learned in short order that it is necessary to keep in mind that even if you are operating VHF from a public park, you may need to secure some kind of documentation ahead of time. Most municipalities will not have an objection if you carefully frame your request to say that you will only operate during daylight hours, or something of that nature.

Another thing is to keep your setup efficient and simple. For a number of years, I had a separate antenna for 432 MHz, but after making a contact on 432 MHz using the three-element 2-meter Yagi for that band instead, I realized that while I obviously lost some gain for that band, I gained in simplicity in the antennas setups, along with quicker band switching. During the great tropo open-

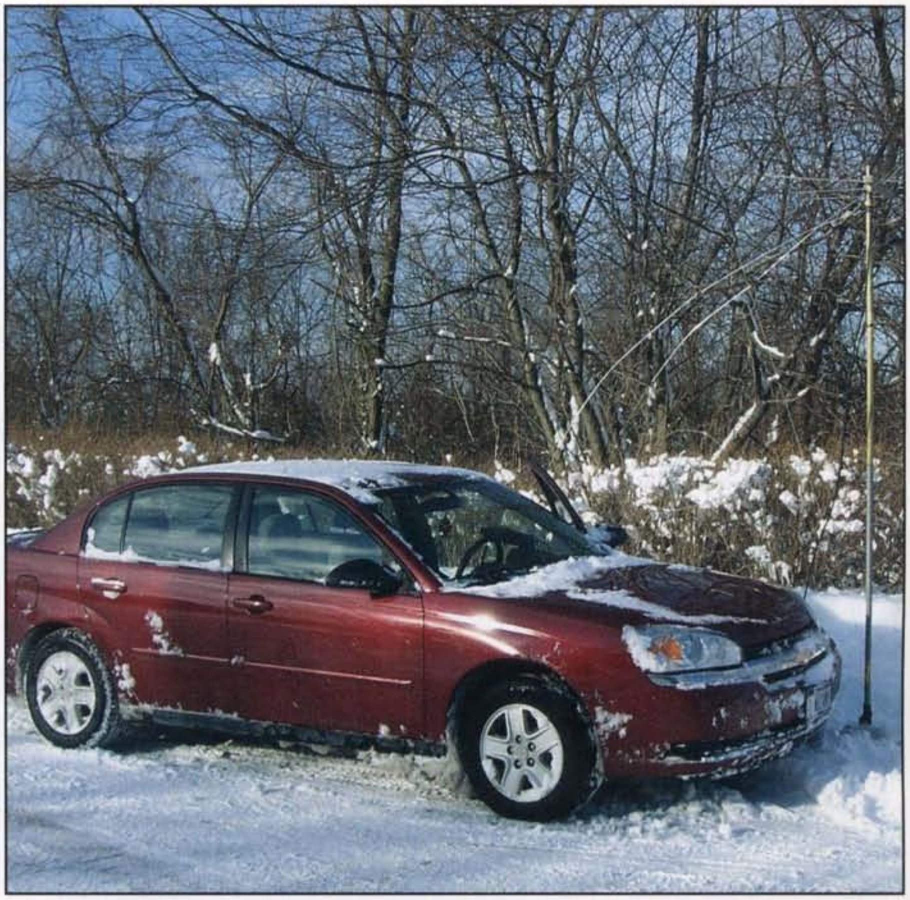


Photo 4. The January 2005 VHF contest effort with a 2004 Chevy Malibu using a three-element 2-meter Yagi.

ing that took place in September 2007, I made over 24 QSOs in 14 grids on 432 MHz using the 2-meter beam as a result of quicker switching between 432 MHz and 2 meters. (Recall that the FT-100 only has one output for 2 meters and 432 MHz, so much time can be lost if switching between two antennas.)

Propagation During the Year

For those stations in the quieter areas of the U.S. and Canada, the September and January contests present challenges in making contacts. Many stations deal with this challenge by going the rover or portable operation route. Some of the things to remember associated with each contest are outlined as follows:

ARRL January VHF Sweepstakes: During January, North America experiences a minor winter sporadic-*E* season. This is nothing like the summer season, as typically three or four days of sporadic-*E* activity may be seen during the month, leading to about a 15-percent chance that some sporadic-*E* may be observed during the 33-hour event of this VHF contest event. In 2008, I observed a three-hour opening from Long Island into Florida. In 2010, I observed no sporadic-*E* during the contest at all, yet a week later there was a string of days of long-duration sporadic-*E* openings. The point here is that sporadic-*E* lives up to its name, and while you hope for it to happen, it has to be viewed as something special.

During the peak years of a solar cycle, the January contest is pretty much the only event of the three where *F2* can be worked on 6 meters. In 2002 I worked into the West Coast and heard one of the biggest pile-ups in history when a ham from Iceland came on 6 meters on Sunday morning. Unfortunately, for that particular event the major opening to Europe happened on Saturday morning, prior to the contest. I am guessing that January 2013 or 2014 may have the possibility of *F2* activity on 6 meters for the ARRL January VHF Sweepstakes.

This situation leaves one to grind out primarily line-of-sight QSOs during the January event for the bulk of the contest period. Unfortunately, for many of our VHF operators in the U.S. who are not near major centers of VHF activity, this may mean only a few contacts if one stays at home. That is why rover and portable operations seem to be a viable option for many in this situation.

Photo 5. WB2AMU's rover effort in Wyoming and Colorado during the June 1996 VHF contest. This photo shows the rental car used by WB2AMU with a mag-mount vertical during a visit to grid DN61 in the mountains of Wyoming.

One can see that this is true by reading the soapbox submittals that are made for this contest on the ARRL website. There seem to be a fair number of rover team. I cannot think of a better way to break up the monotony of winter doldrums and cabin fever!

Thus, scores will not be high because of the propagation situation and most importantly because of the potential of bad weather. In my area of Long Island, there is generally the chance of snow, cold temperatures, and high winds. However, I know that it can be worse for stations north of me. Even home stations can feel the impact with ice on antennas, frozen rotators, and loss of power. The January event truly seems like a survival event for many VHF operators in the U.S. and Canada.

ARRL June VHF QSO Party: Sporadic-*E* is the wild card for the June event. There always seems to be some around, and the question becomes how long, how much, and in what areas. It really does not matter where you are located in the U.S. and Canada. You can be in the middle of Wyoming and a massive sporadic-*E* formation could link you to the Midwest and you can make hundreds of contacts. When a major sporadic-*E* event occurs with multiple formations during the June VHF event, as it did in 2006, watch out! There is bedlam and signals all the way up to 50.300 MHz!

When a strong sporadic-*E* event occurs on 6 meters during the June event, it can impact the amount of activity on the other VHF bands. Thus, it is still important to be ready to go during the slow periods to work line-of-sight stations on 2 meters and up. The multipliers that are made on those bands are just as important as those worked via sporadic-*E* on 6 meters.

By the way, some unusual events have occurred in the past. During the June 2005 event, there was no sporadic-*E* at all, but a significant aurora event occurred in the northern states, accounting for some major activity on 2 and 6 meters. My portable setup was sufficient to work several VE3 stations on 6 meters using 10 watts, but it was not quite enough for me to work stations via 2 meters aurora.

Photo 6. Also during the author's rover effort in Wyoming and Colorado for the June 1996 VHF contest, this is the inside of the car with the FT-690 on the dashboard and the Mirage 1015A amplifier on the hood of the car.

The warm weather also makes this event ideal for portable and rover operations that can be coupled with vacations.

ARRL September VHF Contest: The September contest is traditionally the best time for tropo-related propagation to occur. Sporadic-*E* is very rare in September, and during high geomagnetic activity, aurora propagation is possible, but these would be considered treats. Line-of-sight and any possible tropo enhancement are the keys for this event, with the focus on 144, 220, and 432 MHz.

The weather is generally still warm enough for favorable for portable and rover operations, with participation in these two categories fairly high for this contest event as well. Over the years I have noticed that changing weather patterns are common during September and these have led to major tropo enhancements during the contest. An example is the September contest in 2008, when hurricane activity was pushing into the Carolinas and forcing weather patterns that were favorable for tropo ducts along the northeast coast of the US. Both 144 and 432 MHz were filled with activity during the Sunday morning of that event, and I was able to work over 24 stations in 14 grids on 432 MHz, an number that was double my normal.

When favorable tropo conditions occur, from Long Island I can work stations in Virginia and the Carolinas, even while using QRP power levels. I believe that there are other tropo paths in the rest of country that can occur during the September VHF contest, and sometimes a good heads-up can be gained by checking the Hepburn tropo maps on the internet as well as keeping an eye on the weather maps for front activities prior to the contest.

Thoughts for the Future

It is important to realize that a VHF contest is different than an HF contest, because in reality, there are regional winners and this changes among the three ARRL contests during the year. It would be difficult to say that a ham with the highest score in the U.S. during a VHF contest could truly be judged in the same manner as a high score U.S. winner in an

Photo 7. The surreal sight of the snow-covered landscape in early June 1996 with the temperature at 60°F!

HF contest. The inconsistency and nuances of propagation that occur during a VHF contest make this particularly true, compared to more uniform *F2* propagation patterns experienced on the HF bands. Also, some regions have decided advantages over others with regard to a fair amount of local activity on VHF to begin with. The Northeast is one such area, along with parts of California and in some Midwest areas that have a residual contact base of VHFers who can be worked within a 150-mile radius with moderate VHF equipment. VHF stations from more remote areas such as Wyoming, Montana, Idaho, and Utah only have a possible chance of placing well in the overall U.S. during the June contest when sporadic-*E* propagation may appear on 6 meters, whereas the September and January contests will likely not experience any significant sporadic-*E* propagation, leaving tropo and line-of-sight contacts as the only possibility for these stations. If the number of local VHF stations is low for these quieter areas, then the contest really becomes a very short-time affair and would keep the interest in VHF low.

I do not know how many more years that I personally will be able to do portable operations during the VHF contests. The setup is not particularly heavy, nor physically challenging, but some of the harsh weather conditions that are generally encountered during the January contest can really test your stamina. However, I still think that there is nothing better in the world during the doldrums of winter than to do some portable operating during a VHF contest, even if just for an hour or two.

I have noticed that there have been some issues with the number of stations participating in the contests as the years go by. I believe that both 6 and 2 meters seem to be the main bands, and I also believe that the June and September events will continue to hold their own. There are two or three areas that I believe could use some tweaking in the contest to better fit the band conditions, weather conditions, and band activity.

One major area that I think could help activity is to increase the value of 220-MHz QSOs from 2 to 3 points per QSO. 220 MHz is currently in the crosshairs of Congress for review and has been targeted as an area of interest for industrial use. A big problem is the lack of readily available SSB/CW radios for this band. However, there are plenty of 220-MHz FM radios. Perhaps by increasing the multiplier for a 220-MHz QSO, more stations will pick an FM transceiver and walk stations from other bands to 220 MHz during the contest. One could make a stronger argument for the multiplier to be raised by the ARRL to 4 points per contact, even if it was just for a one-year period just to kick up activity and help the overall band situation in the bigger picture. Ultimately, as hams we may regret the loss of the 220-MHz band in the future if we could have done something about it by promoting more activity. It would be a tremendous shame if hams lost this band, because some characteristics of 220–225 MHz are unique, and radio amateurs have observed the only recorded instances of sporadic-*E* propagation at this frequency.

Photo 8. This is the current antenna setup that has been used by the author for his QRP portable setup since January 2007. The three-element 6-meter Yagi is is an umbrella stand, while the three-element 2-meter Yagi is mounted on a tripod situated on the roof of the car with the latter antenna also used on 432 MHz, mainly for simplicity. There is a mag-mount vertical located underneath the tripod which is used for 220-MHz FM.

I also believe that the January contest is a few hours too long for the number of stations that participate. Part of this is the competition from the NFL football playoffs that occur during the contest weekend in January. Another factor is that January in the U.S. and Canada generally means bad weather, and this takes a major toll on both rover and portable stations. Keep in mind that many of the public parks that these stations go to to operate have closing hours related to sunrise and sunset. Also, it can be hazardous for rover stations and portable stations to be operating during the night-time hours when bad weather (snow, ice, and wind) is present. Therefore, I would recommend the ARRL look at shortening this contest a little bit to meet the actual activity levels.

Another problem is the inherent dichotomy of the contests. While they are called VHF contests, it includes participation up to the microwaves. One would think that it would be called a VHF-Plus or a 50-MHz and Above contest. The problem is that the setups get more and more esoteric as you leave the UHF range, where dish antennas are required. Also, as you get into this range you need to identify your buddies who are within reasonable range and could be worked. While the three contests are a good avenue to promote this activity, I wonder if it would make sense to divide the participation level into three main categories: (1) the lower four bands (50 MHz to 432 MHz), (2) bands above 432 MHz, and then (3) all bands. All similarities among the types of propagation found on 6 meters and say 1.2 GHz are non-existent and the methods to make contacts are

Significant North American Sporadic-*E* Openings during February 2010

By Ken Neubeck, WB2AMU

There is an old adage about wrong time and wrong place. This was true of the January 2010 ARRL VHF Sweepstakes. During the contest there was minimal tropo activity observed and virtually no sporadic-*E* activity on 6 meters. Yet the week before the contest, there were some tropo paths on 2 meters in the Midwest, and the weekend following the contest there was major sporadic-*E* activity observed on 6 meters in North America that continued well into the first week of February.

What was unusual about the sporadic-*E* activity that began on the afternoon of January 31 was not the fact that it occurred during that time of year, but the duration of the event, not only for that day, but for several days following! Beginning during the afternoon of January 31, there were sporadic-*E* paths from parts of Canada into the southern U.S. Later at about 2300 UTC, paths began to open up between the Midwest and the southern states.

I listened during this time but did not hear anything. However, I saw spots on the next day that began in the morning at my work QTH in FN30, and using a mag-mount vertical from my car I worked a few stations in Florida, South Carolina, and Tennessee. Later, the band opened up big time at 2300 UTC during the evening for me and I worked over 20 different stations located throughout the Midwest: Ohio, Michigan, Wisconsin, Illinois, and Indiana. The next day, February 2, saw some activity between the VE1 area in Nova Scotia and parts of the U.S.

I also observed smaller, but significant openings on February 3, when I worked into a narrow grid field in Florida—EL96, EL97, and EL98 from 5:30 to 6:30 EST—and on February 7 at 10 AM. EST into EL87 grid inn Florida. Three 6-meter sporadic-*E* openings during the first week of February was a significant event tbetter than any previous observations that I had made for that month.

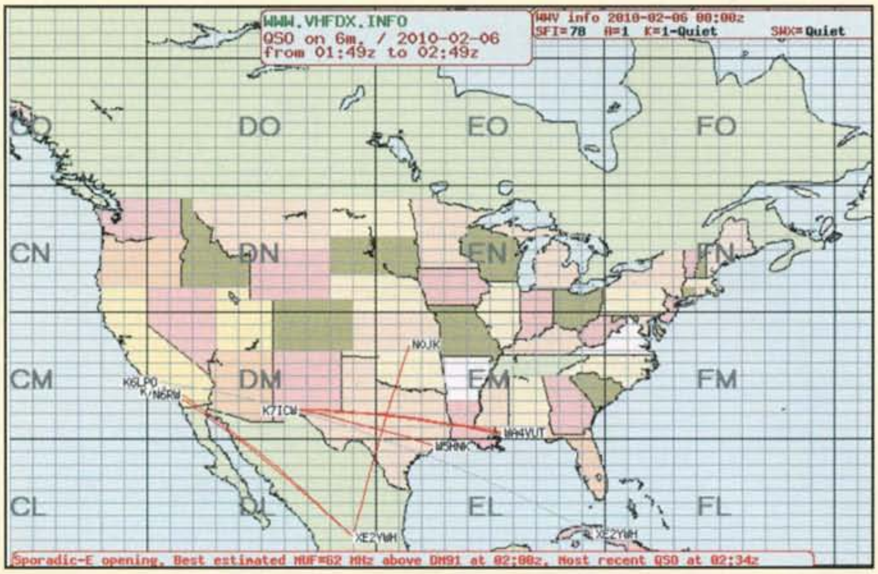


Figure 1. This plots shows a handful of contacts made at 0140 UTC, February 6, 2010 in the southern part of the U.S. and Mexico. (Plot by Jon Jones, NØJK)

Jon Jones, NØJK, an active 6-meter operator from EM17 in Kansas, personally made 6-meter sporadic-*E* QSOs on (CST time for dates) January 31 and February 1, 5, 10, 13, and 21. Jon reported that in addition, active 6-meter operator KD5PBR from EM04 spotted 6-meter sporadic-*E* on February 4, 9, 11, 19, and 25. Jon also reported that Bob Carnahan, N3LL, in EL86 in Florida, reported sporadic-*E* on February 2, 3, 6, and 7—days not reported by KD5PBR. A number of West Coast U.S . stations worked into Central America on February 4 and 5, as well.

Figure 1 shows a plot that Jon made of 6-meter sporadic-*E* activity CST local time on the night of February 5 (0100 UTC on February 6) of a contact that he made into Mexico with XE2YWH, along with a plots of a few other contacts made by others at the same time.

Therefore, in total, an estimate for North America 6-meter sporadic-*E* days in February 2010 is (represented in terms of North American time zones): 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 13, 19, 21, and 25, showing that at least half of the days in February saw some sort of 6-meter sporadic-*E* activity. As of this writing, who knows if this translated into some possible sort of activity during March of this year, typically the toughest month for sporadic-*E* activity in the Northern Hemisphere.

very different, from basically random on 6 meters to a predetermined setup for those very high bands. I think that this situation may have to be explored by the ARRL in the future.

I believe that the rover rules are generally fair, and the recent tweaking by the ARRL to make three categories for rovers (basic, limited, and unlimited) has helped promote more activity in this important category. It is apparent that rover operations are very popular with VHF hams, and it can sometimes promote a family-style activity, based on comments reported in the ARRL contest soapbox section. Indeed, this activity seems to be a popular thing during the January contest when getting out of the house is a good thing!

It is important to mention that for the ARRL VHF contests, the activity level among years for the same monthly events (particularly the January event) is relatively consistent. For the ARRL DX contests, the 15- and 10-meter bands are heavily dependent on *F2* propagation, and activity for those bands can be nonexistent during the valley of the solar cycle. Thus, scores among years can vary drastically for all-band and single-band efforts for HF-based contests. I have found a moderate consistency in the scores that I can make between January of one year and January of the next year, with some variations due to weather, since I operate portable. However, I can generally expect to find some of the same stations that I worked the prior year via line-of-sight to provide a basic level of QSOs to be made. Of course, I have found that June to June can vary a lot with regard to sporadic-*E* based contacts, outside of the line-of-sight QSOs. This modest level of consistency has helped me gauge the number of contacts that I can make and the adjustments I have to make before and during the contest.

I might add that the rover and portable categories are a major part of making the VHF contests fun. Other than Field Day, HF contests do not have this category. The ability to operate an effective station using portable setups is something that may be very important to the survival of ham radio.

Beginning Experiments on the VHF Amateur Bands Part 2

In this, the second of a four-part series, KK7B writes about basic receiver fundamentals and guides the reader through building a simple 6-meter receiver.

By Rick Campbell,* KK7B

In my last article in the Winter 2010 issue of *CQ VHF*, I introduced a 10-mW VXO signal source for the 6-meter band. Generating a clean, stable signal has been the first step in radio experiments for a century, and a CW source is one of the basic blocks on a well-equipped experimenter's bench. In this article we will explore the next step: receiving and amplifying a weak VHF signal.

A radio receiver performs three basic functions: It selects the desired weak signal, amplifies it, and converts it into a form that will drive a speaker or headphones. These three functions are so basic that they have had many names over the history of radio, and as many different definitions. In this article we will introduce three receiver building blocks that perform those functions in an SSB or CW receiver and connect them together in a block diagram with a VHF antenna on one end and headphones or speaker on the other.

A circuit that selects some signals and rejects others is called a *filter*. A circuit that amplifies signals is called an *amplifier*. A circuit that converts a CW radio frequency (RF) electrical signal to an audio frequency (AF) electrical signal is called a *frequency mixer*, or just *mixer*. In Part 1, we built a stable signal source—an *oscillator*. With just these four blocks, we can build everything from low-power CW rigs for backpacking in the hills, to arrays of giant radio telescopes receiving signals from the edge of space. To recap, here are the four basic RF building blocks:

1. Filter
2. Amplifier
3. Mixer
4. Oscillator

Amplifier

A receiver usually has more than one of each of those building blocks, so the list is in no particular order. Let's start with the amplifier block, because that block is easy to understand. An amplifier takes every signal on the input and multiplies it by a constant, called the *gain*. We can express the gain as a voltage gain or gain in decibels (dB), but the concept is the same. If the voltage gain is 1000, then every 1-microvolt signal on the amplifier input becomes a 1-mV signal at the amplifier output. Every 1-mV signal at the input becomes a 1-volt signal at the output, etc. A 6-meter CW receiver can easily hear a 0.1-microvolt signal, and in a quiet room you can hear a 10-mV signal on a small speaker, so a VHF receiver needs a voltage gain of more than 100,000, or 100 dB.

It is difficult to build a stable amplifier with 100 dB gain, but there are some 100-year-old receiver techniques that make it easy. However, as soon as we start amplifying, we realize that many signals arrive at the antenna, and if we have enough gain to amplify a weak VHF CW signal, the 1-mV signal from the local broadcast station will overload our amplifier. Thus, if our receiver includes amplifiers, it also needs filters.

Filters

A receiver has several different filters. All but the simplest, low-performance receivers have selectivity between the antenna and first amplifier. The first amplifier provides a little bit of gain—just enough to establish the sensitivity or "noise floor" of the receiver. After that first amplifier is a second filter. In old receivers the combination of two filters with an amplifier in between was called an *RF stage* and the number of RF stages was a figure of merit. However, modern receivers use just enough RF gain to do the job, and then convert the signal to an intermediate frequency (IF). The fre-

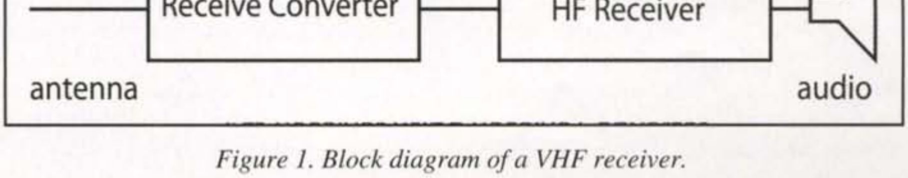


Figure 1. Block diagram of a VHF receiver.

*e-mail: <ecekk7b@gmail.com>

quency conversion is performed using a mixer, which is the next block.

Mixer

A frequency mixer is a block with two inputs and an output. When combined with filters, an amplifier, and local oscillator, it functions as a frequency converter. The RF signal is connected to one input, and the IF signal comes out of the output.

Oscillator

The other input to the mixer is a local oscillator (LO)—a few milliwatts on a frequency offset from the RF input frequency by the intermediate frequency. For example, if our RF signal is at 50.1 MHz and we want an IF signal at 7.1 MHz, we could use an LO at 43.0 MHz. If we want a tunable receiver, we can either tune the LO frequency from 42.9 to 43.4 MHz so that any signal from 50 to 50.5 MHz comes out at 7.1 MHz, or we can tune the IF from 7.0 to 7.5 MHz. Each approach to tuning a VHF receiver has advantages, and either approach can result in outstanding performance.

In addition to providing several convenient ways to tune a receiver, the frequency converter allows us to put some of the amplifiers at the RF input frequency, and some more gain at the IF. After we do the final frequency conversion to an audio frequency, we can add some more gain. A modern receiver might have 10 dB of RF gain, 20 dB of IF gain, and 70 dB of audio gain—enough to easily hear our 0.1-microvolt CW signal, and with most of the gain at audio, where both gain and selectivity are easily controlled—often using digital signal processing. The distribution of gain and selectivity is one of the most interesting challenges in receiver design.

Details of the Project

Figure 1 is the block diagram of a complete receiver for 6-meter SSB and CW signals. Figure 2 is a more detailed block diagram of the RF-to-IF frequency converter, and photo 1 shows the frequency converter fastened to the top of the diecast box containing the rest of the receiver circuitry. Now that we understand each of the blocks, it is easy to see the function of each piece of the 6-meter frequency converter. Six-meter converters were popular accessories in the last half of the 20th century for high-performance weak-signal stations, and even today a good converter in front of a high-performance HF receiver might be used for a critical application such as moonbounce.

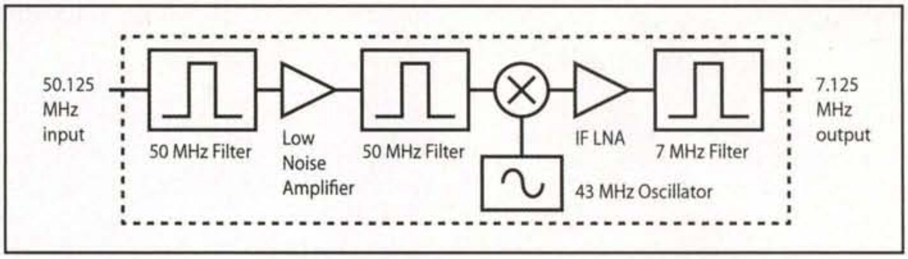


Figure 2. Detailed block diagram of the Rxc1 VHF receive converter.

In the detailed block diagram in figure 2, the antenna is connected to a pair of tuned circuits that form a bandpass filter about 1 MHz wide. The output of that filter is a low-noise amplifier, and that drives a second filter. The output of the second filter is connected to the RF input of a passive-FET mixer. Passive FET mixers are a recent development with significant performance and cost advantages. They are a natural evolution of weak-signal techniques used in physics and radio astronomy in the mid-20th century. Western Electric and (much later) TriQuint Semiconductor designed and built three-terminal field-effect devices optimized for variable on-off control of RF signals, but conventional FETs work just as well. The output of the mixer drives an IF amplifier with a broad tuned output. The LO uses a 43.000-MHz overtone crystal. The input filters and LO output stage tuning are designed so that the converter may simply be tuned up for maximum gain with a weak signal at the input. The CW source available from Kanga and described in the Winter 2010 issue of *CQ VHF* magazine is an ideal weak-signal source, and may be connected directly to the input of the converter without risk of damaging anything for initial tuning. The detector described in the Winter 2010 issue of *CQ VHF* magazine may be connected to the IF output.

Photo 2 is a close-up of the completed 6-meter converter built from the parts kit available from Kanga. The two filters with trimmer capacitors and amplifier transistor are on the top half of the board.

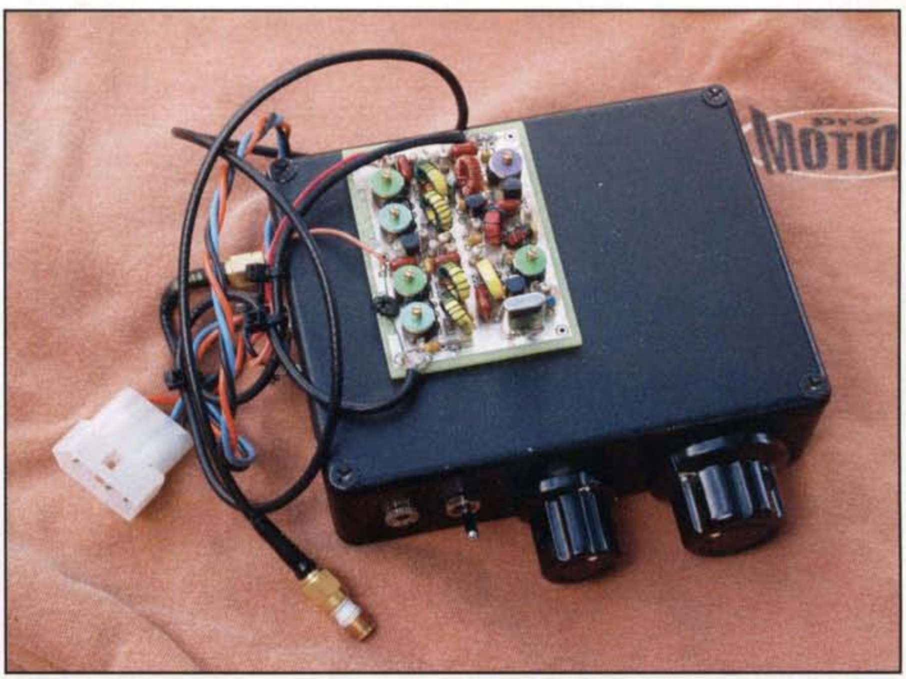


Photo 1. A Kanga Rcx1 6-meter converter transforms a simple 40-meter receiver into a good 6-meter receiver.

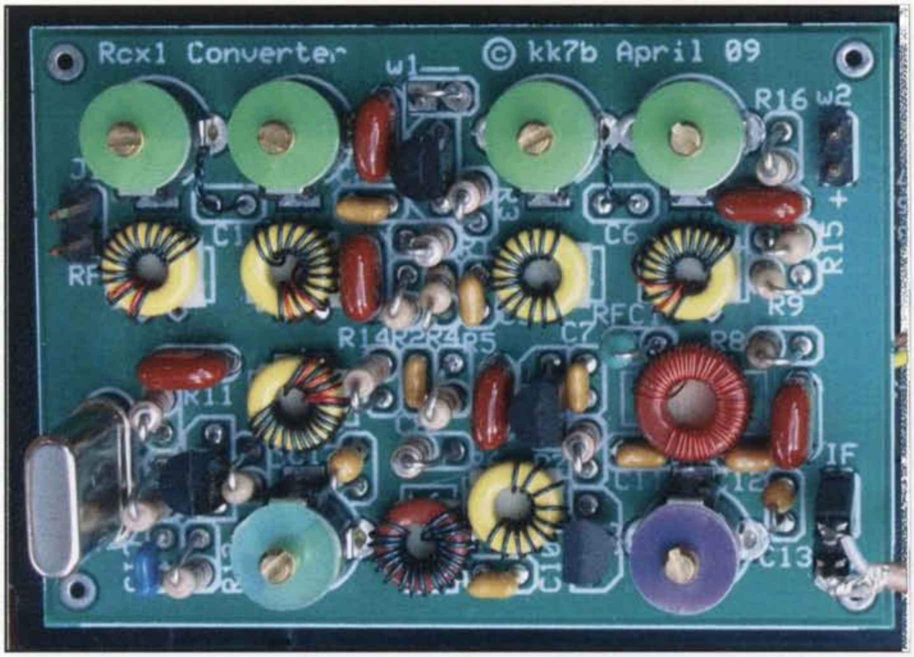
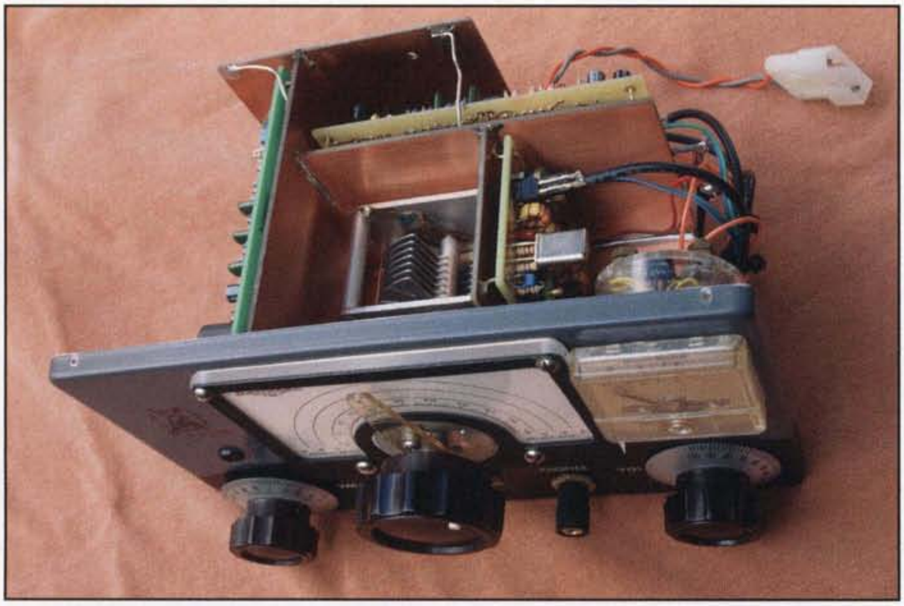


Photo 2. Here's a close-up view of the Rcx1 receive converter. It is small but offers high performance.

The overtone oscillator with its crystal and trimmer are on the lower left, and the mixer and IF amplifier are on the lower right. The layout is compact, but does not require a microscope for construction. More details and the schematic are on the Kanga website pages (see: <http://www.kangaus.com/>). I start by winding the toroids and then mount them on the board. The converter in the photographs uses small toroids, but there is room for larger ones on the circuit board. The trimmer capacitors have enough range to adjust for construction differences.

The converter may be used with any "tunable IF" receiver in the 40-meter band. This 6-meter converter converts a good 7.0- to 7.5-MHz receiver into a very

Photo 3. For extra shielding, put the Rcx1 in a diecast box. This is a very capable 6-meter weak-signal receiver using the new Rcx1 and a vintage Drake 2A.



Photos 4 & 4A. The receiver techniques discussed here may be incorporated into transceivers. The receiver in this compact 6-meter SSB transmitter-receiver is electrically identical to the one shown in photo 1.

good 50.0- to 50.5-MHz receiver. The additional selectivity at both 50 MHz and 7 MHz contribute to basic IF receiver performance, and the gain and noise figure improve sensitivity. Even simple receivers for 7 MHz become better 6-meter receivers when used with this converter. Laboratory-grade HF receivers become laboratory-grade 50-MHz receivers. This old lore—adding a good VHF converter to a good HF receiver to make a very good VHF receiver—was part of the lure of VHF in the mid-20th century, and one reason that experimenters on a limited budget were able to make significant contributions to radio science.

Performance

At KK7B, a half dozen of these converters have been used with everything from the laboratory receiver in the equipment rack to a 40-meter crystal set. The crystal set experiments were fun, but require good headphones to hear weak signals, and there isn't much 6-meter AM in my area. For a more practical receiver, connect the 50-ohm output from the con-

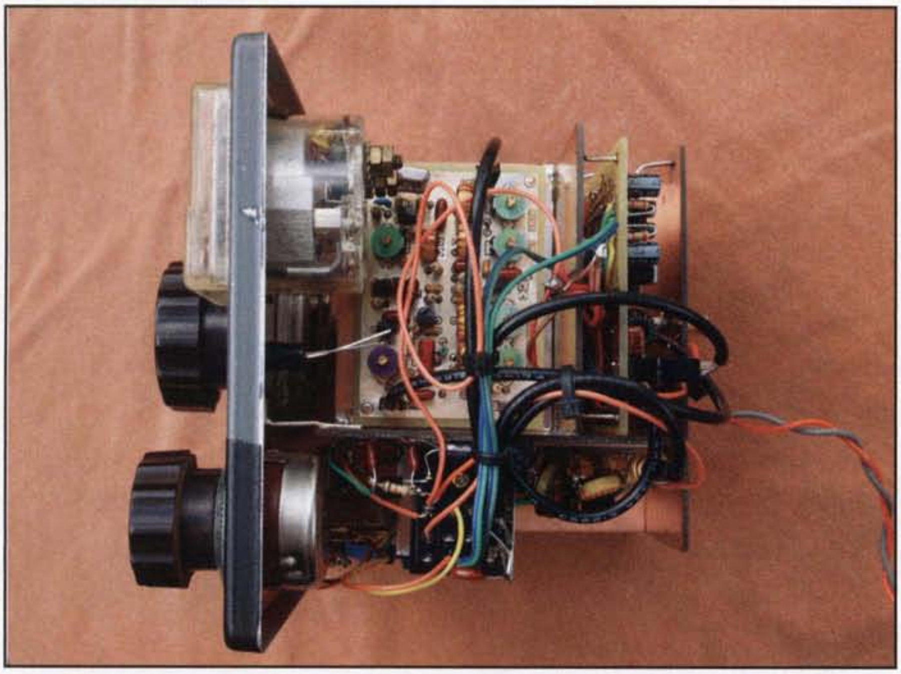


Photo 5. A look inside the 6-meter SSB transceiver. The internal chassis is made from soldered up PC board pieces.

verter to the antenna input of any 40-meter receiver you can get your hands on. A favorite approach at KK7B is to use a vintage SSB-CW receiver from the 1960s with a slide-rule dial and slow tuning rate. Basic receiver performance on the 7-MHz band was quite good in that era, and the combination of a good receive converter and good basic tunable IF receiver will outperform both 1960s vintage VHF gear and compact multi-band multi-mode transceivers in 2010 that tune the VHF bands as an afterthought—without a single menu to navigate! Photo 3 shows a high-performance 6-meter receive setup at KK7B. The receive converter is in the die cast box on top of the old Drake 2A receiver.

For portable use, a smaller tunable IF receiver with long battery life is more appropriate. The receiver shown in photo 1 is assembled from modules available from Kanga—the Rcx1 6-meter converter and microR2 40-meter receiver. Packaging of portable gear can be quite creative. Photos 4 and 5 show a microR2 tunable IF receiver and Rcx1 converter mounted in an old Heathkit Q-multiplier box, along with a simple 6-meter SSB transmitter. The 100-mW SSB transmitter uses an early prototype of the VXO 6-meter source described in the Winter 2010 issue of *CQ VHF* magazine and a microT2 exciter and amplifier described in December 2006 *QST*.

Here's a little hint: Note that the 6-meter converter is outside the diecast box in photo 1, and in a separate shielded compartment in photo 5. Good receivers have lots of shielding between the stages. It's easy if you plan ahead, but disheartening when you pack everything into a tiny enclosure and then hear lots of extra noise and whistles as you tune across a dead VHF band.

For experiments with ultra-portable operation on 6 meters, SSB may not be the best voice mode. Other options are AM, DSB without carrier, and FM. On line-of-sight paths, a few hundred milliwatts is plenty of power. FM is not my first choice for experiments. SSB is hard to tune while sailing a small boat or warming up (myself and the rig) by a camp fire. DSB is even more difficult to tune with simple receiving gear. AM is easy to generate, easy to receive, requires a little bit of experimentation, and is more fun to play with than any other mode. It looks cool on an oscilloscope, and it is easy to tell if a small adjustment to the station or antenna aiming makes an improvement. That's why AM is used in fox-hunting competitions.

A Portable 6-meter AM Receiver

Heavy iron AM transmitters with more than 20 watts carrier output are fascinating technology with a place on the HF bands, but for the VHF experimenter, low power AM—less than a few watts of carrier—offers significant appeal. In my next article we'll explore SSB, DSB, and AM modulators for the 6-meter CW signal source, but for our last project in this column, let's build a portable 6-meter AM receiver that the late Ed Tilton, W1HDQ, long-time ARRL member of Technical Staff and *QST* "The World Above 50 MHz" column editor, would have been proud of.

Tilton published a number of projects

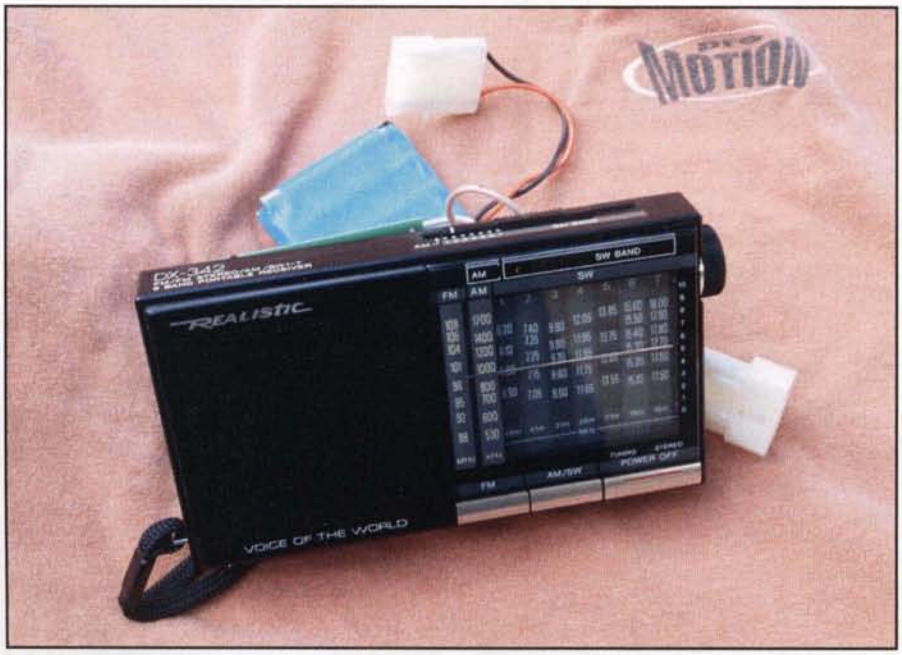


Photo 6. A simple 6-meter AM receiver made from a shortwave pocket radio.

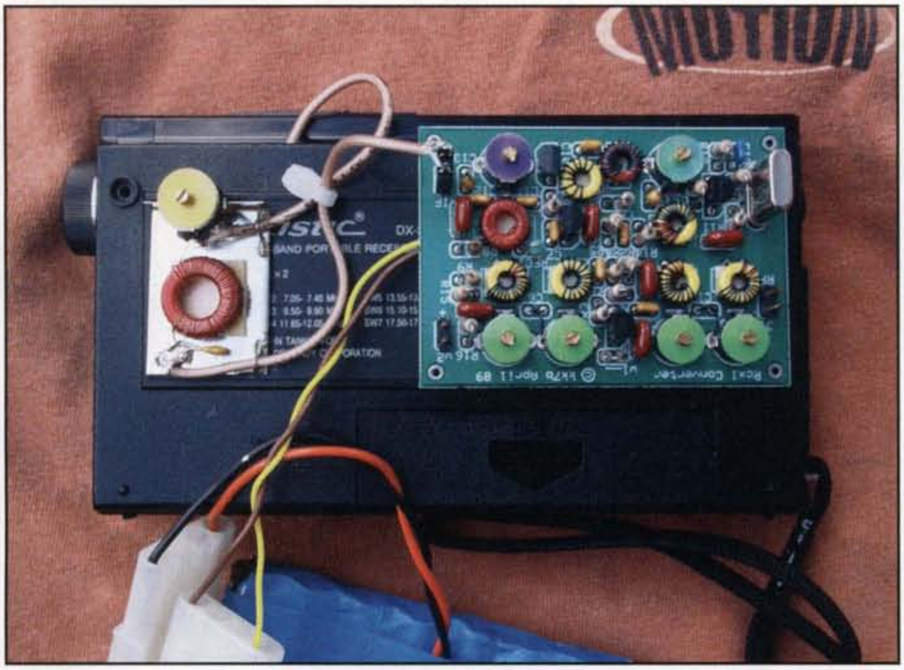


Photo 7. Rear view of the 6-meter AM receiver showing the receive converter and the simple network to transform the whip antenna on the shortwave receiver to 50 ohms input.

in handbooks and journals that used a simple transistor converter in front of an AM transistor radio. He would have been delighted at the plethora of inexpensive shortwave portable radios on the market today. An excellent source is Universal Radio in Reynoldsburg, Ohio (see: <http://www.universal-radio.com/>). Just click on the "Portable Shortwave" link on the web page to see the current selection of several dozen models. The inexpensive ones have either a slide-rule dial with analog tuning, or a simple digital dial—also with analog tuning. Your local RadioShack may also have examples. Try several models until you find one with good performance on the 40-meter band, and don't pay too much, because you are going to crack it open and do a simple hack.

The only modification that needs to be done to the pocket shortwave receiver is to remove the telescoping antenna and add a short length of small coax with a connector. Solder the center connector to the wire that used to connect to the telescoping whip, and solder the coax braid to the nearest ground point. You can follow the ground traces back to the battery case—often the negative lead. Photo 6 shows a shortwave pocket radio that I hacked for an external antenna input.

The little whip antenna on a shortwave pocket radio is of very high impedance, so you need an impedance-transforming

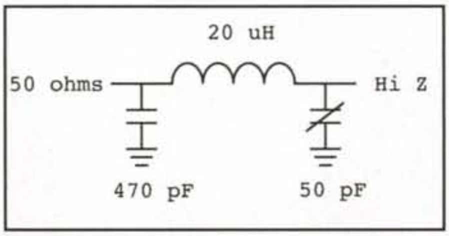


Figure 3. Schematic of a simple impedance-matching network to transform the whip antenna input of a shortwave pocket radio to 50 ohms.

network between that connection and the 50-ohm IF output of the 6-meter converter. The good news is that the network is selective, and greatly improves the basic radio performance of the portable shortwave receiver. The little pi-network I used is in figure 3. Photo 7 shows how I fastened the converter and pi-network to the back of my portable radio to make a 6-meter AM receiver. Batteries for the radio are inside, and the 9-volt battery taped to the back powers just the converter. This receiver is more sensitive and selective than the 6-meter AM receiver in my ICOM Q7a, and it is certainly easier to tune. It is quite handy for locating 6-meter noise sources.

Until next time, enjoy the experiments, and start pulling the covers off your VHF gear to look inside.

Transoceanic VHF Ducting
A Simple Multifunction Beacon

A major problem with transoceanic ducting is having a signal to hear. Realizing this need, N7BHC designed a self-contained, transportable, rack-mountable beacon for almost all situations.

By Dave Pedersen,* N7BHC

In the Summer 2009 issue of *CQ VHF* magazine, we examined transoceanic ducting on VHF. One of the main reasons stated in that article why band openings often go unnoticed is a lack of activity. Beacons are useful propagation indicators in the absence of active stations.

**1305 Langdon Terrace Drive, Indian Trail, NC 28079*
e-mail: <n7bhc@drasticom.net>

This article is based on N7BHC's presentation and Proceedings paper from the 2009 Southeast VHF Society Conference.

They transmit a signal at a stable frequency, power, and beam pattern. This allows distant receiving stations to have a signal to monitor for possible band openings.

Beacons are particularly useful in locations that do not have a lot of regular activity on the band of interest. This is especially true with transoceanic ducts where one end of the path has few or no active stations (photo 1). In many instances, DX operators have limited resources to invest in equipment. HF operation promises many more QSOs than VHF, so HF stations and operations are much more common. Most have little or no interest in or equipment available for VHF. A beacon project could build and deploy beacons at key locations for the purpose of studying extreme-range transoceanic ducting propagation. These beacons would be optimized for studying long-range transoceanic ducting.

Beacon Design Considerations

There are many possible designs for beacons depending on their specific purpose.

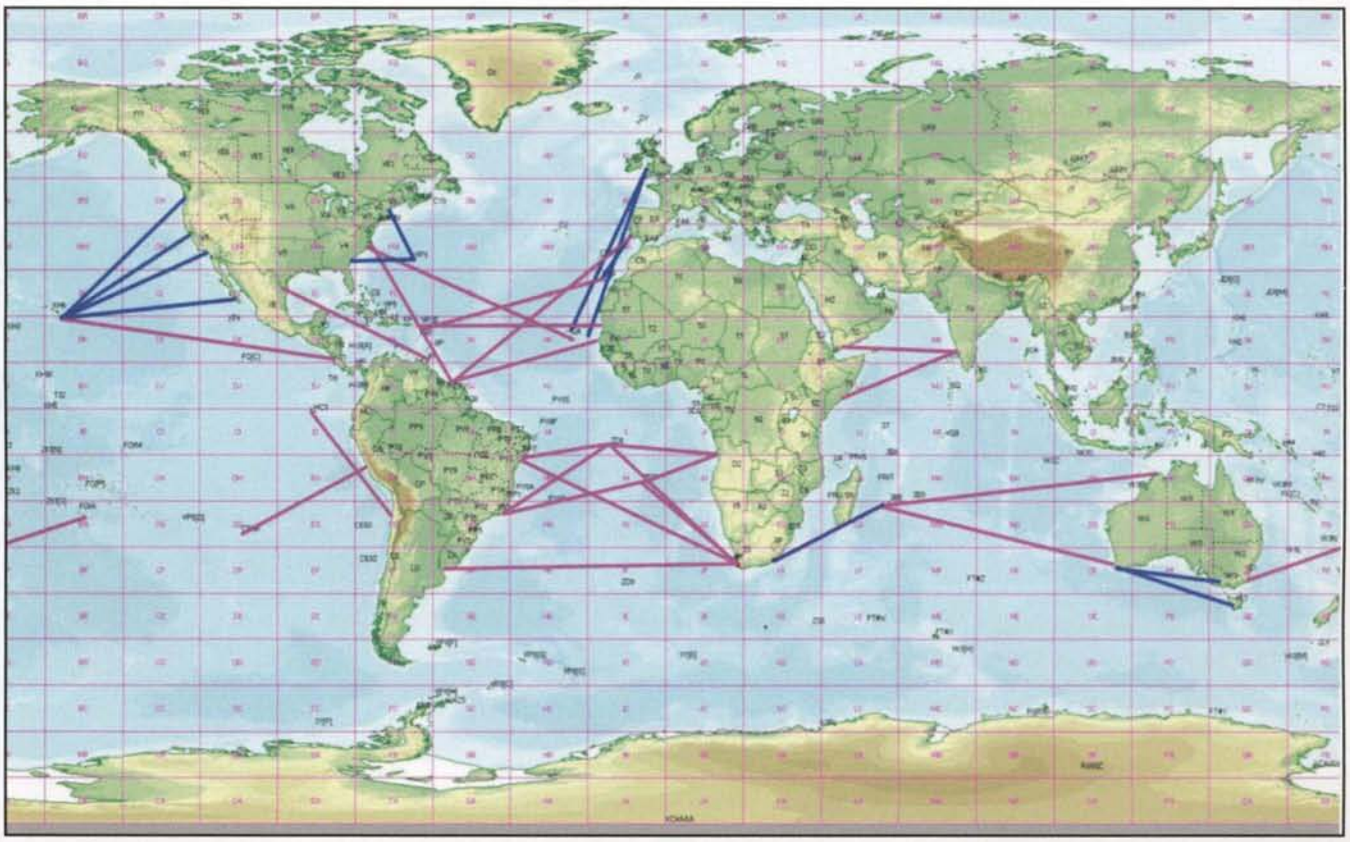


Photo 1. Some transoceanic duct paths. Those in blue have already been worked.

The intended objective needs to be well defined before various design choices can be made. In this case, we're looking for a beacon to explore very-long-range transoceanic paths from remote areas. This implies high ERP (effective radiated power) over a specific path in order to optimize the chances for successful communications. The beacon is to do double-duty and function as a station to work DX as well. These design criteria will define the beacon design and implementation. As these beacons will mostly be deployed in remote locations where there is little or no existing VHF DX activity, they need to address issues such as poor electrical power, overseas shipping, and very limited local spare-parts availability,

Mode. Modern digital modes such as JT-65B and WSPR provide several dB advantage for weak-signal detection over long paths. However, not as many listening stations are equipped to listen for and work the digital modes. In addition, these beacons will be in remote areas often without the accurate time reference source that JT-65 and WSPR require. It's also unlikely that there will be a computer on site. However, the addition of a small PC using a GPS receiver for time reference is practical in areas with reliable power. Phil, FR5DN, started with a simple CW beacon bus and has upgraded to a dedicated PC running WSJT to his 2-meter and 70-cm beacons. Phil has successfully worked ZS2 several times as a result of his beacons.

PSK-31 would be another good digital mode, and it does not require an accurate time reference. PSK-31 still needs a computer on site, although in the past small PSK-31 keyers were available. If a PSK-31 keyer were available, it would be well worth considering for remote beacons.

Simple on-off keyed CW is easy to decode, simple to implement, uses readily available keyers, and is widely recognized. Modulated CW sent as FSK is also possible, but adds complexity and increases duty cycle.

Transceive capability. The beacons for researching new transoceanic paths play a very important role in detecting band openings. In order to exploit the detected conditions and actually work DX, a transceiver is required. By using a multimode transceiver as the basis of the beacon, both functions are supported in a single package.

Power output. The radio, amplifier, and power supply should all be run well below their maximum ratings. This reduces heat and increases longevity and reliability. As high ERP is desired, a 160-watt amplifier turned down to 80–100 watts is ideal.

Antenna selections. The antenna system needs to be chosen with the intended propagation path in mind. The antenna to be used for long-range beacons needs to have as much gain as possible while still addressing the desired target region.

Coastal stations would probably use a unidirectional antenna system beamed toward the target area. If all the target stations are within a narrow beam angle, a high-gain single Yagi with 15–25 elements might be suitable. However, if the target stations are spread over a large angle—e.g. a beacon in the U.S. aimed at Europe and North Africa—a much wider horizontal beamwidth is required. A small Yagi of 5–6 elements will give a 50–60° E-plane beamwidth, but its low gain would not increase the overall ERP very much. The solution is to use a large vertical array of the small antennas, with 4–16 Yagis stacked vertically.

Mid-ocean stations on islands have a bit of a dilemma. They typically need to beam at coastal stations in several directions. They need either omni- or bi-directional antennas. These might be several stacked loops, or a wire-based H-Quadbay. The basic H-Double-bay antenna can be seen at W4GRW's web page at <http://wvfisher.googlepages.com/hdoublebay>. The concept can be expanded to use four, six, or even eight or more slots. An advantage of this design is low cost and complexity.

Off-the-shelf components. All items used in the system should be readily available and not require custom electronics. This improves the reparability and lessens the design and construction complexity and cost.

Cost. Several beacons will be required to cover the paths of interest. It is important to keep the cost as low as possible. Overseas shipping needs to be figured into the cost as well. In some cases, import duty will have to be paid, too, which in some countries can be over 50% of the equipment value. Many of these beacons will need to be subsidized or paid for entirely by donations. An arbitrary maximum value of $1000 per site, including shipping, has been applied.

Simple multifunction beacon. The simple multifunction beacon concept presented in this article is based on a VHF multimode radio with an amplifier and keyer. A UHF beacon can be built using the UHF equivalent radio, amplifier, and antenna. The system operates as a beacon most of the time. When a band opening is reported, the local operator can turn off the beacon and use the same equipment to work DX.

Local host. A local operator interested in trying VHF is absolutely vital to host the beacon. The local host will find a site for the beacon, install and maintain the equipment, and work the DX when the band opens. He will also be responsible for licensing of the beacon. Finding a local ham who is interested and catches the vision to try extreme-long-range tropo experiments is probably the biggest challenge of all. It may require years of patience and effort on his part.

The Simple Multifunction Beacon in Depth

Let's now take an in-depth look at the design criteria and decisions for the simple multifunction beacon. We will also review the construction techniques for the first several beacons that have already been built.

Concept. The simple multifunction beacon concept used by N7BHC is based on a small multimode radio with an amplifier and keyer. The system operates as a beacon most of the time. When a band opening is reported, the local operator can turn off the beacon and use the same equipment to work DX. This allows two-way contacts to be made with the same equipment. The design in this article profiles a VHF beacon operating on the 144-MHz (2-meter) amateur band, but the principles are directly applicable to a 430-MHz (70-cm) beacon as well, or even to other bands.

Design. The design selected is fairly simple. There are undoubtedly more efficient modes and equipment to use. However, simplicity and reliability are considered extremely important. Another consideration is size and weight, as the shipping costs to remote locations can be very expensive.

An all-mode 2-meter radio is the basis for the beacon. A simple memory keyer generates CW at about 12 wpm. The radio can also be used as an SSB or CW transceiver when the band is open. The radio drives a 160-watt amplifier. The output power on the radio is reduced in beacon mode to run the amplifier at the 80–100-watt output level, keeping the amplifier cool and increasing reliability and MTBF (mean time between failure). The radio is switched to full power in operate mode to boost the final output to the full 160 watts. A switching power supply rounds out the equipment line-up. The whole assembly is assembled on a 3U standard 19-inch wide rack shelf about 18 inches deep.

Equipment Selection. Many products were considered and tested in coming up with a simple and reliable beacon/transceiver station. There are countless variations of beacon design; the design here is built around the design criteria and goals already outlined. Different objectives and criteria will lead to other equipment choices and designs, but all will share the same basic tenets of putting a signal on the air on a chosen frequency, power, mode, and direction so DX stations can listen for it. All beacon designs will include several common elements such as radio/amplifier, antenna system, power supply, keying, host operator, and so on.

Radio. The radio forms the basis of the simple multifunction beacon. It needs to be capable of operating on CW as a beacon, and on CW, SSB, FM, or digital modes when used for two-way communications. This means an all-mode radio is required. Models are available for both mobile and base-station installation. The mobile radios are used in this beacon design to cut down on weight and size. Base-station radios would be adequate or even better performers, and can be used if size, weight, and cost are not factors to be considered.

Another consideration is that the radio needs to be a VHF-only model. If an all-band radio covering HF is provided on a beacon shipped to a remote location, it may eventually be removed from the beacon and put to use on HF, which would mean the beacon would be taken off the air.

The radio and amplifier selection need to be considered together. The radio at its maximum power should drive the amplifier to full output in two-way operation. The radio should also have a low-power mode that can be adjusted to drive the amplifier to the desired output level in beacon mode.

Several models of radio were considered for the beacon design, and several were tested before selecting the Kenwood TR-751A for the 2-meter band. The TR-851A is the 70-cm equivalent. The radios that were considered are:

• Kenwood TR-9000 and TR-9130. These radios were tested and functioned well as beacon transmitters. They are older models, and the receivers are not as good as more modern radios. They do require a good receive preamp when used in two-way mode. The biggest downfall of these units is that they lose their programmed frequency and mode memory when DC power is removed. The memories would need to be reprogrammed after every power failure at the site, requiring a local operator who can make repeated trips to the beacon site. If the beacon is not monitored often, it may even be off the air for weeks or months before the problem is found and rectified.

• Kenwood TR-751A. This radio is the next generation after the 9000 and 9130. It has a very good receiver and retains its memory if power is removed. The radio has adjustable low- and high-power settings. It also provides a relay to key the amplifier, eliminating relay chattering in the amplifier. The radio is readily available on the used market at very reasonable prices.

• Kenwood TM-255A. This may be the ideal radio for the beacon. It has excellent sensitivity and is the final generation of 2-meter all-mode, single-band mobile radios produced. It is quite scarce on the used market and sells for 50–100% more than the TR-751A. It is slightly larger than a TR-751A, making integration onto the 19-inch rack shelf more difficult. The TM-455A is the UHF version.

• ICOM IC-260A and IC-290A/E/H. These radios are of the same generation as the Kenwood TR-9000 and TR-9130. They also lose programmed memory data if power is removed and were therefore not considered suitable.

• Yaesu FT-480R. This is another pretty-good performer of the same generation as the TR-9130 and IC-290A. It does not lose its memory if power is removed, but it only puts out 10 watts and is fairly large, making mounting in the rack-mount shelf configuration chosen difficult.

Keyer. The keyer generates the beacon sequence. The simple beacon transmits CW, so a simple memory keyer would suffice, with the radio operating in CW mode. An improved beacon would use both a digital mode such as JT65, WSPR, or PSK-31, and CW on alternate sequences. The digital mode would provide the weak-signal enhancement of the mode, while many more operators not equipped to decode the digital modes could receive CW. One additional complication of the JT-65 and WSPR modes is that the keyed sequence needs to be transmitted at precise time slots. That would increase the complexity and cost of the entire beacon, requiring a computer with an accurate time reference, possibly GPS based. The simple CW keyer is the chosen solution for these simple multifunction beacons.

• Several CW memory keyers such as the PicoKeyer were evaluated. While they did the job, setup required a CW key or paddle. They did work and are viable options.

• The Hamgadgets ID-O-Matic was selected, as it is designed with beacon operation as one of its modes. It is programmed via an RS-232 serial port and can be built in about an hour. Dale Botkin at Hamgadgets provides excellent technical support.

Amplifier. Several models were considered. Reliability and ruggedness are vital for beacons installed in remote locations. As the amplifiers considered were designed for intermittent service, external fan cooling is required. The FCC limit in the U.S. for unattended beacon stations is 100 watts output, so 160-watt amplifiers were selected. The radio's low-power output is adjusted to provide the correct drive required for the amplifier to operate at the 80–100-watt output level. This also helps the amplifier run cooler, further increasing reliability. The fuses and fuse holders on the amplifiers have been problematic, and they are bypassed and an external circuit breaker used for amplifier fusing. Two amplifiers were ultimately selected as being suitable.

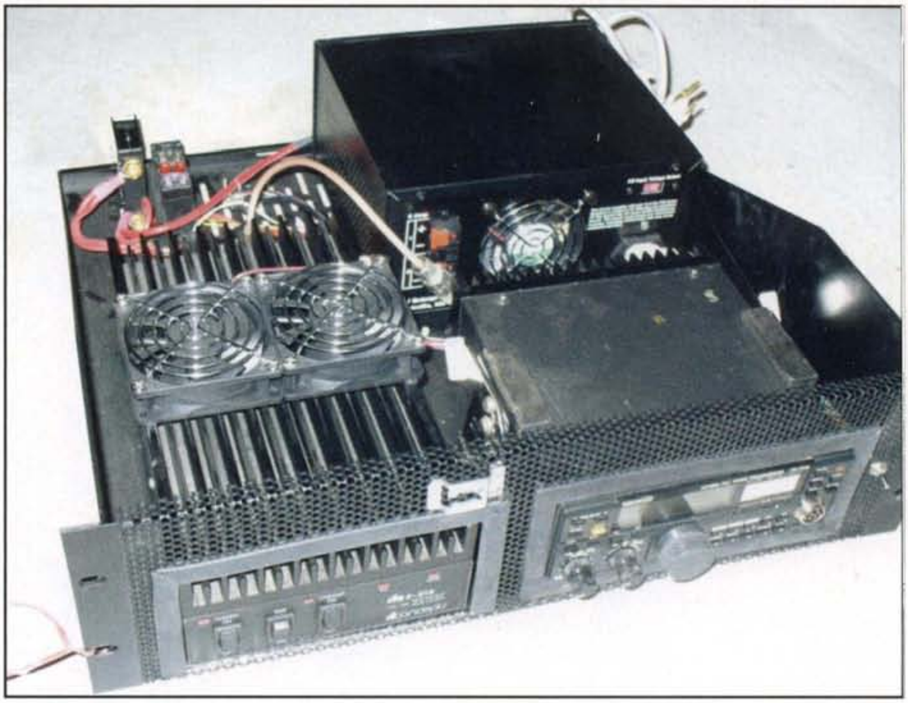


Photo 2. A completed "Simple Multifunction Beacon."

• RF Concepts 25/160-watt models. There are several models available. The most commonly used is the RFC 2/315. Some models do not have external hard PTT keying. This is required for reliable keying, especially at low CW speeds. A serious problem encountered with one unit was no heat-sink compound on the final transistors, leading to early failure.

• Mirage B2516G. Earlier models of this amplifier have been found to be more reliable and better built than the newer ones. The fusing on these amplifiers is internal on the circuit board.

Power Supply. The radio and amplifier require 35 amps at 13.8 volts DC when transmitting on high power. A PSU of 45–50 amps provides enough reserve capacity to operate reliably. While a linear supply is very capable of meeting the power requirement, a switching supply was chosen to reduce the weight for overseas shipment.

The MFJ-4245MV power supply was selected. It provides 40-amp continuous and 45-amp surge current capacity at 13.8 volts. It has proven very reliable over many years of use with not a single failure experienced. An external switch selects either 110 or 220 VAC input. Metering indicates the supplied voltage and current draw. Two fans cool this supply well even in moderately high-power beacon use. The exhaust air is quite cool. Careful positioning of the power supply directs the exhaust air across the radio heatsink, doing double-duty in cooling the power supply and radio.

Construction

The simple multifunction beacon (photo 2) can be built onto any suitable frame or even left on a desktop. The physical layout ultimately chosen was a 19-inch rack shelf, 5.25 inches high and 18 inches or more deep. This allows the entire bacon to be assembled in a compact package with all components anchored in place, increasing reliability and simplifying shipping and installation. Locations without a rack in which to mount the beacon can easily use a metal or wood cabinet to house the rack shelf.

Rack Shelf. The standard design frame is a 19-inch vented rack shelf. A 3U 5.25-inch high shelf makes a compact assembly (photo 3). A 4U 7-inch high shelf would offer additional top clearance for better cooling in hot environments. The shelf needs to be at least 18 inches deep to

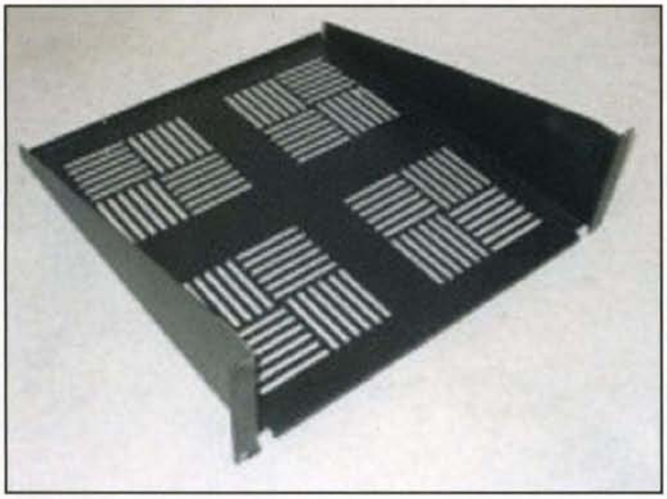


Photo 3. A 3U rack shelf holds the entire beacon.

accommodate the depth of the radio with the power supply behind it. The venting slots make installing the amplifier and other equipment very simple with self-tapping sheet-metal screws inserted from the bottom.

Rack front panel. A vented front panel protects the equipment while allowing reasonable air flow. Cutouts are made to go around the radio and amplifier. The cutouts are made larger than the radio and amplifier by 1/8 to 1/4 inch. The sharp metal edges of the cutouts are covered with a rubber or plastic edge guard. I have found the outer vinyl covering of 1/4-inch coaxial cable to be a very good low-cost solution. Slice a length of coax down its length with a sharp knife or razor blade. Cut to length with 45-degree beveled corners and slide over the sharp metal edge. The keyer on-off switch, CW key jack, and a microphone hanger are attached to the front of the rack panel.

Layout. Photo 4 shows the overall layout. The radio is on the front right, with the power supply on the rear right. The amplifier is on the front left, with DC power distribution at the rear left. The keyer location is not critical, but is usually nestled near the front between the radio and the right edge of the rack shelf to facilitate the keyer on/off switch and an external key jack if desired.

Radio. The TR-751A radio is mounted on the front right side of the rack shelf, and has a few small modifications to make it easy to adjust some internal controls when fixed inside the rack shelf.

It is positioned so the front-panel metal work is 1/8 inch in front of the rack front-panel ears. Mounting the radio an inch or two from the edge of the rack shelf allows better air flow and cooling. If the radio's original clamshell mobile mount is not available, simple aluminum L-brackets can be used to support the radio. The height of the radio can be optimized when using the L-brackets so that the middle of the heatsink on the rear panel is the same height as the middle of the power-supply exhaust fan.

There are three internal trim pots on the TR-751A that typically need adjustment:

Drilling three small holes in the top cover of the radio makes these accessible without having to remove the radio from the rack shelf and remove its top cover. They trim pots to be adjusted are:

- CW sidetone level. Some locations are manned, and the continual sound of the CW sidetone is apparently not universally appreciated.
- Break-in delay. Adjust this control so that the radio does not chatter between receive and transmit between characters while transmitting. If the PTT function on the ID-O-Matic is used, this adjustment is not required.
- Low-power drive level. Adjust this control so that the drive produced in low power drives the amplifier to the desired output power. Most amplifiers tested need about 8–10 watts to produce 100 watts output.

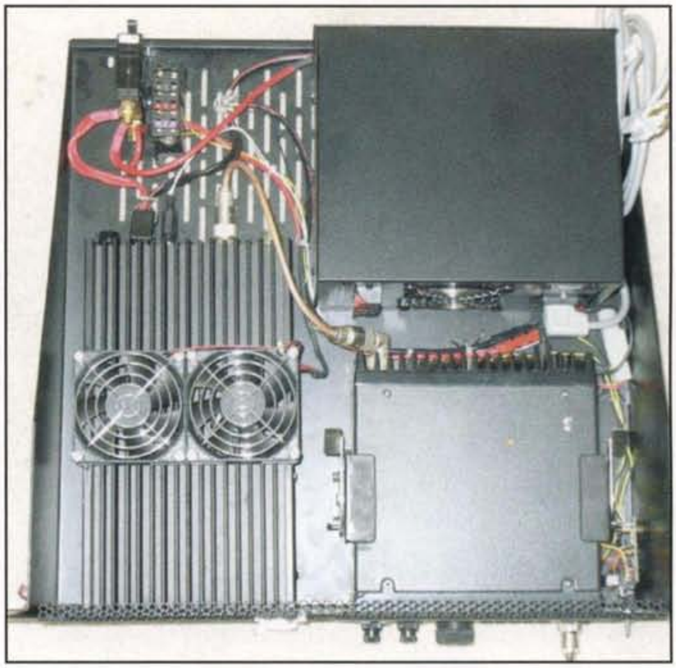


Photo 4. The beacon equipment layout.

The TR-751A provides a relay closure to key the PTT line of an external amplifier. The 4-pin connector is very hard to find. Most of the time one needs to be manufactured. Fortunately this is quite easy. Here is the process I use:

- Remove two pins from a DB9 male connector. Apply heat with a soldering iron until the plastic softens and pull the pins out with a pair of needle-nose pliers.
- Solder a length of hookup wire to each pin.
- Support the radio exactly vertical with the face down.
- Place a piece of masking tape across the rear-panel accessory socket.
- Spread a thin layer of Vaseline or silicone grease across the tape over the area of the connector.
- Push the two pins with wire previously described through the masking tape and into their two pins. Be sure to use the correct two locations in the socket.
- Modify the plastic shell from a 1/8-inch phone plug by cutting off the narrow end, or find some other length of 1/4-inch plastic tube about 3/4 inch long. Feed it down over the wires from the two pins.
- Mix up some 5-minute, two-part epoxy. Carefully drip it down into the connector shell while holding the shell firmly against the masking tape to prevent leakage out the bottom. I use a toothpick for this process.
- After 5 minutes the epoxy will have set well enough to stay in place without holding the connector shell. Let it rest anoth-

er 5–10 minutes and then remove it from the radio.

• Remove the masking tape. The connector is now finished.

Amplifier. The amplifier is mounted on the right front of the rack shelf (photo 5). It requires a small modification to operate reliably in long-term beacon use.

Mounting. The amplifier draws cooling air in through vents on its bottom and side. To enhance cooling, replace the rubber standoff feet with larger 1/2-inch high self-adhesive feet. The amplifier is secured to the rack shelf with self-tapping metal screws that come through the slots on the rack shelf and screw into the narrow slots on the bottom of the amplifier. If your amplifier does not have vent slots on the bottom, remove the amplifier cover and position it in place on the rack shelf. Observe where components are located in the amplifier, and then drill four holes through the shelf slots and up into the amplifier case. As an alternative, L-brackets that secure to the screws on the side of the case to the heatsink could be used.

Photo 5. The amplifier and cooling fans.

Amplifier fuse. The fuse holders and fuses on the amplifiers are weak points. In high duty-cycle extended operation, the fuses tend to age quickly and fail after one to three months. On the RF Concepts amplifiers, the poor fuse-holder/fuse-connection exhibits moderately high resistance, leading to significant heating of the fuse holder and fuse. Temperatures more than 80° F above ambient on the back of the fuse holder have been measured after just 10 minutes of operation. The Mirage amplifiers have a much lower resistance fuse holder, but it is located inside the amplifier. If it does fail, the amplifier must be removed from the beacon to change the fuse.

The solution is to jumper the internal

Photo 6. The power supply is positioned so its cooling fan also cools the radio's heatsink.

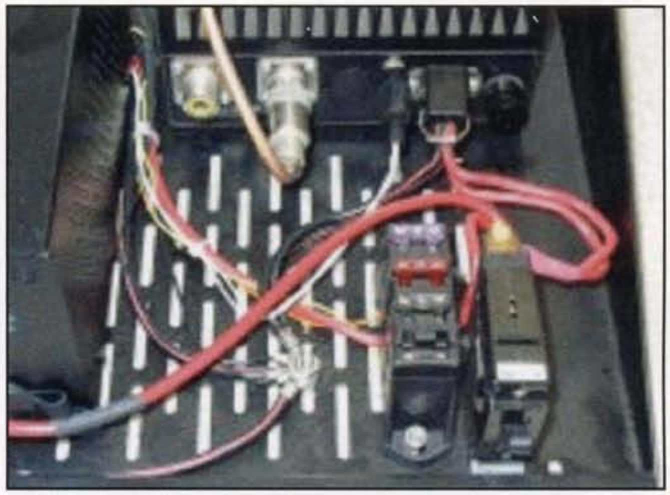


Photo 7. The DC wiring. Note the fuse holder and the amplifier's circuit breaker.

fuse holders and use an external fuse, or better yet, a circuit breaker. A 30-amp magnetically tripped external circuit breaker replaces the fuse. These are more reliable than the thermally tripped breakers in this application.

Cooling. The amplifiers are not designed for extended, high-duty-cycle operation. Although the CW transmission is about 30% duty cycle, and 15-second receive periods every minute allow additional cool-down time, the amplifiers still run hot, shortening the component life. Two 80-mm muffin fans provide additional cooling. The fans use ball roller bearings for long life and quiet operation. They are run at 13.8 volts off the primary supply. The amplifier heatsink runs at less than 5° F above ambient air temperature with two fans. The fans are glued to each other with a superglue, and then super-glued to the heatsink, blowing air down onto the heatsink. Fan guards protect from prying fingers and prevent any wires or tools from falling into the blades.

Keying. The amplifiers should be hard keyed for PTT rather than rely on RF keying. The Mirage amplifiers use a closure to ground. TheRF Concepts amplifiers can either use a ground or +12-volt line for keying. Set the jumper in the RF Concepts amplifiers to use ground for keying (move the wire to the [–] pin internally). This PTT line is keyed by the relay output from the TR-751A,

Preamp. The preamp is normally left off to avoid wear on the preamp relay. It also affords an extra level of protection from nearby static discharges while receiving. The preamp is turned on when the beacon is being used as a standard radio to work DX.

Keyer. The Hamgadgets ID-O-Matic keyer kit is very inexpensive and easy to build. Here are few extra pointers.

- Observe antistatic procedures while handling the FETs and the PIC processor.
- Use an external 10K-ohm trim pot in line with the speaker to reduce the sidetone level.
- If the keyer does not operate properly, checking for incorrect settings in the additional parameters shown by setting Repeater (Y) can prevent operation, even if the Repeater (N) setting is used.

One can use the settings for "Beacon" mode, but there is an even simpler setup suggested by Dale at HamGadgets. The settings I use on the ID-O-Matic keyers are as follows:

- ID Time: 15 (15 seconds Rx time between beacon transmissions)
- Yellow time: 0
- Blink time: 0
- ID Msg, *callsign/B grid callsign/B grid callsign/B grid*:15: (call and grid 3x, 15-second carrier)
- Beacon Msg (blank)
- Alternate Msg (blank)
- Auto CW ID: Y
- CW Speed: 13
- ID Audio Tone: 702
- Repeater: N

The keyer is typically installed between the radio and the left side of the rack shelf. This is convenient for external wiring to the on-off switch that is in the DC supply line.

The only output used is the CW keying line (pin 5) and ground (pin 6).

The keyer does provide a PTT keying line. This can be used to place the radio in transmit, eliminating the need to adjust or have access to the radio's PTT delay control.

A front-panel jack can be wired in parallel with the output of the keyer to allow the use of an external key for CW operation.

Power Supply. The MFJ-4245MV power supply is mounted on the right rear of the rack shelf. It is mounted facing the rear of the assembly. This permits easy access for viewing and wiring. In addition, it directs the exhaust air onto the radio's heatsink (photo 6).

Mounting is accomplished with two self-tapping sheet-metal screws coming through the rack shelf slots onto existing holes on the bottom of the power supply. The power supply is positioned so that the front-panel attachment lugs do not extend beyond the rack shelf.

The AC power cord can push up against the radio heatsink. Either position the power supply and radio to avoid a conflict, or use a right-angle AC power plug. Set the power supply to the correct AC input voltage.

Wiring. There are three categories of wiring on the beacon; DC power, keying, and RF.

The *DC wiring* is the most complex part of the wiring (photo 7). All power is run from the large front-panel lugs on the power supply to a power distribution area behind the amplifier where all devices are individually fused.

The 8-AWG black negative lead goes to a large bolt mounted vertically from the bottom of the rack shelf. The negative leads from the radio, amplifier, and keyer are terminated to lugs attached to the same bolt.

The 8-AWG red positive lead goes directly to the lower (input) bolt on the 30-amp DC circuit breaker. The circuit breaker is just for the amplifier. An 8-AWG red wire from the circuit-breaker output bolt goes directly to the amplifier.

An 8-AWG red wire goes from the lower (input) bolt on the circuit breaker to the DC fuse panel. This fuse panel uses blade automotive fuses and holder, as they are most commonly available overseas. A 10-amp circuit breaker is used for the radio, 3-amp for the fans, and 1-amp for the keyer. Individual wires go to the radio and keyer, and a single wire feeds the two fans that are wired in parallel. Spare fuses should be stored with the beacon.

The *keying wiring* connects the keyer and front-panel key jack to the radio, and the radio to the amplifier.

The keyer outputs on pins 5 and 6 are CW keying and ground. These go to the key input on the radio, a 1/8-inch mono plug. A 1/8-inch mono jack can be mounted on the front panel if an external key will be used to operate CW. It should be wired in parallel with the keyer output lines.

The TR-751A provides a relay closure to key the amplifier. The amplifier side uses an RCA phono connector. If a different radio is used that does not have a relay output, it may have a PTT line that goes low on transmit which could key the amplifier. In addition, the keyer has a PTT output (pin 4) that can be used to key the amplifier directly.

The *RF wiring* is just a cable from the radio to the amplifier. My preference is to use an RG-142/U double-shielded Teflon cable.

The antenna can connect directly to the amplifier output or through a wattmeter.

Surge Protection. Many beacons are in remote installations. Following established grounding and surge-protection practices will result in fewer failures and costly repairs, less down time, and fewer trips to the beacon if it is remotely located. I consider it cheap insurance,

The two cables to provide surge protection on are the AC power line and the antenna lead.

Heavy duty AC surge protectors such as the ICE 330 or 331 (110 or 220 VAC) are ideal. Consumer-grade products tend to fail easily in harsh environments.

RF surge protection should be installed on the antenna lead at the building entrance. The ICE 302 and PolyPhaser IS-50NX are good products.

Summary

Beacons have proven invaluable in spotting and working many transoceanic ducts. The KH6HME multiband beacons on Hawaii are a shining example of beacon use for tropo ducts and are how most operators in California are alerted to W6–KH6 openings.

The simple multifunction beacons presented in this article have proven their worth already. FR5DN on Reunion Island operates a beacon at his home beaming towards South Africa (photo 8). In August 2007, ZS2GK started hearing the beacon, and within a few days the first FR5 to ZS QSOs on 2 meters SSB and FM took place. In 2009, Phil added WSJT and 70-cm capability. In August he and ZS2GK had the first digital QSO.

Photo 8. The first FR5DN multifunction beacon.

Phil's web page is <http://www.astrorun.com/~fr5dn/radio/tropo/tropo.html>.

The N7BHC beacon pictured in much of the article is in operation from Oriental, North Carolina, in FM15PA. It is beaming towards Gibraltar with a KLM 2-meter 16LBX Yagi at 50 feet. The actual power at the antenna feedpoint is 60 watts after feedline losses take their toll. In August 2008, CT1HZE copied a few short bursts of the beacon in IM57 in southern Portugal, a range of 3,707 miles on 2 meters. The propagation appears to have been meteor-enhanced sporadic-*E* for at least part of the path, with tropo ducting possibly responsible for the eastern half of the circuit.

More beacons are required around the world's coastlines if we are to discover and work new tropo ducts across the oceans. The next beacon is already built and ready for deployment. The only thing that is holding back its installation is finding an interested operator willing to host and install it. Prime locations of interest are the Cape Verde Islands, Bermuda, and West Africa. Several more simple multifunction beacons are also planned for the Caribbean, and a "Super Beacon" is in the works, but that's a whole different story.

By Joe Moell,* KØOV

HOMING IN

Radio Direction Finding for Fun and Public Service

Innovators in RDF: An Inventor, a Code Writer, and a Fox Meister

"I know you share my oft-expressed wish that we might live until the 21st century, just to observe the state of radio and television then." Those were the words of radio pioneer Lee de Forest on a Sunday afternoon nationwide radio program in March 1941. "Startling changes are in store," he continued, "but I have a hunch that the little grid will be found in our radio and amplifier tubes even then."

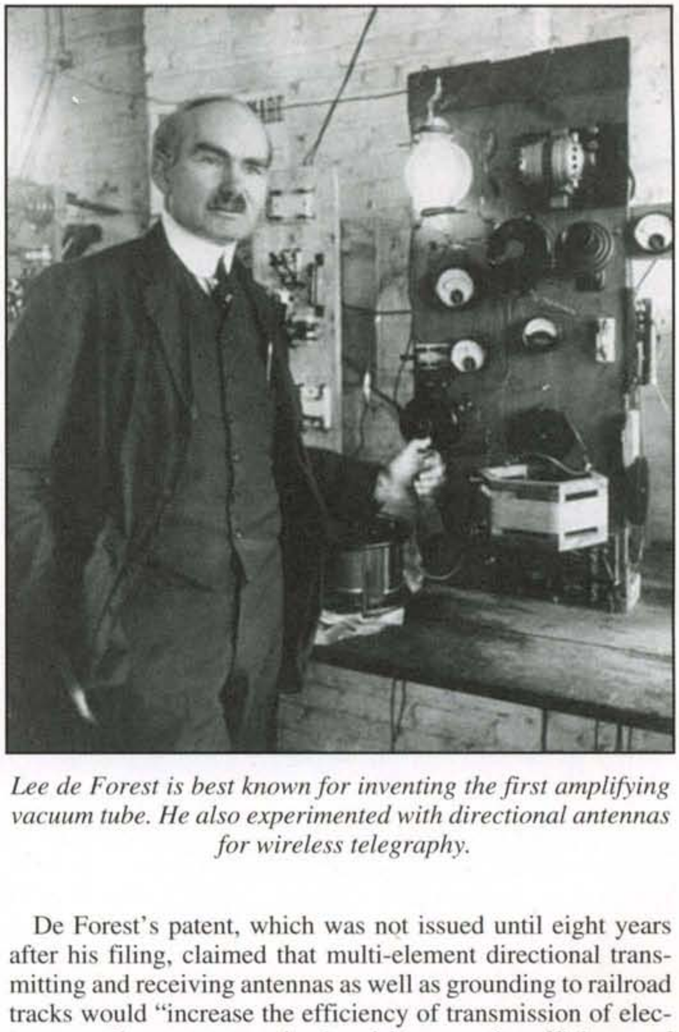
Lee de Forest has been maligned by some for not fully understanding the physics behind his Audion, the first triode tube.[1] However, there can be no doubt that his fragile glass bottle with wires helped make it possible for him to achieve a succession of "firsts" in electronic communication. Radio telegraphers at a the Brooklyn Navy Yard near his laboratory were startled to hear the "William Tell Overture" on their receivers amid the dits and dahs they were copying from ships at sea, as de Forest became the first to play phonograph records over the air. He also made the first sports broadcast, his voice sending the results of Sandusky, Ohio yacht races 14 miles from a boat on Lake Erie to the shore.

Like many inventors, de Forest suffered rejection and ridicule. Even though his Audion receiver was more sensitive than the crystal detectors then in use on battleships, the US Navy refused to procure it because it required a battery which might spill acid on the sailors as the ship swayed. The US government sued him in 1912 for selling stock in his Audion company, saying in court that his claim of a device like an incandescent lamp that could both transmit and receive radio waves was impossible[2] and belittled the work of the great Edison.

De Forest's appearance on that NBC show was about nine months before the USA entered World War II. He didn't yet know the role that the gridded tube would play in radar displays and in television, nor about the microwave transmitting tubes that would be developed for the same purposes and would still be in wide use today. Solid-state amplifiers, switches, and flat screens predominate in most consumer products on the market now, but for the utmost in simplicity, there is still a place for the vacuum tube. I continue to use my home-built cathode-ray bearing display[3] on some of the local mobile transmitter hunts.

One of de Forest's many interests was radio direction finding (RDF). Before he invented the Audion, he submitted a patent application for improvements in wireless telegraphy that took advantage of the directional properties of multiple-wavelength antennas.[4] He noted that straight end-fed horizontal wires of 200 feet to a quarter mile in length have bidirectional gain in the direction of the wire orientation. He also noted that long conductors such as telegraph wires and railroad tracks would guide these low-frequency radio waves.[5]

*P.O. Box 2508, Fullerton, CA 92837
e-mail: <k0ov@homingin.com>



Lee de Forest is best known for inventing the first amplifying vacuum tube. He also experimented with directional antennas for wireless telegraphy.

De Forest's patent, which was not issued until eight years after his filing, claimed that multi-element directional transmitting and receiving antennas as well as grounding to railroad tracks would "increase the efficiency of transmission of electromagnetic waves over land and increase the efficiency of duplex working." Not bad for someone who didn't have the benefits of sensitive field-strength meters, antenna ranges, and NEC software. It is unclear whether he actually built a switched antenna receiving set for the long wavelengths in use then, but his concept is very much like military microwave RDF systems of today, as well as the switched-antenna amplitude-based RDF method that I described in my last column.

Foxhunting—Now There's an App for That

A century ago, innovators used components such as triodes, capacitors, and transformers to make new products. Today, the building blocks are often subsystems such as GPS engines, camera boards, and smart phones. Software tools are now as important as hardware tools. Computerized plotting and triangulation of RDF bearings has been around for a few years, but FoxHunt™, a new iPhone application, makes it possible to do it all on foot. Its creator is Bob Iannucci, W6EI, a MIT-trained engineer and computer scientist.

Among his many activities, Dr. Iannucci is founder of RAI Laboratory, which produces the RadioPort™ USB sound-card interface for hams. He got the idea for FoxHunt when he and his wife Susan, W6SJI, went with friends on their first mobile transmitter hunt with the San Francisco Bay T-hunt group. It was supposed to be an easy one that they could do with handie-talkies, hand-held Yagi antennas, and paper maps.

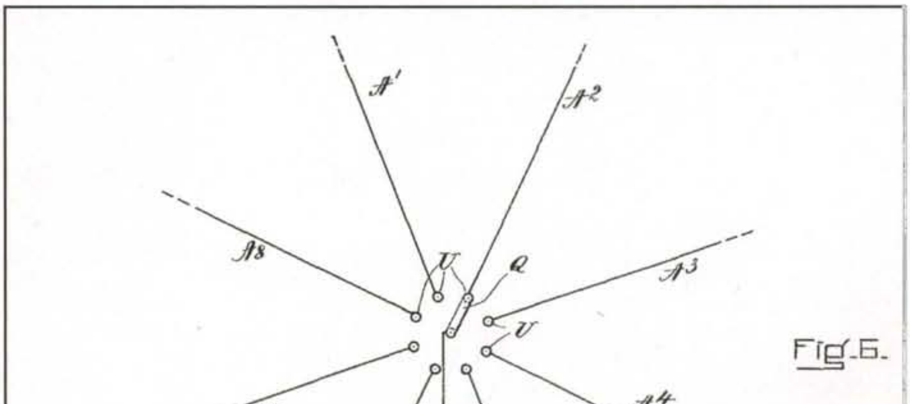
"Even though we got the magnetic declination right, we made the error of assuming that straight-up on the map was true north," Bob wrote. "It was actually about 30 degrees off true north. This caused us to 'spiral in' toward the fox because all of our bearing lines were off by 30 degrees. We never found it.

"I realized that my iPhone 3GS could do a better job of keeping track of all the bearings than I could," Bob continued. "It has a compass, GPS, Google Maps, and a good set of programming tools. Within two weeks, I had the app coded and tested."

The present version of Bob's program[6] doesn't interface directly with radios or RDF antennas. It's just a very simple way for anyone to triangulate bearings from multiple locations and display the bearing intersections on Google Maps. After getting a bearing with his or her RDF system, the user looks in that direction while holding the iPhone directly in front. The phone's GPS engine and internal compass determine location and azimuth, and then the program puts a bearing ray on the display map. When multiple bearings are entered, the best triangulation is computed and displayed, as shown in the illustration.

W6EI explains that you can give the bearings different weights, based on your confidence of their accuracy. The app will take this into consideration in estimating the fox's position. From the list of previously taken bearings, you can select any one and its line will turn red. Then you can edit its perceived quality rating (number of stars) or tell the triangulation routine to ignore it.

Bob says that on his first hunt with his new app, its triangulation predicted the



Is this the first electrically rotated radio direction finding antenna? Lee de Forest received a US patent for it in June 1914.

Triangulated bearings on the screen of an iPhone with the FoxHunt™ application. There are four bearings; the selected one is red. The program makes a best estimate of the fox location (the green pushpin), based on the confidence level given to each bearing.

hidden T location to within 100 feet from a distance of 10 miles. That's a bit too good to be true, considering that this would require each bearing to be accurate within a tenth of a degree. Even if there are no signal reflections, you can expect your results to vary from that, depending on the pattern of your RDF antenna and how well you can sight your bearings from the antenna boom while looking at the screen of the phone. However, the app corrects for magnetic declination, keeps you from making math and plotting errors, and is definitely "cool."

Since it was first offered on December 21, FoxHunt has been downloaded 489 times by iPhone 3GS owners in the USA and 686 outside our borders. Some of them are hams, while others are in law enforcement and professional search-and-rescue work. Bob welcomes suggestions for improvement as he plans his next version. "The current app is free but supported by advertising," he says. "The new Pro version will likely be ad-free but will bear a modest price tag."

W6EI continues, "I am considering a teaming feature for sharing bearing info between phones, an augmented-reality feature that will overlay bearing and intersection information on the view from the iPhone's camera, and the capability to manually enter bearings by the numbers. This may enable those with iPod Touch and older iPhones to use at least some of the features of FoxHunt."

Bob says it would be easy to develop an electrical bearing transfer interface between the iPhone and RDF sets, whether Dopplers or rotating antenna azimuth encoders. He has also dropped some hints about designing and producing a high-tech Doppler RDF unit of his own design to work with FoxHunt. If you are interested in being a beta tester for new products from RAI Laboratory, make contact via the RAI website.[7]

International rules forbid GPS positioning and mapping for participants in formal Amateur Radio Direction Finding (ARDF) contests. Competitive radio-orienteers are expected to do it the old-fashioned way, with paper maps supplied by the course-setters and their own hand-held compasses. Expect the

A Busy Month of May for RDF Contesters

Hidden transmitter hunters have a wealth of opportunities to have fun in May 2010, starting with the annual Foxhunting Forum at the Dayton Hamvention® on Friday, May 14. As of this writing, it is scheduled for Room 2 at the Hara Arena beginning at 11 AM. Hosting the forum will be members of the OH-KY-IN Amateur Radio Club and the Butler County VHF Association.

Then a week later, the USA ARDF Championships get under way a short drive south of Dayton, with practice and equipment testing. On May 22 and 23, there will be separate contests in separate forests on 2 meters and 80 meters with five fox transmitters to find on a course that will be about five kilometers from start to finish each day. Detailed schedules, lodging information and registration forms are available at <www.usardf2010.com>.

As always, the USA championships are open to anyone at any foxhunting skill level, with or without a ham license. Just prior to the championships, on May 19–20, there will be two days of optional intensive training in radio-orienteering, providing an ideal way to get a jump-start into the sport. More information about the rules and techniques of ARDF is at <www.homingin.com>.

The USA ARDF Championships take place on the 13th annual CQ Worldwide Foxhunting Weekend, sponsored by sister publication *CQ* magazine. But since the primary objective of this event is more foxhunt participation, there's no insistence that your event be on that weekend. Any time in the spring is fine with us!

Details and stories of Foxhunting Weekend are in the April and May 2010 issues of *CQ*. For many clubs, it kicks off a season of regular transmitter hunts. For others, it's a special once-a-year event, like Field Day. Some groups prefer formal hunts with carefully crafted boundaries, specifications for signal parameters, time limits, and so forth. Others are completely content by just having at least one signal to hunt. No need for any more regulations, they say.

Make your Foxhunting Weekend activities into a magnet for every club member. Better yet, include the whole community, especially young people. Invite a Scout troop to experience on-foot transmitter tracking or to ride along with the mobile hunters. Look for opportunities to incorporate foxhunting into Scout activities such as Camporees, Scout-O-Ramas and Jamboree-On-The-Air. Seek out other youth groups that might be interested.

Afterwards, write up the results and send them to me. The list of information in a complete CQ Foxhunting Weekend report is posted at <www.homingin.com>. Happy Hunting!

Joe Moell KØOV
ARRL ARDF Coordinator

Tim Kreth, AD4CJ, teaches direction-finding techniques to newcomers in the Nashville area. (Photo by Craig Lamb, N4BAX)

organizers of championship ARDF events to forbid the carrying of iPhones by competitors from now on.

Foxhunting in Music City

Hidden transmitter hunting has come to central Tennessee in a big way. Members of the Williamson County Amateur Radio Emergency Service (WCARES) are learning about the sport and developing their skills under the leadership of Tim Kreth, AD4CJ, a cardiologist in Brentwood. "I've been a ham for 15 years or so and have always been interested in this," he told me. "So I mentioned it to the guys and they said, 'OK, you're in charge.' They call me the Fox Meister."

Tim is justifiably proud of WCARES, saying, "We have a little over 160 members. We've been very busy with a six-week class for Technicians licenses with 30 students. I think 22 have passed already. We had ten students who took our class for General upgrade and I think five have passed their tests so far.

"We really encourage our young hams. There is a club net every Monday night that gets 50 to 75 check-ins. For a half-hour prior to that, there is a youth net that is organized by a couple of adults, but we let the youngsters be Net Controls. We have a really great club communications system with five linked ham repeaters covering middle Tennessee. When one of the youngsters announces his or her presence there, almost every time an adult will come up to chat within 20 seconds."

Because of the large number of youth, WCARES has only been doing on-foot foxhunts instead of hunts in cars. Starting with a couple of foxboxes to find, the club is now ready to do five-fox hunts under international rules. "We don't have a fixed date and time for our hunts," Tim explains. "It's whatever my schedule will allow.

"Six to twelve people show up for each of these hunts, so it's really a lot of fun. We've had a big building effort for 2-meter tape-measure Yagis[8] and I have three of them that I let people borrow if they haven't built theirs yet. Some use loop antennas[9] instead. Both active[10] and passive RF attenuators are popular. For about twenty minutes before each hunt starts, we'll explain foxhunting techniques to those who haven't done it before. More often than not, the experienced adults will go out with the first-timer youths to help them learn the ropes."

With plenty of experience in signal tracking, WCARES members were ready to jump in when interference kept local officials from using the Linked Emergency Telecommunication System (LETS Talk), a new public safety voice communications network that will eventually provide interoperability over the entire state of Tennessee. "The LETS Talk repeater for Williamson County is actually in Davidson County," says Tim. "It's on a hill in downtown Nashville, about 25 miles north of our county's Emergency Management Agency (EMA) offices. A dead carrier on 156.015 MHz was holding up that node, so it had to be disconnected from the rest of the network.

"The EMA people know us very well, so they called us and asked if we could help find the problem. Gary Heddon, W8JFP; Randy Armour, KI4LMR; and I started at the hill. Phil Sherrod, W4PHS, had written a computer program for triangulation, so he was at a local headquarters spot. Each of the rest of us had RDF gear and a hand-held GPS unit so we could transmit our bearings and exact locations to Phil.

"We took our readings at the affected repeater, where the signal was 10 dB over S9. Then we drew a circle on the map 5miles out and we spread out at 120-degree angles from there. None of us could hear it there, so we moved in to just 2.5 miles away and we were all able to pick up the carrier again. W4PHS plotted it and the bearings intersected at a Highway Patrol office, only a third of a mile away from the hill with the affected repeater. When we got there, we used our Yagis and loops to pinpoint it.

Clara Hedden, granddaughter of Gary Hedden, W8JFP, learns about ARDF bearing-taking at a foxhunt of the Williamson County Amateur Radio Emergency Service. (Photo by Dave Mann, N4CVX)

We were able to tell exactly which of the six antennas on the pole was the one from which the carrier was coming.

"We knocked on the door of the Highway Patrol dispatch office that Sunday afternoon and told them that they had a stuck radio interfering with LETS Talk. One dispatcher immediately said to the other, 'I wonder if that's why we've been having trouble with our communications!' When they came in Monday morning, the Highway Patrol technicians found a backup VHF radio that was keyed down."

Tim says that the triangulation program by W4PHS predicted the actual stuck transmitter location to within a few dozen feet. That's possible, since it was quite close and its antenna was up on a high pole, giving reflection-free bearings to the hunters. Phil's program doesn't have the street-mapping features of W6EI's FoxHunt, but if the bearings and user locations are accurate and correctly entered, the triangulation will be right. "He used the same program for one of our hunts in the park," says Tim. "The triangulation was a quarter-mile off because one of the guys hid his fox next to a chain-link fence!"

Next Time

My next "Homing In" column will have coverage of the USA ARDF championships in Ohio and the organization of ARDF Team USA for the World Championships in Croatia this September. I'll also take a look at another new computer program for display and triangulation of RDF bearings. It works on fast PCs, has a serial Doppler interface for mobile transmitter hunting, and displays the results on Google Earth.

73, Joe, KØOV

Notes

1. Lee de Forest's patent application vaguely mentions a "gaseous medium" inside the tube and states that "... the explanation of this phenomenon is exceedingly complex and at best would be merely tentative,; I do not deem it necessary herein to enter into a detailed statement of what I believe to be the probable explanation." Edwin Armstrong later showed by measurement that the triode's grid-to-filament voltage controls the flow of electrons from filament to plate and that a high vacuum is best.

2. "Even a man cannot talk and hear with the same organ," sneered the prosecuting attorney. De Forest was eventually acquitted, but the judge urged him to "get a garden variety of job and stick to it."

3. http://www.homingin.com/nscope.html

4. From US Patent 1,101,533: "... the objects of my invention are to provide transmitting and receiving systems whereby the radiation of electromagnetic signal waves may be concentrated in a definite signal direction and whereby the general direction from which the electromagnetic signal waves which operate a receiving device emanate may be determined ..."

5. From US Patent 1,101,533: "I have discovered that all longitudinal cross-country conductors, such as railway tracks and masses of telegraph or telephone wires act as wave-chutes and lead off the waves in the direction in which they extend, thus draining the ether of the wave energy in their immediate neighborhood. Thus if a transmitting system ... is operated in the immediate vicinity ... the maximum field of force will be created in the direction of said track or line wire system."

6. http://foxhunt.rail.com

7. http://www.rail.com

8. http://www.homingin.com/equipment.html

9. http://www.arrowantennas.com/fhl.html

10. http://www.homingin.com/joek0ov/offatten.html

By Keith Pugh,* W5IU

SATELLITES

Artificially Propagating Signals Through Space

"Satellites 101"
An Introduction to Amateur Radio Satellites

I have been encouraged recently by the increasing number of new hams at hamfests, club meetings, and public service events. Many of them are expressing an interest in amateur radio satellites, and I feel that it is time to re-introduce the wonderful world of amateur radio satellites to this audience. Possibly this will catch a few "old timers" as well.

A Brief History

We have kept our "satellite secrets" well. Many new hams have no idea that amateur radio satellites even exist, much less that we have been building and launching them since Orbiting Satellite Carrying Amateur Radio number one (OSCAR-1) was launched on December 12, 1961. Beginning with OSCAR-1, the early satellites were built, coordinated, launches arranged for, etc., by a group in the San Francisco Bay Area known as Project OSCAR *(for some of the history of Project OSCAR, see the article "Amateur Radio and the Cosmos, Part 4" by WA2VVA elsewhere in this issue—ed.)*. In 1969, most of that responsibility was taken over by the Radio Amateur Satellite Corp. (AMSAT), founded in the Washington, DC area. There are now related AMSAT organizations in many other countries throughout the world. AMSAT is over forty years old and is still building and launching satellites with only one paid employee.

As satellites are placed in orbit and become operational, they typically are assigned an OSCAR number such as AO-07 for AMSAT OSCAR 7 or HO-68 for HOPE OSCAR 68 (the newest satellite from China). Russia also has an amateur radio satellite series known as Radio Sputnik, or RS. So far there have been 68 OSCARs and at least 30 RS satellites, for a grand total of nearly one hundred amateur radio satellites launched. At any given time, there are usually about a dozen satellites of all types active. A listing and status of all of the amateur radio satellites is available on the AMSAT web page: <http://www.amsat.org>.

Amateur radio satellites may be further classified by orbit type, operational mode, frequencies used, and ease of use.

Orbit Type: LEO, HEO, & GEO

LEO: Most amateur radio satellites are placed in a Low Earth Orbit (LEO). A LEO is usually a circular orbit and the orbital altitude is usually 350 to 1500 kilometers above the Earth. Most of these are polar orbits—i.e., passing over the Earth's poles (orbital inclination of approximately 90 degrees). However, there are exceptions, such as the International Space Station (ISS) and Saudi OSCAR 50 (SO-50).

If the orbital altitude is around 750 kilometers and the inclination is approximately 98 degrees, the orbit becomes "sun synchronous," meaning that it will make its passes over any point on the Earth at approximately the same time each day. For example, AO-51 will make two or three passes each in view of Fort Worth, Texas centered around 6:00 AM and again at around 6:00 PM each day. Each pass will last around 10 to 15 minutes and time between passes will be approximately 100 minutes. These same criteria will exist for any other point on the Earth as well. AO-27's passes are centered around 2:00 AM and 2:00 PM. Departures from the ideal orbital altitude and inclination will cause a slow drift of these parameters relative to the time of day.

If the orbit is not "sun synchronous," the orbit passes will drift around the clock in a regular and predictable fashion, but they will occur at different times each day.

The duration of each pass and the maximum communications distance will depend upon orbital altitude, with the ISS having the shortest passes at the current time of about 9 to 10 minutes and the smallest communications circle diameter (footprint) at about 3000 miles; altitude is 350 kilometers. Our old friend AO-07 has pass times as long as 20 minutes and a footprint that will permit QSOs from the U.S. to Europe; altitude is 1500 kilometers. The new Chinese Satellite, HO-68, at 1200 kilometers altitude has the second greatest footprint at the moment.

HEO: All of the satellite "old timers" yearn for the return of the High Earth Orbit (HEO). HEO can cover a variety of high-altitude orbits. The one that has been used most often for amateur radio satellites is a modified Molynia Elliptical Orbit with an apogee (highest altitude point) of 36,000 to 60,000 kilometers and a perigee (lowest altitude point) of 1000 to 2000 kilometers. Orbital inclination ranges from about 6 degrees for a geosynchronous transfer orbit to about 57 degrees for a true Molynia orbit. Pass times are 8 to 12 hours, and the footprint can be as big as half of the Earth at a given time. These footprints and pass times have obvious advantages over the LEO parameters if you like to "rag chew" and work DX. We were fortunate to have AO-10, AO-13, and AO-40 operational from HEO for a total of 20 years, between 1983 and 2003.

Unfortunately, we no longer have the luxury of any satellite in HEO. Furthermore, unless we can find a new way of raising funds, we are not likely to have any in the future even though Phase 3E is currently waiting on the shelf in Germany for an affordable launch to HEO.

GEO: The television relay satellites are the most common examples of GEosynchronous Orbit (GEO). A GEO satellite orbits the Earth at 36,000 kilometers (22,500 miles) in the plane of the equator (zero degrees inclination). With this magic set of orbital parameters the satellite will "hover" over a selected point on the equator at all times, and you can point your antenna at this satellite, lock down the angles, and use it 24 hours a day

*3525 Winifred Drive, Fort Worth, TX 76133
e-mail: <w5iu@swbell.net>

and 7 days a week. This would have definite advantages for amateur radio satellite use, but we again run into the "affordability" problem. Rides to GEO and even rent on a commercial transponder are extremely expensive. Several proposals have been made over the years for amateur radio GEO satellites, but we have never been able to raise the money required. Even with obvious advantages for emergency communications, we have thus far always fallen short of funds for a HEO satellite.

Operational Modes: FM Voice, SSB/CW, Digital, and Manned

FM Voice: FM satellites can be classified as repeaters in the sky. They are typically one or two channel repeaters in orbit and have the advantages of easy Doppler correction and vast and relatively cheap availability of ground-station radios. Disadvantages are crowding and very limited communication time due to the crowding. Visualize your favorite FM repeater located at 800 kilometers altitude over the center of the U.S. with a 3000-mile diameter footprint and think about how many hams are in the footprint. Multiply this by the FM "capture effect" (big signal always wins) and you get the picture. They can be a lot of fun for "grid-square chasing" and other forms of contesting. With proper discipline, they can be used for serious communications. Again, ground-station rigs are plentiful and cheap. Full-duplex operation is highly desirable but not a must. Special applications of Slow Scan Television (SSTV) are possible.

SSB/CW Linear Transponders: Satellites with linear transponders can be used with a multitude of communications modes, but they usually are used with SSB and CW. Most typical HF modes of operation are possible. These satellites have passbands that are typically 50 to 100 kHz wide and can accommodate multiple QSOs at one time. They repeat an entire uplink passband on the downlink passband. They may either invert or not-invert the passband frequency sense and mode. Each QSO gets a share of the available power and therefore contributes to the number of QSOs that can be supported. Only low-duty-cycle (low-power) modes are tolerated on these satellites. Ground-station radios must be capable of SSB or CW, and full-duplex operation is a must. Signal levels are typically weaker; therefore, pre-amps and higher gain antennas are desirable. The obvious advantage of these satellites is the multiple QSO capability which permits real conversations on the satellites.

Digital: Digital satellites usually are channelized and can be either FM or other modulation types. They usually permit "store and forward" messaging and can be built to support several different modulation types and baud rates. Conventional 1200-baud AX-25 packet radio is still used to support APRS digipeating and messaging on the ISS. AO-51 and SO-32

SPACE DESIGNS — The National Aeronautics and Space Administration released these conceptions of configurations of space craft to be used in three separate phases of Project Apollo. Contract was awarded to North American Aviation Co.

DEC 5 1961

giant step in space conquest early next month.

The National Aeronautics and Space Administration also said the next orbit attempt in the Mercury program will be made by a man—ruling out any more tests with animals.

Astronaut John H. Glenn Jr., 40, a Marine lieutenant colonel already has been chosen to take the ride, with Navy Lt. Cmdr. Scott Carpenter, 36, as the back-up or standby pilot.

No firm December target date had been announced for orbiting the first American. But U.S. space officials for months had been pushing to accomplish it in this same year the Russians orbited their two space pioneers. Word had been passed that the attempt might be made as early as Dec. 20.

NASA officials set no specific January date, although there were indications here it might be in the first week of the new year. Unofficial sources at the Cape Canaveral, Fla., launching site reported a date of Jan. 16 had been picked.

No Explanation

There was no official explanation for the decision to wait until next year and the announcement was a surprise to most persons at Cape Canaveral.

There had been reports of technical troubles interfering with plans for an orbit this year, but NASA has insisted all is progressing normally. And officials at the Cape reported checkouts of the Atlas booster, the man capsule and other phases of the program are progressing smoothly.

However, officiails at Cape Canaveral said a launch attempt this year would have put extreme pressure on everyone and this might have affected the success of the venture.

A NASA official here said it normally takes about six weeks to prepare for an orbit attempt and an early January date would just about give that much time since last week's orbit by Enos the chimpanzee. A 15-day technical delay in his flight had been a big factor in stifling hopes for a man-orbit this year.

'Hams' Track Orbiting Radio Robot 'Oscar'

DEC 13 1961

VANDENBERG AIR FORCE BASE, Calif. (AP)—OSCAR, a 10-pound radio robot, is orbiting the world, beeping "hi" to radio hams from Byrdland, Antarctica, to Kodiak, Alaska.

OSCAR—short for Orbiting Satellite Carrying Amateur Radio—was launched Tuesday aboard a Discoverer satellite and about 90 minutes later was transmitting the four dots and two dots that spell "hi" in Morse code.

The Discoverer 36 satellite also carried its usual cargo—a capsule of secret instruments that will be ejected within a few days. The Air Force has planes ready to snag the capsule as it parachutes near Hawaii — a feat achieved seven times to date. Three other capsules have been fished from the ocean.

Most of the attention is centered on OSCAR—carried aloft in the rocket's tail in ,place of ballast. The capsule is in the nose cone.

OSCAR, the world's first satellite built entirely by private citizens, will transmit for about 30 days, or as long as its batteries last.

It was conceived and built by space engineers whose hobby is tinkering with short-wave radio. Project chairman M. C. Towns of Sunnyvale, Calif., said this was the first time a satellite has transmitted on the international amateur frequency of 145 megacycles.

The Air Force has no official connection with the project.

Project sponsors say future OSCARs, if approved by the Air Force, could open up new lines of communications in national emergencies.

All the world's amateur radio operators — about 300,000 — have been invited to help track OSCAR.

OSCAR was ejected on Discoverer's first pass over the antarctic, the Air Force said, and was circling the globe every 91 minutes at an altitude ranging from 150 to 260 miles, slightly behind its mother satellite.

Chute Escape Capsule Passes Air Force Test

EDWARDS AIR FORCE BASE, Calif. — (AP) — The Air Force says it has successfully tested a method of parachuting a pilot to safety in a rocket-powered escape capsule.

Two man-sized dummies, each in a 700-pound steel capsule, were parachuted 12 seconds after being blasted about 250 feet up from a speeding rocket sled.

Monkey Shot Into Space

DEC 2 0 1961

CAPE CANAVERAL, Fla. (AP) —A tiny Rhesus monkey named Scatback with a radio transmitter and medical instruments implanted in its body rocketed 600 miles into space Tuesday night and landed in the South Atlantic Ocean more than 6,000 miles southeast of here.

The Air Force reported 80 minutes after launching that the range vessel Sword Knot was in the impact area and was searching for the special cylinder in which the four-pound monkey rode.

Two search planes also swept the area for a sight of the package.

Scatback was in a six-foot-tall capsule attached to the side of an Atlas missile which blazed away from Cape Canaveral at 10:32 p.m. Five minutes later the rocket's powerful engines shut down as planned and in another minute the cylinder ejected and followed a 15,000-mile-an-hour ballistic course much like the Atlas nose cone.

The cylinder impacted as planned about 1,000 miles southeast of Ascension Island. A buoyant bag was to keep it afloat.

—The Air Force abandoned to a turbulent sea Wednesday a small monkey named Scatback who rocketed 600 miles into space to pioneer techniques for human astronauts.

As the South Atlantic Ocean search was terminated, technicians studied signals radioed during the flight from a transmitter imbedded in the stomach of the four-pound animal. Analysis could help determine if surgically implanted medical sensors are feasible for future space pilots.

The range vessel Sword Knot combed the impact area for nearly 15 hours before darkness forced to an end the search in the area 6,000 miles southeast of Cape Canaveral.

Scatback thundered away from the cape at 10:32 Tuesday night in a 6-foot capsule tacked to the side of an Atlas missile. The Atlas performed flawlessly and unleashed the capsule on a 30-minute, 15,000-mile-an-hour ballistic course which put it right on target.

Two planes joined the search initially, but had to withdraw after three hours because they were low on fuel. Without aerial eyes to guide it, the Sword Knot faced a tough task in rough water where the waves were seven to nine feet high.

The was some feeling that the monkey-bearing cylinder sank shortly after landing. No signals were picked up from a radio beacon in the capsule nor were flashing lights attached to it sighted.

No Details Out On New Satellite

DEC 2 6 1961

POINT ARGUELLO, Calif. (AP) — The Air Force says it launched a satellite Friday—but won't disclose any details.

It was launched at the Point Arguello naval missile facility, adjacent to Vandenberg Air Force Base.

The Air Force recently has been close-mouthed about launchings of so-called sky-spy satellites, designed to orbit over Russia and detect missile launchings and photograph military bases.

The satellite launched Friday is presumed to be a military spacecraft.

The Air Force's terse announcement said only that: "A satellite employing an Atlas Agena B booster combination was launched by the Air Force today at Point Arguello.

"It is carrying a number of classified test components."

The Air Force wouldn't elaborate on whether the launching succeeded in reaching orbit.

Satellites of the Midas and Samos sky-spy series sometimes are launched from the pad where the rocket roared aloft.

An OSCAR AP article from Vandenberg AFB about the launch of OSCAR-1. This came from a western Kansas newspaper (probably the Dodge City Daily Globe *or the* Hutchinson News*) dated December 13, 1961. I have three scrapbooks that contain this and many other space program articles from newspapers in the 1950s, '60s, and '70s. They cover Sputnik through the Apollo programs. Given the media bias toward the spectacular, there are many more failures than successes reported; however, these were tough days and they may be close to accurate. My stepfather found these scrapbooks somewhere around Dodge City, Kansas and presented them to me for Christmas several years ago.*

support 9600-baud FSK packet. AO-51 will accommodate faster rates as well. Operating systems can be optimized for store-and-forward messaging over several orbits if necessary. Future digital modes can be placed in this category as well.

Manned: Starting with the U.S. Space Shuttle we have had amateur radio operators in space. Equipment has been available on the Shuttle, the Russian MIR Space Station, and the International Space Station (ISS). Astronauts and cosmonauts have been licensed and trained to use this equipment for promotion of science, technology, engineering, and mathematics (STEM) in education; personal enjoyment; and backup communications. Currently, the ISS has made over 500 school contacts to support STEM, and several of the astronauts have provided many other manned space contacts to the general ham population. Unfortunately, the astronauts/cosmonauts have a heavy workload and priorities on their personal time are up to them. Some are much more interested in ham radio than others. Modes such as digital television on L and S bands are in the planning stages. Antennas are already in place on the ISS for this.

Frequencies Used

Satellite operational modes are often confused with combinations of uplink and downlink frequencies. For example, Mode A means a 2-meter uplink and a 10-meter downlink, Mode B means a 70-cm uplink and a 2-meter downlink, and Mode J means a 2-meter uplink and a 70-cm downlink. We are in a transition phase with a new terminology: Mode B is being replaced with Mode U/V (Mode *Uplink Freq. Band/Downlink Freq. Band*). U band is UHF and V band is VHF. Mode J becomes Mode V/U. This is being done to permit transition to more combinations on the newer satellites. AO-51 supports Modes V/U, V/S, L/S, and various sub-modes within these designations. Sub-modes are usually various modulation types. Again, AO-51 can support SSB/ CW on the uplink with a FM downlink in several modes. Most of the time modulation type is FM uplink/FM downlink on its modes. A complete study of all of the possible uplink/downlink frequencies and modulation types is beyond the scope of this article, and I recommend a study of the charts on the AMSAT web page. A review of the *Satellite Handbook, Getting Started on Amateur Radio Satellites,* and other publications is also helpful.

The most common frequency pairs used are V/U and U/V; however, a move higher and higher in frequency is the trend. After all "use it or lose it" is still alive, and smaller satellites such as the CubeSats definitely mean higher frequencies to fit the available real estate on the "bird."

Ease of Use

Working the amateur radio satellites is not difficult, but some are more challenging than others. For all satellites, you will need to know when it is above the horizon at your location, what uplink and downlink frequencies are involved, and what type of satellite it is—FM voice, SSB/CW, digital, or manned. If you are using directive antennas, you will also need to know where to point them. In these days of the internet, all of this information is available on the AMSAT web page in one form or another. Orbital pass time and pointing angle information is available from an on-line tool. Frequency and mode information is also available on the web page.

Keplerian data for your own tracking program is available for its use in generating the pointing information. Tracking programs are available through the AMSAT store. These programs can also be used, with proper interfaces, to control your antennas and/or your radios. All of these software controls are nice but not necessary for your first enjoyment of working the satellites.

As mentioned earlier, radios for the FM voice satellites are more commonly available and less expensive. You can use either a dual-band VHF/UHF radio or separate VHF and UHF radios. Some of the older radios may have to be "opened up" to cover all of the frequencies, particularly the UHF radios.

Multimode radios suitable for the SSB/CW satellites may also be of the single-band or dual-band variety. Several new and used single-band and multi-band, multimode radios are still on the market. Some of these even have HF and microwave capabilities. Like many other facets of amateur radio, you can spend as little or as much as you want. Another relatively cheap alternative, if you already have HF equipment, is the use of outboard up and down converters attached to your HF gear. Combinations of relatively inexpensive multimode, multi-band equipment such as the Yaesu FT-817 and FT-857 transceivers, your computer, and a SatPC32 Tracking Program can be used very effectively along with steerable antennas for a deluxe station at a fairly reasonable price. Steerable antennas, antenna rotors, and rotor interfaces are available to round out the deluxe station.

Of course, the simplest and most inexpensive station is a dual-band HT with a hand -pointed directive antenna. This antenna can be homebrewed or purchased from Arrow Antennas or Elk Antennas. A 5-watt, or less, radio will work with enough patience, skill, and cunning. This is usually an FM voice station, but SSB/CW variants are also possible.

One other topic—Doppler tuning. This is necessary on all of the satellites, especially the UHF side of the station. It can be done manually with the aid of frequency steps and radio memories, or automatically with your radio interfaced to your computer and tracking software. It is absolutely essential on both the uplink and downlink of the SSB/CW satellites and at least on the high-frequency component (usually the UHF side) of an FM voice satellite.

All of this may seem complicated, but take it a piece at a time, understand it, practice it, use it, and it will become second nature. By the way, there is nothing quite like the thrill of your first successful satellite contact!

Summary

Follow the above guidelines and join us in the amateur radio satellites part of the hobby. Don't be overwhelmed by the perceived complications. Break them down to their simplest form and join the crowd.

Follow this column for up-to-date information on all of the amateur radio satellites and related topics.

Please continue to support AMSAT in its plans for the future of the amateur radio satellites. AMSAT is now updating its web page at <http://www.amsat.org> on a much more regular basis. Satellite details are updated regularly at <http://www.amsat.org/amsat-new/satellites/status.php>. 'Til next time . . .

73, Keith, W5IU

By Thomas Dean, KB1JIJ

Amateur Television – Methods and Applications

Digital Modulation and Signal Processing in ATV

Digital signal processing is certainly a hot trend in voice communications. Analog television can be vastly improved by the use of digital signal processing. There are many application-specific integrated circuits (ASICs) available, such as the Analog Devices ADV7181, that allow for analog signals to be converted to the digital domain and have properties such as gamma or hue of the video be adjusted or corrected. Additionally, we could easily add an on-screen display in the digital domain, convert between different video formats (NTSC, PAL, SECAM), or take a variety of inputs (Composite, Component, S-Video, VGA, etc.). In all of these cases, nearly all the work of processing and converting can be accomplished by a single chip that has already been manufactured.

Once we get the signal into the digital domain, we can also use digital methods to modulate the signal. This has many advantages, one of which is flexibility. A nearly identical digital system could be used to modulate an analog signal or a digital ATSC signal. Thus, we could have a system that could take a variety of inputs and give us output in the form of a standard ATV signal or a D-ATV signal.

Another great advantage of digitally modulating the signal is that it can reduce the number of components, saving both cost and space in a design. It is difficult to deal with a digital signal that can be directly converted to the 70-cm (or higher) band, as this would require clock rates nearing or exceeding 1 GHz. Instead, we can produce base-band signals around the range of 30 MHz and then upconvert them to the desired band. This also makes our design very easily frequency agile, which is why we typically use base-band frequency levels to modulate and demodulate analog signals.

Television uses a modulation method call *vestigial-sideband (VSB) modulation*. Constructing a vestigial-sideband signal is very similar to constructing a single-sideband signal. In the case of vestigial-sideband, we are taking the entirety of one sideband and a portion (vestige) of another. There are two primary reasons why we do this. First, a television signal, unlike a voice signal, nearly needs the DC components to accurately reconstruct the image. Thus, there is no clear distinction between sidebands and it becomes very difficult to separate them. As a result, we take part of the lower sideband along with the upper sideband. Another reason we use vestigial-sideband modulation is that it allows a portion of our carrier signal to be sent. Anyone who has operated SSB voice knows that it is difficult to tune to the exact frequency to hear the transmitted voice at the correct pitch. When operating voice, it is acceptable to be slightly off frequency, as the speaker's voice is still intelligible; however, demodulating a video signal slightly off frequency would cause unacceptable problems. By allowing a portion of our carrier to be transmitted, the receiver can accurately lock on to the transmitted signal and properly demodulate the signal.

As with single-sideband, there are generally three methods to create a vestigial-sideband. Each method offers advantages and disadvantages depending on the type of signal modulated and the architecture of the system. The three methods that will

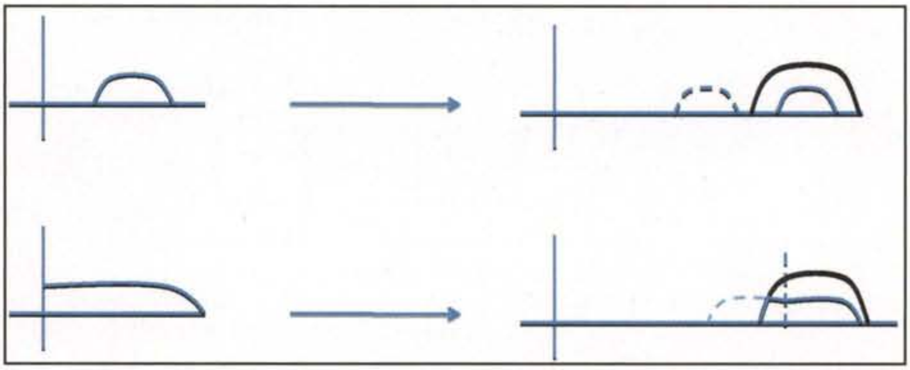


Figure 1. A voice signal, in the top left, is modulated by a carrier. One of the resulting sidebands is selected, and we get a SSB transmission. A video signal, on the bottom left, is modulated by a carrier, but it is not so simple to select a single sideband due to the wide bandwidth of the video signal. Hence, we use VSB.

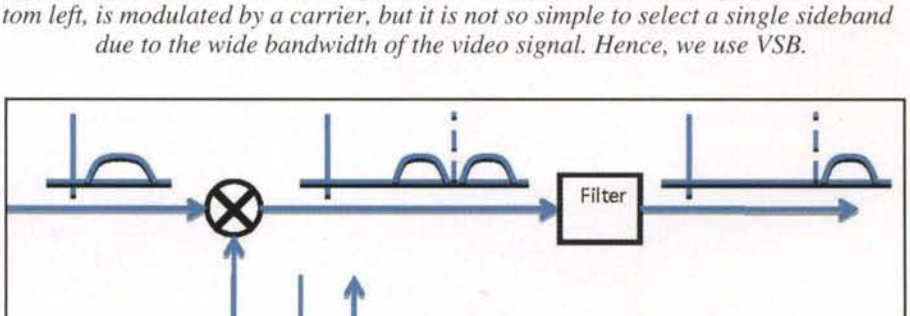


Figure 2. The Filter method. A signal is modulated by a carrier, and one of the sidebands is eliminated by a carrier. This is the simplest method of creating SSB or VSB but does not work so well in the digital domain.

*e-mail: <Thomas.Dean@usma.edu>

be described are: the filter method, the Hartley method, and the Weaver method.

Filter Method

The filter method is the method with which many amateurs may be familiar, as it is the simplest and most easily implemented in analog hardware. In this method, the signal is modulated with a balanced mixer, which results in a double-sideband signal with a suppressed carrier. From here the signal is passed through a filter which selects one of the sidebands to be transmitted.

Transmitting television signals re quires very precisely defined filters. Unlike modulating a voice signal, with a television signal we must filter both the upper (to limit the bandwidth of the video signal) and lower (to transmit only a part of the lower sideband) portions of the signal. Thus, we require a band-pass filter. Such a filter could be realized in many ways in an analog system. It is common in video systems to use surface acoustic wave (SAW) filters, which are somewhat similar to mechanical filters in that they offer a relatively small package, sharp cutoffs, and high efficiencies and stabilities.

This straightforward system introduces a slight problem in the digital domain. In order to create the necessary filters, we would need to have a very large number of taps (digital filter elements) at a very high sampling rate. While this brute-force method may be possible with a high-density FPGA, we can design a system in a much more eloquent way.

Hartley Method

Another method that can be used to modulate a single, or vestigial, sideband signal is the Hartley method. This method is not as commonly used in analog systems, as it requires matching two signals closely in phase and amplitude to fully suppress a sideband. In order to modulate a signal using the Hartley method, we take the original signal and shift a version of it 90 degrees in order to create an in-phase and quadrature version of our original signal. We then mix the two signals with an in-phase and quadrature version of our carrier and sum the resulting signals together. This will result in a single-sideband signal (for a mathematical treatment of the Hartley method, see "The Hartley Modulator"[1]).

In order to create a vestigial-sideband signal using this

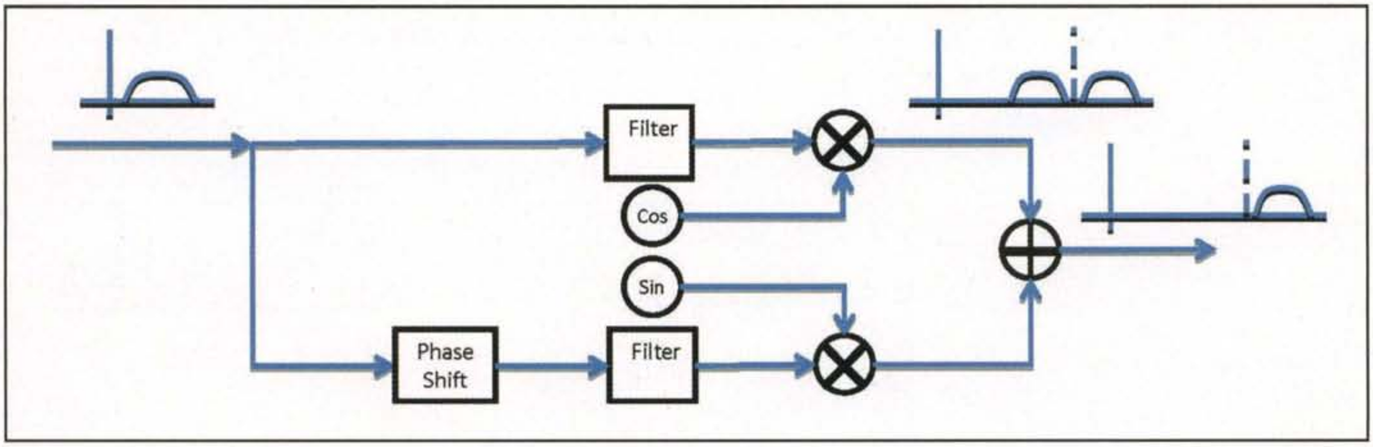


Figure 3. The Hartley method. In this method, phasing is used to cancel out one of the two sidebands. Filtering can be used in order to achieve VSB rather than SSB. This method is impractical with a video signal, because it is impossible to phase shift the near DC components of the video signal.

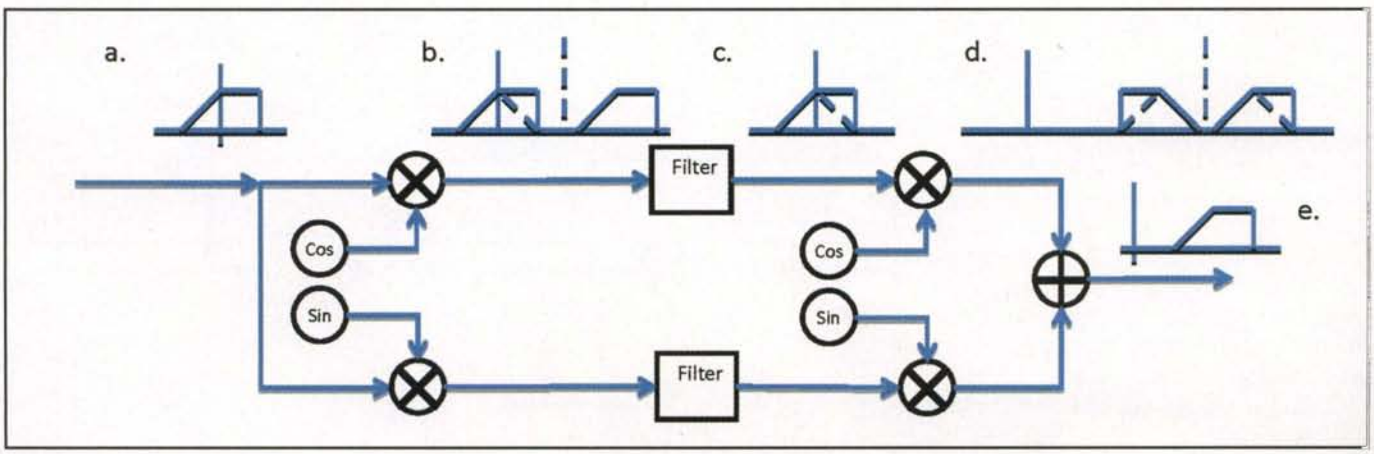


Figure 4. The Weaver method. This is the preferred method in digital modulation. In this method a signal (a) is mixed with a low-frequency carrier resulting in (b). (b) is then filtered to give (c), which is mixed with the RF carrier to give (d). The result of phasing yields only one sideband as shown in (e). This method is difficult to implement in the analog domain but solves the problems of the previous methods.

method, we can filter the signals after they have been phase-shifted but before they are mixed with the carrier. This solves the previous issue of having complicated filters. However, there is one primary difficulty with this method that is present in both analog and digital implementations. The 90-degree phase shift of a signal is often referred to as a *Hartley Transform*. The Hartley Transform can very feasibly be implemented in a narrowband signal such as a voice signal. However, with a wideband video signal, we do not get a very uniform frequency response and we require a large amount of equalization. Although this complicates our design, it is still feasible to perform this equalization, especially in the digital domain. We do run into a larger, but related problem: It is impossible to phase shift a DC signal. This creates a theoretical low-frequency limit to the signal that we modulate. It is still possible to create the needed signal if we reinsert the carrier and carefully study the needed equalization, but it quickly becomes more complicated. There is a third method of modulating our signal which will solve this problem as well.

Weaver Method

The Weaver method is sometimes referred to as the "third" method of single-sideband modulation. This method is very difficult to implement in the analog domain, because it is extremely sensitive to mismatches in filters and signal paths. This problem is trivial in the digital domain, as we do not have tolerances of components with which we have to deal. The Weaver method is the least intuitive method and possibly the most difficult method to understand; for a mathematical treatment of this method, see The Weaver Modulator.[2]

When we modulate a signal with the Weaver method, we mix the original signal with both in-phase and quadrature versions of a low-frequency carrier. When we do this, we choose a low frequency that allows our negative frequencies to overlap with our original positive frequencies. When we mix the in-phase and quadrature versions of the resulting signals with two carriers that are 90 degrees out of phase, we end up with one of our sidebands cancelling out.

Creating a vestigial sideband is simple. All we have to do is choose a slightly lower frequency for our first frequency and only a portion of our negative frequencies will overlap with the positive frequencies; as a result, only a portion of one of our sidebands will be cancelled out! All of our filtering can be done after the first low-frequency carrier is mixed in, and we only need to use low-pass filters. This greatly saves on the complexity of our filter design. Additionally, multiplication of signals with the carriers is extremely simple in the digital domain, as we simply can use sequences of 1's and –1's and we will end up with a signal that can be accurately be reconstructed in the analog domain. Even though this method is much less straightforward, it is clearly the simplest to implement in the digital domain.

Conclusion

Modulating a video signal with the Weaver method can allow us to modulate either a digital or analog signal to a baseband frequency using a common architecture. With typical reprogrammable digital devices, this baseband signal could easily be in the range of 30 to 60 MHz (or greater). Once we have a baseband VSB signal, we can mix it with a carrier that could be created by a variable frequency oscillator (VFO) and pass it through a relatively simple low-pass filter to get our video signal at the band and frequency (or channel) that we desire. Such an architecture would allow us to harness the power of digital signal processing for video signals and would provide us with great flexibility in terms of input formats for our video.

73, Thomas, KB1JIJ

Notes

1. The Hartley Modulator: <http://soe.unn.ac.uk/ocr/teaching/ppp/SSBSC/sld006.htm>.

2. The Weaver Modulator: "A third method of generation and detection of single sideband signals," Weaver, D. K., *Proc. IRE*, Dec. 1956, pp. 1703–1705.

By Kent Britain,* WA5VJB

ANTENNAS

Connecting the Radio to the Sky

Pitfalls in Helix Antenna Construction

Perhaps the VHF antenna with the most misconceptions, old-wives tales, and just plain wrong information is the helix antenna, such as the NASA tracking array shown in photo 1.

There are a lot of helix calculators on the internet and the textbook equations going back to J. D. Kraus, W8JK's original formulas. However, it is generally agreed that these tend to be 3–5 dB too optimistic at predicting the gain of a helix antenna.

I am not saying you can't build a good helix antenna. I'm just saying it's a lot harder to build a good one than most hams think. At various conferences we have tested nearly 100 helix antennas built by different hams on my semi-portable antenna range. Only about one in five had forward gain and was circularly polarized, and here is how the other four out of five went wrong.

Velocity Factor

A radio wave traveling down a wire travels at about 95% the speed of light. The common equations for a dipole antenna take this velocity factor into account. Light slows down when it is traveling though a medium such as glass or plastic—after all, this is how a lens works. Take the common 66-foot, 40-meter dipole. If you build it out of bare copper wire, it will have the lowest free-space SWR at 7.25 MHz. Now build that same 66-foot dipole using insulated wire, and the new SWR minimum will be 6.77 MHz. That thin layer of plastic has moved the resonant frequency down almost .5 MHz, and you have to shorten the dipole about 4 1/2 feet to bring it back to 7.25 MHz.

Note: I have lowered the frequency of a small Yagi just by putting heat-shrink tubing over the elements. Yes, if you cut an element a bit short, you can electrically lengthen it with plastic tubing or heat-shrink tubing.

**1626 Vineyard, Grand Prairie, TX 75052*
e-mail: <wa5vjb@cq-vhf.com>

Photo 1. NASA tracking array.

Photo 2. Helix antenna wound on plastic pipe.

Photo 3. Short helix for use as a dish feed.

Photo 4. More helix antennas wound on plastic pipe.

Back to the dipole example. The dielectric constant, or Er, of the insulation is usually not controlled at the wire factory. Mechanical strength, viscosity, voltage breakdown, and other mechanical factors are tightly controlled, but not Er. As hams we can get close, build the antenna a few feet long, and then trim back for best SWR at our favorite frequency, so this isn't a big deal.

Now let's look at a helix wound on a piece of sewer pipe, such as the one shown in photo 2. Again, the Er of the plastic is not controlled. Call your local hardware store and ask for the dielectric constant of its plastic pipe. I'm sure you will get the "deer in the headlights" response. So get clever and dig out your *CRC Handbook of Chemistry and Physics* or do a quick internet search on the dielectric constant of PVC plastic, and you will get various numbers around Er = 3.2 for the dielectric constant.

Again, Er is not a controlled number during manufacturing, and even worse, the Er of most materials changes with frequency. That 3.2 value was probably measured at 1 kHz, not 2.4 GHz!

Here is where the textbooks and internet calculators lead you astray. The textbooks are calculating a free-space helix antenna. When a metal strip is wound on the plastic, you have a new velocity factor for that line. With most plastics this new velocity factor is about 60% of the free-space value. That is, the signal is traveling along the turns of the helix only about 60% as fast as the formula/calculator assumes it is traveling. This really messes up the turns ratio of the helix. I am not saying you can't compensate for this 60% velocity factor with a new helix design, but plan on building a pile of prototypes and using a lot of test equipment. Then buy a lot of the plastic pipe, because the odds are that sewer pipe from another vendor or a different manufacturing batch will need different dimensions.

Testing a Helix Antenna

Many years ago the original designs for OSCAR Phase 3D, the bird that ultimately became AO-40, called for several helix antennas on a spin-stabilized platform looking back at the Earth. I was sent several of these helix antennas for gain testing. Oh, did I have problems getting a good consistent reading. You see, while a helix has forward gain on a VHF or UHF frequency, lower down it looks like a *big* rubber-ducky. That 1269-MHz helix was also a quarter-wave whip on TV Channel 4, and of course my antenna range is about 5 miles from a TV Channnel 4. In high RF environments, a helix antenna looks like a long wire antenna. Your equipment just might need extra filtering to avoid overload from nearby transmitters even though they are on a much lower frequency.

The Short Helix as a Dish Feed

A two- or three-turn helix has often been used as a simple dish feed such as the one shown in photo 3. The problem is getting circular polarization from only a few turns of wire. Most of the time a short helix comes out more linear polarized than circular. If you test a short helix on the antenna range against a linear antenna, you typically see about a 10-dB change in gain as you rotate the antenna while pointed at the source. A Yagi typ-

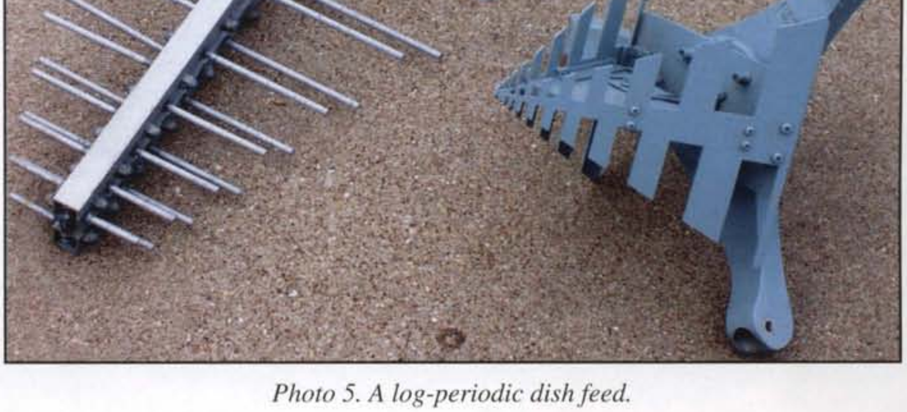


Photo 5. A log-periodic dish feed.

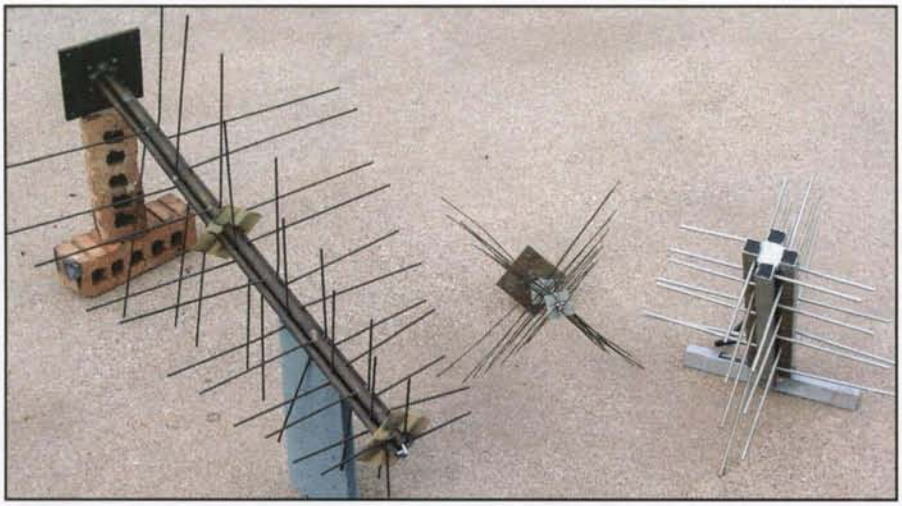


Photo 6. Circularly polarized log-periodic antennas.

ically has about 20 dB of change when you rotate its polarization. A good circularly polarized antenna will have less than 1 dB of variation when rotated. Just trimming a fraction of an inch off the end of the helix can make a drastic change in the polarization of the helix.

With careful trimming, expanding and compressing the helix, there is a magic spot where you will have a good SWR and good circularity. It's in there, but without test equipment the chances of randomly hitting it are not good.

The helix antennas wound on plastic pipe in photos 2, 3, and 4 all came from an RFID (radio-frequency identification) company developing 2.45-GHz RFID tags. While intended for 2.45 GHz, and carefully adjusted for best SWR on very high-dollar test equipment at 2.45 GHz, they actually had maximum gain between 2.15 and 2.2 GHz. Much of their performance issues in the field tests were apparently not in their RFID tags.

Log-Periodic Antennas as the Dish Feed

The active area of a log periodic moves as the frequency changes. The high frequencies radiate from the front of the antenna; the low frequencies radiate from the back of the antenna. So which part of the log periodic do you mount at the focus of the dish?

In photo 5 we have a log periodic designed to be used as a dish feed. Note the "squashed" or compressed look for this dish feed compared to a more typical log periodic. The highest frequency of the log periodic comes off the short elements at the front, and the lowest frequency of the log periodic comes off the longer back elements. The compressed style keeps more of this 1–10 GHz antenna at the focus of the dish.

Yes, a circularly polarized log periodic is possible, such as the ones shown in photo 6, but they are not a simple project. They also are a problem to store—one reason why these look a bit bent. You can't set them down without bending something. I hang these from the ceiling and try not to walk into them too often.

I have gotten some comments on all the unusual antennas of which I have photos. Most come from years of collecting unusual antennas. Last week I stood in the attached garage and counted 192 antennas. The troubling part is I was standing in only one place, looking only at the top layer, and not even counting the back garage or the storage building!

The Bottom Line

Suspending the helix on spokes from a central support, keeping all other materials near the helix to a minimum, and doing it like NASA did 50 years ago (photo 7) is the way to make a helix antenna. If someone has an optimized and tested design, do not change materials or dimensions. Even using a different wire diameter or different insulating materials will affect performance.

A Plug for a Special Conference

The 14th International EME Conference will be held on the north edge of the Dallas/Forth Worth (DFW) airport from August 12th to the 14th. An excellent slate of speakers will be assembled for this cutting edge aspect of ham radio. For more information, contact me at <wa5vjb@cq-vhf.com> or Barry Malowanchuk, VE4MA, at <ve4ma@shaw.ca>.

Finally

As always, our readers are one of the best sources of ideas for future antenna projects. Any antenna questions or antenna projects you would like to see, just drop an e-mail to <wa5vjb@cq-vhf.com>, or visit <www.wa5vjb.com> for additional antenna projects.

73, Kent, WA5VJB

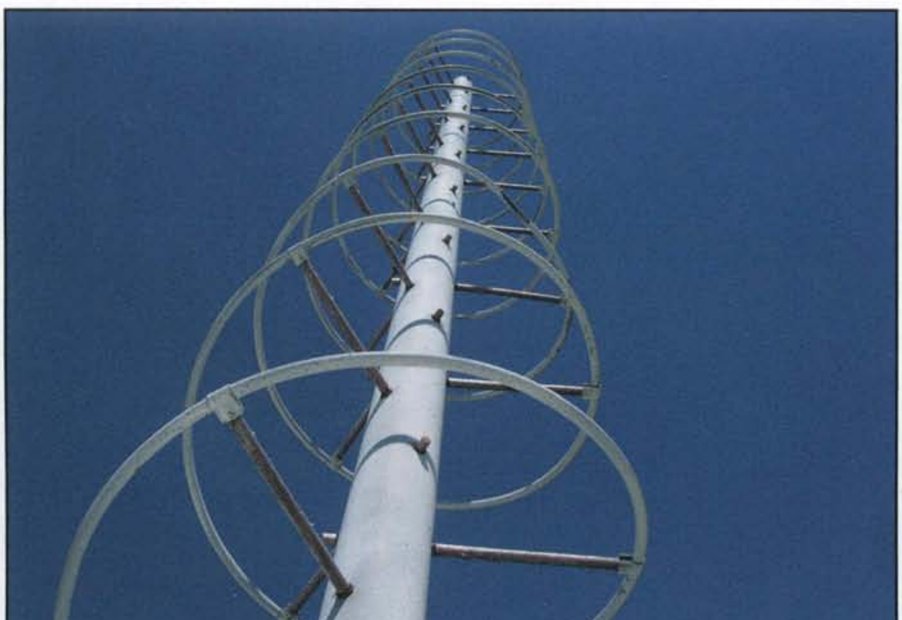


Photo 7. A helix antenna the way NASA likes them.

By Bill Brown,* WB8ELK

UP IN THE AIR

New Heights for Amateur Radio

New Heights for Science Fairs

Eighth grade student Jodie Tinker of Huntsville, Alabama wanted to take her science fair project to new heights. She decided to research the use of weather balloons to study the atmosphere and to ultimately take photos and videos from the very edge of space with her own balloon camera payload (see photo 1).

Stephanie Long and Wes Cantrell, with the support and encouragement of Dr. Newchurch of the National Space Science and Technology Center's (NSSTC) ozonesonde program, took her under their wings and taught Jodie how to prepare an ozonesonde payload. She participated in a number of the weekly launches of their ozone sounding balloons and learned how this data helps monitor the ozone layer and its impact on the environment.

I helped introduce Jodie to amateur radio high-altitude ballooning and how to use Automatic Position Reporting System (APRS) to track and recover balloons. A good portion of her final display was dedicated to amateur radio and APRS.

Jodie did some research and came up with a new camera that had never been flown before in near space. It's called the Tachyon XC helmet cam (www.tachyoninc.com) and is designed to mount on the helmets of extreme-sports enthusiasts. It has some very nice features, including the ability to start it up via an infrared (IR) remote control. This feature is very handy in that you don't have to pop open a payload lid or retape anything just prior to liftoff. Just point the remote control at the camera lens and it gives you an audible beep acknowledging that it's recording.

*12536 T 77, Findlay, OH 45840
e-mail: <wb8elk@aol.com>

Photo 1. Eighth grade student Jodie Tinker with her video camera payload. (Photo by WB8ELK)

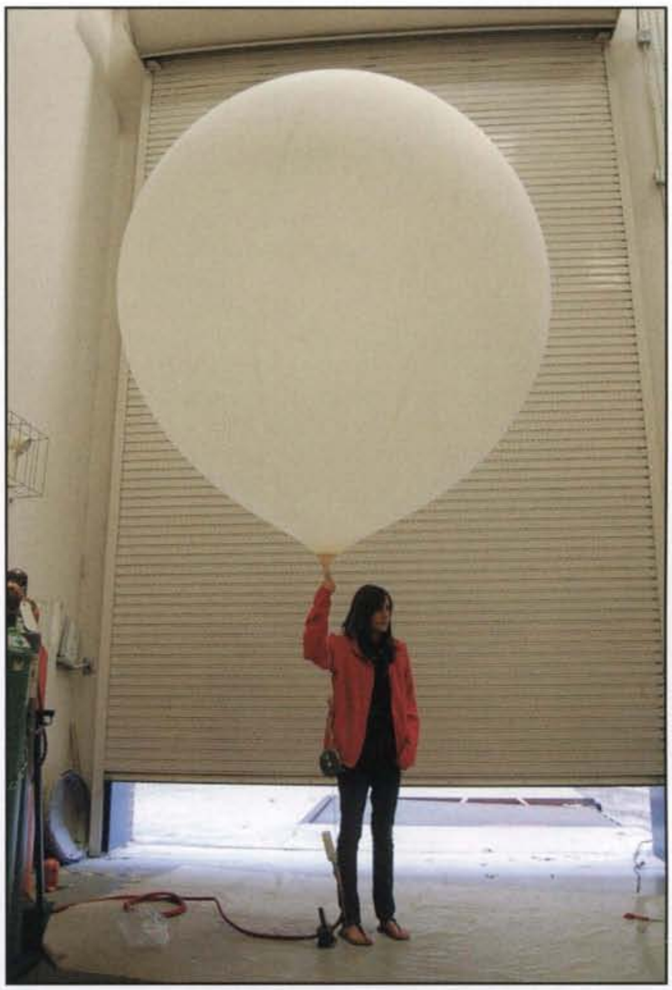


Photo 2. Jodie and her balloon inside the NSSTC highbay. (Photo by WB8ELK)

Photo 3. Liftoff of Jodie's balloon. (Photo by Alan Sieg WB5RMG)

The Tachyon XC has a number of additional features that are hard to find in many consumer-grade digital camcorders, which makes it quite useful for BalloonSat flights: The Tachyon can handle up to 32 GB SDHC memory cards to allow 8 hours of recording time. No special battery pack is needed; you can run this on two lithium AA batteries. You also have the option of putting the camera into a Time Lapse Photography mode that takes a still-frame photo every 2 seconds.

Video Cam Flight

Jodie's first flight was in February. She put her camera experiment into video mode for this mission. The jet stream winds were fairly high and the balloon quickly headed towards north Georgia. None of our usual balloon trackers were available that weekend, so I stayed behind after the launch to be Mission Control and guided Jodie and her father, Mike Tinker, towards the predicted landing zone via our cell phones. Jodie was very lucky on this flight, as the payload landed a few feet from a small road near Dalton, Georgia. Rugged mountains are on either side of this valley and her balloon managed to land right in the middle of the flat area in between. Using Google maps displaying APRS data on <www.aprs.fi> and <www.findu.com>, I was able to guide them onto the right road near the landing spot. I could hear Jodie's excitement over the phone as they approached and spotted the parachute and payloads. They just stopped the car, grabbed their experiment and the tracking equipment, and headed back home. Of course, all BalloonSat recoveries are this easy ... not!

Photo 4. 95,000 feet above Chattanooga, Tennessee. (Photo by Jodie Tinker's near-space camera)

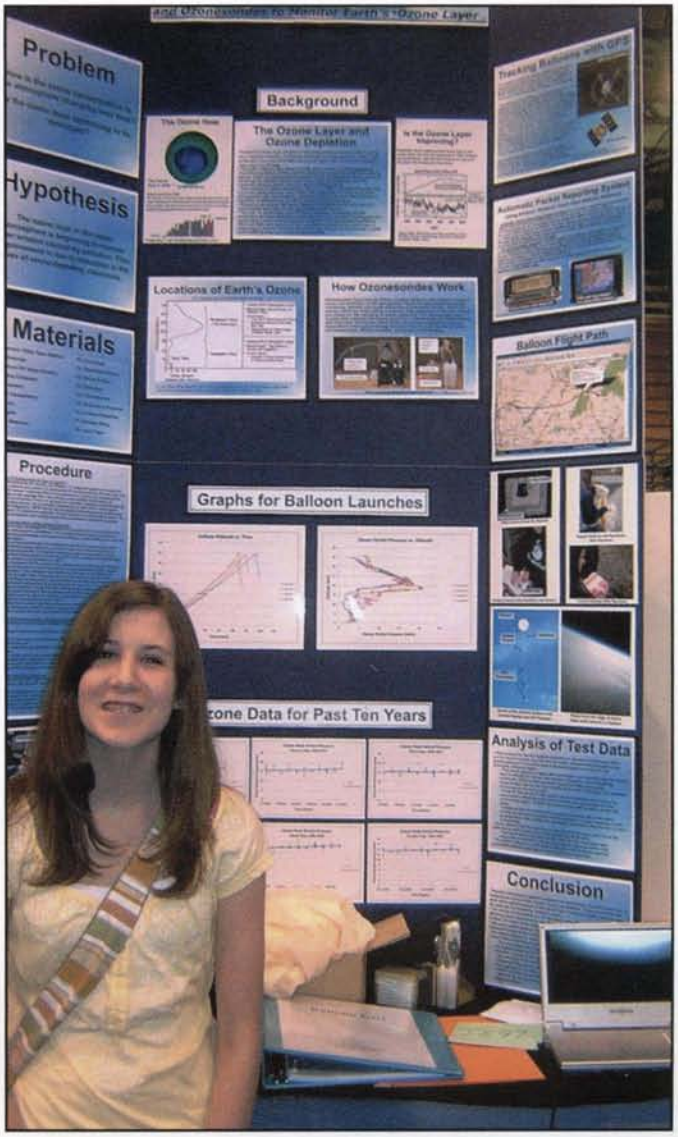


Photo 5. Jodie wins her category at the Alabama State Science Fair. (Photo by Mike Tinker)

The amazing video she recorded during this flight helped her to win the regional science fair a few weeks later. She decided to add to her display by doing yet another flight to prepare for her State Science Fair competition.

Thousands of Near-Space Photos

This time Jodie put her camera in the time-lapse still-photo mode. The still frames are not as high resolution as a dedicated digital still camera, but they are still quite remarkable.

It was a beautiful, clear day in late March, but the surface winds were quite breezy (good kite-flying weather). The UAH (University of Alabama, Huntsville) Space Hardware Club flew right before Jodie's flight so this time we had a full contingent of balloon trackers available. The SHC liftoff was quite exciting as their balloon nearly hit the ground several times just prior to liftoff. Fortunately, the winds died down a bit for Jodie's launch and went off without a hitch (see photo 3).

The Space Hardware Club flight landed near Chattanooga and was a fairly easy recovery. However, Jodie's balloon decided to make up for her previous flight's incredibly easy recovery and landed on top of a heavily wooded ridge line near Cleveland, Tennessee. It was a few hundred feet from a road that was only passable by a pickup truck. Fortunately, Jason KG4WSV, Gary, N4TXI, and several students from the UAH Space Hardware Club came to her rescue as Jodie and her dad did a visual search in the woods and recovered her payload by tracking the APRS and DominoEX beacon transmitter.

We Have a Winner

After a two-hour flight taking a photo very two seconds, Jodie had thousands of photos to sort through. The results were quite beautiful. In photo 4 you can actual see part of east Chattanooga, Lovell airfield, as well as Interstate highway 75 from the vantage point of 95,000 feet above the earth. The curvature of the Earth and the blackness of space are quite evident.

How did Jodie do in the Alabama State Science Fair? She won first place in her category and ten additional special awards at the competition (see photo 5).

73, Bill, WB8ELK

Announcing:

The 2010 CQ World-Wide VHF Contest

Starts: 1800 UTC Saturday, July 17, 2010
Ends: 2100 UTC Sunday, July 18, 2010

Rules Summary

Bands: 50 MHz (6 meters); 144 MHz (2 meters)

Categories:

Single-Op All Band
Single-Op Single Band 6 Meters
Single-Op Single Band 2 Meters
Single-Op QRP All Band (<10 watts)
Hilltopper (SOAB QRP Portable limited to 6 continuous hours operating)
Rover (1 or 2 ops mobile/portable operating from 2 or more Grid Locators)
Multi-op

QSO Exchange: Maidenhead Grid Locator to 4 digits (e.g., FN41)

Multipliers: Total number of different Grid Locators worked *per band.*

Scoring: Work stations once per band regardless of mode. Count 1 point per QSO on 50 MHz and 2 points per QSO on 144 MHz. Total QSO points × Multiplier = Final Score.

Rovers only: Final score = Sum of QSO points from each Grid Locator visited × sum of different Grid Locators worked from each Grid Locator visited.

Awards: Certificates are awarded to high-scoring stations in each USA state, Canadian province, and DX country in categories with outstanding effort. Rover certificates are awarded on a regional basis.

Club Competition: Credit your club for aggregate club score. See <http://www.cqww.com/clubnames.htm> for a list of registered clubs. Follow directions for registering your club if it is not already listed.

Log Submissions: Cabrillo formatted logs via e-mail attachment to **<cqvhf@cqww-vhf.com>** with subject line Callsign (used in the contest) only. It is *strongly recommended* that paper logs be entered online via "Web Form for Typing in Paper Logs" link at <http://www.cqww-vhf.com> or postmarked by September 1, 2010 to: CQ VHF Contest, 25 Newbridge Rd., Hicksville, NY 11801 USA. Callsigns of electronic logs received are posted on: <http://www.cqww-vhf.com>.

Complete Rules: Complete rules for the contest are in the June issue of *CQ* magazine, on the *CQ* website <www.cq-amateur-radio.com>, and at <http://www.cqww-vhf.com>.

By Rich Arland,* K7SZ

BEGINNER'S GUIDE

All you need to know but were afraid to ask . . .

Go For It! Ham Radio . . .

Have you ever been to the Dayton Hamvention®? No? Well, you really need to go, at least once. Each year in mid-May, Dayton, Ohio hosts the equivalent of Ham Radio Mecca, a place to go and find out what's new, what's happening in the world of ham radio, renew acquaintances of the past and make new friends for the future. To be sure, the Dayton Hamvention® is a "must" for any and all ham radio operators.

I was at the CQ Communications booth at Dayton last year and noticed a young man standing back from the herd of inquisitive hams moving along the front of the booth, all asking questions and looking over the collection of publications on display. Obviously, this person was a ham radio newbie, judging by his demeanor and hesitant actions. He looked to be in his mid-teens, well built, athletic, and well groomed.

Finally, he worked up the nerve to approach the booth. I asked the obvious question: "Did you just get your license?" He nodded in the affirmative. In an attempt to get him talking, I asked about how he got interested in ham radio.

"My dad and my grandfather are both hams and I figured that I better not let the family tradition die," he replied.

"Great! So how did you go about getting your license? Work with the local ham radio club?" I queried.

"No, my mom helped me work through the Technician license exam at night, after dinner," was his reply. He added quickly, "Dad is in Afghanistan for his third tour of duty, so it was just mom and me. She knows as much about radio as I do."

"Wow! It sounds like your dad is in the military," I said.

"Yes, sir, he is in the Air Force. He is a Pararescue Jumper," he replied.

"A PJ, huh? Great bunch of guys. I have known several during my time in the Air Force," I offered.

"Do you know about PJs?" he eagerly countered.

"You bet. Went SCUBA diving in the Azores with a couple of them, a great bunch of folks. The type you want taking care of you on the battlefield," I replied.

I saw his eyes light up at my mention of the term "PJ," and I knew I'd made a friend. In continuing to talk with him I found out that his name was Jay. He was 16 and played varsity football and was on his high school swim team.

It seemed that Jay wanted to get his ham ticket in preparation for college, with a thought toward becoming involved with the MARS (Military Auxiliary Radio System) program. In continuing our conversation it became apparent that Jay missed his father tremendously and was immensely proud of him and his work as a USAF equivalent of a battlefield doctor.

USAF PJs are part of the special operations division of the Air Force and are several steps above the average medic in training and ability. PJs are the folks who accompany special operations (unconventional warfare: Green Beret, Navy SEALS, etc.) operators into battle and are responsible for taking care of the wounded. Trained to the level of most General Practitioners in the civilian world, USAF PJs are the people who treat and stabilize the wounded and get them ready to medevac to a field hospital. All in all, the USAF PJs have a sterling record. Their motto: "So that others may live" says it all. I could tell that Jay was very proud of his dad.

My new-found friend and I continued our chat for another 20 minutes. Jay told me that after coaching from his mom, they contacted a local amateur radio club in his area and took the Technician test, which he passed with flying colors. Although no longer required by the FCC, Jay had committed himself to learning the Morse code because both his dad and grandfather had passed the CW requirement back in their days. Not one to be left out of the loop, Jay, and his mom, dutifully studied CW and proudly confessed to me that he could copy a solid 15 wpm with no errors! I was duly impressed.

Why is it that *after* the FCC drops the CW requirement for obtaining a ham license do so many people learn Morse? Weird ... just plain weird! Then again, I told Jay that I would meet him in about an hour and we would continue our conversation.

Thinking back on my early days as a newly licensed Novice Class ham, it was a wonder that I ever got on the air at all! Thankfully, I had the help of four "Elmers," folks who took the time and made the effort to help me with the various challenges encountered with getting on the air and making those first crucial contacts.

I fully understood Jay's dilemma, remembering my early days in the hobby, way back in the mid-1960s. Yes, there were radios back then! To tell the truth, I could not have gotten on the air as a Novice in 1963–64 had it not been for George Comstock, W7CJ, Mel Syms, W7CIS, and Jessie and Mike Brabb, K7TWS/K7TWR. I was very fortunate to have four Elmers who were always a phone call away to help me sort out the daunting task of setting up a shack.

The most notable problem in my early amateur radio career occurred when the FCC monitoring station in Livermore, California, 1500 miles south of my eastern Washington QTH, sent me a "pink slip" stating that they copied me working 80, 40, and 20 meters simultaneously! Thanks to the efforts of George, W7CJ, who helped me troubleshoot my Knight Kit T-60 transmitter, I got the rig all tidied up and back on the air, sans harmonics!

One thing that many of us who have been in the ham radio hobby for a while tend to forget is that newcomers to our hobby do not necessarily have a lot of the technical and operating information needed to successfully get on the air and operate. It is up to us, the current crop of "Elmers," who need to be proactive and help the "Jays" of the hobby.

I found Jay about an hour later waiting for me at one of the food venues at the HARA Arena complex at Dayton. We picked up a hot dog, some onion rings, and a couple of drinks and proceeded to talk ham radio for the better part of an hour. I was truly impressed with him. Here was a kid who actually wanted to study for and pass a test to get on the air and talk to the

*770 William St. SE, Dacula, GA 30019
e-mail: <k7sz@arrl.net>

world via ham radio. We say that amateur radio is an "old -person's hobby." We need more "Jays" in our ranks.

Jay proudly showed me his newly acquired hand-held transceiver (HT), wondering if he'd made the right choice. I pulled my HT off my belt and handed it to him. He immediately noted that my HT and his were identical! I told him that a dual-band HT was just great in today's ham radio world. The extra flexibility offered by a dual-bander offset the small increase in price. Likewise, should he be inclined to get involved with emergency communications (EmComm) and become active with the local ARES/ RACES chapter, he was ahead of the game with his new dual-bander.

Over the course of the remainder of our conversation we discussed clubs, Elmers, and the gathering of information necessary to function in today's amateur radio world. I also told him that for things that are rapidly changing, the basics and history of ham radio, ongoing activities, and more, there is nothing that beats subscribing to *CQ* and *CQ VHF* magazines for the latest on what's happening in the hobby. There is the also CQ Store (http://store.cq-amateur-radio.com/ StoreFront.bok), a place to wander via your internet connection (www.cq-amateur-radio.com) and procure technical literature that is second to none.

I had brought several issues of *CQ, CQ VHF,* and *Popular Communications* (the latter a CQ Communications magazine basically dedicated to shortwave radio and related hobbies) with me to our meeting and presented them to Jay, telling him that the authors published in these magazines were experienced radio enthusiasts and their columns, along with the feature articles, were a great place to obtain pertinent information about the radio hobby.

One other thought I imparted to Jay was that all of the authors, myself included, need feedback from the readership. We need this information because it tells us whether or not we are hitting our target audience and how well we are doing. Positive or negative, all writers need this information to tweak their material to include the things that people need and want to know.

I gave Jay my e-mail address and told him to look over my "Learning Curve" column in *CQ* and my "Beginner's Guide" column in *CQ VHF* and to please provide me with some real-time feedback on what he thought and what he'd like to see included in the columns.

As Jay and I parted, I had the distinct feeling that this young man would go far, both in the ham radio hobby and his professional career. As a parting gesture I asked Jay to relay to his parents my personal thanks for his father's service to our country. It's people like Jay's dad who allow all of us to pursue a ham radio hobby in a free country. Also, now that his mom knows as much about ham radio as Jay does, when will she get her license? Jay grinned and with a shrug said, "I've been trying to convince her to take the Technician test, honest!"

Riding the emotional high of my meeting with Jay, I returned to the CQ booth at Dayton. If being a columnist has a downside, it is not being able to address everyone's needs. However, the editorial talent available from the authors who contribute to the magazines and books published by CQ Communications is second to none. We can, and should, use that talent to continue and promote the wonderful hobby of ham radio.

Speaking of Feedback . . .

The complex answer to the question of republishing articles and columns is directly related to copyright restrictions. Thankfully, with CQ Communications the authors are able to retain their rights and can republish as they see fit after the article or column has been printed and received by the subscribers, with certain caveats explained below. This is great news, as it allows me the opportunity to target an audience that may have missed the original material.

In addition to the contents of the columns, I am planning on adding instructional videos on how to solder, installing coaxial connectors, how to properly and safely erect antennas, and a host of other topics. Remember, this will be about 12 months from now, so don't expect to see this very soon. The ham radio hobby is too important *not* to proceed with an additional internet medium such as this. Besides, CD/DVDs are a great way to catalog and collect a huge amount of data in a manageable format. I propose to offer a collection of the "Learning Curve" columns along with other information on a CD/DVD in about a year.

The complex answer to the question of publishing articles and columns by each specific author is directly related to copyright restrictions. Regarding CQ Communications, the authors are able to retain the rights to their material once it has been published in each of the magazines, and can make it available to the public, while CQ Communications retains rights of the presented layout in each magazine, which is not able to be reproduced without expressed written permission and credit from the publisher. This is great news, as it allows me, along with my fellow authors, the chance to target an audience that may have missed the original material.

In addition to the contents of my columns, I am planning material related to properly and safely erect antennas, and a host of other topics. Remember, this will be about 12 months from now, so don't go out expecting to see this very soon.

Further Information

Another question that often arises: "What are the necessary books I need to add to my technical library?" Believe it or not, that is a pretty easy one to answer.

When I first started college, my professor's book list included, among other titles, the current edition of the ARRL's *Handbook*, along with the current edition of Robert L. Shrader's *Electronic Communications*. If you look closely at past issues of *CQ* you will find Robert Shrader's by-line on a number of articles. Bob Shrader is no stranger to the radio hobby press. *(Note: I have found the 6th edition of* Electronic Communications *on Amazon.com. This apparently is the last or current edition of this fine text.)*

In addition to these two books, a number of selections from CQ's Bookstore (especially *The NEW Shortwave Propagation Handbook*, the book by Lew McCoy on antennas, plus more of CQ's own books and a good cross-section of RSGB [Radio Society of Great Britain] pubs, adding many books on other topics of interest) are available. Also keep a lookout for new titles from CQ coming soon, stopping by the CQ booth at the Hamvention® or checking current magazines for a listing.

The information is definitely out there. It's just a matter of prioritizing your needs and buying books and digital media as needed.

That's a wrap for this time. Don't forget to get on the air, as the 6-meter band is opening on a regular basis, and let's not forget the multitude of contests geared to the VHF+ crowd. See you on the bands!

73, Rich, K7SZ

By Bob Witte,* KØNR

FM

FM/Repeaters—Inside Amateur Radio's "Utility" Mode

What is a Trail Friendly Radio?

This column is adapted from an article originally published in the Summer 2009 issue of QRP Quarterly, *the official publication of the QRP Amateur Club International. It strays a bit from the pure FM/repeater focus of this column, but I hope you find it interesting.* *—KØNR*

In the QRP world, there is a notion of a Trail Friendly Radio (TFR), which usually refers to QRP rigs for the HF bands. The basic definition of a TFR usually includes light weight and portability, low power (battery drain), and ease of operation in typical "on the trail" situations. On the trail might also mean sitting on the beach, paddling a canoe, or maybe sitting on the back deck at home, but you get the idea. Some hams have emphasized the need for "controls on the top of the radio," but I'll just refer to this as apropraite design for trail-operating conditions. A good example of a TFR is the Elecraft KX-1.

**21060 Capella Drive, Monument, CO 80132*
e-mail: <bob@k0nr.com>

This got me thinking about the question of what constitutes a TFR for the VHF and higher bands? Does one exist today? I did a little poking around on the internet to see if this issue has been discussed much. Not finding anything, I posed the question on the vhfqrp Yahoo group and my twitter feed, and received some good comments.

TRF for VHF

Rather than dive into the specific features of a VHF TRF (shortened to VTRF), let's first look at how we would apply it. I imagine using a VTRF for a walk around the park, a day hike in the forest, or an overnight backpacking trip. Obviously, I'd want the VTRF to be independent of AC power, compact, and easy to carry. I'd want to be able to work all modes on 50 MHz, 144 MHz, and 432 MHz, the most popular VHF (and one UHF) bands. CW and SSB are important for serious weak-signal work on all three bands and sporadic-*E* openings on 6 meters. There is nothing more fun that catching a good 6-meter opening during the summer months out "on the trail."

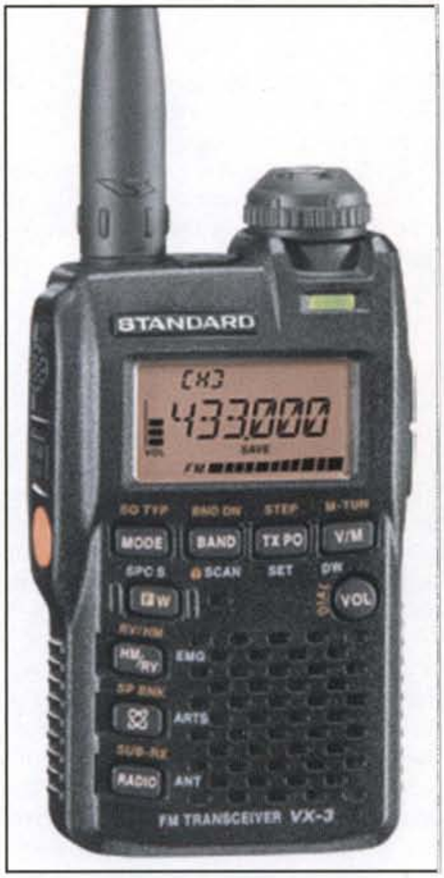


Photo 2. The Yaesu VX-3R is an example of a "mini-HT" with dualband (2 meters and 70 cm) capability.

Photo 1. The Yaesu FT-817ND covers the HF, 6-meter, 2-meter, and 70-cm bands in one rig.

Although less efficient, having FM provides access to the largest number of VHF radio operators, and, yes, of course, I would want to be able to work those FM repeaters when wandering in the back country (or lying on the beach). Adding to the wish list, I'll include some of the fancy extras common to typical handheld FM transceivers: weather radio receive, FM broadcast receive, extended coverage receive for fire/police/forest service, etc. These features let me keep tabs on the weather and listen in on public service agencies such as park rangers and fire departments.

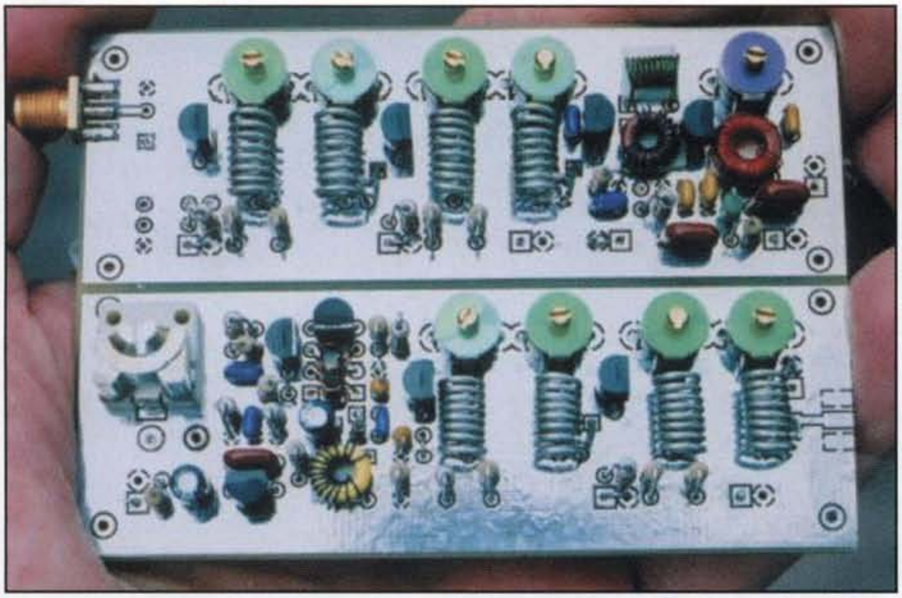


Photo 3. The KK7B RCX2 receive converter for 2 meters.

Photo 4. Some telescoping BNC antennas.

I had several people mention to me that APRS is a great capability to have on the trail. People commented that they can hitch an HT (such as the Kenwood TH-D7AG) to a small GPS receiver to create a compact position reporting station. Family members back home can keep tabs on your location via the various APRS websites. Yaesu offers a GPS option for the VX-8R handheld radio and is just now introducing the VX-8GR with GPS built in. I tend to carry a GPS with me when doing VTRF activity anyway, so coupling it to the VTRF makes sense to me.

This is a tough set of requirements, but what the heck. It never hurts to dream big!

Practical Choices

Let's bring this down to reality by looking at some practical choices for a VTRF. The first radio that comes to mind is the Yaesu FT-817 (photo 1), since it is the only commercially available rig that is relatively compact, portable, and has CW/SSB/FM on the three bands of interest. It has the added benefit of covering the HF bands as well. Unfortunately, the FT-817 does have a significant flaw:; it is a battery hog. The FT-817ND manual lists the receive (standby) current as 250 mA (squelched) and 450 mA (unsquelched). Compare this to, say, an Elecraft KX-1 with a receive current of 34 mA (typical). This is a real problem for extended portable operation. A less significant shortcoming of the FT-817 is that the extended receive frequency coverage on the 2-meter band stops at 154 MHz, missing the U.S. weather radio band at 162 MHz. For trail-friendly operating, it is really handy to be able to check the weather forecast.

Next on our list of potential VTFRs is the good old FM handheld transceiver (see "My QRP Rig is an HT," *QRP Quarterly*, Summer 2008). Of course, the HT falls short on the ability to do CW and SSB. It does excel in the compact and portable category, as it is hard to beat how an HT slips onto your belt or into a pocket. Dualband HTs are very affordable, usually covering the 2-meter and 70-cm bands. Some of them include 6 meters but only on FM.

There is a class of mini-HTs that includes the Yaesu VX-3R and the ICOM IC-P7A, which are extremely compact and easy to carry (photo 2). Both of these radios have a rich feature set and extended coverage receive (from the AM broadcast band all the way up through UHF). While they are compact in size, they still pack in the features. These small radios are a shirt-pocket ham shack. They are a bit light on output power, producing only 1.5 watts when using the standard battery pack.

As mentioned previously, having an APRS transmitter in your equipment is a handy way to bleep out position information and other messages. The classic handheld radio for APRS is the Kenwood TH-D7AG (now discontinued), but now Yaesu has joined the party with the VX-8 series. These rigs are full-featured, with a hefty 5 watts of RF output power.

QRPers like to build kits, even for the VHF bands. Rick, KK7B, recently introduced some VHF kits that are of interest to us. The RCX2 is a receive converter for the 2-meter band that translates down to 7 MHz, for use with your favorite 40-meter QRP transceiver, including the KK7B microR2 (photo 3). The RCX1-6 converter is the same basic kit but receives the 6-meter band. For transmit, KK7B also has kits for two CW sources for 2 meters and 6 meters, with an output power of 10 mW. The KK7B kits fall short of my ideal VTFR, but are a fun way to get on the air with a rig that you can build.

Antennas

Every radio needs an antenna, so what kind of antennas will we use for our VTFR? All handheld transceivers come equipped with shortened vertical antennas known as "rubber ducks." The FT-817 also comes standard with a large rubber-duck antenna that works better than you might expect. Still, however, these antennas are limited in size and gain, so there are a number of longer telescoping BNC antennas available (photo 4). These antennas will work well when moving on the trail and temporarily setting up.

We might want something more capable if we stop for the night. For 6 meters,

Photo 5. The Arrow II antenna is a Yagi that works on 2 meters and 70 cm.

we can use the standard dipole, cut to resonate on 50 MHz. For the 2-meter and 70-cm bands, a small Yagi might be the way to go (photo 5). Experimenting with antennas is always a fun part of the hobby, so it is great to try out different antennas that work well for your specific operating conditions.

Sum It Up

By my definition, there really isn't an excellent VTRF available today. The FT-817 comes quite close, except for the battery-drain issue. Maybe we just have to overlook that. (Several people suggested that we should *just get over it* and accept having to carry a larger battery.) I don't suppose that Yaesu is too worried about the battery issue, since the FT-817 is unmatched in the marketplace. I wonder if one of the manufacturers might start sneaking in some basic CW and SSB capability into their handheld radios? It is technically feasible, but the market demand may not drive them to do it. Mizuho (and others) used to have SSB handhelds for both HF and VHF bands, but they are no longer made.

Faced with such a dilemma, what do I really do? My first choice for casual hiking, day trips, and backpacking is still the common FM handheld transceiver. There are many to choose from, available from ICOM, Yaesu, Kenwood, and Alinco (photos 6 and 7). I lean heavily towards the 2-meter and 70-cm dual-band rigs, since they are not that much more expensive than a single-band radio. Some folks will want 222 MHz and maybe 50 MHz as well, depending on the available repeaters. Let's face it: Most of the VHF and higher activity is on FM, so carrying an HT is a very practical choice. Also, you cannot beat the compact size of these radios.

If I am really thinking serious VHF + operating, I will take along a radio that can do SSB and CW. Basically, the only practical choice is the FT-817 . . . with a big battery. I use it often in VHF contests and other operating events.

What's your VTFR? Drop me a note at <bob@k0nr.com> or stop by the blog at <www.k0nr.com/blog>. 73, Bob, KØNR

References

Elecraft website: http://www.elecraft.com/

VHF QRP Yahoo Group: http://groups.yahoo.com/group/vhfqrp/

KK7B Kits, Kanga US: http://www.kangaus.com/

KI6SN's monthy TFR column in *Worldradio Online*

Photo 6. The VX-8R is a classic HT design with optional GPS receiver.

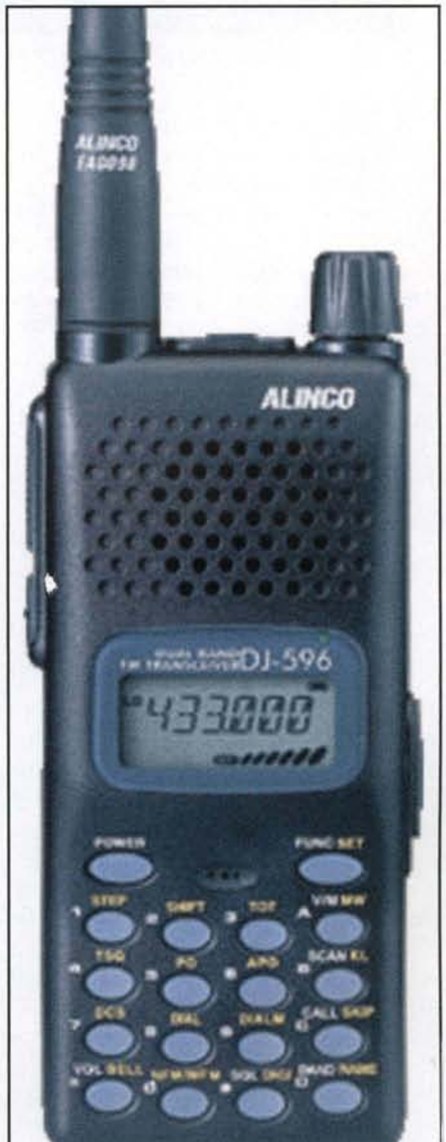


Photo 7. The Alinco DJ-596T is a classic dualband handheld radio.

CQ's 6 Meter and Satellite WAZ Awards

(As of April 1, 2010)

By Floyd Gerald,* N5FG, CQ WAZ Award Manager

6 Meter Worked All Zones

No.	Callsign	Zones needed to have all 40 confirmed
1	N4CH	16,17,18,19,20,21,22,23,24,25,26,28,29,34,39
2	N4MM	17,18,19,21,22,23,24,26.28.29,34
3	JI1CQA	2,18,34,40
4	K5UR	2,16,17,18,19,21,22,23,24,26,27,28,29,34,39
5	EH7KW	1,2,6,18,19,23
6	K6EID	17,18,19,21,22,23,24,26,28,29,34,39
7	KØFF	16,17,18,19,20,21,22,23,24,26,27,28,29,34
8	JF1IRW	2,40
9	K2ZD	2,16,17,18,19,21,22,23,24,26, 28,29,34
10	W4VHF	16,17,18,19,21,22,23,24,25,26,28,29,34,39
11	GØLCS	1,6,7,12,18,19,22,23,28,31
12	JR2AUE	2,18,34,40
13	K2MUB	16,17,18,19,21,22,23,24,26,28,29,34
14	AE4RO	16,17,18,19,21,22,23,24,26,28,29,34,37
15	DL3DXX	18,19,23,31,32
16	W5OZI	2,16,17,18,19,20,21,22,23,24,26,28,34,39,40
17	WA6PEV	3,4,16,17,18,19,20,21,22,23,24,26,29,34,39
18	9A8A	1,2,3,6,7,10,12,18,19,23,31
19	9A3JI	1,2,3,4,6,7,10,12,18,19,23,26,29,31,32
20	SP5EWY	1,2,3,4,6,9,10,12,18,19,23,26,31,32
21	W8PAT	16,17,18,19,20,21,22,23,24,26,28,29,30,34,39
22	K4CKS	16,17,18,19,21,22,23,24,26,28,29,34,36,39
23	HB9RUZ	1,2,3,6,7,9,10,18,19,23,31,32
24	JA3IW	2,5,18,34,40
25	IK1GPG	1,2,3,6,10,12,18,19,23,32
26	W1AIM	16,17,18,19,20,21,22,23,24,26,28,29,30,34
27	K1LPS	16,17,18,19,21,22,23,24,26,27,28,29,30,34,37
28	W3NZL	17,18,19,21,22,23,24,26,27,28,29,34
29	K1AE	2,16,17,18,19,21,22,23,24,25,26,28,29,30,34,36
30	IW9CER	1,2,6,18,19,23,26,29,32
31	IT9IPQ	1,2,3,6,18,19,23,26,29,32
32	G4BWP	1,2,3,6,12,18,19,22,23,24,30,31,32
33	LZ2CC	1
34	K6MIO/KH6	16,17,18,19,23,26,34,35,37,40
35	K3KYR	17,18,19,21,22,23,24,25,26,28,29,30,34
36	YV1DIG	1,2,17,18,19,21,23,24,26,27,29,34,40
37	KØAZ	16,17,18,19,21,22,23,24,26,28,29,34,39
38	WB8XX	17,18,19,21,22,23,24,26,28,29,34,37,39
39	K1MS	2,17,18,19,21,22,23,24,25,26,28,29,30,34
40	ES2RJ	1,2,3,10,12,13,19,23,32,39
41	NW5E	17,18,19,21,22,23,24,26,27,28,29,30,34,37,39
42	ON4AOI	1,18,19,23,32
43	N3DB	17,18,19,21,22,23,24,25,26,27,28,29,30,34,36
44	K4ZOO	2,16,17,18,19,21,22,23,24,25,26,27,28,29,34
45	G3VOF	1,3,12,18,19,23,28,29,31,32
46	ES2WX	1,2,3,10,12,13,19,31,32,39
47	IW2CAM	1,2,3,6,9,10,12,18,19,22,23,27,28,29,32
48	OE4WHG	1,2,3,6,7,10,12,13,18,19,23,28,32,40
49	TI5KD	2,17,18,19,21,22,23,26,27,34,35,37,38,39
50	W9RPM	2,17,18,19,21,22,23,24,26,29,34,37
51	N8KOL	17,18,19,21,22,23,24,26,28,29,30,34,35,39
52	K2YOF	17,18,19,21,22,23,24,25,26,28,29,30,32,34
53	WA1ECF	17,18,19,21,23,24,25,26,27,28,29,30,34,36
54	W4TJ	17,18,19,21,22,23,24,25,26,27,28,29,34,39
55	JM1SZY	2,18,34,40
56	SM6FHZ	1,2,3,6,12,18,19,23,31,32
57	N6KK	15,16,17,18,19,20,21,22,23,24,34,35,37,38,40
58	NH7RO	1,2,17,18,19,21,22,23,28,34,35,37,38,39,40
59	OK1MP	1,2,3,10,13,18,19,23,28,32
60	W9JUV	2,17,18,19,21,22,23,24,26,28,29,30,34
61	K9AB	2,16,17,18,19,21,22,23,24,26,28,29,30,34
62	W2MPK	2,12,17,18,19,21,22,23,24,26,28,29,30,34,36
63	K3XA	17,18,19,21,22,23,24,25,26,27,28,29,30,34,36
64	KB4CRT	2,17,18,19,21,22,23,24,26,28,29,34,36,37,39
65	JH7IFR	2,5,9,10,18,23,34,36,38,40
66	KØSQ	16,17,18,19,20,21,22,23,24,26,28,29,34
67	W3TC	17,18,19,21,22,23,24,26,28,29,30,34
68	IKØPEA	1,2,3,6,7,10,18,19,22,23,26,28,29,31,32
69	W4UDH	16,17,18,19,21,22,23,24,26,27,28,29,30,34,39
70	VR2XMT	2,5,6,9,18,23,40
71	EH9IB	1,2,3,6,10,17,18,19,23,27,28
72	K4MQG	17,18,19,21,22,23,24,25,26,28,29,30,34,39
73	JF6EZY	2,4,5,6,9,19,34,35,36,40
74	VE1YX	17,18,19,23,24,26,28,29,30,34
75	OK1VBN	1,2,3,6,7,10,12,18,19,22,23,24,32,34
76	UT7QF	1,2,3,6,10,12,13,19,24,26,30,31
77	K5NA	16,17,18,19,21,22,23,24,26,28,29,33,37,39
78	I4EAT	1,2,6,10,18,19,23,32
79	W3BTX	17,18,19,22,23,26,34,37,38
80	JH1HHC	2,5,7,9,18,34,35,37,40.
81	PY2RO	1,2,17,184OM,19,21,22,23,26,28,29,30,38,39,40
82	W4UM	18,19,21,22,23,24,26,27,28,29,34,37,39
83	I5KG	1,2,3,6,10,18,19,23,27,29,32.
84	DF3CB	1,2,12,18,19,32
85	K4PI	17,18,19,21,22,23,24,26,28,29,30,34,37,38,39.
86	WB8TGY	16,17,18,19,21,22,23,24,26,28.29,30,34,36,39
87	MUØFAL	1,2,12,18,19,22,23,24,26,27,28,29,30,31,32
88	PY2BW	1,2,17,18,19,22,23,26,28,29,30,38,39,40.
89	K4OM	17,18,19,21,22,23,24,26,28,29,32,34,36,38,39.
90	JHØBBE	2,33,34,40
91	K6QXY	17,18,19,21,22,23,34,37,39
92	JA8ISU	2,7,8,9,19,33,34,36,37,38,39,40
93	YO9HP	1,2,6,7,11,12,13,18,19,23,28,29,30,31,40
94	SV8CS	1,2,6,7,18,19,23,26,28,29
95	SM3NRY	1,6,10,12,13,19,23,25,26,29,30,31,32,39
96	VK3OT	2,10,11,12,16,34,35,37,39,40

Satellite Worked All Zones

No.	Callsign	Issue date	Zones Needed to have all 40 confirmed
1	KL7GRF	8 Mar. 93	None
2	VE6LQ	31 Mar. 93	None
3	KD6PY	1 June 93	None
4	OH5LK	23 June 93	None
5	AA6PJ	21 July 93	None
6	K7HDK	9 Sept. 93	None
7	W1NU	13 Oct. 93	None
8	DC8TS	29 Oct. 93	None
9	DG2SBW	12 Jan. 94	None
10	N4SU	20 Jan. 94	None
11	PAØAND	17 Feb. 94	None
12	VE3NPC	16 Mar. 94	None
13	WB4MLE	31 Mar. 94	None
14	OE3JIS	28 Feb. 95	None
15	JA1BLC	10 Apr. 97	None
16	F5ETM	30 Oct. 97	None
17	KE4SCY	15 Apr. 01	10,18,19,22,23, 24,26,27,28, 29,34,35,37,39
18	N6KK	15 Dec. 02	None
19	DL2AYK	7 May 03	2,10,19,29,34
20	N1HOQ	31 Jan. 04	10,13,18,19,23, 24,26,27,28,29, 33,34,36,37,39
21	AA6NP	12 Feb. 04	None
22	9V1XE	14 Aug. 04	2,5,7,8,9,10,12,13, 23,34,35,36,37,40
23	VR2XMT	01 May 06	2,5,8,9,10,11,12,13,23,34,40
24	XE1MEX	19 Mar. 09	2,17,18,21,22,23,26,34,37,40

CQ offers the Satellite Work All Zones award for stations who confirm a minimum of 25 zones worked via amateur radio satellite. In 2001 we "lowered the bar" from the original 40 zone requirement to encourage participation in this very difficult award. A Satellite WAZ certificate will indicate the number of zones that are confirmed when the applicant first applies for the award.

Endorsement stickers are not offered for this award. However, an embossed, gold seal will be issued to you when you finally confirm that last zone.

Rules and applications for the WAZ program may be obtained by sending a large SAE with two units of postage or an address label and $1.00 to the WAZ Award Manager: Floyd Gerald, N5FG, 17 Green Hollow Rd., Wiggins, MS 39577. The processing fee for all CQ awards is $6.00 for subscribers (please include your most recent *CQ* or *CQ VHF* mailing label or a copy) and $12.00 for nonsubscribers. Please make all checks payable to Floyd Gerald. Applicants sending QSL cards to a CQ Checkpoint or the Award Manager must include return postage. N5FG may also be reached via e-mail: <n5fg@cq-amateur-radio.com>.

**17 Green Hollow Rd., Wiggins, MS 39577; e-mail: <n5fg@cq-amateur-radio.com>*

By Tomas Hood,* NW7US

VHF PROPAGATION

The Science of Predicting VHF-and-Above Radio Conditions

Aurora Season and the New Solar Cycle

Since the last edition of this column, the new sunspot Cycle 24 has become reliably active. From the beginning of 2010, until press time, we have witnessed a nearly consistent parade of new sunspots. With this exciting sunspot activity comes some of the most intense solar flares and geomagnetic storms so far in the new cycle. For several years we've seen long periods when there were no sunspots on the sun. Since January 1, 2010, there have been very few periods with zero sunspots, and each has been very short.

The period from mid-January through April up to press time has revealed a constant appearance of active sunspot regions. By January 19, the sun became very active and produced a constant stream of x-ray flares, some of them moderately powerful (figure 1). Conditions continued to improve, and February became the month of incredible excitement. By February 7, the official Penticton, BC, Canada 10.7-cm radio flux was 90. By February 12, solar activity ranged from low to high, and included the largest M-class flare yet recorded in solar Cycle 24. This flare originated in Active Region 1046, and was the source of a full-halo coronal mass ejection (CME) that was aimed directly toward Earth. This later produced minor aurora and geomagnetic disturbances. Active Region 1045 also produced a series of flares, including another M-class X-ray flare. By February 12, the 10.7-cm flux peaked at 96, just shy of 100! This level of activity was last seen in 2006.

All of this solar activity creates opportunity for possible VHF activity because of the increased chance of CMEs and increased solar winds. As sunspot regions grow larger and the number of spots increases, the sun also unleashes many flares. Often, when a flare explodes, it can unleash an associated CME toward Earth. This massively huge cloud of solar plasma (billions of tons!) arrives about three days later, and could cause geomagnetic disturbances, sometimes even causing "storm-level" geomagnetic activity. These geomagnetic disturbances counter any positive effect that the increased sunspot activity may have on radio signal propagation on the frequencies below 6 meters.

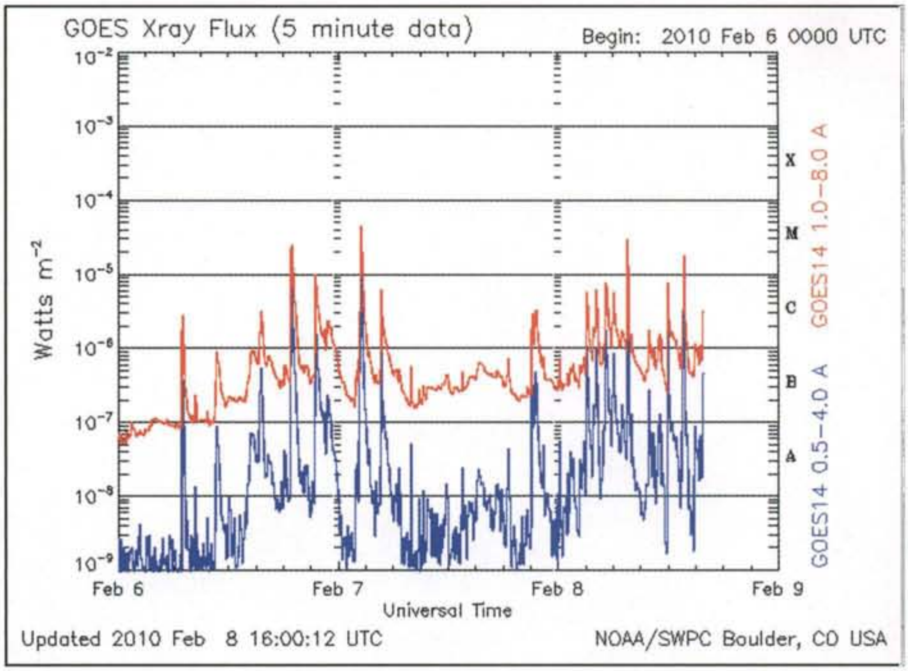


Figure 1. Sunspot Cycle 24 has consistently produced new sunspots since the end of 2009. During February 2010, the most powerful X-ray flares to date in the new cycle errupted one after another. This X-ray graph shows the steady "stream" of X-ray flares errupting from February 6 through February 9, 2010. (Source: Space Weather Prediction Center [SWPC]/The National Oceanic and Atmospheric Administration [NOAA])

To the joy of VHF weak-signal enthusiasts, however, these geomagnetic storms often enable propagation of signals via "aurora-mode propagation." Auroral activity occurs at the *E*-region of the ionosphere, and "clouds" of highly ionized clouds form which in turn may reflect radio signals in VHF and sometimes even UHF spectrum.

Auroral observations over the last 100 years reveal that peak periods of radio aurora occur close to the equinoxes—that is, during the months of March and April, and again in September and October. Of the two yearly peaks, the greater peak, in terms of the number of contacts reported, occurs during October. However, some of the strongest levels of geomagnetic storms are in the spring. The minimum activity yearly occurs during the months of June and July, with a lesser minimum during December.

Aurora is a direct result of solar plasma interacting with gasses in the upper atmosphere. Geomagnetic storms develop when strong gusts of solar wind and CMEs (see figure 2) hit the Earth's magnetosphere in just the right way. The magnetosphere (figure 3) is filled with electrons and protons that are normally trapped by lines of magnetic force that prevent them from escaping to space or descending to the planet below.

When the impact of a CME breaks loose some of those trapped particles, it causes them to rain down on the atmosphere. Gases in the atmosphere start to glow under the impact of these particles. Different gases give out various colors. Think of a neon sign and how the plasma inside the glass tube, when excited, glows with a bright color. When the molecules and atoms are struck by solar wind particles, the stripping of one or more of their elec-

*e-mail: <nw7us@arrl.net>

trons ionizes them to such an extent that the ionized area is capable of reflecting radio signals at very high frequencies. This ionization occurs at an altitude of about 70 miles, very near the *E*-layer of the ionosphere. The level of ionization depends on the energy and amount of solar wind particles able to enter the atmosphere.

These precipitating particles mostly follow the magnetic field lines that run from Earth's magnetic poles, and are concentrated in circular regions around the magnetic poles called "auroral ovals." These bands expand away from the poles during magnetic storms. The stronger the storm, the greater these ovals will expand. Sometimes they grow so large that people at middle latitudes, such as in California, can see these "Northern Lights."

While correlations exist between visible and radio aurora, radio aurora could exist without visual aurora. Statistically, a diurnal variation of the frequency of radio aurora contacts has been identified that suggests two strong peaks, one near 6 PM and the second around midnight, local time.

VHF auroral echoes, or reflections, are most effective when the angle of incidence of the signal from the transmitter, with the geomagnetic field line, equals the angle of reflection from the field line to the receiver. Radio aurora is observed almost exclusively in a sector centered on magnetic north. The strength of signals reflected from the aurora is dependent on the wavelength when equivalent power levels are employed. Six-meter reflections can be expected to be much stronger than 2-meter reflections for the same transmitter output power. The polarization of the reflected signals is nearly the same as that of the transmitted signal.

The planetary *K*-index (*Kp*) is a good indicator of the expansion of the auroral oval, and the possible intensity of the aurora. When the *K*-index is higher than 5, most operators in the northern states and in Canada can expect favorable aurora conditions. If the *K*-index reaches 8 or 9, it is highly possible for radio aurora to be observed by stations as far south as California and Florida.

Look for aurora-mode propagation when the *Kp* rises above 4, and look for visual aurora after dark when the *Kp* rises above 5. The higher the *Kp*, the more likely you may see the visual lights. However, you don't have to see them to hear their influence on propagation. Listen for stations from over the poles that sound raspy or fluttery on frequencies above 28 MHz, possibly up as high as 440 MHz. Sometimes aurora will enhance a path at certain frequencies, while at other times it will degrade the signals. Sometimes signals will fade quickly and then come back with great strength. The reason for this is that the radio signal is being refracted off the more highly ionized areas that are lit up. These ionized areas ebb and flow, so the ability to refract changes, sometimes quickly. I've observed the effect of aurora and associated geomagnetic storminess even on lower HF frequencies.

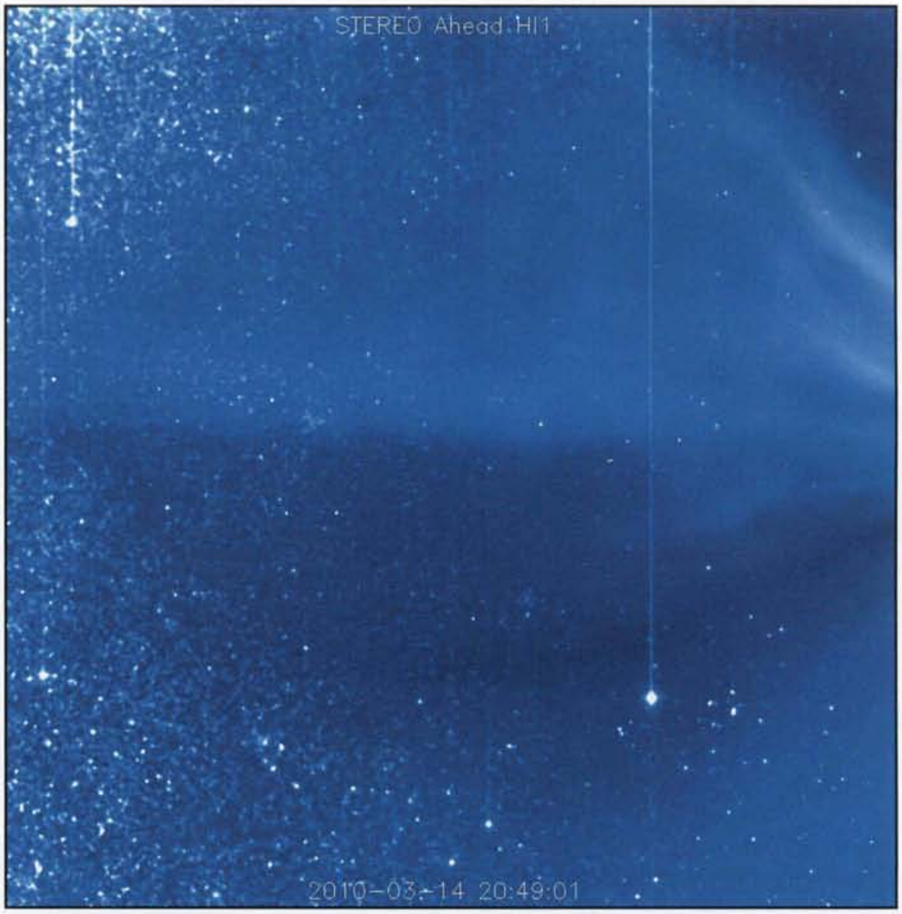


Figure 2. The Heliospheric Imager (HI) on the STEREO Ahead spacecraft observed as solar wind streamed from the sun and three coronal mass ejections (CMEs), which appear as more distinct, elongated clouds, expanded into space over a 15-day period (March 11–25, 2010). The HI instruments on each of the two STEREO spacecraft are off-pointed from the sun to observe a 20-degree field of view to the left and the right of the sun, beginning four degrees from the sun's center. Its sensitive instruments are attuned to observing the faint structures and particle streams billowing out from the sun. With the two perspectives, scientists are gaining a better understanding of how solar wind and CME structures evolve as they head into space. Solar wind constantly streams away from the sun, while CMEs are less frequent but much more powerful clouds of particles caused by solar explosions. (Source: SOHO [Solar and Heliospheric Observatory])

During February, the arrival of flare-triggered CMEs produced active geomagnetic disturbances and minor aurora. March was quieter than February, but April, on the other hand, was a very exciting month. On April 5, a strong solar wind shockwave crashed into the Earth's magnetosphere, causing a major geomagnetic storm (figure 4). This was the result of a CME unleashed from the sun only three days prior. The timing was right for such a shockwave to trigger aurora. The initial shockwave pushed the *K*-index up to 7, and the storm continued for the next couple of days, slowly weakening. This storm and related aurora were the strongest yet of sunspot Cycle 24.

More on the *K*-index

The *K*-index is a code that is related to the maximum fluctuations of horizontal

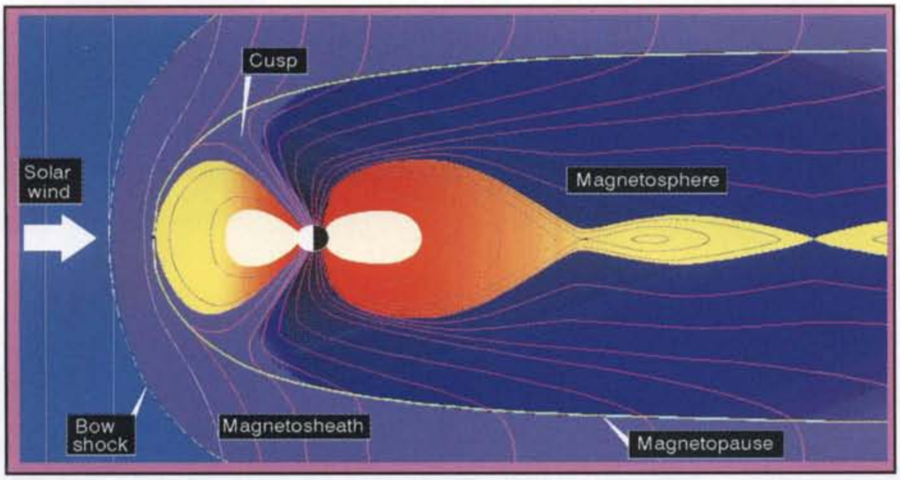


Figure 3. The Earth's magnetic field is completely invisible, but it can be felt by a compass needle on the Earth's surface, and it reaches thousands of miles out into space. The magnetosphere of Earth is a region in space whose shape is determined by the Earth's internal magnetic field, the solar wind plasma, and the interplanetary magnetic field (IMF). In the magnetosphere, a mix of free ions and electrons from both the solar wind and the Earth's ionosphere is confined by electromagnetic forces that are much stronger than gravity and collisions. Despite its name, the magnetosphere is distinctly non-spherical. Earth's magnetic field gets stretched out into a comet-like shape with a tail of magnetism that stretches millions of miles behind Earth, opposite from the sun. The sun has a wind of gas that pushes Earth's field from the left to the right, in this drawing. (Source: NASA)

components observed on a magnetometer relative to a quiet day, during a three-hour interval. The conversion table from maximum fluctuation (nT, "nano-Teslas") to *K*-index varies from observatory to observatory in such a way that the historical rate of occurrence of certain levels of *K* are about the same at all observatories. In practice, this means that observatories at higher geomagnetic latitude require higher levels of fluctuation for a given *K*-index. The conversion table for the Boulder magnetometer is shown below:

K	nT
0	0–5
1	5–10
2	10–20
3	20–40
4	40–70
5	70–120
6	120–200
7	200–330
8	330–500
9	>500

The final real-time *K*-index is determined after the end of prescribed three hourly intervals (0000–0300, 0300–0600 . . . 2100–2400)

The official planetary *K*-index (*Kp*) is derived by calculating a weighted average of *K*-indices from a network of geomagnetic observatories. Since these observatories do not report their data in real time, it is necessary for an operations center such as ourselves to make the best estimate we can of this index based on available data. Space weather operations uses near real-time estimates of the *Kp* index which are derived by the U.S. Air Force 55th Space Weather Squadron. These estimates of *Kp* are based on a network of observatories reporting in near real time. Most of the observatories are in North America, although there is one European station also contributing at this time (Hartland, UK).

The *Kp* scale is a reasonable way to summarize the global level of geomagnetic activity, but it has not always been easy for those affected by the space environment to understand its significance. The NOAA G-scale was designed to correspond, in a straightforward way, to the significance of effects of geomagnetic storms. To rate the geomagnetic activity using the G-scale, estimates of the planetary average *Kp* index are used to determine geomagnetic storm (NOAA Space Weather Scale) levels, as shown below:

Kp-index	Geomagnetic Storm Level
$Kp = 5$	G1
$Kp = 6$	G2
$Kp = 7$	G3
$Kp = 8$	G4
$Kp = 9$	G5

Kp of 0 to 4 is below storm, which has the label of G0.

The geomagnetic storm of April 5 was a G3-level event.

Spring 2010 VHF Propagation

As we move into May, short-distance (only short when compared to long-haul DX of thousands of miles often experienced in the high-frequency spectrum) hundreds of miles) propagation opens up in the VHF and sometimes UHF spectrums. These opening provide propagation of radio signals for hundreds of miles, and occur almost as if a switch is turned on. This is a mostly summer-time phenomenon called sporadic-*E*.

Sporadic-*E* (*Es*) is the term given to the mode of propagation in which clouds of highly dense ionization develop in the *E*-layer of the ionosphere. These clouds might be very small, but regardless of their size, they seem to drift and move about, making the propagation off these clouds short and unpredictable. It is well documented that *Es* occurs most often in the summer, with a secondary peak in the winter. These peaks are centered very close to the solstices. The winter peak can be characterized as being five to eight times less than the summer *Es* peak.

Ten-meter operators have known *Es* propagation as the summertime "short skip." These "clouds" appear unpredictably, but they are most common over North America during the daylight hours of late spring and summer. *Es* events may last for just a few minutes to several hours and usually provide an opening to a very small area of the country at any one time.

During periods of intense and widespread *Es* ionization, two-hop openings considerably beyond 1400 miles should be possible on 6 meters. Short-skip openings between about 1200 and 1400 miles may also be possible on 2 meters.

For a great introduction on mid-latitude sporadic-*E* propagation, visit the AM-FM DX Resource website <http://www.amfmdx.net/propagation/Es.html>.

Tropospheric Ducting

Most propagation on VHF and above occurs in the troposphere. There are a number of well-documented modes of tropospheric propagation. The most common is line-of-sight propagation, which

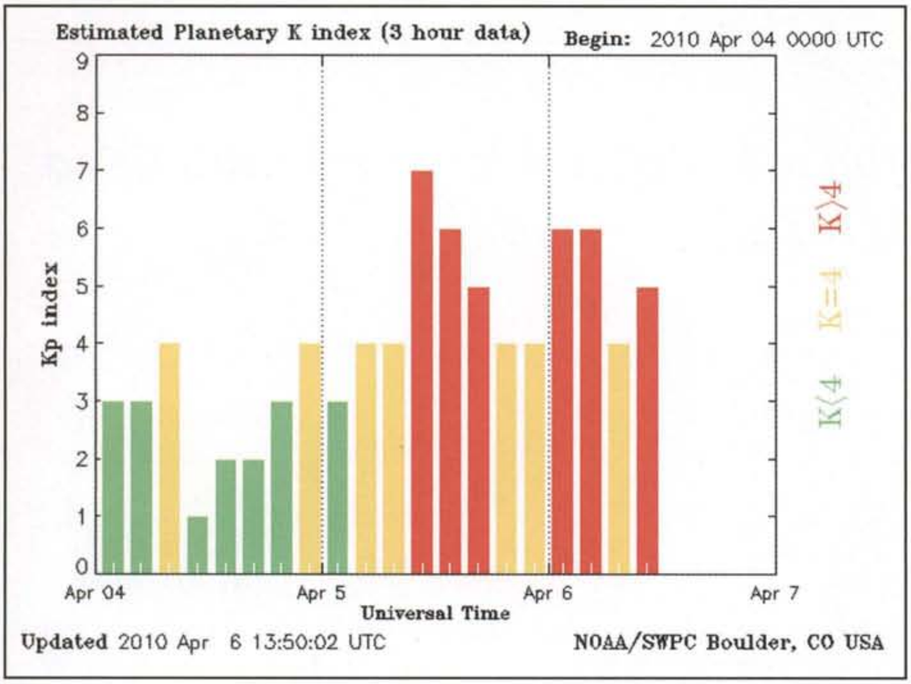


Figure 4. An interplanetary shock was detected around 0800 UTC April 5 on the ACE spacecraft. It was probably linked to a halo CME, which occurred on April 3, 2010. A G3-level geomagnetic storm (see text) occurred when the shockwave, riding the high-speed solar wind, crashed into the Earth's magnetosphere. Major storm conditions were observed in Boulder, Wingst, and Niemegk observatories. The planetary K-index reached a level of 7 on April 5, as seen in this plot. (Source: Space Weather Prediction Center/NOAA)

can, depending on the height of the transmitting and the receiving antennas, extend to about 25 miles. When you work simplex FM or FM repeaters in your local area, you are hearing typical line-of-sight tropospheric propagation.

Another possible mode of propagation is by tropospheric ducting. The term "tropospheric ducting" refers to the stratification of the air within the troposphere. These ducts are created by inversion layers formed from solar warming of the ground and the atmosphere immediately above it.

Under perfect conditions, the troposphere is characterized by a steady decrease in both temperature and pressure as height increases. When layers form within this region of air, the refractive index between each layer causes a refraction of VHF and UHF radio waves. If the layers form in just the right way and at the right height, a natural wave-guide is created. A tropospheric duct develops. A VHF signal can be ducted hundreds if not thousands of miles. It is common for California stations to work Hawaii stations during tropospheric ducting between the islands and the mainland.

It is worth watching for this mode of propagation. The spring weather season may well be violent and eventful this year, as has already been the case. Advanced visual and infrared weather maps can be a real aid in detecting the undisturbed low clouds between the West Coast and Hawaii or farther during periods of intense subsidence-inversion band openings. This condition also occurs over the Atlantic. There is a great resource on the internet that provides a look into current conditions. Bill Hepburn has created forecast maps and presents them at <http://www.dxinfocentre.com/tropo.html>, which includes maps for the Pacific, Atlantic, and other regions.

If you know that conditions are favorable for tropospheric ducting in your area, try tuning around the 162-MHz weather channels to see if you can hear stations way beyond your normal line-of-sight reception. It is possible to hear stations over 800 miles away. Amateur radio repeaters are another source of DX that you might hear from the other end of the duct.

These openings can last for several days, and signals will remain stable and strong for long periods during the opening. The duct may, however, move slowly, causing you to hear one signal well for a few hours, to then have it fade out and another station take its place from another area altogether.

The Solar Cycle Pulse

The observed sunspot numbers from January through February 2010 are 13.1 and 18.6. March numbers were not available at press-time. The smoothed sunspot counts for July and August 2009 are 3.6 and 4.8. The smoothed sunspot count for September 2009 was not available at press-time.

The monthly 10.7-cm (preliminary) numbers for January and February 2010 are 81.1, and 84.7. The smoothed 10.7-cm radio flux numbers for July and August 2009 are 71.0 and 72.1.

The smoothed planetary *A*-index (*Ap*) numbersfor July and August 2009 are 3.9 and 3.8. The monthly readings for January and February 2010 are 3 and 4.

The smoothed monthly sunspot numbers forecast for May through July 2010 are 25.8, 28.8, and 31.7. The smoothed monthly 10.7-cm is predicted to be 85.1, 87.1, and 89.0 for the same months. Give or take about 12 points for all predictions. Clearly, the observed and calculated monthly numbers support the forecast of increasing sunspot activity. Sunspot Cycle 24 is alive and growing in strength.

(Note that these are preliminary figures. Solar scientists make minor adjustments after publishing by careful review).

Feedback, Comments, Observations Solicited!

I am looking forward to hearing from you about your observations of VHF and UHF propagation. Please send your reports to me via e-mail, or drop me a letter about your VHF/UHF experiences. I'll create summaries and share them with the readership. I look forward to hearing from you. Up-to-date propagation information is found at my propagation center at <http://prop.hfradio.org/>. If you are using Twitter, follow @hfradiospacewx for space weather and propagation alerts, and follow @NW7US to hear from me about various space weather and amateur radio news. Facebook members should check out the *CQ VHF* magazine Fan Page at <http://tinyurl.com/ cqvhffb>, and the Space Weather and Radio Propagation Group at <http:// tinyurl.com/hfrswfb>.

Until the next issue, happy weak-signal DXing.

73 de Tomas, NW7US

OP ED

One Reader's Opinion

Petition to Establish a 4-meter Amateur Radio Band

By Glen E. Zook, K9STH*

Many newspapers around the U.S. print a page entitled "Op-Ed." This usually runs opposite the editorial page; hence its name. Sometimes the name takes on a double meaning, when the author has a viewpoint opposite to the editor's. Its purpose is to give a writer an opportunity to express a view or propose an idea for discussion in a longer format than what is normally found in a letter to the editor. There are many views and ideas floating around in the world of VHF that are worth considering and discussing. Please note that the views expressed herein are those of the author and do not reflect the views of CQ VHF *or its editorial staff.* —*N6CL*

On 27 January 2010, I submitted to the Office of the Secretary, Federal Communications Commission, a petition to establish a new, at least for amateur radio operators in the area governed by the FCC, amateur band in the 70.0-MHz to 70.5-MHz segment (see sidebar). There are reasons why this particular segment was chosen, including the fact that there are now 28 countries in Europe and Africa that have granted all, or part, of this segment to their amateur radio operators. Until the required transition to HDTV, the 66.0-MHz to 72.0-MHz range was utilized by television Channel 4. However, with the migration of commercial television broadcasting from Channel 4, this frequency range has become considerably less used. There are still a few television stations operating on Channel 4, but those are primarily "translator" stations used for getting television reception into mountain valleys and so forth. In addition, there are a "handful" of digital television stations now operating on the old Channel 4 frequencies. However, the areas in which there is still Channel 4 activity is minuscule when compared to the area of the entire country. Basically, I believe that there would

*e-mail: <k9sth@sbcglobal.net>

Glen E. Zook
410 Lawndale Drive
Richardson, Texas 75080
gezook@sbcglobal.net

27 January 2010

Federal Communications Commission
Office of the Secretary
445 12th Street, SW
Washington, DC 20554

Subject: Petition for proposed changes in 47 CFR Part 97 Section 97.301(a) and Section 97.305(c) to add the 4-meter band

Commissioners:

The 4-meter (70.000 MHz to 70.500 MHz) amateur radio band has been authorized in a growing number of European and African nations and establishing such privileges for amateur radio operators in the United States and other areas over which the Commission has jurisdiction would be of great benefit to those operators residing in such areas. The recent migration of broadcast television stations to primarily the UHF frequencies basically eliminates any probable interference to television channels 4 or 5 which otherwise might have occurred because the 4-meter band is located on frequencies that were allocated to television channel 4. Since the 4-meter amateur radio band does not fall in the 72.0 MHz to 76.0 MHz segment which is allocated to Operational Fixed and various mobile services there would be no potential co-channel or adjacent channel interference.

It is proposed to allow all classes of amateur radio operators operating privileges on this new band. However, it is suggested that Novice Class licensees be restricted to a lower output level than those allowed for Technician Class, General Class, Advanced Class, and Amateur Extra Class licensees. If the present power output limitations of 1500 watts are granted to the higher class licensees then the Novice Class licensees should be restricted to no more than 200 watts power output as per most of the privileges granted those operators who hold a Novice Class license. If a lower power limit is placed on other classes of operator then the power output limits on the Novice Class should be reduced accordingly. For example, if power limitations of 200 watts maximum output power are placed on Technician Class and higher licensees, then it is suggested that Novice Class licensees be held to no more than 25 watts output.

One possible scenario would be to limit the Technician Class and higher licensees to 200 watts output power for a period of time (i.e. for 2 years) to determine any major interference problems which may occur by establishing these new operating privileges. At the end of that time, then the power output should be increased to the 1500 watts output power now allowed to Technician Class and higher class licensees. The power output allowed for Novice Class operations would then be 25 watts for 2 years increasing to 200 watts after the 2-year time frame.

It is recommended that 47 CFR Part 97 Section 97.301(a) have the following additions made:

Wavelength band	Region I	Region II	Region III	Sharing
4m	70.0–70.5 MHz	70.0–70.5 MHz	—	(a)

and Section 97.305(c) have the following additions made:

VHF		
4m	MCW, phone, image, RTTY, data, test	(2), (5), (8)

Respectively submitted:

Glen E. Zook, K9STH

be little, if any, possible interference from amateur radio operations in this frequency range.

There are those who believe that amateur radio should have a segment in the 72.0-MHz to 76.0-MHz range. However, that segment is now being used by all sorts of services, including the radio control of model cars, model boats, and model airplanes. Also, having an allocation in this range would not be compatible with the rest of the world. The end result is that I believe the best frequency segment is the 70.0-MHz to 70.5-MHz region.

The proposal would grant operating privileges to all license classes, from Novice Class (no longer issued) to Amateur Extra Class. However, existing Novice Class licensees would not be able to run as much power as the higher class licensees. This is akin to the now-in-place power restrictions for Novice Class operators in those segments in which they now have operating privileges. One of the possible scenarios is to limit the power output of all classes of operators for a period of two years to determine the extent of any possible interference between amateur radio operations and other services. It is suggested that, for the initial two years, higher class operators be limited to 200 watts output and Novice Class operators be limited to 25 watts output. After this initial "test" period the power output of operators holding Technician Class through Amateur Extra Class licenses would be increased to the full 1500 watts now allowed on other bands (excepting the 60-meter and 30-meter bands) and Novice Class operators would be increased to 200 watts output. I visualize being able to utilize the same modes as now allowed on 6 meters and 2 meters. Unlike those bands, I also do not visualize having CW only for the first 100 kHz.

Although preferred, the Amateur Radio Service does not have to have a "primary" classification. That is, amateur radio could be granted secondary use like that which is now granted in the 70-cm (420-MHz to 450-MHz) band. By granting secondary use, the FCC would not have to make changes in any regulations concerning other radio services. This would make allocating the new 4-meter band considerably easier for the FCC.

The availability of equipment is now scarce, but not absolutely unavailable. There are units available to commercial users in the 72.0-MHz to 76.0-MHz range which certainly could be retuned down to the 70.0-MHz to 70.5-MHz segment. Also, it would be very easy for equipment to be homebrewed. Additionally, there are a few European companies that are making equipment for the 4-meter band.

Several people have criticized the petition for being "too simple." However, I have been "dealing with" the FCC for several decades and have been successful in the past with proposals that were brief and not filled with "legalese." Sometimes I believe that the FCC staff appreciates proposals that are straightforward and do not require a law degree to interpret. Of course, whether or not the FCC will even issue a Notice of Proposed Rulemaking on this proposal remains to be seen. Again, there are those who have said that even sending the petition to the FCC was a "waste of time." However, there are those of us who say that if there is no request made, then there is definitely no chance of getting a new band. Besides, the total cash outlay was for the paper on which the petition was printed, for a manila envelope, and a couple of first-class stamps. For such a little investment the possible rewards are very great.

For those who wonder exactly what "good" having a 4-meter band would be, there are several reasons. First, having additional bandwidth available is always a good thing. Next, the frequency range is low enough such that building homebrew equipment would not be that challenging; it would be a lot like building equipment for the 6-meter band. Then, from time to time, there is excellent propagation much like on the 50-MHz band. In years past, before amateur radio operators in the United Kingdom got 6-meter privileges, those of us in the United States used to work cross-band from 6 meters to 4 meters. Somewhere I still have a receiving converter that took 70 MHz down to 28 MHz.

The lower television channel frequencies are going to be "re-farmed," and I believe that the Amateur Radio Service is in a position to "get a piece of the pie." Securing the 4-meter band, because it is becoming an international amateur band, is, in my opinion, an excellent project that can reap many benefits for amateur radio.

By Mitch Gill, NA7US

EMERGENCY COMMUNICATIONS

The Role of VHF in EmComm

Amateur Radio at Its Best

For me, the devastating earthquake in Haiti in January reaffirmed the validity of our hobby and how much we bring to the world community. The volunteer spirit of the many emergency amateur radio operators and MARS operators continues to make me proud of those who serve for the good of others less fortunate.

There are many who are still in Haiti helping, but I would like to tell you about one such station with many operators: WX4HNC. This is the amateur radio station at the National Hurricane Center located on the campus of Florida International University (FIU) in Miami, my hometown. This station has been providing emergency communications to a major university medical field hospital in Port-au-Prince, Haiti. This hospital, as of this writing, has performed over a thousand operations and is helping hundreds on a daily basis.

The ham radio club has installed two completed HF/VHF/UHF radio stations with multiple antennas at the field hospital and at the university's Miami/Haiti Command Center in order to assist in the massive humanitarian effort still under way. Volunteer teams of ham radio and MARS radio operators have been deployed on a weekly basis to operate the station in Haiti for five weeks at a time, even though their expenses have gone beyond their initial equipment grant and the club's savings. Many of the volunteers have paid their own way to Haiti, suffered through multiple vaccines, and carried over a hundred pounds of equipment, but they do not complain. This station is asking for your help by donating to their non-profit organization. Please donate what you can to this worthy cause at <http://www.fiu.edu/orgs/w4ehw/>. No, that is not a typo, just the station's old callsign.

It is important to note that the Chief of the International Bureau for the FCC, Mindel DeLaTorre, commented on the FCC blog, "The amateur radio community is also contributing to the relief efforts. In the aftermath of the earthquake, the amateur radio communities in Haiti, the Dominican Republic, and elsewhere have dedicated equipment and spectrum resources to the relief efforts."

My hat is off to all who have shared their time, money, and resources during this time of need.

My EmComm Home Away from Home

I just bought another antenna for my trailer. It's a three-element lightweight beam. In addition to that, I have a 2-meter/440-meter J pole and a 6- through 80-meter screwdriver mounted on the ladder for when we stop to stay somewhere.

During Field Day I will be testing it out near the beaches of the Puget Sound north of Seattle and just south of the Canadian border. That's what Field Day is for, right!?

I will be adding both solar and wind power to the trailer this year. Here in the Northwest the sun does not always shine, but you can be sure to get wind, especially on the beaches. My intent is that in the event of an emergency, I can live off the grid if I have to.

*29838 SE 285th Place, Ravensdale, WA 98051
e-mail: <na7us@arrl.net>

WX4NHC team volunteer Louis Cruz, N4LDG, took this picture of U.S. 82nd Airborne medics assisting an injured woman in Haiti in January. "Conditions there are critical," said Cruz, who trains and teaches emergency preparedness, information security and crisis management negotiations for the U.S. government. (Courtesy of N4LDG)

What Could Possibly Happen?

This brings up something that I have been thinking about and would love to hear your opinion. First you need to know that I am a lover of technology. I have an Apple computer, a laptop running Windows® 7, another laptop running Windows® XP, and a netbook running Linux. I really enjoy utilizing many different programs for amateur radio and for emergency communications. I have even tossed around the idea of playing with some programming languages such as Python. At my job I am presently working with Radio Over IP (ROIP), and I love it. I believe in Software Defined Radio (SDR), though I do not own one.

Here is the issue: Based on what we know today, there are two possibilities out there. One is a cyber attack on our electrical grid. As much as we would like to believe that our electricity will always be there, we should be prepared just in case. A Chinese student has developed a paper showing two different attacks that can literally take down our entire grid, showing just how vulnerable we are. Anyone reading the news today knows that we are constantly under cyber attacks that seem to be coming from either China or Russia.

Another possibility is a nuclear weapon detonated miles above an area, causing an electro magnetic pulse (EMP). Over California it could shut down most of the West Coast as it would shut down the grid as well as all electronics. In this type of scenario only the old boatanchors such as those made by Drake or Heathkit brand names, to name only two, may work, but no one knows for sure.

I know that all of this sounds like I am preparing for the end of the world, but I am not. I like to think to the extremes. I do not believe a cyber attack or EMP will occur, but since it is possible, I feel the responsibility to my family to prepare at some level. It is no different than preparing for the next major earthquake here in the Northwest. An earthquake could occur today or not for another hundred years, but should I wait until it actually happens and then hope for the best? I don't think that would be wise.

The real problem comes down to our dependency on the internet. Obviously, ROIP will not be available during any of those scenarios, but many police and fire departments utilize this type of system. As we become more dependent on those types of systems, the radios we know today will become obsolete. That in itself is not a real problem, as SDRs are becoming more and more refined. ROIP, though, is dependent on the internet, and if that goes down, so will ROIP.

How About Some Good News?

After a long hiatus, it seems that more and more manufacturers are bringing back radios for 222 MHz. Why is that good news? 222 MHz was dying in this part of the country. It was not being used, and about eight years ago there were several companies attempting to access that band for commercial services. Lately there has been a resurgence in the use of this band, and apparently many of you petitioned companies out there to build or bring back the radios for this band. I am all for it and hope to choose my radio soon.

Until next time, remember what the Boy Scouts have known for over a hundred years: always "Be Prepared."

73, Mitch, NA7US

By Dr. H. Paul Shuch,* N6TX

DR. SETI'S STARSHIP

Searching For The Ultimate DX

To Venus and Back

The notion of radio amateurs bouncing signals off the Moon and receiving detectable echoes back here on Earth is a familiar one to many readers of this column. Ham moonbounce is a notable space communications accomplishment to be sure, but how about expanding it on an *interplanetary* scale? That's what a team of German amateurs did on March 25, 2009, when they used the Bochum 20-meter dish to recover their 2.4-GHz transmissions bounced off the planet Venus. The 100-million km round trip took some five minutes and required two minutes of integration before echoes could be discerned in their digital-signal-processing (DSP) display. DSP is the key here.

I first began contemplating the Earth-Venus-Earth path (EVE, or Venus-bounce) in the 1980s after a visit to the 2-meter EME superstation of W5UN in Texas. Noting the strength of my friend Dave Blashke's lunar echoes, I ran some back-of-the-envelope calculations to determine whether his station could possibly hear its own echoes bounced off Venus. The disappointing result was that this EME "big gun" fell about 30 dB short of closing the loop. In other words, its kilowatt transmitter would have to be increased to a megawatt in order to achieve successful Venus-bounce.

However, transmitter power is not the only way to improve link margin. An improved antenna pays double dividends, because its gain benefits both transmission and reception. Thus, increasing antenna gain by a mere 15 dB would have made Dave's station EVE-capable. Of course, that "mere" 15 dB translates to a mind-boggling 30-fold increase in the size of the already monstrous W5UN antenna. There had to be an easier way.

How about increasing receiver sensitivity by 30 dB? If we could reduce the receiver's bandwidth by a factor of a thousand, we could reduce background noise (and hence increase signal-to-noise ratio) by the required 30 dB. If memory serves, Dave was using a 200-Hz correct IF filter in his receiver to produce the EME echoes I heard. If only we could decrease that bandwidth to 200 mHz, or .2 Hz, I reasoned, Venus-bounce would become possible.

The only way I could figure out this might be accomplished was by employing DSP. However, at the time no digital-signal-processing hardware or software was available to provide the needed 30-dB boost. "But it will become available some day," I assured Dave.

"Some day" is now here, as the Bochum group ably demonstrated last March.

Although a first for amateur radio, the German team's EVE was not unprecedented. On November 19, 1962, three scientists from the Russian Institute of Radio Engineering and Electronics (IRE RAS)—Drs. Vladimir F. Morozov, Oleg N. Rghiga, and Vladimir M. Dubrovin—succeeded in bouncing the word "Mir" (Russian for "peace" and also for "world") in slow-speed Morse code off the surface of Venus and received their own echoes.

Their station was hardly a typical ham rig. They used the 50-kW transmitter of the Evpatoria Planetary Radar in Crimea,

Figure 1. On November 19, 1962, three scientists from the Russian Institute of Radio Engineering and Electronics succeeded in bouncing the word "Mir" in slow-speed Morse code off the surface of Venus and received their own echoes. They used the 50-kW transmitter of the Evpatoria Planetary Radar in Crimea, Ukraine, into an array of eight 16-meter parabolic dishes.

*Executive Director Emeritus, The SETI League, Inc., <www.setileague.org>
e-mail: <n6tx@setileague.org>

В космосе слова: «Ленин», «С С С Р», «М и р»

Первая в мире радиолокация планеты Меркурий ◆ Радиоразговор Земля—Венера—Земля.

Институт радиотехники и электроники Академии наук СССР сообщил агентству печати Новости (АПН) о новой победе советской науки и техники.

Как известно, исследование планет Солнечной системы до последнего времени производилось астрономическими методами, в основе которых лежит наблюдение отраженного планетами солнечного света и собственного теплового излучения планет. Создание мощных передатчиков, больших антенных сооружений и чувствительных приемных устройств позволило в настоящее время получить радиолокационные отражения посланных с Земли сигналов от ближайших планет — Венеры и Меркурия.

Впервые успешная радиолокация планеты Венера была проведена в 1961 году одновременно в Советском Союзе, Англии и Соединенных Штатах Америки. Целью этих экспериментов было определение астрономической единицы — основного масштаба при измерении космических расстояний, оценка периода вращения Венеры и получение данных о ее поверхности.

До последнего времени астрономическая единица и определяемые через нее расстояния в Солнечной системе были известны с ошибкой, как теперь выяснилось, около 0,1 процента. Такая, казалось бы, высокая точность была достаточна для астрономических наблюдений, но совершенно недостаточна для вождения межпланетных космических кораблей. Ошибка определения расстояния до планеты Венера, например, составляла несколько ее диаметров, то есть порядка 50 тысяч километров.

Для радиолокационных наблюдений Венеры в Советском Союзе использовались радиосигналы на частоте около 700 мегагерц. Расстояние до Венеры в этих наблюдениях (около 45 миллионов километров) было в 120 раз больше, чем расстояние до Луны.

Значение астрономической единицы, полученное по этим измерениям, составляет 149.599.300 километров, с максимальной ошибкой в две тысячи километров.

Коэффициент отражения Венеры, определенный по принятым радиосигналам, составил 8 процентов.

Летом 1962 года в СССР был сделан дальнейший шаг в уточнении масштабов Солнечной системы. Благодаря усовершенствованию приемо-передающей аппаратуры и применению новейших методов обнаружения слабых сигналов **удалось впервые в мире произвести радиолокацию планеты Меркурий,** во время наблюдений находившейся на расстоянии 84—88 миллионов километров от Земли. Этот опыт подтвердил полученное в 1961 году значение астрономической единицы и показал, что отражение радиоволн от поверхности Меркурия примерно такое же, какое наблюдается при радиолокации Луны.

Следующим этапом радиолокационного изучения планет является произведенная в октябре—декабре 1962 года в СССР повторная радиолокация планеты Венера. На протяжении этого времени регулярно производились измерения расстояния до Венеры и наблюдения за свойствами поверхности. Результаты измерений сейчас обрабатываются.

Одновременно с этим **советским ученым впервые в истории человечества 19 и 24 ноября 1962 года удалось осуществить радиосвязь через планету Венера.** Переданное с Земли телеграфным кодом 19 ноября 1962 года слово «МИР» достигло планеты Венера, отразилось от нее и, пройдя общее расстояние 81 миллион 745 тысяч километров, через 4 минуты 32,7 секунды было принято опять на Земле.

24 ноября этим же методом на планету Венера были переданы слова «ЛЕНИН», «СССР». Отразившись от поверхности планеты, через 4 минуты 44,7 секунды эти слова были приняты на Земле. Общий путь, который они прошли в космосе, равен 85 миллионам 360 тысячам километров.

Подробные результаты радиолокационных наблюдений Меркурия и Венеры в 1962 году будут опубликованы в научных журналах.

Создание в Советском Союзе мощного космического радиолокатора и проведение с его помощью наблюдений планет Венера и Меркурий — результат работы большого коллектива представителей науки и техники.

(АПН).

Л Е Н И Н

С С С Р

М И Р

На снимках: осциллограммы отраженных от поверхности планеты Венера радиотелеграфных сигналов, принятых 19 и 24 ноября 1962 года. На каждом снимке сверху указаны переданные слова: «ЛЕНИН», «СССР», «МИР» и показан вид переданных азбукой Морзе сигналов. В нижней части снимка приведена запись принятого отраженного от Венеры сигнала.

КРАСНАЯ ЗВЕЗДА

30 декабря 1962 г. 5 стр.

Figure 2. The feat described in figure 1 and the text was accomplished at a frequency of 769 MHz (wavelength of 39 cm), integrating 10-second "dits" and 30-second "dahs," and recovering the echoes of the three scientists on a strip-chart recorder as seen in this newspaper account of the time.

Ukraine, into an array of eight 16-meter parabolic dishes (see figure 1). They accomplished this feat at a frequency of 769 MHz (wavelength of 39 cm), integrating 10-second "dits" and 30-second "dahs" and recovering their echoes on a strip-chart recorder, as seen in a newspaper account of the time (figure 2). All of this was without today's advanced DSP technology!

What does all of this have to do with SETI, the reputed subject of this column? Simply this: Every interplanetary transmission is also an interstellar one. In 2002, Segey E. Gurianov calculated the November 1962 position of Venus and determined that this first EVE signal was sent in the direction of the star HD131336, in the constellation Libra, some 2160 light years distant. This means that if any SETI scientists there are listening, they might just send a reply our way. Thus, be sure to listen for it—in the year 6284 AD!

73, Paul, N6TX

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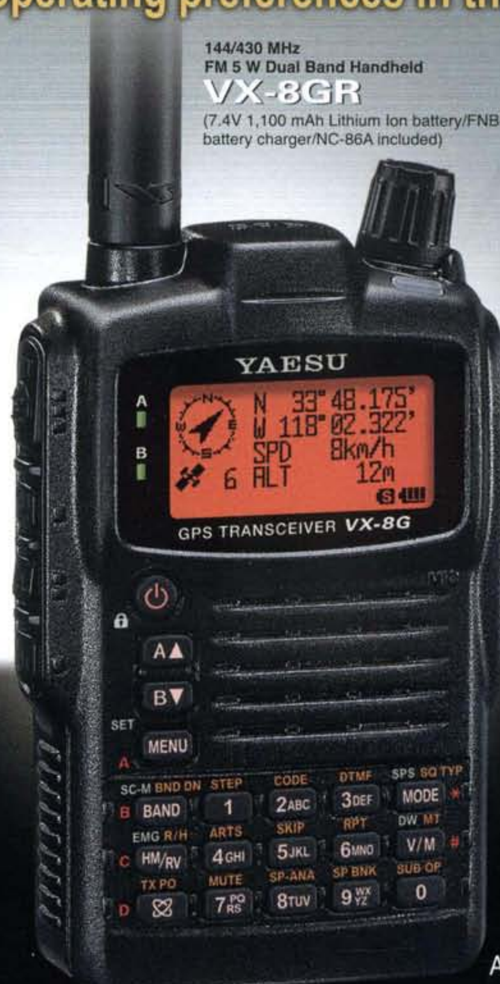

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