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Title: A Portable NVIS Antenna
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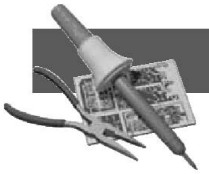

By Robert Hollister, N7INK

A Portable NVIS Antenna

As the Amateur Radio Emergency Service (ARES) District Emergency Coordinator (DEC) and Radio Amateur Civil Emergency Service (RACES) officer for Cochise County, Arizona, I am always looking for simple solutions to complex problems. The problem in this case was to provide easy-to-use antennas for our county Emergency Response Vehicle (ERV) (Figure 1). Our ARES/RACES unit operates the ERV communications unit for the county sheriff's department in support of the Emergency Services Office, Search and Rescue Team and other emergency missions. Located in the southeast corner of Arizona, Cochise County consists of high desert, higher mountains and deep canyons. This presents a difficult environment to maintain reliable radio communications. Although the Amateur Radio clubs and the sheriff's department have a good network of VHF/UHF repeaters, there are many areas where repeaters or cell phones just do not provide the coverage we need to maintain contact with the sheriff's dispatch center in Bisbee.

A Solution

I recently read a Web article published by WØIPL that described the use of mobile monoband whip antennas in a near vertical incidence systems (NVIS) configuration (**www.w0ipl.com/ECom/NVIS/nvis.htm**). I decided, therefore, to experiment with this NVIS technique and build a portable kit for use with our ICOM IC-706 installed in the ERV.

The first step was to develop a shopping list (Table 1) and purchase the necessary items I thought I would need to make it work. At a recent hamfest, I purchased two monoband mobile whip antennas for each of the two bands I wanted to operate, and a dipole adapter that I had seen at the Dayton Hamvention.[1] I then broke out my trusty MFJ antenna analyzer to help with the trimming and SWR measurements.

First, I set up antenna number 1 (75 meters) on my Outpost tripod to start the tuning process.[2] The target was a 5 MHz frequency that I wanted to use to connect with the Fort Huachuca Military Affiliate Radio Service (MARS) station digital bulletin board. Many of our ARES/RACE members are also active in the Army MARS program and we have a TNC in our ERV for both HF and VHF digital communications. I knew that the normal range of the mobile whip antenna covered the 75 meter portion of the band effectively, but that it would require a much shorter stinger than the 48 inch standard length to reach the target 5 MHz frequency.

Figure 1—The Cochise County, Arizona emergency response vehicle (ERV).

[1]Notes appear on page 58.

Construction

Rather than trimming the stainless steel stinger that came with the antenna in steps, I started with a piece of wire coat hanger cut to 24 inches that fit into the collar on the top of the bottom section of the antenna. I scraped the varnish off the wire on the piece to be inserted in the collar for a good electrical connection (Figure 2). If you have ever tried to cut stainless stingers before, you will understand quickly why using the softer coat hanger wire is the preferred method. On the first test, the antenna was resonant at about 6.250 MHz. This told me that I was still much too long. I cut the wire stinger in half with my wire cutters to about a 12 inch stinger and tried again. I was now in the ballpark and only 500 Hz away. I continued cutting at half-inch intervals and tested the results.

I was soon at my desired resonant frequency. The stinger was now extended only 6 inches above the bottom section of the antenna. The antenna instruction sheet suggested that not more than 4 inches be inserted into the bottom section. The

Table 1
NVIS Antenna Parts

75 meter mobile monoband antenna	2 each = $30
Extra 48" stingers	2 each = $18
40 meter mobile monoband antenna	2 each = $30
Dipole adapter	1 each = $15
Stainless radiator clamps, 2"	2 each = $1
5 foot fiberglass pole, surplus	2 each = $15
RORO ("big foot") mount	1 each = $90
10" section, 3/8" aluminum stock	1 each from junk box
10" section, 2" aluminum stock	1 each from junk box
	Total = $199

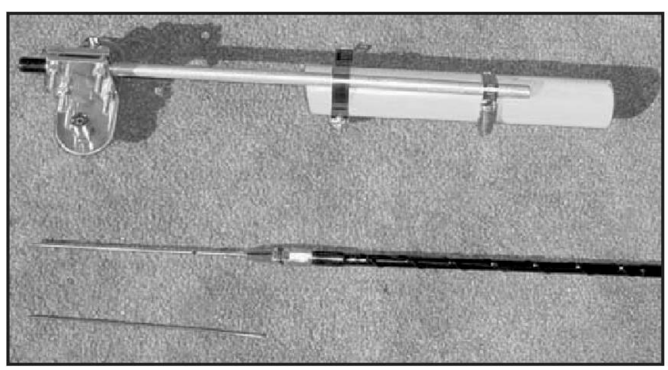

Figure 2—A coat hanger is used as a prototype "stinger" during testing and requires that the paint be scraped off its end. It is shown next to a new stainless steel tip. The dipole adapter is shown at the top.

total length of the now resonant stinger was 10 inches. I used this trimmed piece of wire as a template and laid it next to the original stainless stinger. After carefully marking the new length and allowing for adequate length to extend into the top of the lower section, I cut the stainless stinger to length with my hacksaw. After smoothing and rounding the cut end of the stainless steel whip with a diamond file, I rechecked the resonant frequency. It was right on. I took the new short stainless stinger and, using the same measurement as the first one, checked it with the second 75 meter antenna bottom section for resonance. It was close, but required a slight amount of adjustment to be brought to frequency. The second stinger was quickly cut and ready for testing (Figure 3).

NVIS Height

Since the dipole adapter I purchased did not come with any instruction sheet, I needed to figure out how to get the antenna to a suitable height above ground. I already had something we call our roll-on/roll-off (RORO) or "big foot" to use as an antenna support base plate (Figure 4).[3] The NVIS literature and field testing suggests that the optimum height above ground is not an exact science but that it should be approximately 10-12 feet high to reliably cover a range from 0 to 300 miles. Height above ground and the conductivity of the soil below the antenna will affect the optimum range and the resonant frequency. Minor adjustments to stinger lengths may be required at different locations, depending on ground conductivity. A height of 10 to12 feet above ground also ensures that it is high enough so that most pedestrians and NBA basketball players are not likely to run into the ends.

As I owned a number of 5 foot military surplus aluminum and fiberglass antenna mast sections, I decided to use two of the fiberglass sections as the main antenna support.[4] These are the same type we use to hold up our spare dual band (144/440) antenna when we need additional range over the vehicle-mounted antenna. I then had to decide how to easily and quickly attach the adapter to these mast sections. A short piece of a scrapped aluminum mast section cut to 10 inches, two each 2 inch stainless hose clamps, and another 10 inch piece cut from some 1/2 inch aluminum tubing fit the bill. This allows a quick slip-on fit over the top of the fiberglass mast section (see Figure 3).

The next step was to attach the two modified mobile antennas and coax to the dipole adapter. I slipped the adapter over the top of one of the fiberglass masts, inserted it into the "big foot" and reattached the coax to my analyzer. It was too much to hope that it would still be exactly on frequency and, unfortunately, I was correct. There was enough interaction with the added metal of the adapter to require some additional tuning. Fortunately, it was minor and only required shortening both of the elements approximately another 3/4 inch to bring it back to my desired frequency. The next step: On-the-air testing.

Testing

With the two fiberglass mast sections inserted into the "big foot" base, the completed horizontal dipole was now approximately 11 feet in the air (Figure 5). Hooking up the radio, the computer and the TNC (terminal node controller), my first attempt to connect to the Fort Huachuca MARS BBS (bulletin

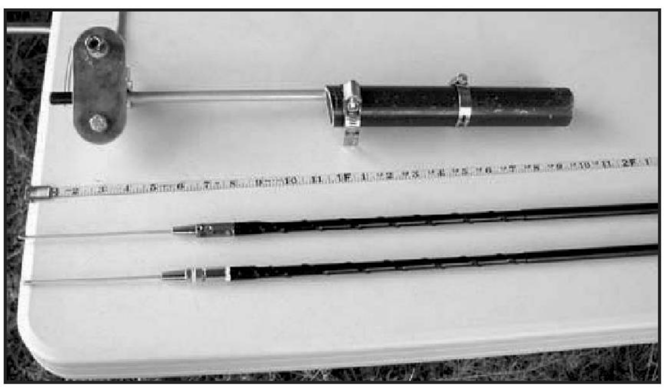

Figure 3—A top view of the assembled dipole adapter used to mount and secure both antennas, which are shown below it.

Figure 4—The RORO ("big foot") mount. This was custom-built for the author by a welding shop (see text).

Figure 5—The completed antenna in use in the Chiricahua mountains of Arizona.

board system) using PACTOR (a digital communications protocol) was a success. Solid S9 copy was obtained with approximately 40 W output. I quickly prepared a sample message to send, reconnected to the BBS, uploaded the message and disconnected. Again success! Before disassembly to move to the next frequency of interest, each stinger and bottom antenna section were color coded with a band of red and white paint to ensure the correct stinger could easily be reassembled with the correct bottom section.

I had purchased a second set of stingers (of normal 48 inch length) for the 75 meter antennas and a pair of 40 meter antennas at the time I made the original purchase. Setting up for the other two primary frequencies I wanted to use was straightforward and required no trimming. Using two standard-size 48 inch whips and collets, these two stingers were adjusted for the Arizona RACES frequency of 3.990 MHz on the Outpost tripod. These are adjusted for our Arizona state RACES net on 3.990 MHz, and the third set is set for our alternate frequency of 7.248 MHz. There was adequate flexibility using the standard stingers to adjust to the state MARS nets just outside the amateur band with no additional trimming required.

The state RACES net has stations representing most state counties and reaches all corners of the state. I am located in the southeast corner with the furthest station about 250 miles away. Again, attaching the antennas to the dipole adapter required some minor shortening to achieve resonance (1.2:1). During a Sunday morning RACES net, I conducted on-the-air A/B testing. I compared the NVIS configuration to a Hustler vertical (previously used for portable operation), attached to the Outpost tripod. The NVIS configuration demonstrated an approximate 1-2 S unit improvement for most signals compared to the vertical.

Switching to 40 meters, and using the same procedure with two 40 meter antennas on the Sunday morning Arizona MARS net, showed a similar improvement. Most signals showed a 1-2 S unit improvement in signal strength using the NVIS dipole compared to the vertical. The biggest audible improvement was noticed in interference/noise levels. Some stations were totally lost in the noise on the vertical and came back to Q5 on the NVIS dipole. This net included stations in Arizona and southern California. Similar distances to those of the Arizona RACES net were covered. At that time of day (one hour later than the RACES net), the 40 meter coverage was generally better on all stations.

Conclusion

Two weeks later, I was able to run a few more tests from a remote location in the Chiricahua Mountains. Over the Labor Day weekend, the Cochise Amateur Radio Association conducts a special event operation from the ghost town of Paradise. This provided the most realistic test yet, as we deployed the ERV and operated portable in the mountains, much like a normal search mission. I tested all configurations on both voice and digital frequencies. The antenna was quick to set up and provided reliable communication to the stations I needed to contact. The complete antenna kit requires less than 5 minutes to assemble and erect. This antenna has proven to be a reliable addition to our emergency communications needs and it meets all of my expectations.

Notes

[1]The antennas are available from the Lakeview Company (**www.hamstick.com/9106.htm**) and WBØW (**wb0w.com**) as well as other sources. The dipole adapter is available from a number of sources, including: Atoc Technologies (Iron Horse) (**www.atoctechnologies.com/**) and Quicksilver Radio Products (**www.qsradio.com/products.htm**).

[2]**www.alphadeltacom.com/pg6.htm**.

[3]The RORO mount was built to specification by a local welder for $90. A drawing can be provided for others who are interested in having one fabricated. I have seen similar designs available at several hamfests.

[4]The mast sections came from The Mast Company (K4TMC), PO Box 1932, Raleigh, NC 27602; **www.tmastco.com/**. Henry offers a variety of military surplus mast sections in aluminum or fiberglass. I prefer the lighter fiberglass but I have used both with equal success.

Photos by the author.

Robert Hollister, N7INK, was first licensed as N2BCY in 1978, while serving with the US Army in Germany. He's also held the calls DA2HO and GM5ELQ. Bob retired from the Army in 1986 as a communications intercept technician. He has a BA from The State University of New York and an MS in Applied Management from Lesley College, Cambridge, Massachusetts. Bob also has an Amateur Extra class license and is a life member of the ARRL. He can be contacted at 5457 S San Juan Ave, Sierra Vista, AZ 85650, or at **n7ink@cox.net**.

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