

Emergency Antennas

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Increasing the effectiveness of Your Comm System

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The argument over whether Citizen's Band (CB) amateur radio or commercial radio transceivers are best suited for survival purposes is short-sighted and a matter of amusement to communications professionals. The real question has nothing to do with how much power is available (as in ham sets), or how cheap they are (as in CB sets), but rather what do you want to do with the radio?

CB radios are good for very short-range communications, but are afflicted by a huge amount of interference because of the large number of stations on the air. They are essentially very short-range devices. A CB set can easily communicate cross-country when conditions are right. But then again, that's the rub: only a few years out of each 11-year sunspot cycle make skip in the upper HF bands any good. A better solution for purely local communications might be a VHF or UHF ham rig. And for those who cannot pass the ham exams there are also VHF and UHF CB-like and business radios available.

The HF ham rig is capable of communications across the country, like the CB set, but also has other bands that permit medium distance communications (try communicating 40 or 50 miles on CB when the skip is in!). I've heard many cases where two HF stations 40 miles apart could not hear each other, and had to have a station in South America relay the traffic between them.

Perhaps of even greater interest is the selection of antenna, and the tactics used to improve the performance of antennas in the field. Mobile and portable antennas have one characteristic that works against solid communications: they are inefficient, especially in the lower end of the HF band. Unfortunately, it is the lower end of the HF band where one would go for intermediate range communications. If the interference is kept down to a dull roar, those frequencies are also good for local communications, although VHF/UHF and even CB might be preferred. World War II squad-level walkie-talkies operated on frequencies in the lower HF band (I owned one on 3,885 kHz).

Another reason for preferring the lower end of the HF band, or the VHF/UHF bands for field communications is the matter of privacy. A CB set, or a ham rig operated in the upper end of the HF portion of the spectrum, may skip a long way. A story from the early days of World War II is sufficient to give the lesson. A ham operator in Connecticut listening on a homemade 10-meter band (next to the CB band) receiver heard German-language speech. Because it was 1942, and we were at war with Germany, this discovery caused some concern when he reported it. It soon became obvious that the signals were skipping in from North Africa. The low power tank-to-tank used in the panzers of Rommel's Afrika Korps were skipping into North America... providing some decent intelligence info.

The problem that requires solution is how to make portable and mobile radio systems more effective. If the principal attribute is immediate portability, then one is pretty much stuck with the antennas that come with the rig. But if you are going to stay put for awhile, then there is quite a bit that can be done.

Improving VHF/UHF systems -

One of the things that can be done to improve VHF/UHF operation is to gain as much height for the antenna as possible (in fact, this helps at all frequencies). Coupling the rig to an antenna on top of a mast, in a high tree, or on a high hill will result in increasing the communications range. VHF/UHF signals travel radio line-of-sight, which is a bit further than the optical line-of-sight, being equal to 4/3 of the earth's curvature. In other words, a bit beyond the horizon. Increasing the height of the antenna increases the line-of-sight distance.

Of course, if you can possibly rig up a repeater, then that's even better. This option wasn't considered in preparing this article because the basic assumption is the need for portability and mobility.

Height will also help HF communications. Being on top of a mountain makes it easier for both skip and local communications. I recall one time participating in an ARRL Field Day Contest (held every June). Our 7.5 watt two-meter band (144-148MHz) transmitter worked from a mountaintop in Virginia all the way into Pennsylvania - a distance of more than 100 miles. During the same weekend I was working the 25 watt 40-meter (7.0 - 7.3 MHz) CW (i.e., Morse code) transmitter, racking up contacts in Hawaii, Alaska, California, Oregon and all over the West. After about three hours it was noticed that the antenna transmission line had parted from the antenna, and we were essentially using about 40 feet of 300-ohm twin-lead transmission line for the antenna (no wonder the antenna tuner settings were odd). The mountain top height and the skip conditions helped us make those contacts.

Some years ago I attended a week-long writer's conference at a Christian college in the Midwest. One of the people sharing the dormitory with us was a Swedish Pentecostal missionary who had just returned from the Sudan, where he worked at a medical missionary station. He was also a ham radio operator, as well as being a medical doctor. He gave me some interesting advice on portable and mobile operations that I will share with you.

The Sudanese desert is mile after mile of nothing but trouble. It is so harsh that dead camels are found along the trails they call roads. If the heat doesn't kill you, then the snakes and other wild life will do it quite nicely. And if Nature fails, then there are plenty of armed bandits available to do the job. As a result of these situations, communications were very important.

The missionary told me that he put his faith in God and an HF SSB transceiver. The model that he had comes in two varieties, one for the ham bands and one for the commercial and maritime bands (the internal circuitry differences were nil - lifting a single connection converted the frequency limited ham version into the commercial version). His organization required him to check in twice a day, once in the morning and once

in the evening. If he missed two radio checks, the four-wheelers and helicopters went out to find him and his medical team.

The frequencies that they used were 3.88 MHz in the ham band, and around 4.5 MHz in the commercial bands. The antenna was a nine-foot stainless steel whip mounted on the Landrover. Because antennas for these frequencies are 6070 feet long, the short antenna required a loading coil to make it resonant. A short antenna is an inefficient antenna, no matter how you make it. But there are some things that can be done.

The usual configuration for an automobile consists of a whip antenna mounted on a base-mount bolted or held magnetically to the rear of a car. The only "ground" available to this antenna is the body of the car, and that's a pretty poor excuse for a ground. The Swede told me their solution to increasing the efficiency of the antenna: install two or more quarter wavelength radials. The radials form an artificial or "counter-poise" ground, making the performance of the antenna much more effective.

When I first moved into a new house I used a Hustler HF mobile antenna and two radials hanging out of an upstairs bedroom window to get me on the ham bands in the weeks before I found time to erect a proper antenna. It worked quite well. Not as well as a properly designed and installed dipole.

The radials are attached to the body of the vehicle at the same point as the shielded braid of the coaxial cable. In other words, at one of the mounting bolts of the antenna mount. The Swede had installed a five-way binding post in place of one of the bolts in order to facilitate quick connection and disconnection of the antenna.

The radials are made of ordinary wire, and are quarter wavelength long. The length (L) in feet is found from $L = 246/F$, where F is the desired operating frequency in MHz. For the Swede's case, he worked on both 4.5 and 3.88 MHz, so he cut four radials, two for each frequency. These were 54.7 feet and 64.3 feet, respectively.

When he made camp each evening, or when arriving at a village where the mobile medical team operated for awhile, he would get the coiled up radials out of the back of the vehicle, unroll them and connect one end to the binding post at the base of the antenna. The radials were then laid out on the ground, spread out as much as circumstances permitted. It's all right if the radials touch the ground.

Another trick used by the Swede was to carry a 50-foot slip-up mast in one of the Landrovers, along with an ample supply of guy ropes and a cinder block base. If they were going to be at a location for a longer period of time, then they rigged the mast. At the top of the mast, they put a VHF antenna cut for a band close to the ham two-meter band. Also near the top was the center insulator for an inverted-vee dipole antenna.

The inverted-vee dipole is a half wavelength, center fed dipole antenna made of wire, and fed with either 52-ohm or 75-ohm coaxial cable. The lower end of each quarter wavelength element is insulated from the ground by tying it off on a tent stake. Alternatively, end insulators can be used, and these connected to the stakes with rope.

The normal overall length of a half wave dipole is found from $L(\text{feet}) = 468/F$ (each element is half this length), but for the inverted vee variety it must be about 6 percent longer to account for the drooped radials and their proximity to the ground. The overall length of the inverted vee is therefore $L(\text{feet}) = 496/F$.

The inverted vee dipole offers a single point of mounting installation, and that can be important in portable applications. But where two mounting points are available, then a regular horizontal, half wavelength dipole is generally preferred.

The lengths of these antennas can be calculated from the formulas. However, it must be realized that the local installation determines, to some degree, the actual necessary length. As a result, the antenna should be trimmed to the actual proper length using either an antenna impedance meter or a VSWR meter (look for the minimum value in each case). Both instruments are available from ham and CB shops.

Although the example above was for antennas in the lower end of the HF bands, they also work in the upper bands as well. A CB rig, or a 10-meter ham rig, will work a lot better when a mobile antenna (operated stationary, of course) is fitted with two or more quarter wavelength radials.

In my experiments, and the experiments of the Swede, two radials were used. These increased signal strength considerably. The best situation is to have as many radials as possible. The traditional number for vertical AM broadcast towers is 120 radials, although a distinct diminishing returns effect is seen when more than 15 or 16 are used. As a practical matter, two to six radials per band are optimum. However, if all you can use is one, then use it - it's still better than none.

The radial concept works well in portable situations, but is also useful in base station cases inside a building. For several years I operated 40-meter CW bands from a boarding house room at college. The rig was a 50-watt 1950's vintage transmitter built from a kit. I worked all over the world with that rig and a simple antenna. The coaxial cable from the rig was connected to an antenna tuner, which in turn was connected to a random length of wire antenna run out the window. The form of the antenna tuner depends on whether the wire radiator element was less than quarter wavelength, right on quarter wavelength, or greater than quarter wavelength (my home-brew tuner, like most commercial tuners, could accommodate all three cases).

For awhile, when the landlady was concerned over neighbors' reactions, the radiator element was in the attic. For most of the time, this antenna was used the radials were run out the window to distant points in the yard. But for awhile (again the neighbors) two radials were stapled to the baseboard of my room (warning: high RF voltages exist at the end of the radial, so make sure they don't touch anything...and are not touched). It still worked well, but was a might touchier to tune.

A ground rod is a desirable option. If you use one anywhere but a brackish marshland, get one that's at least 6 to 8 feet long. Anything shorter is less effective. Of course, those long ground rods are usually stuck once they're in that deep, so don't use one anywhere that you want to abandon in short order.

The antenna can make or break a communications system. No matter how good the transmitter, receiver or transceiver, if the antenna is ineffective then the best rig in the world might as well be a pair of tin cans connected by string. If you want to find out more about radio antennas, let me immodestly recommend my books: "Joe Carr's Receiving Antenna Handbook" (\$19.95, High Text Publications, Inc., 1-800-247-6553) and "Practical Antenna Handbook - 2nd Edition" (\$29.95, TAB/McGraw-Hill, 1-800-233-1128). The latter book received a compliment from a communications instructor for a "sensitive" government agency. He used it to train comm technicians. When I pointed out to him, somewhat bewildered, that it was intended mostly for ham operators, he retorted: "Yes, but it's the only book around that I can give to an embassy secretary and expect her to put up a dipole and get it working two hours after the wookies come over the wall."

Antenna length calculations are made easier with a computer program such as my own "Antlers for Windows" (\$30). This program requires you to select the antenna and set the center operating frequency, and the makes the length calculations for you. The author can be reached at P.O. Box 1099, Falls Church, VA 22041.

You're listening to "Sweet Dreams"