Down On The Antenna Farm

by Clyde Kirlin

No discussion of communications at sea would be complete without a word or two about antennas. To many seamen, antennas have always had a touch of black magic about them. The best of radiomen will approach any new installation armed with a bag of tricks, but the laws of physics still prevail.

Unraveling The Single—Side Band (SSB) Antenna

Two antenna forms exist: horizontal and vertical. The vertical antenna best suits the needs of the world afloat. Because antennas must be resonant at the frequency of transmission, the length of antenna becomes very important in meeting several technical requirements and in being compatible with most antenna tuners (couplers) being built today. A good calculation of length begins with the magic number 234. Divide this number by a popular frequency of transmission in megahertz (MHz) and the result is the length in feet of the vertical antenna required. The formula also is good for calculating emergency antenna lengths to be rigged after a dismasting.

Since there are a variety of frequencies now at our disposal for everyday communications, it begins to appear as if we need an infinite number of antennas. But wait! Let's look at some solutions to the problem. When using other frequencies for the chat "down range," an antenna coupler, or tuner, is used to fool the antenna into believing that it is always resonant. For convenience, a 30- to 35-foot antenna is usually chosen, one that is in the middle range of a group of ¼ wavelength multiples. This antenna is close to the point of resonance for six or eight MHz, yet it may be tuned correctly with the antenna coupler, electronically believing that it is able to radiate on frequencies between two and 22 MHz.

Whether you choose to use a vertical whip or backstay for your antenna, the performance will not be impaired.

Assuming the eight MHz frequencies usually to be most productive for transmission over a 1,500- to 2,500-mile range, the backstay is insulated by inserting a high quality lower insulator in it some six to eight feet above the deck, measuring an antenna length of 30 to 35 feet and insulating the upper portion near the masthead. Two insulators at the masthead produce better results by eliminating certain detuning effects found in a metal mast.

A Quick Answer To Tuning

Couplers, those devices that deceive the antenna into thinking it is of all lengths required, are best left to technicians for adjustment, though several of today's truly automatic tuners are but a matter of mating connectors.

Recent innovations in the trade have produced passive tuning devices priced in the $149 range, a price far below the normal $500 to $1,100 for manually set or automatic tuners. Claiming "automatic tuning," the passive coupler is little more than a glossy "dummy" load that allows an efficient transfer of power from today's solid-state transceivers to the load, this time fooling the transceiver into thinking it is connected to a good antenna. Tapping into the passive device with a 23- or 35-foot wire provides the radiating antenna.

Steven Hahn of Teiresias, Inc., in Sag Harbor, New York, producer of such a device, openly admits to a falling off of efficiency, yet properly points to the lack of efficiency of any vertical antenna short in length with respect to wavelength. "If it does the job of communicating for you, then it is an effective device," said Steve. I must agree with him and quickly point to the advantages of using this as an emergency antenna, as well.

There Are Many Ways

Not only are vertical antennas used for effective communications, they also stow nicely on deck for emergency needs. Do vertical antennas work as well? Of course! An easy approach is to mount the antenna aft in a place where a swinging boom or clinging hands will not cause a disaster. A 23-foot vertical whip will do the job but, if carriage is possible, more efficiency can be gained from 28- and 35-foot vertical antennas. In all cases they must be kept in the clear. Never mount them

The Loran/VHF Combo (left) looks like any other VHF antenna, and saves valuable space on the 'antenna farm'. Center, the bulges on what would be a normally smooth, tapered antenna whip depict the 'traps' in a trap antenna. Right, a typical single-sideband vertical antenna for stern pulpit mounting.

inboard of shrouds and other rigging or in a place where they are likely to be used as a handhold by unthinking crew.

Another Way Out

For any boat with need for a limited selection of SSB frequencies, often the trap or trapped whip antenna will suffice. Employing vertical styling that uses a combination of internal coils and capacitors, trap antennas allow pre-designated sections of the whip to operate on specific frequency bands from four to 22 MHz. Such a combination might be 4-6-8 MHz or 8-12-17 MHz. While this works well with a small number of frequencies, the efficiency of the system deteriorates as several bands are attempted in the trap networks.

The unique design of this antenna eliminates the need for a costly antenna coupler. The trap antenna operates close to its resonant frequency, thus a high level of power is radiated into the air, rather than being dissipated as bilge heat generated by an antenna tuner.

Whether for SSB or VHF, antenna theory remains the same. However, with VHF frequencies more can be done with a smaller antenna.

The effectiveness of a whip antenna is measured in decibels (db) "gain." Simplified, creating gain in an antenna may be likened to squashing a doughnut. What was a nicely rounded form becomes a thick disc of larger diameter. Antenna signals from gain antennas do likewise. The higher the gain number, 3 db, 6 db or 9 db, the farther the signal will extend in range. The question is, will it be pressed to the water or extend at an upward angle into the air? Some antennas are ⅝ wavelength systems, with a multiple quantity of these elements stacked in a vertical (colinear) fashion to raise the gain levels. It is the ⅝ wavelength design that keeps the signal on the water, even produces some down tilt to accommodate heeling. Were ½ wavelength elements used, gain would be achieved but the angle of radiation would tend to elevate and longer ranges would be foreshortened at distant points.

HyGain Division of Telex Communications, Minneapolis, Minnesota, constructs their antennas in a wrapped triangular fiberglass cloth configuration, baking a gel coat sealant on the outside and epoxy potting the internal elements to eliminate vibration effects. Their 3 db gain antenna is of ½ wavelength design, while the rest are ⅝ wavelength.

Putting It Together

With VHF signals traveling in a "line-of-sight" pattern, mounting height becomes more important than gain. A large angle of heel is detrimental to the signal range of a 6-db gain antenna, whether mounted at the masthead or at deck level. Reduce the gain to that of 3 db, place it at the masthead and the wider signal angle will place more power down range to out perform a 6-db gain antenna every time.

A Look At Ham Antennas

An amateur radio station antenna afloat differs in no way from those previously described. Being licensed as an amateur station allows the use of manually adjusted couplers to tune the variety of frequencies used though, as with marine systems, automatic couplers are also available.

There is also nothing wrong with using amateur mobile antennas, though few are made to withstand the marine atmosphere. For use in the 75, 40, 20, 15 and 10-meter bands, place it on the pushpit for a ground surface and good communications will result. Marine-band models are also available on special order.

However, for two-meter-band operation on which you will find many coastal repeaters responding to your signal, masthead mounting of a two-meter antenna is required.

On The Antenna Farm

If you are like many of us, the space available for the mounting of antennas soon is at a premium. What to do? Try the combos. Datamarine International produces a combination Loran-C and VHF antenna (to be used with their equipment) that solves the cluttered "antenna farm" problem. Now, Shakespeare has introduced a similar design but one that fits over any of today's Loran-C antenna couplers. Eight feet high, it has the capability of a 6-db gain VHF antenna and a good Loran-C whip. It also can be used as a backup VHF antenna in the event of a dismasting.

How do you accommodate all the necessary antennas? I suggest that you mount one of them, then imagine a cone with a 60-degree apex placed over the tip of the antenna. Do not mount another antenna within the circle inscribed by the base of that cone.

The Oft-Forgotten Other Half

Early antenna tinkerers found that an antenna must be ½ wavelength at the frequency of operation in order to perform efficiently. But what about vertical antennas that are only ¼ wavelength long? The laws of physics decree that an image of the vertical antenna is formed within the Earth to provide the missing half, hence, a vast area of damp earth or a pseudo-means, under the base of vertical antennas, is required for good performance as either receiving or transmitting antennas. For applications afloat, this means a large horizontal ground surface built close to the waterline to take advantage of any coupling effect to the vast water surface.

What Is A Good Ground?

The secret is this: According to the textbook, a ground plane consisting of 120 radials extending from the base of the antenna in all directions (radials as long as the antenna is high), would make an excellent ground system. But 35-foot radials are impossible on my 30-foot ketch. Naturally, it does not work out that way in our real world and thus another compromise is reached.

Copper screening, 16 to 22 mesh, though costly, is the simplest material with which to work. Keeping it well aft, lay it under bunks, cabin sole, quarter berths, tankage, shelves and overheads. Give not a thought to the fact that all sections do not lay in a horizontal plane. When the antenna looks down on it, it sees nothing but horizontal grounding. Seam each individual section with soldered copper straps and join the sections with multiple strapping. As a final touch, deterioration by copper oxides and other bilge water agents may be prevented by coating the screen with epoxy-type materials.

Enhancement of the ground counterpoise system (another term for radio ground system), may be gained by bonding it to the engine (if negative ground and not floating), hydraulic steering tubing, the fire extinguisher system, any metallic waterlines and the common boat ground.

Often, the interior of a sailboat is too congested to perform the proposed work. When this is the case, a loop of copper strap along the sheer to describe the perimeter boundaries of a 200- to 400-square foot counterpoise area, or merely using the stainless steel lifelines and toe rails, is often adequate for good communications.

Select your antennas for performance and strength to withstand all weather. Position them for efficiency and complement them with a good ground system and you, too, will be able to communicate with fellow sailors clearly.

Clyde Kirlin is a free-lance writer who owns and operates a marine electronics business in Walnut Creek, California.