Easy 50-Ω Feed for a Helix

Looking for an easy way to match that helical antenna? Here's a new twist that will keep you from going in circles.

By Joe M. Cadwallader,* K6ZMW

Recent interest in circular polarization (cp) on the vhf and uhf bands is growing, perhaps partially because of AMSAT-OSCAR Phase III and other satellite work. One of the most popular cp antennas is the helix, first described in depth by J. D. Kraus.[1] The helix is easy to build and very forgiving of minor dimensional errors owing in part to its rather broad (70%) bandwidth. For this reason the actual performance of a helix closely matches the theoretical performance.

Problems and Cures

While working at 1296 MHz, where I've used both a quadhelix[2] and a helical feed for a dish, I found two deficiencies of the helix. First, terminating the helix at a connector in the center of the helix (Fig. 1) is mechanically awkward and electrically rather undefined. I chose to terminate the helix in an N connector mounted on the ground screen at the periphery of the helix (Fig. 2). Simply connect the helix conductor to the N connector as close to the ground screen as possible (Fig. 3). Then adjust the first turn of the helix to maintain uniform spacing of the turns.

This modification goes a long way toward curing the second deficiency of the helix — the 140 Ω nominal feed-point impedance. Troetschel's approach[3] solves the feed impedance problem nicely in multiple helix arrays, but matching 50 Ω coax to a single helix is still a problem. The traditional quarter-wavelength matching section has proved difficult to fabricate and maintain. But if the helix is fed at the periphery, the first half turn of the helix conductor (leaving the N connector) acts much like a transmission line — a single conductor over a perfectly conducting ground plane. The impedance of such a transmission line is:

$$Z_0 = 138 \log \frac{4h}{d}$$

where Z_0 is the impedance of the line, h is the height of the center of the conductor above the ground plane and d is the conductor diameter (both h and d must be in the same units of measure). The cross-sectional detail of Fig. 1 diagrams this. Clearly, the impedance of the helix is 140 Ω a turn or two away from the feed point. But as the helix conductor swoops down toward the feed connector (and the ground plane), h is getting smaller; therefore, the impedance is dropping. The 140 Ω nominal impedance of the helix is being transformed down to a lower value. For any particular conductor diameter, an optimum height can be found that will produce a feed-point impedance equal to 50 Ω. Preferably the height should be kept very small, and the diameter should be large. Apply power to the helix and measure the VSWR at the operating frequency; adjust the height for an optimum match.

[1]Notes appear on page 29.
*23427 Clearpool Pl., Harbor City, CA 90710

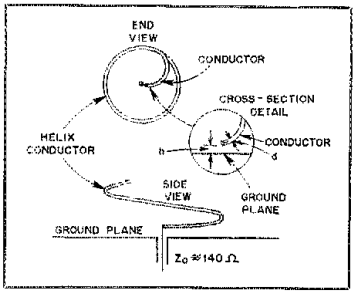

Fig. 1 — End view and side view of traditional helix configuration. Cross-sectional detail shows "standard" method for attaching feed line to the helix.

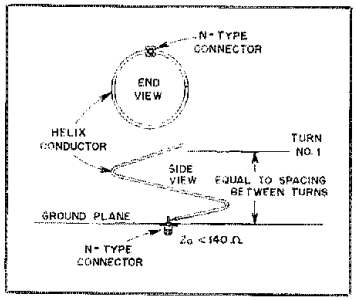

Fig. 2 — End view and side view of peripherally fed helix.

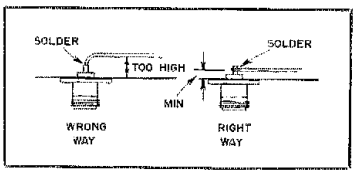

Fig. 3 — Wrong and right ways to attach helix to N connector.

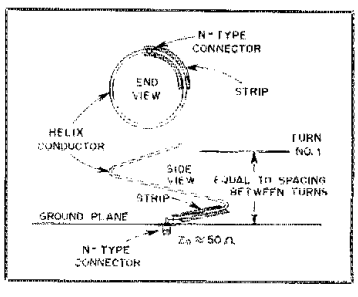

Fig. 4 — End view and side view of peripherally fed helix with metal strip added to improve transformer action.

Typically, the conductor diameter may not be large enough to result in a 50-Ω match at practical (small) values of h. In this case a strip of thin brass shim stock can be soldered to the first quarter turn of the helix conductor (Fig. 4), as described recently by Kraus.[4] This effectively produces a larger diameter conductor which causes the impedance to drop further. The edges of this strip can be slit every 1/2 in. (12 mm) or so, and bent up or down (toward or away from the ground plane) to tune the line for an optimum match.

This approach will yield a perfect match to nearly any coax. The usually wide bandwidth of the helix (70% for VSWR less than 2 to 1) will be reduced slightly to about 40% for the same conditions. This is not enough to be of any consequence for most amateur work. The improvements in assembly, adjustment and performance are well worth the effort to make the cp helix more practical to build and tune. ~~QST~~

Notes

[1]Kraus, *Antennas*, McGraw-Hill Book Co., 1950, chapter 7.
[2]*The ARRL Antenna Book*, 13th edition, pp. 260-263.
[3]Troetschel, "A Quadhelix Antenna for the 1215-Mc. Band," *QST*, August 1963, p. 36.
[4]Kraus, "A 50-Ohm Input Impedance for Helical Beam Antennas," *IEEE Transactions on Antennas and Propagation*, Vol. AP-25, No. 6, November 1977, p. 913.

Strays

PRUDENT READING

☐ The National Electrical Code, the purpose of which is ". . . practical safeguarding of persons and property from hazards arising from the use of electricity," has many headings (in Article 810) applicable to Amateur Radio. Among them are: Amateur transmitting and receiving stations — antenna systems, Material, Supports, Avoidance of contacts with conductors of other systems, Splices, Grounding, Grounding conductors — receiving stations, Size of antenna, Size of lead-in conductor, Clearance on building, Entrance to building, Protection against accidental contact, Antenna discharge units — transmitting stations, and Grounding conductors — amateur transmitting and receiving stations. If you would like specific details of these subjects, check your local library for the *1981 National Electrical Code Book*. It may also be obtained from the Construction Book Store, Inc., 1830 NE 2nd St., P. O. Box 717, Gainesville, FL 32602. — *John Reisenauer, KA7BKI*

I-D'ING FOR PROTECTION

☐ According to *Desert AIRE Waves*, you can help protect your gear from theft by engraving it with a number already accessible to the FBI's computer file listing of stolen property, the National Crime Information Center. You should use, for example, your driver's license number preceded by your state's two-letter code, thus automatically linking your name and address to your gear. Don't use your Social Security Number; it is meaningless to this computer. In the event of theft, chances of recovery of your gear are somewhat increased by using this system. — *Worldradio News*

I would like to get in touch with . . .

☐ anyone interested in forming a net of amateurs who are also lawyers. Peter B. Broida, K3SFP, 353 N. Edison St., Arlington, VA 22203.

Three of the four Associate Deans at Yale Law School also happen to be Amateur Radio enthusiasts. They are, from left to right, Edward Dauer, K1CBR, Arthur Charpentier, N1AQM, and James Zirkle, AG1X. N1AQM recently retired, and his gift was a 2-m, hand-held transceiver to keep in touch. *(photo by Sven Martson)*

MOVING? UPGRADING?

☐ When you change your address or call sign, be sure to notify the Circulation Department at ARRL Hq. Enclose a recent address label from a *QST* wrapper if at all possible. Address your letter to Circulation Department, ARRL, 225 Main St., Newington, CT 06111. Please allow six weeks for the change to take effect. Once we have the information, we'll make sure your records are kept up-to-date so you'll be sure to receive *QST* without interruption. If you're writing to Hq. about something else, please use a separate piece of paper for each request.

MOUNT ST. HELENS AWARD

☐ A full-color photographic award showing last year's spectacular eruption is now available by contacting, with no band or mode restrictions, eight or more stations in Clark, Cowlitz, Skamania or Lewis counties, Washington. Any contacts made after March 27, 1980, are valid. Send log information, station calls, dates, signal reports and $2 to: Awards Manager, CCARC, P. O. Box 1424, Vancouver, WA 98668. All proceeds will go to the Reid Blackburn Scholarship Fund. Reid, W7AIA, lost his life in the disaster. — *John Mollan, AE7P*

AMATEUR ANTICS

Strange Antennas

☐ A long time ago, a VE7 was on the air with a good signal. He said he was using his bedsprings as his antenna. His wife was still asleep, he added, and the rig loaded up better that way!

☐ Ted Wion, WA6OJE, reports having great success using his soldering iron for an antenna. One day, Ted was repairing a coax line that was still connected to the receiver. He touched the tip of the hot soldering gun to the inner conductor of the coax, and a few signals jumped out of the 75-meter noise. Thinking that if he could hear them maybe he could work them, he tried and succeeded — with the gun still plugged in the wall! This became a challenge, and Ted claims to have subsequently worked all 50 states and four countries with that unique antenna. He sends a special certificate with his QSL stating that he was using a soldering-iron antenna.

Big Antennas

☐ In the 1967 Sweepstakes contest, Thomas Taormina, WA5LES, and Charles Coleman, K5LZO, strung a V beam from a blimp floating at 185 ft. Each leg was half a mile long, and the array was so heavy that they had to use an automobile to pull the V legs out tight.

☐ During the 1974 Field Day, the operators at K5DUT/5 erected a full-sized, 2-element quad for 75 meters. The array was pulled up on four 60-ft poles, and the loops were spaced 40 ft apart. — *John G. Troster, W6ISQ, 82 Belbrook Way, Atherton, CA 94025*

[Editor's Note: Please send all correspondence to the author at the above address.]

I would like to get in touch with . . .

☐ other amateurs who are pathologists. Philip Altman, MD, 1050 Linden Ave., Long Beach, CA 90801.