

The W3KH Quadrifilar Helix Antenna

By Eugene F. Ruperto, W3KH

If your existing VHF omnidirectional antenna coverage is "just okay," this twisted 'tenna is probably just what you need!

I still remember that hollow, ghostly signal emanating from my receiver in 1957. The signal was noisy and it faded, but that was to be expected—it was coming from outer space. I couldn't help but marvel that mankind had placed this signal sender in space! They called it *Sputnik*, and it served to usher in the space race.

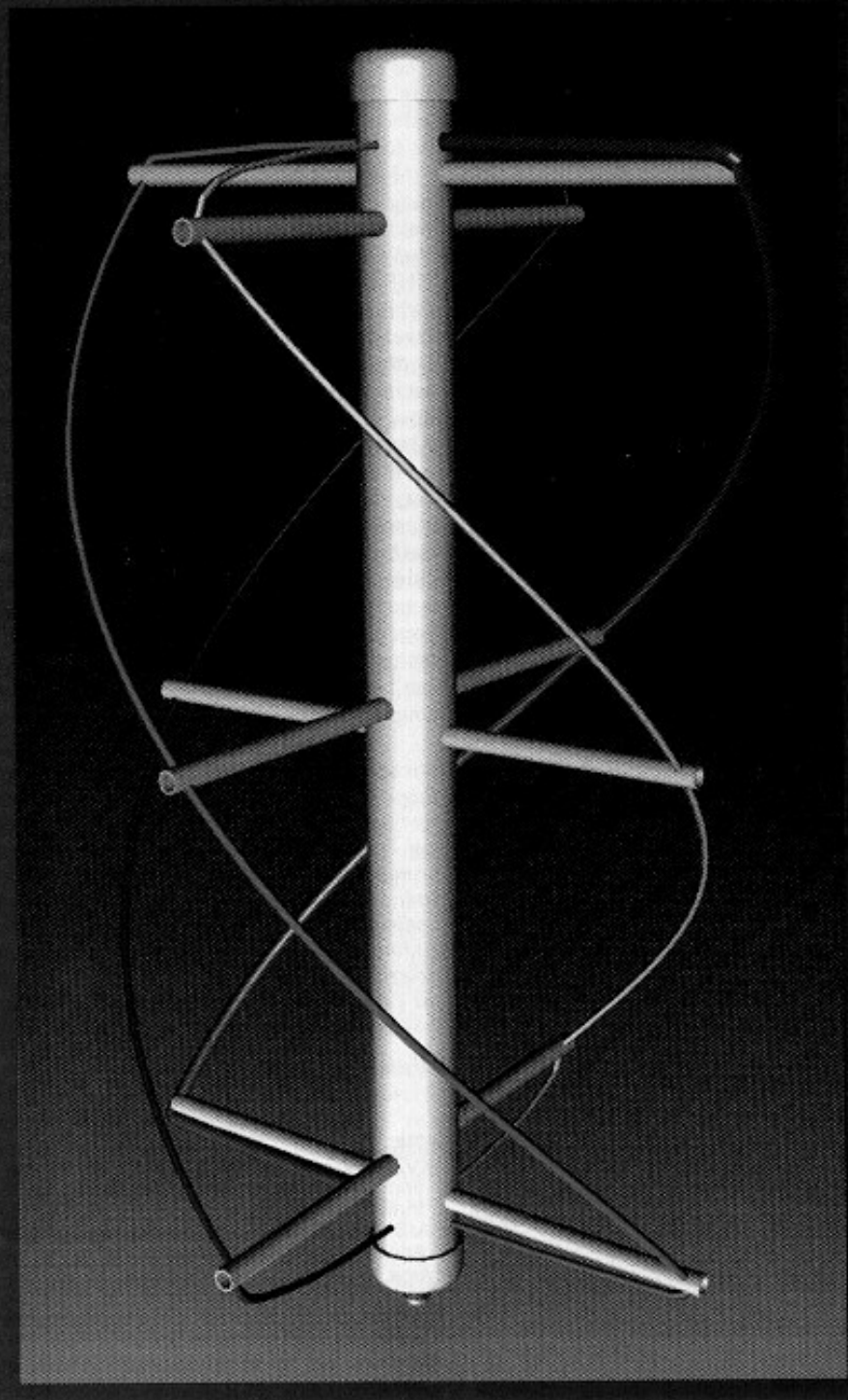
Little did I realize then that four decades later we would have satellites in orbit around Earth and other heavenly bodies performing all sorts of tasks. Now we tend to take satellites for granted. According to the latest information on the Amateur Radio birds, I count about 15 low-Earth-orbit (LEO) satellites for digital, experimental and communications work, and two in *Molniya*-type highly elliptical orbits (AO-10 and AO-13), with the probability of a third to be launched in early 1997.

The world has access to several VHF weather satellites in low Earth orbit. Unlike geostationary Earth-orbiting satellites (GOES), the ever-changing position of the LEOs presents a problem for the Earth station equipped with a fixed receiving antenna: signal fading caused by the orientation of the propagated wavefront. This antenna provides a solution to the problem. Although this antenna is designed primarily for use with the weather sats, it can also be used with any of the polar-orbiting satellites.

These days, technical advances and miniature solid-state devices make it relatively easy for an experimenter to acquire a weather-satellite receiver and a computer interface at an affordable price. So it was only a matter of time before I replaced my outdated weather-sat station with state-of-the-art equipment.

Yesterday

In the early '70s, I built a drum recorder that used a box with a light-tight lid. It was a clumsy affair. The box and photo equipment took up most of the 6x8-foot room in which it was housed. Next to the recorder, a 3x4-foot table supported a tube-type receiver, frequency converters, a reel-to-reel tape recorder (our data-storage medium), a



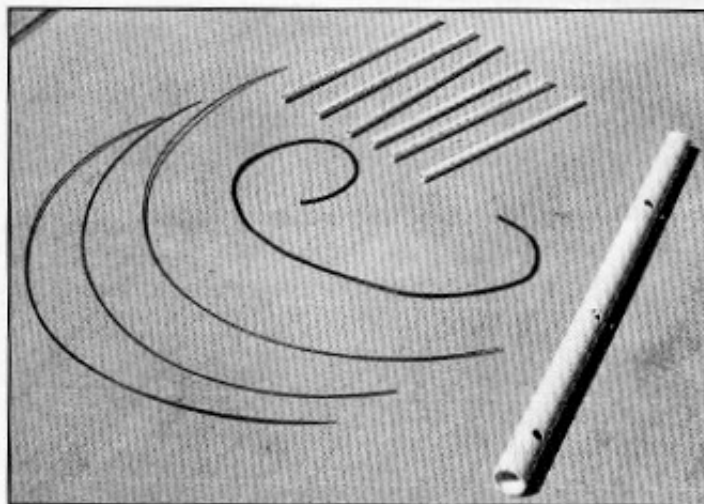


Figure 1—The humble beginnings of a terrific antenna.

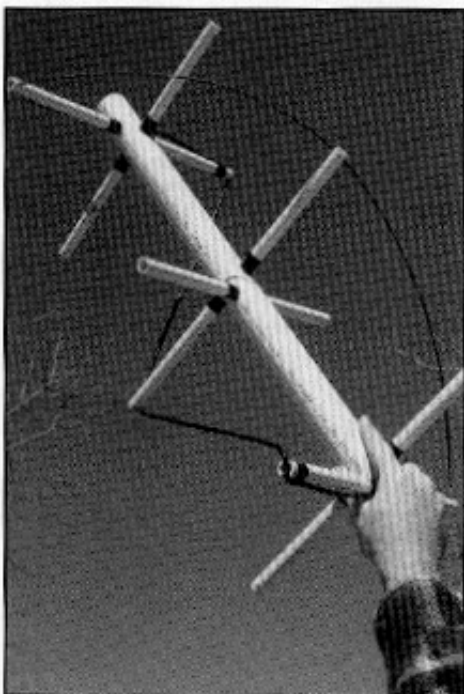


Figure 2—The quadrifilar helix antenna with two of the four legs (filars) of one loop attached.

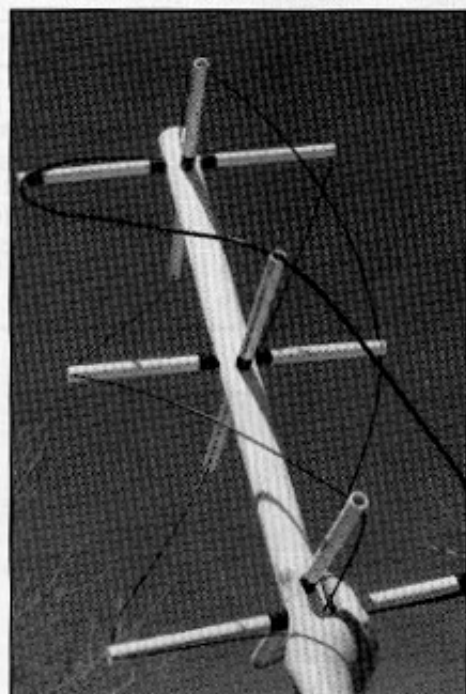


Figure 3—This view shows the QHA with all four legs in place. The ends of the PVC cross arms that hold the coaxial leg are notched; the wire elements pass through holes drilled in the ends of their supporting cross arms.

50-pound monitor oscilloscope, az/el rotator controls for the helical antennas and a multitude of other devices including the drum-driver amplifiers and homemade demodulator. This station provided coverage of the polar-orbiting and geostationary satellites and furnished me with "tons" of data. Over time, my weather-satellite station evolved into a replica of mission control for the manned-spaceflight program! I had so much gear, it had to be housed in a shed separate from the house.

Today

Now, my entire weather-satellite station sits unobtrusively in one corner of the shack, occupying an area of less than one square foot—about the same size as my

outboard DSP filter. My PC—now the display for weather-sat photos—is used for many applications, so an A/B switch allows me to toggle the PC between the printer and the weather-satellite interface.

What I needed next was a simple antenna system for unattended operation—something without rotators—something that would provide fairly good coverage, from about 20° above the horizon on an overhead pass. It was a simple request, but apparently one without a simple solution.

Background

Initially I used a VHF discone antenna with mixed results. The discone had a good low-elevation capture angle, but exhibited severe pattern nulls a few minutes after

acquisition of signal and again when the satellite was nearly overhead. The fades and nulls repeated later as it approached the other horizon. About this time, Dave Bodnar, N3ENM (who got me reinterested in the antenna project), built a turnstile-reflector (T-R) array. The antenna worked fairly well but exhibited signal dropout caused by several nulls in the pattern. Dave built two more T-Rs, relocating them for comparison purposes. Unfortunately, the antennas retained their characteristic fades and nulls. Another experimenter and I built T-Rs and we experienced the same results. I suggested that we move on to the Lindenblad antenna. The Lindenblad proved to be a much better antenna for our needs than either the T-R or the discone, but still exhibited nulls and fades. Over a period of several months, I evaluated the antennas and found that by switching from one antenna to another on the downside of a fade, I could obtain a fade-free picture, but lost some data during the switching interval. Such an arrangement isn't conducive to unattended operation, so my quest for a fade-free antenna continued.

The Quadrifilar Helix Antenna

Several magazines have published articles on the construction of the quadrifilar helix antenna (QHA) originally developed by Dr. Kilgus,¹ but the articles themselves were generally reader unfriendly—some more than others. One exception is *Reflections* by Walt Maxwell, W2DU.² Walt had considerable experience evaluating and testing this antenna while employed as an engineer for RCA.

Part of the problem of replicating the antenna lies in its geometry. The QHA is difficult to describe and photograph. Some of the artist's renditions left me with more questions than answers, and some connections between elements as shown conflicted with previously published data. However, those who have successfully constructed the antenna say it is *the* single-antenna answer to satellite reception for the low-Earth-orbiting satellites. I agree.

Design Considerations

I had misgivings about the QHA construction because the experts implied that sophisticated equipment is necessary to adjust and test the antenna. I don't disagree with that assumption, but I *do* know that it's possible to construct a successfully performing QHA by following a cookbook approach using scaled figures from a successful QHA. These data—used as the design basis for our antennas—were published in an article describing the design of a pair of circularly polarized S-band communication-satellite antennas for the Air Force³ and designed to be spacecraft mounted. Using this antenna as a model, we've constructed more than six QHAs,

¹Notes appear on page 34.

mostly for the weather-satellite frequencies and some for the polar-orbiting 2-meter and 70-centimeter satellites with excellent results—without the need for adjustments and tuning. Precision construction is not my forte, but by following some prescribed universal calculations, a reproducible and satisfactory antenna can be built using simple tools. The proof is in the results.

The ultrahigh frequencies require a high degree of constructional precision because of the antenna's small size. For instance, the antenna used for the Air Force at 2.2 GHz has a diameter of 0.92 inch and a length of 1.39 inches! Nested inside this helix is a smaller helix, 0.837 inch in diameter and 1.27 inches in length. In my opinion, construction of an antenna that size requires the skill of a watchmaker! On the other hand, a QHA for 137.5 MHz is 22.4 inches long and almost 15 inches in diameter. The smaller, nested helix measures 20.5 by 13.5 inches; for 2 meters, the antenna is not much smaller. Antennas of this size are not difficult to duplicate even for those of us who are "constructionally challenged" (using pre-cut pieces, I can build a QHA in less than an hour!).

Electrical Characteristics

A half-turn half-wavelength QHA has a theoretical gain of 5 dBi and a 3-dB beamwidth of about 115°, with a characteristic impedance of 40 Ω. The antenna consists basically of a four-element, half-turn helical antenna, with each pair of elements described as a *bifilar*, both of which are fed in phase quadrature. Several feed methods can be employed, all of which appeared to be too complicated for us with the exception of the infinite-balun design, which uses a length of coax as one of the four elements. To produce the necessary 90° phase difference between the bifilar elements, either of two methods can be used. One is to use the same size bifilars, which essentially consist of two twisted loops with their vertical axes centered and aligned, and the loops rotated so that they're 90° to each other (like an egg-beater), and using a quadrature hybrid feed. Such an antenna requires two feed lines, one for each of the filar pairs. The second and more practical method, in my estimation, is the self-phasing system, which uses *different-size loops*: a larger loop designed to resonate *below* the design frequency (providing an inductive reactance component) and a smaller loop to resonate *higher* than the design frequency (introducing a capacitive-reactance component), causing the current to lead in the smaller loop and lag in the larger loop. The element lengths are 0.560 λ for the larger loop, and 0.508 λ for the smaller loop. According to the range tests performed by W2DU, to achieve optimum circular polarization, the wire used in the construction of the bifilar elements should be 0.0088 λ in diameter. Walt indicates that in the quadrifilar mode, the fields from the

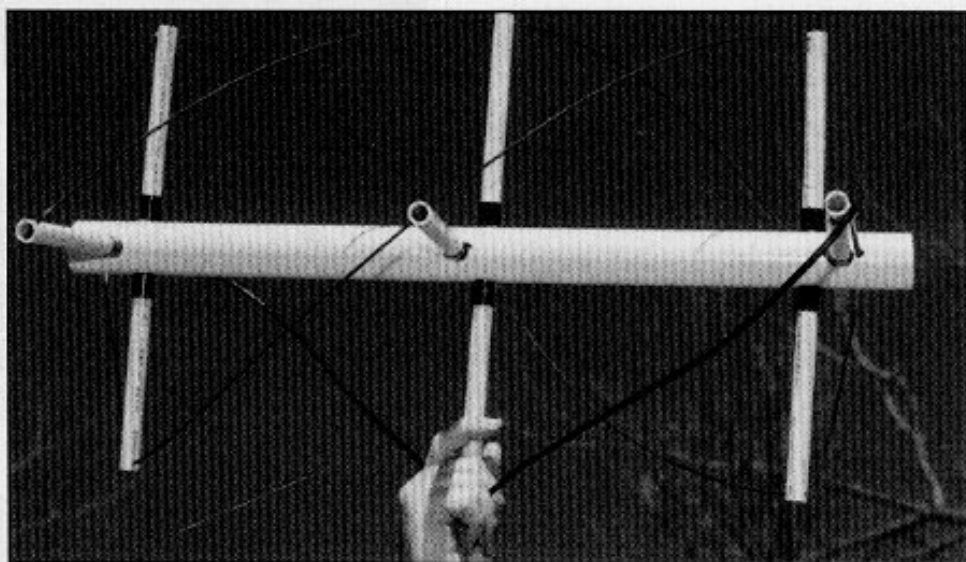


Figure 4—Another view of the QHA.

Table 1

Quadrifilar Helix Antenna Dimensions

$\lambda = 85.897$

Freq (MHz)	Wavelength		Small Loop		Big Loop		
	λ (inches)	Leg Size (0.508 λ)	Diameter (0.156 λ)	Length (0.238 λ)	Leg Size (0.560 λ)	Diameter (0.173 λ)	Length (0.26 λ)
137.5	85.9	43.64	13.4	20.44	48.10	14.86	22.33
146	80.9	41.09	12.6	19.25	45.30	14.0	21.03
436	27.09	13.76	4.22	6.44	15.17	4.68	7.04



Figure 5—An end-on view of the top of the QHA prior to soldering the loops and installing the PVC cap.

individual bifilar helices combine in optimum phase to obtain unidirectional end-fire gain. The currents in the two bifilars must be in quadrature phase. This 90° relationship is obtained by making their respective terminal impedances $R + jX$ and $R - jX$ where $X = R$, so that the currents in the respective helices are -45° and $+45^\circ$. The critical parameter in this relationship is the terminal reactance, X , where the distributed inductance of the helical element is the primary determining factor. This assures the $\pm 45^\circ$ current relationship necessary to obtain true circular polarization in the combined fields and to obtain maximum forward radiation and minimum back lobe. Failure to achieve the optimum element diameter of 0.0088 λ results in a form of elliptical, rather than true circular polarization, and the performance may be a few tenths of a decibel below optimum, accord-

ing to Walt's calculations. For my antenna, using #10 wire translates roughly to an element diameter of 0.0012 λ at 137.5 MHz—not ideal, but good enough.

To get a grasp of the QHA's topography, visualize the antenna as consisting of two concentric cylinders over which the helices are wound (see Figures 1 through 5). In two-dimensional space, the cylinders can be represented by two nested rectangles depicting the height and width of the cylinders. The width of the larger cylinder (or rectangle) can be represented by 0.173 λ, and the width of the smaller cylinder represented by 0.156 λ. The length of the larger cylinder or rectangle can be represented by 0.260 λ, and the length of the smaller rectangle or cylinder can be represented by 0.238 λ. Using these figures, you should be able to scale the QHA to virtually any frequency. Table 1 shows some representative antenna sizes for various frequencies, along with the universal parameters needed to arrive at these figures.

Physical Construction

After several false starts using plywood circles and plastic-bucket forms to hold the helices, I opted for a simple PVC solution that not only is the simplest from a constructional standpoint, but also the best for wind loading. I use a 25-inch-long piece of schedule 40, 2-inch-diameter PVC pipe for the vertical member. The cross arms that support the helices are six pieces of 1/2-inch-diameter PVC tubing: three the

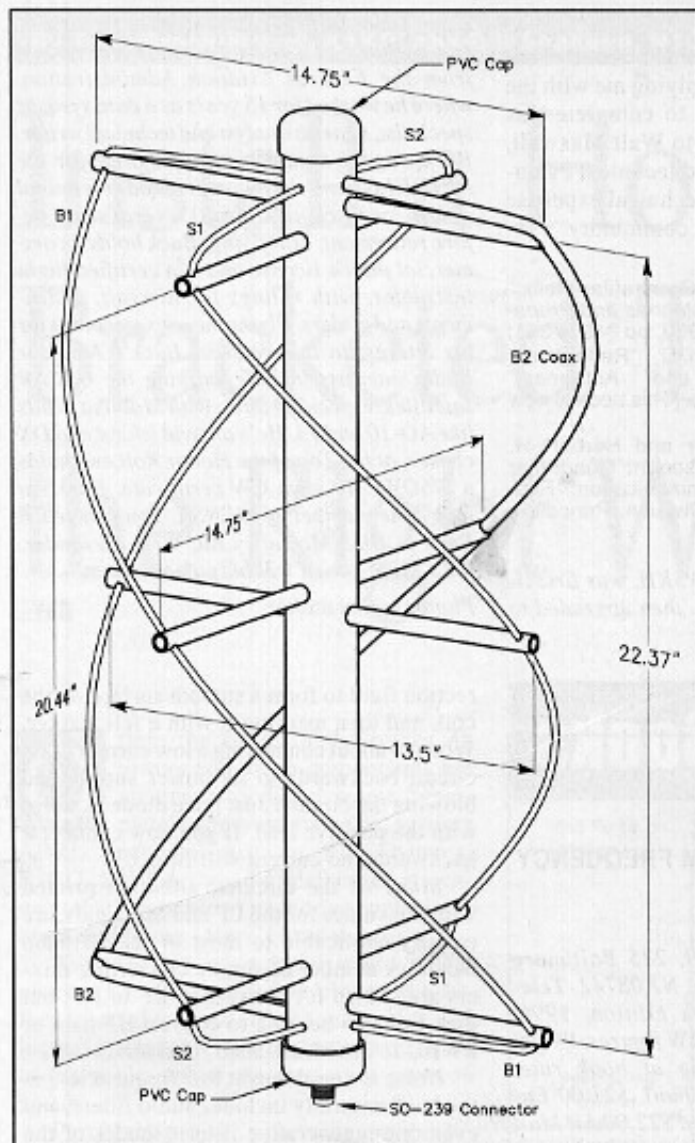


Figure 6—Drawing of the QHA identifying the individual legs; see text for an explanation.

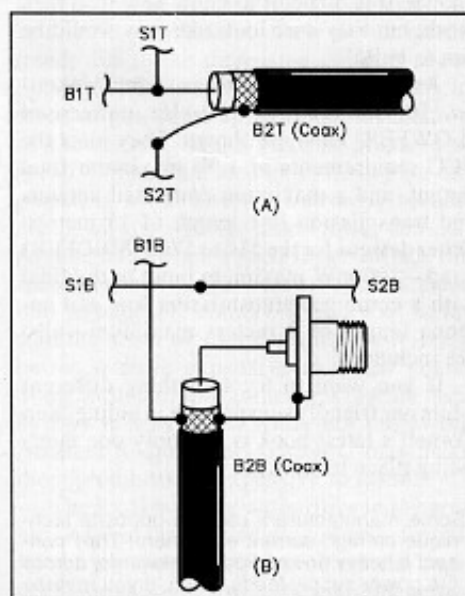


Figure 7—At A, element connections at the top of the antenna. B shows the connections at the bottom of the antenna. The identifiers are those shown in Figure 6 and explained in the text.

width of the large rectangle or cylinder, and three the width of the smaller cylinder. Two cross arms are needed for the top and bottom of each cylinder. The cross arms are oriented perpendicularly to the vertical member and parallel to each other. A third cross arm is placed midway between the two at a 90° angle. This process is repeated for the smaller cylindrical dimensions using the three smaller cross arms with the top and bottom pieces oriented 90° to the large pieces. Using 5/8-inch-diameter holes in the 2-inch pipe ensures a reasonably snug fit for the 1/2-inch-diameter cross pieces. Each cross arm is drilled (or notched) at its ends to accept the lengths of wire and coax used for the elements. Then the cross arms are centered and cemented in place with PVC cement. For the weather-satellite antennas, I use #10 copperclad antenna wire for three of the helices and a length of RG-8 for the balun, which is also the fourth helix. (I do not consider the velocity factor of the coax leg for length calculation.) For the UHF antennas, I use #10 soft-drawn copper wire

The prototype worked better than expected and duplicates required no significant changes.

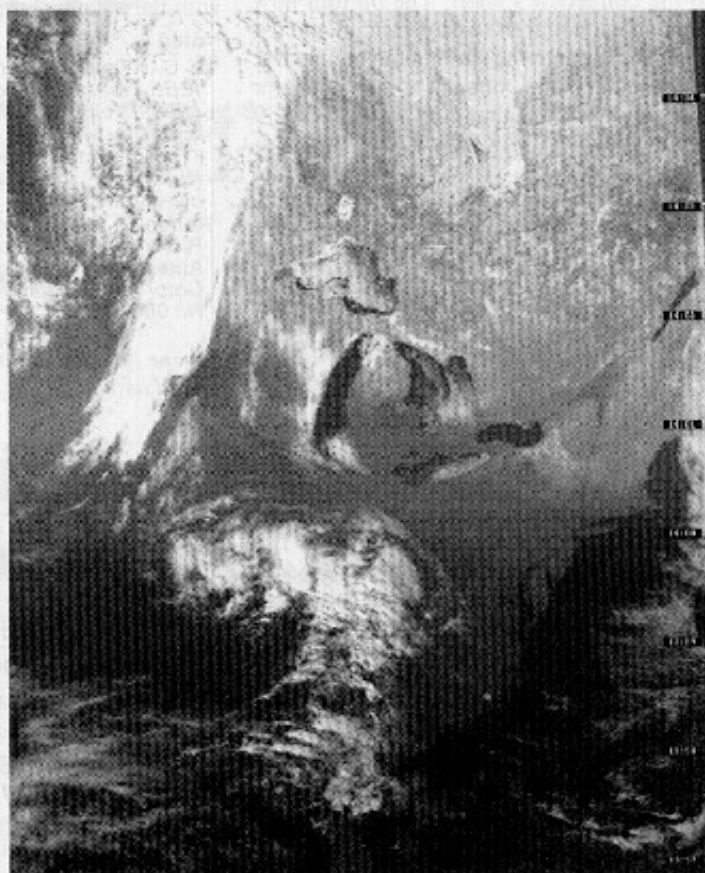


Figure 8—It's said that "The proof of the pudding is in the eating." To a weather-satellite tracker, clear, no-fade, no-noise pictures such as this one—compliments of W3KH's quadrifilar helix antenna—are delicious fare!

and RG-58 coax. Copperclad wire is difficult to work with, but holds its shape well. Smaller antennas can be built without the cross arms because the wire is sufficiently self-supporting.

To minimize confusion regarding the connections and to indicate the individual legs of the helices, I label each loop or cylinder as B (for big) and S (for small); T and B indicate top and bottom. See Figures 6 and 7. I split each loop using leg designators as B1T and B1B, B2T and B2B, S1T and S1B and S2T and S2B, with B2 being the length of coax and the other three legs as wires. For right-hand circular polarization (RHCP) I wind the helices *counterclockwise* as viewed from the top. This is contrary to conventional axial-mode helix construction. (For LHCP, the turns rotate *clockwise* as viewed from the top.) See Figure 7 for the proper connections for the top view. When the antenna is completed, the view shows that there are two connections made to the center conductor of the coax (B2) top. These are B1T and S1T, for a total of three wires on one connection. S2T

connects to B2T braid. The bottom of the antenna has S1B and S2B soldered together to complete the smaller loop. B1B and the braid of B2B are soldered together. I attach an SO-239 connector to the bottom by soldering the center conductor of B2B to the center of the connector and the braid of B2B to the connector's shell. The bottom now has two connections to the braid: one to leg B1B, the other to the shell of the connector. There's only one connection to the center conductor of B2B that goes to the SO-239 center pin.

Insulator Quality

A question arose concerning the dielectric quality of the tubing and pipe used for the insulating material. Antennas—being reciprocal devices—exhibit losses on a percentage basis, the percentage ratio being the same for transmit and receive. Although signal loss may not be as apparent on receive with a 2- μ V signal as with a transmitted signal of 100 W (ie, it would be apparent if dielectric losses caused the PVC cross arms to melt!), signal loss could be a significant factor depending on the quality of the insulating material used in construction. As a test, I popped the pipe into the microwave and “nuked” it for one minute. The white PVC pipe and the tan CPVC tubing showed no significant heating, so I concluded that they're okay for use as insulating materials at 137.5 MHz or thereabouts.

The antennas cost me nothing because the scrap pieces of PVC pipe, tubing and connectors were on hand. Total price for all new materials—including the price of a suitable connector—should be in the neighborhood of \$8 or less.

Results

I use a 70-foot section of RG-9 between the receiver and antenna, which is mounted about 12 feet above ground. As with the earlier antennas, I use a preamp in the shack. With AOS (acquisition of signal) on the first scheduled pass of NOAA-14, I was pleasantly surprised to receive the first of many fade-free passes from the weather satellites, including some spectacular pictures from the Russian Meteors! Although the design indicates a 3-dB beamwidth of 140°, an overhead pass provides useful data down to 10° above the horizon. (My location has a poor horizon, being located in a valley with hills in all directions but south.) I've also received almost-full-frame pictures of the West Coast and northern Mexico at a maximum elevation angle of only 12° at my location. (The 70-cm antenna works fine for PACSATs, although Doppler effect makes manual tracking difficult.) The weather-satellite antenna prototype worked better than expected and a number of copies built by others required no significant changes. The quadrifilar helix antenna is *definitely* a winner! And believe me, it's *easy to build!*

Acknowledgments

Thanks to Chris Van Lint, and Tom Loebl, WA1VTA, for supplying me with the necessary technical data to complete this project. A special thanks to Walt Maxwell, W2DU, for his review and technical evaluation and for sharing his technical expertise with the amateur satellite community.

Notes

- ¹C. C. Kilgus, “Resonant Quadrafilary Helix,” *IEEE Transactions on Antennas and Propagation*, Vol AP-17, May 1969, pp 349 to 351.
- ²M. Walter Maxwell, W2DU, “Reflections, Transmission Lines and Antennas,” (Newington: ARRL, 1990). [This book is now out of print.—Ed.]
- ³Randolph W. Brickner Jr and Herbert H. Rickert, “An S-Band Resonant Quadrafilary Antenna for Satellite Communication,” RCA Corp, Astro-Electronics Division, Princeton, NJ 08540.

Eugene “Buck” Ruperto, W3KH, was first licensed as W3QYG in 1950, then upgraded to

Extra Class in 1957. Buck worked for American Airlines as a radio operator and retired from the Federal Aviation Administration, where he worked for 15 years as a data systems specialist, systems analyst and technical writer. Buck was the manager of automation for the ARTS III system (the automated radar terminal system for tracking aircraft) several years before retirement. Still flying, Buck holds a commercial pilot's license and is a certified flight instructor, with ratings for aircraft, instruments and gliders. Flying, he says, accounts for his interest in the weather. Buck's Amateur Radio interests include working the OSCAR satellites, especially those with Molniya orbits like AO-10 and 13. He's an avid island and DX chaser, at the Top of the Honor Roll and holds a W6OWP 40-wpm CW certificate. Buck's a long-time member of MESA. You can reach Buck at 1035 McGuffey Rd, West Alexander, PA 15376, e-mail w3kh@pulsenet.com.

Photos by the author

QST

New Books

THE LOW AND MEDIUM FREQUENCY RADIO SCRAP BOOK

By Ken Cornell, W2IMB

Published by Ken Cornell, 225 Baltimore Ave, Point Pleasant Beach, NJ 08742. Telephone 908-899-1664. 10th Edition, 1996. 8 1/2 x 11 inches, stapled, B&W figures, 99 pp. \$17.50 including shipping at book rate, \$18.75 shipped first-class mail, \$21.00 Europe Air Mail (US funds) and \$22.00 Air Mail (US funds) to other parts of the world.

Reviewed by Paul Danzer, N1H
Assistant Technical Editor

Want a real challenge? Pick a set of frequencies where you are limited to low power, antenna length is regulated to a tiny fraction of a wavelength, the noise level is usually very high, and propagation is primarily ground wave. In addition, you will have occasional competition from commercial stations, incessant power line conducted noise, and only a handful of fellow enthusiasts close enough to talk to. Sounds like no one would really want to do this? Well, Ken Cornell, W2IMB, believes that many people would want to try it, and if you notice his most recent book is the 10th edition, it appears he is correct.

Of course, the popularity of the book may be due to its content—it is really a manual on circuits and home construction projects. It contains helpful hints for the first-time builder and the details of a dozen one-night projects. Many of the hints and tips are very practical—related by someone who has been homebrewing for many years. As an example, suppose you want to modify a circuit you built a few years ago, or perhaps build another one? Do you remember how many turns you wound for the inductor? W2IMB suggests using white typewriter cor-

rection fluid to form a smooth surface on the coil, and then marking it with a felt marker. Worried about connecting a low current drain circuit backwards to its power supply and blowing the circuit? Just put a diode in series with the positive lead. If you now connect it backwards, no current will flow.¹

Many of the circuits, although printed with the values for the LF and MF bands, are equally applicable to most of the HF ham bands. A number of simple converting mixers are shown for converting LF to HF, but they can also be used to convert HF ham or SWBC to broadcast-band receivers.

Noise is a problem at low frequencies, so the book naturally includes audio filters, and even one regenerative filter—shades of the old National *Select-O-Ject*. Circuits such as small audio amplifiers, wave traps and power supplies are scattered through the book. A number of loop and ferrite core antennas are shown. It is difficult to know how well they work, but they sure look like they would be fun to build!

As in previous editions, simple exciters for the 160 to 190-kHz unlicensed (LOWFER) band are shown. They meet the FCC requirements of 1 W maximum final output, and a maximum combined antenna and transmission line length of 15 meters. Other designs for the 510 to 1705 (MEDFER) band—100 mW maximum input to the final with a combined transmission line and antenna length of 3 meters maximum—also are included.

If you want to try something different while our friendly sunspots are in hiding, Ken Cornell's latest book is certainly one interesting place to start.

¹ Some manufacturers use the opposite technique on high-current equipment. They connect a heavy power diode backwards, across the power supply leads. Then, if you reverse the supply leads, the fuse presumably will blow before the equipment does—and, under normal conditions, the supply voltage to the equipment is not reduced by the drop in a series diode. But notice the word *presumably*.

QST

replacement drive belts. Then, one day as I was driving past a local bearing supply company, the "bulb in my head" lit. Another day, I stopped to check out the company's supply of O rings. Using an old belt from the SB-102 as a sample, the clerk came up with a 1/8x2 1/8x2 1/8-inch OD O ring. The rings are sold in bags of five at \$3.50 plus tax. I needed only three rings (belts), but now have two spares to go with the rig when I sell it at a swap fest.

COHERENT CW AND GPS—SOME IDEAS

By William H. Alliston, W3ICB, 4880 Greensburg Rd., Murrysville, PA 15668; williamsa@nb.net

♦ The excellent article by Brooks Shera, W5OJM,⁴ can also be the basis for a coming of age for coherent CW. With a frequency (and hence, timing) standard better than 1 part in 10¹⁰, it should be practical to keep a coherent CW transmitter and receiver synchronized for something like a year at speeds up to 40 WPM, with no further synchronizing adjustments! (And—thanks to the orbiting GPS atomic clocks—at global distances).

The original concept for coherent CW had obvious advantages in terms of very narrow bandwidths, maximizing the number of stations that could operate within an assigned band and the ability to copy signals down in the noise. But the thought of copying hours on end of perfectly sent Morse at the proposed 12 WPM is enough to send any experienced CW operator running for the hills!

Improved timing from the GPS satellites will allow the 12-WPM-only idea to be scrapped in favor of a selectable set of code speeds suitable for most operator skill levels. For example, speeds of 10, 12, 13.3, 15, 17, 20, 24, 30 and 40 WPM might be selected by the stations in contact by using multiples of a basic (fastest) timing interval for each Morse character. The set of speeds in this example would be available using a basic timing interval corresponding to a dot length at 120 WPM, which would still allow two stations to remain synched for months without further adjustment.

Coherent CW on this new basis provides something for everyone interested in CW operation. An operator could select copy by ear, and send using a conventional key or keyer. The operator would hear the as-keyed sidetone, and remain blissfully unaware that a microcomputer interlaced to the transmitter was continuously adjusting the Morse timing to match the timing of the coherent CW channel. The only clue might be an occasional prompt from the computer if the timing of the keyed-in message starts to fall behind the timing of the transmitted coherent CW signal. On the other hand, the operator not interested in

CW *per se* can type a message as if for Packet or RTTY, and allow the computer to copy the return message and display it on a monitor or send it to a printer.

Faster code speeds would, of course, result in wider bandwidths. But this should not be a limiting factor, considering the small bandwidth needed anyway; the data rate per Hertz of bandwidth would be maintained regardless. In fact, mark and space frequencies could be used, resulting in a readability improvement of several decibels. These frequencies could be separated by several hundred Hertz for better frequency diversity. Several channel frequencies could then be interleaved, so that other stations could operate between them using channel spacing smaller than the mark and space difference of any two stations in communication. Even separate dot and dash frequencies, with other mark and space arrangements, can be considered. The overwhelming number of arrangements possible obviously calls for setting standards.

With synchronized coherent CW using channelized frequencies, it will be much easier to use correlation techniques to copy signals down in the noise. The computer at the receiving end need only determine if a signal was, or was not, present in each timing interval. Use of separate mark and space frequencies would further improve the reliability of this decision, and added improvement could come from the standard Morse timing and its 1:3 dot/dash ratio. (If separate dot and dash frequencies were used, the fact that a station would never send a dot and dash simultaneously could be used for a further gain in reliability, but now the extra bandwidth starts to add up). Finally, when automatic (computer) copy is in use, the computer could reject any non-Morse combination of dots and dashes, for more accuracy.

This is a bit of speculation on my part as to what might now be done with coherent CW. Getting something started needs the cooperation of several interested hams. I would appreciate hearing from others interested in trying it, or who have suggestions on changes.

Letters for this column may be sent to Technical Correspondence, ARRL, 225 Main St., Newington, CT 06111, or via e-mail to ppagel@arrl.org. Please include your name, call sign, complete mailing address, daytime telephone number and e-mail address on all correspondence. Whether praising or criticizing a work, please send the author(s) a copy of your comments. The publishers of QST assume no responsibility for statements made herein by correspondents. **QST**

Feedback

♦ Please refer to "The W3KH Quadrifilar Helix Antenna," QST, Aug 1996, page 33, Figure 7. The labels S1T and S2T in Figure 7A are transposed; please reverse them. —*tnx Eugene F. Ruperto, W3KH* **QST**

VHF/UHF Century Club Awards

The ARRL VUCC numbered certificate is awarded to amateurs who submit written confirmations for contacts with the minimum number of Maidenhead grid-square locators (indicated in *italics*) for each band listing. The numbers preceding the call signs indicate total grid squares claimed. The numbers following the call signs indicate endorsement levels claimed. The totals shown are for credits given from February 2, 1999 to April 16, 1999. The VUCC application form, field sheets and complete list of VHF Awards Managers can be found on the Web at <http://www.arrl.org/awards/vucc/>. Please send an SASE if you cannot download the forms online. VUCC lapel pins are available for \$5 each. If you have questions concerning VUCC, send an e-mail to vucc@arrl.org.

Compiled By Bill Moore, NC1L, Century Clubs Manager

50 MHz		222 MHz	
1007	N9XMU	101	W9JN
1008	W2BZY		
1009	KC8WFS		
1010	KL7NO	432 MHz	
1011	KB8O	50	
1012	K0VSV	276	WD9BGA
1013	KD8DR	277	K7XD
1014	NE0P		100
1015	NE0P/9		
OK1MP	150	1296	
K0VSV	150	25	
NE0P/9	125	K3HZO	75
K0OST	200		
W2BZY	175	5.7 GHz	
WD5K	825	5	
W5DB	200	38	WA8RJF
KL7NO	275		
KB8O	175	10 GHz	
K8PT	200	5	
W9JN	400	100	WA8RJF
144 MHz		Satellite	
561	K0DOK	100	
562	KY4SA	N1JEZ	300
563	NY2Z	K8TL	450
564	W4KXY		
KB8O	150		
WA9PWP	125		

Strays

FREE FIELD DAY SOFTWARE

♦ Scott, N3FJP, is offering free logging software just in time for Field Day. His *Field Day Logging Program*, version 1.0, checks for duplicates (including partials), lists sections (that change color when they've been worked), lists all contacts, writes ASCII log, dupe and summary files, and provides many statistics. You can download it from the Web at <http://members.aol.com/snkDavis/page1.html>.

I would like to get in touch with...

♦...anyone who may have known my grandfather, Clinton "Pappy" Painter, W5HNF. He passed away in November 1998. This is my feeble attempt to lay him to rest since I live in Okinawa and was unable to be with my family at the funeral. You can contact me, Jill Syrotchen, via e-mail at syrotchen@sunnynet.or.jp.

FREE E-MAIL AND WEB HOSTING

♦ Mike Cranc, KC5GJN, is offering free e-mail and Web hosting to amateurs at the Ham's Net International Amateur Radio Club site at <http://www.hamsnet.net/home.htm>. Services include up to 5 Mbytes of mailbox and personal Web page space.

⁴Brooks Shera, W5OJM, "A GPS-Based Frequency Standard," QST, Jul 1998, pp 37-43.

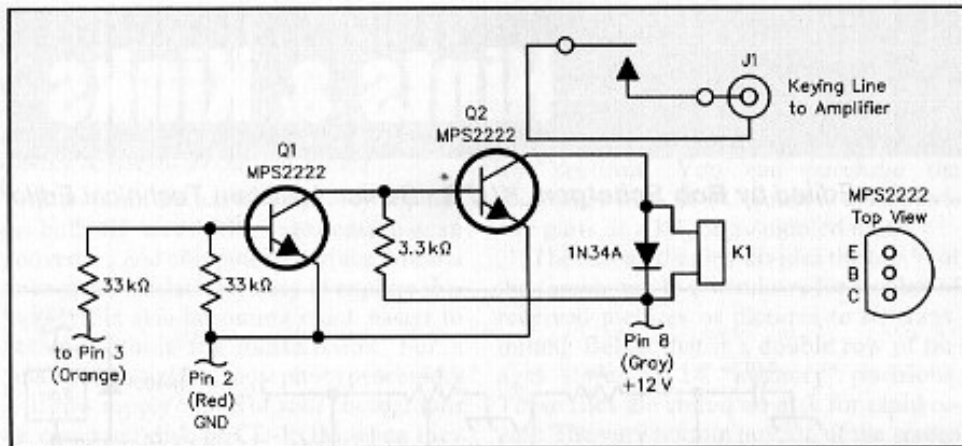


Figure 3—A schematic of W3NZ's circuit that lets the IC-706 Mk 2 transceiver control an external power amplifier. All resistors are 1/4-W, 5% units. Equivalent parts may be substituted for those shown. RS and RSU numbers are RadioShack catalog numbers.

J1—Jack for amplifier key line (builder's choice)

K1—12-V reed relay (RS 275-233)

Q1, Q2—MPS2222 NPN transistor (RSU 11370228)

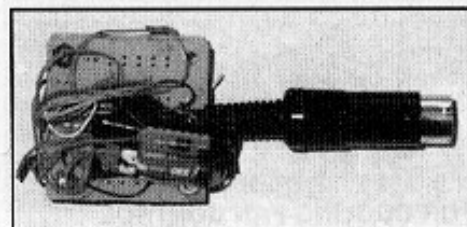
the trimpot until the fan starts then slowly back it off until the fan just stops. This should ensure that the fan stops running when the diode returns to near room temperature. The voltage across the bias diode in my amplifier drops significantly when RF drive is applied. This causes the fan to turn on immediately, and it will follow CW keying or SSB voice peaks until the temperature of the heat sink rises above room temperature. Once the amplifier has warmed a bit, the fan switches on (if it is off) when drive is applied and remains on, rather switching to follow keying or voice peaks. The fan does not switch off until the heat sink temperature returns to near room temperature.

This type of control circuit can be applied to any existing amplifier that uses a diode (or transistor base-emitter junction) to temperature stabilize its dc operating point. For other cooling applications, such as a power supply or FET amplifier, a stud-mount diode can be mounted on the device's heat sink to act as a temperature sensor. Just about any diode can be used for simple on/off control. There are special temperature-sensing diodes available for precision temperature-control or measurement applications.³ They exhibit a linear change in junction voltage with temperature.—Larry East, W1HUE, 1355 S Rimline Dr, Idaho Falls, ID 83401; w1hue@arri.net

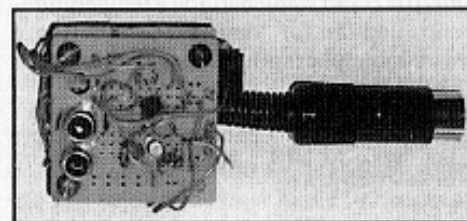
AN EXTERNAL-AMPLIFIER CONTROL CIRCUIT FOR THE IC-706 MK 2

After buying a new IC-706 MK2, my enthusiasm was overflowing on the way home from the store. I was going to hook up my little (27 pounds) 450-W amplifier and have some fun. To my disappointment, there was no jack on the new rig to control an out-

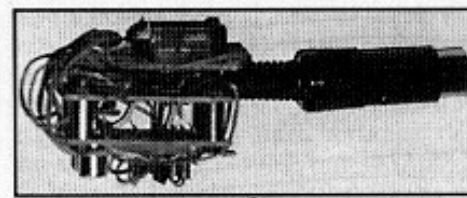
board amplifier. Consulting the manual did not help because I was not about to buy an IC-4KL with a remote control. However, after studying the ACC socket connection, a solution came to light. At pin 3, the orange wire goes from +8 V when receiving to ground or negative when transmitting. Fig 3 is a two-transistor circuit to close a reed relay when transmitting. This circuit is the brainchild of W3NNL. In a few hours, I



(A)



(B)



(C)

Figure 4—Photos of W3NZ's IC-706 Mk2 external amplifier-keying circuit. (A) The ACC plug and termination board. The relay is taped to the cable jacket. (B) The board containing the transistor circuit and two phono jacks. One keys the amplifier; the other is for ALC. (C) A side view of the assembly containing both boards.

built it on a RadioShack #276-148 dual mini-circuit board. (Fritz snapped the board in half to make two smaller boards.—Ed.)

I used one half of the board to terminate the 13 wires from the ACC socket. The board is clamped to the cable jacket. The other half of the board contains the two-transistor circuit plus two phono jacks to make the relay and ALC connections. Pin 8 (gray wire) supplies +12 V for the circuit, pin 2 (red wire) is ground and pin 3 (orange wire) is the keying input from the ICOM. The reed relay is mounted on a very small piece of project board (RadioShack #276-149) that is taped to the ACC cable. See Figure 4.

The reed relay completely isolates the amplifier keying line from the transceiver. Since my amplifier does not have the luxury of full QSK, I use semi-QSK and a 0.2-second delay. It works great!—Fritz Hauff, W3NZ, 875 NW 48 St, Lot 352, Pompano Beach, FL 33064

ADDRESS CORRECTION

The e-mail address for Rod McLennan, W6MWB, is incorrect in the June column (p 76). To reach him, use mclennan@home.com.

Hints and Kinks items have not been tested by QST or the ARRL unless otherwise stated. Although we can't guarantee that a given hint will work for your situation, we make every effort to screen out harmful information. Send technical questions directly to the hint's author.

QST invites you to share your hints with fellow hams. Send them to "Attn: Hints and Kinks" at ARRL Headquarters (see page 10), or via e-mail to rschettgen@arri.org. Please include your name, call sign, complete mailing address, daytime telephone number and e-mail address on all correspondence. Whether praising or criticizing an item, please send the author(s) a copy of your comments.

QST

Feedback

Please refer to "The W3KH Quadrifilar Helix Antenna," QST, Aug 1996, page 33, Figure 6. Swap the S1 and S2 labels at the top and the bottom of the drawing. The Feedback item that appears on page 78 of the June 1999 issue referring to Figure 7 is incorrect.—Eugene Ruperto, W3KH

In the August 1999 QST, the Morse code table on page 44 contains several typesetting errors. The letter G should have been shown as — — •. The letter P should have been • — — •, and 9 should have been shown as — — — — •.

Also in the August 1999 issue, "This Month in Amateur Radio" incorrectly refers to the "Southwestern" Division Convention in Huntsville, Alabama. That should have been the "Southeastern" Division Convention. On page 40 the URL for the Microchip Web site is incorrect. The address changed after the issue went to press. The links can now be found at <http://www.microchip.com>.

QST

³The Motorola MTS102 and National LM335 are two examples. Some design information for the Motorola device is given in their AN-1535, "Semiconductor Sensors Provide a Hot Temperature Sensing Solution at a Cool Price."