The Modified Windom Antenna

by Wilfred N. Caron

Antennas that are fed off-center are commonly known as the "Windom antenna." Loren Windom, 8GZ, has been given the credit for developing this antenna. Actually, it was developed by John Byrne, 8DKZ, and E. F. Brooke, 8DEM, under the guidance of W. L. Everett, their teacher and instructor. Windom was a student of Byrne who did most of the developmental work on the Windom antenna. Windom described the antenna in the September 1929 issue of *QST* and, since then, it has been dubbed the Windom antenna.

Off-center feeding an antenna plays a role of impedance-transformer. Off-set feeding has some effect on the radiation pattern but the impedance level changes greatly, rising as the feed point is moved off center.

The Windom antenna takes advantage of the fact that when it is resonant the characteristic impedance along the length of the antenna is a pure resistance which varies from 0 ohms at its center to over 4000 ohms at the ends. The magnitude of this impedance being a complex function of length-to-diameter ratio of them antenna element and, of course, its height above ground.

The antenna element is fed off-center by a single feed line at a point where the resistance equals the input resistance of the feed line. When this condition occurs, no standing wave exists on the feed line. This is illustrated in Figure 1.

The lack of a standing wave on the feed line does not preclude radiation from the feed line. Like the rhombic and terminated V -- antennas that have no standing waves -- strong radiation takes place in the absence of standing waves. Understandably, a standing wave on the line would increase the level of radiation from the line.

There are several reasons why the original Windom concept became obsolete:

- o A single feed point on the antenna causes a current to flow outwards in both directions thus creating nulls broadside to the antenna and asymmetrical radiation patterns;
- o Power is wasted by radiation from the feeder;
- o Power is lost in the ground return path because the feeder is functioning as a vertical radiator and the ground is its counterpoise;
- o No precise method for locating the offset feed point which is a function of the input impedance of the vertical section. Published feed point locations vary from 0.037 to 0.083 wavelength from center.

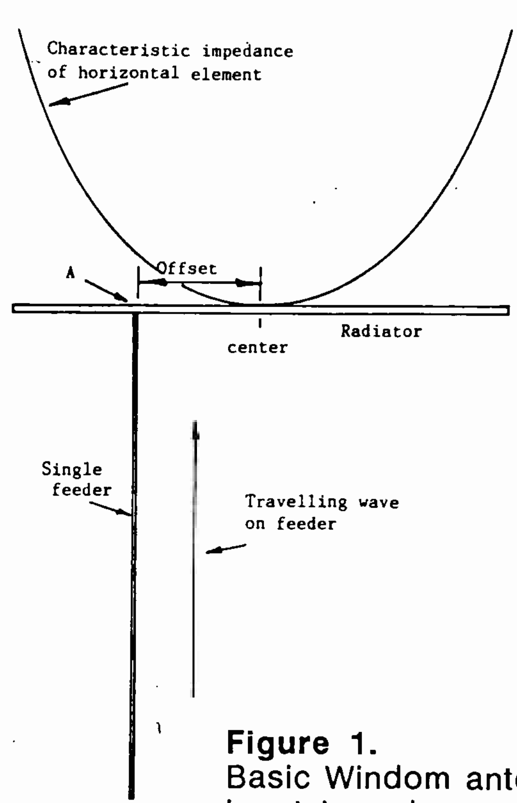

Figure 1.
Basic Windom antenna. Impedance at point A must equal input impedance.

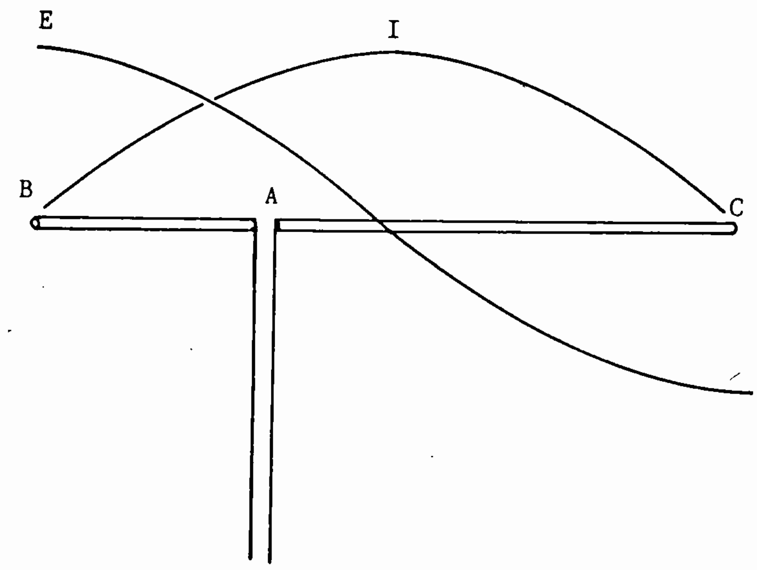

Figure 2.
Dipole fed off-center with balanced feeders.

It is possible to overcome the problems stated above by simply incorporating a balanced transmission line. Let us consider a half-wave antenna as shown in Figure 2, on which is shown stationary waves of current and voltage.

The balanced feeder is tapped at point A. We can see that section B-A is less than one-quarter wavelength and that section A-C is greater than one-quarter wavelength.

If we look at the reactance curve on Figure 3, we can see that wherever point A is located, the reactance of the antenna length B-A is almost equal and opposite to that of length A-C as referred to point A.

If point A is at the center of the antenna the reactances from both halves of the antenna will be equal and quite small. As point A is moved away from the center, the reactance of each section rises to a larger value, but at any feed point the effective reactance is almost zero, and thus we are constantly seeing an almost pure resistance regardless where point A is placed.

This can be expressed mathematically as

$$Z_0 = R - jX_{BA} + jX_{AC}$$

It remained for Jim MacIntosh, GM3IAA, to develop the "one-third tap" on the early Windom. MacIntosh's concept is incorporated in the modified Windom where the feed point is 22 feet from one end of a 66-foot horizontal antenna resonated at about 7.20 MHz.

To prevent feedline radiation and ground losses, two methods of feeding can be used: 1, a coaxial cable and balun arrangement and, 2, a two-conductor feeder (see Fig. 2).

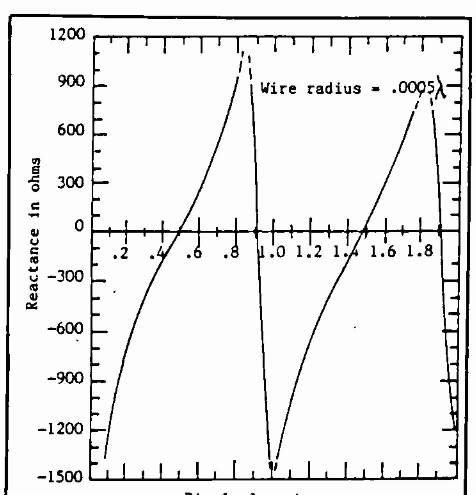

Figure 3.
Reactance of a dipole vs. dipole length.

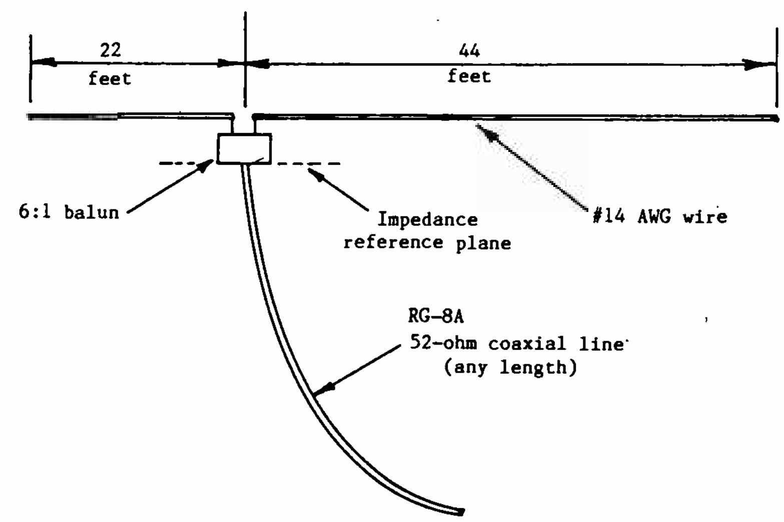

Figure 4.
The modified Windom antenna.

Wilfred N. Caron is the author of the Grove book, Antennas for Receiving, now out of print.

The coaxial-balun arrangement was used to obtain the test data presented and is shown in Figure 4. The balun used is a 6:1 balun (Palomar Engineers Model PB-6) which matches the 52-ohm RG-8A to the 300-ohm feed point impedance of the antenna. The data presented is referenced at the balun input.

It can be seen from the Smith chart data (Fig. 5) that the worse case mismatch occurs at 7.0 MHz which is equivalent to a SWR of about 1.2:1. The performance in the 20-meter band is also shown. Worse case mismatch occurs at 14.0 MHz, equivalent to an SWR of about 2.2:1.

Radiation patterns at the second harmonic frequencies are expected to be different as compared to those of the fundamental frequencies due to current reversal on the full-wave element. The patterns should resemble a four-leaf clover.

The sloping V configuration of Figure 6 was also investigated because it represented an unknown area. The test results proved to be most interesting.

In the 7.0 to 7.4 MHz frequency range the worse case SWR is about 1.8:1. For the 14.0 to 14.4 MHz range the worse case appeared to be less than an SWR of 1.16:1. These test results are also presented in Figure 5.

The modified Windom antenna and, in particular, the modified Windom sloper V are, indeed, very interesting antennas that offer optimum radiation efficiency and performance. ■

References:
Historical comments obtained from: J.M. Haerle, *The Easy Way HF Antenna Systems*, page 57; Overtones, Inc., Denton, TX, 1984.

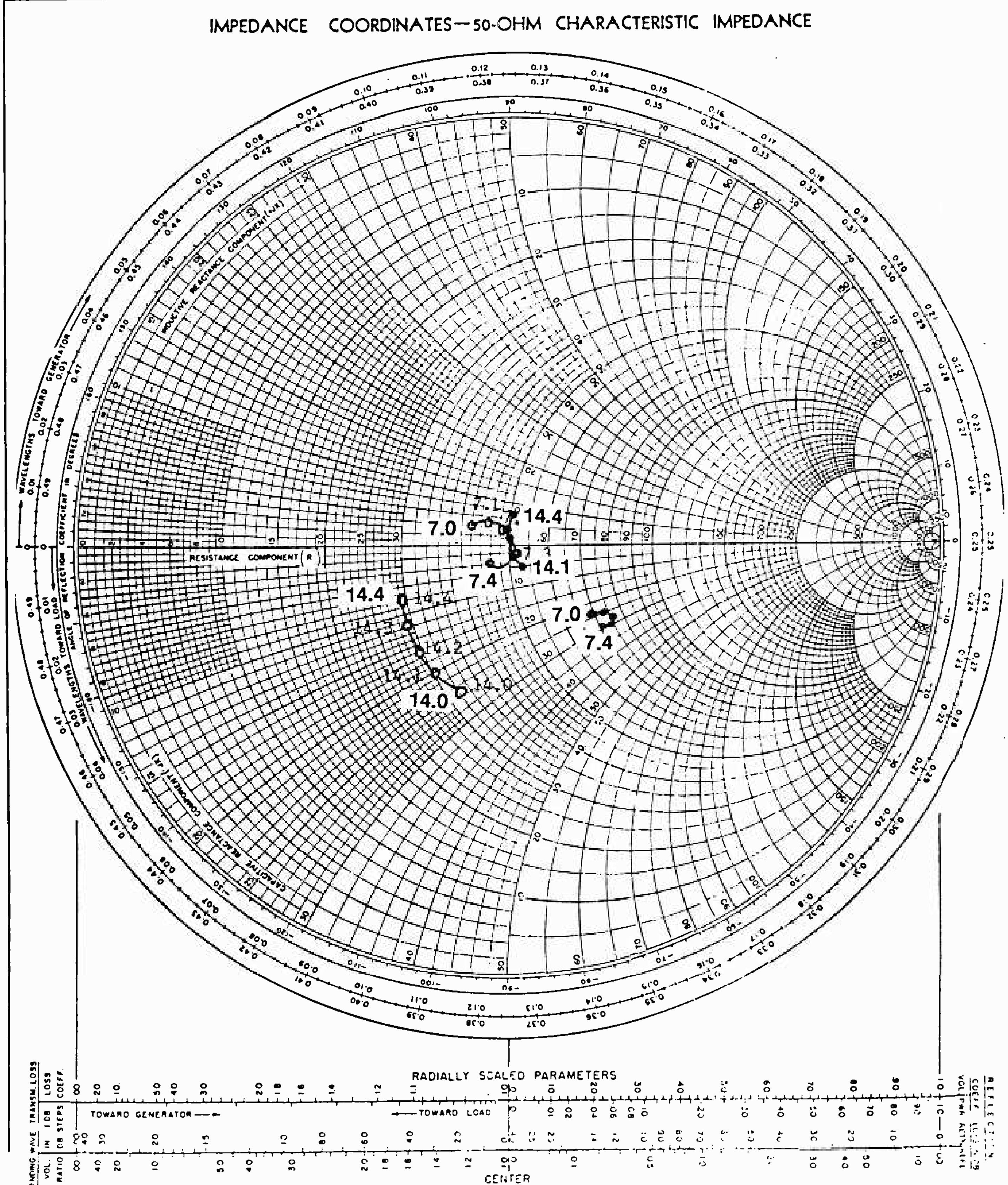

Figure 5.
o = The modified Windom
● = The modified Windom sloping V

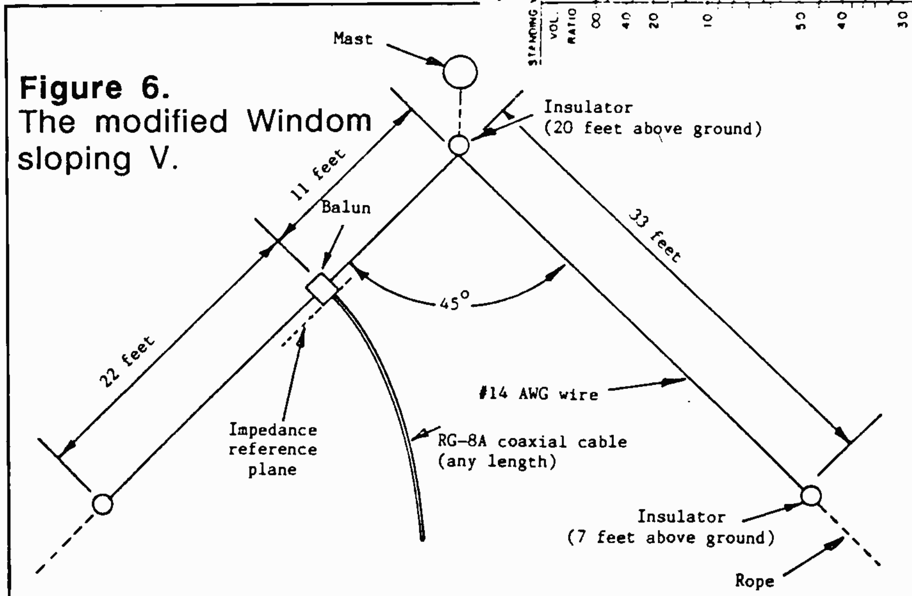

Figure 6.
The modified Windom sloping V.

R7000 Scan Delay Update

Last month's Experimenters Workshop detailed a method of making a real scanner out of the popular ICOM R7000 general coverage VHF/UHF receiver. Many experimenters have successfully tried the procedure and their constructive comments have been most informative.

Next month *MT* will present a special update showing the best way to make the conversion with minimum effort. It's well worth the wait!