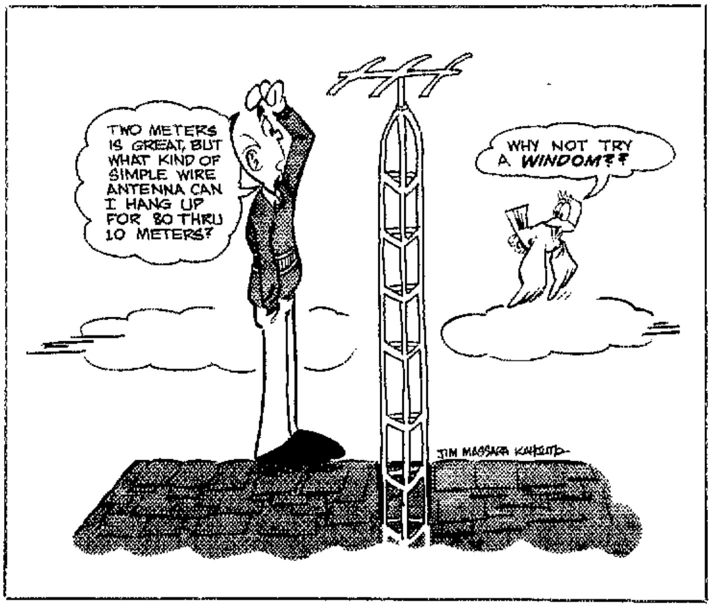
A New Antenna Twist — The "Windom J-L"



Many HF-band enthusiasts seek simplicity, performance and multiband capability. The author shows how to structure the famous Windom off-center-fed wire antenna for better performance.

By R. R. Schellenbach,* W1JF

Are you looking for an antenna that radiates effectively, is easy to erect and use with a minimum of adjustment difficulties? The Windom antenna fits the description quite nicely.[1] It is true, however, that the single-wire feed line of this antenna produces some uncontrolled radiation because it is not balanced: It relies on the earth ground for the circuit return, but this characteristic may be exploited to our advantage. (More on this later.)

After I searched for methods to develop an efficient multiband antenna, I chose the Windom over previously published designs that contained traps, coils and parallel conductors in various combinations. The Windom seemed to be the ideal model for additional features and versatility.

Simplicity was my foremost consideration in the initial selection. Later in the design process, compromises such as polarization, directivity, bandwidth and impedance matching would take hold, offering a practical and economical solution to the quest for a multiband antenna.

The letters "J-L" in the article title provide a tip-off for the versatility added to the capability of a standard Windom antenna. In our new system we find the added features of an inverted "J" and "L" combination, which provides a five-band, single antenna system that covers 80 through 15 meters.

Six-band operation is possible. The "Windom JL" can be resonated on the 160-M band by the simple inclusion of a base loading coil. A 3-inch dia coil of no. 14 wire, spaced one wire diameter on each turn, does the trick. Operation is satisfactory, although the coil does complicate matters: It must be switched in or out. Also the "JL" design called for ultimate simplicity (no coils, traps, etc.) The polarization changes brought about by the differences in antenna configuration, band to band, were an attempt to optimize the system performance. The objective was to provide maximum *signal-radiating characteristics* for each operating band.

The evolution of the simple Windom into the Windom J-L followed to some extent the principles I developed and described in *QST*.[2] There is one exception: Eliminate the traps and loading coils. The objective with this antenna is to use only wires and insulators, while providing reliability, with reduced weight as a bonus.

Compromise Multiband Antennas

Regular doublet antennas fed with low-impedance transmission lines are practically worthless on harmonic frequencies. An example of one exception is the trap dipole. Another is the use of a single-band dipole at the third harmonic (40 and 15 meters is one such case). The limitation is not so much the fault of the antenna response to harmonics, but of the feed system incompatibility. Whether it is deliberate or not, the Windom will radiate on odd *and* even harmonics, either from the flat top or single-wire feeder. It is mainly for this reason the Windom lost favor in preference to other less susceptible harmonic-radiation types of antennas with low-impedance feeders.

A doublet antenna for use in the new 30-meter band, with low-Z feed line, can't operate effectively on the second harmonic — the 15-meter band. Although we might use a center-fed doublet with open-wire feeders (tuned), and would find that it performed well on both bands, it would require a balanced matching scheme, such as a balun or Transmatch at the radio-room end of the line. This would enable us to convert the balanced line to unbalanced low-Z coaxial cable.

Our single-wire feed line for the Windom offers greater simplicity (no spreaders or baluns) and the added advantage of harmonic operation, for which an inverted-J configuration may be adapted easily. In using an antenna for harmonic operation, the basic half-wavelength antenna is not resonant at the exact harmonics. Therefore, we should adjust it in length for the band in which it will have the most frequent use. Keep in mind that it is better to err on the higher-frequency band than the lower one, because there will be a smaller-percentage error on the highest band. For this reason I chose to compromise the 15-meter band dimensions. This was accomplished with the Windom J-L by setting the flat-top length on 30 meters so it is resonant at the higher end of the band. I used the well-known equation:

$$L(\text{feet}) = \frac{468}{10.150\ \text{MHz}} = 46.1 \quad \text{(Eq. 1)}$$

where 0.3048 × feet = meters.

[1]Notes appear on page 39.

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The operational length for the second harmonic closely follows the applicable equation:

$$L(\text{feet}) = \frac{492\,(N - 0.05)}{f(\text{MHz})} = 45.68 \quad \text{(Eq. 2)}$$

where f(MHz) is 21 and N = 2 (for second-harmonic operation). The result comes very close to the calculated length of 46.1 feet for 30 meters, making it feasible for us to use the 46-foot dimension for the flat-top length on both bands.

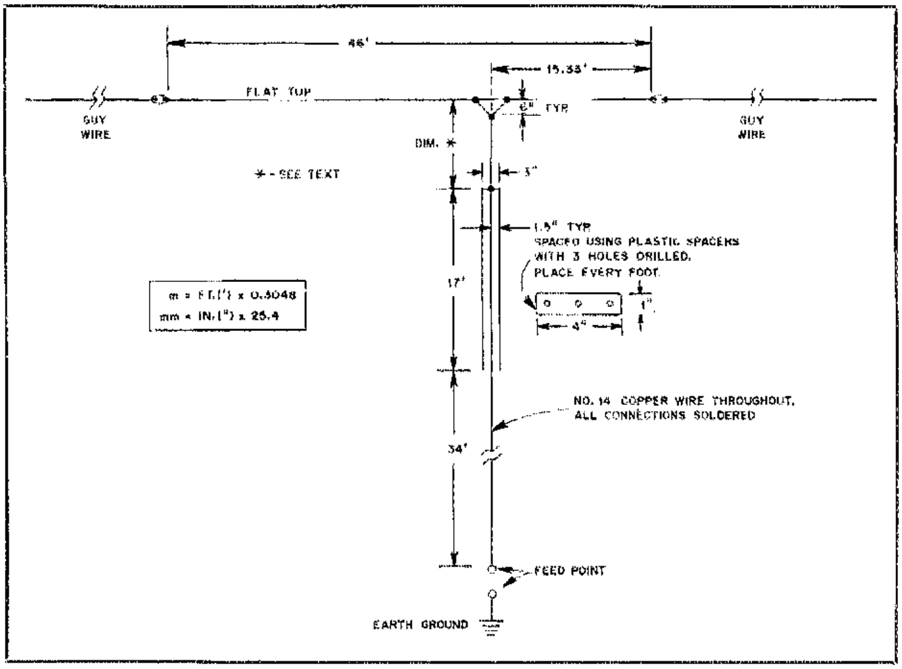

Fig. 1 — Dimensional details for the Windom J-L antenna. The single-wire feeder, including the 20-meter stub, should be kept perpendicular to the flat top as closely as possible. If this can't be done, at least the 20-meter stub section should be maintained vertical respective to the flat top.

Feeder Tap Point

We can learn the feeder tap point on the antenna by simple calculation. Further adjustments will not be necessary unless you are a perfectionist. Improper location of the feeder tap point will not alter the resonant frequency of the antenna, but it will affect the standing waves on the feeder.

A single-wire feed line can be operated over a fairly wide frequency range without serious losses, and with a suitable matching network at the station end, little difference will be noted. I configured the tap point as a "Y" that is 6 inches (mm = in × 25.4) on a side. This technique (Fig. 1) broadens the impedance-matching point. This not only produces a less sensitive position electrically, but offers a mechanical advantage: The connection will be less prone to breakage under the stress of wind and excessive feed-line movement.

The proper tap point would be determined normally for fundamental operation, as with the old standard — 14% off center for the 46-foot 30-meter length specified earlier. Our result would be 16.56 feet off one end of the antenna for the tap. However, for harmonic operation we can obtain a better match if the tap point is 33% of the antenna length, from one end. Although this disagrees with the accepted 14% specification, I have found it much better for fundamental and harmonic operation.

Owing to these considerations, our Windom J-L has the tap point 15.33 feet from one end. This results in somewhat more inverted-L format than found with the "T" for the T-J of note 2. Because of this dissymmetry around the tap point, the currents in the two sides of the flat top do not balance completely. Unlike the balanced "T" top-loaded antenna of my previous design, there is some minor radiation from the horizontal portion when it is operated as a vertical antenna on 40 and 80 meters. Being that there is very little RF current on the horizontal portion, the radiation from this short length is similarly low.

Adding the Inverted J

We can provide enhanced operation on 20 meters by adding the inverted-J configuration. The twin stub, as shown in Fig. 1, is only resonant at 20 meters. It adds so little to the feed line used during Windom operation that it permits an easy 20-meter addition to the system.

By virtue of the resonant quarter-wave decoupling technique, the ¼-wave stub disassociates the influence of the upper-wire portion beyond the stub and the flat-top portion that functions as the active section on 20 meters. In effect, we now have an inverted-J antenna that is vertical, mounted at ground level and base tuned. This results in an ideal situation for low-angle DX-antenna operation in the 20-meter band.

The length of the 20-meter stub and active vertical section (Fig. 1) is for the lower part of the 20-meter CW band. Other operating-frequency ranges may, however, be implemented by using the following equations.

$$\text{stub length (ft)} = \frac{240}{f(\text{MHz})} \quad \text{(Eq. 3)}$$

and

$$\text{vertical length (ft)} = \frac{480}{f(\text{MHz})} \quad \text{(Eq. 4)}$$

This results in a stub for 14,050 kHz that is 17.08 feet long. The vertical section is twice that length, or 34.16 feet. These dimensions may be rounded off to 17 and 34 feet, respectively, without any significant detuning effects. These dimensions also provide low SWR and no detuning effects across the 150-kHz lower part of 20 meters when matched by means of a Transmatch between the feed line and the transmitter.

We should recognize that the vertical section must be measured from the point where the quarter-wave stub ends (downward). This must include the lead length that goes to the base-mounted tuner. Therefore, the 35-foot dimension illustrated in Fig. 1 can be physically shorter by inclusion of the tuner lead length.

The final dimensions were checked by means of a dip meter while I was aloft on a guyed extension ladder. I do not recommend this risky procedure unless your medical insurance is paid up, or if you are a daredevil! I was pleased to learn, however, that the theory held up in practice: The desired resonances were verified.

Provisions for 40 and 80 Meters

Now that we have exploited the system to cover the 30-, 20- and 15-meter bands we can adjust the remaining portion of the antenna to function as a 3/4- or 5/8-wavelength top-loaded vertical on 40 meters. The remaining variable dimension of Fig. 1 (marked with an asterisk) may be altered without affecting our calculations for the higher bands. Irrespective of the physical dimensions of this antenna section, the system will operate successfully at half frequency as an "inverted L" on 80 meters. The polarization on 80 meters will be vertical, with the system worked against ground.

The section marked with the * has a 6-inch minimum dimension. The operational characteristics on 40 meters will be similar to those for a 5/8-wave vertical. Increasing this dimension to 16 feet will alter the antenna to function as a 3/4-wavelength radiator.

In operation, the differences between the two 40-meter conditions influence not only the overall system height, but allow you to select the radiation characteristics you desire. The 5/8-wave format is best for DX work, as shown by the vertical-angle lobe profiles in Fig. 2A: The angle of radiation is predominantly low. If the dimension with the * is increased to 16 feet, the high-angle responses shown in Fig. 2B will prevail. This is useful for short-haul work on 40 meters. Table 1 provides dimensional data for both antenna configurations.

My Windom J-L has a nominal height above ground of 67 feet. I chose the 3/4-wave format for maintaining strong signals up and down the East Coast. If DX is your bag try the 5/8-wave setup. I received signal reports of RST 579 from Europe at approximately 0000Z on 20, 30, 40 and 80 meters. The dc power input to my transmitter was 200 watts. These reports were received in August 1983.

Matching Networks

A matching network is essential for the proper operation of this antenna. This is because the system is highly responsive to harmonics and the selectivity of the network is helpful in minimizing unwanted harmonic radiation. Also, the network provides an impedance match between the station equipment and the feed line of the Windom J-L. This antenna is fully compatible with most single-wire Transmatches. Approximate feed-point impedances for the antenna are listed in Table 2. The Transmatch may be one of the commercial units that are rated to handle the power of your transmitter. Homemade units of the type described by DeMaw for remote control will prove very useful for multiband operation.[3] I prefer remote tuning for the sake of convenience. It reduces RF power loss. A remote network permits you to locate the antenna farther from the house, which reduces the pickup of man-made noise. Also you can keep the antenna farther from trees and power lines when using a remote-controlled matching network.

Orientation for Azimuthal Effectiveness

The directional properties of the Windom J-L, however modest, can be used to advantage at 15 and 30 meters. For example, from my QTH in eastern Massachusetts, the antenna flat top is oriented broadside to 30° east of north. This provides a fairly wide (60°) azimuthal-coverage angle of Europe and Oceania. On 15 meters the clover-leaf pattern (less than 50° angle lobes) covers north and central Africa, the Mediterranean, Oceania, most of Asia and the Far East. The vertical-polarization mode for 80, 40 and 20 meters provides omnidirectional coverage.

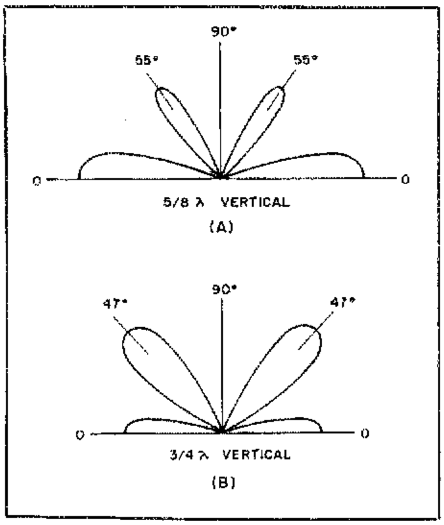

Fig. 2 — Vertical-lobe profiles for 40-meter operation, 3/4 versus 5/8-wave mode. It can be seen that the 5/8-wave pattern is the most favorable for low-angle DX work.

Table 1
Windom J-L Dimensions (40 meters)

Desired Configuration	*Dimension (*Fig. 1)*	*Height Above Ground*
5/8 wave	6"	51' 11"
3/4 wave	16"	67' 5"

Table 2
Feed-Point Impedances for Five-Band Operation

Band (meters)	*Impedance (ohms) Approx.*
80	100 to 170
40	30 to 100
30	600
20	>1000
15	600

Ground System

While the antenna appears to be relatively simple and easy to adjust, it is an effective radiating system. But, as with any of the single-wire systems, especially those used in the lower-frequency bands, a major problem is obtaining a low-resistance ground. An effective ground is needed for the efficient operation of this antenna.[4]

Again, with the implementation of a remote antenna-matching network and coaxial-cable feed, we will help to avoid having unwanted RF energy on the station equipment. An effective ground system under the antenna and matching network will aid performance and reduce the chance for migration of stray RF voltage.

In Conclusion

This antenna has proven itself to be highly effective and seems to provide equal performance to much more complicated antenna systems. You should be pleased with this multiband antenna I have reconstructed and modernized from the old favorite of the 1930s — the Windom. Long may it live!

Notes

[1]L. Windom, "Notes on Ethereal Adornments," *QST*, Sept. 1929.
[2]R. R. Schellenbach, "Try the T-J," *QST*, June 1982, pp. 18-19.
[3]D. DeMaw, "Antenna Matching, Remotely — Some Thoughts," *QST*, July 1982, pp. 14-16.
[4]J. Stanley, "Optimum Ground Systems for Vertical Antennas," *QST*, Dec. 1976, p. 13.

Dick Schellenbach was first licensed as W6TKX in the 1930s. He is a veteran of the U.S. Army and Navy, and has served as a communications specialist for nearly 40 years. Dick is a consulting scientist with Support Systems Associates in Burlington, Massachusetts. His work involves electronics and communications programs for the U.S. Air Force. He was recently awarded his doctorate in electrical engineering, with concentration in telecommunications.

Strays

I would like to get in touch with...

☐ anyone with information on converting a Sonar FM 40 Business Radio for amateur use. Clyde LanPhear, KB9KL, 3201 W. Calle Fresa, Tucson, AZ 85741.

☐ any Mississippi hams who are active on 6- and 2-meter SSB. Bill Jones, KA5LVP, 106 N. 38th Ave., Hattiesburg, MS 39401.

☐ anyone with information on modifying the Hal DS-3000KSR (Version III). Harry Palmer, W4VDC, 4009 Peach Dr., Jacksonville, FL 32216.

☐ any Ø-land hams interested in Christian fellowship. Franklin Brodale, AGØM, 1602 Susan Ave., Cherokee, IA 51012.

☐ anyone having a schematic drawing of the Mini Scan Monitor, Model 5050, manufactured by Toshiba for Sears. Thomas W. Darga, KA8GBB, 35775 Schmid Dr., New Baltimore, MI 48047.