Putting the Quarter-Wave Sloper to Work on 160

Want a 160-meter signal that has real DX capability? This half-sloper antenna will put your station in the heat of competition. The cost is next to nothing!

By Dana Atchley, Jr.,* W1CF

Many of us older amateurs have not used the 160-meter band for years. The reason lies not in a lack of interest. Rather, our failure to participate in 160-meter activities stems from the fact that the typical ssb transceiver manufactured in the United States from the late 1950s to the middle 1970s did not provide 160-meter coverage.

In the past two years, more than just a few of us have traded in our tried and true transceivers that had served us well for some 15 years. A deciding factor in the purchase of the replacements is that many new transceivers have excellent coverage of 160. Hence, as the urge to acquire new equipment gets stronger, the repopulation of 160 increases at a rather steady rate.

Moving to the top band raises the question of what to do about an effective antenna. A conventional half-wave horizontal antenna, popular through the years on this band, has limitations. Frequently, amateurs do not have room to put up 260 feet of wire. Moreover, the high angle of radiation from this type of antenna does not make it perform well as a DX chaser. What alternative then?

The writer, like many vintage DXers, is the proud possessor of a high, guyed steel tower festooned with monoband Yagis. I considered the several approaches to putting this combination to work without a major investment of time and money in order to have a *competitive* top-band signal.

My solution led to the construction of a quarter-wave sloper (also referred to as a half sloper[1]) strung from the top of the tower and fed with 50-ohm coaxial cable connected through an existing six-position coaxial switch. (See Fig. 1.) The switch is remotely controlled from the operating position, allowing quick selection of other slopers which I plan to add. There is a directional effect produced by this type of sloping antenna which makes it desirable to have additional wires sloping in different directions.

Provided that an amateur has a tower, the incremental cost of adding the half sloper is negligible. A single antenna of this type involves just the purchase of two insulators and 130 feet (39.6 m) of copper-clad wire. The relays for a system having more than one radiator would, of course, be an additional expense, but a modest one.

A 45-Degree Slant

The author's antenna slopes away from the tower in a southwesterly direction at an angle of 45 degrees to the tower. The bottom end of the radiator is fastened to a tree at a point 15 feet (4.6 m) above ground.

Rf is fed to the top end of the 130-foot

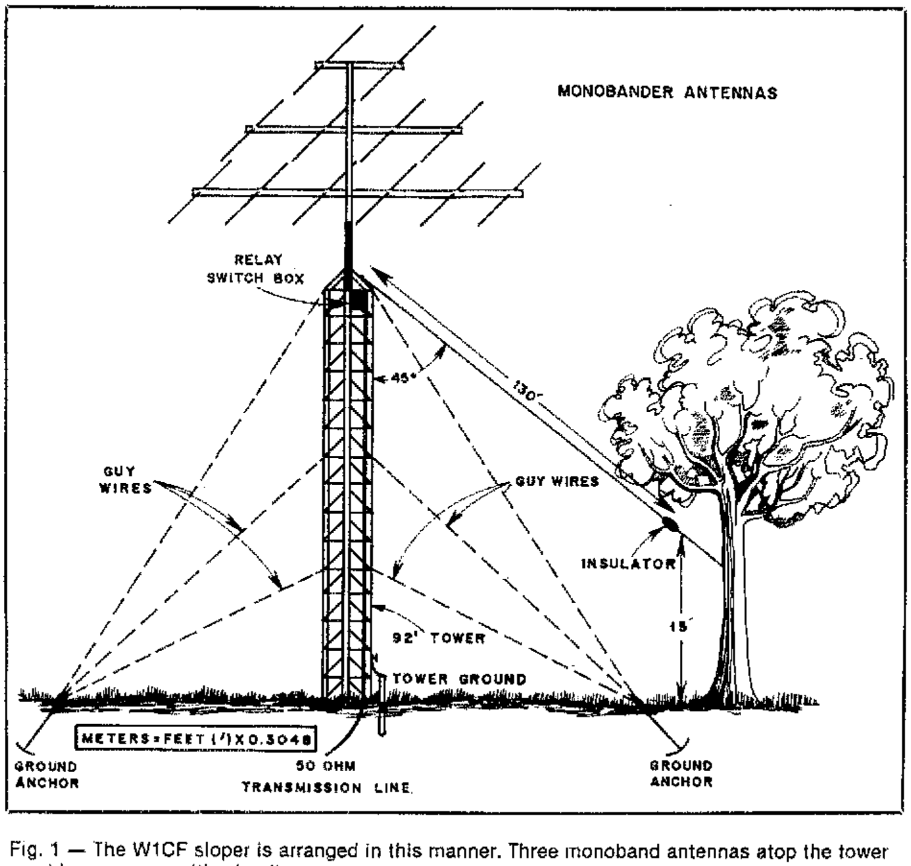

Fig. 1 — The W1CF sloper is arranged in this manner. Three monoband antennas atop the tower provide some capacitive loading.

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[1]Notes appear on page 20.

wire by means of coaxial cable. From the end of the transmission line, rf is passed through one of the relay-operated coaxial switches to the antenna as shown in Fig. 2. A short length of copper wire connects the antenna to the center pin of one of the switches. The body of the relay enclosure is electrically grounded to the tower by means of the attachment plate and to the RG-17/U cable braid through the input cable connectors.

How Does It Perform?

The whole process of putting up a single antenna consumed one hour. But unlike many endeavors performed in haste in the middle of the winter, this one was very successful. Without taking time to trim the antenna, the full massive power of the TS-820 (90 watts key down!) was applied to the half sloper through a Bird wattmeter having a 250-watt element. The reflected power was less than one dial division over the 160-meter band. It virtually was unreadable.

With only two weeks of operating under my belt at the time of writing this article, I can give little more than a qualitative opinion on the operation of the antenna. However, in a recent 160-meter contest, my station seemed to be reasonably competitive, both on domestic and overseas contacts. I held a frequency for about an hour while chaining contacts using CQs and QRZ without being blown away by the competition. On overseas calls, the first or second try provided the wanted contacts. Most of the reports were RST 569.

Conversations after the contest with KØRF, who shares many of my antenna and operating thoughts, indicated that although my signals were down approximately 5 dB compared to K1PBW, who uses two top-loaded, quarter-wave radiators driven in quadrature (90 degree separation), my signals were well near the top of the New England pileup at his Colorado location. All this with a barefoot TS-820S — sigh!

The quarter-wave sloper "listens" well. I have heard K6SE (in the direction of the slope), and, surprisingly, PAØHIP and G3SZA with S9 signals. I do feel that this antenna is not the equal of a 1000-foot terminated Beverage receiving antenna, but it will bring in most of the multipliers that are on the air for the one night stand of an ARRL DX contest.

A 92-Foot Tower Helps

Inasmuch as this quarter-wave sloper appears to perform well, it is worthwhile to explore why. The W1CF 92-foot tower provides an advantageous height for putting out an attention-getting signal. Remember, the shield of the coaxial feed line is connected to the top of the tower. Although the ruggedness of the structure has little to do with radiating ability, I will mention in passing that it is made of heavy-duty galvanized steel. The bottom is bolted to a concrete base. Guy wires of 3/8-inch (10-mm) cable without insulators are placed at three levels. The guy anchors are buried to a depth of 6 feet (1.8 m).

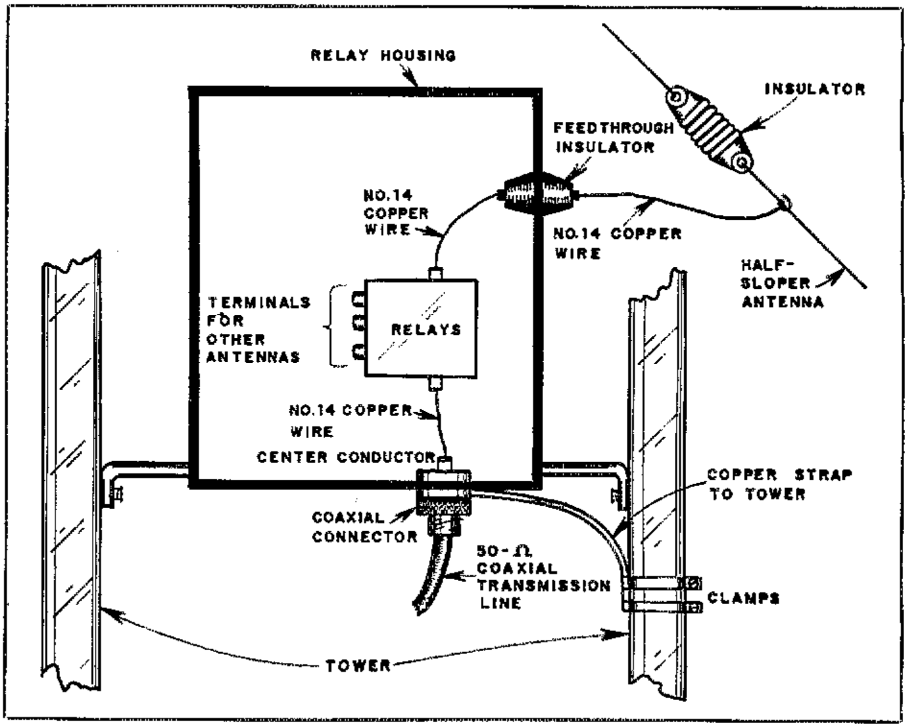

Fig. 2 — This drawing illustrates how the half-sloper antenna is fed at the top of the tower. The use of remotely controlled relays permits the choice of two or more slopers in order to take advantage of the individual directional effects.

Atop the tower, three monobanders staggered at 5-foot (1.5-m) intervals on a 2-inch (51-mm) OD pipe act as capacitive loading. This large assembly must provide a fair amount of capacitance to ground, even at 160 meters. The "fat" tower and the parallel-connected guy wires provide relatively low inductance to ground.

Of course, each tower arrangement is found to be different. Several other amateurs using the quarter-wave sloper on the 40- and 80-meter bands have been enthusiastic about individual performances even though their masts were much shorter (50 feet). A detailed analysis of the actual antenna circuit is beyond my capabilities. What is apparent, however, is the following: (1) my particular tower provides a reasonably good ground return (counterpoise?), (2) the maximum-current point of the antenna is high, where it can do some good, (3) the measured feed-point impedance is close to 50 ohms, (4) the match is relatively broadbanded, and (5) the sloper provides an appreciable amount of vertically polarized radiation.

The writer feels that the quarter-wave sloper lends itself to many existing U.S. amateur installations with almost zero increase in cost. It seems to be reasonably competitive and is easy to erect. My guess is that an eager amateur with three spare positions on a relay-operated antenna switching circuit could string three quarter-wave slopers from his tower at 60 degree intervals and probably obtain some worthwhile directivity at low radiation angles.[2]

The writer is indebted to Dr. James Lawson, W2PV, for helpful suggestions concerning this article. Words of appreciation also go to "Duke" Brown, W1ZA, for his installation assistance, and to Phil True, W7AQB, for filling me in on his extensive experience on 75-meter phone with a similar installation.

Notes

[1] *The Radio Amateur's Handbook*, ARRL, 56th Edition, 1978.

[2] The quarter-wave sloper working against a good water-pipe ground suggests itself as being of use to a "cliff dweller" who wishes to drop a reasonably unobtrusive wire out a window of a high condominium or apartment.

Additional Notes on the Half Sloper

My first rhetorical exposure to "half-sloper" antennas left me feeling that the person who lauded the concept belonged to some secret voodoo cult. The technique appeared to be laced with "black magic" with respect to the DX capabilities and simplicity of installation. At the time, I was entirely happy with my 40-meter "full-sloper" antenna, which had given superb DX performance over a three-year period. With change sometimes being good for the soul, I decided to look further into the matter. So during an "eyeball" QSO with Rush Drake, W7RM, I asked his opinion of the half-sloper antenna. He had used them on 80 and 160 meters with very good results. Not being of a mind to dispute a DX baron like Rush, I decided to "put up" (if I may resort to a pun), then "shut up" if need be.

The 40-meter full sloper was taken off the tower. The high end of the dipole was at 50 feet (15 m) and the low end was 7 feet (2 m) above ground. A 50-ohm coaxial feeder came off the center of the sloper at approximately 90 degrees. A TA-33 Jr. triband Yagi was located above the sloper, and a system of 16 buried radials (varied lengths of 60 to 110 feet — 18 to 33.5 m) was fanned out below the tower.

With all things remaining the same, exclusive of the 40-meter antenna just discussed, W1VD climbed my tower and "implanted" the new 40-meter half-sloper antenna. It had been cut to the traditional $L_{(feet)} = 234/f_{(MHz)}$. The shield braid of the coaxial cable was made common to the tower top near the driven-element insulator (Fig. 1). Then the feed line was taped to a tower leg at intervals all the way to the ground. It was then routed along the surface of the earth to a feedthrough panel which is used as an rf service entry to the shack. It should be mentioned that my purpose in having the buried radials has nothing to do with the 40-meter antenna. They were laid for use on 80 and 160 meters because the tower is employed as a vertical antenna (shunt fed) on those bands.

Antenna Adjustment

I had been told that it was a simple matter to adjust the half sloper for an SWR of 1. All that was supposed to be necessary was the pruning of the radiator length until an SWR of 1 was observed in the chosen part of the band. I made my adjustments for 7025 kHz. It took nearly two hours of adding wire, removing wire, and hoofing it into and out of the shack before the SWR bottomed out at 1.6:1. Bandwidth between the 2:1 SWR points was approximately 100 kHz. This was determined by readjusting the radiator for the lowest attainable SWR at 7100 kHz. In my installation, the radiator length was somewhat greater than 1/4 wavelength. The best match was secured when the radiator was 3 feet (0.9 m) longer than the formula dictated. The enclosed angle between my unguyed tower and the half sloper is roughly 45 degrees. RG-8/U cable is used as the feeder.

Others who have worked with this type of antenna, but on 80 and 160 meters, tell of conflicting results with the radiator length. Two amateurs who erected 160-meter half slopers on 50-foot towers reported that the radiator had to be considerably shorter than 1/4 wavelength, and that an SWR of 1 was obtained. No doubt the reduced length can be related to the proximity of the wire to ground (added capacitance). Two amateurs who erected half slopers for 80 meters (on 100-foot or 30-m towers) said the lengths were precut to 1/4 wavelength, and an SWR of 1 resulted. This suggests that each installation is unique, requiring some empirical work on behalf of the amateur. I hope to do some antenna scaling to 28 to 144 MHz soon. No doubt a model half sloper can be checked then for characteristic impedance, radiation pattern and radiation angle. For the present, anything I might claim would be pure conjecture.

As for performance, the 40-meter half sloper seems to greatly exceed the full sloper thus far. Even though it slopes off the *west* side of my tower, and supposedly has radiation reinforcement in that direction, I am receiving good reports from Europe to the northeast and South America to the south. This also was true of the full sloper, which tilted to the *south*. For the most part, my signal reports are 10 to 20 dB better than previously. This has been noted by three W8 stations in Michigan with whom I've maintained weekly schedules for the past two years. At 0100 UTC my 1-kW signal reports consistently run from 20 to 40 dB over S9 in Michigan, whereas they used to be on the order of S9 to 20 dB over S9. I have observed the same improvement with stations I contact frequently in Texas and California.

Perhaps the major improvement in performance comes from the current portion of the antenna being raised to twice the original height, which is significant with any type of antenna. What role the tower plays in the overall system requires careful analysis. Perhaps such an investigation would dispel any black magic that seems to exist. But the half sloper *does* work, and mighty well.

One weak characteristic I noted is that when the upper insulator and feed-connection point become covered with ice, the antenna is rendered useless. The SWR reads full scale in the forward and reflected directions, and the transmitter won't load into the system. A protective covering is suggested for that part of the system if you live where sleet storms are likely to occur.

W7RM suggested a unique way to employ half slopers. Two or four of them are placed on the tower. Opposite wires can be joined to the feeder by means of a remote relay to convert any two half slopers to an inverted-V antenna. This gives the operator a choice between low-angle radiation with the half sloper and higher angles of radiation with the inverted V. Four half slopers can be installed 90 degrees apart on the tower, then switched for any one of four chosen points of directivity. A remote switch would be used for this also. — *Doug DeMaw, W1FB*

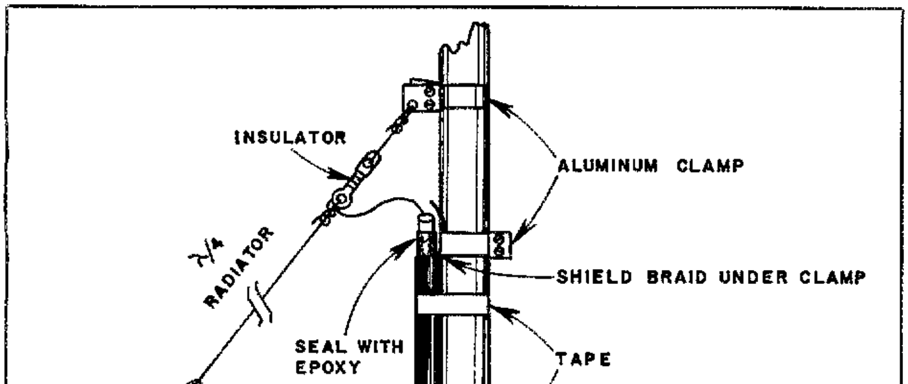

Fig. 1 — A method of installing and feeding a half-sloper antenna.