Broadbanding the Half-Square Antenna for 80-Meter DXing

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N6LF discusses a simple way to broadband the classic half-square antenna to operate in both the CW and SSB "DX windows" on 80/75 meters.

The half-square antenna is by nature relatively narrow band.[1] On 80 meters, for example, an SWR below 2:1 can be achieved anywhere in the band, but only over a relatively small range (60 to 100 kHz). The primary reason for using a half-square instead of a dipole is for improved performance on DX contacts.

There are two DX "windows" on 80 meters, 3.500-3.520 MHz and 3.750-3.800 MHz—most CW activity is close to 3.500 and SSB around 3.790 MHz. It is very easy to adjust a normal half-square antenna to have low SWR at either one of these frequencies, but not at both. Practically speaking, any serious DXer will want to be able to use both CW and SSB, so this is a real disadvantage.

It is possible of course to build a matching network of some kind or to use a tuner to load the antenna at both frequencies. However, that may not be as simple as it sounds, because if the SWR is low in one window, it will be very high at the other. It could be 20:1 or more!

The attraction of the half-square is its simplicity. It would be nice to allow operation in both windows while keeping the simplicity. This article shows a way to do that by adding two wires to the classical half-square.

Broadbanding the Half-Square

On 80 meters even a dipole is not a broadband antenna. One trick frequently used to broadband or multiband a dipole is to add additional wires to the dipole to form a fan, as shown in **Fig 1**. The two wires on each side of the feed point have different lengths and are adjusted to produce two resonance points. A variation of this idea works for the half-square. It can provide the desired double resonance and can also provide 3-4 dB of front-to-back ratio if that is desired.

The bi-directional (0 dB front-to-back) version of the half-square is shown in **Fig 2**. The single vertical wires at each end of the antenna have been replaced with two wires, of different lengths (L1 and L2), with the lower ends well separated. Note that the vertical wires are in the plane of the horizontal top wire (L_T). In a bit we will see what happens if the wires are not in this plane. The pattern from this antenna is shown in

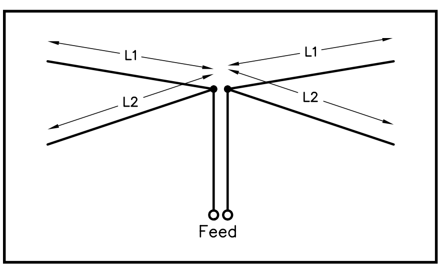

Fig 1—Broadbanding an 80-meter dipole using a fan-shaped pair of unequal-length radiators.

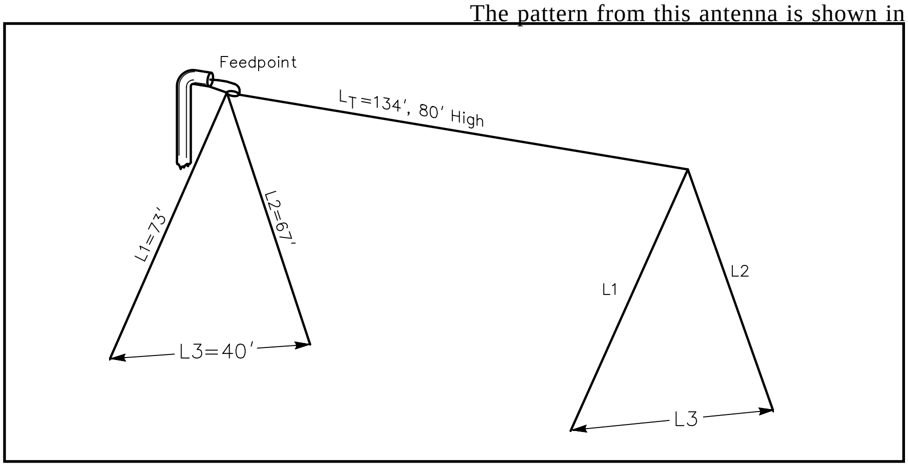

Fig 2—Typical N6LF broadband symmetrical half-square for 80 meters. All wires are in the plane of the horizontal top wire. The vertical wires are spread out 40 feet at the bottom in this case.

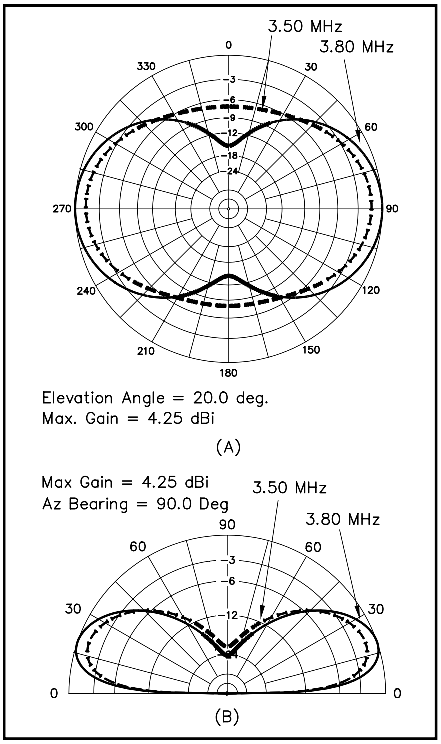

Fig 3—At A, azimuth response of symmetrical broadband 80-meter half-square at 3.8 and 3.5 MHz. At B, elevation response of symmetrical broadband 80-meter half-square at 3.8 and 3.5 MHz.

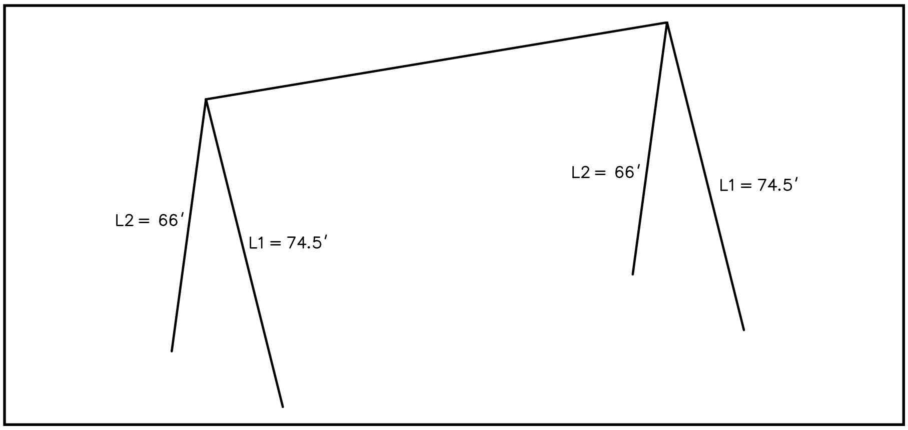

Fig 4—An asymmetrical variation of broadband half-square. Here, the equal-length vertical wires are placed on the same side of a vertical plane cutting through the length of the horizontal top wire.

Fig 3. There is some sacrifice in gain at the lower resonance, but only about 1 dB.

If the vertical wires do not lie in the plane of the top wire, as shown in **Fig 4**, it will still be possible to obtain the double resonance, but the pattern will be affected. As shown in **Fig 5**, the pattern is no longer strictly bi-directional. There can be several dB of front-to-back ratio. The front-to-back ratio improves the gain in one direction; this may be helpful in some situations. More often, however, it is desirable to work long path as well as short path and the bi-directional pattern will be preferred.

Experimental Results

An antenna with the dimensions in Fig 2 was built and the measured SWR is shown in Fig **6**. As expected, there are two resonances, giving acceptable SWR in both the CW and SSB DX windows.

The exact lengths for each wire will depend on the particular installation—the width and height available. If an antenna modeling program such as *EZNEC*[2], *NEC/Wires*[3] or *NEC-WIN*[4] is available, then the antenna can be designed very closely for a particular site, including the ground effects. If the modeling is not available, then it will be necessary to adjust the wire lengths experimentally. Fortunately, all of the adjustments can be made at ground level.

The length of the top wire (L_T) is set during initial construction and can vary from 120 to 150 feet, depending on the space available. The longer lengths will mean that the vertical wires can be made shorter. This allows for lower heights. More detail of this trade-off can be found in Reference 1. There are three other variables: L_1, L_2 and L_3.

The adjustment begins by setting the spacing between the ends of the vertical wires (L_3), then L_3 is adjusted for resonance at 3.790 MHz. Finally, L_1 is adjusted to resonate at 3.510 MHz. L_2 and L_1 are then adjusted one more time. Usually this will be sufficient to place the resonances in the desired locations. If the SWR is not as low as desired, then L_3 can be changed and L_1 and L_2 readjusted. This process should converge rapidly.

Because L_1 and L_2 may need to be either shortened or lengthened, I usually start with extra wire and fold the excess length back on the wire, rather than cutting it off. That way, extra is available to lengthen the wire, if needed.

Conclusion

The narrow bandwidth of the classical half-square antenna can be overcome by adding another set of vertical wires. With a little adjustment, two resonances, with SWR < 2:1 can be achieved. This will allow operation in both the CW and SSB DX windows on 80 meters.

The principle shown here will, of course, also work on other bands. On 160 meters, for example, it would allow a substantial part of the band to be covered without retuning.

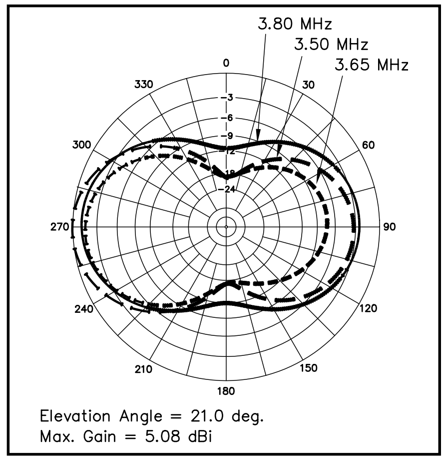

Fig 5—Azimuth response of asymmetrical broadband 80-meter half-square at 3.8, 3.65 and 3.5 MHz, showing how front-to-back ratio changes with frequency.

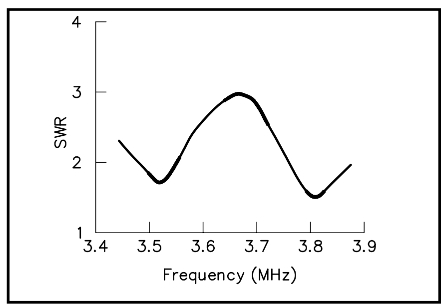

Fig 6—SWR curve versus frequency for symmetrical broadband 80-meter half-square showing characteristic double-resonance.

Notes and References

[1]Severns, Rudy, N6LF, "Using the Half-Square Antenna for Low-Band DXing," elsewhere in this book.

[2]*EZNEC* is available from Roy Lewallen, W7EL, PO Box 6658, Beaverton, OR, 97007.

[3]*NEC/Wires* is available from Brian Beezley, K6STI, 3532 Linda Vista Drive, San Marcos, CA 92069, 619-599-4962.

[4]*NEC-WIN Basic* is available from Paragon Technology, 200 Innovation Blvd, Suite 240, State College, PA 16803, 814-234-3335.