

OFF CENTER FED DIPOLE RESEARCH

This is about the OCFD and not a Windom, Carolina Windom, or End-Fed Zepp. All the power goes up to the feedpoint with coax and very little comes back because we will CHOKe it ! For this design we look at a resonant dipole for the lowest band desired and feed it off center with a balun.

WHAT IT IS: An antenna that will operate well on all Ham bands with minimal assist from the tuners included in many modern transceivers. The very predictable pattern of a resonant dipole applies only to the lowest, or design frequency, of the OCFD and the patterns for all bands above will be distorted. This distortion may be good or bad for the desired operating. A fullwave dipole when driven at the center will display a typical $\frac{1}{2}$ wave dipole pattern being directional broadside with null off the ends. This pattern will reverse when the feed-point is moved as little as 5% off center. Remember that our 160M and 80M antennas are actually NVIS because most of us have height limitations under 70 feet.

The lowest feed-point impedance for a resonant $\frac{1}{2}$ wave dipole is at the center but when we move off center the impedance increases. The classic OCFD is fed at $\frac{2}{3}$ - $\frac{1}{3}$ of the length. Both a standard dipole and the OCFD will have drive impedance variations caused by height above ground unless the antenna is mounted a half-wave above ground or more. The height of the feed point is critical but the ends may droop or be bent with little effect. This becomes most severe with a 160M (250' long) dipole because it is so close to the ground relative to the wavelength. Most of us would really need to use one balun to feed the 160M signal and another for all bands 80M and up. Variations in the exact amount of off-center feed may help our special band preferences or physical limitations. There's quite a variation of impedances caused by both the off-center distance and height above ground. **EZNec** is our friend for modeling and saves untold miles of wire and elbow-grease. Remember that the dipole doesn't care where it is fed and it will radiate happily forever but we do need to efficiently match that feed point.

Resonant $\frac{1}{2}$ wave dipoles when center fed will repeat a resonant and resistive impedance at odd multiples of the fundamental.

For 160 M dipole --

That means: 1.8 , 5.4 , 9 MHz, 12.6, 16.2, 19.8, 23.4, & 27 MHz if fed at the **center** of the dipole.

And: 1.8, 3.6, 7.2, 10.8, 14.4, 18, 21.6, 25.2, & 28.8 MHz if fed **off-center** of the dipole.

Or for an 80 M dipole –

That means: 3.5, 10.5, 17.5, 24.5, 31.5, 38.5, & 45.5 if fed at the **center** of the dipole.

And: 3.5, 7, 15.2, 21, 28, 35, 42, & 49 MHz if fed **off-center** of the dipole.

NOW..... these may not look like we are really going to cover more than a couple of Ham bands with either choice but don't give up the game yet. I would like to cover 3.5, 7, and 14 MHz Ham bands and it looks like the off center feed is most likely to yield these bands but that does not exclude good operating on all other Ham bands with a transceivers's 'on-board' tuner. There are quite a number of real-world factors that may help this situation also.

BALUNS: Those strange things that **Jerry Sevick** has helped us with so much. A 1:1 balun is generally used for a center fed dipole and a 1:4 balun for off center feed but this is not a very good generalization.

First of all, a Ruthroff balun which is a voltage type is often preferred for a center fed dipole because it carries a DC ground which helps drain static and provides a debatable amount of lightning protection. Even using a Ruthroff 1:4 balun or an 'auto-transform' type voltage transformer works well for a center fed dipole where the currents and voltages are well balanced. When we go off center the currents and voltages are no longer in correct phase and it becomes necessary to use a Guanella or current type balun. It may also be necessary to use additional decoupling to prevent unwanted currents from flowing in the feedline, which is coax in this case. The 80M OCFD at a height greater than 40 feet will exhibit a feedpoint impedance of about 200 ohms and the 1:4 balun is most suited. The 160M antenna presents a problem on 160M where the feedpoint impedance may be as low as 15 ohms.

The old feedline problem comes up at this point. I've been a strong proponent of balanced-line feed whether it is open-wire, ladder-line, or twin-lead. Balanced line has very low loss and therefore can tolerate extremely high SWR and still be efficient. But balanced-line is exactly that, it is **balanced** and when we feed off center it can no longer be balanced and becomes a radiator and we've just invented the Windom one more time. The variations on the Windom use the radiating feed-line to an advantage which works to some degree but that is not this OCFD. The balun and decoupling needs to be up at the antenna feed-point and coax brought down to the transceiver. Feedline losses will be very reasonable with low-loss coax (no RG-58 please) and using a good balun up at the antenna feed-point. There will be standing waves on the coax but not extreme if we select the correct off-center location

By spending some time with **EZNEC** it should be possible to use the height that you have available, the length for either 80M or 160M versions, and then vary the feed-point to find the best compromise. Remember that all multiband antennas are a compromise and we only want to give up something on the bands we use least. Adjusting the overall length is generally done to maximize coverage of the lowest band but may be useful to optimize one of the other bands. Remember those bands that are NOT even multiples of the fundamental frequency? I have found those to be well within the reach of the IC-746 on-board tuner also. Once again, **EZNEC** will let you check these before cutting any wire too. **EZNEC** can not show what happens with the mismatch at the balun and various other effects of the coax feedline. Some of these 'side-effects' seem to help on the bands that don't fall on even multiples.

Be certain that the transceiver is well grounded and use adequate lightning protection. When running power levels above 200 Watts you must remember that there will be standing waves on the coax which could exceed the voltage breakdown of the coax and connectors. This is unlikely but gas discharge type surge protectors (lightning arrestor) may be permanently damaged by this operation. Be wary of any changes in SWR during prolonged operation as this may indicate a coax or balun problem. A slow increase may be balun heating and rapid little spikes indicate some arcing. Neither can be tolerated.

EZNec -- Antenna modeling SW by W7EL --- <http://www.eznec.com/>

Jerry Sevick, W2FMI --- Transmission Line Transformers, 4th ed, Noble.
And other notable writings in QST and for Amidon Assoc.