OCF (Off-Center Fed) Dipole for 80m and 40m

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This month is another break from tradition in that I won't be talking about solar issues or ionospheric issues or propagation. I'll be talking about an antenna. Of course an antenna is an important part of propagation, so I don't feel too bad about writing about antennas! What brought this on was a question about the OCF antenna, and I did a lot of work to understand how this particular antenna works.

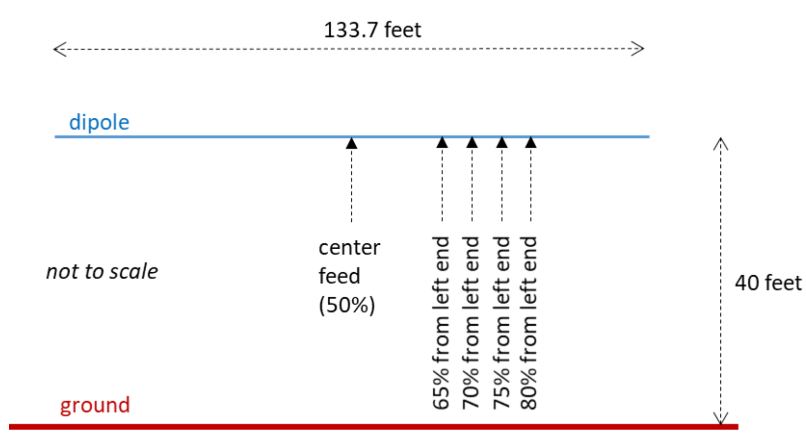
Let's assume you want to focus on 80m and 40m CW. What antennas are available? There are many: a length of wire with a tuner, a dipole (or inverted-vee) with traps, a vertical with traps, an 80m dipole with a tuner for 40m, a 40m dipole with a tuner for 80m, and probably a couple others. But we'll look at the off-center fed antenna, as it has the capability of working on two bands (and maybe more – I didn't go any farther than just two bands) with a simple 4:1 transformer at the feed point (no tuner needed).

Let's start with a run-of-the-mill 80m dipole up at 40 feet cut for 3.525 MHz. The resulting length is 133.7 feet overall. The SWR (per 4nec2 – a free antenna modeling software package available from Arie Voors) when fed at the center is as follows.

frequency	impedance	SWR (50 ohm ref)
3.500 MHz	56 – j12	1.28:1
3.525 MHz	58 + j0	1.15:1
3.550 MHz	59 + j12	1.32:1
3.575 MHz	61 + j25	1.62:1
3.600 MHz	62 + j37	1.97:1

Impedances of a Center-Fed Dipole on 80m

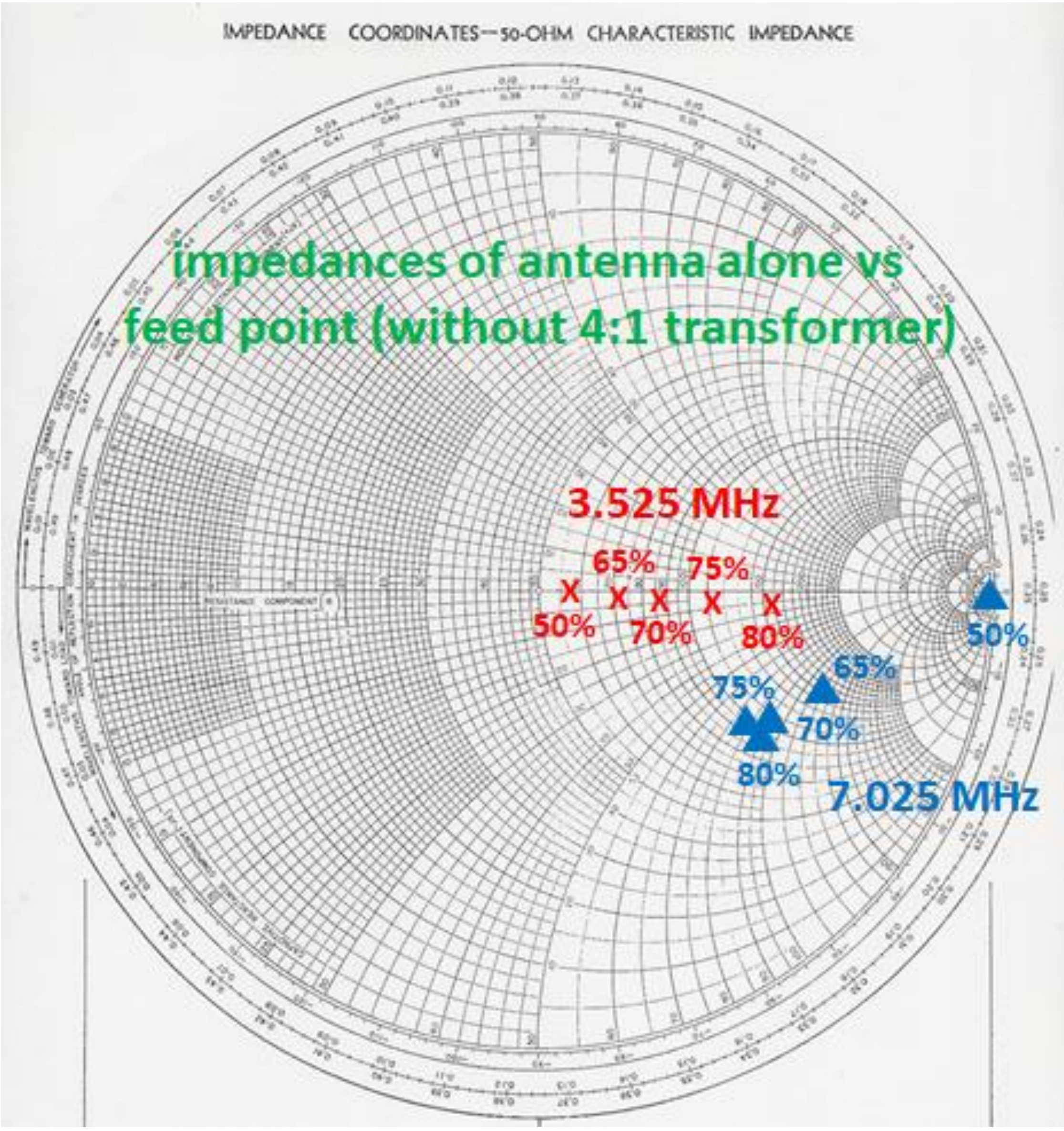
This antenna would work just fine from 3.500-3.600 MHz. What about 40m? It's a full-wave on 40m, and will thus have a very high impedance when fed in the center. From 7.000-7.100 MHz, the resistive component of the impedance is around 4100 ohms and the reactance is capacitive around -j1200. That's an SWR of around 90:1, so you would need a darn good tuner to use it on 40m. Here's where the off-center fed dipole can help out. Here's a sketch of this antenna.



Sketch of the Off-Center Fed Dipole

What I'm going to do is move the feed point from the center of the dipole (50%) to four other positions: 65% from the left end, 70% from the left end, 75% from the left end and 80% from the left end. I'll record the impedances on 3.525 MHz and on 7.025 MHz, and plot them on a Smith chart. Then I'll pick out the feed position that will give the best results for duo-band operation using the 4:1 transformer.

After some work with 4nec2, here's the Smith chart with the antenna impedances vs feed point position from the left end (without a 4:1 transformer) at 3.525 MHz and 7.025 MHz.

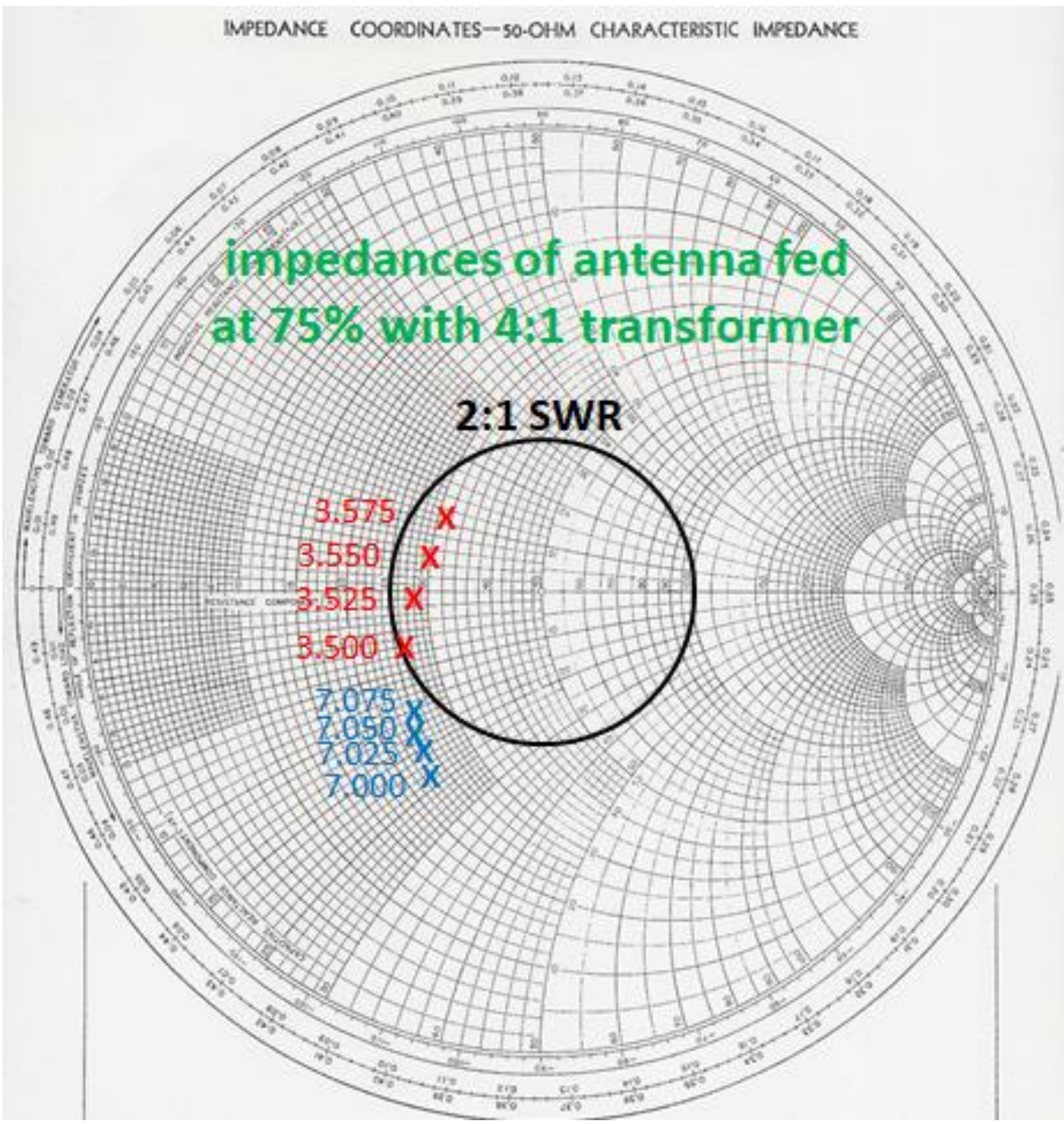


Antenna Alone

First observation: At 3.525 MHz, as the feed point is moved off-center, the resistive component of the impedance increases from 58 ohms at 50% to 159 ohms at 80% without straying too far from the real axis (small amount of capacitive reactance).

Second observation: At 7.025 MHz, as the feed point is moved off-center, the impedance goes from around 4100 – j1200 at 50% (these values come from the first page) to around 100 – j90 at 80%. There is no feed point position where the impedance at 7.025 is near the real axis (no reactance). As a side note, if we go up to the 40m phone band (7.200 MHz and above), the impedance does get near the real axis (to around 120 – j5).

Now we have the impedances vs the feed point position at both frequencies. Ideally we'd like 200 + j0 at both frequencies to use with a 4:1 transformer. But we don't have this luxury, and running various scenarios in 4nec2 indicates the 75% feed point position would be the best compromise. So let's put the impedances at the 75% feed point position through an ideal 4:1 transformer (no loss) and plot them on a Smith chart.



Antenna with 4:1 Transformer

The “good” news is the 80m frequencies are within a 2:1 SWR circle. The “not-so-good” news is the 40m frequencies are just outside a 2:1 SWR circle. But the “kind-of-good” news is the SWR will be just inside a 2:1 SWR circle in the real world due to the expected loss in the 4:1 transformer and in the 50-ohm feedline to the shack (assuming 0.5 dB of loss in the transformer and 1.0 dB of loss in 100 feet of RG-58).

Now let’s summarize the results. The off-center fed antenna described in this month’s column will work on 80m CW and 40m CW using a 4:1 transformer. The resulting SWR will be marginal to a 2:1 SWR, especially on 40m CW. The results would be better if this was to be used on 80m CW and 40m phone. I would expect the same performance trend of any off-center fed antenna that is designed to work on a frequency and twice this frequency. Somewhat above the exact second harmonic on the second band would give better results.

As for adjusting this antenna (for example, allowing for ground parameters different than what I modeled), the only solution is to lower the antenna to make slight length adjustments and raise it back up. You could also move the feed point position a bit with some difficulty.

Perhaps installing this as an inverted-vee (with the midpoint at the apex and the feed point position 75% from one end). This should allow the angle between the two sides of the inverted-vee to be varied a bit and the length of each side to be varied a bit to tune it for best performance on both bands – and I think this should be able to be done from ground level.