**2/7/19 Training – Windom Antennas and the OCFD**

***Analysis of the original Windom antenna and various modifications, including the Off Center Fed Dipole***

It seems that ham radio operators have been searching for all-band antennas since ham #1 talked to ham #2, and that search continues today.

When the Federal Radio Commission was formed in the 1920’s (later superseded by the Federal Communications Commission via the Communications Act of 1934), one of the first things they did was establish designated “bands” of frequencies in the HF range for ham radio operators. In a stroke of “wisdom” (not “windom” !!! 😊), they established these bands in a harmonically related sequence, today known as 160, 80, 40, 20, and 10 meters (15 Meters was added later). The driving thought behind this action was to keep harmonic energy from ham radio transmitters within the ham bands… for example, the 2nd harmonic of an 80 meter signal would fall into the 40 meter band, etc., etc. You see, back in those days ham transmitters had very little filtering and harmonic suppression, and they commonly radiated a lot of harmonic signals!

Anyway, this decision to create harmonically related bands for hams gave rise to the interest in, and consequent unending experimentation on multi-band antennas, and the Windom was one of the most popular such antennae for multi-band operation then, and even today (although in modified form).

The original “Windom” was essentially “invented” by Loren G. Windom (ex-W8GZ), who lived in Reynoldsburg, Ohio. Windom’s original idea was off-center feeding a horizontal wire antenna to present a feedpoint impedance of 600 ohms. This is close to the surge impedance of a single-wire feed line, allowing an inexpensive single conductor to be used as a feed line!

In theory, with suitable selection of the feedpoint tap point location and antenna length, a reasonable match should occur on multiple harmonically related bands.

The achilles heel of the original single wire Windom is the single-wire feeder! It has no “return conductor” or shield, so the single-wire feeder…

1. …radiates and couples to everything around it, causing RFI and couples local noise into the receiver
2. …causes considerable common mode currents along the feed line and at the matching system. The common mode currents and strong electric field extending a considerable distance from the feed wire cause RF grounding problems and common mode currents in the hamshack and on all the shack wiring and equipment… and…
3. …when television came on the market, the single-wire feed Windom was a major source of TVI.

Later versions of the Windom continued to be off-center fed, but used coax or balanced line all the way up to a balun transformer at the feed-point location on the horizontal element. Essentially this is the Off Center Fed Dipole we know today.

Note that because of common mode currents created by the different lengths of radiating wires caused by the off-center location of the feedpoint, an extremely good quality balun transformer must be used, one that also includes a line isolator choke to prevent common mode current caused radiation from the feed-line.

That’s the basic story - - - but there’s a bunch of other peripheral stuff that becomes part of the story. Here’s some examples:

* Transmitters at that time didn’t use PI-Network output tuning in the final amplifier stage – they generally used a parallel “LC” tank circuit, link coupled to a secondary winding that was connected to the antenna. So, you had 2 output leads… one from each side of the secondary winding, which was usually connected to a balanced “ladder line” made up of 2 wires separated by periodic insulators, and having a typical impedance of around 600 ohms. Such ladder lines had very VERY low loss, and could be coupled to the center of a dipole antenna… thus eliminating common mode current problems.
* When the Windom antenna came along, a lot of hams grounded (!) one side of the tank circuit’s secondary link and ran the other side directly to the off-center feedpoint of the antenna. In this configuration, the antenna actually became a top-loaded vertical antenna, with the horizontal wire acting as a capacitive top-hat (!) to lower resonance frequency!
* Some hams ran ladder line up to within 10’-20’ of the antenna, then just cut off one side of the ladder line and ran the remaining side to the feedpoint of the antenna… kind of like a ZEPP antenna… again with everything radiating because of common mode currents all along the feedline.
* When PI-Network final amplifier tuning became popular, the transmitter’s output was now unbalanced and coaxial cable was used as a feed line. Again running coax to the off center feed point resulted in common mode current problems, and the shield of the coax radiated… thus the need for a line insulator choke.

There are lots and lots of other related stories about the evolution of the Windom and Off Center Fed Dipole – a great conversation piece – and we’ll discuss this more in the future.

I’ve used the term “common mode current” several times, and you’re probably wondering what is. Well, the full definition is very technical… so, as a general idea, think of it this way… common mode currents are currents that are not cancelled out by the presence of identical opposite polarity currents. For example, in ladder line, the same currents are normally flowing in both wires, but their opposite polarity nulls out any radiation from that balanced ladder line. Another example is in coax, current is following thru the center conductor, and back through the shield, and the shield totally encases any stray radiation… so there’s no common mode currents present. On each side of a dipole are common mode currents that aren’t cancelled out, because the opposite signal is on the other side of the dipole… so, signals get radiated equally from both sides of the dipole, and there shouldn’t be any common mode currents on the feed line. BUT, if one side of the dipole is longer than the other, common mode currents can appear on the feedline, unless they’re suppressed by a line insulator choke.

I’ve been modeling a whole bunch of different Windom and OCFD antenna configurations on EX-NEC Pro, and have found a lot of interesting stuff… For example, the 160 meter band is 1.8-2.0 MHz. If you cut a dipole (or OCFD) for 1.825 MHz (just inside the CW portion of the 160 meter band), it’s harmonic resonance points will be at 3.650 MHz (80M CW band), 7.300 (the top of the 40M SSB band), 14.600 MHz (OUTSIDE the 20M band!), and out of the 15M & at the very top o the 10M band. I’ve also found the – even if I use an 80M OCFD starting with 3.525 MHz (just into the 80M CW band), the resonance at 20M would be 14.100 MHz but with a load impedance of over 1,200 ohms (a 6:1 SWR even with a 200 Ohm balun at the feedpoint). I’m experimenting now with a ¼ wavelength stub at the feedpoint to transform the high impedance load at the OCFD feedpoint to a lower impedance to the feed-line.

In summary, a “Windom” has a single wire feedline to a point off the center of the antenna (1/2 wavelength at the lowest frequency). A “Carolina Windom” has a 2-wire feeder with a choke around the feedline about 10’ below the antenna. An OCFD runs coax to a high quality balun transformer with a choke to suppress common mode currents, mounted at the feedpoint to the antenna. More to follow……….