Some Remarks About Flag And Loop Arrays

Dallas Lankford, 5/22/2011

My association with Carlos, N4IS goes back to 5/23/2007. I met Doug, NX4D shortly after that, I don't remember exactly when, although I could establish the date by a careful search of my email archives. These two gentlemen introduced me to dual flag arrays. I did not catch on right away, and in fact at first I thought that such arrays would not be useful for MW DXers. I was wrong. About a year and a half passed before my 750' and 1500' beverages at Quoddy Head failed to live up to expectations and I began to search for better MW splatter reducing antennas. Doug Waller's dual rotatable top band flag array had become operational as early as November 12, 2003. To the best of my knowledge, it was the first dual phased flag array, or for that matter, the first dual phased loop array of any kind. According to what I have been told, it was not universally well received. This does not surprise me because of human nature. On the first evening of testing my my dual flag array optimized for MW splatter reduction, I believe it was on December 24, 2008, I enjoyed the best nulls of domestic MW signals to the North of my location in Louisiana that I had ever experienced. That night I came to believe that flag arrays would become better splatter reducing MW antennas than any other kinds of antennas, except, perhaps, for multi 1000 foot phased beverage arrays at low noise coastal sites which none of us will ever experience. Had it not been for N4IS and NX4D, I would have never experienced dual flag arrays or any of the other antennas which have evolved from those experiences.

I do not mean to say that our first flag arrays were perfect. When I met them, NX4D and N4IS had already improved their WF arrays, as Carlos christened them, and were interested in any suggestions I might have to improve them. At first I had little to offer them because I was busy optimizing their RDF optimized designs for MW splatter reduction.

In the past we have wished that if only we could get rid of the flag resistor but retain the flag cardioid-like pattern, then we would eliminate the resistor loss of the flag arrays. Merely deleting the resistors is not satisfactory because dual loop (no resistors) arrays do not have either as good RDF or as good splatter reduction as dual flag arrays. Until a few days ago, I thought that the same was true for quad arrays, but the (as yet untested) mini quad delta loop arrays may prove me wrong.

Well, anyway, it just occurred to me yesterday that the high Z preamp I use eliminates flag resistor loss. My high Z preamp is a FET follower. That means essentially no power is required at the input. Only voltage. A high Z input follower merely "follows" the input voltage, which is virtually identical to the open circuit voltage. The output voltage of a high Z input follower is approximately the same as the input voltage, generally somewhat less, about 6 dB less in the case of my J310 - J271 follower. The output of a high Z input FET follower also provides power for the the feeder (coax or twin lead). If gain is desired, merely add an LIN to the output of the follower; see the antenna simulations in “Hi Z PPL's For Loop And Flag Arrays.”

Now here is the point. What is the open circuit voltage of a loop (with no resistor), and what is the open circuit voltage of a flag (with a resistor)? They are approximately the same! The open circuit V of a loop is found as follows. Use KVL (Kirchoff's Voltage Law) to find the output voltage V across a very large value resistor R at the output of a loop with a voltage E induced by a passing electromagnetic wave: $E - ij\omega L - iR = 0$, so that $i = E/(R + j\omega L)$, from which $V = iR$, namely $V = ER/(R + j\omega L)$, and the magnitude of V is virtually identical to E. The open circuit voltage V of a flag with 1000 ohm resistor and large value resistor R at the output is: $E - i \times 1000 - iR - j\omega L = 0$, so that $i = E/(1000 + R + j\omega L)$, from which $V = iR$, namely $V = ER/(1000 + R + j\omega L)$, and the magnitude of V is virtually identical to E . So the resistor causes virtually no flag loss when a high Z input FET follower is attached directly to the flag element.

The open circuit voltage of a flag with supercharger is about 6 dB greater than the flag alone, which should eliminate the undesirable high Z follower loss. The supercharger open voltage analysis requires the use of Thévenin's Theorem and some non-trivial algebra

Be forewarned that if you do not implement these antennas correctly, sufficiently far away from other antennas, with resonant antennas detuned sufficiently far away from the operating frequency ranges of these antennas, with common mode chokes as required, and with radials when the ground is almost solid rock, then the antennas probably will not perform as described.