Antenna of the Month

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Moxon

Given a chance, most hams would prefer to have a Yagi up on a tower for as many bands as possible. It's horizontally polarized, has good forward gain and rejects signals off the back and sides... A great combination. But sometimes there is an issue of space because the elements can be quite long. Fortunately a fellow named Les Moxon G6XN (SK) a British ham, came up with a simple way to shrink a conventional 2-element Yagi to about 70% of original length without compromising performance. In fact, it's front-to-back ratio is actually superior.

The basic outline of a **Moxon rectangle** antenna appears in Fig. 1. It's really just a two-element Yagi with the element tips bent at 90 degrees. In fact, the total lengths are the same: A half wavelength for the driven element, and about 5% longer for the reflector. The trick is that the bend locations and the gaps between the elements have to be optimized to give you the best front-to-back ratio, gain, and a good 50-ohm match. In fact, the dimensions are fairly critical if you want peak performance.

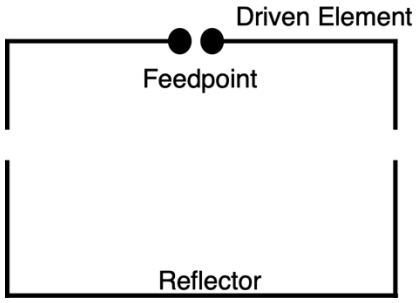

Figure 1. Basic layout of the Moxon rectangle antenna.

Like many antenna designs, this one is evolutionary. The last great contribution was by L. B. Cebik W4RNL (SK) who studied it in depth and came up with a set of equations that provide those important optimized dimensions [Ref. 1]. And to make life really easy for us all, Dan Maguire AC6LA as written a dedicated application (*Moxon Rectangle Generator*, Fig. 2) that gives you the magic numbers [Ref.2]. You simply supply the frequency and the size of the wire or tubing. What could be easier? His program even supplies an output for simulators including EZNEC in case you want to explore further. I should also mention that the bent-element concept has been further adapted and morphed into many other designs including the popular Spiderbeam and Hexbeam. Good ideas do seem to propagate.

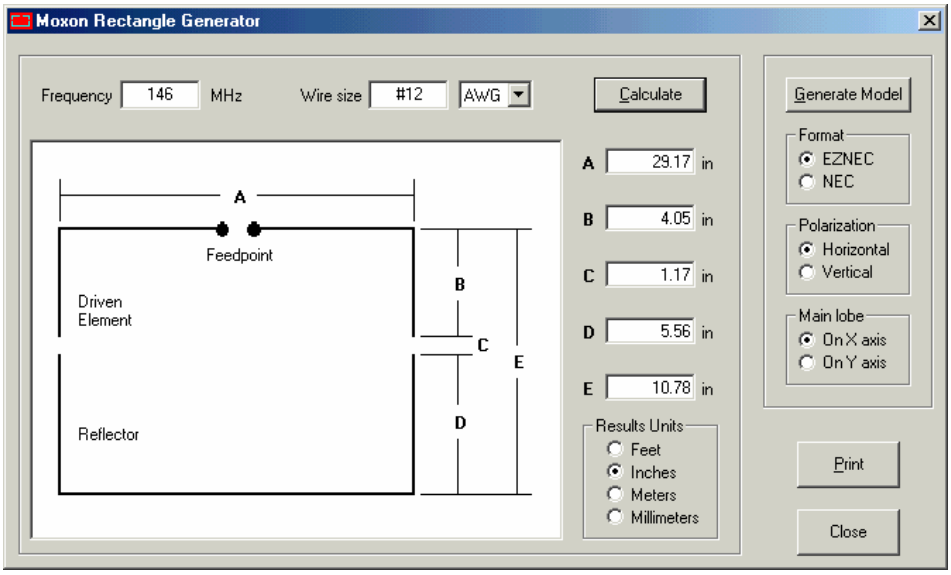

Figure 2. Screenshot of the Moxon Rectangle Generator *(courtesy AC6LA).*

Construction

You can build a Moxon from either wire or tubing but most designs are based on wire supported by lightweight fiberglass spreaders in an X-shaped configuration. Look up Moxon construction on the web and you'll find many practical examples. An interesting adaption for 40 m was designed by Dave Leeson N6NL who modified a Hy-Gain XM240 2-element Yagi to achieve superior pattern and greater bandwidth in the same compact footprint. This has been very popular and is easy to build [Ref. 3].

Performance

Compared to a regular 2-element Yagi, an equivalent Moxon will yield a forward gain only 0.2 dB less. But it's distinct lack of rear lobes is remarkable, reliably down 20 dB versus only 10-12 dB for the regular Yagi. It achieves this in a manner similar to a loop-fed array (LFA) Yagi via the added coupling provided by the end wires. Those perpendicular wires give the designer an extra degree of freedom when optimizing the pattern. Results are shown in Cebik's report. Also, the Moxon has excellent bandwidth in terms of SWR–much better than Yagis shortened with coils.

Conclusion

The Moxon rectangle is really a win-win design and its popularity including its many derivatives is well deserved.

References

1. L. B. Cebik, W4RNL (SK), Designing Moxon Rectangles by Equation and by Model. http://on5au.be/content/a10/moxon/moxgen.html

2. Moxon Rectangle Generator application by AC6LA. https://ac6la.com/moxgen1.html

3. W6NL Moxon on a Cushcraft XM240.
http://www.k3lr.com/engineering/moxon/W6NL_Moxon104.pdf