

The M-Quad

A revolutionary new antenna design, from recent studies into a well-known mathematical curiosity. It's a practical 2m antenna with extraordinary performance you can build.

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Author's Note

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Before building this antenna, be sure to read ALL about mono-directional coax on w6nbc.com (link in left column).

This recent development in antenna design comes from the RF implications of an 1858 mathematical novelty, the "Möbius Strip". See Figure 1.



Figure 1: Paper Möbius Strip

Uniquely, it has ONLY ONE SIDE. The new antenna design utilizes this unusual property to manipulate two RF waves introduced simultaneously into one antenna.

The possibility of applying the Möbius principle to EM waves was suggested in 2005 by Hiram Percy Täuschung of Hölle-Raiser University in Israel. He speculated that if the axis of two laser beams could be manipulated at the specific angle of 26 degrees, their combined electric fields would trace out a cubical Möbius surface, with astonishing consequences. But as he wrote, "We did not know if such a topology could actually exist," The theory was, however, brought to reality just this year at the Maxim-Plink Institute of EM Science in Misthafen, Germany. The team

there re-configured an antenna hams are well familiar with, the cubical quad, into what they call an M-Quad. And it is an antenna you can build.



Figure 2: My home-brew 2m version of an M-Quad

It is structurally two half-turn helices, one right-handed (red) and the other left-handed (blue), connected end to end. See Figure 3. The edges define a cubical Möbius surface.

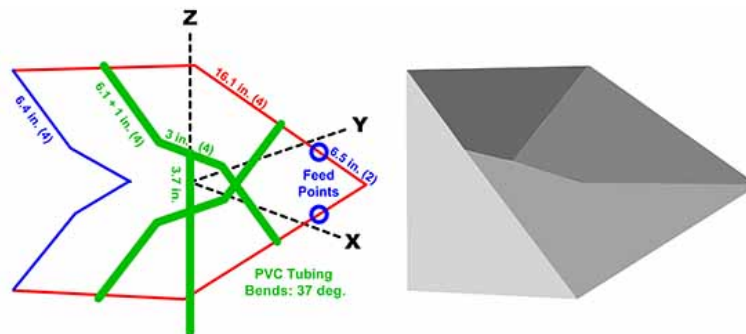


Figure 3: Details of the 2m M-Quad and its corresponding virtual cubical Möbius surface

An M-Quad exhibits extraordinary gain. Secondly, it has an excellent front-to-back ratio. Thirdly, its polarization is epi-cycloidal, (a version of circular). It's an excellent choice as a satellite antenna or for t-hunting.

These benefits, however, only exist if one feeds an M-Quad symmetrically with two electrical half-wavelengths of mono-directional coax.

Before proceeding, be sure to go to the QST announcement for Monax just below the link for this article on the home page.

The mono-directional stubs create two waves with the Möbius twist. Figure 2 details the feed points. The stubs join at a “T” connector.

Figure 4 is the resulting free-space elevation (vertical) radiation pattern of the 2m M-Quad shown here. Gain is 19 dBi –equivalent to a very long 26-element 2m beam, on a 23 ft. boom. Further, unlike a conventional beam antenna, an M-Quad has azimuth gain in all directions.

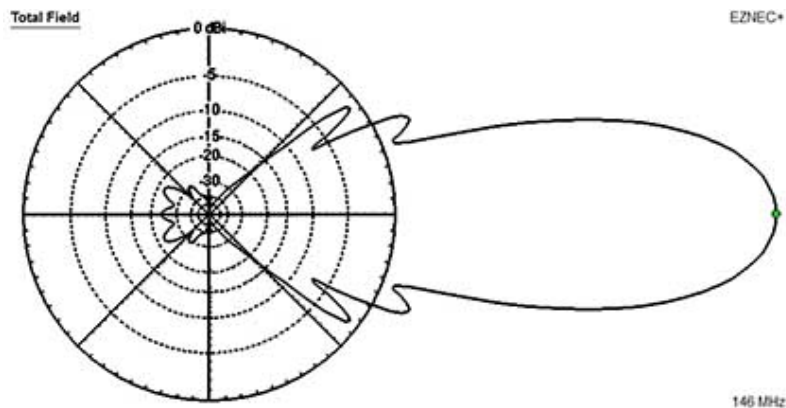


Figure 4: EZNEC elevation radiation pattern. Azimuth pattern is omni-directional. Gain is 19dBi, front-to-back ratio, 41dB.

Construction Details

I used common hardware-store tubing for construction. To guide me, I made a small 1/10th scale model from 18 AWG bare solid wire. It was invaluable as a visual guide during the somewhat tricking bending and assembly process.

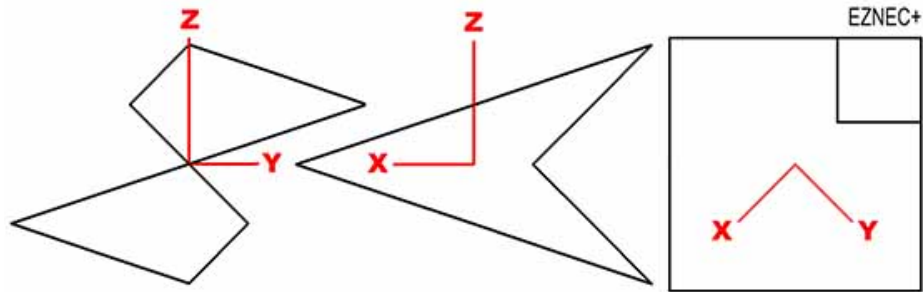


Figure 5: X,Y,Z views. Bends are right-turn, right angle, rotated upward/downward

The easiest way to make the bends in the tubing is to first make a ½ in. flat spot at each bend with Vice Grips. Adjust the angle of each appropriately for the upward or downward twist in the loop. Use the wire model as a guide.

Support Structure

The support structure is also tricky. The ½ in. PVC arms must be bent at a 37° angle, 3 in. from the center axis. This lets them enter straight into the fittings. PVC pipe bends easily with a heat gun. Further, you'll need to cut a 1 x ¼ in. two-sided slot in the outer end of each arm at a 12° angle to horizontal to hold the antenna.

Feeding the Antenna

For the connection to coax, flatten and drill the ends of the tubing. Make two small terminal blocks from any plastic material. At the coax ends use crimp-on ring terminals. Be certain that the mono-directional coax stub on the descending side of the loop faces toward the loop and on the ascending side, away from the loop. Ordinary coax completes the run to the transceiver.

See ordering details for mono-directional coax just below the link for this article on the home page. Be sure to read all about mono-directional coax on w6nbc.com before ordering (link in left column).

The M-Quad is new to the ham world and is also a little tricky to build. But it is well within the capabilities of many experienced home-brew hams, but its performance is well worth the effort.

