The Magic Loop

By Henry Chamberlain, ZS1AAZ

Subject:

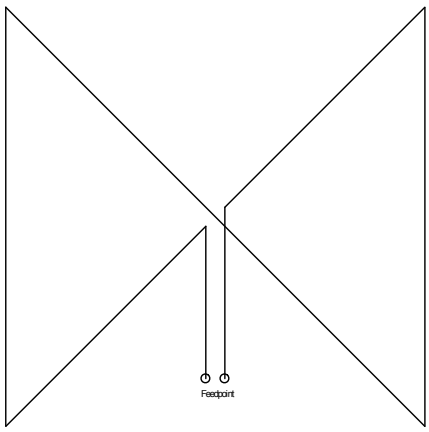
A folded loop antenna for 40 and 80M and scalable for other bands.

Since writing this article, I have moved to a retirement centre where visible antennas are not allowed although I would have liked to continue my experiments with this antenna! A quad type beam for 20, 15 and 10 would be more compact!

I have read quite a number of articles about loop antennas, and usually the outstanding characteristics of loop antennas, are that they are quiet, that they perform well, and are easy to construct. So I started thinking seriously about putting up a loop antenna on my property. The problem however, was that my house occupied the centre of the plot, and I was reluctant to use the front part of the garden for antennas. In the back part of the property there was already a three element tribander at 10M height, mounted on a 40mm metal pole, with three guy wires. Then there was a trap dipole for 40 and 80M, and an assortment of antennas for 2M and 70cm. Putting up four supports for a square loop just would not be acceptable.

I started to think how I could put up a loop with the minimum of supports and one day had the idea to twist one side of the loop so that it would form two triangles with the feedpoint in the middle. The idea may not be original, but I have not seen any publications with this configuration.

Here is a sketch of the antenna:



The wire length is a full wave length on 80M. A full wave loop has two current maxima, which means that maximum radiation takes place at two places on the loop,

180 degrees apart. One of them is at the feedpoint, and seeing that the feedpoint is in the middle, the other point of maximum radiation is also in the middle of the antenna, but at right angles to the first point.

An added advantage is that the area taken up by a twisted loop is 70% of a full sized loop.

I suspended the antenna from the tribander support at about 9M in an inverted vee configuration with four low supports at the four corners, each about 4M above ground. These four supports were 25mm pipes that were fairly well hidden amongst shrubs and trees. I removed the dipole.

Theoretically the impedance of a loop is about 100 Ohms and I thought that the internal antenna tuner in my TS570 should easily match the antenna to my transceiver, and this has been the case. I then asked a friend, Chris, ZS1DX, to do an analysis of the antenna using his antenna simulation software, and this is included.

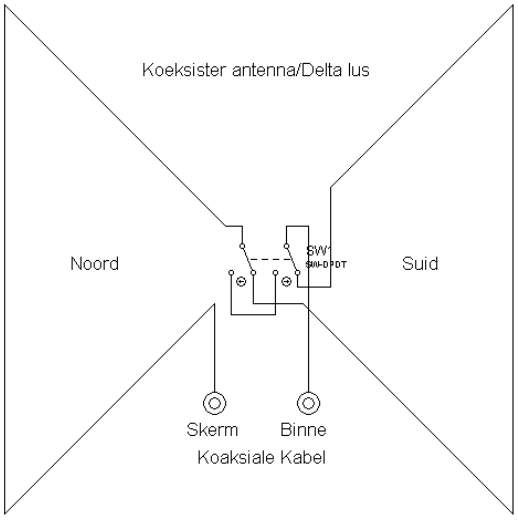
Later on I had the idea to place a DPDT relay in the middle, and to switch one half of the loop out of the circuit and to use the remainder of the antenna as a 40M Delta Loop. Here the feedpoint and maximum radiation would again be at the highest point.

The reports I have had on 80M have been very good and I have often been asked whether I am using an amplifier. ZS1YT, who had an identical antenna, received good reports on both 40 and 80M, in fact, his reports have been better than with his trap dipole. Incoming signals on 40M have been about one S-point better when the loop is switched to a Delta loop on 40M.

The loop has been quiet and I could operate comfortably on 40 and 80. Another interesting discovery had been that the loop seemed to suffer much less from fading than other antennas. This was probably due to having what is in effect two dipoles at right angles to each other, making it a usable diversity receiving antenna. I have read that fading is due to polarisation changes, and the two diagonals at right angles appear to be effective in picking up whichever polarisation arrives at the antenna, especially with high angle signals.

My TS570's internal antenna tuner could only cope with a maximum SWR of 3:1 but successfully matched the antenna on all bands from 80 to 10 except the 30M band. I have worked some DX on 20M with it.

Antenna with relay:



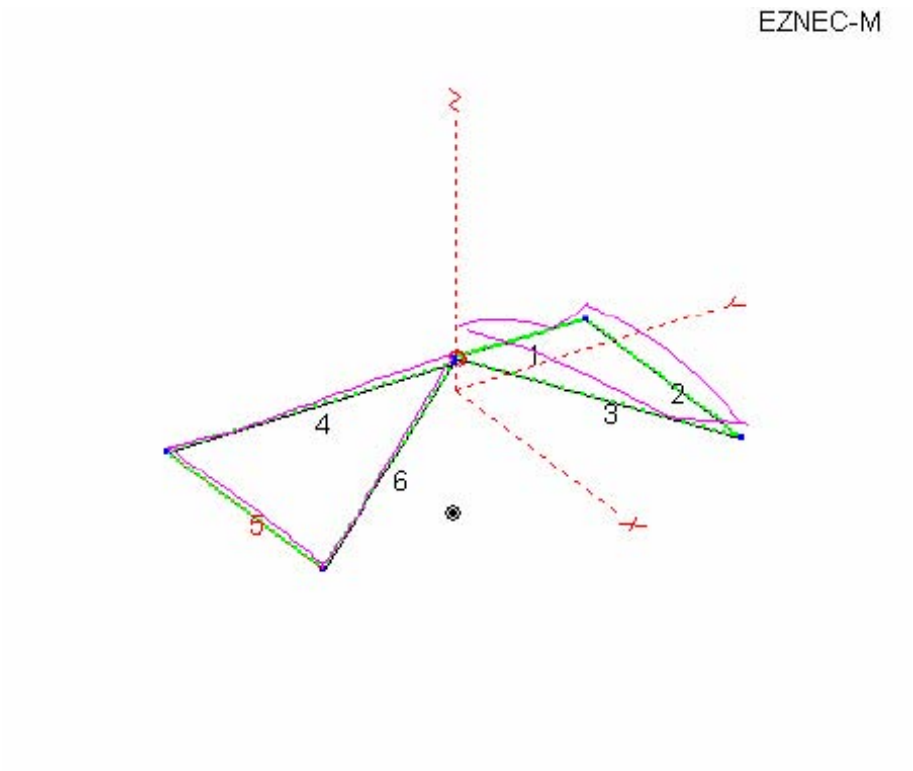
Construction:

I personally prefer the antenna without the relay and would advise anyone who wishes to try it, to construct it without the relay. It is easier to add the relay afterwards.

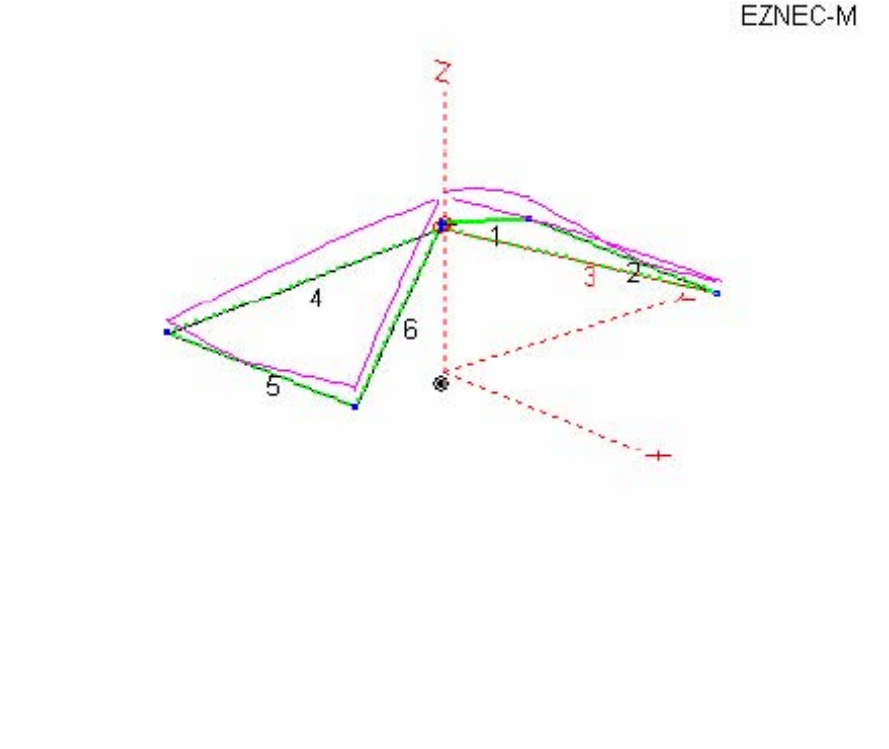
First install the 40M Delta loop by using a full wavelength wire. Divide 300 by the frequency, in my case, 7,07 MHz, to give 42,4 metres length. Install the Delta loop with the feedpoint at the highest point and check the SWR. We found this to be about 2:1, indicating a possible 100 Ohm impedance. Then calculate the length for 80M, 300 divided by 3,67MHz, to give 81,73 metres of wire. Subtract the 42,4 metres that is already installed, and add the 39,34 metres to complete the full 80M loop. Then check the SWR again on 80M. In my case I had to shorten the wire by 3 metres to make the full antenna resonate at 3,67MHz. Again the SWR was about 2:1. Proximity of objects such as the house affected the resonant frequency.

EZNEC plots:

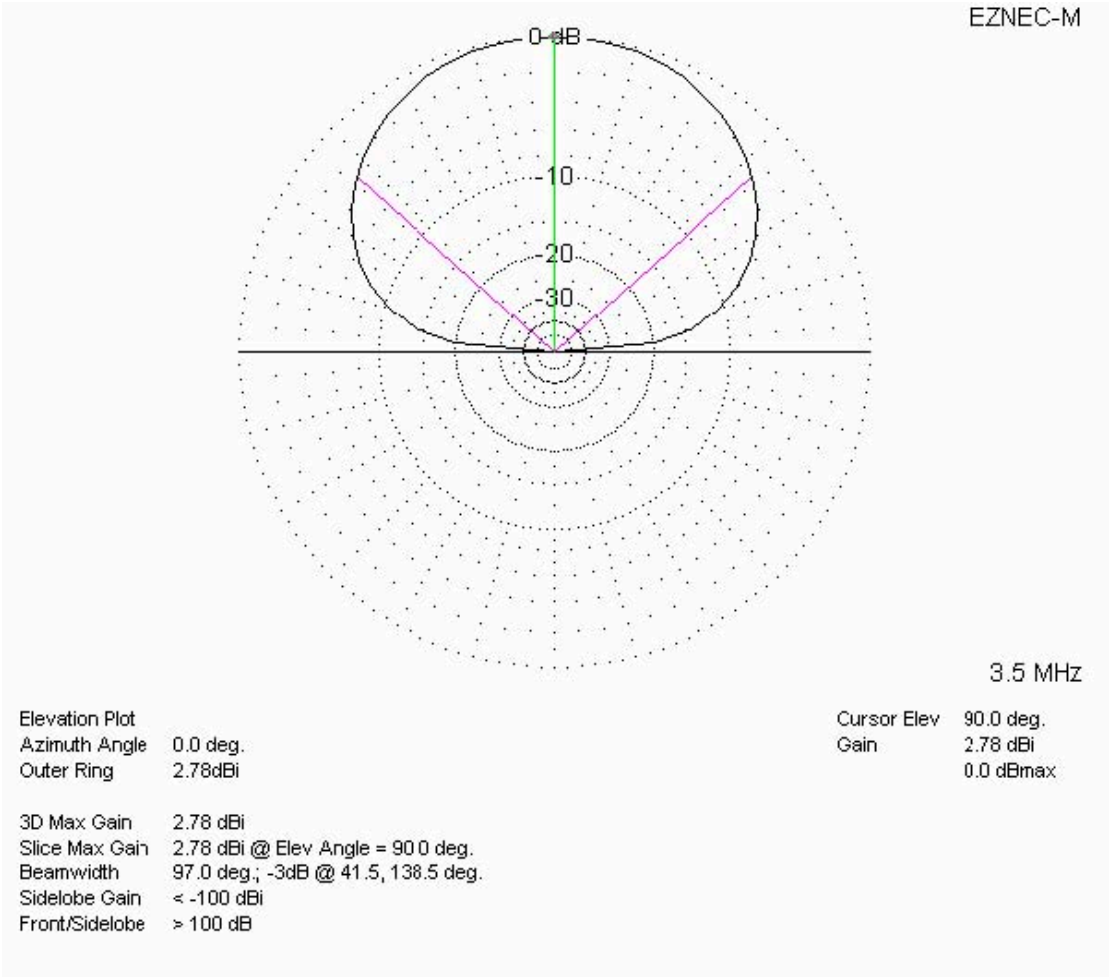
Current distrubution using the 40M Delta loop only.



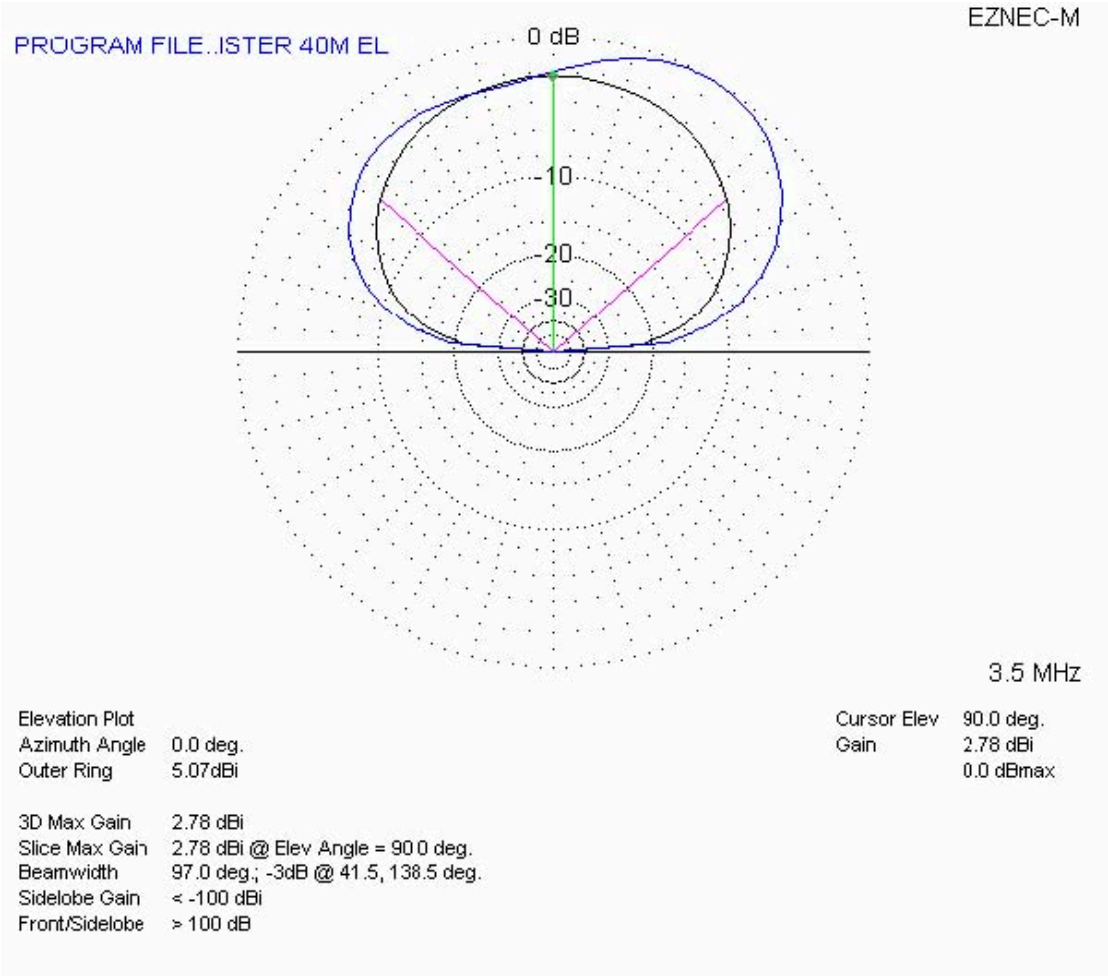
Current distribution of the whole loop on 80M



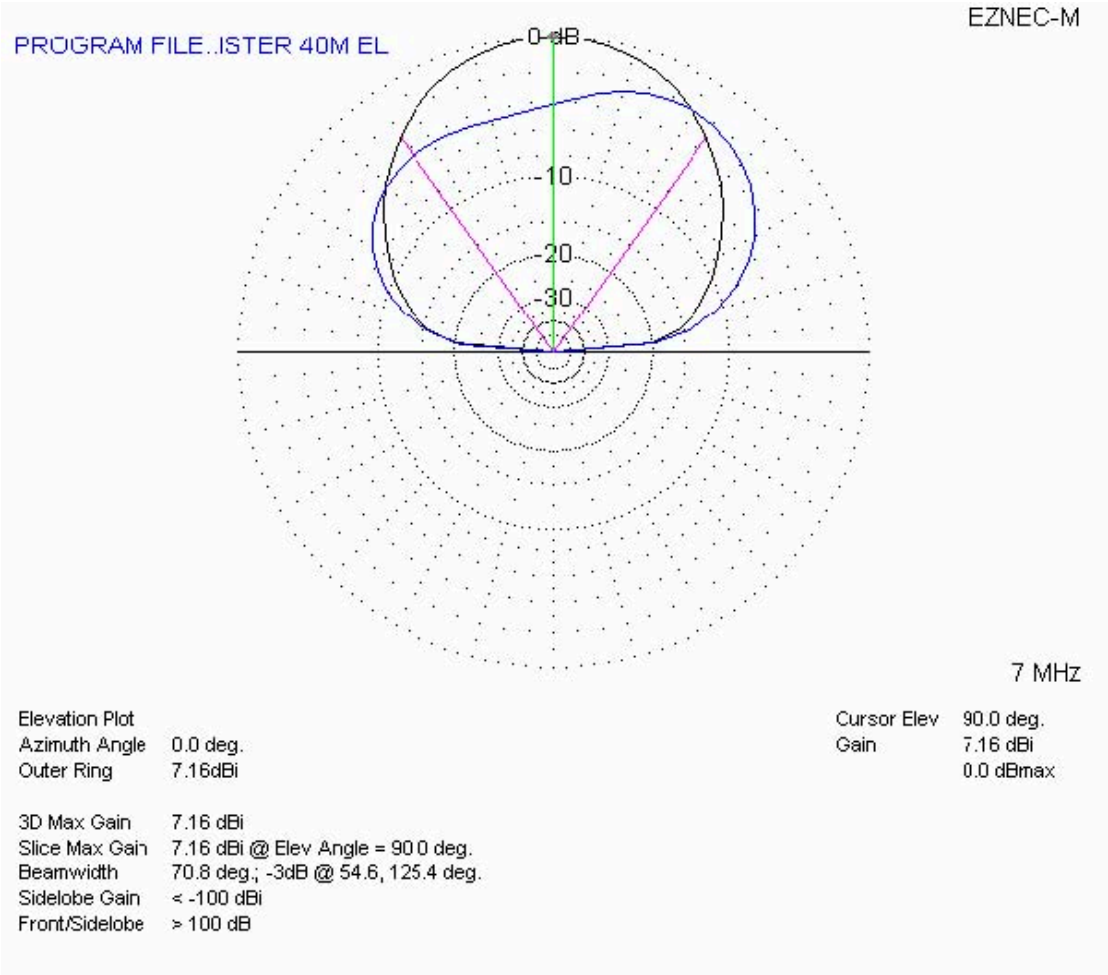
Radiation pattern on 80M. Note that the antenna is omnidirectional in the horizontal plane.



Radiation pattern, 40M Delta loop compared to the 80M full loop. The blue line is the 40m radiation pattern using the delta loop, while the black line is for the 80m pattern using the full koeksister.



The full loop on 80M and 40M. Here is a comparison between the full 80m loop vs. the 40m delta loop, both transmitting on the 40m band i.e. 7MHz.



I would like to thank Chris von Wechmar, ZS1DX, for his assistance with the antenna simulations and corrections. My thanks also to Rassie Erasmus, ZS1YT, for his assistance in testing the antenna and signal reports.