Adventures with compromised 160M antennas….and a win.

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A tale of antenna building, modelling, improvements and an embarrassing modelling 'accident' with a happy ending.

160M is a truly special band in amateur radio circles. Nearly everyone has compromised shortened antennas. There are exceptions of course with a few gigantic, and very expensive antenna farms existing. But the average ham has short and low footprint antennas that provide compromised ownership performance. This is the 'normal' for 160M.

No question it is a difficult band to operate and seasonal variations are extreme. Yet, it has a huge following. Why? Well, in my opinion it is an arena that welcomes innovators, do it yourselfers, make do enthusiasts, technical enthusiasts and those that enjoy the old time ham operating environment. CW rules here and is a perfect operating mode for 160 typical conditions. Propagation conditions are unlike the rest of the HF bands and unlike many of the higher bands is not affected by the solar flux index as much.

I am no exception. I love fooling with 160 antennas and jumping on 160 for DX opportunities, DX contests and the occasional local rag chew. Now that I am retired, I can devote lots of my time to these activities. I also try to help a few other 160 enthusiasts in the area. I do have an envious QTH for antennas and operating, at least locally. It is a spacious site, rural, low noise , has a few useful tall trees and is restriction free for antenna projects. Nova Scotia also has the envious location for North American hams where our primary 160M desired locations are North East to Europe and Western Asia, and South West to cover most of North America. These are 180 deg directions. Ninety five percent of my operating activity is in these two directions.

This leads to the obvious benefit of simple two direction arrays. These are much easier to build than 4 or more directions, and have a lot of utility in trying to gain that slight extra edge for contests and the occasional DX. In Canada, we have a CW power limit of 750 watts, which also leans us toward pursuit of directional gain to aid in levelling the playing field.

My First 160 Antenna

For years I have deployed an OCF Dipole for 80M and up which worked well for me. When I lived in Halifax, I had a typical urban lot with not enough room for long antennas. In pondering how to get on 160, I read up on using flat top and inverted L antennas. These radiate pretty much like a short vertical. If you can match to it, and have some radials, you can do OK with them. I did this for years and was content with the performance. This antenna was transferred to my retirement QTH where I have room and taller trees for larger antennas. In its present configuration it is 75 ft high at the feed line and the short end, and 60 ft high at the long end.

It slightly favours the SW direction. During the latest rebuild I removed the 4:1 feed point balun and replaced it with a 1:1 current balun at the bottom. It now looks a lot more like an almost "T" antenna with a 75 ft. vertical section.

Radials for this antenna have varied over the years. In my Halifax QTH they were a random collection of about 10 wires, from 30 to 100 feet long. Here they started out that way but I was interested in my friend Roger's (VA1RST) folded counter poise antenna (from K2AV information) and I built one of those which was deployed until the latest overhaul. My EZNEC modelling showed it to provide similar ERP as the random radials on the ground. In practice, I couldn't say one way or the other if it was better or worse than the radials.

This was the FCP configuration. The switching system allowed me to use it as a normal OCF dipole or a Marconi 160 T antenna with a switch selection in the shack.

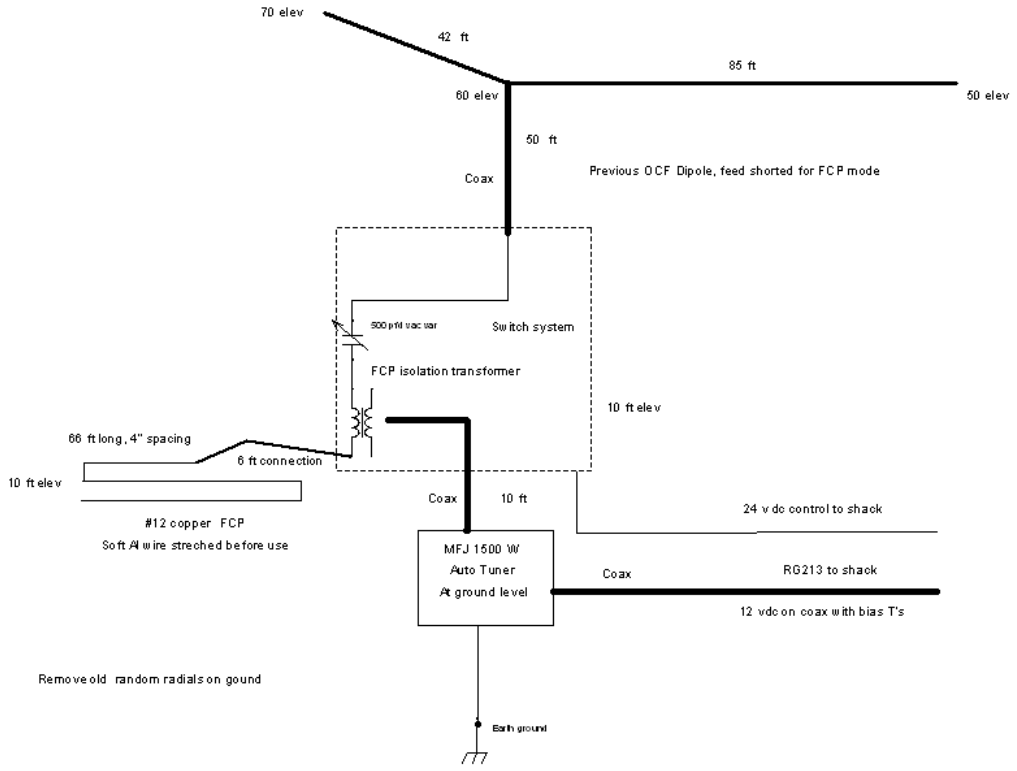


Figure 1 Previous OCF/ Marconi 160 T with FCP

During ensuing modeling, I was interested in getting the lobe to the SW to increase, at the expense of the NE direction. (More on this further on). I removed the FCP in the model and went back to radials. I discovered that a single 'Fat' radial to the SW produced an increase in power to the SW. I tried this out, and RBN testing convinced me it might be working as I hoped.

This is what it looks like after the latest overhaul.

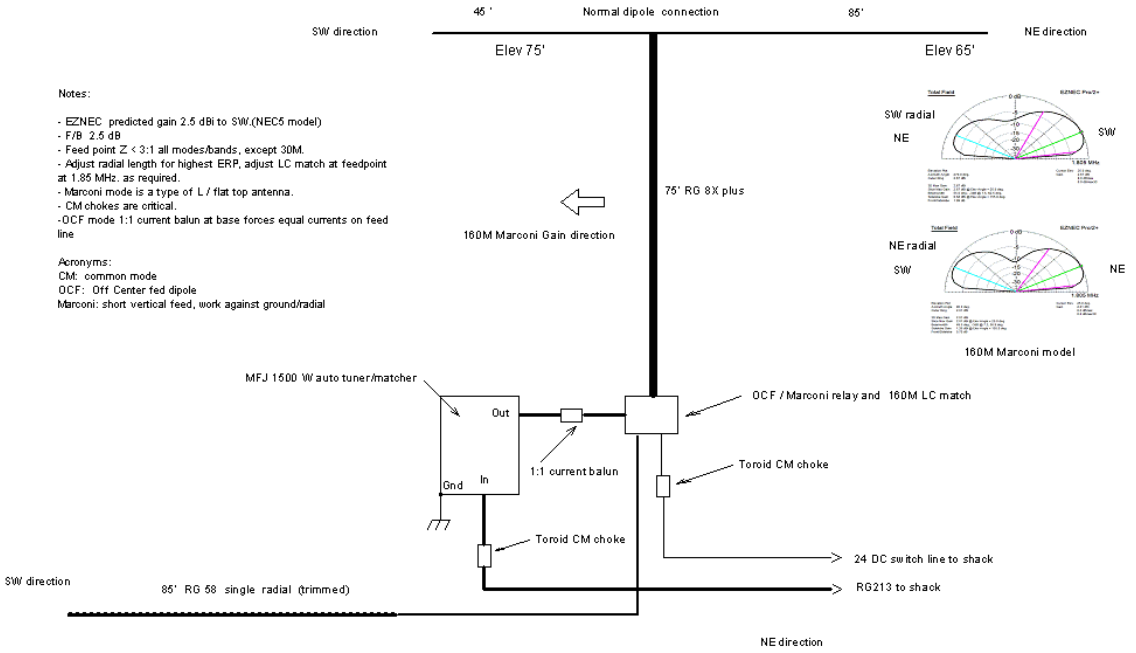


Figure 2 Overhauled OCF / Marconi 160 T

My Second 160 antenna

Last year I decided I needed a second 160 antenna that favoured Europe to the NE. Modelling a second L antenna that favoured the NE direction and a convenient tree support allowed a setup in a field by the house. The base of this antenna would be 167 feet from the OCF /Marconi antenna and I figured that at some point in the future I would look at doing phase control to make both these antennas into an array. I promptly forgot about that while getting this second antenna into working order (An omission and mistake, I discovered later). This one would have an improved radial field. Radials consisted of 15 wires 100 to 40 ft. long spaced equally around the base, and secured to a homebrew stainless steel ground plate (making it easy to experiment with radials at any time)

The tree and base forced the 70 ft. vertical section to tilt slightly. This antenna was also to serve as a 630M experimental antenna. The base has two remote control match networks, one for 160M and one for 630M. There is also a remote control antenna feedline and control cable switch, incorporated a vacuum relay and stepper motor control switching to allow engaging and adjusting the antenna from within the shack. The height of laziness! This antenna has a 190 ft. feedline from the shack.

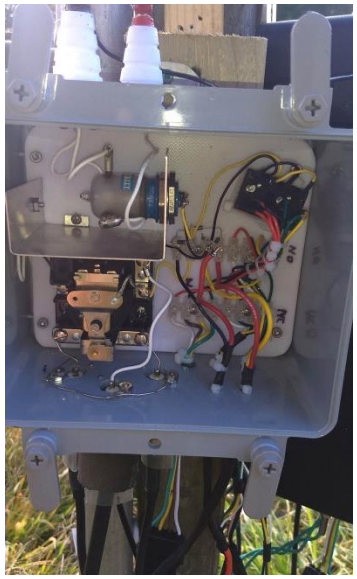


Figure 3 Base of the field 160M L… Neighbours give this thing a wide birth… I wonder why ?

Figure 4 The 630M variometer match.

Figure 5 The 160M L match

Figure 6 The band –matcher switch for 630M and 160M

During last winter's 160 activity, this antenna did favour the NE. I could work EU stations with it that I could not reach with the other OCF/Marconi antenna.

2024 Field L Updates

I decided to apply some improvements to the field L. This involved replacing the #12 vertical with a 1.5" diameter caged section. I also studied the model carefully and found this antenna could increase the power in its NE lobe by removing some of the radials and just leaving the ones heading NE from the base.

Array Time

I finally got around to seeing what I could do with phase control of both arrays. Updating the physical measurements and bringing both models into the same model space is the start. Then I put a source on each antenna and setup the phase difference.

It looked like it was possible to add a few dB to the SW and NE lobes with the right phase applied. This was expected, and it was doable. At this point I have a 70 ft. transmission line from the matcher at the OCF/Marconi antenna in the shack, as well as a 190 ft. transmission line from the field L matcher in the shack. All the needed switching, and delay line issues can be added indoors at the shack. Not a daunting prospect.

The new phase control array setup would look like this:

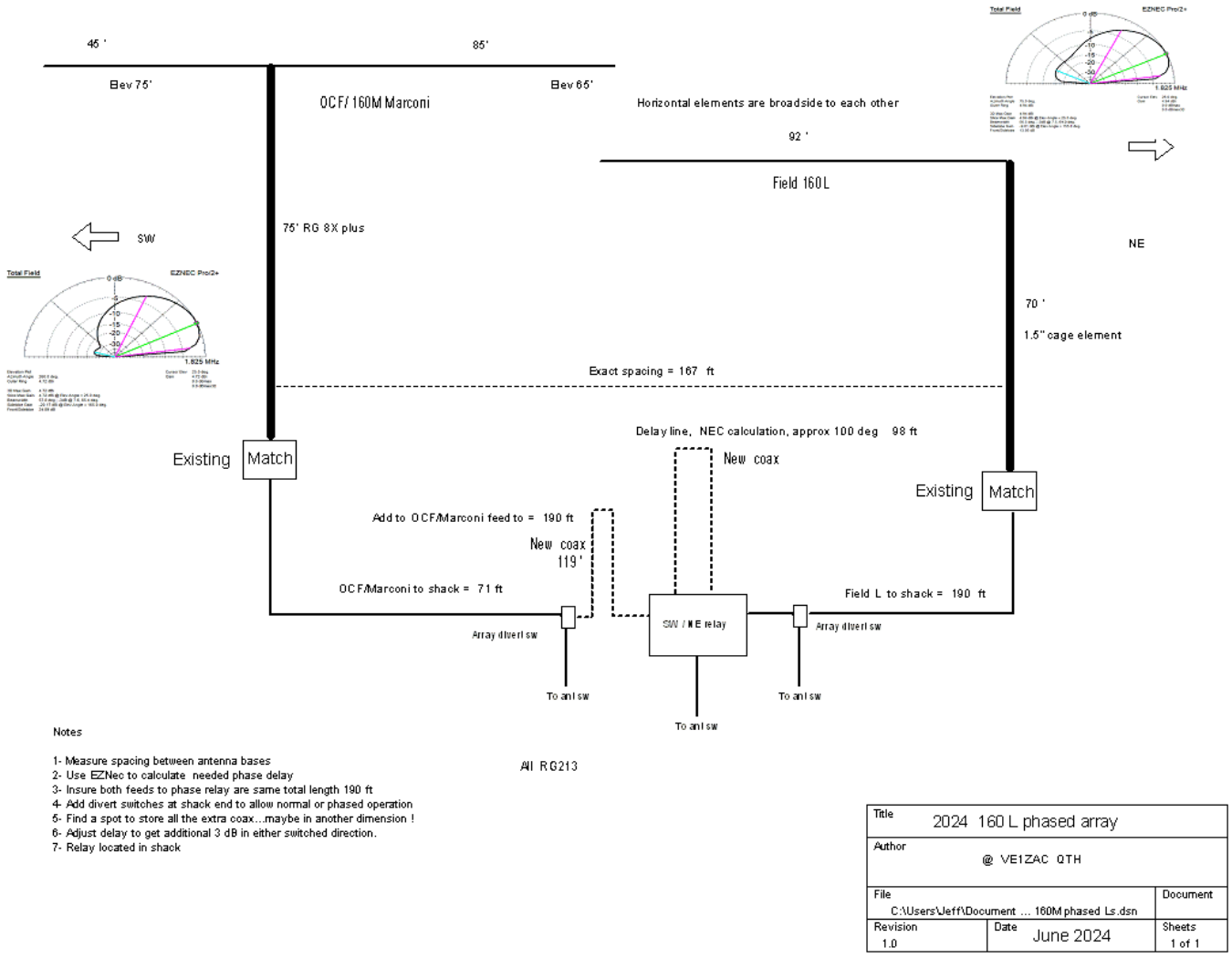


Figure 6 Potential Phase Control

Getting this kind of improvement looked pretty interesting.

The Modelling "Accident"

While I was playing with the model in EZNEC, I accidentally deleted one of the antenna sources and hit the FarField (run) button at the same time. The output changed slightly from the first run. But not much. On investigation, I discovered I had deleted one of the sources. What ??? How could the array still be operating?

This is the embarrassing part. Seems I had a decent passive array in place without the phase control and hadn't realized it. I never checked the interaction of both antenna models, a cardinal modelling sin. I was aghast that I had done this, but the shock disappeared when I realized what I had on my hands. This was a decent reversible array already, just by driving the appropriate feed point on either antenna, with no active phase control.

This was a happy accident! I got out measuring tape , and a golf type laser range finder and went outside to measure everything up again to refine the model. Sure enough, it was a real passive array. Darn.. sometimes you trip over your own feet and land on a cushion.

A layout view of the antennas on my property.

Figure 7 Oblique layout view. Purple lines are radials

Here is what the passive array looks like from the model perspective. These plots are ground wave.

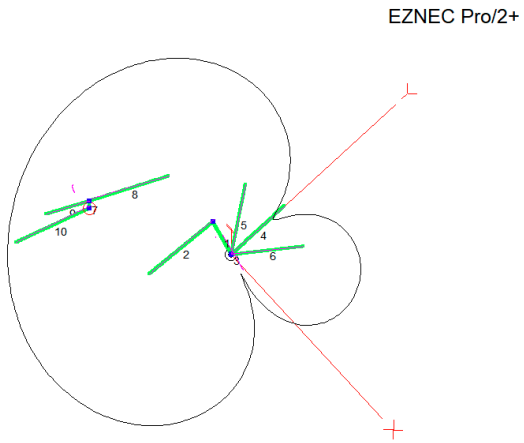
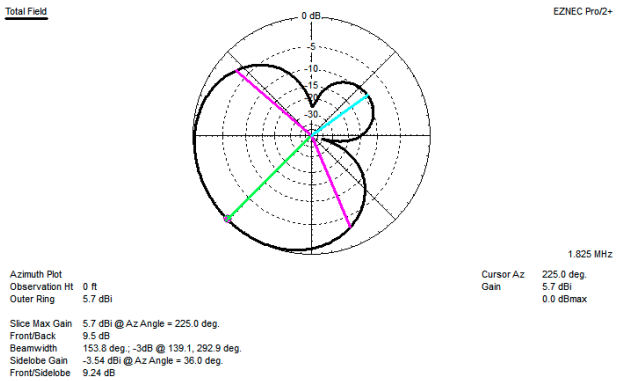


Figure 8 SW drive. -Y axis is 258 deg.



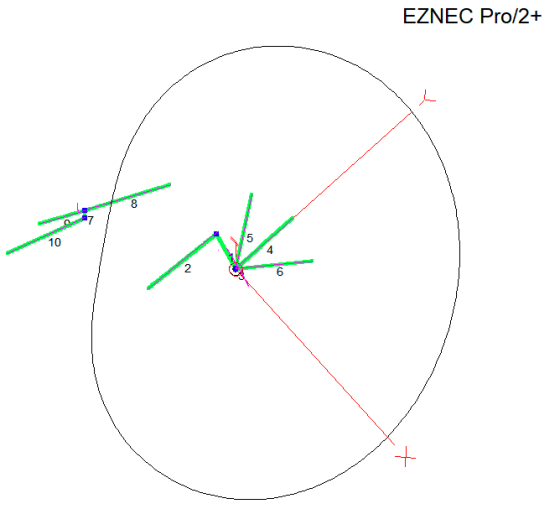
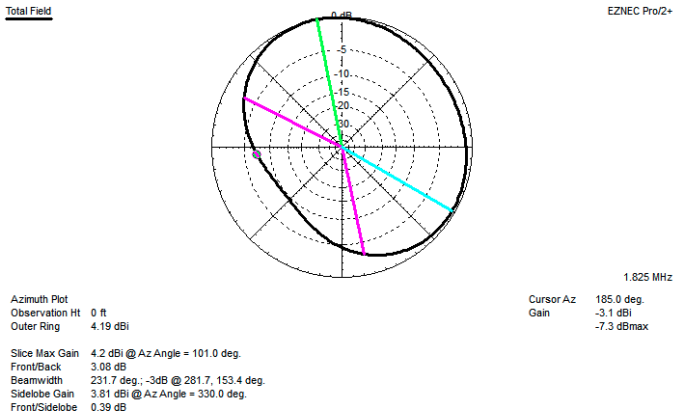


Figure 9 NE drive. Y is 59 deg.



The model with active control of both sources only increases the max ERP of the favoured direction by 1 dB. I will try active control at in the future to confirm.

Validation

Reverse Beacon: several evening sessions with beacons in the New England and New York area (SW from here) confirm there is a 10 to 12 dB difference on one bounce signals when I switch arrays.

Stew Perry summer contest : Not a lot of stations on but I had good results to the West and Southwest with the OCF/ Marconi 160 and poor with the Field L , which favours the NE. Worked some EU DX in the contest on the Field L to the NE but they could not hear me on the OCF/ Marconi 160. A GM3 mentioned that the only response he got to a cq call was mine. Other US stations were calling him but did not get through.

A local ground wave test. VE1GY, 88 KM NE of me reported better than 2 S units difference when I switched directions.

Self ranging tests with a mobile SDR and computer at approx. 5000 meters from me at NE and SW points show 2 S units difference when I switched directions (after normalizing and correcting for distance).

What Happens Now?

I am going to use this setup as is for my seasonal 160 activities, mostly contests. I will give the active phase control a try at some point since it is an all indoor project. Maybe when the weather starts getting cool in late fall.

In the meantime, I am looking forward to trying this setup and see if I can improve my previous contact counts in the contests, and some dx opportunities when they occur.

The improvement take away is an effective doubling of ERP to the SW or NE.

There may be reception improvements too, but I have excellent directional receive antennas for 160 now, and mostly use those when there are lots of signals from both directions coming in.

This is a real 'Trees and wire' 160 project. Looks like decent improvements to my 160M output, so far.

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