Jan. 17, 2008

VE3MLB Phased Double V Antenna for 75/80 Meter Band

This is a story of a double inverted V antenna that I built in January 2008.

I already had a full 80 meter Delta loop suspended from my 45 feet tower but I was not happy with the results. Deltas are supposed to be very quiet, but it was picking up a lot of static noise from the tower. My 40/80/160 meter sloper antenna installed under tri-bander beam also picks up a lot of noise so I do not recommend any wire antennas close to the metal towers. Also, when I was calling DX stations with my Delta loop I was not heard, even with 1000W of power. My goal was to build a decent but inexpensive antenna for the 80 meter DX band from 3.790 to 3.800 Mhz. Also I wanted to improve my strength of my local signal. So I decided to build a simple double V antenna between the poles that I installed over half of the wavelength away from the tower and the house in the open field.

The Vs are suspended from a 3/8" Dacron rope hanging 44 feet above the ground, between two wooden hydro poles. The total cost of brand new red pine poles was $1500 including installation with a winch truck. No need to use concrete but they have to be at least 6 feet in the ground. Used hydro poles cost much less but I could not find any that were 50 feet tall. Both hydro poles have 5/8" nylon guy cables at 60 degrees to the ground to hold the tops in place. The Dacron rope is tensioned with a ratchet rated 2500 lbs. I had a 40 meter Delta between these poles before, which worked very well with South America but 40 meter band is not very good for DX work with Europe.

First I suspended a single inverted V from the Dacron rope, close to one of the poles. Each side of the V was aprox. 63 feet and I trimmed it later on to around 62 feet for the 3.795 Mhz resonant frequency. The bottom each end of the V was about 10 feet from the ground. I fed the V with a VDE 1:1 balun, which has no specified power rating but I used these baluns with 1500W of RF power in the past and they do not fail. I used RG213 as a feed line, going down to ground. The MJF 259 antenna analyzer indicated 1.0 SWR and 50 ohms impedance. A single V worked better than my Delta suspended from the tower. There was not much static noise and the reception was good but not as good as my beverage antenna.

A week later I removed first V and installed a second, identical V 65 feet away, which is a quarter wavelength on 80 meter band. It also had a 1:1 VDE balun and RG213 coax cable going to ground. For the sake of symmetry I was careful to install baluns with labels towards the same side. After I trimmed it for 3.795 Mhz measured SWR was 1:1 and impedance 50 ohms.

Now, this is very important to install only one V at the time. Clear the second V from the ground as it can also couple to the V up in the air. I also removed all other adjacent wire antennas to eliminate possibility of a nasty coupling problem. This antenna is in the open field far away from any metal objects.

Because I was going to phase the Vs, the length of the RG213 feed line to V1 closer to Europe (direction of broadcast) was 168 feet and the V2 behind was 126 feet. This was calculated as 4 and 3 quarter wave sections multiplied by .66 Velocity Factor of RG213. The idea was to have a 90 degrees phase difference between the Vs. In theory according to mathematical equation the performance is best at the phase difference of 90 degrees.

Next I connected the two V feed cables with the UHF T connector and I ended up with impedance of 30 Ohms. Luckily on the first search of Internet I found a very good write-up by Darrel Emerson AA7FV, how to built a The Twelfth-Wave Matching Transformer from three 13.4 feet sections of RG213. (**http://ourworld.compuserve.com/homepages/demerson/homepage.htm**) This transformer easily brought me back to the impedance of 50 ohms. The overall resonance frequency of the dual V array has changed but I was determined to keep both elements resonant at 3.795 Mhz.

I connected 86 feet of the RG213 cable as the feed line to the shack and measured the SWR and impedance inside the house. I was very happy to find that the SWR was under 2.5 pretty much across the entire 80 meter band. And there was little variation in impedance of 50 ohms. Perhaps cutting the cable to a multiple of a half or quarter wave times velocity factor would be an improvement here.

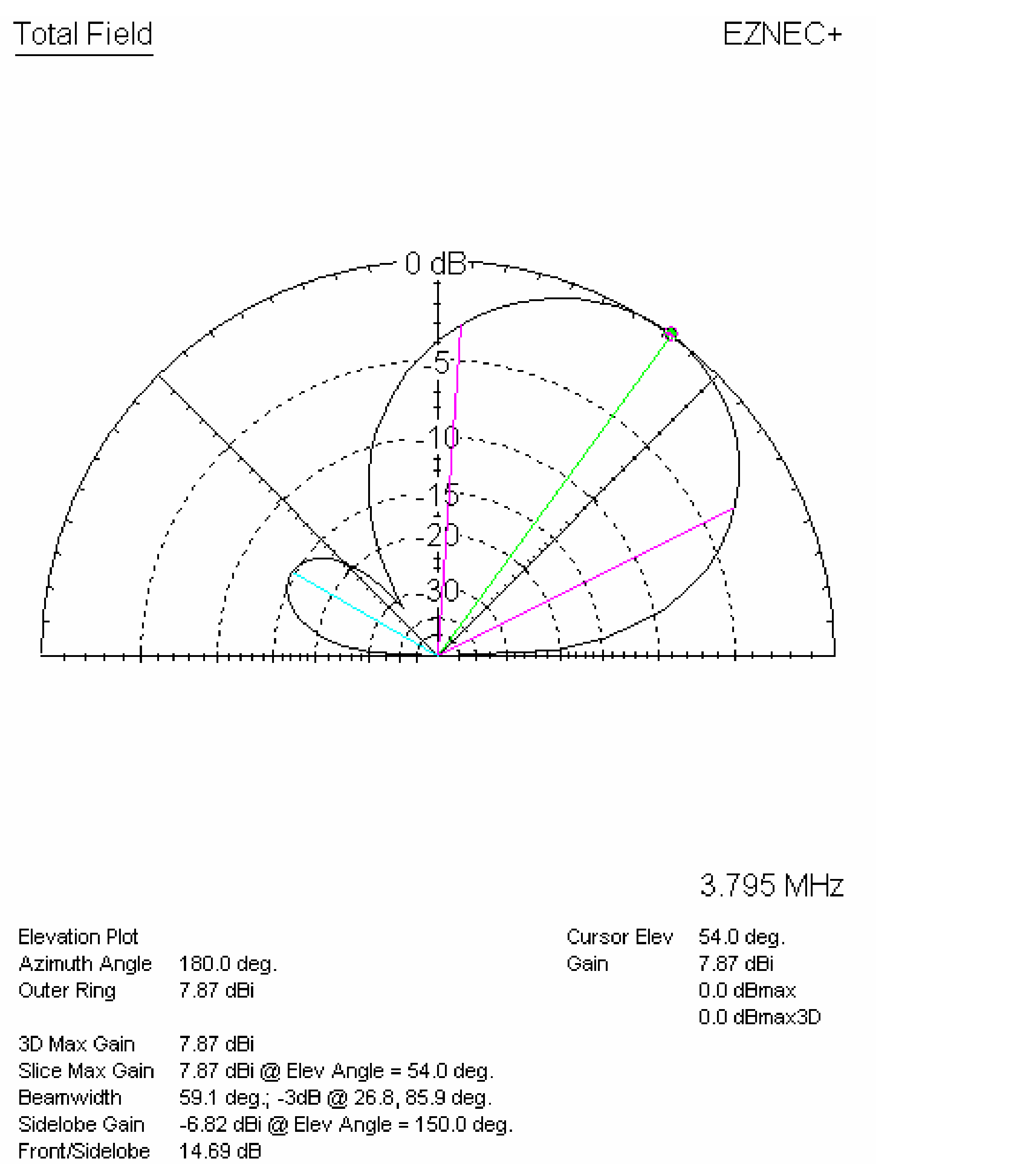
The best part was using this antenna for DX work with Europe. Before, when I called European stations with 1000W RF on my Delta loop, many times I had no response. I heard them quite well with my beverage antenna but they could not hear me. Now with double phased Vs I was getting callbacks even on the first call during huge pile – ups. I was getting excellent reports of 59+ from stations in Greece, Bosnia and Serbia. Even better reports of course from France, Germany, Italy and many people startled by the power of my signal asked me what type of antenna I have. Also, my local stations 300 miles away gave me reports 59 + 60 dB.

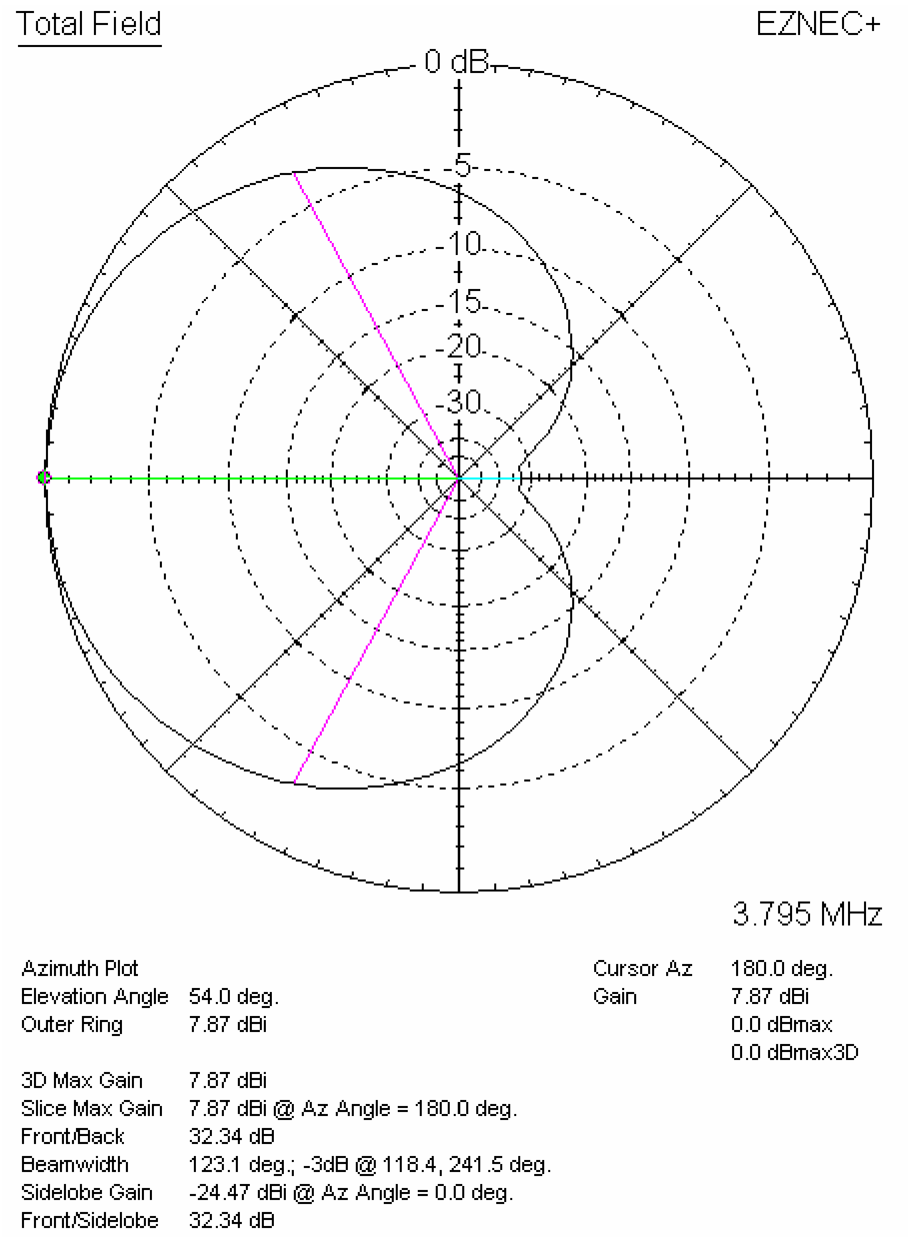
Eznec antenna modeling program shows data that I think is pretty good. For a few hundred dollars of cable I ended up with a DX directional antenna with a 54 degrees angle of transmission and 7.87 dBi gain in comparison with an isotropic dipole. With the wide range of low SWR and average impedance of 50 ohms across the entire 80 meter band I was happy with this design.

The following weekend I measured RF power going to each V. When I transmitted 15W, 5W went to V1 and 10W to V2. Next I measured the phasing between the Vs with a dual channel 100 Mhz oscilloscope set up in the open field. I used ferrite current transformers at the ground end of each V. Much to my surprise the phase difference was not 90 but 120 degrees. The Eznec model indicated 128 degrees as optimal phase difference. The phasing seems to affect directivity and Front to Back signal ratio quite a bit. Even a difference of 2 feet in one of the feed lines can change F/B signal ratio quite a bit but has only a small effect on gain.

Also the Eznec model indicated that RDF (Receive Directivity Factor) of phased double V is pretty good, around 9.5 dBi but I intend to use this phased double V antenna mostly for transmission. For reception I still prefer to use my beverage antenna as it has lower static noise being closer to the ground.

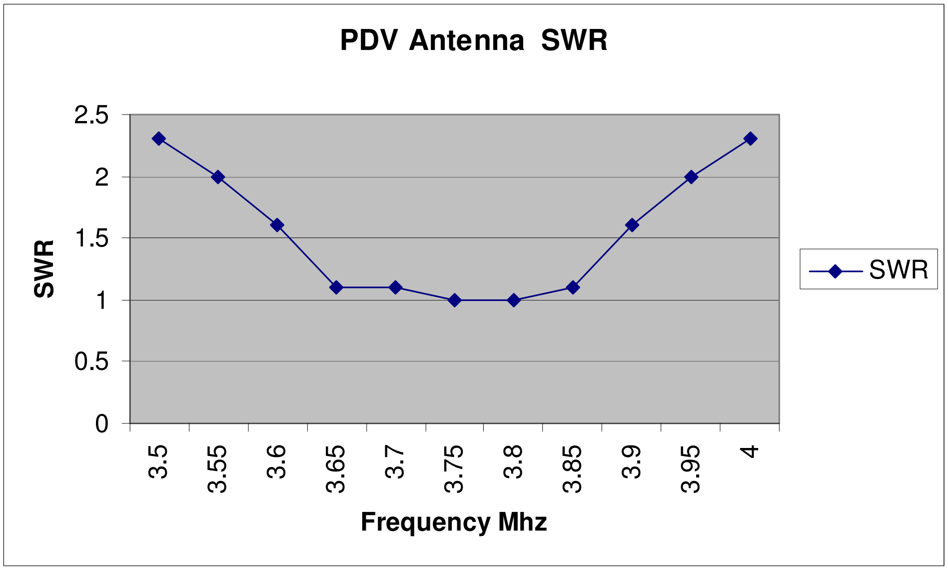
I live on 40 acres in the countryside and all my neighbors are far away so I do not suffer from man made electrical noise. But the static atmospheric noise, sometimes at S9 is my main problem. The beverage antenna still has better signal to noise ratio than my phased double V. Plus the beverage antenna has superior pattern of directivity, which cuts off interference from strong American stations beaming Europe. But if I had a choice of only one antenna for a low band, it would have to be a phased double V.





Of course if this phased double V antenna was suspended 20 feet higher from the ground (64 instead of 44 feet), the gain in the direction of transmission would be 2 dBi higher. Like with a dipole – the higher antenna has better results.

Addition of a third 5% longer V as a reflector, 1/8 or 1/16 wavelength apart is not worth it as it offers only negligible improvements of performance. Addition of a director 70 feet in front would add almost 1 dB, make a beam pattern more narrow and lower transmission angle to 48 degrees.



SWR of the phased array was measured with DAIWA SWR meter and 50W power from the transceiver. DO NOT measure SWR of the array with antenna analyzer or you will get false readings. You can use antenna analyzer to measure SWR of the single Vs.

Summary of a Phased Double V Antenna for 80 Meter Band:

Gain up to 7.87 dBi
DX Transmission Angle 54 degrees
SWR below 3 across the 80 meter band
Impedance around 50 ohms across the band
Receive Directivity Factor up to 9.5 dBi
Front to Back signal Ratio 14.69 dBi

Great low cost antenna for DX and local contacts. Now I feel sorry for everyone that uses a single V antenna for DX work. This is because a single V has no DX angle – it radiates mostly at 90 degrees straight to the sky. A single V is great for local work but not for DX.

You can make this antenna bi-directional by switching 42 feet of the V1 feed cable to V2 feed cable. This can be accomplished using relatively inexpensive outdoor remote 8 positions antenna switch model RCS-10LX from Ameritron.

Of course the vertical arrays offer best performance for DX work but they cost much more. Bottom line is that addition of a second phased V antenna provides spectacular results at a very low cost. Plus PDV is excellent for local work.

I am very grateful to Greg W8WWV for all his help with EZNEC modeling and useful suggestions and to Darrel AA7FV for his publication of the Twelfth-Wave Matching Transformer on the web.

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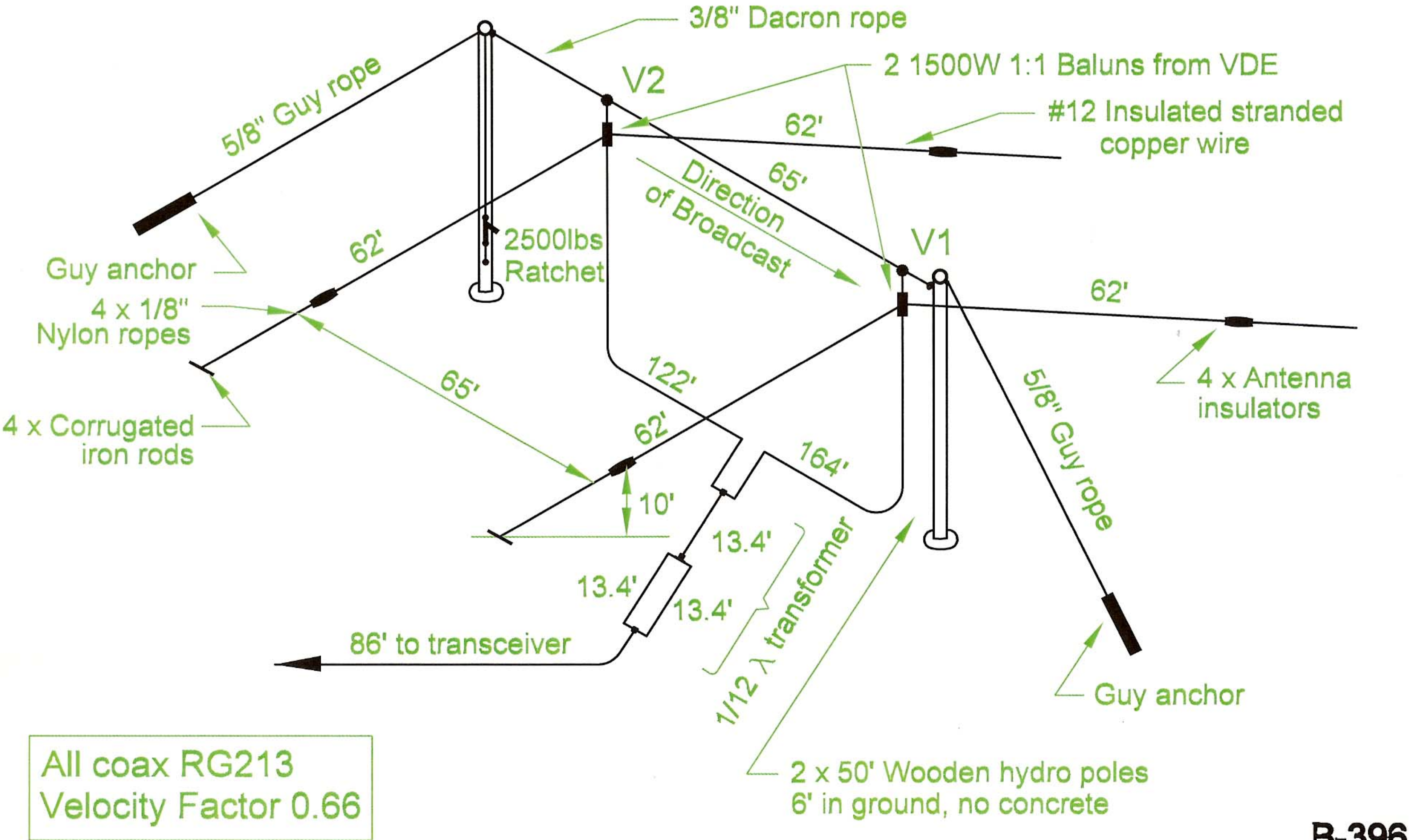
Center Frequency 3.795 MHz



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