Rx antennas at IV3PRK: Double DHDL Broadside

Trying again two Double Half-Delta Loops in Broadside configuration

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In September 2013 we were waiting for a new DXpedition from Lord Howe is. by VK2CCC as VK9LL. Tomas loves 160 m. and promised a big effort, as usual, on that band.

Propagation in this period is not yet as good as it was in November 2009, when I worked him as YJ0CCC with his 100 watts only, but I decided to try all my possible in order to work my last needed DXCC country in that area.

In the nearby field the grass mowing had been completed. It's laying north-south, useless for Beverages, but some kind of broadside array can be fit to point to the target direction.



In the mean time I had bought the new AutoEZ program by Dan AC6LA which is a great complement to EZNEC and does automatically all the work I did with Excel...and much more! So I went back to my old DHDL files (all papers are still downloadable from this page <u>http://www.iv3prk.it/TX3A-DHDL.htm</u>) and revisited the models with AutoEZ.

The single DHDL (Double Half Delta Loop)

From the original model by N4IS and AA7JV design I tried again some dimension variations without any meaningful result. So I reused the same poles and fiberglass fishing rods of four years ago and just reduced the overall length from 21 to 20 meters .





These are my final dimensions: wires 1 and 6 = 6.5 m. wires 4 and 3 = 10 m. height above ground = 2 meters



At mid point the wires cross each other but are not connected.

With AutoEZ I put the load resistor as a variable from 800 to 1600 ohms. The following are the most significant graphs showing that Front to Back and RDF are peaking at the 1.300 value.





This is the azimuth plot taken with a 1300 ohm load (blue trace) superimposed to those taken with 1200 and 1400 ohms: only a small back null difference.

Next, keeping the load resistor chosen of 1250 ohms (my practical values of $2 \ge 1000 + 2 \ge 1500$ carbon resistors), I put as a variable the secondary impedance value of the matching transformer (primary to 75 ohms of RG6 coax cable). Of course the xfmr does not influence RDF and antenna pattern, but only the source data. The following graphs, related to the source impedance, are enlighting.





Both graphs indicate that the best match is around 900, which is the impedance at the antenna side. A 12:1 transformer is needed for a good match to a 75 ohm feedline. <u>That is 2 turns on the primary and 7 turns on the secondary of a binocular BN73-202.</u>

I wound such a transformer as a test and checked it with both load resistors on my antenna analyzer ARA CIA –HF. As shown below the readings correspond with what should be: around 75 ohms with a 900 ohm load and around 100 ohms with a 1250 ohm load.



The Broadside array of two DHDL's

14

13.5

13

(**gp**) **1**2,5 **1**02 12

11,5

11

10,5 + 0

Next I aligned side by side two identical loops and put as a variable on AutoEZ the separation between them (in meters beyond 40 m. . that is 50 means 40 + 50 = 90).



The slice Front to Rear of the azimuth lobe is peaking at 90/95 meters, while the RDF is 12.7 dB at 90 m. and still improving until reaching 13.7 dB beyond 120 m. of separation.

But if we carefully look at the azimuth plot we see that the best pattern is at 90 meters, blue trace in the imagine below. The F/B does never change, but beamwidth and side lobes make a great difference.



Cyan trace = 80 m. distanceBroad lobe without side nulls BW -3 dB = 57 degrees

Blue trace = 90 m. distance: Perfect lobe with side nulls BW -3 dB = 52 degrees

Green trace = 110 m. dist. Big secondary side lobes BW -3 dB = 43 degrees

So not worth going beyond 90 or 95 m. of separation.

The following is the final azimuth slice of the chosen broadside array at 23° elevation angle (red trace) superimposed to a single DHDL (blue).



Now let's give a look at the output impedance of this array. With two exact lengths of 75 ohm coax (50 meters each in my case) to a common "T", the source impedance is 46 - j4 ohms. This should be perfect for a 50 ohm coax to the shack, but I want to use the 75 ohm RG6 coax and the capability to switch from broadside to a single DHDL when a broader lobe is needed.

With a 2:1 transformer at the T junction the source impedance would be carried back to that of single DHDL: 92 –j8 ohms with an SWR of 1.25 for the 75 ohm cable.

But these are receiving antennas and a modest SWR can be accepted (provided we don't work with end-fire arrays where the correct phasing would be affected by any feedline mismatch). The broadside array is more easy, only two equal cable lengths are needed, and so I decided to keep things simple without that transformer.

As I had already a CAT5 cable coming there from the shack I provided switching directions also for both single DHDL's. I did it in order to test how the same loop can perform different if placed 90 meters apart in my noisy environment. For a normal use some of this switching is in excess!



Complete broadside DHDL drawing; the 75 ohm feedlines must have the same length to C point. Control wires to boxes B and C through CAT5. From B to A the +12 VDC is trough coax cables.



Construction details

These are the four antenna (A) two switching (B) and central (C) boxes completed.





All the system has been checked for correct switching and impedances outside the shack

The antenna analyzer graphs below show the impedance around 100 ohms on single loops (left) and around 50 ohms when switched to broadside (right graph).





One of the switch box showing the copper strip I use to connect together all the coax shields.



The crossing point



One antenna box mounted on the wooden pole at the base of the fiberglass fishing rod.



The central box with a common mode choke on the feedline to the receiver: 12 turns of RG6 cable on an FT200-31 core (Round Cable EMI Supp. Cat. Fair-Rite 2631803802).



Southern DHDL in better free space.

Measurements and testing

The following is the impedance reading taken in the shack for all the single DHDL's, all in the 75 ohms ballpark.



.....and this is the impedance reading for the two switchable broadside configurations:



Very good, but if you want to make happy your preamplifier 50 ohms input it's quite easy to add between it and the 75 ohm feedline a 1.5 :1 transformer. That is 6 and 5 turns separate windings on a binocular BN73-202, which acts also against common mode at the receiver end.

The same analyzer graphs taken as before show the correct impedance shift down to 50 ohms.



I had not yet enough time to make many tests on the air and comparisons with other receiving antennas, but two cases are sufficient for me to say that the DHDL broadside array is working ok:

- 1. after carefully listening to EA3JE who is only 1.000 km. far, but at 245° bearing, exactly on my back array direction and with a strong and stable signal for true s-meter readings: above 20 dB of difference by switching directions.
- 2. finally heard and worked VK9LL a very difficult one and just a short opening which was the target and the object of all this work, thanks Tomas for giving my # 306 on 160 m.!

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