The Kongsfjord Quad Delta Flag Array

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The Idea

I have always wanted an antenna that could attenuate European QRM better than my beverages can. In my home town Berlevåg I had quite some success with a Wellbrook K9AY which I could phase to reduce interference from the south. When I erected it in Kongsfjord, the results were disappointing. Apparently, the good ground location I found in Berlevåg made it work as expected, while the poor ground in Kongsfjord mostly ruined its nulling capability.

Night-time DX is not easy because of the strong European and Middle East stations. Hence, night-time DX has rarely been very rewarding; I had to wait for closer to sunrise for the Europeans to fade down a bit.

Antenna arrays with a phaser, such as the Misek type, are of course a good option if you have a conventional receiver. The problem is that the phaser usually needs to be retuned after a significant frequency change. After the SDRs were introduced with the capacity of recording large parts of the MW spectrum (all of it, in fact), the usability of a phaser became indeed questionable.

So I had all but given up the prospect of having good, wide-band attenuation of European signals until Dallas Lankford came up with a new design, the Quad Delta Flag Array. The story behind it and how it evolved can be read in this pdf-file.

The first real DX test was done at Grayland, WA in April 2009. The results were indeed promising. Since Kongsfjord and Grayland have the same problem, namely unwanted signals from the back and the desired signals at the front, I thought that this array might be a good alternative for me as well. Dallas decided to build the QDFA phaser unit for me while I did all the rest, which turned out to be quite a handful.

The Construction

I had some vital considerations to make. First and foremost: The climate. 15-ft supports should be able to withstand strong winds and at the same time be cost effective. Air salinity is often high, which makes the environment corrosive. Blowing snow will penetrate even the tiniest crack. And rapid temperature fluctuations between freezing and thaw create moisture. After all, my ambition was to have it up the whole winter. Or at least a few months.

First, the supports. I already had one 11-meter pole which could be used. For the three other positions I first built 2.5 meter high permanent supports. I had a friend buy me 10 5-meter telescoping fibreglass angling rods at a Finnish travel fair, removed the top element (where the rod's only ring was placed) and put a modified rod ring on top of the new top element. The rod was now 4.1 meters and the rods were tied up to the permanent supports to the desired height of 15 feet. A test of the fishing rod prior to this with an ALA-100 loop told me that direct contact between the fibreglass rod and the wooden support would create enough pressure and tension to eventually destroy the fibreglass. So I wrapped the part of the rod that would get in contact with the permanent support in bubble wrap to distribute the pressure and avoid tension.

The phaser box is placed near the third loop (counting from the south), 60 meters from the house. Since it includes a 30 mA preamp, I needed power. I wasn't too enthusiastic about feeding the DC from the house, so I bought two 18Ah batteries instead. One such battery will last at least a week and probably more (depending on the temperature). While one is out, the other is charging or on standby.

I placed the phaser box and the battery in a plastic storage box. It is not weatherproofed but reasonably well protected from wind and precipitation. As is the case with the Grayland QDFA, banana plugs are used for all phaser box connections. But not just any banana plug. Proper, gold-plated ones. They're in a different league than the banana plugs I've used before. But then my banana plugs have rusted away long ago.

The feed lines (4 x 200 ft from the loops to the phaser box and 1 x 300 ft from the phaser box to the house) are all lamp cord generously supplied by Rolf Torvik. Unlike most lamp cord they are green (!) and blend nicely with the terrain. Military surplus?

The loop's horizontal elements were mounted first, while the sloping elements came up as OJ Sagdahl and I mounted the fishing rods to the permanent supports. I used 14 AWG insulated copper wire. It is light, flexible and quite strong.

We were uncertain as to how to protect the transformers on each loop. After some to and from, we decided not to "box them in" as it were, but to "encapsulate" them in vulcanizing tape and use thick plastic bags and duct tape for extra protection. Time will tell.

The 300-ft feed line goes into the house where it is transformed down to 50 ohms. Two in-house preamps, totalling 24 dB give the necessary gain.

Making It Work

An array like this is a puzzle to set up, and things can go wrong. While I won't go into details (at least one of the rather embarrassing kind), we worked a while to get things right.

Initially, we tested the array with the beacons BF-348 (to the south) and BV-399 (to the northwest), in addition to the Kola peninsula semi-locals on 657, 1134, 1449 and 1521 – the only ground wave signals I have. Results were quite promising as the MW stations were reduced by 10-15 dB compared to my 310-degrees beverage, while BV-399 (in the desired direction) only lost 4-5 dB. Longyearbyen-1485 (also in the desired direction) proved to have a good signal as sunset approached. But there was nothing spectacular. The following night was disappointing. The array's front lobe proved sensitive enough, but there was little if any backlobe attenuation.

On upper MW, the signal-to-noise levels were roughly the same or a few dB in favour of the QDFA. Readability was mostly the same. What I heard on the QDFA I could also hear on the 310. It was also quite evident that the QDFA is less sensitive than the beverage up to around 1000 kHz. The reduced sensitivity of the QDFA revealed itself on frequencies like 740 (Ontario) and 590 (Newfoundland) where the 310 had audible and even readable levels (590) and the QDFA couldn't hear any audio. On an undisturbed frequency like 1650 (Ontario) the QDFA and the 310 were identical. The QDFA was less sensitive to Loran C noise though, even if the Loran C station is in its front lobe. A dedicated Loran C notch filter was not necessary, contrary to the beverages.
The sensitivity should increase quite a bit if the delta flag elements are replaced with full flag elements. Given the same height, the antenna's area would double. But it requires eight masts instead of four, and most certainly more sturdy ones than the fishing rods I described.

The Whys

After spending several hours trying to find errors in the setup, we had to admit that the QDFA did not have the desired effect. Yes, it was a good antenna, and its broad front lobe let DX through from both Japan and North America (and even bordering areas as Australia and Argentina). But it was no better than the 310 degrees beverage at night-time, and it performed worse with approaching daylight. One possible explanation was ground. The two places where the QDFA has been tested before have much better ground than the rocky, stony moraines in Kongsfjord. Dallas Lankford mentioned that EZNEC simulation did not give any answer as to how the QDFA would perform over lossy ground. Very poor ground favours the beverage (and other longwire types) antenna. Antenna designs like the EWE and K9AY want good ground. Both the EWE and the K9AY have been tested here, with mediocre results while as I mentioned before, a well grounded K9AY made wonders back home in Berlevåg. The beverage is literally on "home ground" here in Kongsfjord and is a worthy opponent to any other antenna design.

Too many hours and too much money had been invested in the QDFA to just abandon it. In the following week Dallas, OJ and I began to discuss the possibility of using radials to improve the QDFA ground properties. As chance would happen, I had some bare copper string available, surplus from navaid upgrades at the local airport. We might as well try.

The Fix

So I laid out one copper string on the ground, roughly the length of the loop's base (60 ft), perpendicular to and centered on each loop. At least things didn't get worse, so I laid out two more strings, at 45 and -45 degrees angles to the first string. Evening tests revealed that the QDFA was indeed performing better now. I reduced the slop from St. Petersburg 1494 enough to get a readable signal from Longyearbyen-1485. Furthermore, I tested 1557, where the 58-degrees Asia beverage had Taiwan and France (backlobe) equal strength. The North America beverages had Lithuania very strong on their backlobes, while the QDFA (which points directly towards Lithuania on its back lobe) had Taiwan soundly on top with France underneath. Sooo...the QDFA was attenuating signals that the beverage did not. Indeed promising!

The following night confirmed the evening's impressions. That night, when strong signals from Europe dominated the band, the QDFA proved to be totally superior. In a large number of instances where European interference totally obliterated the NA frequency when using the beverage, the QDFA either brought audible levels, or even readable levels. If I had audible levels with the beverage, the QDFA produced readable levels. And in *every* instance where the beverage had readable levels from North America, the QDFA produced *better readability*.

Of course we don't know for sure if the radials were the reason why the QDFA performed better. But it is very likely. The following day I put up a fourth radial, directly under the loop's horizontal element. All radials within one loop are interconnected.

The QDFA was designed and built for Medium Wave use. It is quite capable on Long Wave too, but less sensitive than the beverage. As for Short Wave, don't expect too much. A quick visit to the 60 meter and 49 meter bands revealed that the QDFA has a significantly higher noise level than the beverage and is much less suited for DX-ing than the beverage. Up to and including the 90 meter band the QDFA may actually be better, while they are roughly equal on the 75 meter band. The noise level is marginally higher. As for the 41 meter band and upwards: Don't waste your time with the QDFA. I have not tested how well the QDFA nulls on Short Wave. But there aren't any Europeans on 120 and 90 meters so it would not need to.

The Verdict

Pros: Provides very good back lobe attenuation during the dark hours over the entire MW spectrum; no need to retune the phaser. You will hear more stations with the QDFA. Wideband phasing especially suitable for use with software defined radios capable of recording large parts of the frequency spectrum.

Cons: A handful to build and maintain, especially in areas with adverse weather conditions. The Kongsfjord QDFA will not outperform a properly designed and properly built long beverage during twilight periods, but it has proved capable of doing so over good ground. It will perform worse than a beverage at daylight. It needs good ground for best performance. Not suited for Short Wave monitoring above 5 MHz. Nearby antennas may degrade the QDFA's nulling capabilities.

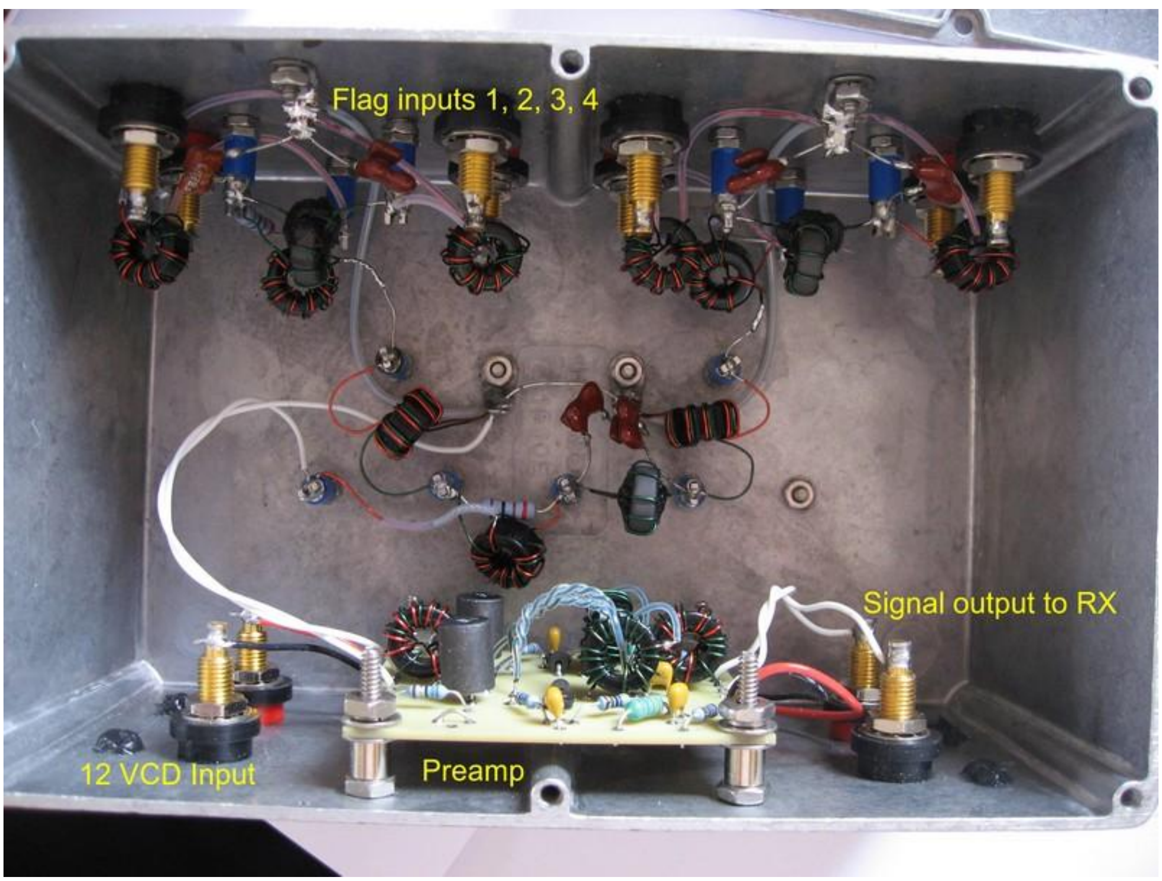
The Kongsfjord QDFA Facts

Bearing: 350 degrees. Since the front lobe is wide, one doesn't need to point the antenna directly towards the target area (such as North America, in my case 310 to 340 degrees). Instead, one should find out where the most offending interference is coming from, and point the backlobe towards that area.

Numbers: Four delta loops each measuring 18.3 meters (60 ft) (horizontally) by 4.6 meters (15 ft) (vertically) with the base element elevated to 0.9 meters. Distance between each loop centre is 30.5 meters (100 ft). Total area use is 120 meters in length and 18 meters in width (with radials). Four sets of interconnected copper string radials on the ground on each loop, placed at

0, 45, 90 and 135 degrees from the loop's plane. Four 61 meter (200 ft), 100 ohm (lamp cord or speaker wire) twin-lead feed lines to the phaser. One 92 meter (300 ft), 100 ohm twin-lead feed line from the phaser to an in-door transformer. One 18Ah battery is placed at the phaser to provide 30mA, 12VDC current to the phaser's preamp.

Kongsfjord QDFA Pictorial




Phaser and battery are placed here.
Feed lines and ground radials cover the ground


Phaser box and battery uncovered


Transformer protection

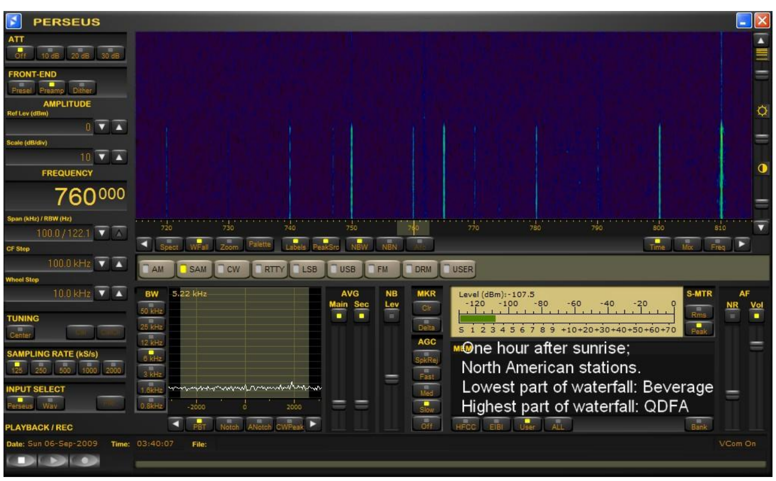

Resistor protection


Fishing rod attached to permanent support.


Modified tip of fishing rod

Compared to a beverage, which has uniform sensitivity over the frequency spectrum, the QDFA sensitivity tends to roll off as frequency decreases. Placing additional preamps in the phaser will increase low frequency sensitivity.

Or you can choose to replace the delta flags with full flags, which will increase the overall gain with 6 dB (assuming the same height and width).



This screendump with the Perseus centered on 790 and a 100 kHz frequency span, illustrates the point above, and also illustrates that after sunrise, the beverage is far more sensitive than the Kongsfjord QDFA. The lower part of the waterfall shows mostly audible North American stations (810 is Scotland) while on the QDFA you can only see traces of their carriers.