

Rx antennas at IV3PRK: building and testing the Waller Flag

From modeling to the real life, where there is no free lunch.

Part 2: The documentation of an unsuccessful work

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The Waller Flag construction.

In the second half of September 2007, a big storm broke a fiberglass spreader of the existing rotatable Flag, so I had to take it down and hurry up with the new Waller Flag construction. But, with a last check in the Eznec model, an error arose with the wires diameters, which I never changed from the original #12.

As I was going to use two of my old 10 meters log-yagi elements (split and insulated from the boom) as vertical wires for the loops, I corrected their diameter to that of the aluminium tubes. My God.... the pattern resulted destroyed...unbelievable!! So, I went back to the #12 wire (actually better, I changed to #14) and I modeled the two vertical insulated aluminium elements (in two halves as they are) at a distance of 30 cm. from the vertical wire they are supporting.

Everything went in order again, with the lobe and the FB as before! A little more complicated in the construction, but quite easy to do.

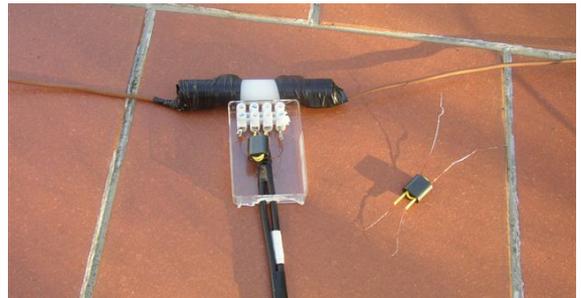
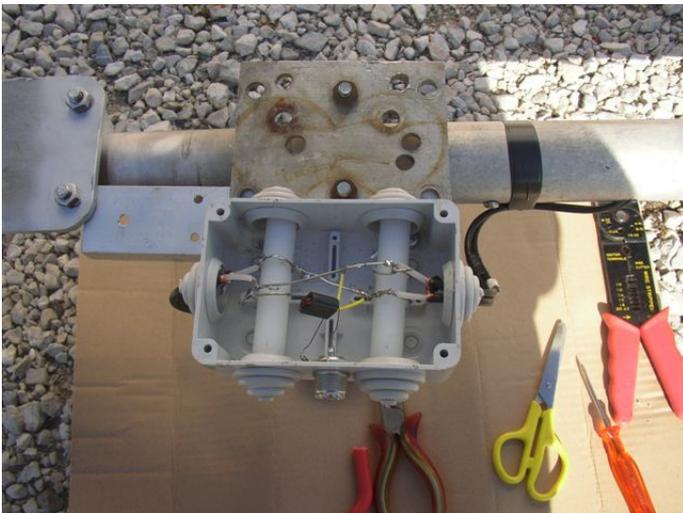


Fig.1: Sept. 2007 - the first Waller Flag built by IV3PRK

Construction details:

- boom length m. 5.24
- fiberglass spreaders m. 2.95
- loops dimensions m. 2.00 x 4.27 with 5.00 m. separation
- load resistors with 1 watt OY series-parallel: 590 ohm on the front loop and 607 ohm on the back loop
- transformers (impedance ratio 600/100 ohm): 5 by 2 turns on binocular BN73-202
- both phasing lines 4.25 m. long made with two parallel RG58 ($Z = 100$ ohm)
- 180 degrees phasing by inverting the feedlines at the T junction.

As far as common mode noise is concerned, at the beginning I put only a 1:1 phase inversion transformer with 6 twisted turns on a binocular BN73-202 in the T-junction box.



On the air test

They have been reported in the following e-mails sent to NX4D and N4IS:

On Sept. 26, 2007:

Good morning Doug and Carlos,

the Waller Flag has been assembled and put on the tower.

It looks fine, but I am disappointed.

Conditions have been poor the last couple of days, but I could test the WF and compare it with the Pennants, which are still the same.

The previous rotatable Flag (with only the KD9SV preamp) was ALWAYS BETTER than any Pennant (with the KD9SV + the K9AY PRE-1 preamp. buried on their feeding line). Thus, the S/N and the output level of the Flag was many dB's higher than the Pennants.

At first I took that PRE-1 preamplifier, put it on the WF tower, and connected to the 1:1 balun at the antenna feed point.

But that caused the RG213 coax shield to be connected with the boom, and thus with the tower and the ground.

Remember that with the old Flag I got better results after removing the second RFC choke and the T connection from the coax shield to the ground.

So I was keeping the Flag (and Pennants) ground independence peculiarities with only one RFC

choke (11 turns of RG58 through two FT150-75 toroids) and the floated RG213 coax to the shack.

After the first tests I removed that preamplifier from the tower and, instead, I put in line, in the shack, a second KD9SV preamp., so there are 27 + 27 dB's of variable gain available.

It uses a 3SK88 device with tuned input and output for 160 meters on both units.

Usually I had one of them in function at 3 quarters of level (18/20 dB) and that gave a better S/N reception on the Flag than on the Pennants (with the additional 12 dB of the fixed PRE-1).

Now I have not yet brought back the PRE-1 on the Pennants hub, but they are performing better with only one KD9SV preamp, than the WF with both.

This morning, at my sunrise, the band was quiet, with a very low noise level, but I could hear K6LZ only on the NW Pennant; no trace at all on the WF (even turning it up and down).

In this moment, almost at noon local time, it's a little bit raining and I look at the noise level on ORION S-meter :

NW Pennant (0 preamp.): S 1 - (27 dB preamp) : S 3

WF Flag : (no preampl.): S1 - (27 dB preamp) : S 3 - (54 dB preamp): S 5

TX antenna = S 7

Unfortunately I am unable to get a polar plot, but for sure the Waller Flag has the right directivity and FB but the signal level is too low.

Before going back to the classic full size Flag, which has been my best receiving antenna - with the Pennants as a benchmark, I will try to remove that binocular 1:1 balun and connect the feedline directly to the T junction.

Then I will add the RG58 choke balun I used before

On Sept, 28, 2007:

Hi Doug and Carlos,

I have not yet given up!

Despite the raining days I made a lot of corrections and trialsthanks to your support !!!

At first I realized that I made a mistake with the binocular 1:1 balun, 6 twisted turns connected as isolated windings: I corrected, but nothing changed.

So I took it away and I connected the T junction directly to the coax fitting.

From there I put a toroid choke (12 turns of RG58 through two FT-140-J) to the K9AY PRE-1 amp. (which has a ground connection) and then another choke with two FT140-J to the RG213 feedline entering the house.

Some years ago I made some measurements on many toroids (10 different types I had). Not a laboratory test, but just 5 turns on each and the AEA CIA Analyzer readings on many frequencies.

The meaningful data with 5 turns on 1.8 MHz for my usable stuff are:

FT140-43 : Z = 166, R = 44, XL = 160 ohm

FT140-J : Z = 311, R = 310, XL = 29 ohm

FT114-77 : Z = 308, R = 291, XL = 102 ohm.

As the Gurus on the Reflector (K9YC and W8JI) said that for transformer use we need reactance and for RF chokes we need resistance, I hope the J (75) material should be adequateand I have plenty of these toroids (advised by Roy Lewallen, W7EL, they were used to decouple the short vertical dipoles of my 4 square array)

But now back to the Waller Flag!

Conditions have been very poor and not too many chances to test with DX signals, but at last this evening the EU signals are on the same level of the Pennants, with much MORE directivity.

I wish I could hear some JA's and see how it is performing on low angles.

Of course there is still some more background noise introduced by so many preamplifiers!

But not as high as the "roar" of the ICE preamp., Doug. I have also one of them, but it has been always unusable.

With two KD9SV in series in the shack at full gain, and NO antenna connected, the Orion S-meter is still to S-1

With the Waller Flag connected and no signals (almost 10 in the evening local time) the S-meter is up to S-2. If I switch in also the PRE-1 (I put it again on the mast), the S-meter jumps to S-4 ...but that's too much gain.

So I can reduce the gain of the 1st KD9SV amp. to half and the second one to 3 quarters.

With this set-up I read the beacon YR2TOP at S-8, the same as with the best Pennant (on which line there is only the second KD9SV amp. at 3/4 gain).

This beacon is S-9+5/10 on the Tx antenna and that's ok since with also the PRE-1 amp. on its original place I was used to have the same readings on both the Tx ant. and the Pennants.

Doug and Carlos, I made it very long ...

On Oct.12, 2007:

Hi Carlos and Doug,

I am very sorry my friends but, after many trials and modifications, I realized to be unable to get the Waller Flag working with my setup.

I followed almost all your suggestions:

- two RF chokes at the antenna
 - brought up there a direct ground wire at the T connection between RFC's
 - another big RFC (with 5 FT140-J on 12 turns of RG58) at the receiver (with another T connection and a direct ground cable)
 - taken away all my RX switching relays system
 - checked on both sides the RG213 feeding line and tested with another one
 - brought on the tower also the KD9SV preamplifier (as a temporary test)
- NEVER a minimum change!

The Pennants were ALWAYS better with a lower background noise. And that happened on the EU signals, but also on JA and NA.

On Sept. 20 we had a nice opening into the West Coast (from WA and WY to NV): I worked a couple of new calls also, but no way to hear them on the WF.

As a last try I inverted one of the phasing lines (as somebody said that there is 50% chances of failure in the phase inversion) and immediately the antenna came to LIFE.

The Flag is again better than the Pennants, with a clean signal and now I can work again also the second layer of the JA's calling me.

Not a great directivity, a modest FB (especially on the EU stations), but a louder signal requiring half preamplification and thus a better S/N with less background noise.

But there was no mistake on the Waller Flag phasing!

I went again on Eznec to see what happens with NO inversion in the 180 degrees line: of course the pattern is quite poor, with a modest FB, an higher TOA, but with a gain of -37 dB.... i.e.18 dB higher than the correct design of the WF.

That's my problem: in my situation I am unable to rise those 18 dB without degrading the S/N.

Within a couple of weeks I will go back to the regular full-size Flag for further better results.

I apologize for my failure on the Waller Flag, but in any case you have rekindled my interest on RX antennas and I will go on with end-fire phasing on some of my fixed Pennants.

Many thanks for all your support and best greetings

On October 15, 2007, I wrote the following e-mail to Larry Molitor, W7IUUV, who designed the rotatable Flag and the well known W7IUUV preamplifier:

Hi Larry,

many thanks for calling me this morning, it's always a pleasure to work you on Topband! Unfortunately I was not using "your" rotatable Flag. It has been my best Rx antenna in the last couple of years, but one month ago I decided to modify it into the Waller Flag (by NX4D and N4IS design). I performed a lot of studies and modeling on this two end-fire loops arrangement and in fact the pattern is very interesting with an 11 dB RDF. (my long paper on Flags is on the K3KY page). The -55 dB gain should have been overcome with good preamplifiers and common noise chokes.

Now my question to YOU, Larry:
do you honestly believe it possible to rise a -55 dB signal with a useful S/N ratio ?

I have a K9AY PRE-1 and two KD9SV preamplifiers (variable gain and tuned input and output on 160 m.) which never seemed to add noise, but in this case the resulting S/N was not satisfactory.

I still have six Pennants and they are always better than the new Flag, while the W7IUV Flag was always outperforming them.

As a last trial the last week I switched the phasing line to one of the end-fire loops. So there is no more the designed 180 deg. phase inversion and thus the pattern is miserable, but the gain (as confirmed by Eznec) improved from -55 to -37 dB and the antenna came to life!
It is better than the Pennants again, but of course I have to take it down and rebuild "your" Flag as it was, to get a better performance.

But before doing that, do you suggest me to try some other way to rise those critical missing 18 dB?
...maybe with the W7IUV preamplifier?

I heard that Tom, W8JI, some time ago said that there is no way to manage a good S/N ratio from such a low gain antenna, but no further comments on the matter, and he never replied to my direct inquires.

Many thanks in advance Larry, and best 73

Luis IV3PRK

And this was the reply from W7IUV which sets the word "END" on my Waller Flag experience:

Hi Luis,

Yes, it was very nice to work you on Topband for the first time this season. I had heard you a few times before, but never well enough to call. Condx were good.

When that Waller flag was announced, I looked at it and decided it wasn't anything I wanted to waste my time on. A serious problem with developing antennas with EZNEC (and other software) is that the NEC engine lies. Or more precisely, it doesn't tell the full truth. Look at K6SE's antennas. The Flag, Pennant, Diamond, and Delta all look alike in EZNEC, but they don't actually work the same in practice due to outside influences that are not accounted for in the software. Yes you could create a detailed model that would take all that into consideration but it's far easier to build and test a real antenna than it is to create a proper model.

Anyway, as you found out, real life is a bit different than a computer simulation.

As far as the preamp, it's really difficult to make up for that -55 dB gain. I think it could be done, but it would be very difficult and I think not worth the effort.

My preamp has a noise figure of about 6 dB, way better than need be for the normal applications on topband. It would be possible to cascade two of them but I don't think it would be good enough to make the antenna work as advertised.

The problem is that the noise added by the preamps directly reduces the effective RDF. So you need a preamp that not only will provide about 30 dB of gain, it needs to do it without affecting the total system noise figure and still survive the TX RF and local BC stations without causing IMD.

It can be done I think. I'd have to sit down and do a lot of calculations to prove it one way or another and I'm not inclined to do that. My gut feel is that it will be very difficult to find a device that is suitable for the task, and probably not worth the effort.

An alternative solution might be to place a preamp like mine at each loop and then run into the phasing lines. Another preamp after that would bring the level up to a usable number but the phasing might become very critical due to the individual preamps having slightly different characteristics.

All in all, my opinion would be to discard the Waller and work with phased Flags which I know work well.

I would be interested in knowing what you eventually wind up with.

73, Larry



Last picture of the Waller Flag before dismantling and the Tx antenna showing the detuning rod on the left and the gamma rod on the right.

Luis IV3PRK

October 2007.