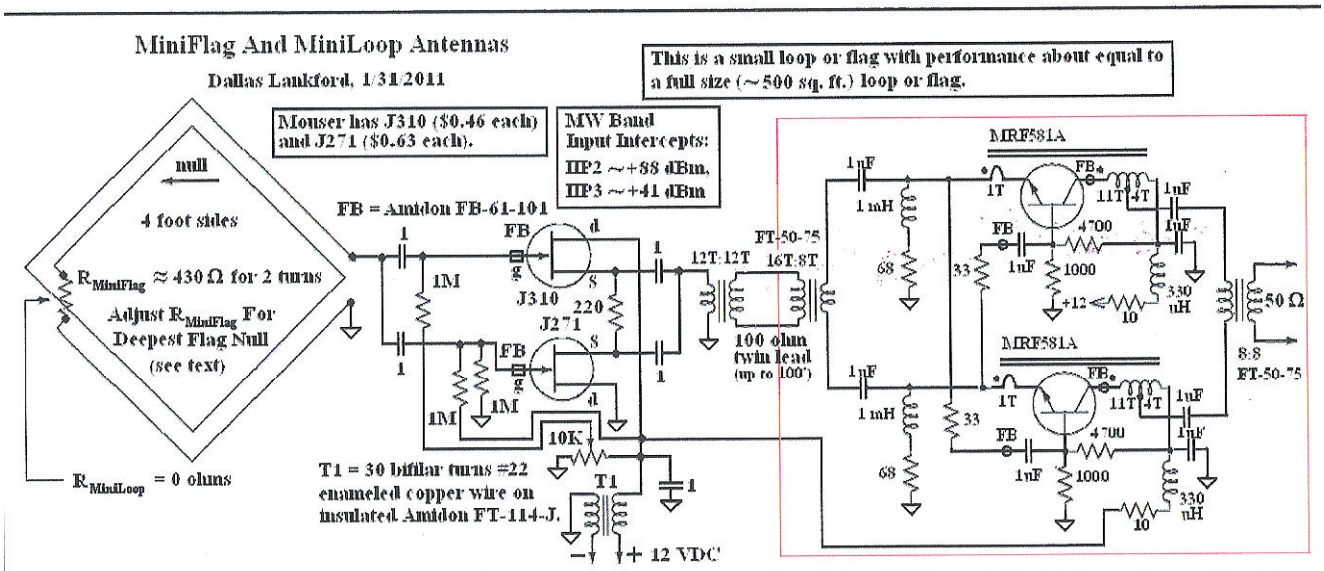
Rx antennas at IV3PRK: the 3 wires MiniLoop

Trying another innovative design by Dr. Dallas Lankford

by Pierluigi "Luis" Mansutti IV3PRK

After given up with the Quad Delta Flag Array project, due to my lot constraints, (see this page) I turned my attention on a new small receiving loop, among all the Dr.Dallas Lankford designs, and decided to build it.

Dallas Lankford, 2/6/2011, rev. 3/7/2011



The amplifier inside the red box is a capacitor cross coupled push-pull Norton transformer feedback amplifier with about 13.5 dB gain and about 1.0 dB noise figure; see the article "Lankford-Ikin-Norton Feedback Amplifiers" in The Dallas Files at www.kongsfjord.no . An ordinary push-pull Norton transformer feedback amplifier with about 10." dB gain and 2.0 dB noise figure can be used instead... they are available from KIWA Electronics and Clifton Laboratories (do a Google search if you are not familiar with them). The complementary J310 - J271 amplifier you will have to build for yourself... not difficult to do using the "dead bug" construction method. How to adjust the 10 K ohm pot for maximum IIP2 is discussed in the article "Hi Z PPLs + Hi Z Loop And Flag Arrays" in The Dallas Files. Other mini flag antenna articles have been published before, but none like this one. The others used 16:1 step down transformers followed by traditional amplifiers, which cause about 18 dB voltage loss (6 dB loss due to the step down transformer impedance match, and 12 dB loss due to the voltage step down). The complementary high input impedance FET amplifier above has about -6 dB gain, which gives it a net gain of about 12 dB over the impedance matched transformer step down approach. This means that the signal to noise ratio for weak signals is as much a 16 dB better than the impedance matched step down transformer approach. This approach, discussed in detail in the article "Hi Z PPLs + Hi Z Loop And Flag Arrays", also improves the signal to noise ratio of full size loops and flags.

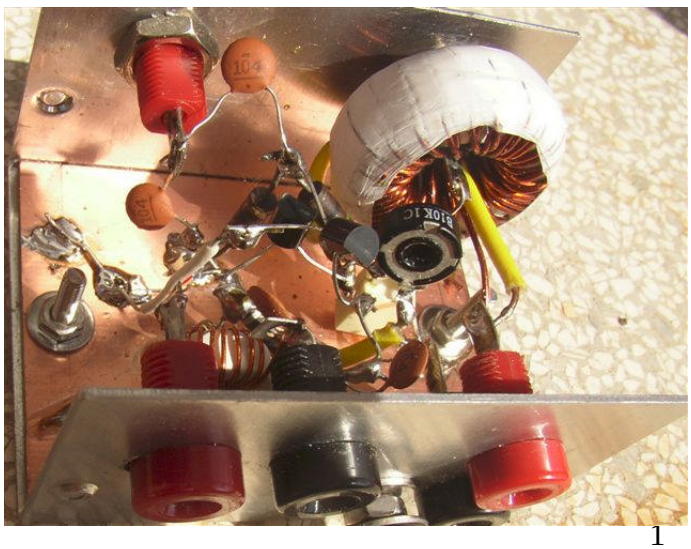
From the original design I duplicated the Hi-Z amplifier (actually I found J310 and J271 only by Mouser) with a couple of minor modifications: 0.1 µF instead of 1 µF and the number of turns on the FT50-75 output xfmr, which seemed to be wrong. I use 14T:8T to match the 100 ohm feedline. As a feedline I found a very cheap shielded CAT5 cable and used two twisted pairs for RF signal and 12 DCV, while the other two are left floating. With the CAT5 cable I wound 20 turns around a big FT-240-31 for more than 3.000 ohm of impedance as a common noise choke on the antenna side.

I did not use the MRF581A push-pull amplifier yet (in the red box above) and matched the 100 ohm CAT5 to the 50 ohm Rx input through a BN73-202 transformer (7 turns : 4 turns). I ordered the Norton amplifier to Clifton Laboratories, but not yet mounted it.

As we will see the Hi-Z J310-J271 amplifier is working well with correct impedance matching and there is enough signal for the tests.

I have no experience with transistors, but this construction has been quite easy with the "Ugly bug" technique.

It is built in a small 7 x 5 x 4 cm. aluminium Box which fits, with all Banana plugs, into a plastic 12 x 8 cm. enclosure for waterproofing.

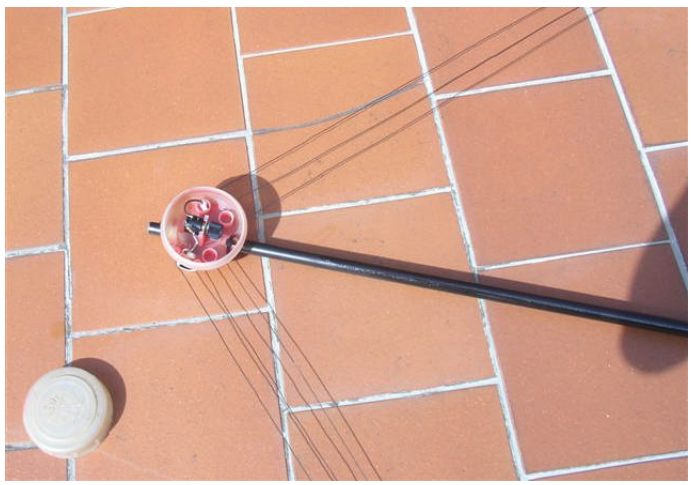


For the loop construction I used a fiberglass fishing rod and aluminium wire, and thus it's very light.

One meter sections of one and half fiberglass fishing rods with a crossing joint through a round electrical derivation box reinforced by means of polyester resin

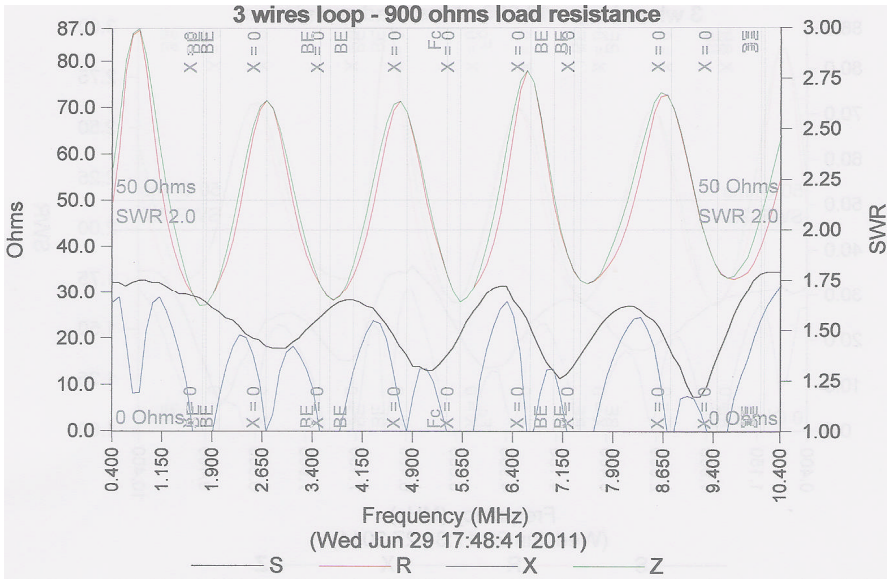
The Hi-z amplifier aluminium box with banana plugs in a sealed electrical plastic box

On the other side is a temporary container with the 10 turns loading potentiometer.



The feedline is a cheap shielded CAT5 cable (one pair for RF signal and one pair for 12VDC, two pairs floating) with 20 turns wound on a FT-240-31 as a common choke.

Checking at first with the AEA CIA antenna analyzer confirmed that the Hi-Z amplifier was working OK with the expected impedance transformation:



Listening on the radio the AM BC signals were about 10 to 15 dB lower than on the regular W7IUV flag, but not yet any front to back was found on any band. Just a modest null on the side directions.

At this point Doug, NX4D, forwarded me an e-mail from Dr. Dallas where he wrote :

"Are you sitting down?

The 3 turn mini-flag DOES NOT WORK a currently described in the mini flag and mini loop article….."

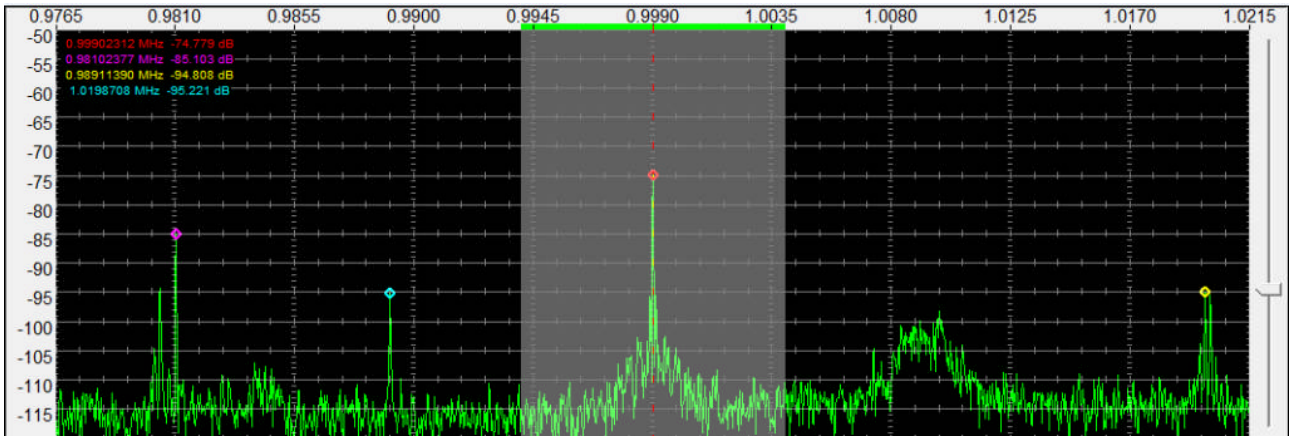
In fact no back null was found also in his direct experience and he recommended to move the loading resistor on the opposite side, after two turns, near the preamplifier. His recommended resistance value resulted to be 1.416 ohms and he wrote: *"EXCELLENT NULLS WERE GENERATED !!!"*

I substituted my 1K loading potentiometer (in series with a 390 ohms resistor) with a new one going from 0 (actually a few ohms) to 2.5 K ohms.

The first tests were on some known AM BC stations and NO BACK NULL was found while adjusting the potentiometer, but a very DEEP SIDE NULL was found at the minimum resistance value. Thus the antenna DOES NOT WORK AS A FLAG, BUT WORKS VERY WELL AS A MINILOOP ONLY !

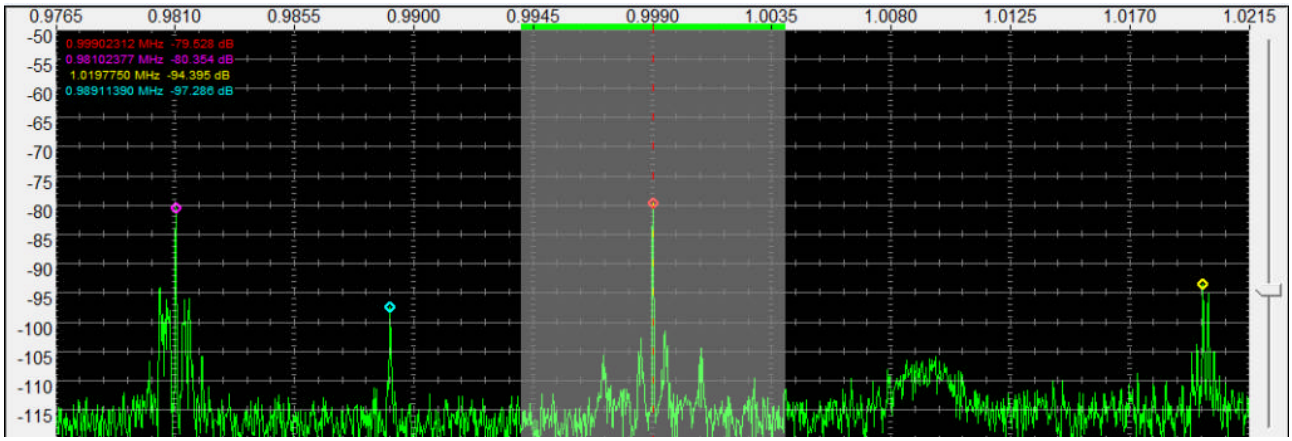
The following are the SDR-IQ printouts taken in the afternoon when only Italian stations are heard:
- center frequency: 999 KHz – RAI Radio 1 - Rimini 20 KW – 240 km. distance at 192 degrees,
- on the left: 981 KHz – RAI "Trst A" - Trieste 10 KW - 80 km distance at 130 degrees
- on 989 and 1020 KHz there are two spurious signals….

1) loop pointed to South (or North no difference) and <u>loading potentiometer from one third to full open</u>



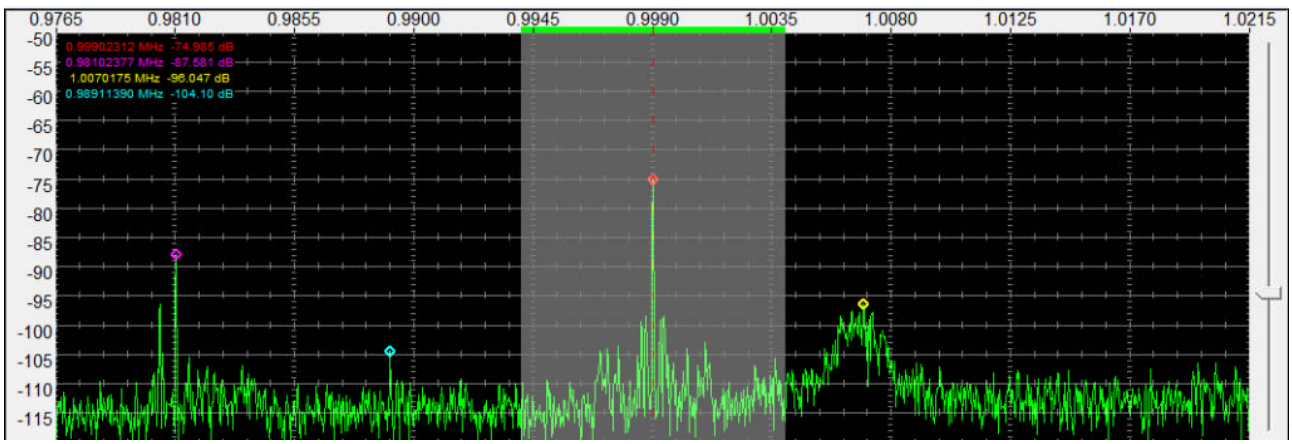
Target station on 999 KHz: – 75 dBm; closer station at 60 degrees to the East on 981 KHz: - 85 dBm
Both spurious signals: - 95 dBm

2) loop pointed to West (or East no difference) <u>keeping the loading potentiometer in the same position</u>



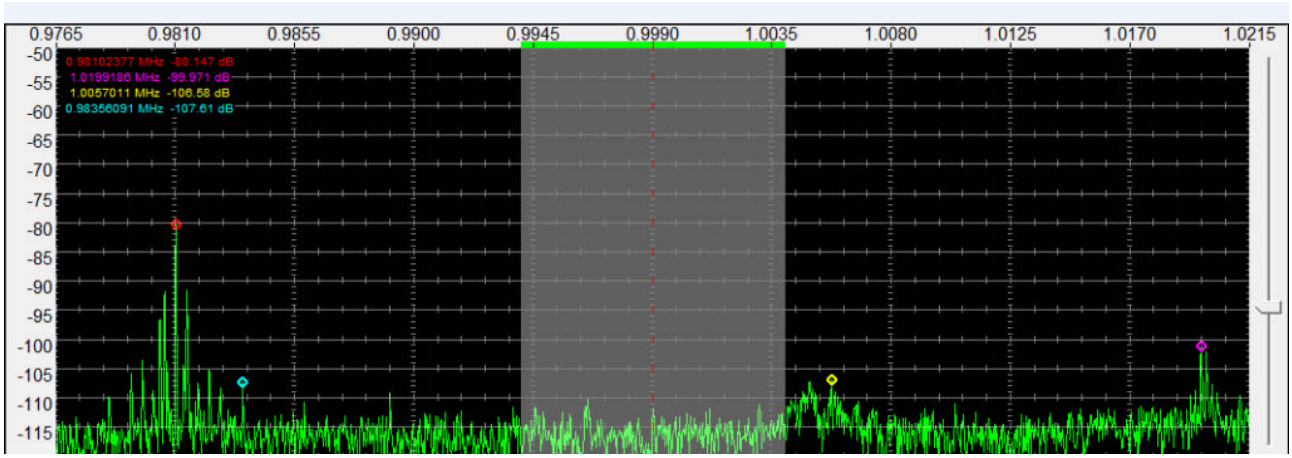
Target station on 999 KHz: on 5 dB down to – 80 dBm; closer station at 60 degrees to the East on 981 KHz: increase by 5 dB ….so both at -80 dBm !!
Spurious signals: one slightly down and one slightly up ……

3) loop pointed to South (or North no difference) and <u>loading potentiometer at MINIMUM</u>



Target station on 999 KHz: <u>still – 75 dBm</u>; closer station at 60 degrees to the East on 981 KHz: - 88 dBm
Spurious signal on 989 KHz: - 105 dBm …the other one is disappeared

4) loop pointed to West (or East no difference) <u>keeping the loading potentiometer in the MIN. position</u>



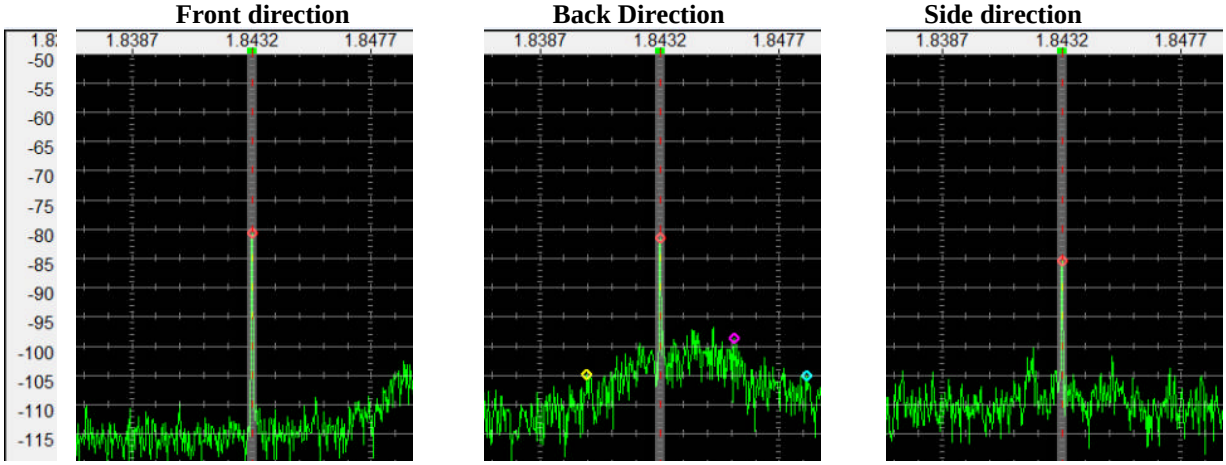
Wow … what a NULL! Now the target station on 999 KHz is down 40 dB, disappeared in the noise at – 115 dBm.
The other station, 60 degrees to the East is UP 8 dB to – 80 dBm …so really a sharp side null.
Spurious signal on 989 KHz is disappeared while the other on 1020 is back at – 100dBm.

Than I repeated the tests after moving the load half a turn ahead, near the preamplifier, as suggested by Dr. Dallas, but the results were exactly the same….no back null at all!

<u>Next I made some tests on 160 m. with my test 1.843.2 oscillator put to the South at about 300 m. distance.</u>

5) Turning the loop with loading resistance at MINIMUM (almost zero value)

Front direction **Back Direction** **Side direction**



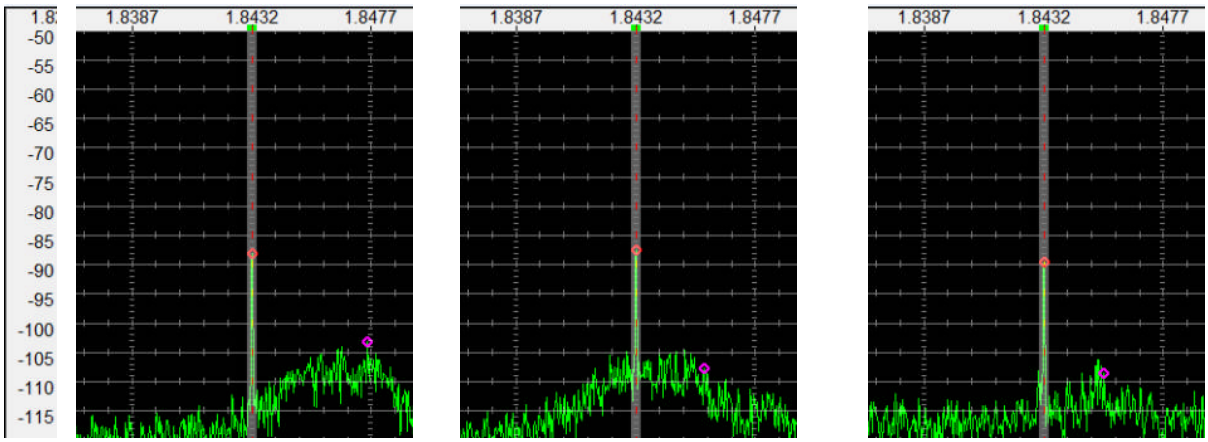
The back null is ONLY 1 or 2 dB (from – 80 to – 82 dBm) but the noise background is about 5 dB higher.

Note <u>my</u> usual typical noise hill moving slightly up and down on the band.
<u>The side null is ONLY 5 dB</u>, to – 85 dBm….. WHAT A DIFFERENCE from the Broadcasting Band !

So I tried again to find a null while increasing the loading resistance value, but the only result was a slight reduction in the signal strength until reaching about 1.000 ohms and than flat until maximum.

6) Turning the loop pointed with loading potentiometer from 1/3 to maximum

Front direction **Back direction** **Side direction**



The signal in the front direction is 8 dB down, at – 88 dBm, and noise is also a little bit down. Absolutely NO DIFFERENCE on the back, and tThe side null is ONLY 2 dB, to – 90 dBm….. so definitely it DOES NOT WORK AS A FLAG!

As a last test I changed again the loading potentiometer with a 0 – 10Kohm one, but nothing changed.

Now my question is:

Why this small loop works so well on the BC 1.0 MHz Band (30 - 35 dB side null) and so poorly on 1.8 MHz band?

Incidentally I made also a lot of tests in the evening with further sky wave Europeans BC stations. The results are the same: by turning the loop I can change the station heard, but the graphs are meaningless being the carriers exactly on the same frequency.

With such a sharp side null I would put it on a rotator mast, but on 160m. it's only 5 dB and so not worth for sure!

June 23, 2011 Luis IV3PRK