

Rx antennas at IV3PRK: again Noise Tests

Top loading wires resulted to be the noise culprit for the 4-square vertical array !

by Pierluigi “Luis” Mansutti IV3PRK

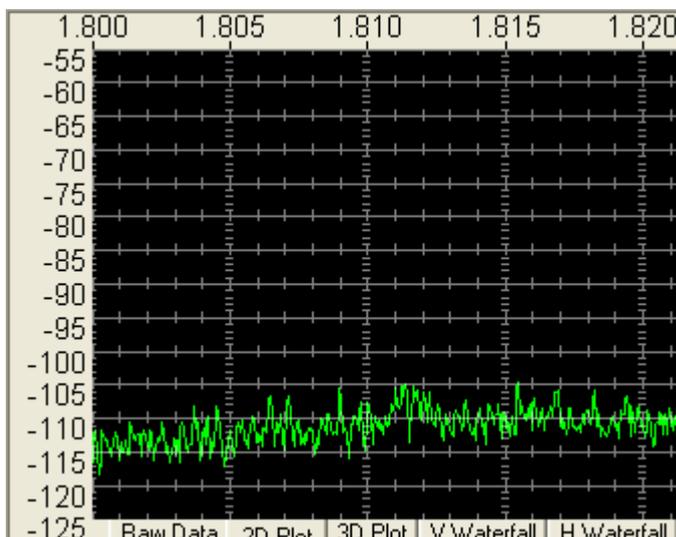
With reference to the previous tests on my Rx antennas (documented [on this page](#)) I got the following advice from my friend Lee, K7TJR:

“... Here is what I believe should be tested at your station. If this was my system, I would place a termination in place of all 4 verticals in the 4-square array and take a noise level reading out of the receiver. Next I would re-connect all 4 verticals and make another measurement. This would tell us how far out of the receiver noise the 4-square array is. If it is not very far (at least 10 dB) out of the noise there indeed could be room for improvement of the array by reducing the noise figure.(Better amps, less losses, or other means). I would also make this same test with the pennant type loop antennas and get a system noise floor reading with resistors in place of the elements. If the noise figure of the arrays are vastly different I suspect you may not be getting the most out of the worst one. I would personally guess the 4-square to be low because of this. The 4-square pattern is formed from destructive signal phasing making the array output lower than a single element. As such the output can be much lower than a loop. I would strive to get a handle on having both systems noise at about the same level above their system noise figure or at least far enough above the system figure it could not affect the measurement.”

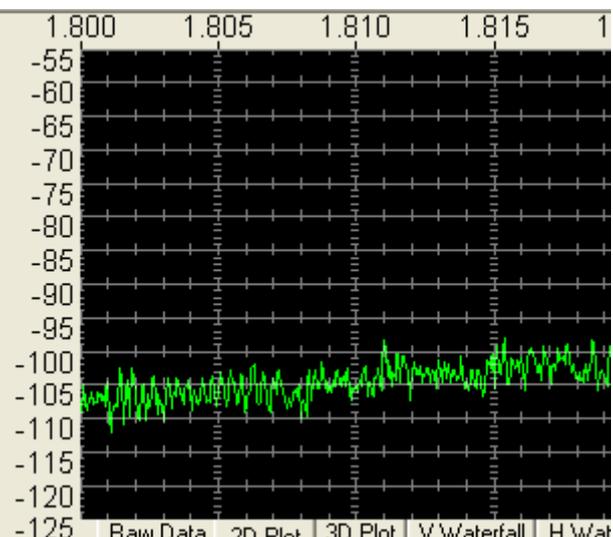
So in a sunny dry afternoon I repeated the noise readings on the SDR-IQ receiver, without any preamplifier, (in the previous tests I kept the preamplifiers at their usual operating positions).

The following are two of the screen graphics taken in all the 8 switchable directions clockwise from South West to South. These are the less noisy and the most noisy directions:

4 square RX – dir. SW (best): - 110 dBm

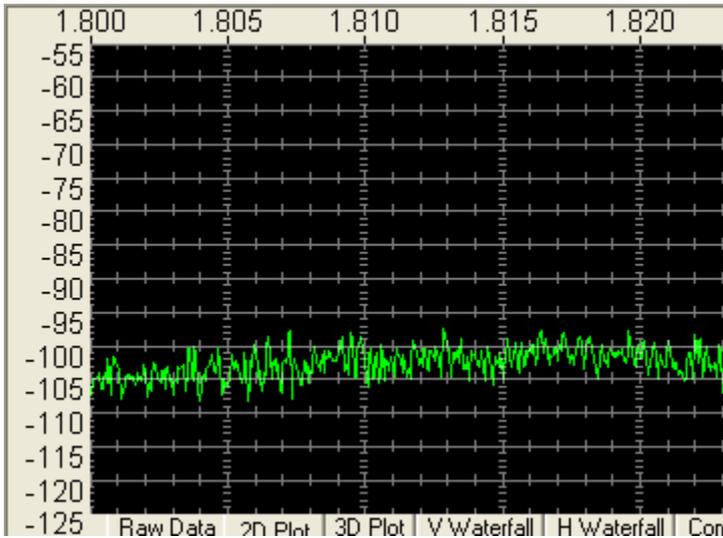


dir. NW (worst) – 103 dBm

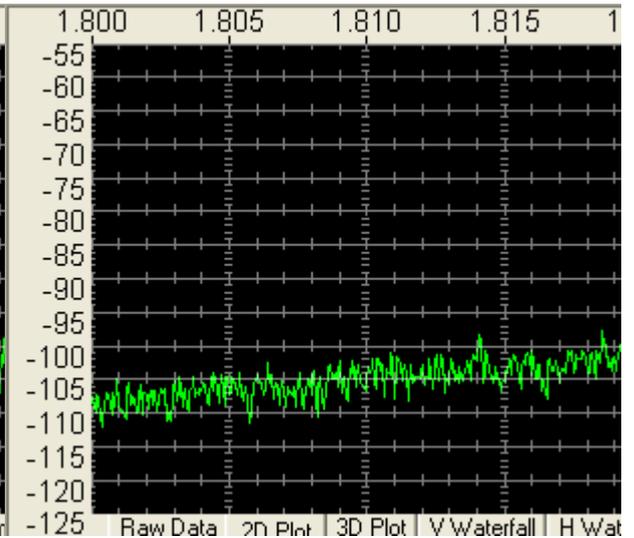


Then I connected the 75 ohm feedline directly to the single vertical elements in order to find which is the worst among them:

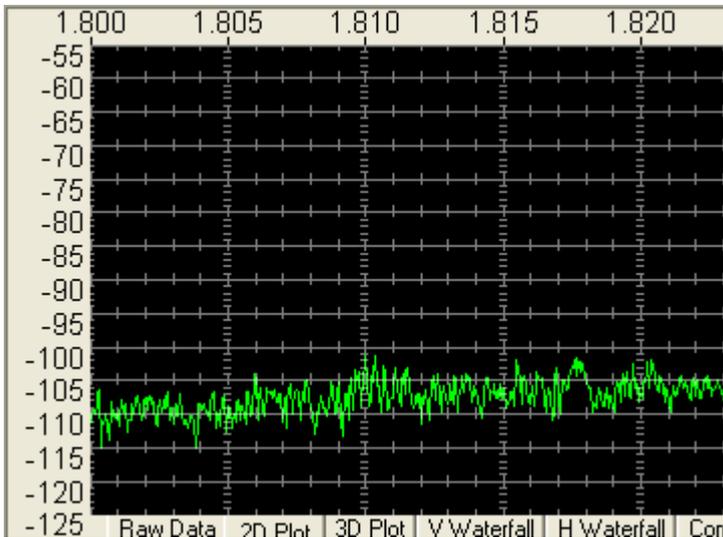
4 square RX – Single Ant. N.2 NW: -103dBm



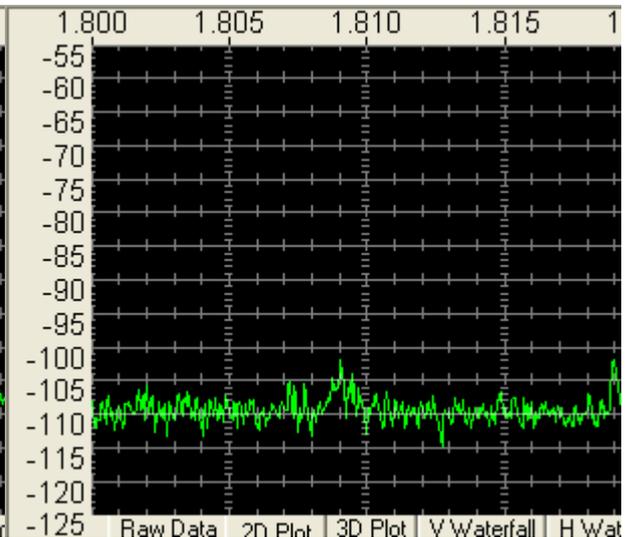
Single Ant. N. 4 NE: -104dBm



4 square RX – Single Ant. N.1 SW: -107dBm

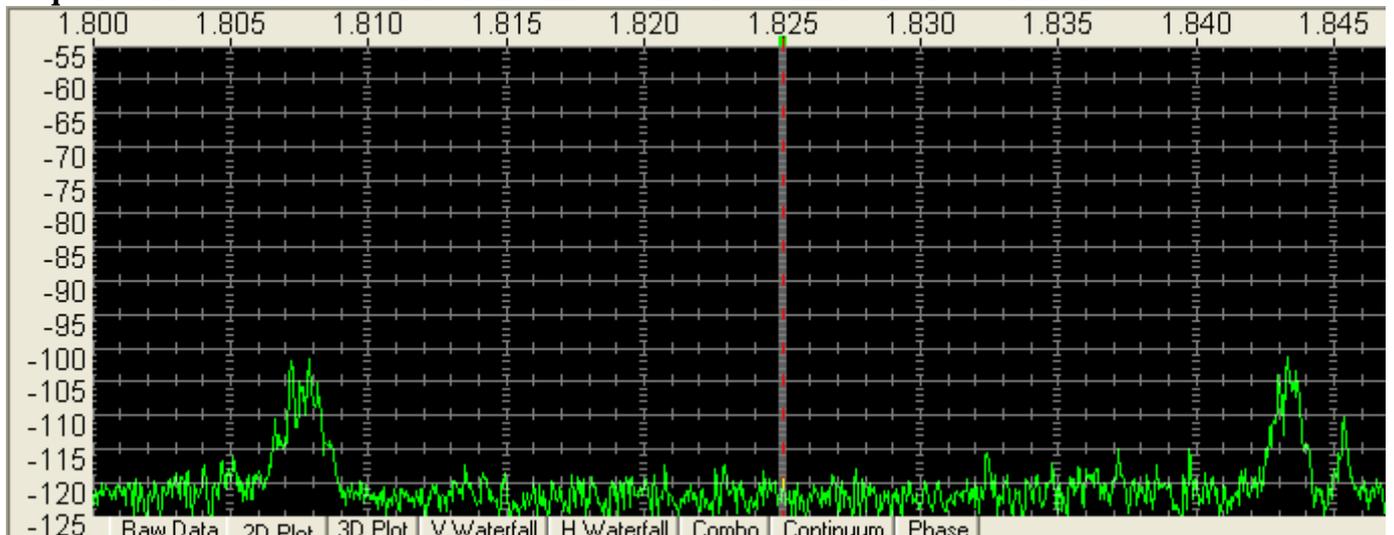


Single Ant. N.3 SE: - 110 dBm



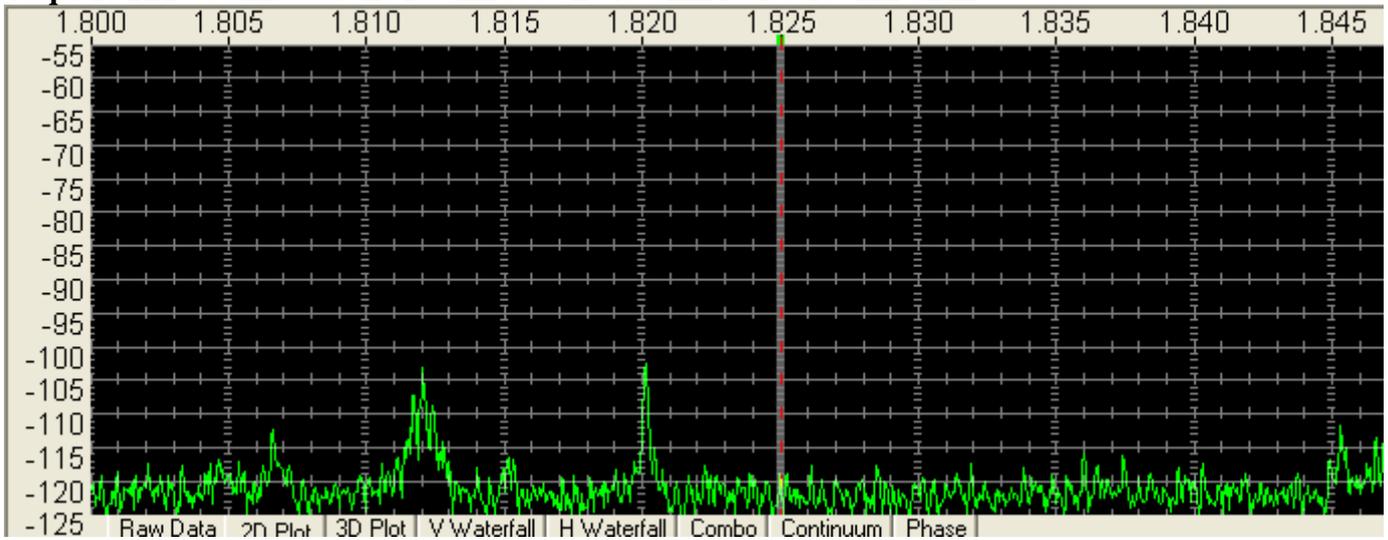
Then I connected all the 4 feeding lines to 75 ohm resistors, replacing the antenna loads:

4 square RX – substituted vertical antennas with 4 x 75 ohm resistors : - 122 dBm



Finally this is the noise reading after replacing the combiner/phasing box with a 75 ohm resistor:

4 square RX – connected the feedline to one 75 ohm resistor: -122 dBm

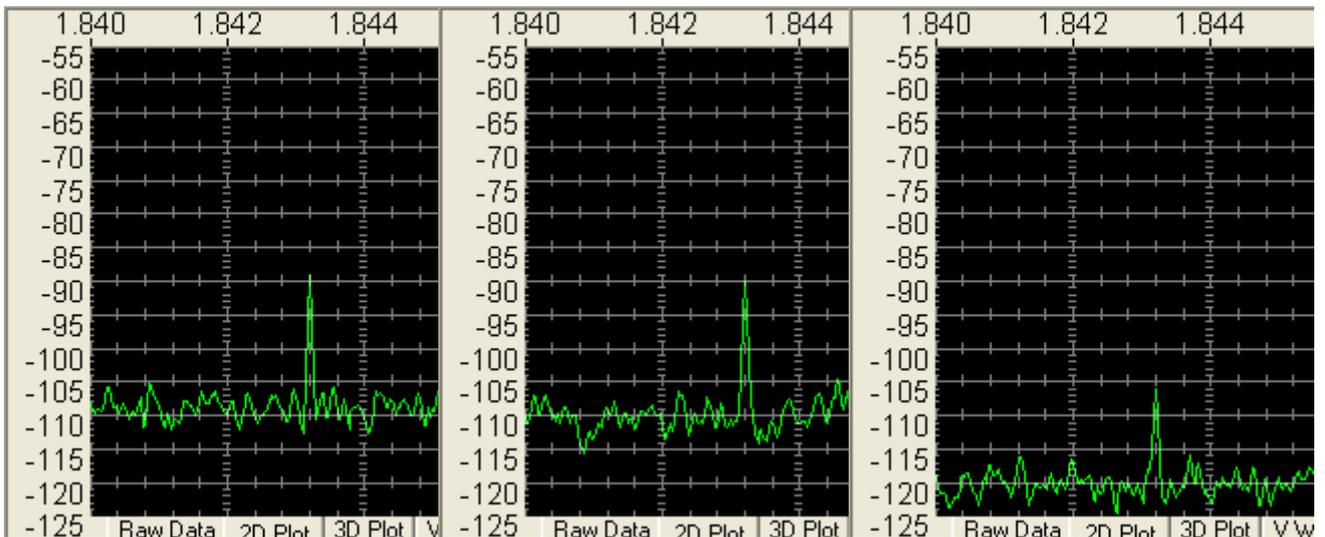


Absolutely NO DIFFERENCE from step before, so we must guess that the combiner, phasing circuit and feeding lines are working correctly: ALL THE NOISE is originated in the antenna elements. At this point I guess the problem could be in the loading wires of the vertical elements and/or the expanded ground system.

So I put again at almost one wavelength the 1.843 test oscillator and began to modify the 4-square elements.

This is the vertical Nr.2 (in the NW quadrant).

Vert.2: A) Original B) disconnected from radials C) cut the loading wires + 4 feet

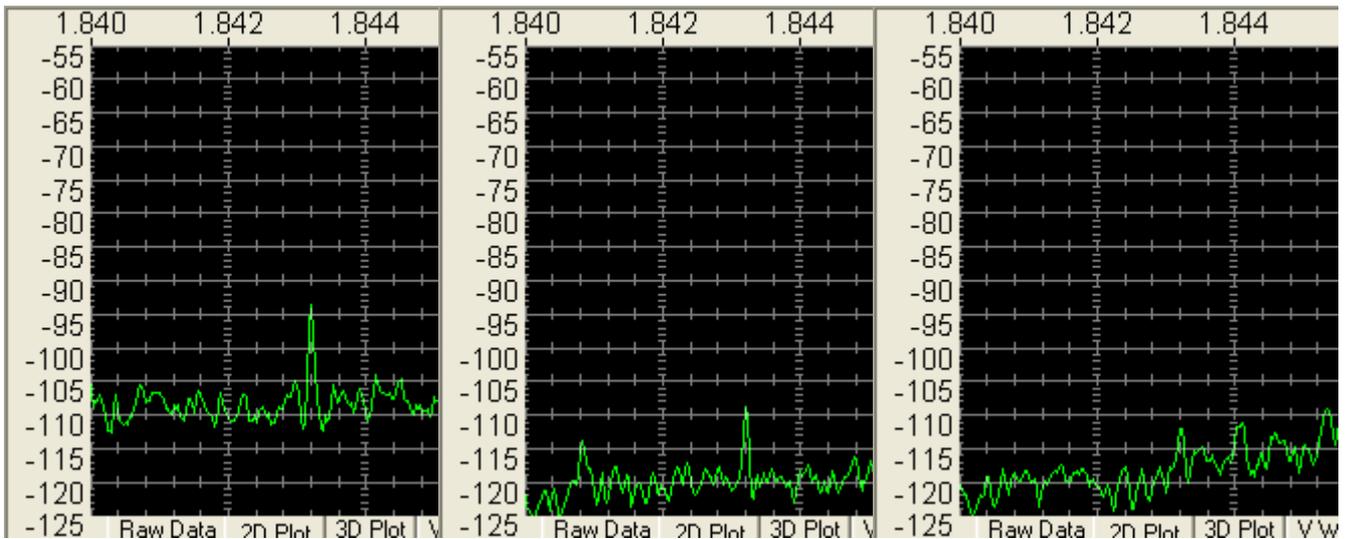


This is the vertical Nr. 1 (in the SW quadrant)

Vert.1: A) Original

D) cut the loading wires

C) disconnected the radials

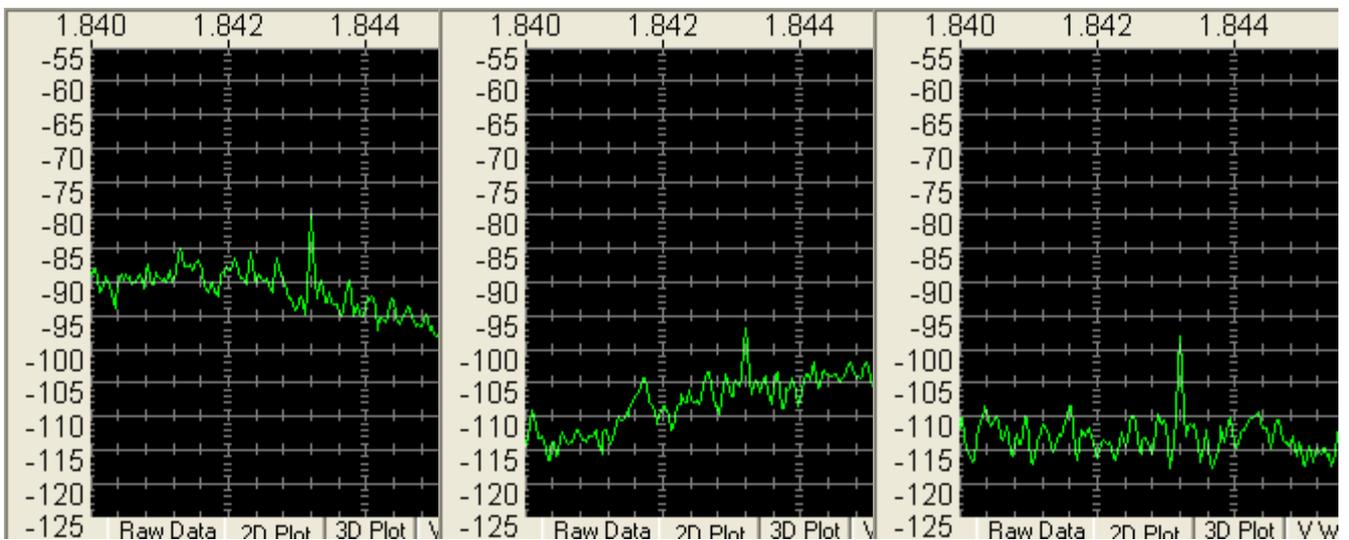


This is the vertical Nr. 4 (in the NE quadrant)

Vert.4: A) Original

D) cut the loading wires + 4 feet

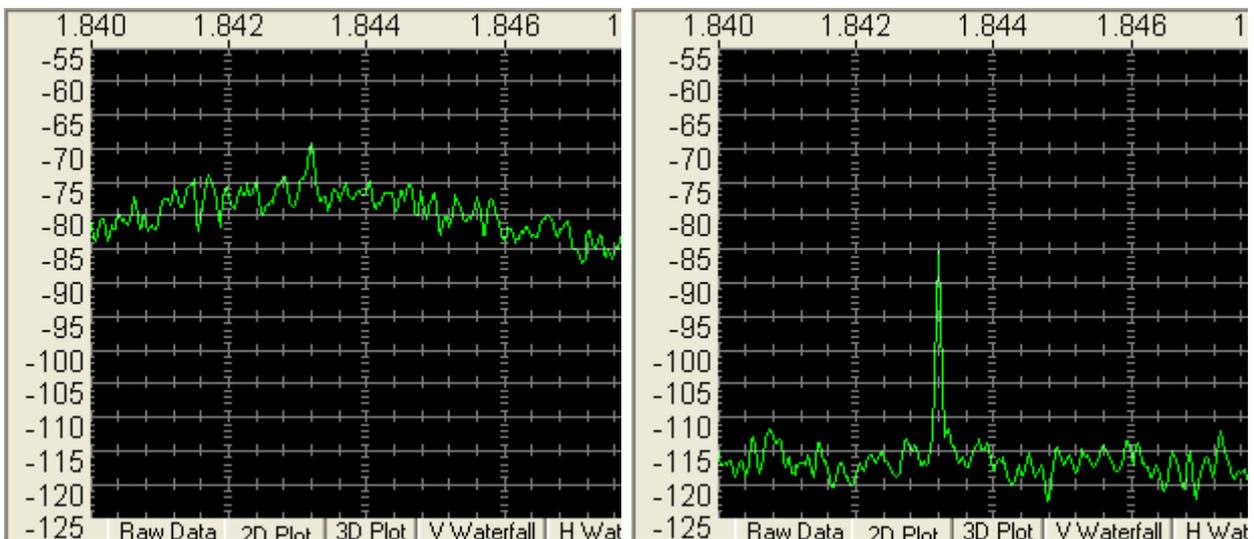
C) disconnected the radials



This is still the same vertical with 15 dB preamp., before and after cutting the loading wires.

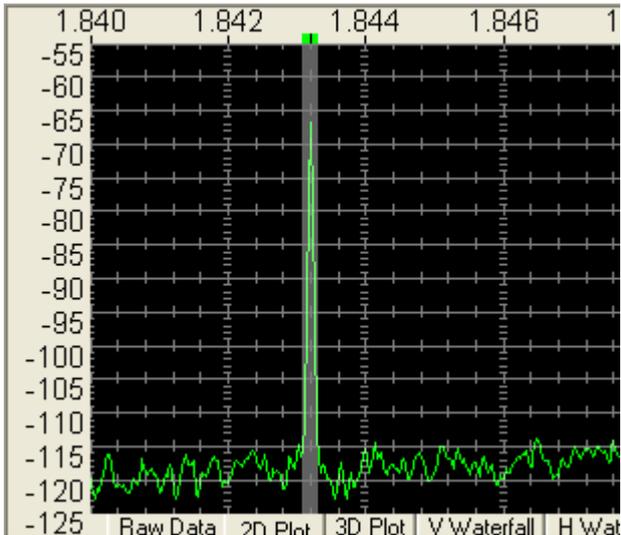
Vert.4: A) Original

C) cut the loading wires + 4 feet and the radials

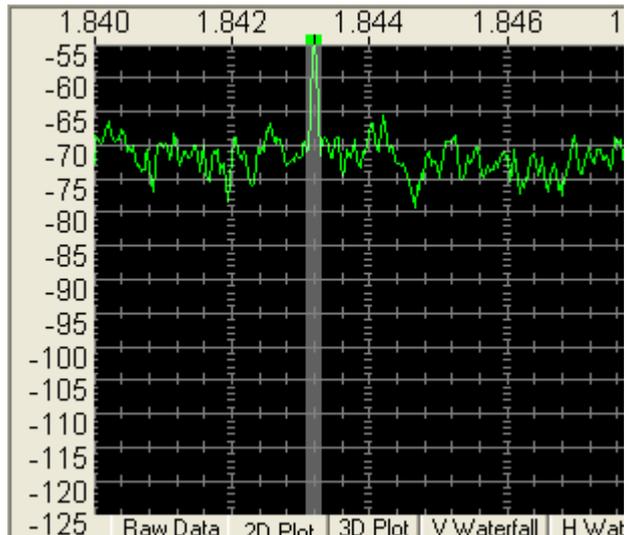


This is a last test, some hours later, after recharging the oscillator battery.

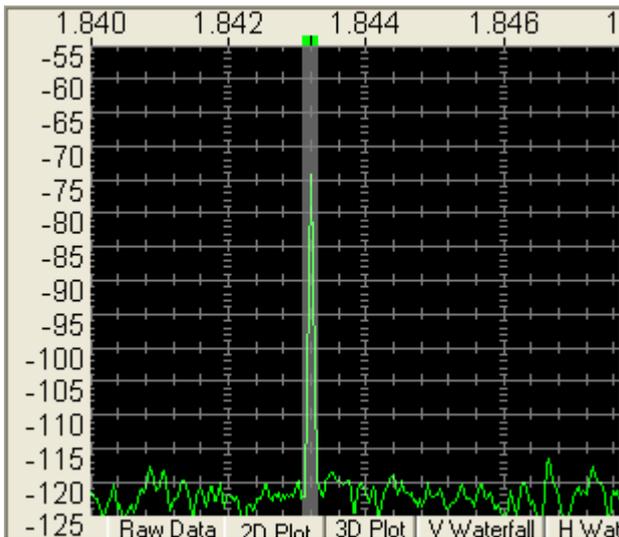
**A) Vertical Nr.4: signal - 67 dBm
noise – 117 dBm ; S/N = 50 dB
(140 meters from the Test Oscillator)**



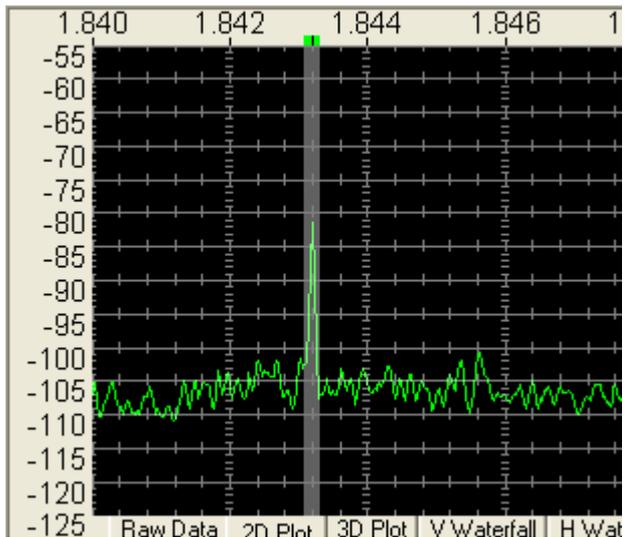
**B) TX Ant. : signal -55 dBm
noise – 70 dBm ; S/N = 15 dB
(60 meters from the Test Oscillator)**



**C) Pennant NE(north): signal - 74 dBm
noise – 122 dBm ; S/N = 48 dB
(30 meters from the Test Oscillator)**



**D) Pennant NE(south) : signal -82 dBm
noise – 107 dBm ; S/N = 25 dB
(90 meters from the Test Oscillator)**



The above results are quite satisfying:

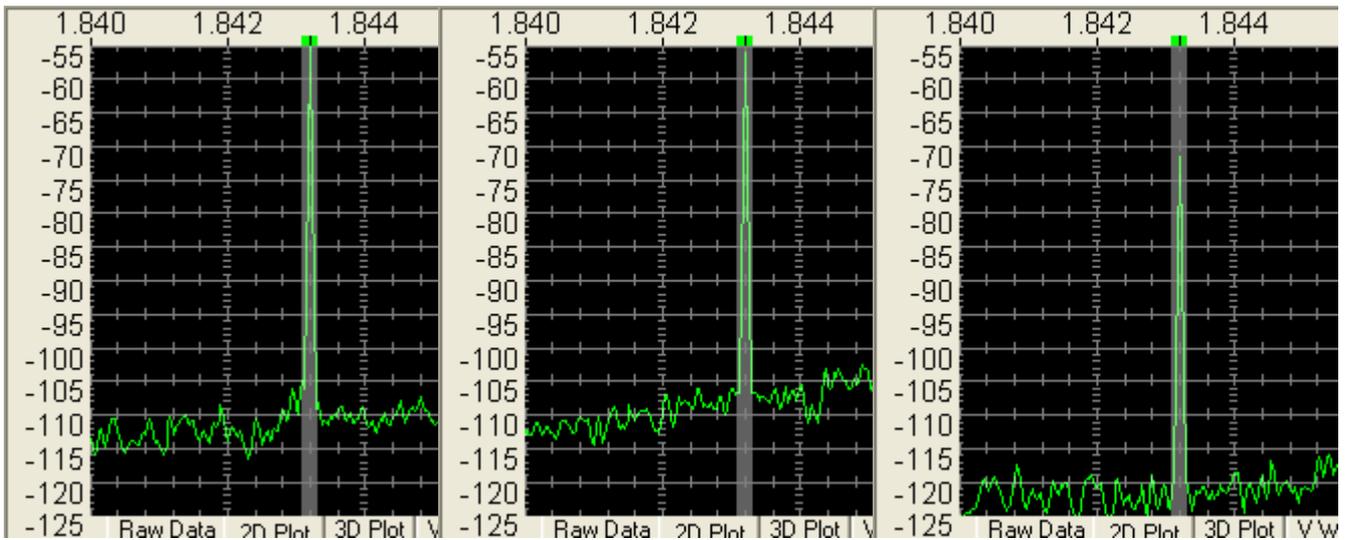
- the signal received on the shorted vertical element, not yet matched to the 75 ohm impedance and much further from the test oscillator, is stronger than on the best Pennant
- the noise level has been reduced by 10 to 15 dB

The following is the Vertical Nr. 3 (in the SE quadrant). I disconnected again all the radials at first – no effect – and than the loading wires. The element length has been cut to 6.33 meters.

Vert.3: A) Original

B) disconnected from radials

C) cut the loading wires + 4 feet

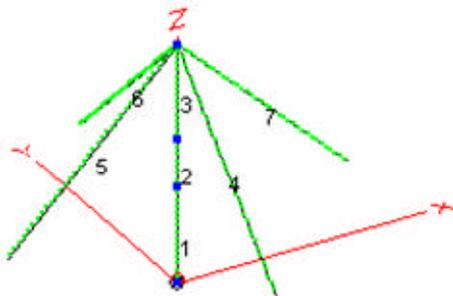


The noise level is the same as in the best Pennant and the signal is a few dB better, despite the greater distance from the test oscillator (160 m. vs. 30 m.).

Of course the impedance has not yet been matched to the 75 ohms feedline and there is a lot of room for improvement and getting a good pattern in a 4 square phased array.

It has been proved that a well designed and carefully built 4-square Rx array, with the W8JI top loading elements technique , does not work in my environment. A F/B of 30 dB was achieved, but only on strong signals ...no way to pull out of the noise the weak DX, better on the Pennants!

The loading wires and the elaborate ground system (see here on side) did a good job for stable impedance matching and correct phasing, but producing a huge NOISE PICK-UP (may be due to the surrounding power and telephone lines).



Now back to EZNEC to see which is the impedance of the simple vertical after removing the loading wires: $R = 0,55 - jX 1214$ ohms.

With such an increase (from $-jX 300$), the inductance required for a stable matching is more difficult to deal with the old classic inductors, but I'm confident that a good solution could be found with the Hi-Z amplifiers and the 4 square system by K7TJR.

