Rx antennas at IV3PRK: the 4-Square Rx Vertical Array

Part 4: Changing into a 75 ohm feed line and final improvements

by Pierluigi "Luis" Mansutti IV3PRK

The final decision

After a couple of months of tests I realized that the 4 square was working quite well, with a front to back ratio better than on any other antenna but, generally, the Pennants were more "quiet".

Despite all my common mode cares and the feed line tests (ON4UN book, page 7-61) were not bad, I decided, as a last resource, to substitute all the buried RG213 coax going to the shack (150 meters), with the same RG6 style 75 ohm CATV SAT cable used for the array delay lines.

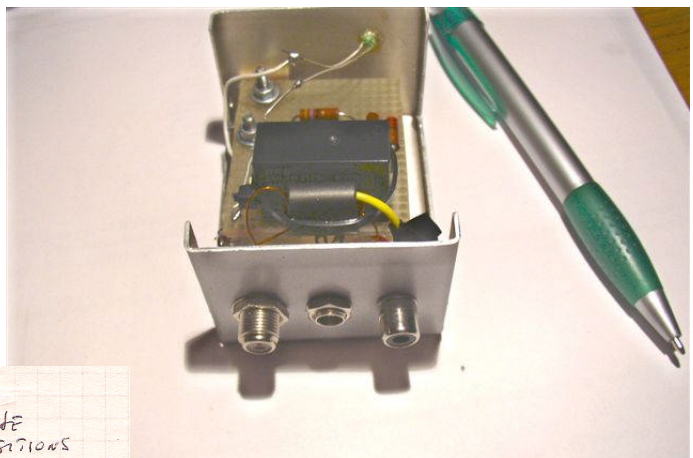
Of course the output transformer had to be changed to match the new feed line impedance.
Going up from 18.75 to 75 ohms is exactly 1: 4 impedance ratio, and thus 1:2 turns ratio. So just one more turn was required on the binocular BN73-202: 3 turns on the primary and 6 turns on the 75 ohm side.

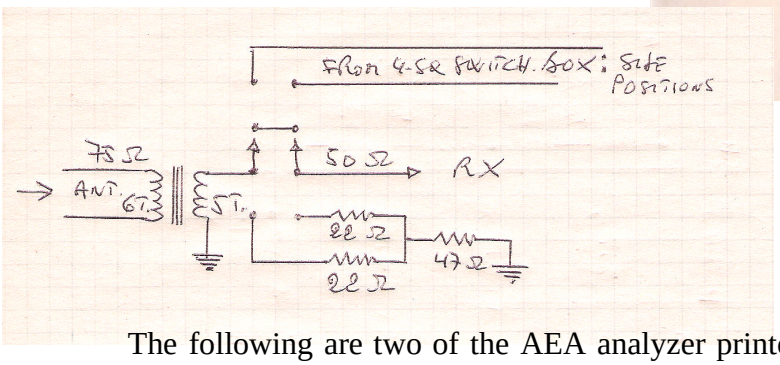
The new impedance at the output of the combiner box is now around 70 ohms, quite ok for the 75 ohm coax cable going to the shack.

Though not strictly necessary, I wanted to be perfect and decided to reduce again the impedance in the shack, in order to match the 50 ohms input of the preamplifier.

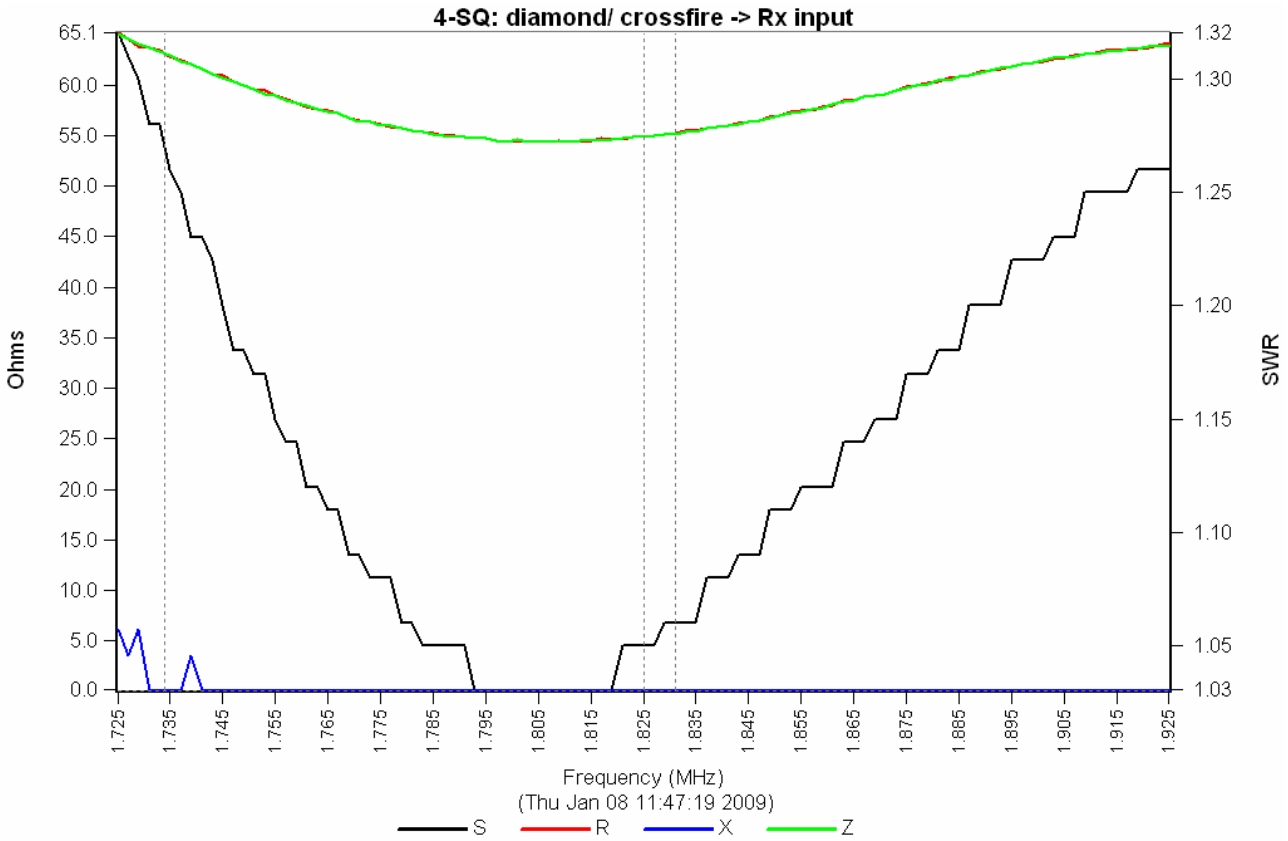
Now the impedance ratio is 1.50:1 and thus the required turns ratio is 1.22:1; hence for 6 turns on the 75 ohm side, we need 5 turns on the 50 ohm Rx input side.

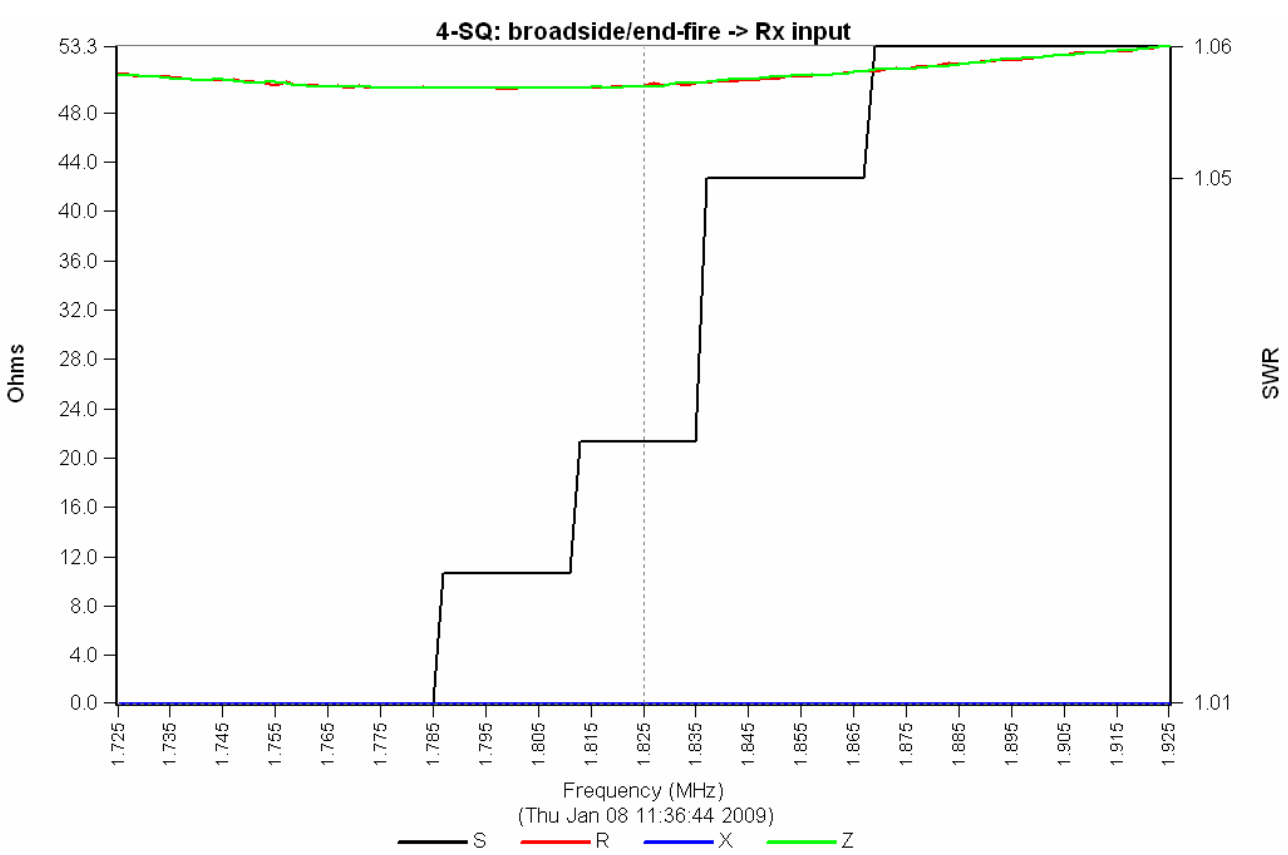
In the small box hosting the relays and the T-attenuator for the alternate side positions (see part 2 – page 4) I inserted the binocular input transformer and substituted the connector with a F-type one.





The following are two of the AEA analyzer printouts taken at the receiver input and both the diagonal and the side positions show a good impedance matching.


4-SQ: diamond/ crossfire -> Rx input
Ohms
SWR
65.1
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1.32
1.30
1.25
1.20
1.15
1.10
1.05
1.03
1.725
1.735
1.745
1.755
1.765
1.775
1.785
1.795
1.805
1.815
1.825
1.835
1.845
1.855
1.865
1.875
1.885
1.895
1.905
1.915
1.925
Frequency (MHz)
(Thu Jan 08 11:47:19 2009)
S
R
X
Z


4-SQ: broadside/end-fire -> Rx input
Ohms
SWR
53.3
48.0
44.0
40.0
36.0
32.0
28.0
24.0
20.0
16.0
12.0
8.0
4.0
0.0
1.06
1.05
1.01
1.725
1.735
1.745
1.755
1.765
1.775
1.785
1.795
1.805
1.815
1.825
1.835
1.845
1.855
1.865
1.875
1.885
1.895
1.905
1.915
1.925
Frequency (MHz)
(Thu Jan 08 11:36:44 2009)
S
R
X
Z

Adding the T-attenuators

With the combiner box on the workbench I decided also to add the small T-attenuators in order to improve the F/B ratio as suggested by my friend Lee, K7TJR, and described also on the ON4UN "Low Band DXing" page 7-26.

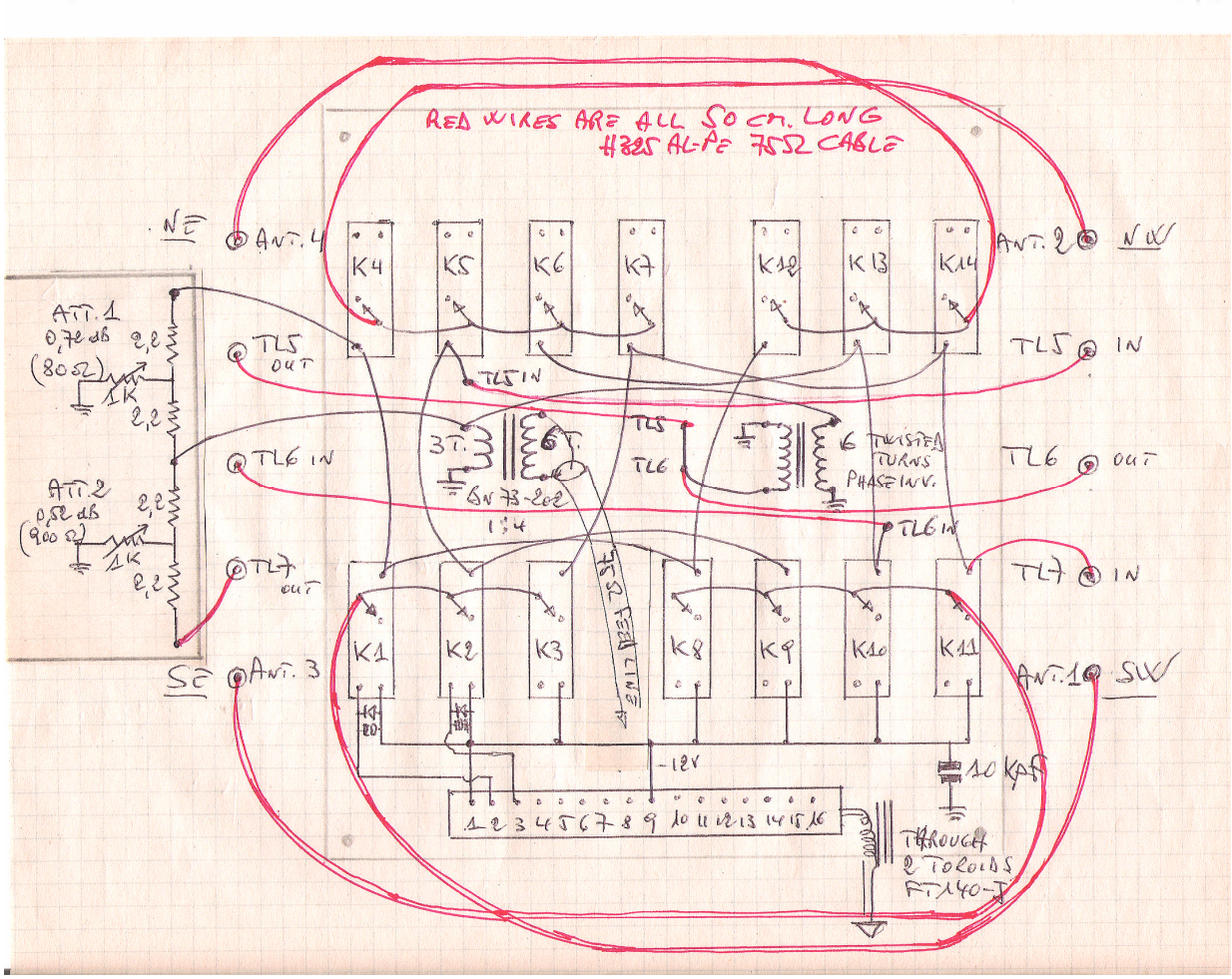
Though I have not yet been able to find a Vector Voltmeter or some other suitable equipment for accurate measurements of RF magnitude and phases for precise adjustment of the two 1K ohm potentiometers, I calculated what should be the shunt resistance and set their value as follows.

In the combiner we have three lines with different phasing, but also with different losses, which may cause a few degrees of variations from what calculated. So the small attenuators are added on the lines with lower losses in order to null those differences.

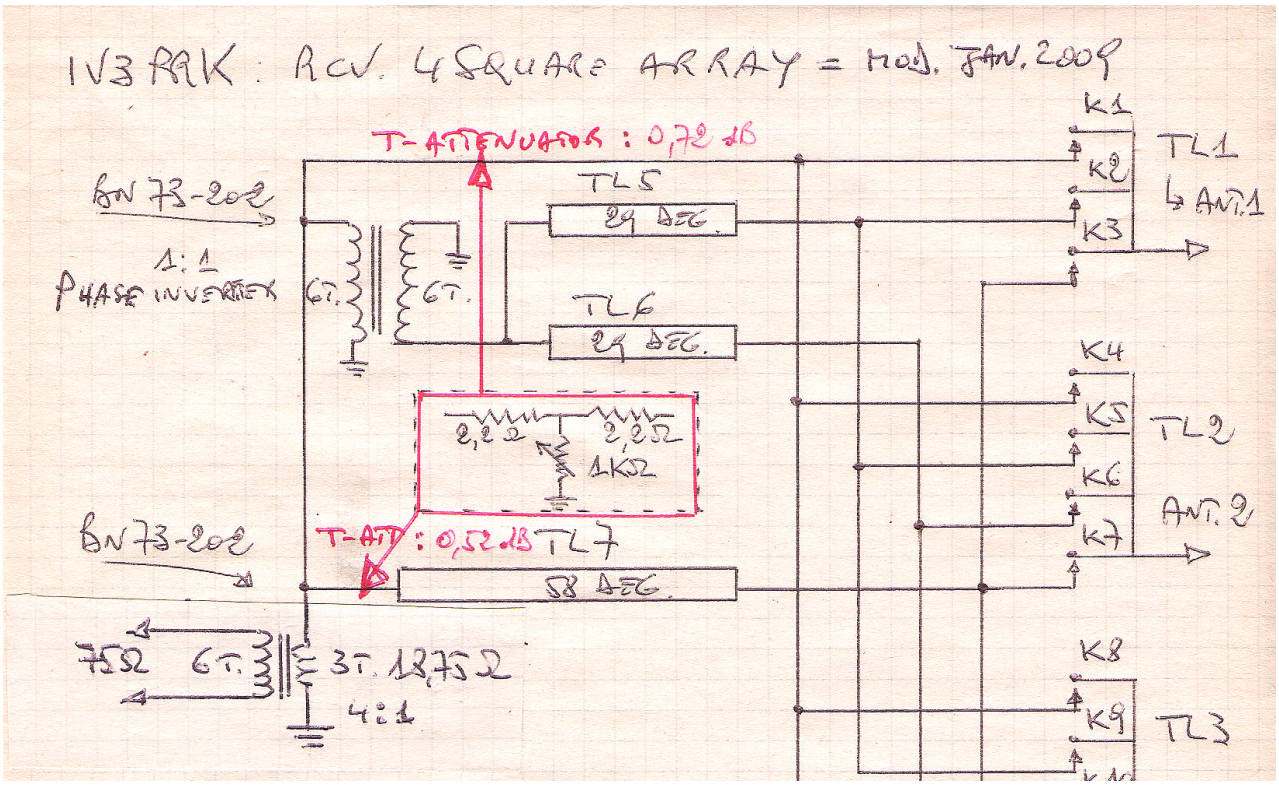
In the diagonal configuration the lines from the two middle elements have more loss (TL5 + TL6 and the phase inverter); the line from the back element travels twice through TL7 (but no Xfmr losses), while the front element is fed directly.

So I set the potentiometer of ATT.2 (to the back el.) at 900 ohms to get an attenuation of 0,52dB, and that of ATT.1 (to the front el.) at 80 ohms to get an attenuation 0,72dB. The difference of 0,20dB is supposed to be the attenuation of TL7 (21 meters of coax cable at 1,8 MHz).

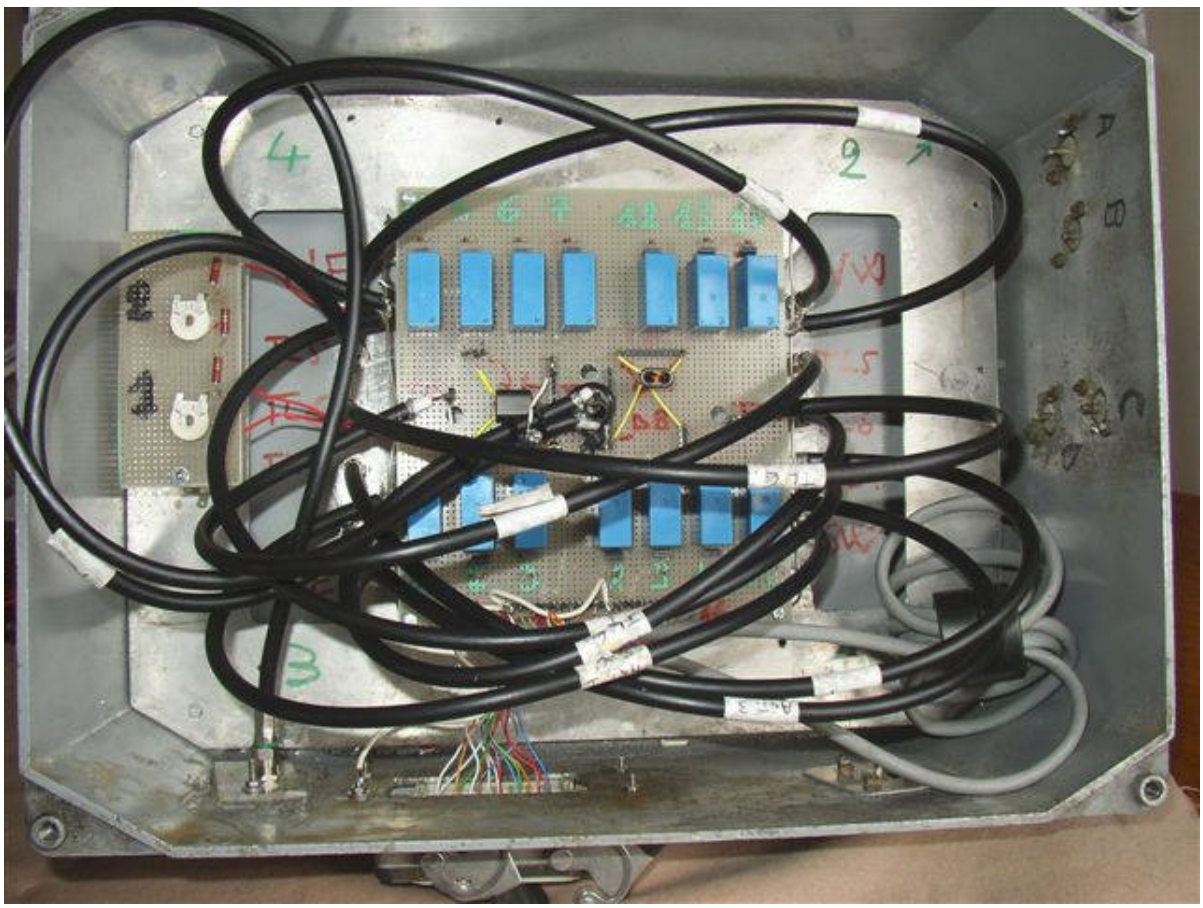
This is the wiring layout of the combiner box modified with the new output transformer and the insertion of the T-attenuators.



In the next electric sketch of the array it is more clear where the attenuators are inserted.



This is a new picture of the combiner box with the T-attenuators board on the left side.



Of course as soon as I get the necessary measurement equipment I will fine tune the array, trying to further squeeze something more, but for now I think that the above "guessed" procedure would be better than nothing !

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