MEMO

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PAON2-OptX21cm/22.02.13

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Subject: Summary of some Electronic Test Bench analysis at LAL

1 Introduction

In the continuity of references PAON2-OptX21cm/15.02.13rev, 16.02.13, 19.02.13 a series of systematical cross-checks have been performed concerning the oscillations with cable & LNA.

2 The setup

The setup is essentially the same used in PAON2-OptX21cm/16.02.13 where we have used an Agilent frequency synthesizer to generate the 1250MHz with the possibility to modify the OL frequency and a splitter to send the clock on both mixer entries. We have also used 7m coax cable and 2x1m cables connected by "I" and a special attenuator and the standard LNA.

2.1 OL frequency change

We have played with the synthesizer frequency: 1250MHz (default), 1247MHz and 1245MHz. We cannot play too much due the limited filter band of the mixer.

On Figure 1 is shown the "reference plot" at 1250MHz were we have picked up the intermittent 1385MHz line[1] as well as other activity around 1400MHz. Then on Figure 2 and Figure 3 we have changed the frequency. Each time the correspondence between frequency channel 0-8191 and MHz is redefined as:

$$f(n) = OL + (n/8192) \times 250$$

A true line picked up before the mixer between ["OL", "OL"+250]MHz is not affected by the "OL" clock modifications while a line emitted between [0, 250]MHz after the mixer will be shifted according to OL frequency evolution (ie. decreasing when the OL clock is switched from 1250 to 1245 MHz).

According to this interpretation, the 1375MHz as well as the 1385MHz lines (for instance) are true lines while the wavy deformation of the Ch0 spectrum around 1405MHz may be interpreted as disturbances at ~155-160MHz. The pending question concerns the true line at 125MHz of the ADC (see Figure 2 of PAON2-OptX21cm/11.02.13) as it should have been shifted it is powerful enough.

[1] This has been demonstrated on a long night run.

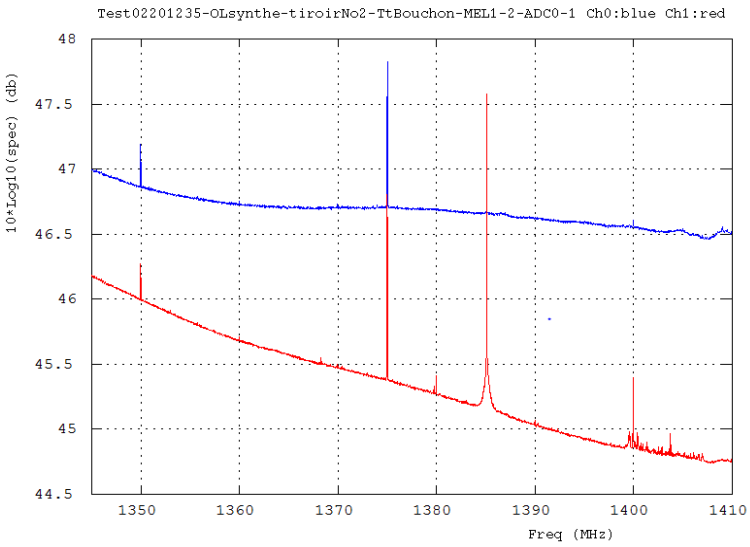

Figure 1: synthesizer @ 1250MHz

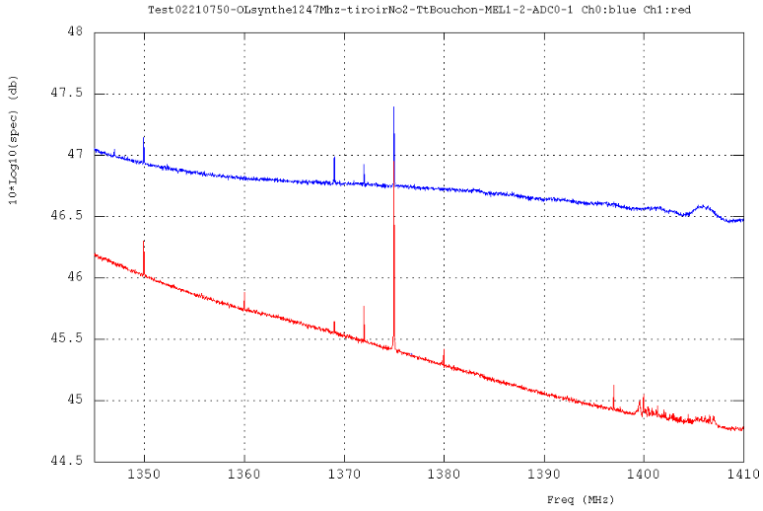

Figure 2: synthesizer @ 1247MHz

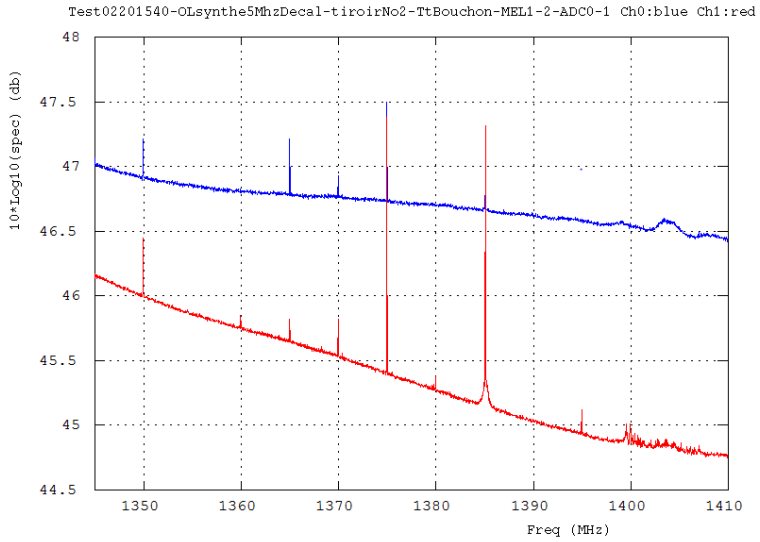

Figure 3: synthesizer @ 1245MHz

2.2 Cables, LNA…

The synthesizer frequency is set to the default 1250MHz and on a mixer entry we add 7m coax + 50Ω load while on the other entry we plug 1m coax + 50Ω. The result is presented on Figure 4. Apart from the spurious fine lines emerging (pick up?) we see clearly the modulations/oscillations due to the presence of 7m cable (red curve).

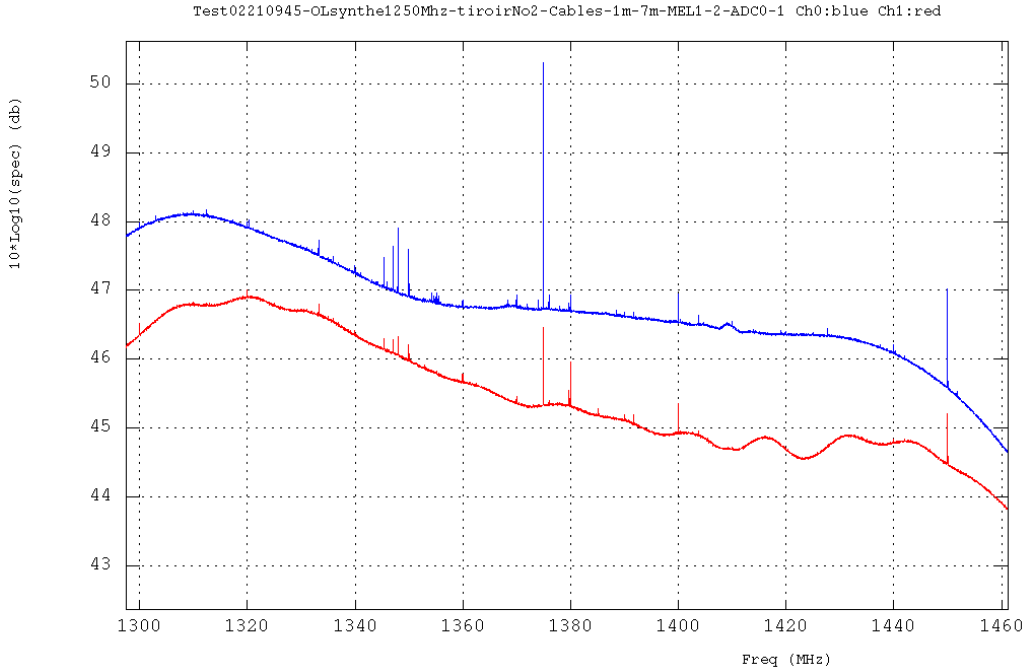

Figure 4

Adding a 6dB attenuator to the 7m cable, we get the following spectra (Figure 5). It is clear that the modulations have decreased but there are still present.

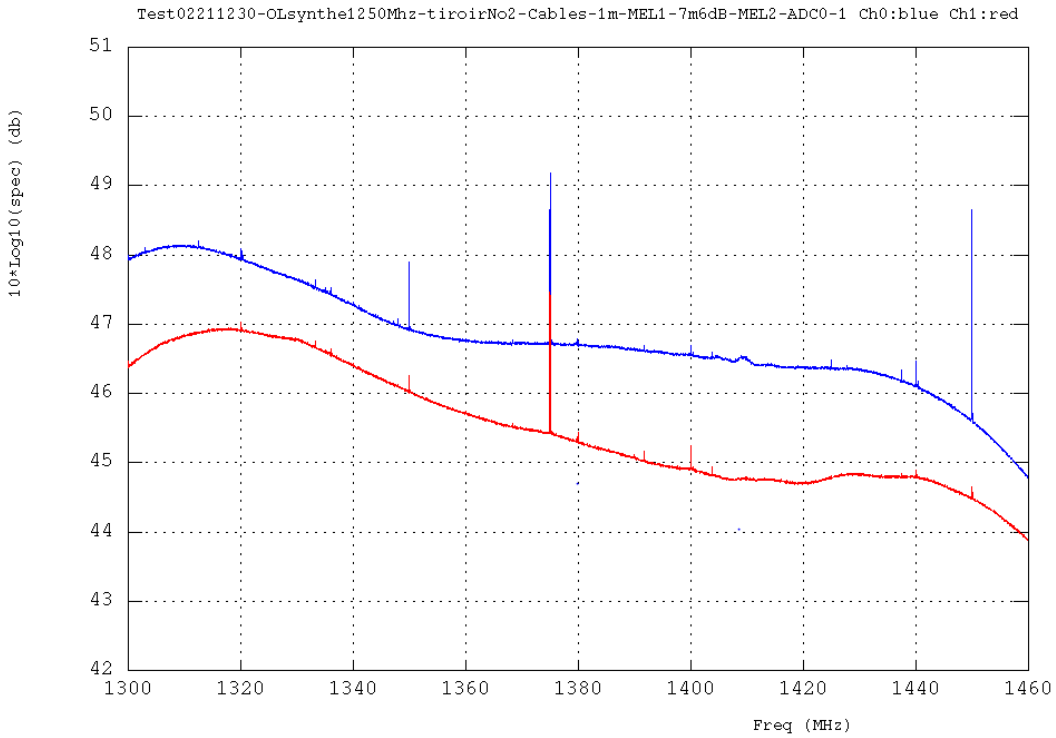

Figure 5

This is more striking when we add the LNA to generate a noise spectrum at the end of the 7m cable. On Figure 6 it is shown in blue the response of both channels with for the highest curve (~ 65dB) the LNA + 7m cable and for the lowest one (~ 47dB) only 1m cable. We see that the LNA produce a large increase of the level. In red, this is the response of both channels but we add the 5dB attenuator on the LNA + 7m cable channel (note the lowest blue and red curves ~47dB are very close to each other as expected as nothing change between the two runs).

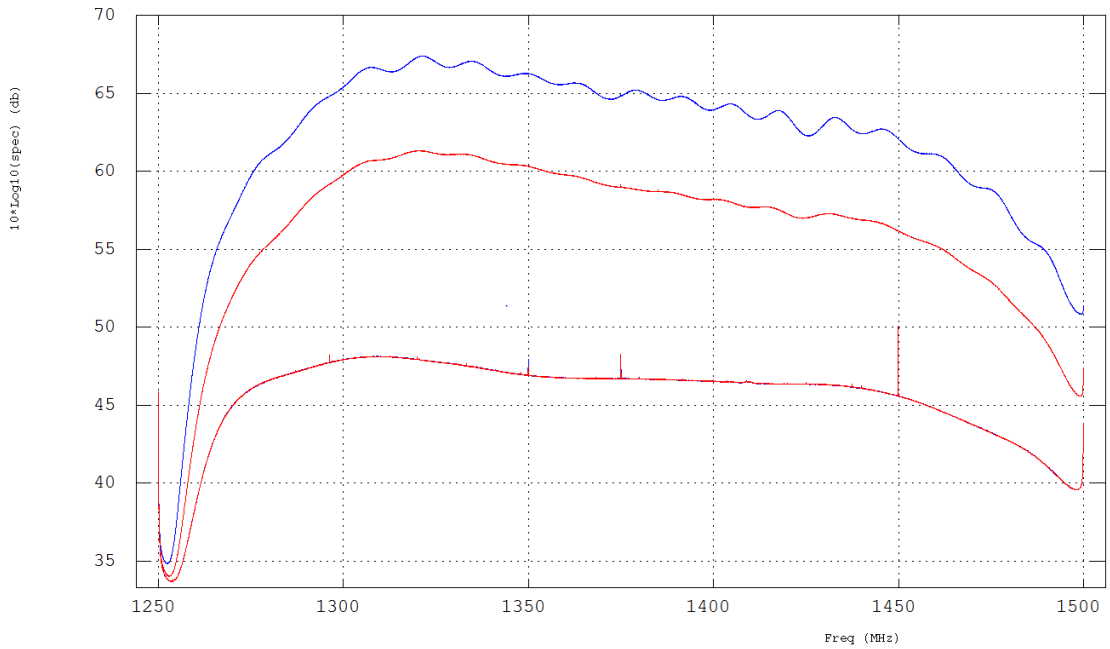

Figure 6

A zoom is presented on Figure 7 where one can appreciate the reduction of the global level by 5dB and also that the oscillations still modulate clearly the reduced spectra. In a signal reflection model, one would have expected (TBC) 10dB (factor 10) reduction of the wave amplitude, while this is not the case.

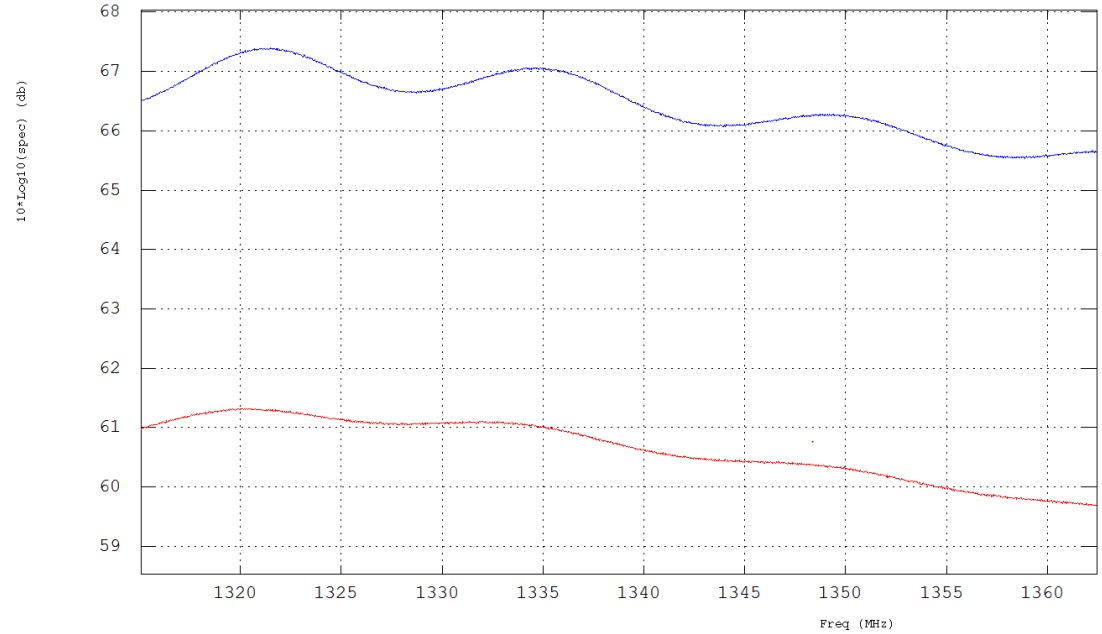

Figure 7

With 2x1m of coax cables on both channels and with the LNA active on one channel, we see Figure 8 the modification of the general amplitude and the modulation waves too. This is not yet satisfactory.

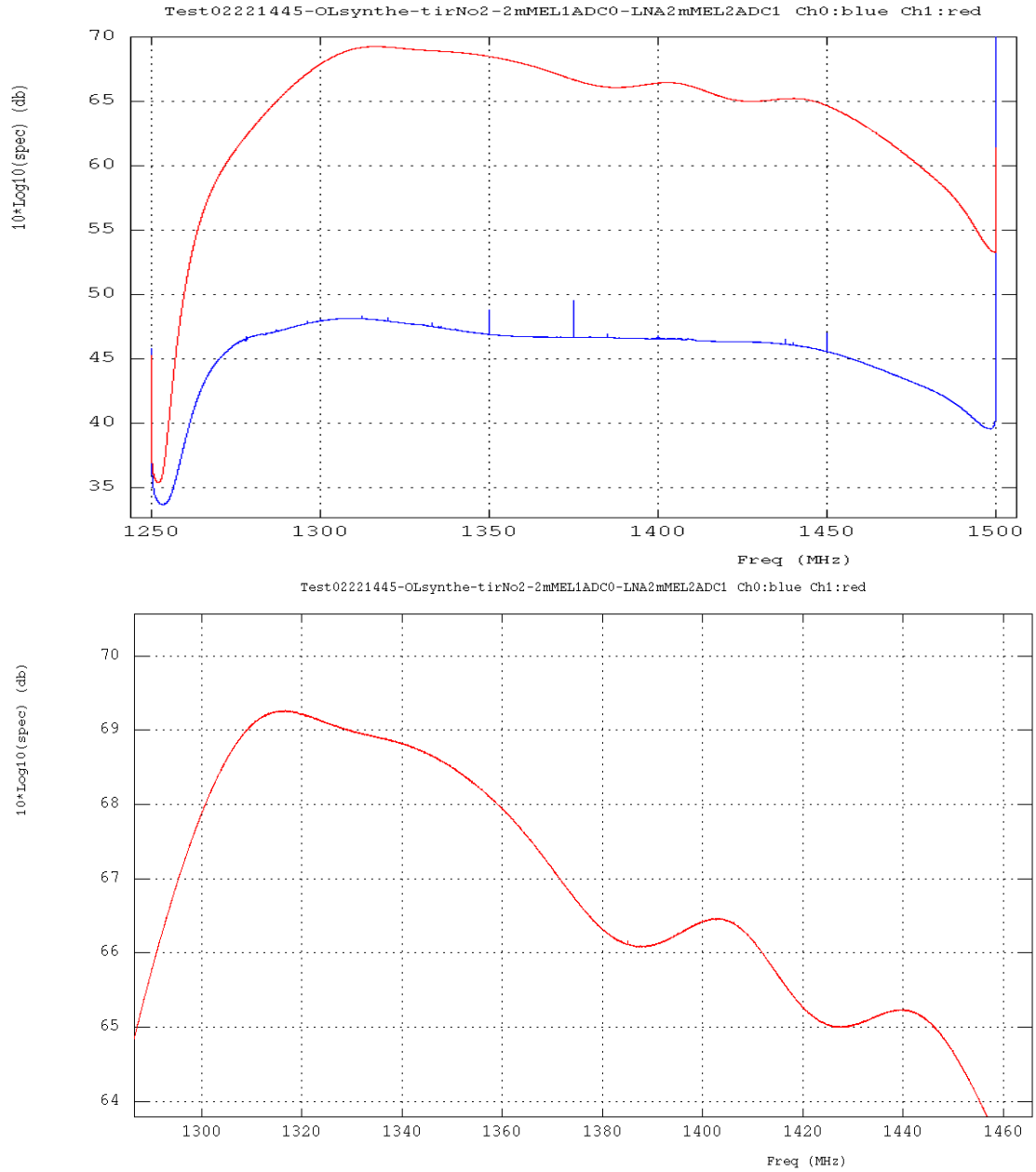

Figure 8

3 Summary & Outlook

In summary it seems that the present setup is picking external signals and we need a better shielding. In principle the NRT chariot is a Faraday cage, but we must as much as possible switch off all unnecessary electronic devices (eg. portable PC) as the NRT LNA is a very low noise device. In the context of PAON2 unfortunately the current BAO LNA has not the same level of noise and most of the pick-up lines do not emerge from the base line.

Concerning the modulations/oscillations of the spectra no solution has yet been found to moderate their amplitudes. If it is a impedance miss-match between the cable and the mixer entry then one may question the cable quality or the way the entry impedance of the mixer is realized. For the cable, we will use as soon as possible a semi-rigid 2m long coax cable that might be used for the OptX21cm setup.