Low Noise Amplifier for 23 cm band, with a BFP640

By Yves OESCH / HB9DTX, 2006

Introduction

Since some time, I own an old commercial LNA, mounted on the top of my mast, for 23 cm use. Unfortunately, for some unknown reason (probably thunderstorm or static discharge), the GaAs Fet transistor blew up. Of course, this was an old transistor, no more available. The manufacturer of the LNA sold me an « equivalent » the MGF1302. But as I changed the transistor, it was impossible to have a stable preamplifier. Some oscillations occured and couldn't be killed. As I didnt' have the exact schematics, with components values, I decided to take the problem at the beginning, and redesign a new LNA.

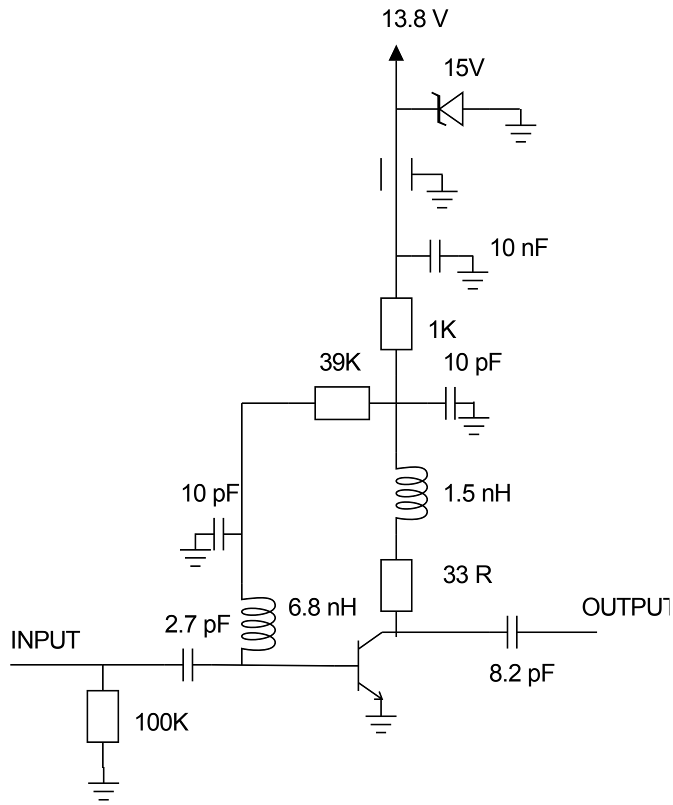
Choice of the components

As I could obtain samples of the new BFP640 **Si**licium **Ge**rmanium transistor, and having access to the student version of APLAC simulation program, I could start designing. The transistor is given at about 0.5 dB noise figure, OR 25 dB gain (but you cannot reach both together!)

The goal was to optimize the LNA for minimum noise, not for maximum gain, as the noise figure is the most important parameter in the first stage of a receiver chain. As I am using low loss cables (AIRCOM, less than 10m) and my receiver (an IC-1275) is not too bad, the gain only need to be moderate.

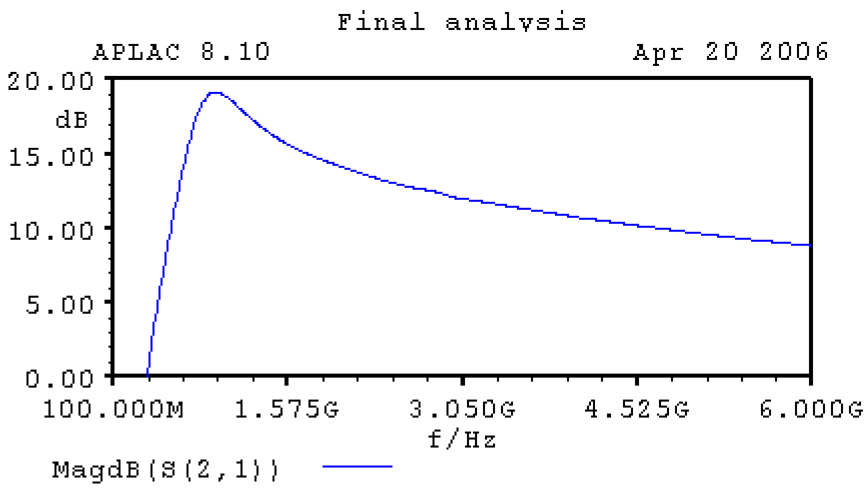
Schematics

The schematics is a very classical one. Using the simulation program, I could find the best values easily. Having powered up the soldering iron, the values were adjusted « in situ » and optimised for best measured Noise Figure.

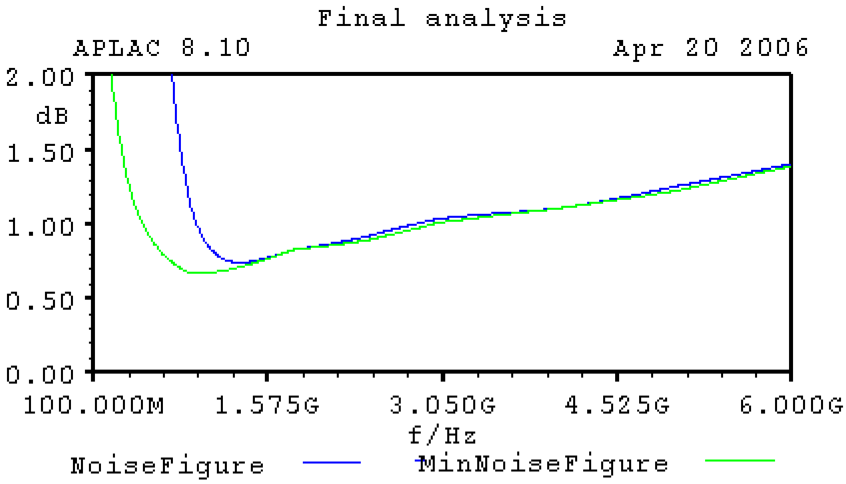


Simulations results

The simulated **gain** is following:



The simulated **Noise Figure** is following:



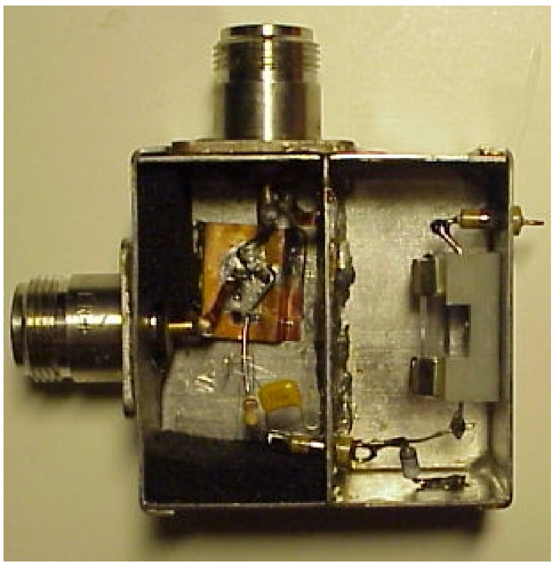
One can see that the circuit was optimised for about 1.3 GHz work.

Picture

The LNA was realised without printed circuit board, just soldering components on each other. The 2 main reasons for this choice are following:

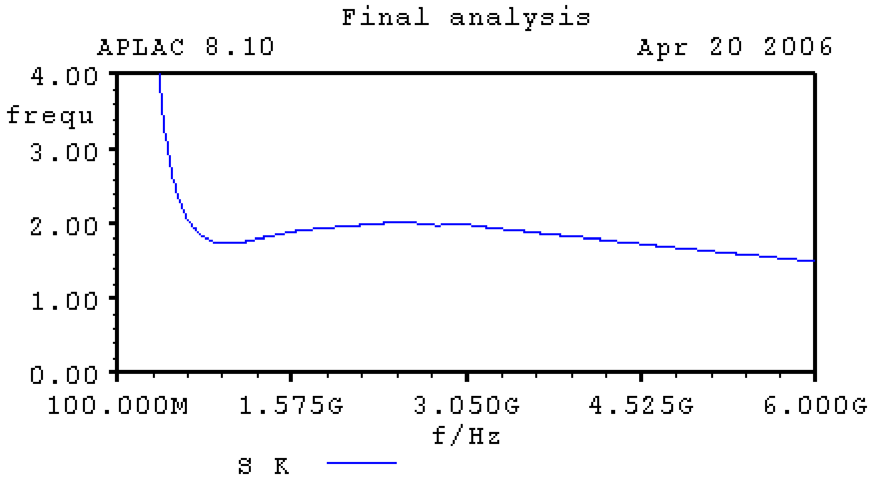
- No need to realise a print
- No loss due to FR4 material. (Teflon is much better, but is also much more difficult to find, and much more expensive)

The picture is not very good, but anyway, one can see the inside of the LNA. Note that the components were not soldered directly on the bottom of the case, but on a small piece of copper, which was soldered afterward in the housing. So there is no risk to overheat the components when soldering them on a largeand thick piece of metal which needs a lot of heat. Second advantage is that the distance between the components and the center pin of the N connectors is smaller, leading to less loss and parasitics inductance.



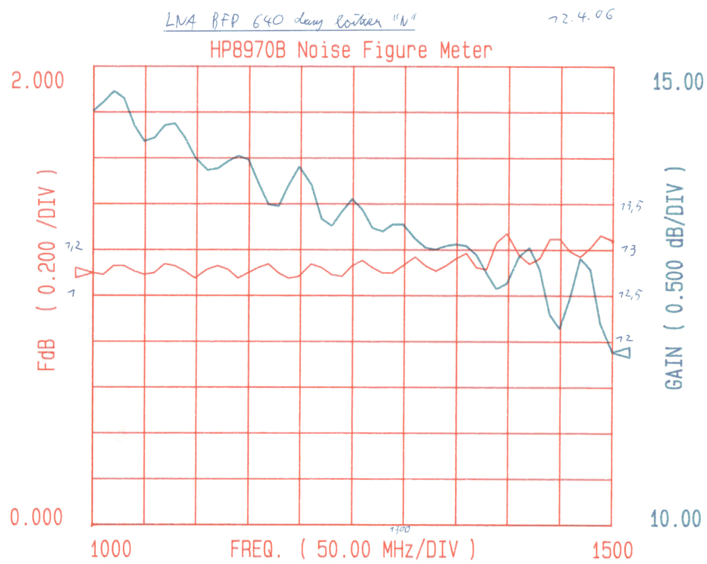
Stability

Regarding the simulations results, the amplifier is inconditionnaly stable. It will never oscillate, even if the source or load impedance are far away from 50 ohms. This was tested with two « tripple stub tuners », one at each port, and no oscillations could be observed on the spectrum analyser.



The graph shows the simulated Rollet stablilty factor (K factor). If this factor is greater than 1, the amplifier is stable. (there are some other conditions, but not leading to a problem here) The transistor's S parameters are given up to 6 GHz. That's the reason why the K factor was studied up to this limit.It is clear that K>1 is assured. It's good to have some margin as it's only a simulation! The rela life will always be worse!

Gain and noise figure measurements



Be careful to the scaling of the graph. (0.2 dB/ division for NF ; 0.5 dB/ div for the gain, beginning at 10 dB)

The measurements are: **G= min 13.5dB ; F=1.1 dB**, around 1.3 GHz. These are not excellents values. Good LNAs have much lower than 1 dB noise figure. But for my application, and regarding the short time available for this developpement, I didnt' optimise the circuit anymore. The UHF contest of may was approaching, and I wanted to be QRV!