

ADS Application Notes

Wireless Communication Laboratory
Department of Electrical and Electronic Engineering
Hong Kong University of Science and Technology

The Design of Low Noise Amplifier Using ADS

Introduction

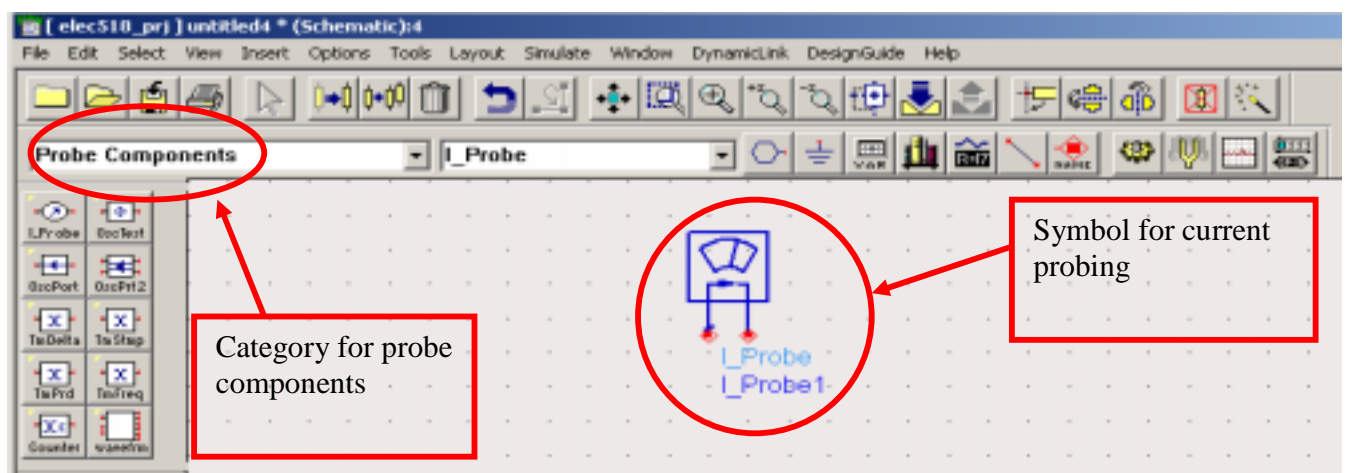
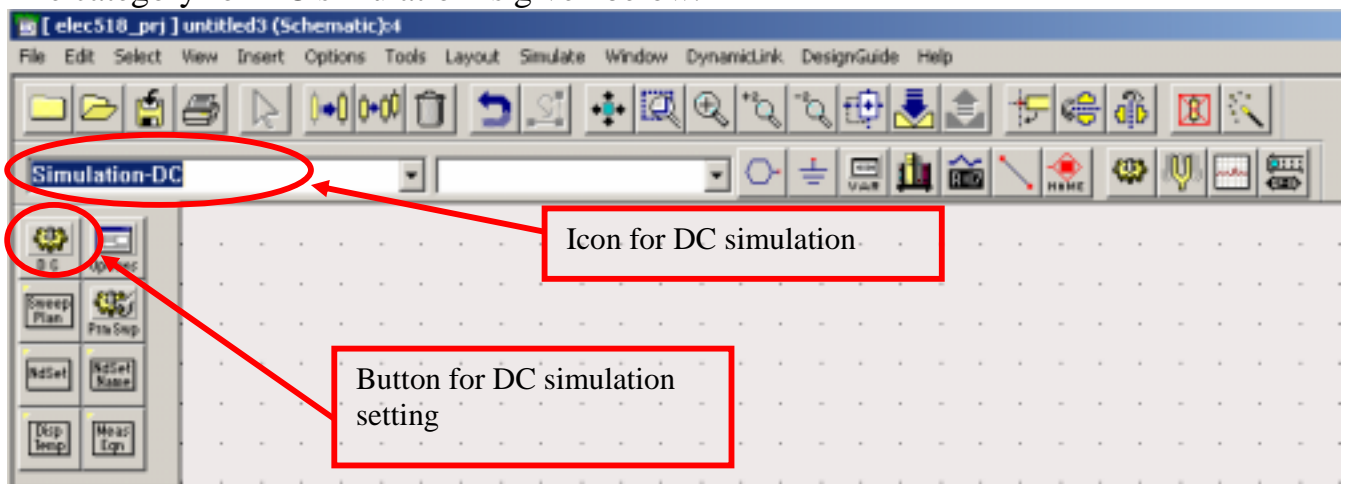
This application note describes the design procedure of low noise amplifier(LNA) working from 3GHz to 4GHz using agilent's ADS. In the following part of this note, I will show the design procedures step by step.

Design procedures

1. DC-biasing

In this design, a NE76184AS GaAs FET transistor is used. You can choose the model for this transistor from the library(Details can be found in our application notes for the oscillator design). After selecting the transistor, suitable DC biasing is required for the transistor to operate properly.

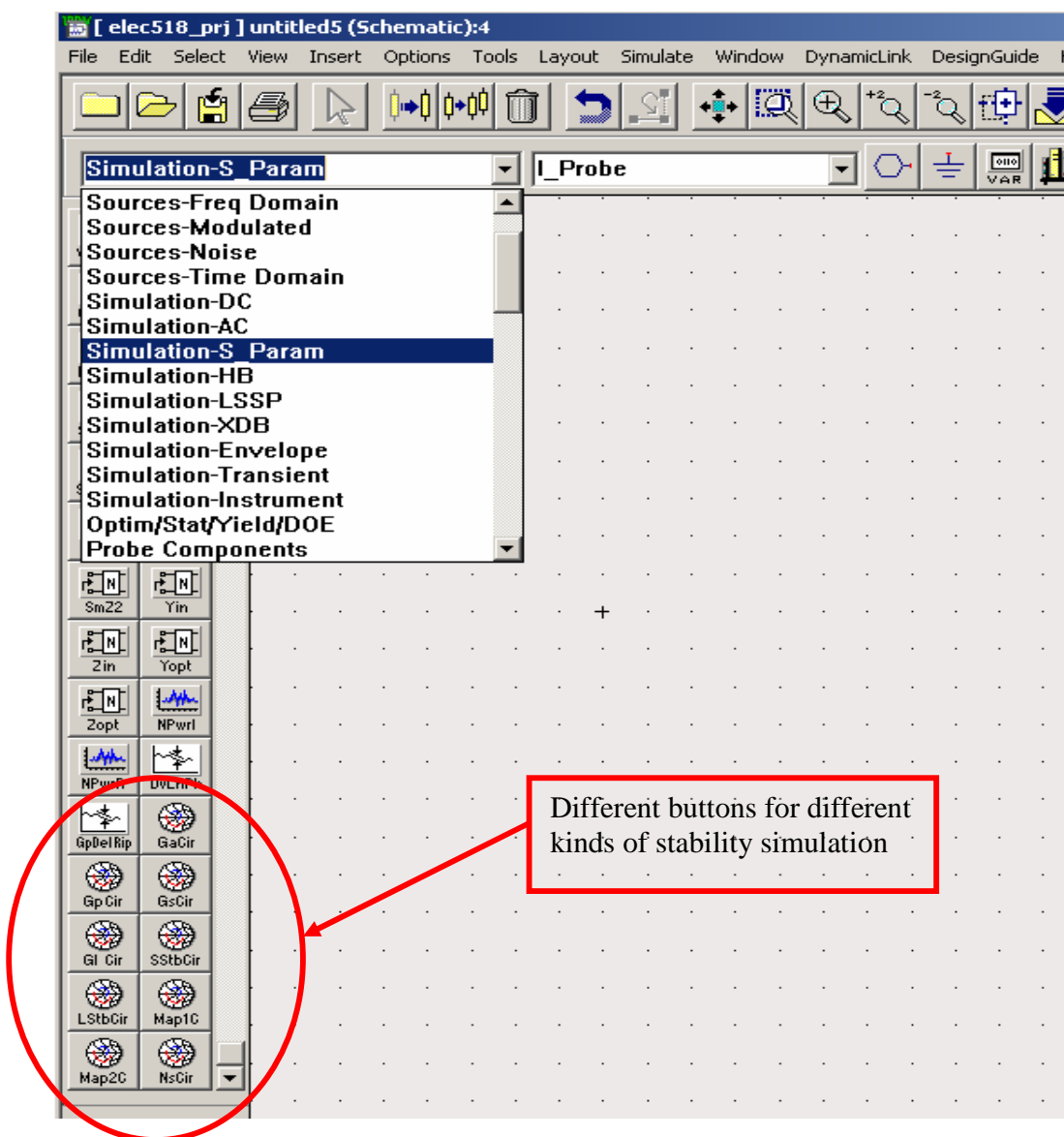
The category for DC simulation is given below.



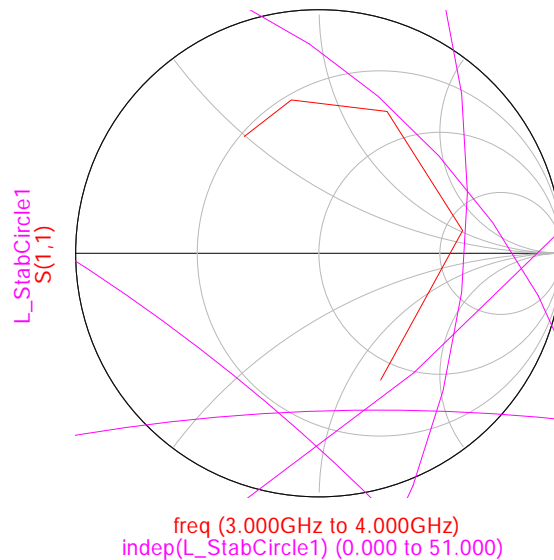
Finally we find the bias voltage is $V_g = -0.818V$.

2. Stability of the transistor

We will not mention the theory of the stability. We only show the setting for the stability simulation. The button for stability simulation are included in the S-parameters as shown below:



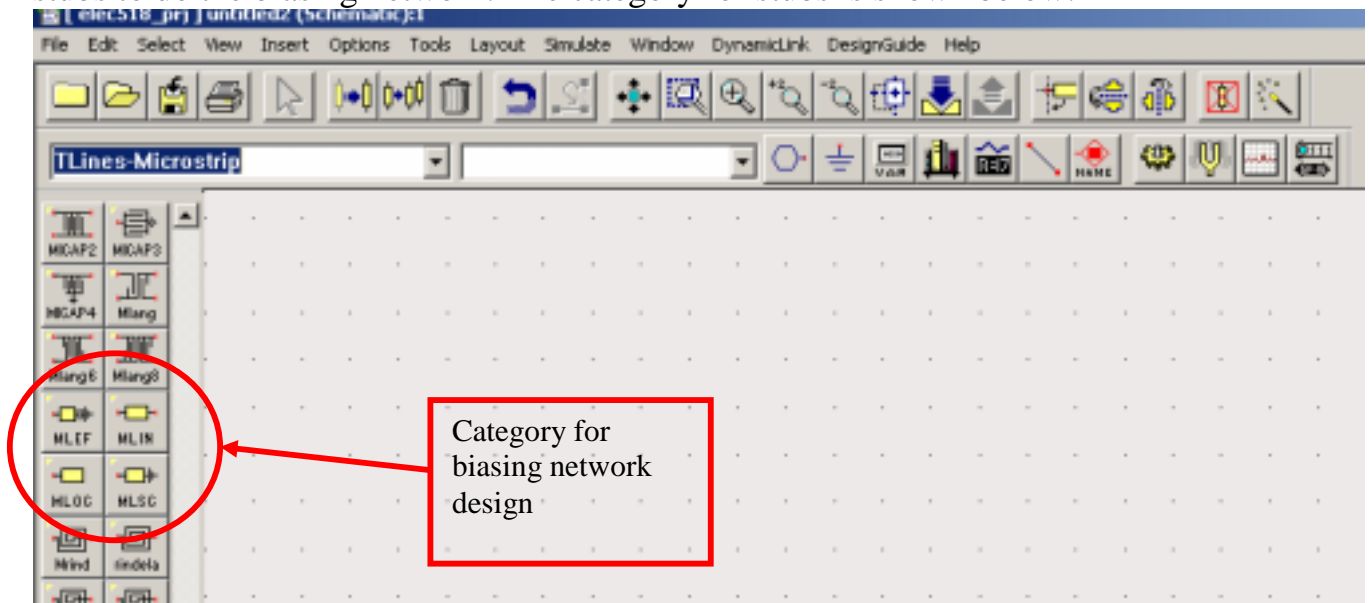
After choosing the icons we need, the final simulation result for stability simulation of the transistor is given below:



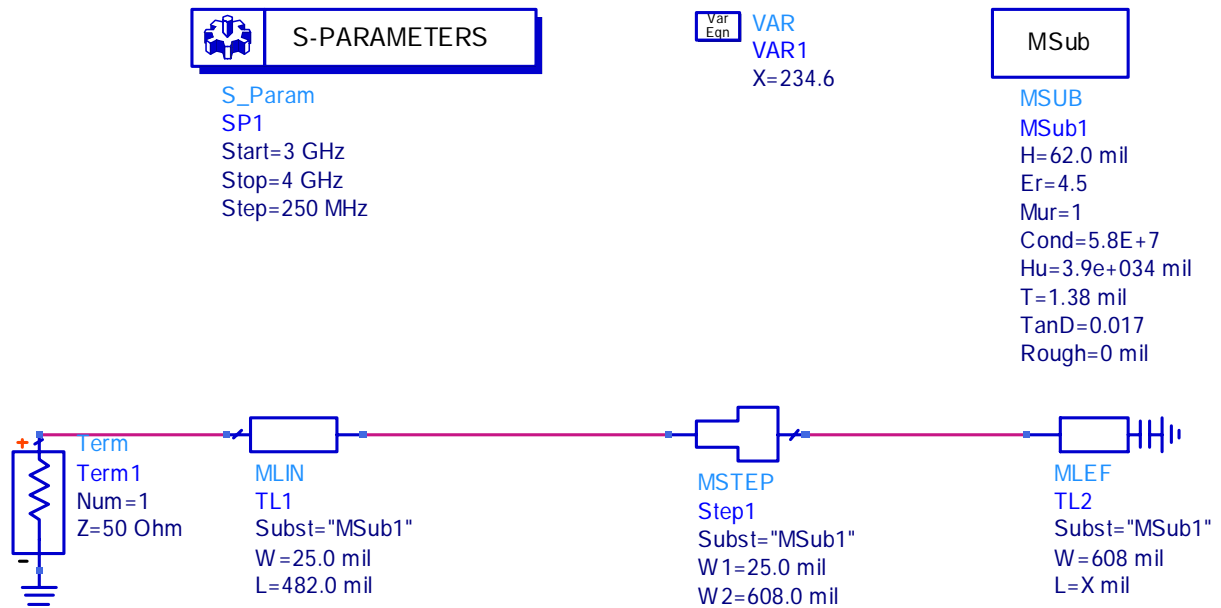
It can be seen from the figure, the transistor is stable at most of the frequency band in the simulation. But at the frequency $f > 3.75\text{GHz}$, it is not stable.

3. Biasing Network Design

To provide gate and drain bias of transistor, biasing network should be designed. We use stubs to do the biasing network. The category for stubs is shown below:

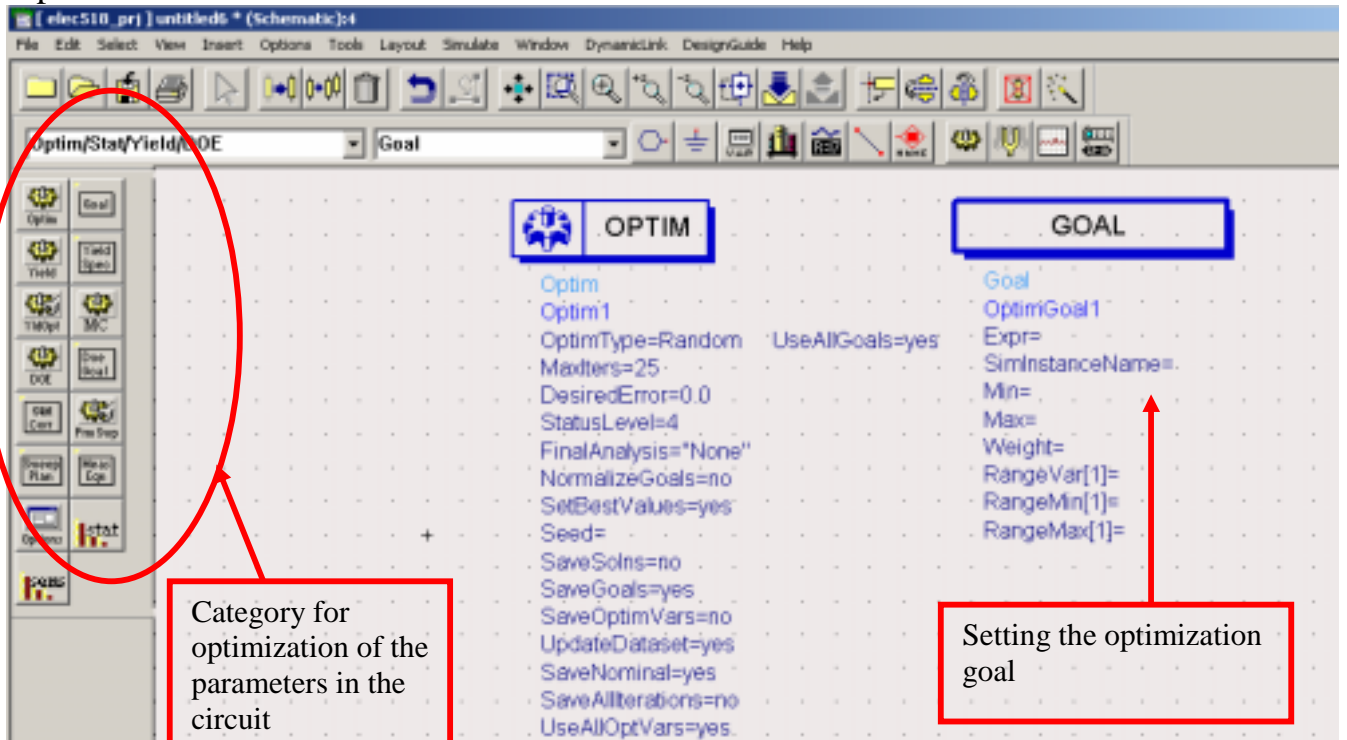


The schematic of the circuit for bias network is shown below:

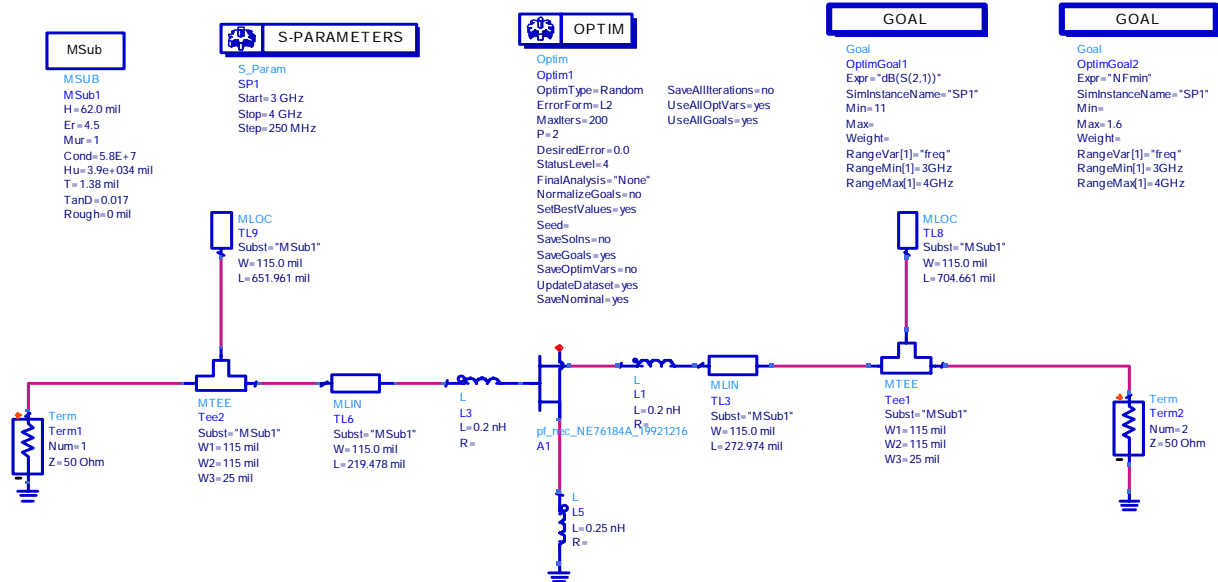


4. Input-matching and output-matching network

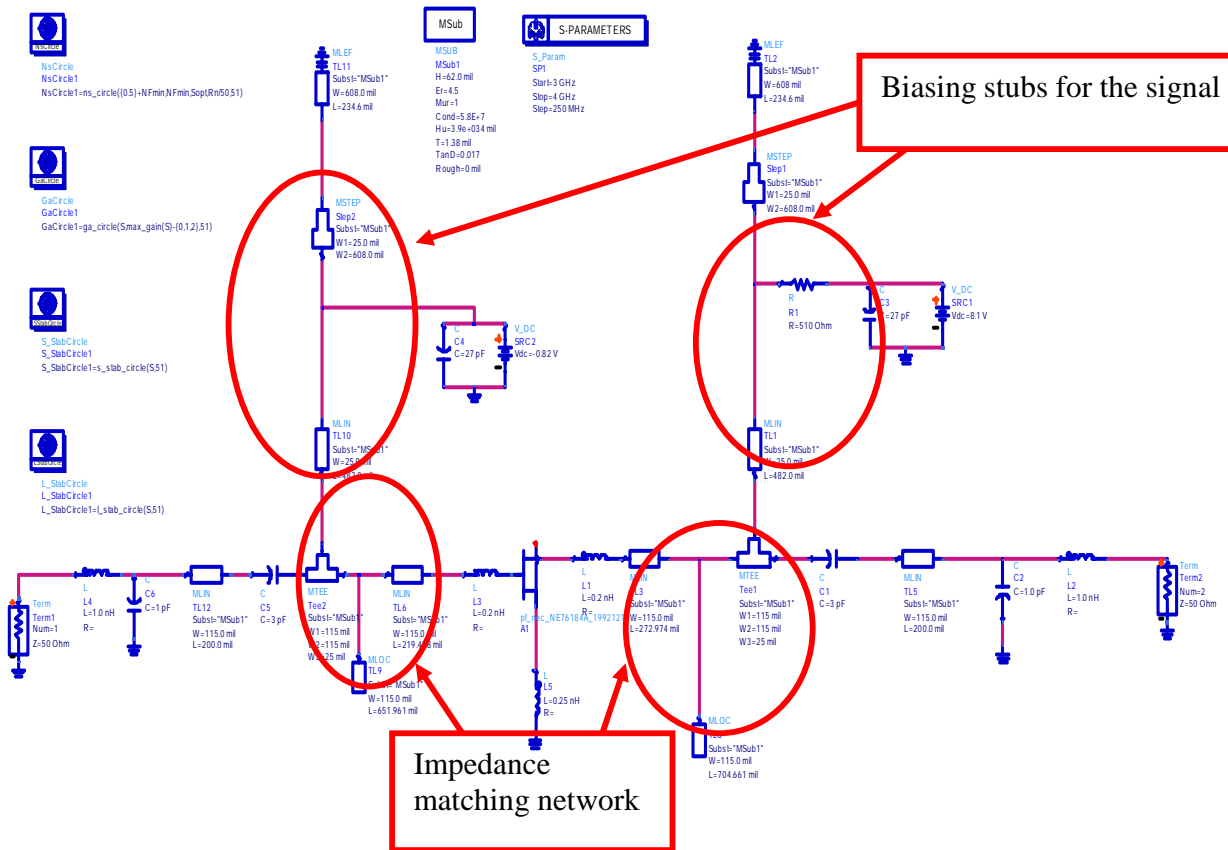
We choose open-stub to do the input and output matching. In ADS we can use the 'optimization' function to do this.



The schematic in ADS for input and output matching simulation are given below:

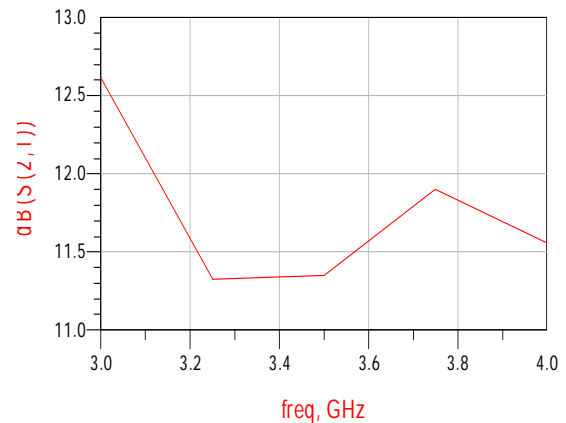
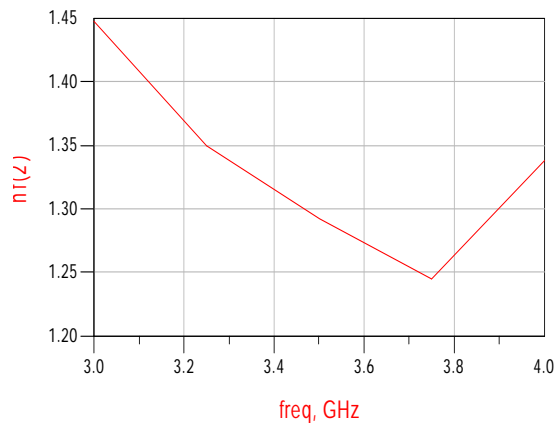


5. The whole circuit plus biasing circuits and DC block capacitance.



6. Results

The details about how to display the results can be found in our application notes for oscillator. Here we only give the final simulation results in ADS.



The noise figure of the LNA is about 1.35dB and gain of the amplifier is about 12dB. This is what we want for the power amplifier design.

Conclusion

In this note we show how to design a low noise amplifier using ADS. All the necessary steps including the matching network, bias point selection, stability simulation are given in this note. The ADS even provides the function to choose the parameters automatically for the user, provided that we give the optimization target. In a word, agilent's ADS is powerful for the circuit design at RF frequency.