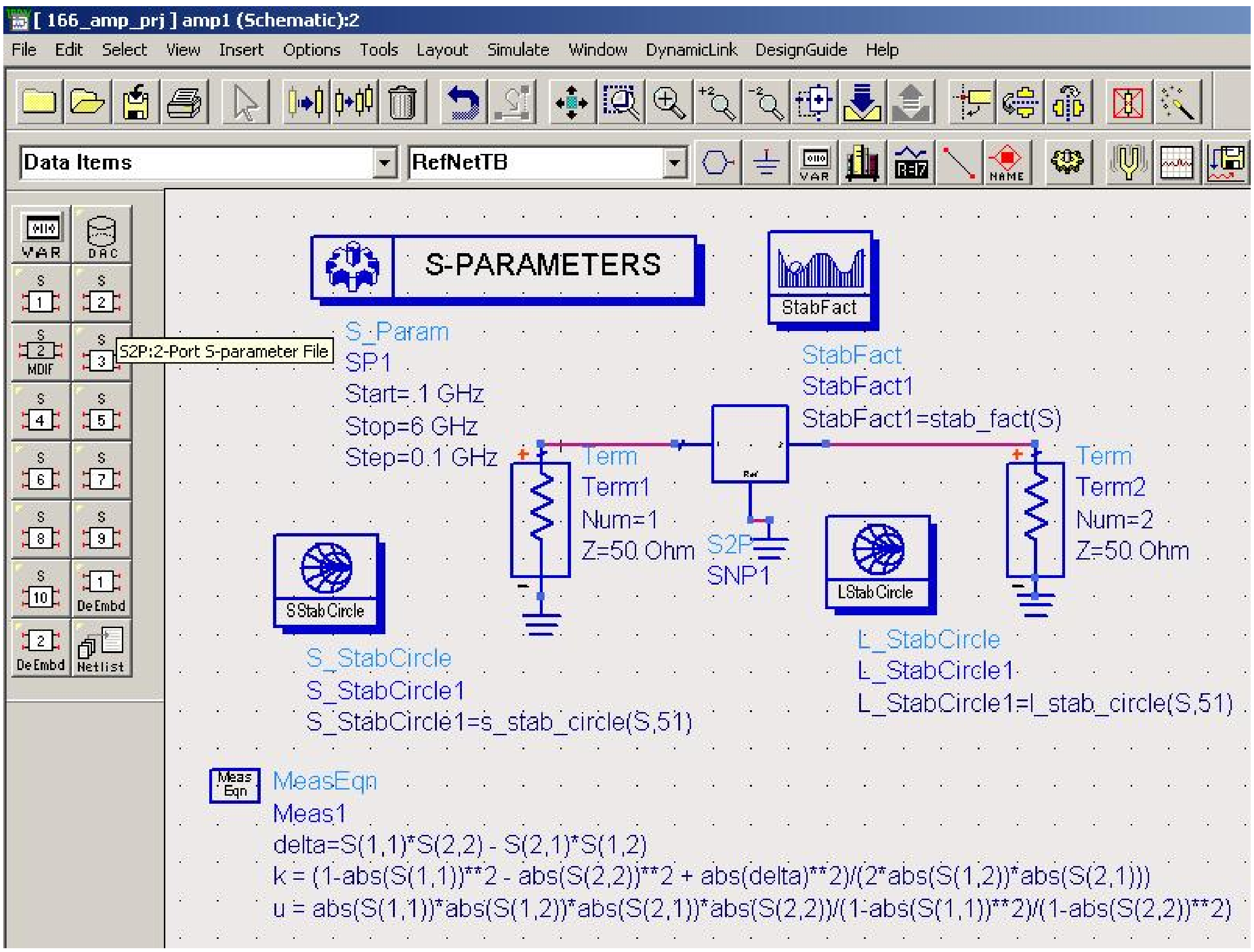
ECE 166- Microwave Circuits
ADS Commands for Amplifier Design

This document illustrates some ADS commands for measuring noise and stability. As an example, a 1.5GHz LNA has been designed using the Agilent Silicon AT-41486 transistor and the provided S-parameter files. Note that the file t414868s_n.s2p provides low-current (and low noise) S-parameters and noise measurements for the transistor, and the t414868s_25m.s2p file provides high-current S-parameters.

Figure 1 illustrates several components that will be used in the amplifier analysis.

Figure 1: Schematic for measuring transistor noise and stability parameters.



Your circuit must contain the two-port S-parameter block S2P, as shown in figure 1, which corresponds to the given .S2P file. To add the S2P component to your schematic in ADS,

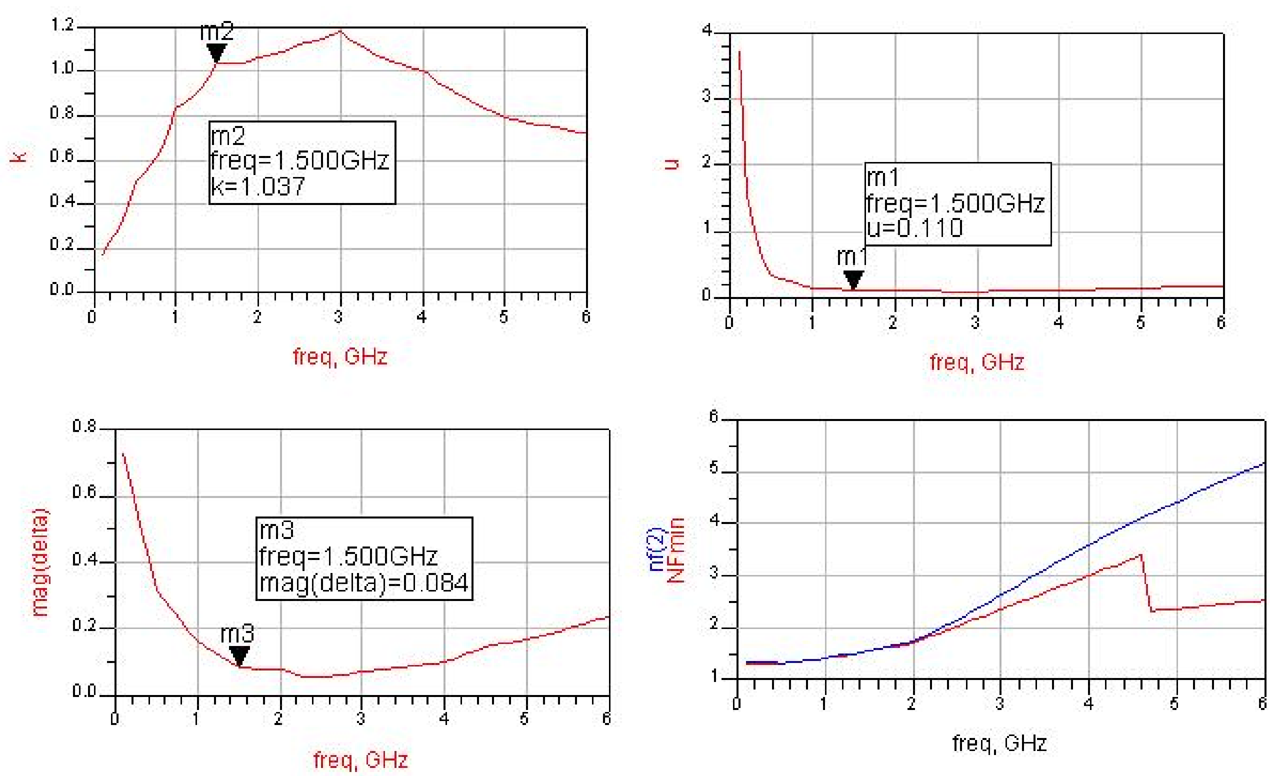
a) Select **Data Items** from the **Component Palette List**.
b) Select the button **S2P: 2-port S-parameter file** from the component palette on the left-hand-side. Place the component on the schematic.

c) After placing the component, double click on the component. A **2-Port S-parameter File** dialog box pops up.
d) Specify the corresponding S-parameter file for the file parameter in the dialog box. You can also browse and select the desired file. To browse for a file, click on the **Browse** button in the dialog box.
e) Click **Apply** then **OK** in the **2-Port S-parameter File** dialog box.

Next, set up your S-parameter simulation. To calculate noise parameters, do the following: In the S-parameters "**Edit Parameter Window**" choose the **Noise** tab. In the noise display, select "**Calculate Noise**". This allows the simulator to include noise calculations during a simulation. There are three noise figure parameters: nf(1), nf(2), and nf. **Choose nf(2) to plot the noise figure** of the circuit (this will be plotted in dB by default) as in Figure 2. Note that noise in the transistor is poorly modeled above 4 GHz.

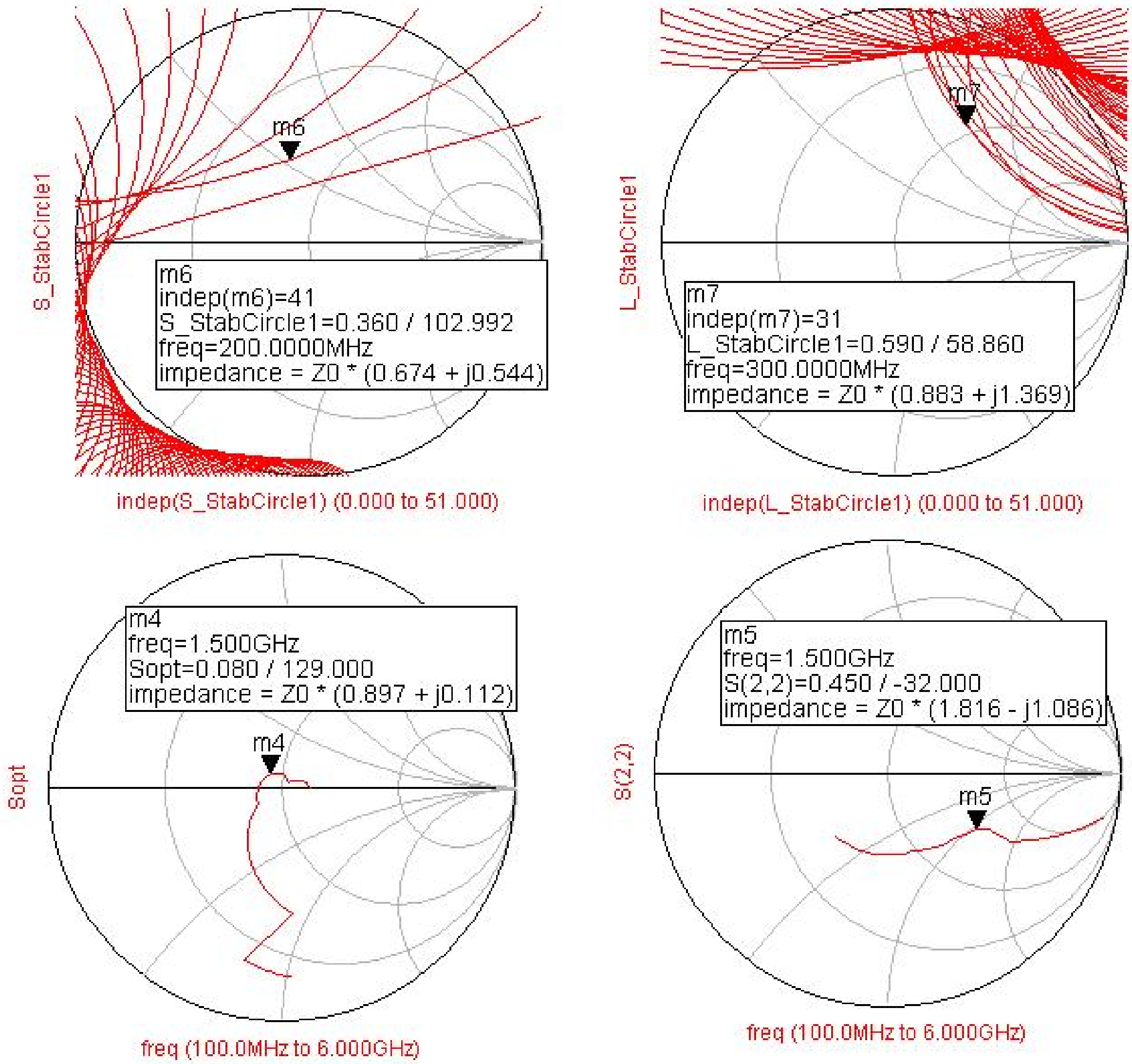
The **StabFact** element in Figure 1 calculates the **K stability factor**. The **MeasEqn** element is used to calculate any user-defined expression, and here it calculates delta, K, and u. Both the StabFact and MeasEqn components are located in **Simulation-S_param** in the **Component Palette List**. Note that the exponent operator in ADS is **, and that K can be calculated with either StabFact or MeasEqn.

Figure 2: K, u, delta, and NF plots. NF plots are in dB



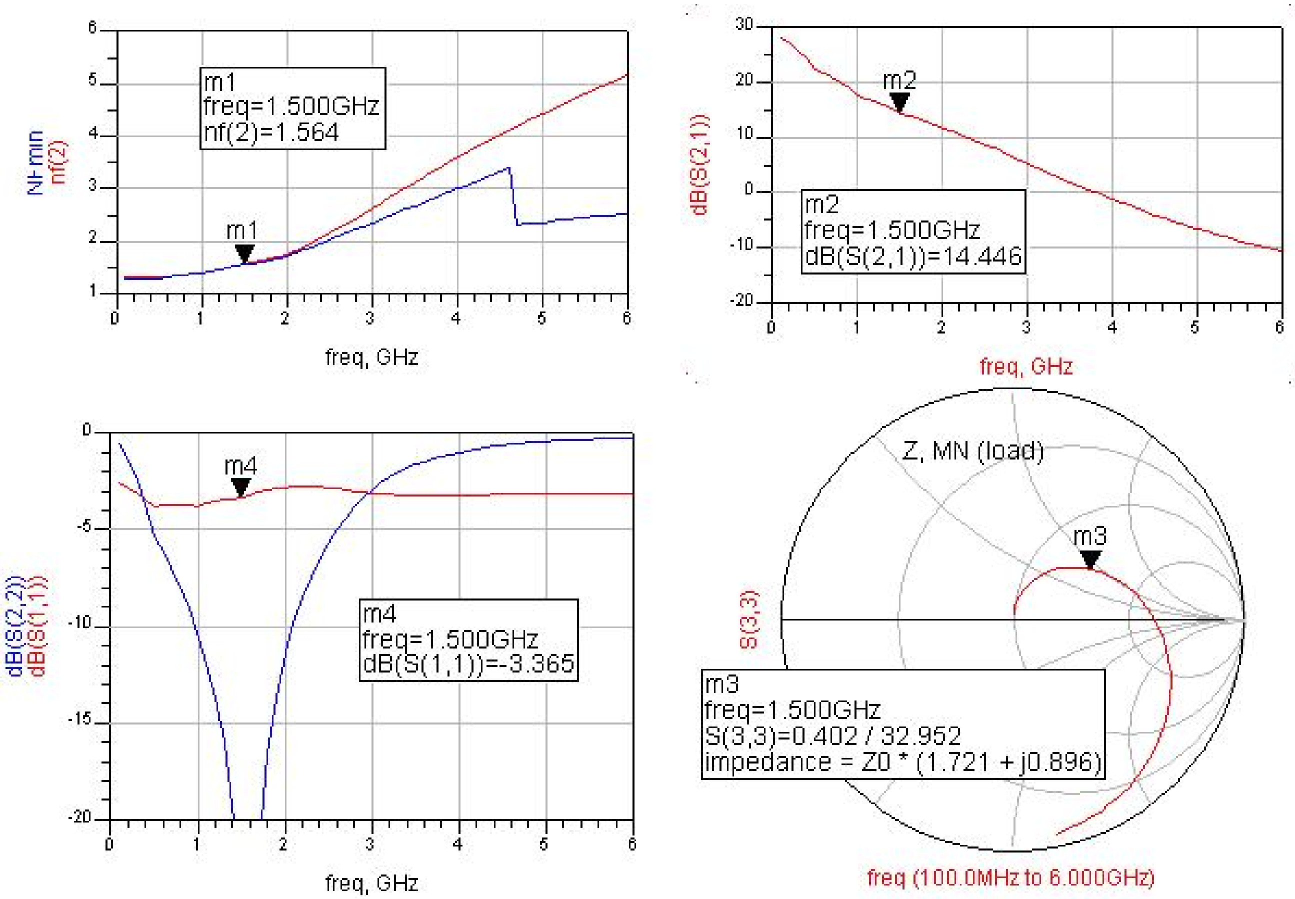
The **S_Stabcircle** and **L_Stabcircle** are also located under in Simulation-S_param, and are plotted in Fig. 3 along with S22 and the optimum source impedance Sopt. To adjust the scope of the stability circle plots, double-click the plot, select the "**Plot options**" tab, uncheck "**Autoscale**", and set the max gamma to 1.

Figure 3: Stability circles, S22, and optimum source impedance for low noise.



In this example, no matching network is needed for the source (Zsopt ~ Zo), so a load matching network MNL should be designed. The impedance of the MNL (terminated with 50 ohms) is shown in figure 4, along with the S and noise parameters of the complete LNA. *The S-parameters of the complete amplifier and the matching networks should be calculated in a different schematic from the transistor measurement schematic, because the S_Stabcircle and L_Stabcircle will only function in a two-port network.

Figure 4: 1.5GHz LNA NF, gain, matching, and MN



The source and load reflection coefficients Gamma(S) and Gamma(L) do not cross the stability circles (Gamma(S) ~ 0), so the amplifier is stable.

Note: Text regarding .S2P adapted from Bradley University Tutorials: http://cegt201.bradley.edu/tutorial/