# EE160 LAB2: BJT Bias. Stability Analysis.

Spring 2009


## Summary

The purpose of this lab is to apply the basic concepts and techniques of microwave amplifier design with S-parameters using ADS. DC characteristics and S-parameters of a microwave BJT are analyzed. Stabilizing circuit is designed to achieve unconditionally stable 2-port network.


# 1 BJT bias circuit

## 1.1 Curve Tracing. Choosing Q-point.

When creating a new design choose the BJT_curve_tracer template. In the component library::RF transistor library::Packaged BJT choose pb_hp_AT41435 transistor and position it in the proper place in the schematics.

In the "Parameter Sweep" properties choose the range for the base current: from 0 to 50uA with step of 2uA. The collector  emitter voltage range should be set to 0 to 15V in the . Run Simulation. In the resulting Data display window place a marker in the Q-point: Vce=8V, Ic=10mA.

## 1.2 Bias circuit calculation

Pick one of the passive DC bias networks studied in class. Calculate the values of the resistors. Place DC voltage supply and Current probe into the schematics. Verify the value of the collector current. An example of the dc bias network with the negative voltage feedback is shown in the Figure 1.

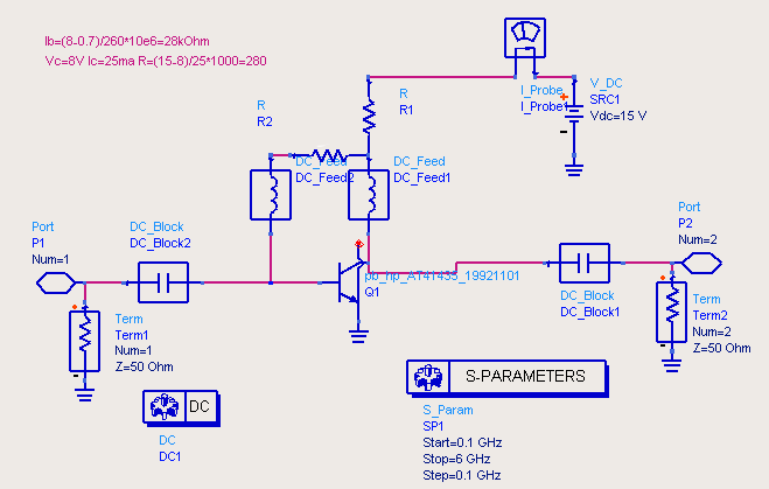


Figure 1: Bias network .

# 2 Stability Analysis

Most of the components for this section can be found in the Simulation: S-parameters palette. The definition of the S-parameter simulation functions (each icon in the palette invokes one of the functions during simulation) can be found on the Agilent web site, (S-parameter simulation section): http://eesof.tm.agilent.com/docs/adsdoc2005A/manuals/pdf.html

From the "Component library :: S-parameter library" select BJT device sp_hp_AT41435_2_19921201 with Vce = 8V and Ic = 10mA (this set of S-parameters contains noise specifications as well). This is parametrized device. S-parameters for a range of frequencies are provided by the manufacturer and usually contained in a text file.

Compose schematic for S-parameter measurement of the BJT, see Figure 2. Place an icon for s-parameter simulation in the schematic window. Modify the frequency range to span from 0.1GHz to 6GHz. Run simulation and plot S-parameters on Smith chart (S11, S22) and Polar plot (S12, S21) in the Display window.

Place icons for Mu-factor, K (Rollett stability factor), B (stability measure), load and source stability Circles from the S-parameter simulation palette. Run simulation. In the Display window plot stability factors and stability circles. An example of the Display window is shown in Figure 3. You can use multiple pages of the Display Window.

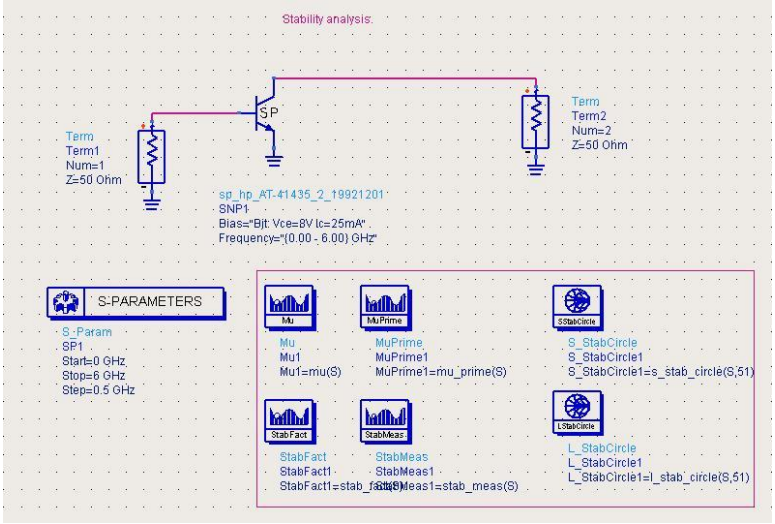


Figure 2: Schematic window for S-parameter measurements and stability analysis.

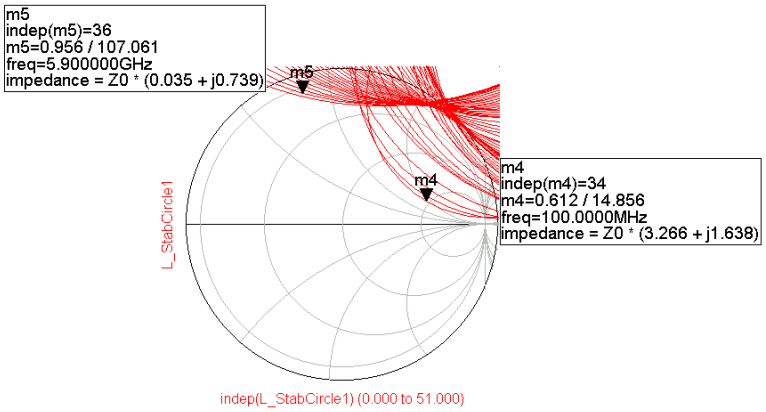


Figure 3: Stability analysis. Output stability circles.

# 3 Stabilizing transistor.

Place stabilizing resistor either in the input or the output. Try to stabilize the transistor ($\mu > 1$) across all frequencies while maximizing the S21 parameter at 2 GHz. You can experiment with L and C components in the stabilizing circuit. Use tuner and/or optimization. Specify frequencies and loads for which transistor is not stable.