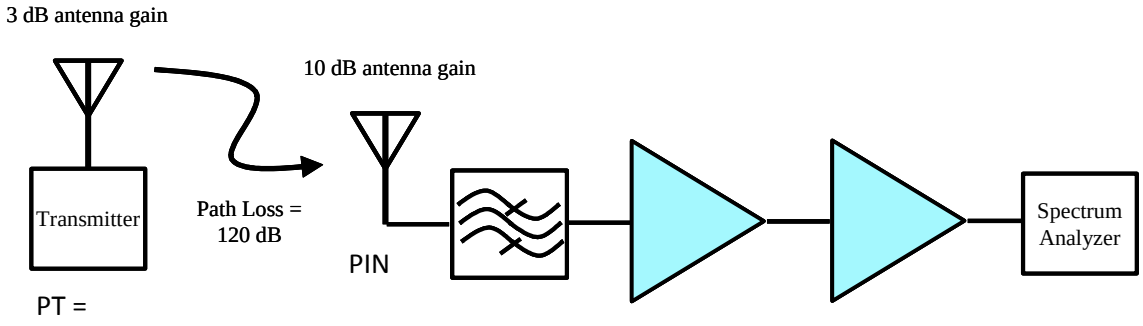
ECE145B/ECE218B Homework #1 Winter 2011

Due 1/14/2011 at homework box, 3rd floor

1. Noise and distortion analysis. The diagram below shows a transmitter and receiver link. The spectrum analyzer is being used as the detector/power meter.



Gain	-3dB	20dB	10dB	0 dB
NF		1dB	6dB	20dB
IIP3		0dBm	+10dBm	+20dBm
BW	1MHz	10MHz	10 MHz	10 kHz

6. a. Calculate the minimum transmitter power output PT that will produce a 10 dB S/N ratio at the spectrum analyzer display.
b. You are testing the link by transmitting two signals at frequencies f1 and f2, both within the bandwidth of the preselector bandpass filter. Calculate the transmitter power (equal powers at each frequency) that will produce a 3rd order IMD output just equal to the minimum detectable signal power at the spectrum analyzer.
2. (refer to the ADS Tutorial on Stability and Gain Circles and the ADS Noise Figure Analysis Tutorial on the course web page. Example ADS files are also available there.) Use the NE85639 S parameter model in the ADS components library - biased at 2.5V and 3mA - for this exercise.
a. Use ADS to determine stability using the stability factor k and delta = det(S) from 50MHz to 5 GHz. Plot the source and load stability circles at 400 MHz on separate Smith chart displays. Identify clearly on the plots which region is stable and which is unstable.
b. Show how to make the transistor unconditionally stable at 400 MHz on the load side by adding a stabilizing resistor. Explain how you predict the resistor value from a. and show that it produces an unconditionally stable device.
c. Using the load side stabilization from part b, plot available gain circles for this device on the Γ_S plane. Also, plot noise figure circles on the same display. Determine suitable Γ_S and Γ_L to achieve at least 12 dB of gain at 400 MHz with noise figure less than 2 dB.
d. Design lumped element or distributed matching networks which will provide the selected Γ_S and Γ_L. Simulate the complete amplifier gain and stability at 400 MHz to verify your design.
e. Modify the matching network design adding low frequency resistive loading so that the amplifier will also be unconditionally stable from 50 to 500 MHz. Verify that the gain and noise figure at 400 MHz still meet specifications and that the amplifier will also be stable up to 5 GHz.