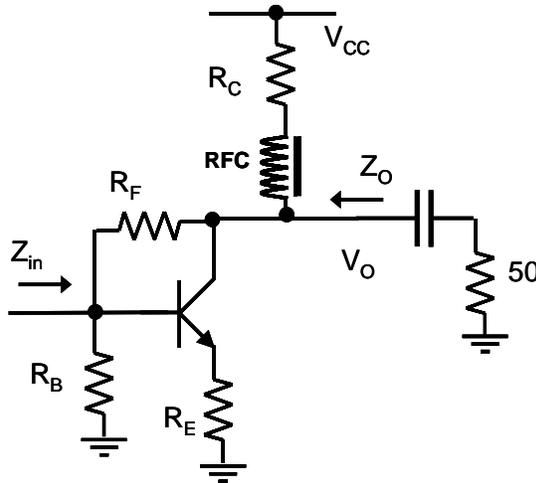


REFs: Class Notes Set #6 (xanadu.ece.ucsb.edu/~long); Stanford Chap. 2 (eres); HB tutorial.

1. Design a dual feedback amplifier as shown in the schematic below. You should use a combination of shunt and series feedback as illustrated in Chapter 2 of the Stanford notes, “Series-Shunt Feedback Amplifier Design”. Sections 2-1 through 2-6 are directly relevant to this design¹.



Design for a power gain of 6 dB and $Z_{in} = Z_o = 50$ ohms when the source and load terminations are 50Ω . Note that your biasing circuit may require splitting up R_F into 2 parts such as is shown in Fig. 2.8 of Ref. 1. Assume that the RFC impedance is high compared with R_C .

2. Design a suitable bias circuit to produce: $I_C = 7$ mA, $V_{CE} = 10$ V, and assume $\beta_o = 80$. You have a 15V power supply available.

3. Simulate your amplifier in ADS using the NEC 85639. There are two models for this device in the ADS component library.

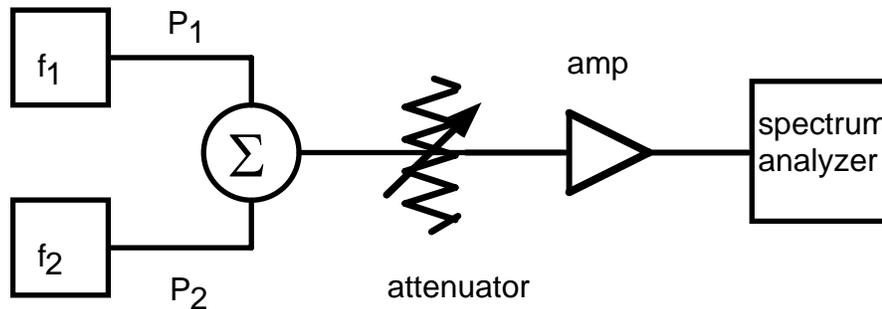
Model type	Library	Sub-Library	Model name
S-parameter	S Parameter Lib.	NEC	sp_nec_NE85639_4_19940401
Nonlinear	RF Transistor Lib.	Packaged BJTs	NE85639_19960601

a. Use the nonlinear model and DC analysis to verify the bias conditions.

¹ H. Swain, “Series-Shunt Feedback Amplifier Design,” EE344 High Frequency Laboratory, Stanford Univ., 1995. Can be found at ERES website.

- b. The RFC inductance is 7 μ h. Use the S-parameter simulation mode with the S parameter model to determine transducer power gain, Z_{in} , and Z_{out} vs frequency. Determine the 3 dB bandwidth.
- c. Determine the 1dB gain compression input power (P_{1dB}) at 400 MHz using the ADS Harmonic Balance simulation mode with the nonlinear model. See the Harmonic Balance Tutorial on the course web page. There are also sample ADS files that demonstrate the use of this mode².
- d. Calculate the slopes of the fundamental and IMD3 distortion power at 400 MHz and compare with theory. Calculate an input third-order intercept if possible (IIP3). Simulate using a P_nTone source with frequency spacing of 1 MHz.

2. The amplifier below is being tested for intermodulation distortion. The measurement data is in the table below.



$f_1 = 100$ MHz; $f_2 = 101$ MHz; $P_1 = P_2 = 5$ dBm

- a. At what frequencies will the third order IMD components be generated?
- b. At what frequencies will the second order IMD components be generated?
- c. Assuming typical losses in the splitter, determine the amplifier gain.
- d. Determine the input intercept points for second and third order IMD.

IIP2 = dBm

IIP3 = dBm

Attenuator dB	Pout @ fundamental	Pout @ second order	Pout @ third order
50	-28		
40	-18	-90	
36	-14	-82	
33	-11	-76	
30	-8	-70	-88
27	-5	-64	-79
24	-2	-58	-70

² HBtutorial.zip. Note that Internet explorer tries to call this a .zip file. You need to change the extension to .zap after downloading it.