

Laboratory #12: RF Amplifier Design – Input/Output matching

I. OBJECTIVES

Design, simulate, and test a matched input and output biased RF transistor for use as an amplifier with proper isolation of the DC and RF signal paths. Determine the S -parameters and compare to the simulations.

II. INTRODUCTION

Impedance matching can readily be performed between $50\ \Omega$ generators or loads and arbitrary complex impedances. Impedance matching to the input or output (base and collector) of an RF transistor is no different. Given certain bias conditions, the S -parameters for the transistor are specified in the data sheets. Therefore, the standard impedance matching techniques using conjugate matching for maximum power transfer can be used.

Using Berner Smith Chart and Ansoft Designer SV, input and output matching networks can be designed.

A straightforward way to achieve matching with lumped parameters is the circuit shown in Figure 1

The capacitors CB1 and CB2 are RF shorting capacitors with values in the order of $1\ \mu\text{F}$.

The resistors R1 and R2 form the fixed bias configuration for the MRF581A RF transistor. C1 and C2 are DC blocking capacitors of $1\ \mu\text{F}$ which should not significantly affect the input and output characteristics of the amplifier. C3 is a DC bypass capacitor for noise reduction and is typically in the order of $0.1\text{-}1\ \mu\text{F}$.

By biasing the MRF581A according to the measured specifications sheet's S -parameter DC conditions, appropriate amplifier S -parameters can be achieved. For the MRF581A, the S -parameters over frequency are specified at $V_{CE} = 10\text{V}$ and $I_C = 50\ \text{mA}$ bias.

The amplifier circuit will be constructed on SurfBoards®. Use lumped parameter resistors, inductors, and capacitors.

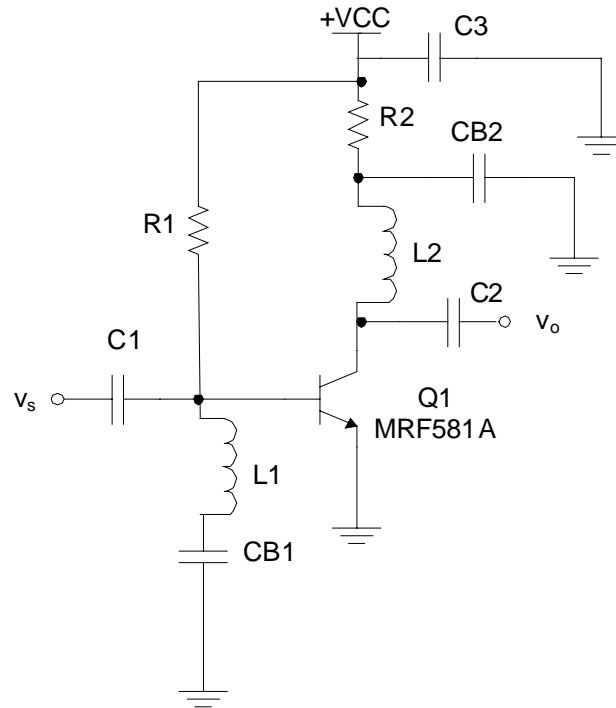


Figure 1. RF BJT Amplifier Biased with Matched Input and Output

III. PROCEDURE

- A. *Bias the RF Transistor*
 - Bias the MRF581A RF Transistor to $I_C = 50$ mA with $V_{CE} = 10$ V according the DC conditions for the measured S-parameters. The Operational Frequency is 500 MHz. Assume the transistor $\beta_F = 180$ (or as measured).
- B. *Confirm the Bias Conditions*
- C. *Design the Input and Output Matching Networks Using Lumped Parameters*
- D. *Measure the S-Parameters of the MRF581A BJT Amplifier*
- E. *Comment on your results.*