EEL 6936; RF & MICROWAVE CIRCUITS II

CAD EXERCISE #4 (Due 3/19/03)

ANALYSIS OF ACTIVE TWO-PORT NETWORK

The purpose of this exercise is to provide an opportunity to become familiar with the simulation and analysis of an active two-port network. S-parameter data for a Motorola bipolar microwave transistor will be used. Familiarity with the material in Prof. Weller's WAMI application notes "*ADS Basics*" and "*Creating A Circuit Element Using Measured Data In ADS*" is a prerequisite. The files are on the course web page: p01-010904.pdf, p03-000730.pdf.

PART 1. Simulation Procedure For Device Characterization.

1. Construct a schematic for the file mrf901.s2p which is on the web page. See Figure 1.

2. Evaluate the device stability and plot K, B1, GMAX, S_{11}, S_{21}, S_{12} and S_{22} to obtain the results shown in Figure 2, Figure 3, Figure 4 and Figure 5. Notice that the device is unconditionally stable over only a limited bandwidth.

PART 2. Simulation Procedure For Design Determination.

1. Change the schematic frequency specification to "0.5 GHz" to evaluate performance when the device is potentially unstable. Assemble a Smith plot showing the input stability circle, the image of the source termination as seen looking at Γ_{out}, and the available gain circles for several values of gain. Your plot should look like Figure #6. Assemble a Smith plot showing the output stability circle, the image of the load termination as seen looking at Γ_{in}, and the operating gain circles for several values of gain. Your plot should look like Figure #7.
2. Change the schematic frequency specification to "1.0 GHz" to evaluate performance when the device is unconditionally stable. Follow the same procedure as in item 1. above to produce two more Smith plots. Include the simultaneous conjugate match reflection coefficients, Γ_S and Γ_L. Your plots should look like Figure #8 and Figure #9.

PART 3. Write-up.

Submit printed copies of your schematics and simulation results. Your name should be included on each page.

Note:
At the last major revision of this CAD exercise, ADS contained an error that was compensated by reversing the use of functions map1cir and map2cir. The current version has corrected the problem and thus the definitions must be reversed from what is shown in the figures.

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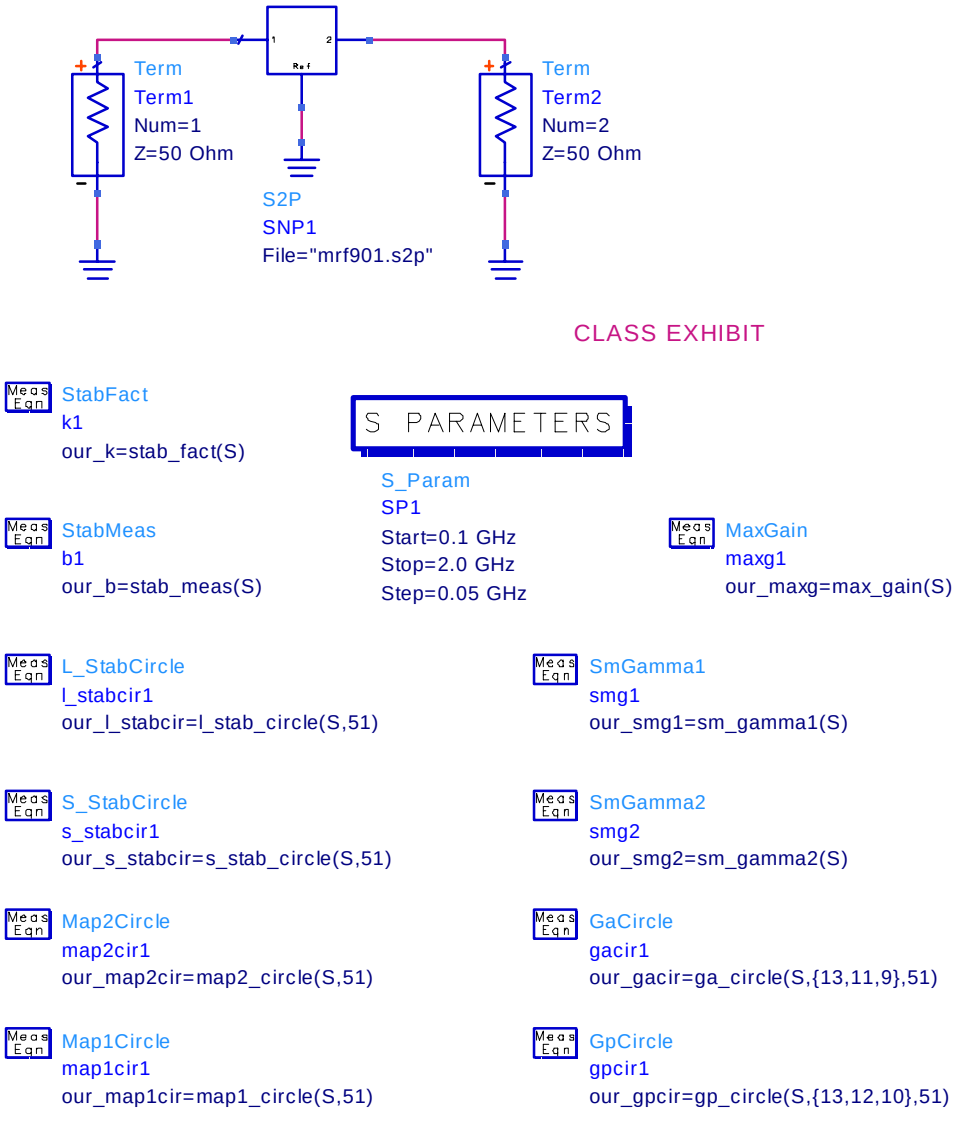

Figure 1. Schematic Diagram For MRF901 Device Evaluation.

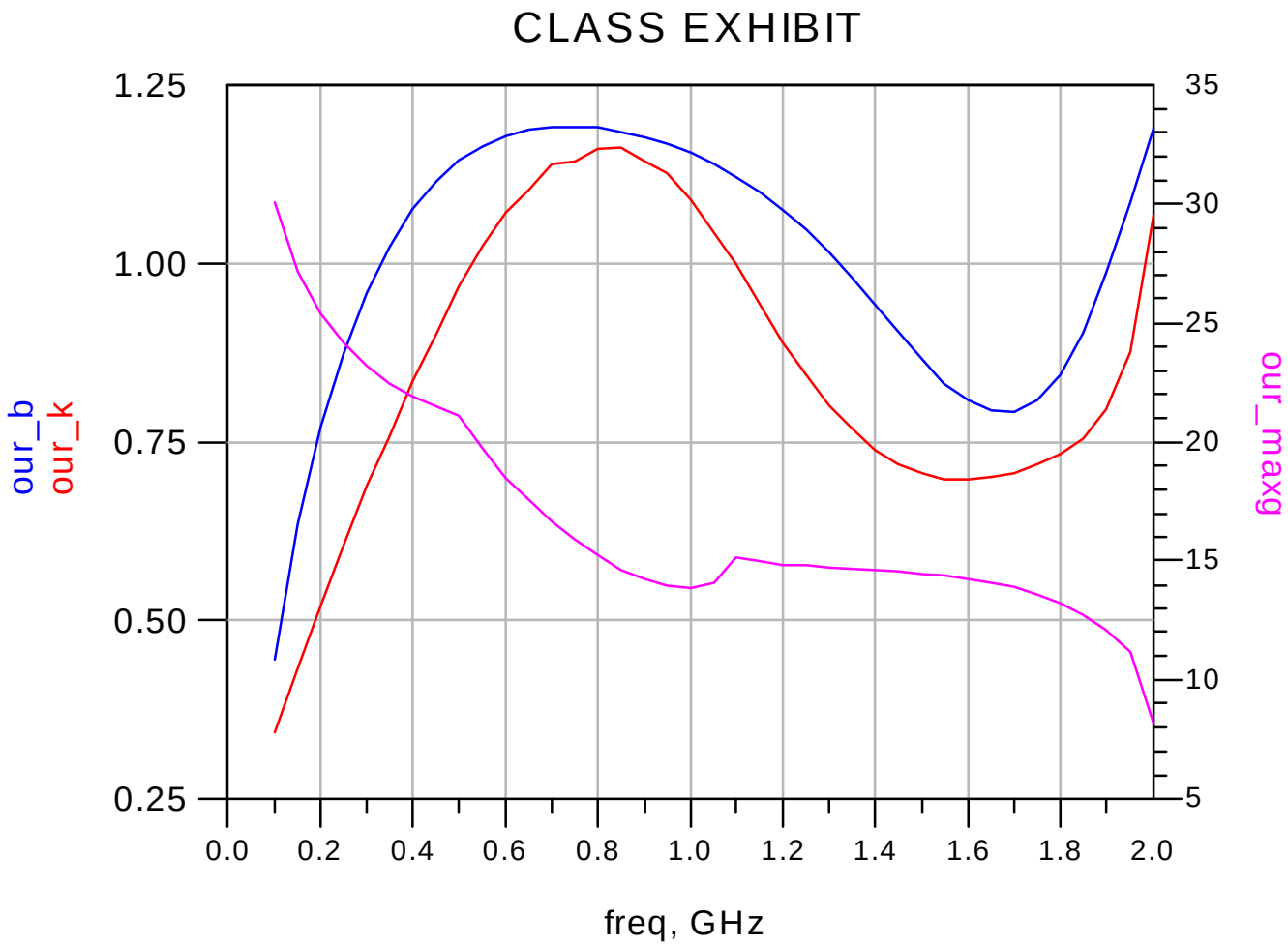

Figure 2. Frequency Response For K, B1 And GMAX. (GMAX reports the maximum gain for stable frequencies and reports MSG for potentially unstable frequencies.)

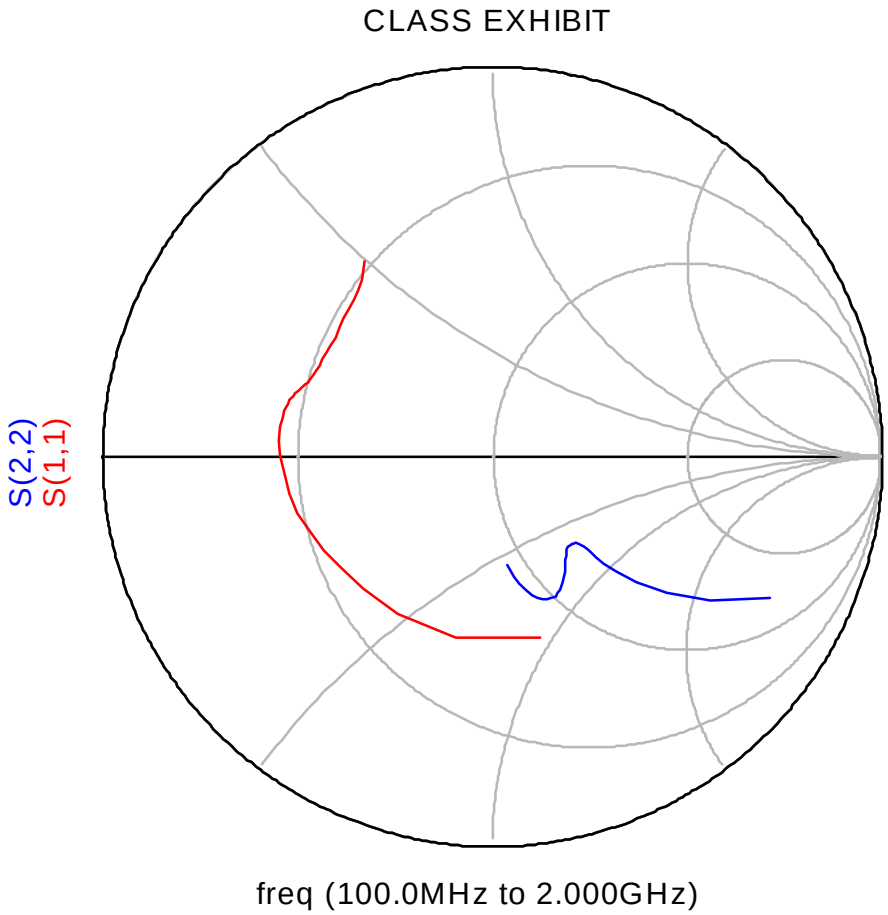

Figure 3. Frequency Response For S_{11} And S_{22}.

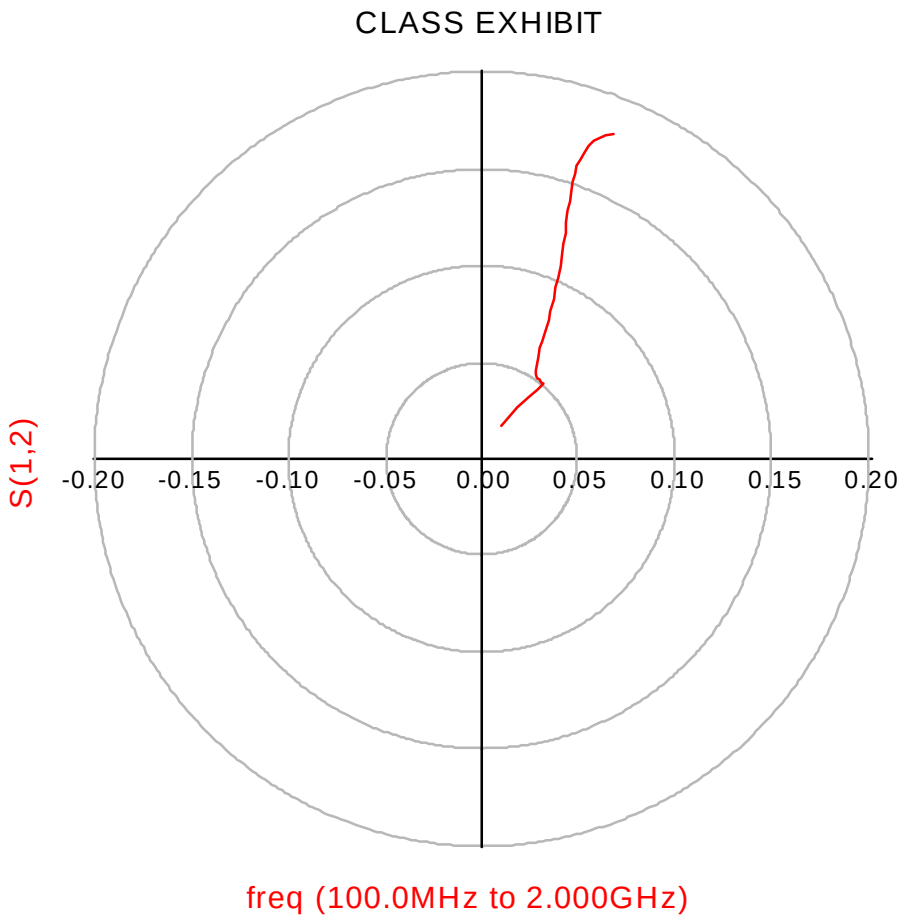

Figure 4. Frequency Response For S_{12}.

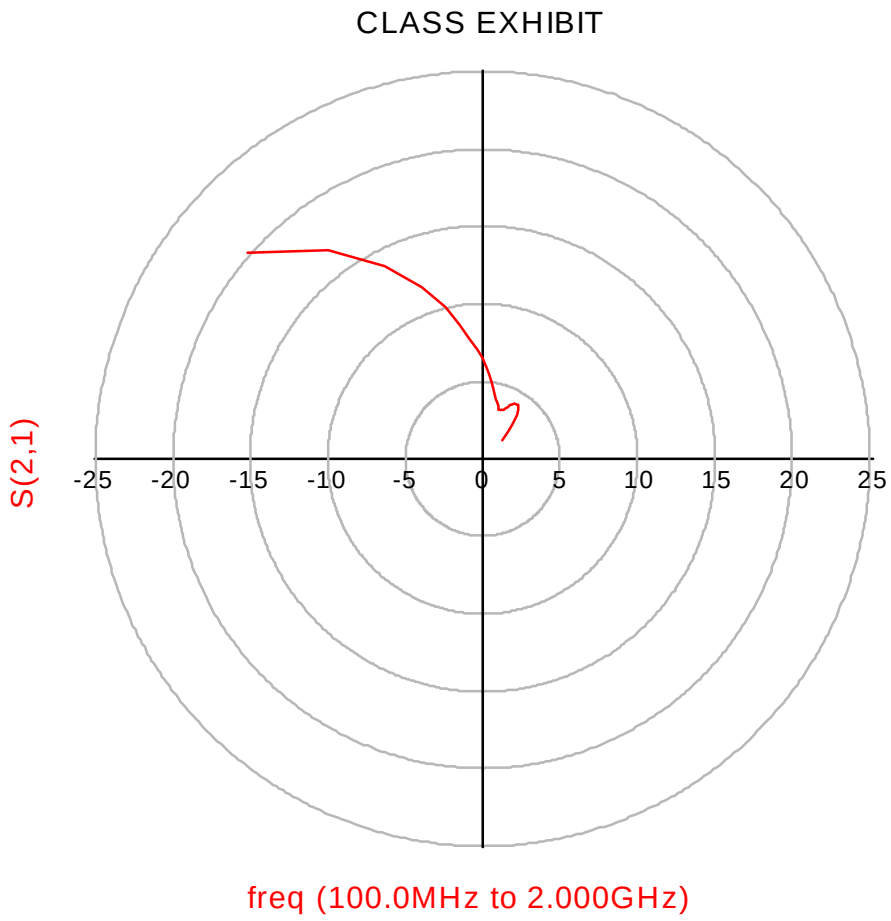

Figure 5. Frequency Response For S_{21}.

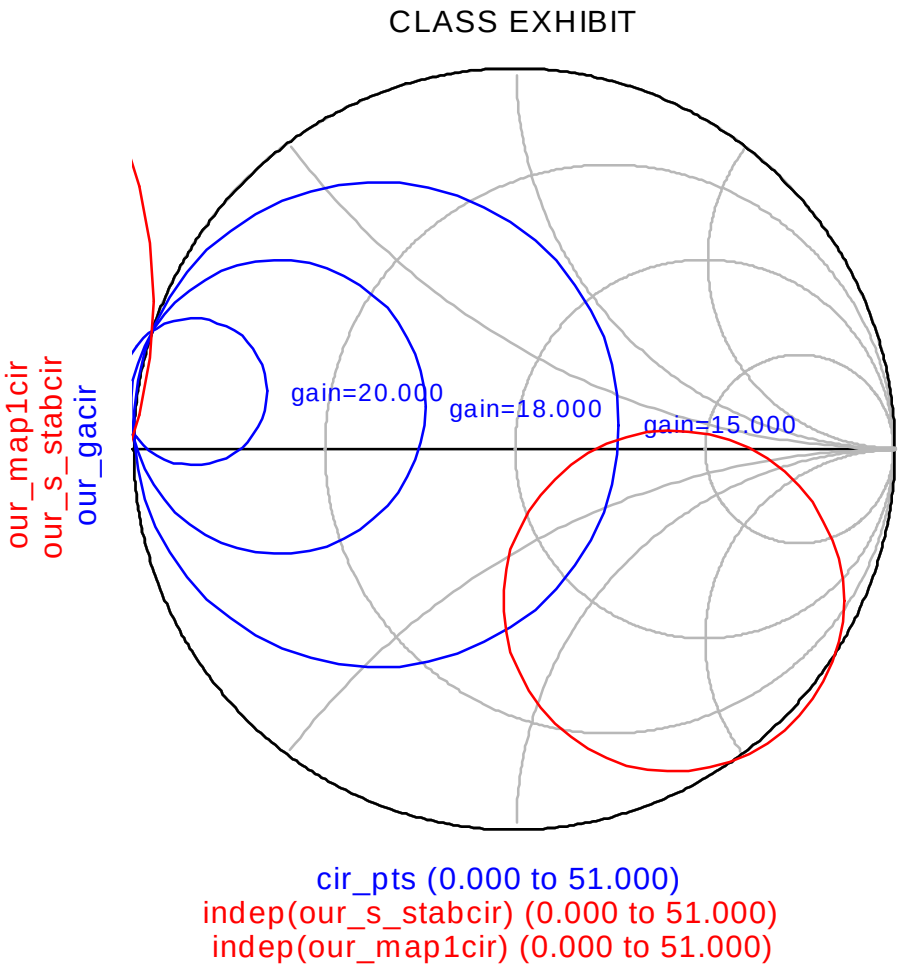

Figure 6. Input Stability, Available Gain And Source Mapping.

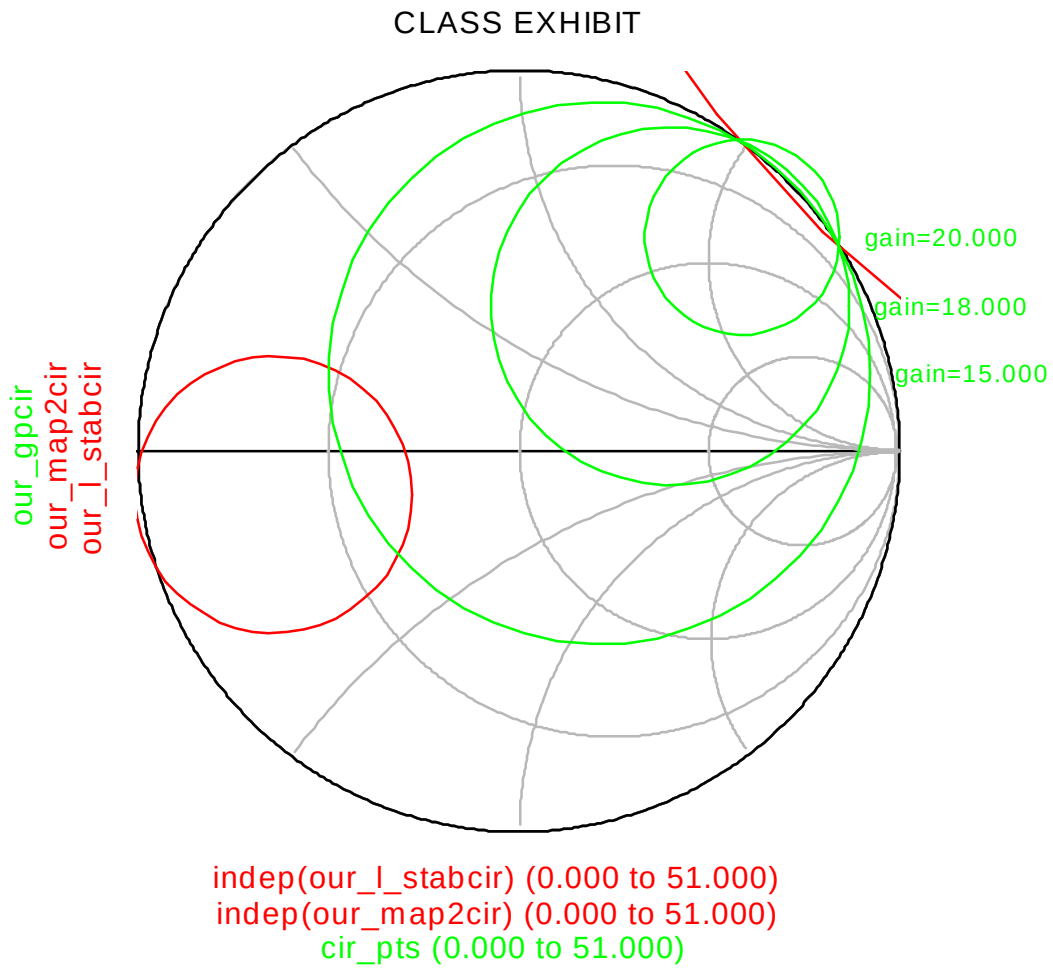

Figure 7. Output Stability, Operating Gain And Load Mapping.

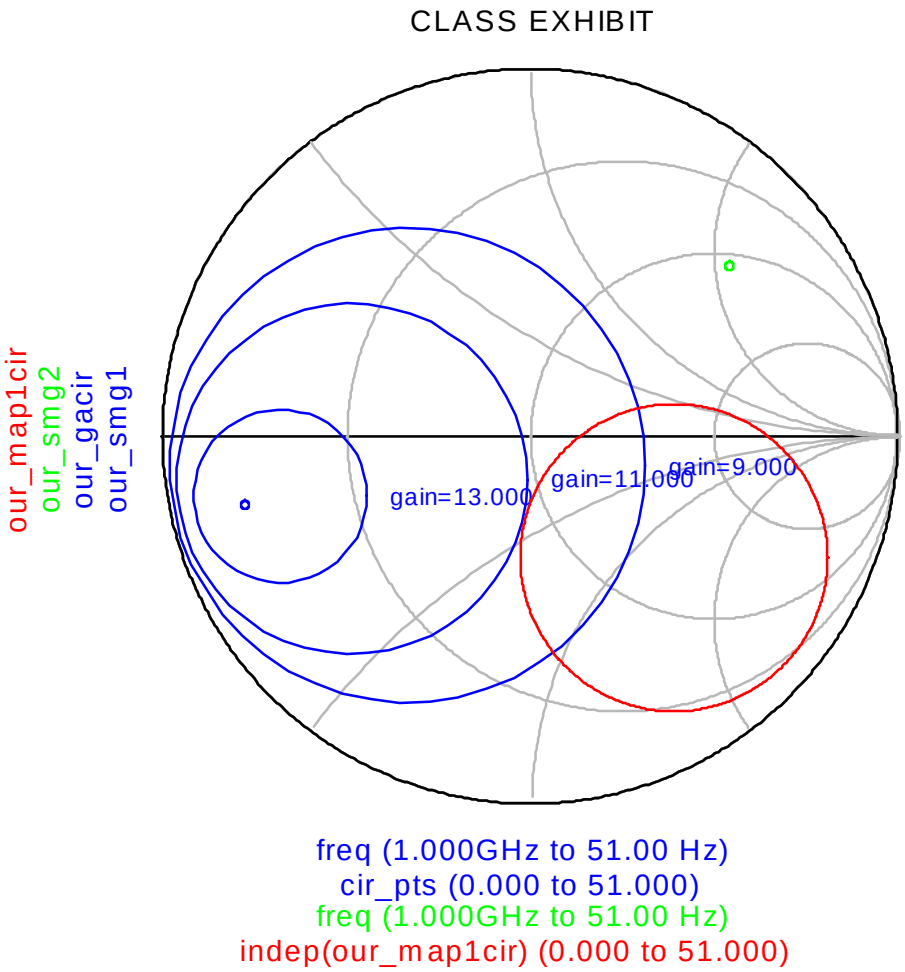

Figure 8. Conjugate Match, Available Gain And Source Mapping.

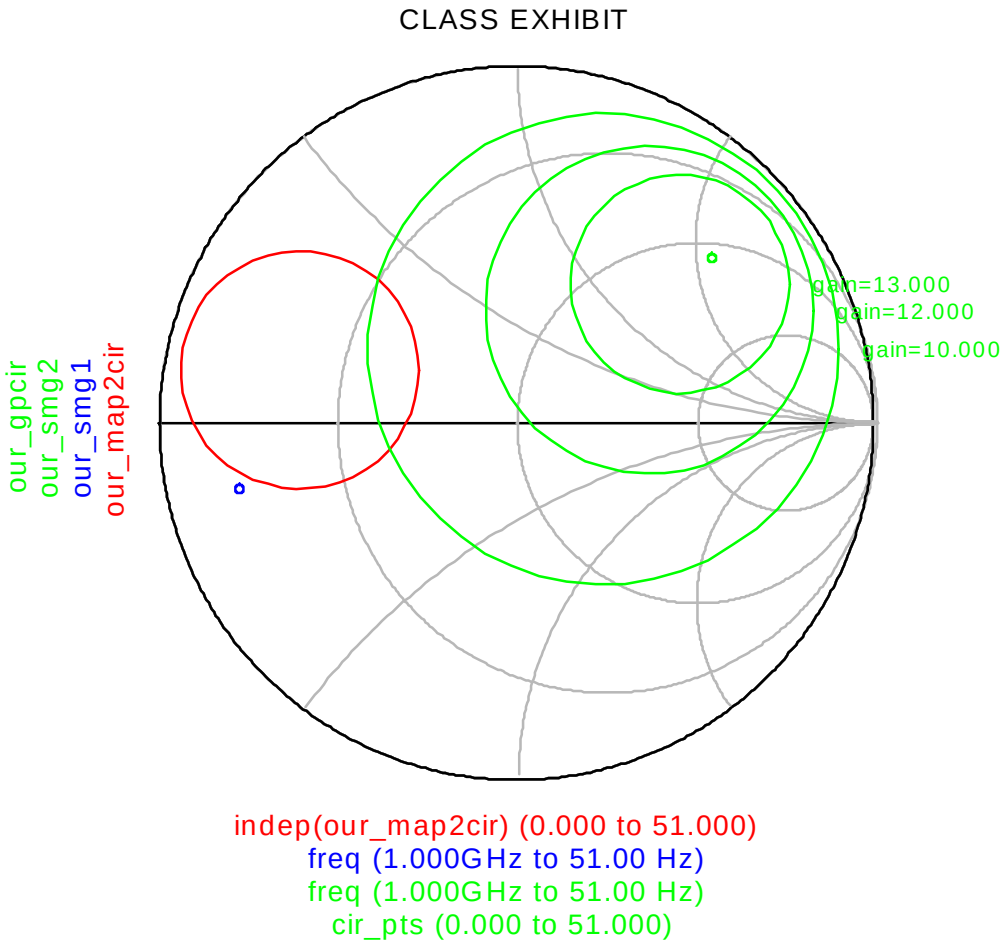

Figure 9. Conjugate Match, Operating Gain And Load Mapping.