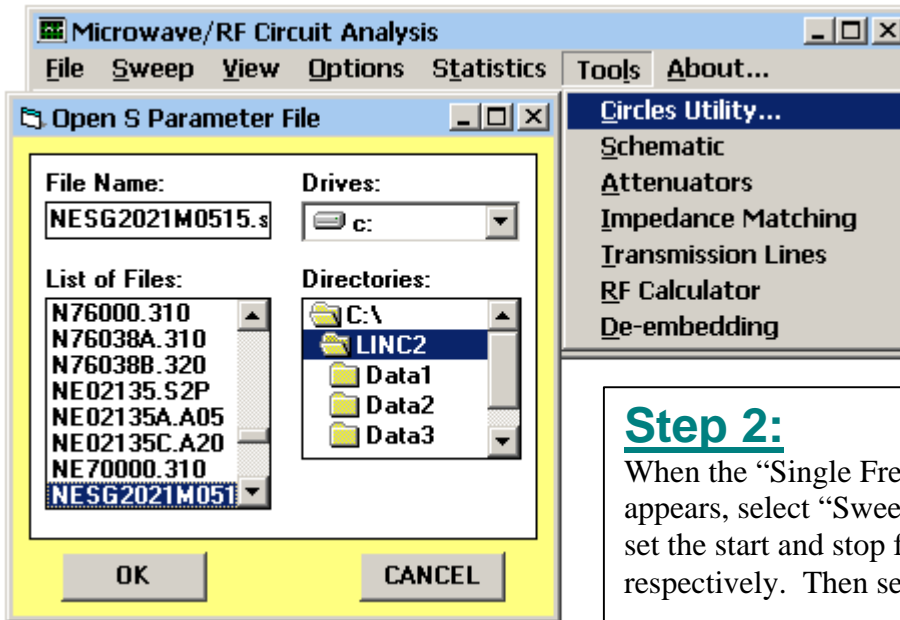


LNA Design for Min Noise and Improved Input Match

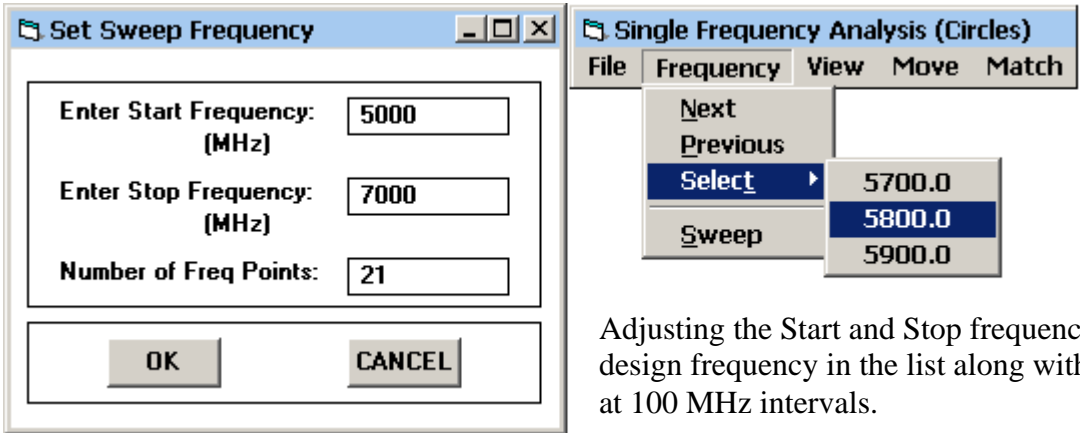
This procedure will show how to design a low noise amplifier (LNA), for minimum noise figure, while at the same time applying the best (return loss) match to both ports. When the input matching circuit, M1, transforms the system impedance to Γ_{opt} (for minimum noise), the input RL (return loss) becomes a function of the load reflection coefficient (Γ_L). If the output matching circuit, M2, terminates the device with a conjugate match ($\Gamma_L = \Gamma_{out}^*$) then a certain input RL will result. However, the output can be mismatched in such a way as to improve the input RL without changing the input circuit (keeping the source impedance set for minimum noise figure).

The LINC2 Circles Utility will be used to find a tradeoff between input and output RL so that both will be equally optimum. The input match (transformed source impedance) will remain at the minimum noise figure ($F_{min}=1.33$ dB) and will not be changed in the process.



Step 1:
Launch the Circles Utility from the “Tools” menu and select the two-port S Parameter file for the transistor. For this example, use NESG2021M0515.S2P.

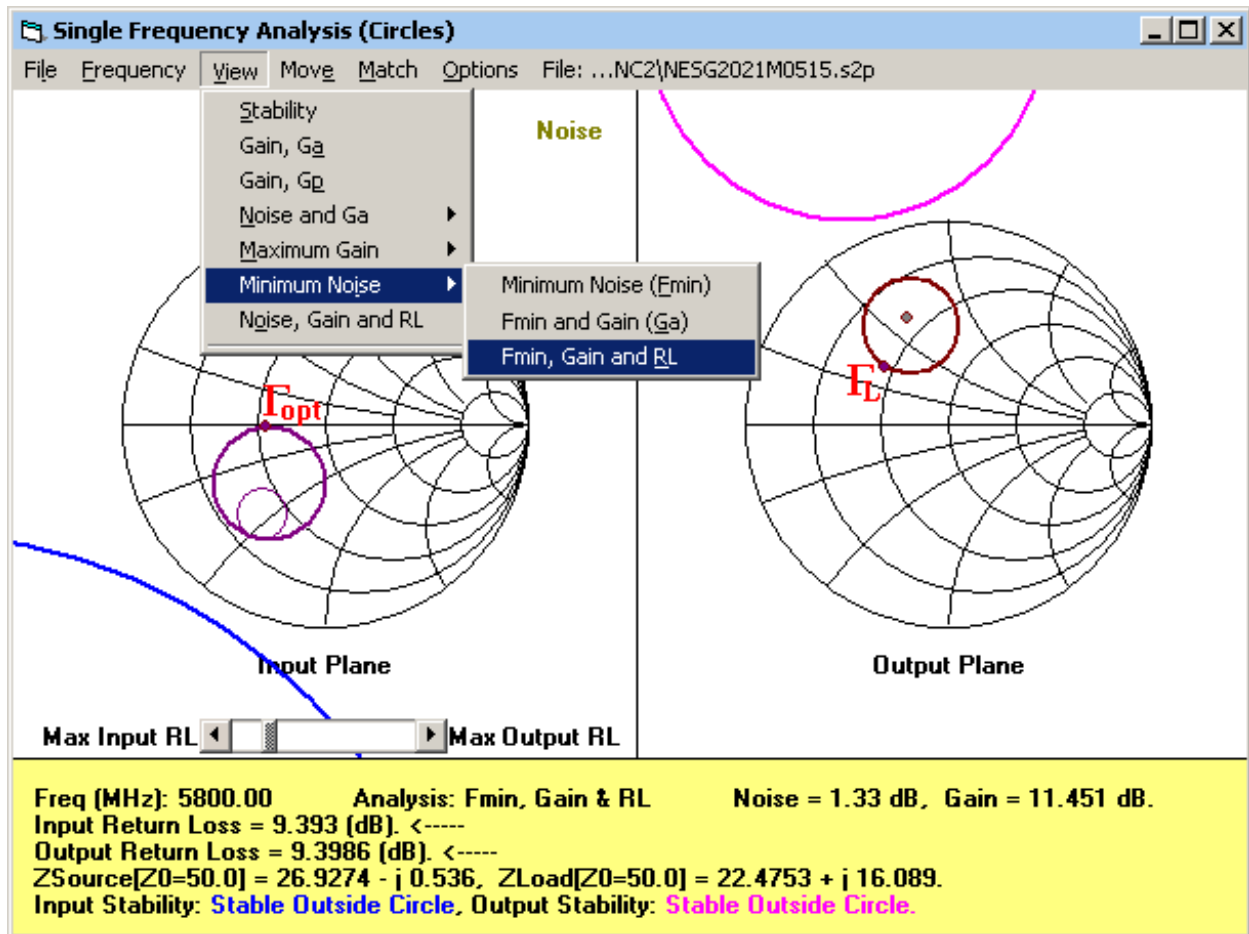
Step 2:
When the “Single Frequency Analysis (Circles)” window appears, select “Sweep” from the “Frequency” menu and set the start and stop frequencies to 5000 and 7000 MHz respectively. Then select 5800 (MHz) from the menu list.



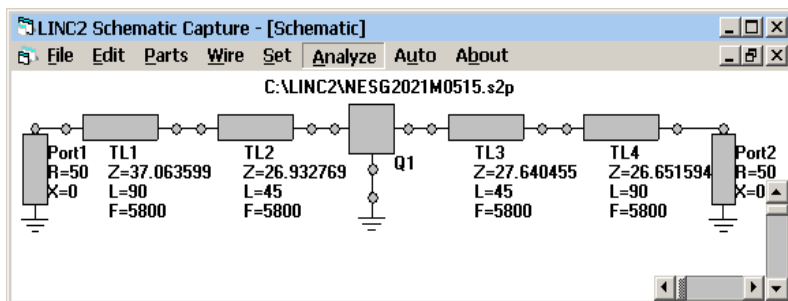
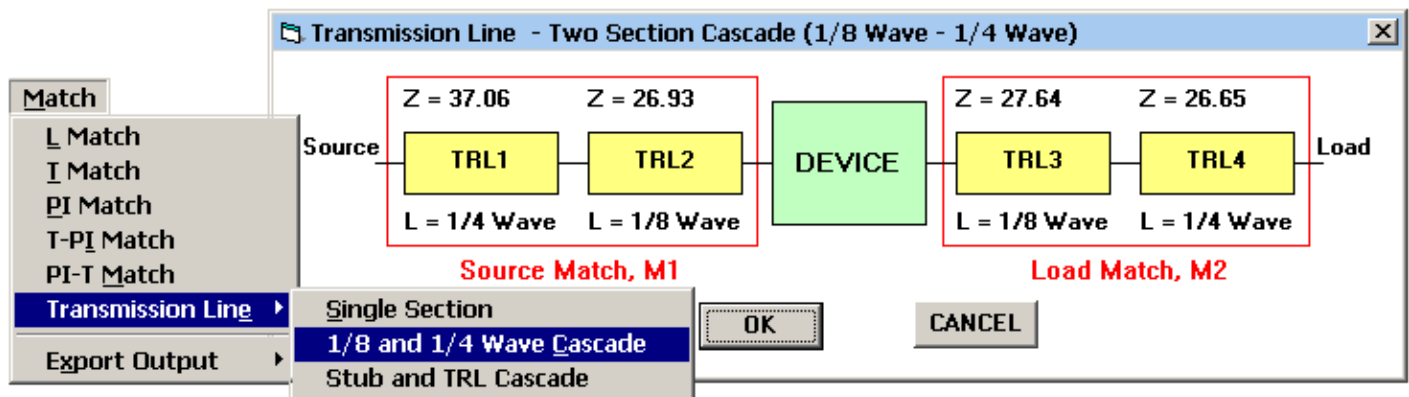
Adjusting the Start and Stop frequency as shown includes the design frequency in the list along with 20 other analysis points at 100 MHz intervals.

Step 3: Select “Minimum Noise | Fmin, Gain and RL” from the View menu. The source reflection coefficient is set to Γ_{opt} for minimum noise (1.33 dB). Move the slider control to the left (toward Max Input RL) until the input and output return losses are approx. equal at ~9.4 dB (or press ENTER and enter 9.4 dB directly).

The 9.4 dB (RL) mismatch circle is plotted on the output plane. Near the center of this circle is the conjugate output match point. However, the chosen Γ_L is a point on the circle such that the input RL is also 9.4 dB. The 9.4 dB input return loss (mismatch) circle is constructed to pass through the Γ_{opt} point.



Step 4: Select “Transmission Line | 1/8 and 1/4 Wave Cascade” from the “Match” menu.



Step 5 (run the simulation):

Click “OK” to accept the matching topology (shown above). The schematic (left) will be automatically generated. Click “Analyze” and then “View | Plot” to see the results. The GRAPH reveals that a gain of 11.45 dB has been achieved at 5800 MHz. The associated noise figure will be about 1.39 dB. “View | Smith Chart” shows ~9.4 dB RL at each port.