

Problem Set 2
Due Monday March 2, 2009

1. Assume that the third port of a three port circuit is terminated in a load Γ_3 . Calculate the resulting two-port parameters directly using scattering parameters.
2. Derive a transformation between the S and T matrix (both ways). The T matrix is defined to allow cascading of two-port parameters (similar to the $ABCD$ matrix) when using forward/reverse waves a and b .
3. Derive the scattering parameters of a “pad” or a resistive Π and T attenuator. Derive design equations for a given attenuation for a matched system.
4. Consider the composite S-parameters of a cascade of amplifiers. Show that if $S_{12} = 0$ for one of one components, then the overall system is unilateral.
5. Design an amplifier using the raw S-parameter measurements provided. Your goal is to realize a power gain of 12 dB at 5 GHz when driven and loaded by a 50Ω environment.
 - (a) Plot the maximum stable gain, maximum available gain, and unilateral gain curves for the device.
 - (b) Draw the load stability and power gain circles and comment on various choices for the load impedance.
 - (c) Draw the source stability and available gain circles and comment on various choices for the source impedance.
 - (d) Design the input and output matching network to realize stable gain. Use ideal matching networks (inductors, capacitors, transmission lines). Design for a reasonable input match but assume the output match is not needed.
 - (e) Design a two-stage amplifier that is unconditionally stable over all frequencies 12 dB power gain. The input and output match should be better than -15 dB. You may use any topology and any elements, including resistors.