ECE 6130 – S-Parameters

Text Section 4.3

Describe and Compute S-Parameters
Examples: Chapter 4, Problems 10,11

S-Parameters:

Recall –

Scattering Matrix (S-parameters)
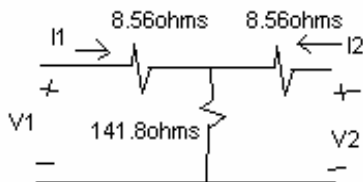
$$
\begin{bmatrix} V_1^- \\ V_2^- \\ \vdots \\ V_N^- \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} & & S_{1N} \\ S_{21} & & & \\ & & & \\ S_{N1} & & & S_{NN} \end{bmatrix} \begin{bmatrix} V_1^+ \\ V_2^+ \\ \vdots \\ V_N^+ \end{bmatrix}
$$

Where
$S_{ij} = V_i^- / V_j^+$ when $V_k^+ = 0$ for $k \neq j$

1) Terminate all ports except j with matched load.
2) Drive port j with V_j^+
3) Measure reflected voltage V_i^- on port i.

EXAMPLE: 3dB attenuator

Find S11:
Z2 = 50 ohms; Zin(port 1) = 8.56 + (141.8 || (8.56 + 50)) = 50 ohms
V1⁻ = 0 (no reflection)
$S_{11} = V_1^- / V_1^+ = 0$

Find S22:
Circuit is symmetric.
$S_{22} = S_{11}$

Find S12:

S12 = V2- / V1+ when port 2 is terminated

Since S11 =0, we know that V1- = 0 when port 2 is terminated, and V2+ = 0 (by definition)

Then V2- = V2 = Vmiddle (8.56 / (8.56 + 50))

Vmiddle = V1 (8.56 || 141.8) / (8.56 + 8.56 || 141.8)

Return Loss

RL = -20 log(Sii) dB

Insertion Loss

TL = -20 log(Sij) dB

EXAMPLES