February 23, 2010

ECEN 689: High-Speed Links

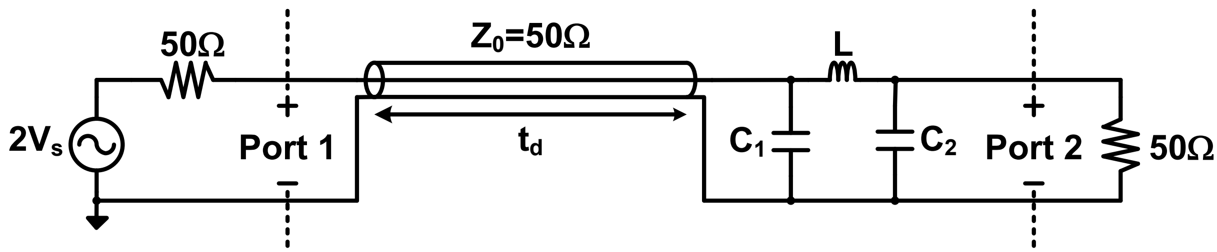
Homework #3

Due: 3-3-2010, 9:10AM

Homeworks will not be received after due.

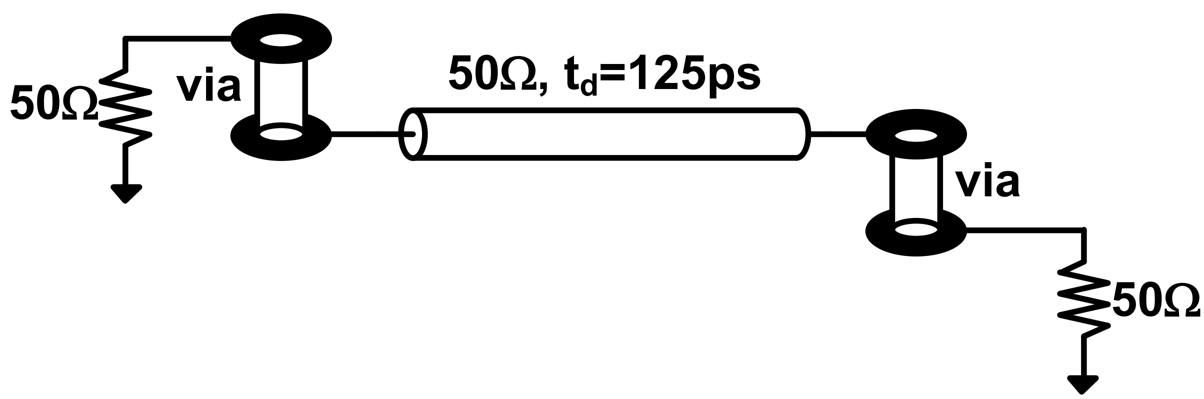
Instructor: Sam Palermo

1. Plot S_{11} and S_{21} for the following two-port model for each of the following cases:
   a. t_d=0ps (no t-line), C_1=0pF, L=0nH, C_2=1pF
   b. t_d=0ps (no t-line), C_1=0.6pF, L=1nH, C_2=0.4pF
   c. t_d=100ps, C_1=0.6pF, L=1nH, C_2=0.4pF



Hint: Probably the easiest way to do this is to simulate this in Cadence.

2. S-parameter values extracted with 50Ω termination at 5GHz are given below for a via structure and an ideal 50Ω transmission line with a delay of 125ps. Using these independent s-parameter matrices, calculate the equivalent 5GHz s-parameter matrix of a channel consisting of a via, transmission line, and another via.



$$\begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix}_{via} = \begin{bmatrix} -0.194 - j0.215 & 0.464 - j0.837 \\ 0.464 - j0.837 & -0.285 - j0.05 \end{bmatrix}$$

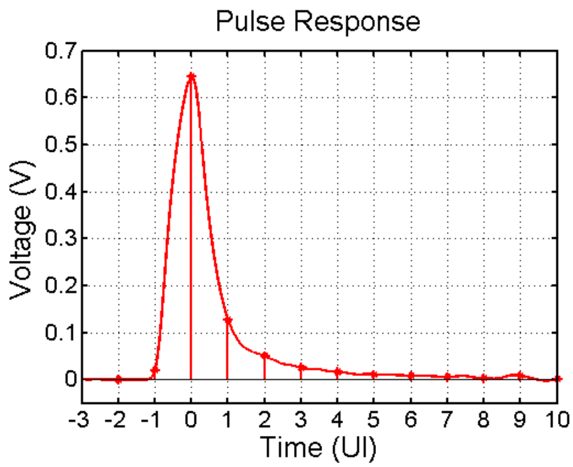
$$\begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix}_{t-line} = \begin{bmatrix} 0 & -0.707 + j0.707 \\ -0.707 + j0.707 & 0 \end{bmatrix}$$

Hint: Feel free to use Matlab.

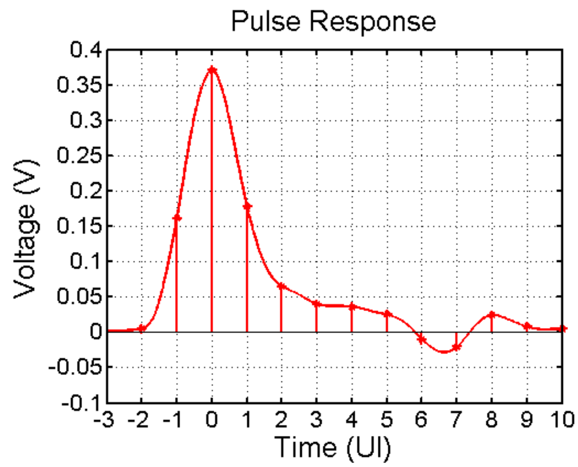
3. **Channel Transient Simulation**. The objective of this problem is to use measured channel s-parameter data to produce an impulse response and perform a transient simulation in Matlab involving sending random NRZ data across this channel.
   a. Download the s-parameter file for a 12" Backplane channel, "**peters_01_0605_B12_thru.s4p**"
   b. Use the matlab file "**read_sparam.m**" to produce an impulse response. Note this code requires the function "**xfr_fn_to_imp.m**".
   c. Use the produced impulse response to perform transient simulations. **Plot eye diagrams at 2.5, 5, and 10Gbps.** Example code for this is the file "**channel_data.m**".
   d. **Extra Credit (10%)**: Using peak distortion analysis, generate the worst-case bit pattern and plot the worst-case eye at 5 and 10Gbps. In generating the worst-case bit pattern, truncate the pulse response such that there are 10 pre-cursor samples and 100 post-cursor samples.

4. **Peak Distortion Analysis**. For the 2 "1-bit" pulse response responses, $y^{(1)}(t)$, below
   i. Give the worst-case input bit pattern. Assume the ISI is zero for samples outside the plot range.
   ii. Give the worst-case eye height.

a.



b.



Time (UI)	Sample(V)
-3	0.001
-2	0.000
-1	0.020
0	0.645
1	0.127
2	0.050
3	0.025
4	0.016
5	0.011
6	0.008
7	0.005
8	0.003
9	0.008
10	0.001

Time (UI)	Sample(V)
-3	0.001
-2	0.005
-1	0.161
0	0.370
1	0.178
2	0.065
3	0.040
4	0.036
5	0.025
6	-0.010
7	-0.020
8	0.025
9	0.008
10	0.005