University of Portland
School of Engineering

EE 301
Spring 2013
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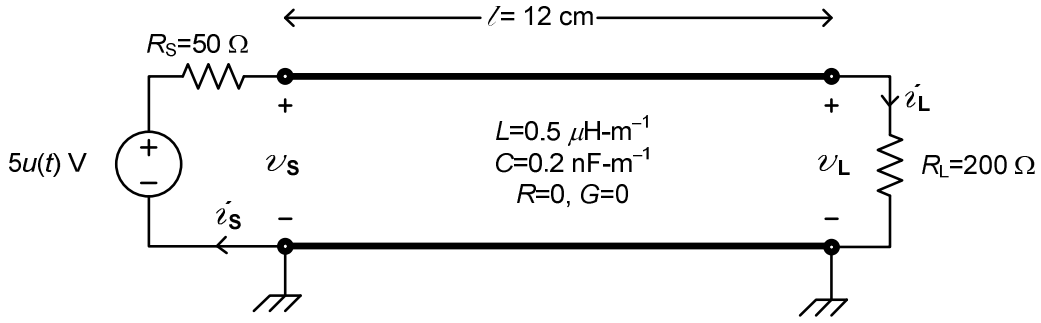
Homework # 2
Distributed-Circuit Parameters of Simple Transmission-Line (TL) Structures & Digital Signal Propagation on Lossless TLs
(Copyright by A. S. Inan)
(Assigned: Monday, January 28, 2013)
(Due: Wednesday, February 6, 2013, 11:25a.m.)

(1) A resistively terminated transmission line. Consider the transmission-line circuit excited by an ideal step voltage source as shown. Assuming lossless transmission line and using a bounce diagram, determine the values of the source-end and load-end voltages v_S and v_L and the source-end and the load-end currents i_S and i_L at the following times:

(a) t_1 = 1 ns.
(b) t_1 = 2 ns.
(c) t_1 = 3 ns.

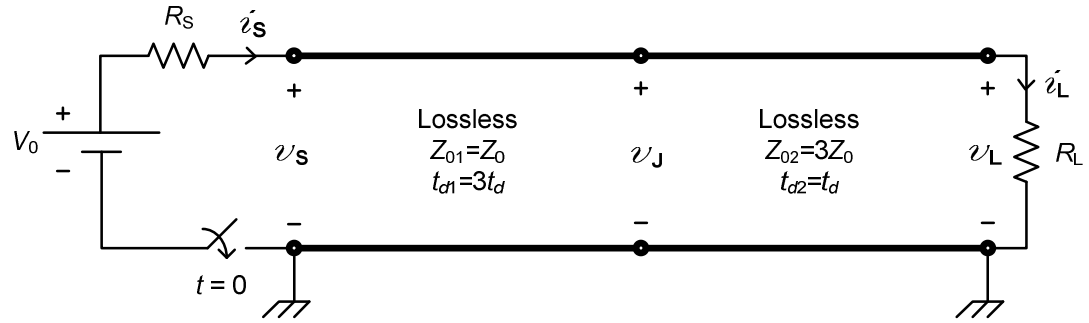


Provide all of your answers in a table form. A sample table could be of the form given by

t (ns)	v_S (V)	v_L (V)	i_S (mA)	i_L (mA)
1				
2				
3				

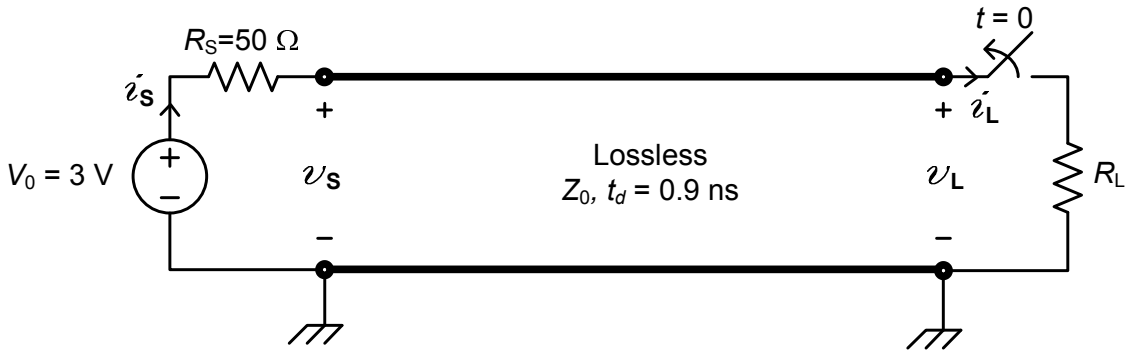
(2) Transient response of a cascaded transmission-line circuit. Consider the circuit consisting of two cascaded lossless transmission lines each with characteristic impedance and one-way time delay provided as shown. Assuming both lines to be uncharged before t = 0, sketch the source-end, junction and load-end voltages v_S, v_J, and v_L as a function of time for the following three cases:

(a) $R_S = Z_0$ and $R_L = 3Z_0$.
(b) $R_S = Z_0$ and $R_L = Z_0$.
(c) $R_S = Z_0/3$ and $R_L = 3Z_0$.



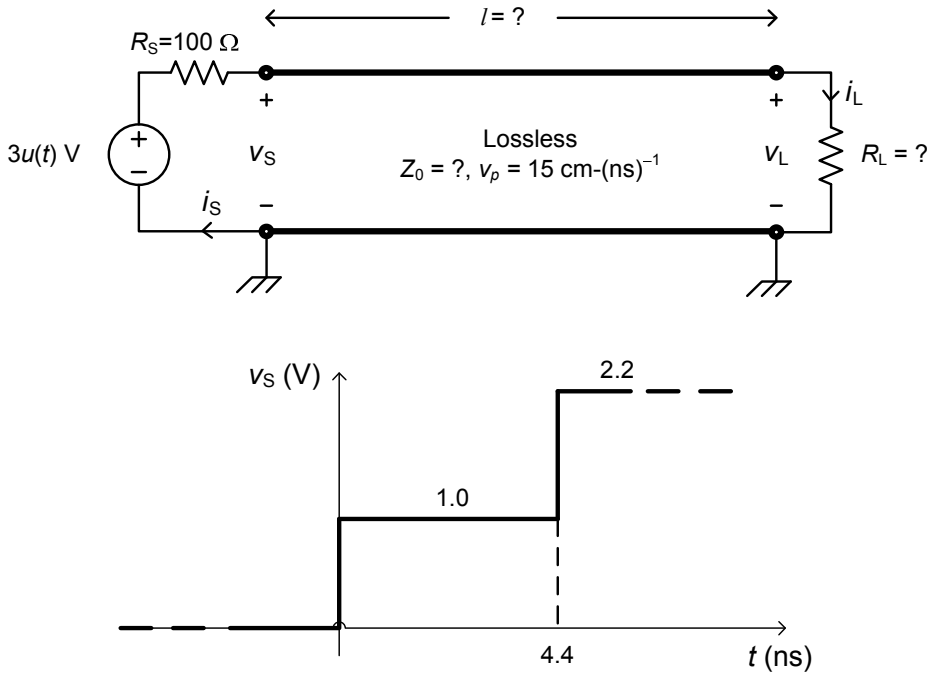
For each case, provide a complete bounce diagram. Sketch each voltage waveform only over the time interval $0 < t < 9t_d$. Note that in your sketches, your voltage values will be in terms of V_0 and your time axis will be in terms of t_d.

(3) A resistively terminated transmission line. Consider the transmission line circuit terminated with a resistive load as shown. If the switch at the load end opens at $t = 0$ after being closed for a long time, calculate and fill out the source-end and load-end voltage values in the table provided below. Provide a bounce diagram in each case to justify your voltage values.

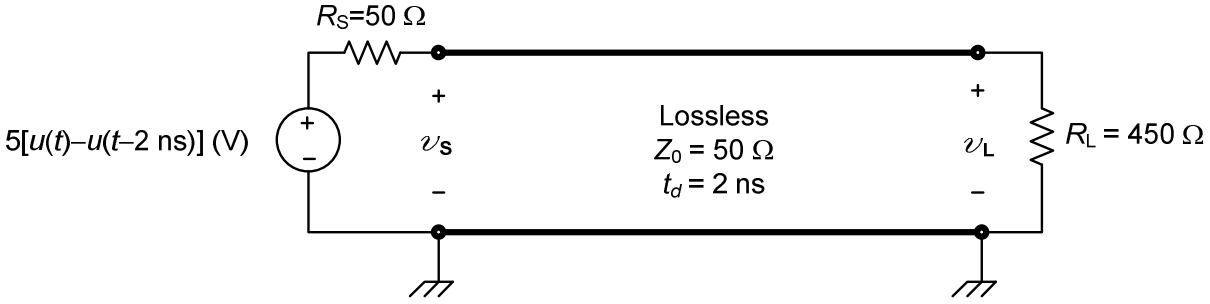


Z_0 (Ω)	R_L (Ω)	t (ns)	v_S (V)	v_L (V)
50	50	0^+		
50	50	1		
50	50	2		
50	0	0^+		
50	0	1		
150	0	1		
150	0	2		

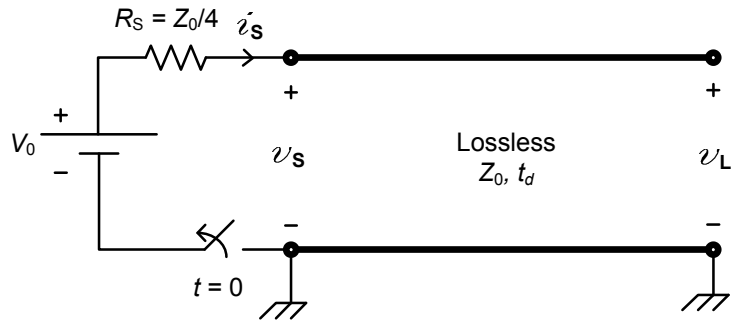
(4) Characterizing a transmission-line circuit using a TDR waveform. Consider the transmission-line circuit below. At $t = 0$, the circuit is excited by an ideal step voltage source of 3 V peak value. Using the source-end voltage waveform v_S observed on a TDR display as shown, determine the characteristic impedance and the length of the line, Z_0 and l, and the unknown load resistor, R_L. Show your work step-by-step.



(5) A pulse excited transmission line. Consider the transmission-line circuit excited by a voltage pulse with 5 V peak value and 2 ns duration, as shown. Using a bounce diagram, find and sketch the source-end and load-end voltages v_S and v_L as a function of time up to $t = 9$ ns.



(6) An open-circuit terminated transmission line excited by a dc voltage source. Consider a lossless open-circuit terminated transmission-line excited by a dc voltage source with voltage V_0 as shown. At $t = 0$, the switch opens. Assuming steady-state condition to apply at $t = 0^-$, complete the values of the source-end and load-end voltages v_S and v_L in terms of the dc voltage V_0 in the table provided below. Provide a bounce diagram to justify your values.



t/t_d	v_S/V_0	v_L/V_0
0.5		
1.5		
2.5		

Please use the following guidelines for your homework solutions:

1) On the first sheet, at the top center, write: Homework #2-Solutions.
2) Provide your full name on the upper right corner of the first sheet.
3) Also write: EE 301/Spring 2013 on the upper left corner of the first sheet.
4) Solve each problem on a separate sheet unless your solution is very short.
5) Box all of your answers.
6) Staple your solutions in the above order before you turn them in.

Please turn in your homework on time.