

EELE 461/561 – Digital System Design

Homework #5

Name: _____
 Grade (EELE461): _____ / 10
 Grade (EELE561): _____ / 15

NOTE: Print this sheet and use as a cover for your homework set.

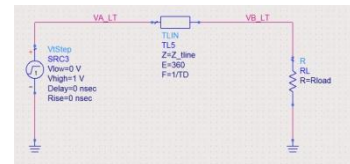
EELE 461 & EELE 561

You are designing a digital link and are evaluating termination techniques. You find a 50 ohm resistor on DigiKey that has a tolerance of +/-10%. This means that the resistance can vary between 45ohms to 55ohms and still be considered within specification. You can assume that your transmission line has $Z_0=50\Omega$, $T_D=1\text{ns}$ and that your driver has an output impedance of 0 ohms.

A) Load Termination (3 POINTS)

Evaluate a Load Termination approach. Use DxDesigner to simulate both the +10% and the -10% cases of your termination resistor. Analytically describe the 1st four transient events in the system for the -10% case.

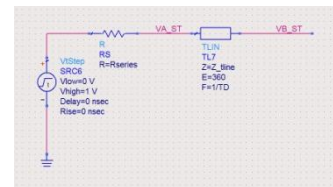
- Event #1: The voltage observed at VA at t=0ns.
- Event #2: The voltage observed at VB at t=1ns.
- Event #3: The voltage observed at VA at t=2ns.
- Event #4: The voltage observed at VB at t=3ns.



B) Series Termination (3 POINTS)

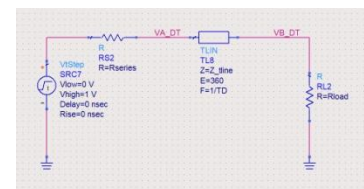
Evaluate a Series Termination approach. Use DxDesigner to simulate both the +10% and the -10% cases of your termination resistor. Analytically describe the 1st four transient events in the system for the -10% case.

- Event #1: The voltage observed at VA at t=0ns.
- Event #2: The voltage observed at VB at t=1ns.
- Event #3: The voltage observed at VA at t=2ns.
- Event #4: The voltage observed at VB at t=3ns.



C) Double Termination (2 POINTS)

Evaluate a Double Termination approach. Use DxDesigner to find the variation in the response under all four corner cases (i.e., RS:RL = High:High, Low:Low, High:Low, Low:High). You **do not** need to perform the analysis by hand. Turn in a plot of VA under all 4 cases and another plot of VB under all 4 cases. Which case yields the most positive net voltage and which case yields the most negative net voltage?



D) Thevenin Termination (2 POINTS)

You want to create a load termination impedance into 1.0 volts using a Thevenin termination. What values of R1 and R2 should you use to achieve a 50ohm termination if your system has a 2.5v power supply?

EELE 561 Only

- E) One of the practical issues of using termination resistors is how close you can get them to the transmitter or receiver. If you use a discrete component, the actual receiver can be significantly far away due to the extra propagation delay through the package and on-chip interconnect. Build a DxDesigner model of a simple 50ohm, double terminated system being driven with a risetime of 100ps. Model the effect of the additional receiver interconnect beyond the termination load resistor with a 50ohm transmission line. At what electrical length does the additional receiver interconnect cause significant (i.e., 10% reflections of 10% risetime degradation) problems to the signal arriving at the receiver?
(5 POINTS)