

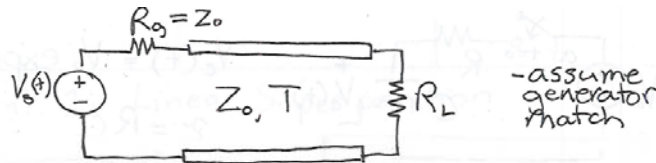
TDT8: Reactive Terminations on Transmission Lines

By Prof. Gregory D. Durgin



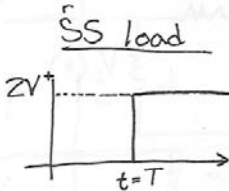
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Open and Short Loads

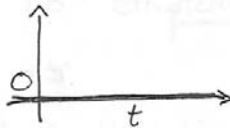


Termination

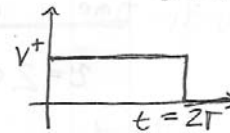
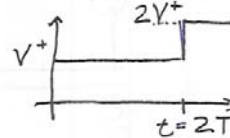
Open Circuit
($R_L = \infty, \Gamma \rightarrow 1$)



Short Circuit
($R_L = 0, \Gamma \rightarrow -1$)

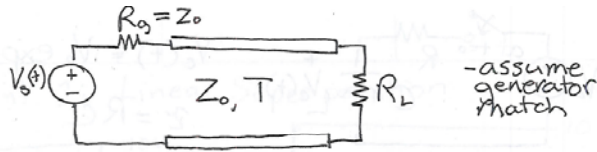


SS source



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Reactive Loads

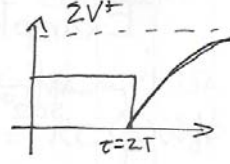
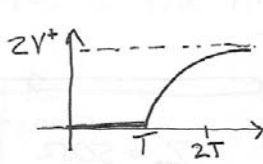


Termination

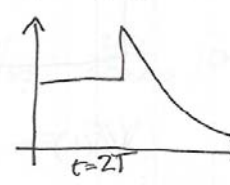
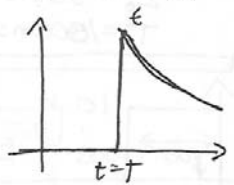
SS load

SS source

Capacitor



Inductor

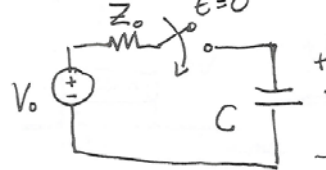


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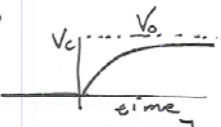


Time Constants for Reactive Loads

Capacitive

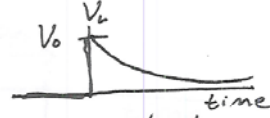
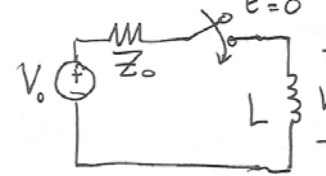


$$\tau = RC$$



$$V_c(t) = V_0 \left[1 - \exp\left(-\frac{t}{\tau}\right) \right] u(t)$$

Inductive



$$V_L(t) = V_0 \exp\left(-\frac{t}{\tau}\right) u(t)$$

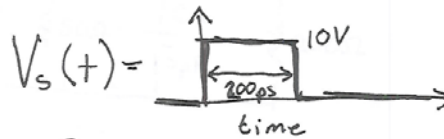
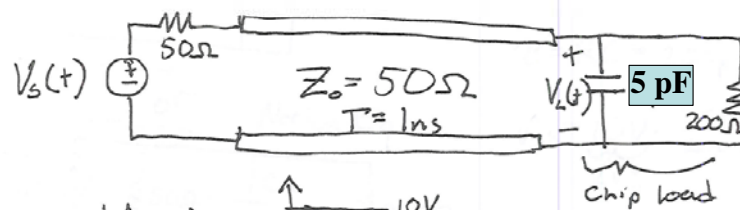
$$\tau = L/R \leftarrow Z_0$$

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Example: Square Pulse on a T-Line

Example



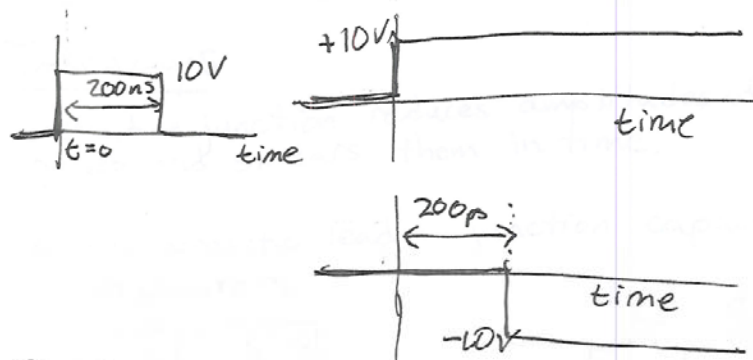
Solve for $V_L(t)$

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Solution for a Pulse on the Line

Step 1: Linear Superposition

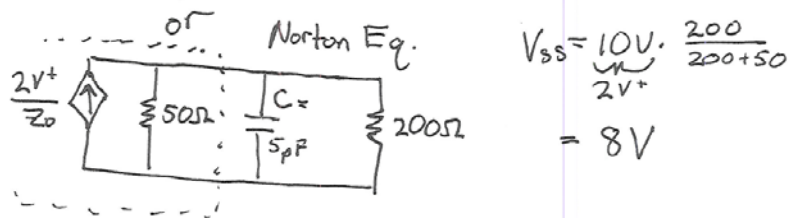
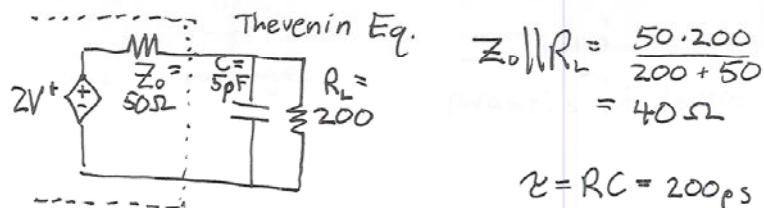


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Basic Solution

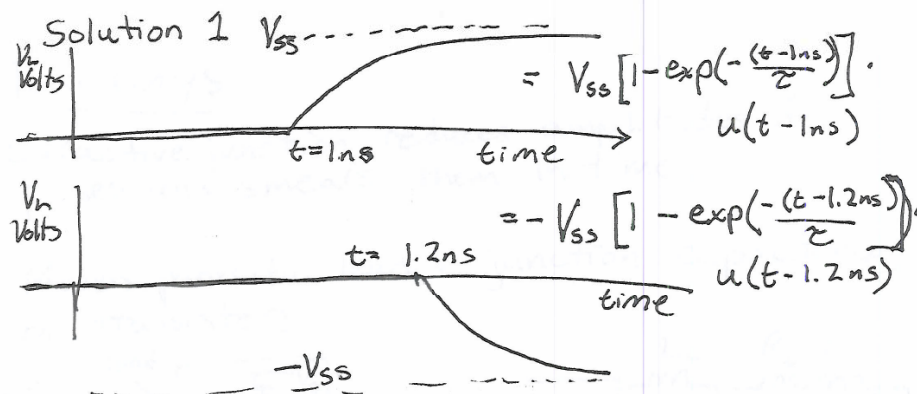
Step 2: Calculate Time Constant



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Two Solution



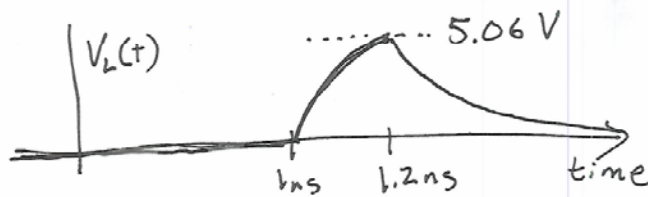
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Total Solution

Total Solution

$$V_L(t) = \begin{cases} 0 & \text{for } t < 1 \text{ ns} \\ 8 \left[1 - \exp\left(-\frac{t-1 \text{ ns}}{200 \text{ ps}}\right) \right] & \text{for } 1 \text{ ns} < t < 1.2 \text{ ns} \\ 8 \left[\exp\left(-\frac{t-1 \text{ ns}}{200 \text{ ps}}\right) - \exp\left(-\frac{t-1.2 \text{ ns}}{200 \text{ ps}}\right) \right] & \text{for } t > 1.2 \text{ ns} \end{cases}$$



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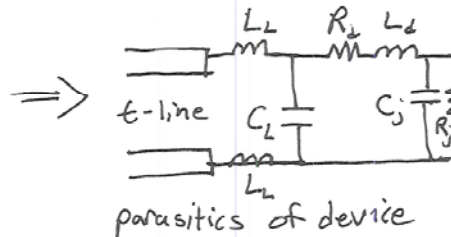
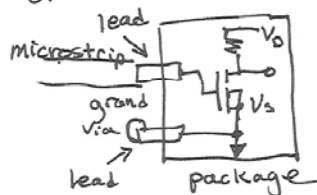
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Example Takeaways

Takeaways

Capacitive junction reduces amplitudes of pulses and smears them in time.

Models parasitic lead + junction capacitance of transistors

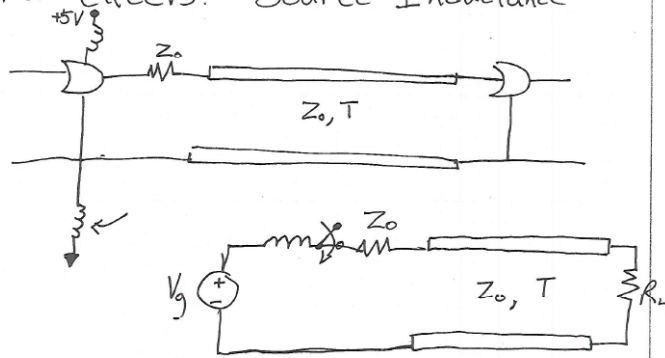


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Inductive Effects

Other effects: Power Source Inductance



Retards pulse generation

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