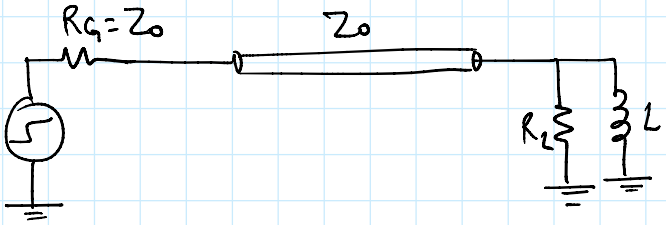
Lec-12

Monday, February 10, 2020 8:42 AM

HW-3 Posted Online - Due 02/17

Q1 HW#3 – Fig 2.34 in text book

Q4 HW#3

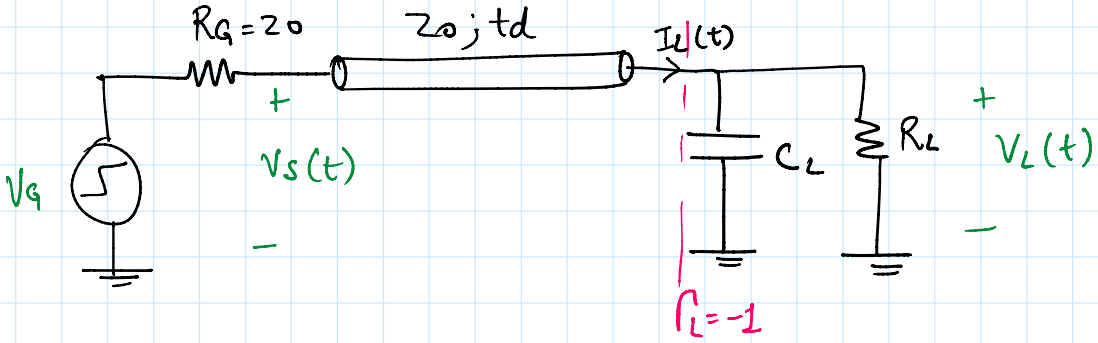


a) $R_L < Z_0$

b) $R_L > Z_0$

c) $R_L = Z_0$

Capacitive Load in a Transmission Line



- Capacitor acts like a short
- $\Gamma_L = -1$ at the time when forward travelling wave hits the capacitor.

$$V_L(t) = V_1^+(t) + V_1^-(t)$$

$$I_L(t) = I_1^+(t) + I_1^-(t)$$

$$I_L(t) = \frac{V_1^+(t)}{Z_0} - \frac{V_1^-(t)}{Z_0}$$

$\Gamma_L = -1 \Rightarrow V_1^-(t) = -V_1^+(t)$

$I_1^-(t) = I_1^+(t)$

we can measure $I_L(t)$ at $t = t_1^+$ the current

$I_L(t) = \frac{V_1(t)}{Z_0} - \frac{V_1(t)}{Z_0}$

→ we sign because $I_L(t)$ at $t = t_d^+$ the current become twice the current at $t = t_d^-$

$$I_L(t) = \frac{V_L(t)}{R_L} + C\frac{dV_L(t)}{dt}$$

$$\begin{cases} V_1^+(t) = V_G/2 \leftarrow \end{cases}$$

$$\frac{V_1^+(t)}{Z_0} - \frac{V_1^-(t)}{Z_0} = \frac{V_1^+(t)}{R_L} + \frac{V_1^-(t)}{R_L} + C\left[\frac{dV_1^+}{dt} + \frac{dV_1^-}{dt}\right]$$

$\frac{dV_1^+}{dt} \to 0$

$$\frac{dV_1^-}{dt} + \left[\frac{R_L + Z_0}{R_L Z_0}\right] V_1^-(t) - \left[\frac{R_L - Z_0}{R_L Z_0}\right] V_1^+(t) = 0$$

$V_1^+(t) \downarrow V_G/2$

$$V_1^-(t) = K_1 + K_2 e^{-[(R_L+Z_0)/(R_L Z_0 C_L)](t - t_d)}$$

K_1: Const, K_2: Const.

Boundary Condition

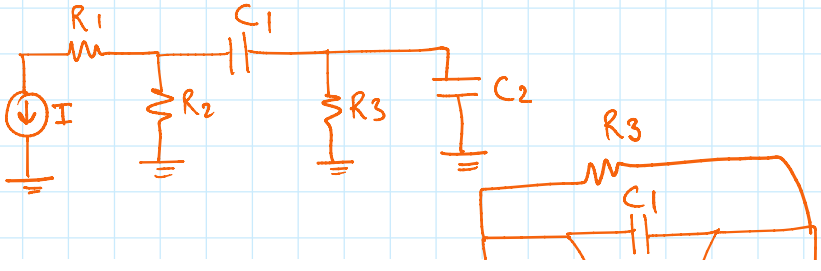
1) $t = t_d$ $\quad V_1^- = -V_1^+ = -V_G/2$

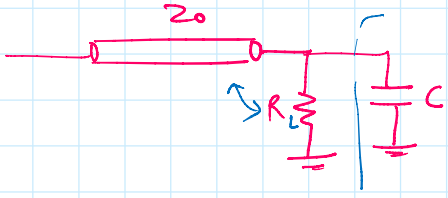
2) $t = \infty$ $\quad V_1^- = \left(\frac{R_L - Z_0}{R_L + Z_0}\right) V_1^+$ → at $t = \infty$

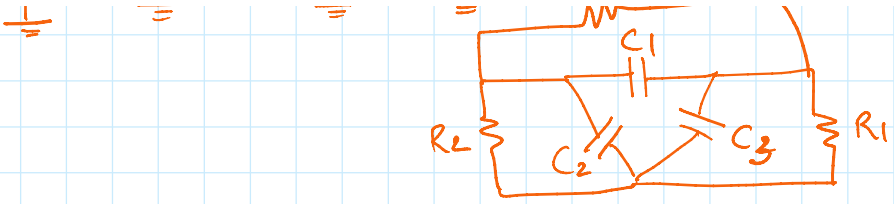
$$V_L(t) = \frac{R_L V_G}{R_L + Z_0}\left[1 - e^{-[(R_L+Z_0)/(R_L Z_0 C_L)](t - t_d)}\right]$$

$$\tau = \frac{R_L Z_0 C_L}{R_L + Z_0}$$

$$1 - e^{-t/\tau}$$

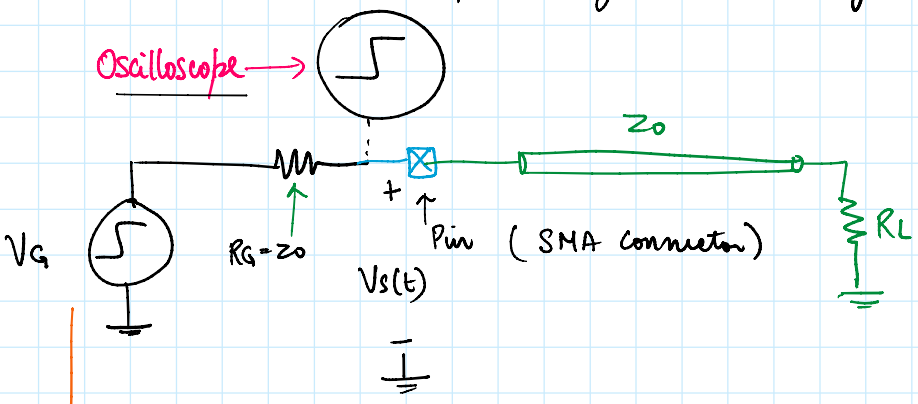






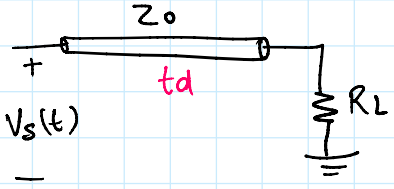
Time Domain Reflectometry (TDR)

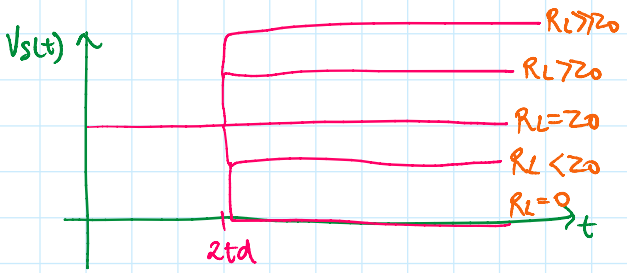
1. Measure the characteristic impedance
2. Determine the nature of the load
3. Detect the presence of discontinuity in the Tx line.



Sharp Rise Time → ~50ps or less

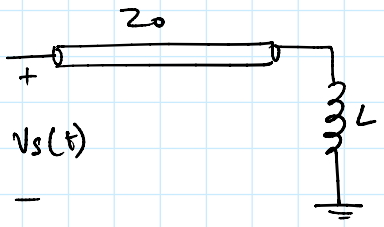
Resistive Termination

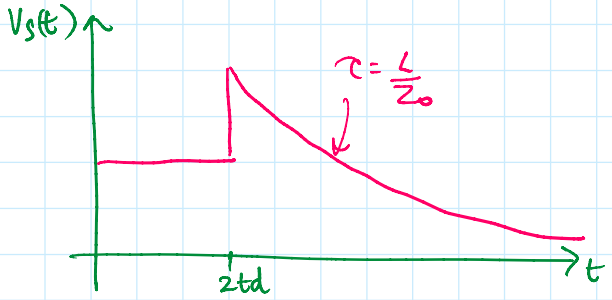




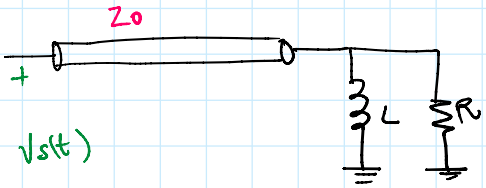
Inductive Termination

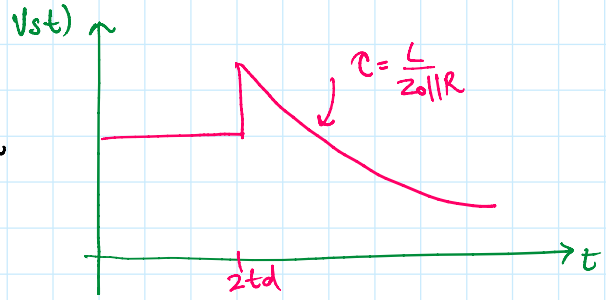
1)





2)





Capacitive Load