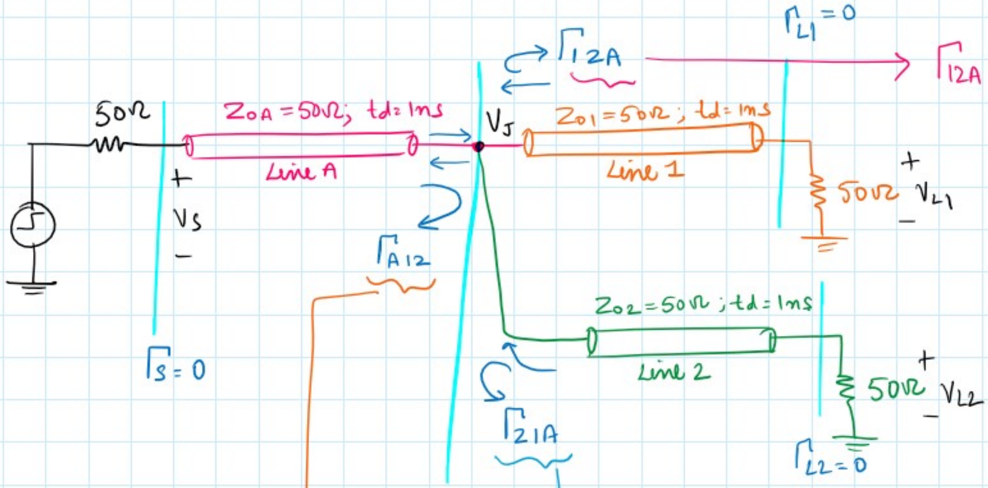
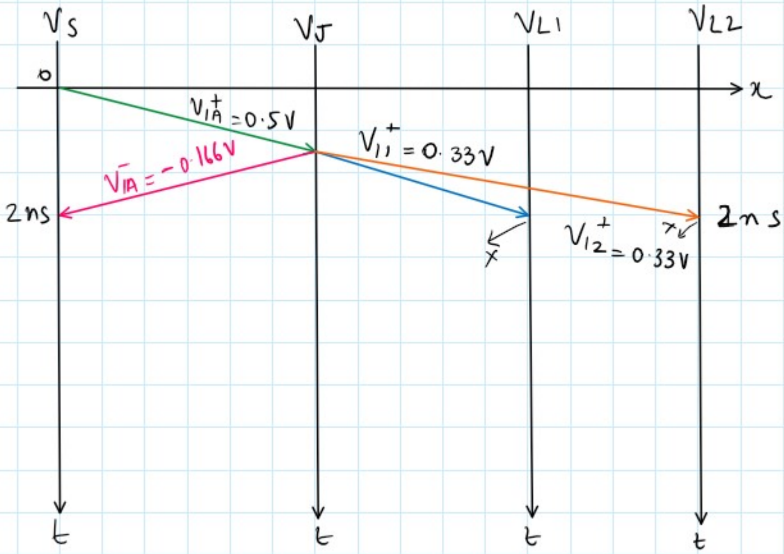
Three Parallel Transmission Lines.



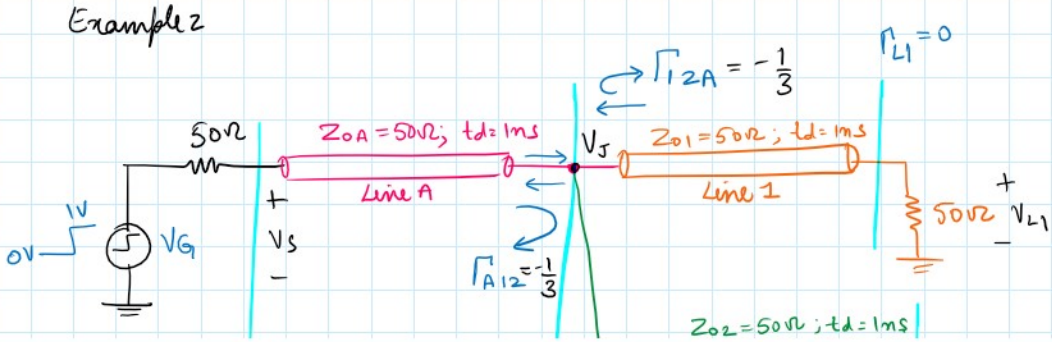
$$\Gamma_{12A} = \frac{(Z_{0A} \| Z_{02}) - Z_{01}}{(Z_{0A} \| Z_{02}) + Z_{01}} = -\frac{1}{3}$$

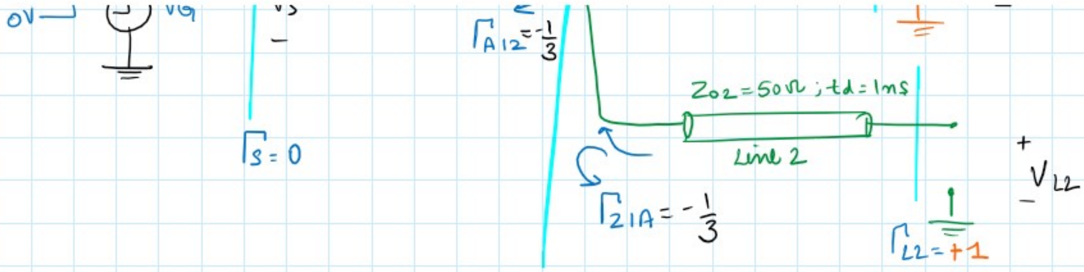
$$\Gamma_{A12} = \frac{(Z_{01} \| Z_{02}) - Z_{0A}}{(Z_{01} \| Z_{02}) + Z_{0A}} = -\frac{1}{3}$$

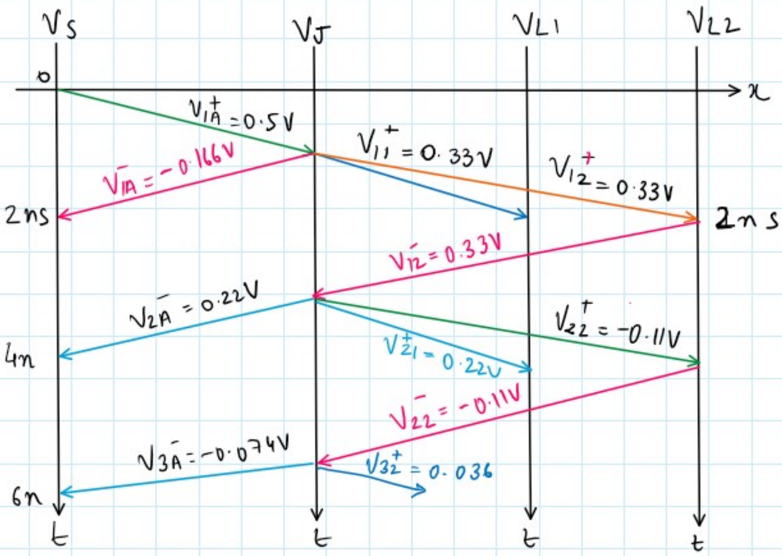
$$\Gamma_{21A} = \frac{(Z_{0A} \| Z_{01}) - Z_{02}}{(Z_{0A} \| Z_{01}) + Z_{02}} = -\frac{1}{3}$$

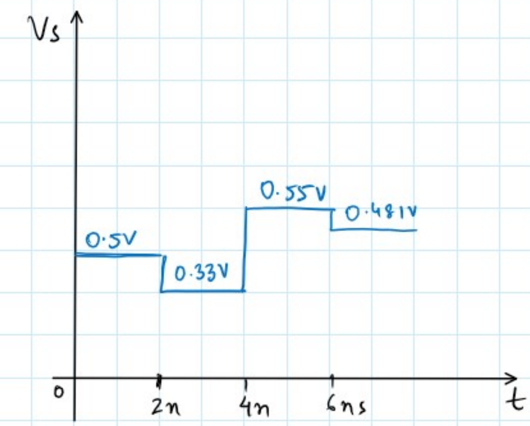


Example 2







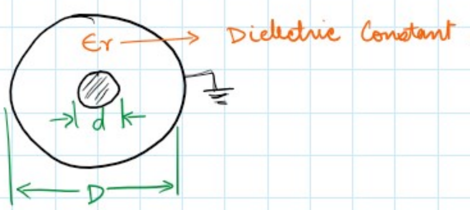


$V_S(t=\infty) = 0.5V$

Characteristic Impedance

$$Z_0 = \sqrt{\frac{R + j\omega L}{G + j\omega C}}$$

1) Coaxial Cable



$$Z_0 = \frac{138}{\sqrt{\epsilon_r}} \log\left(\frac{D}{d}\right)$$

{ many accurate ways to write Z_0 }

Assume $\epsilon_r = 4$

$$Z_0 = 69 \log\left(\frac{D}{d}\right)$$

Observations

- $\frac{D}{d}$ increases exponentially as Z_0 increases.

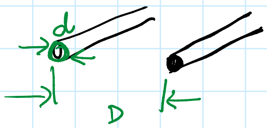
$$\frac{D}{d} = 10^{Z_0/69}$$

a) $Z_0 = 50\Omega$; $\frac{D}{d} = 5.3$

b) $Z_0 = 75\Omega$; $\frac{D}{d} = 12.2$

c) $Z_0 = 200\Omega$; $\frac{D}{d} \approx 800$

2) Two Wire Transmission Line



Dielectric is air

Ribbon cable →

$$Z_0 = \frac{276}{\sqrt{\epsilon_r}} \log\left(\frac{2D}{d}\right)$$

$\epsilon_r = 1$

$$Z_0 = 276 \log\left(\frac{2D}{d}\right)$$

• D can be as small as d

↑ This is the limit of Z_{0min}

$$Z_{0min} = 276 \log(2)$$

a) $Z_{0min} = 83\Omega$

b) $D/d = 5$

$Z_0 = 276\Omega$

Observation: Two wire transmission lines can have higher characteristic impedance.