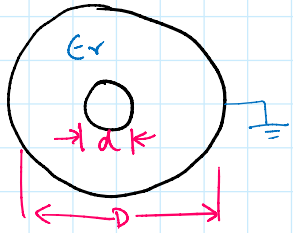
Lec-8

Monday, January 27, 2020 8:55 AM

HW-2 Posted Online

Characteristic Impedance (Z_0)

1) Coaxial Tx Line



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

1) text book → $60 \log\left(\frac{D}{d}\right)$

2) $Z_0 = \sqrt{\frac{\mu}{\epsilon_0 \epsilon_r}} \frac{\ln(D/d)}{2\pi}$

Assume $\epsilon_r = 4$

$$Z_0 = \frac{138}{2} \log\left(\frac{D}{d}\right)$$

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

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

Observations

1) $\frac{D}{d}$ increases exponentially as $Z_0 \uparrow$

ex: $Z_0 = 200\Omega$

$$\frac{D}{d} = 10^{200/69}$$

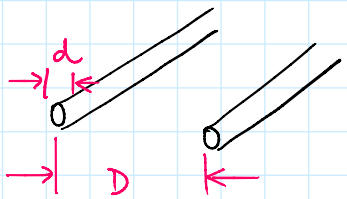
$$\frac{D}{d} = 10^{2.89} = 776$$

d

2) Typical $Z_0 = 50\,\Omega$ or $75\,\Omega$

3) Not practical for $Z_0 = 100\,\Omega$ or $200\,\Omega$.

2) Two wire transmission line



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

Z_0 min : $D = d$

$$Z_0 = \frac{276}{\sqrt{1}} \log\left(\frac{2D}{d}\right)$$

$\epsilon_r = 1$ (air)

$$Z_0 = 276 \log(2) \qquad \{D = d\}$$

$$Z_0 = 83\,\Omega$$

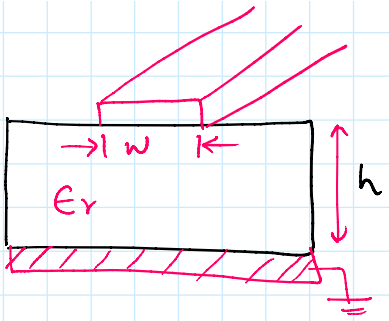
Z_0 min

Example: $\frac{D}{d} = 5$

$$Z_0 = \frac{276}{\sqrt{1}} \log(10) = 276\,\Omega$$

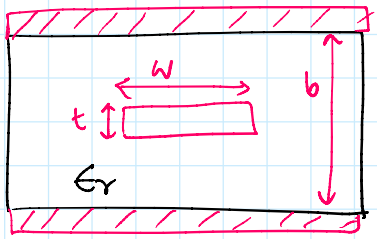
Typical $Z_0 =$ $300\,\Omega$ or $600\,\Omega$

3) Microstip line



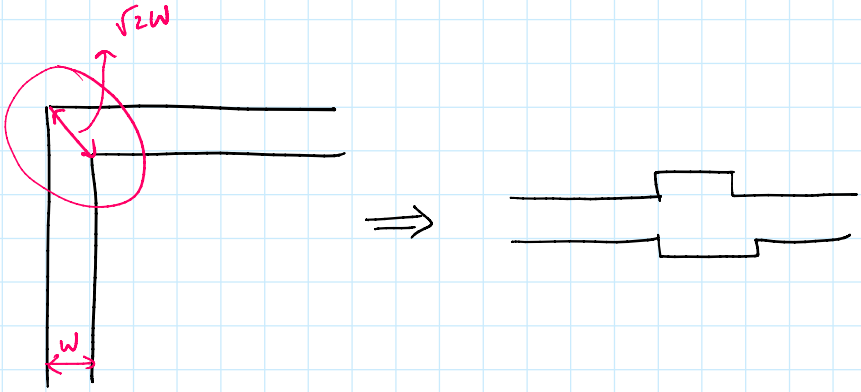
$$Z_0 = \frac{377}{\sqrt{\epsilon_r}\left((W/h) + 2\right)}$$

4) Stripline



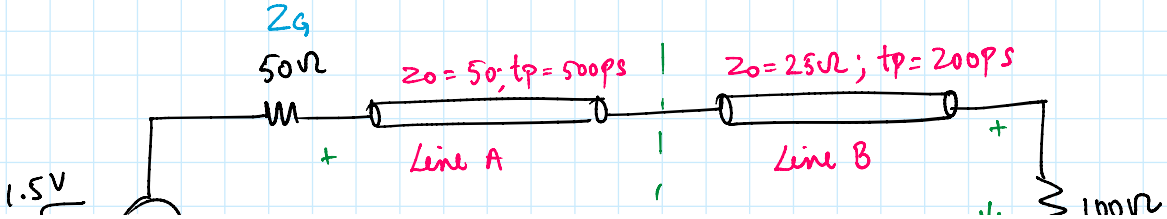
$$Z_0 = \frac{60}{\sqrt{\epsilon_r}} \ln\left(\frac{4b}{0.67\pi(t + 0.8w)}\right)$$

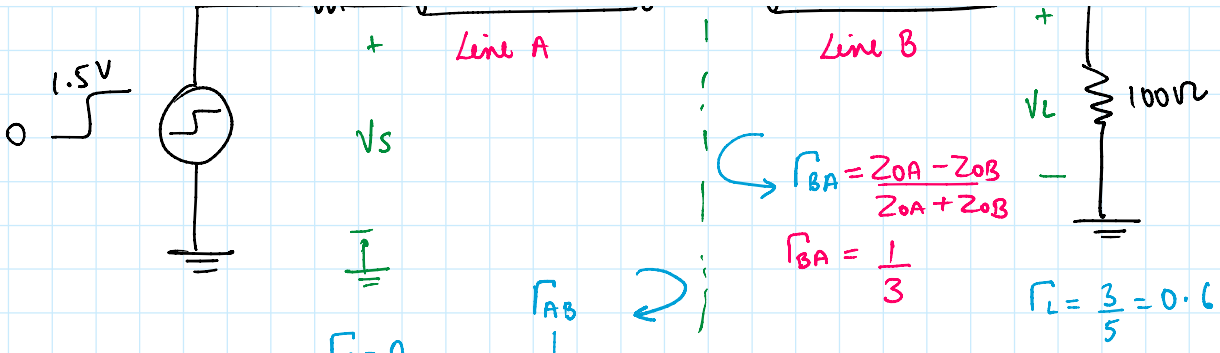
Sharp corners on Tx Line



Reflections at the junction of transmission lines

Example 1





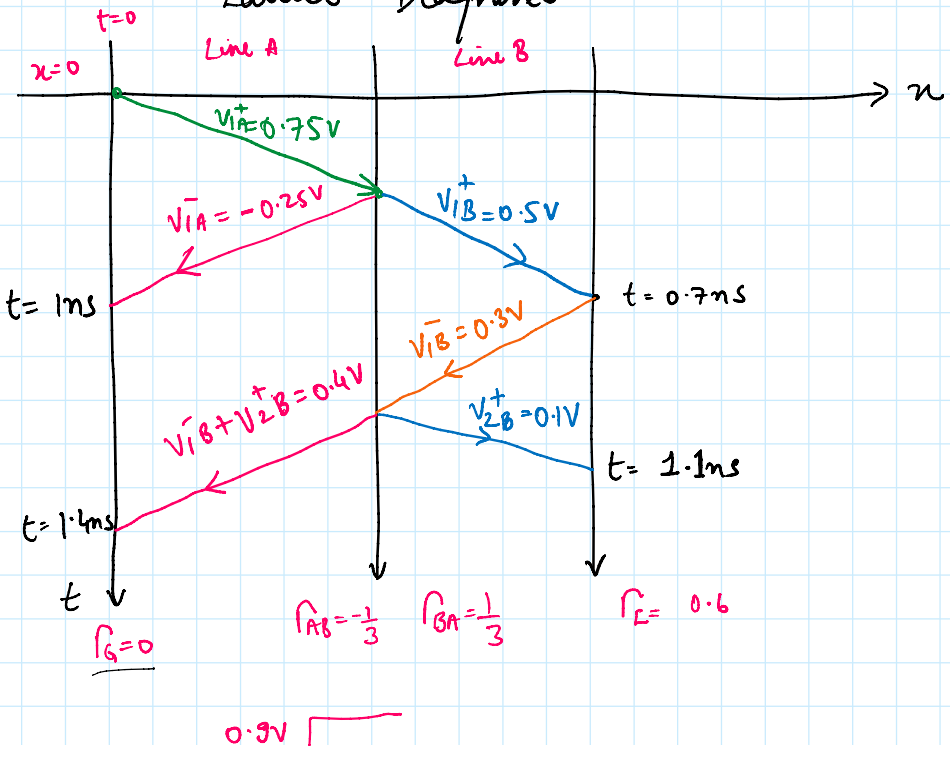
- Boundary condition at the junction of two transmission lines.

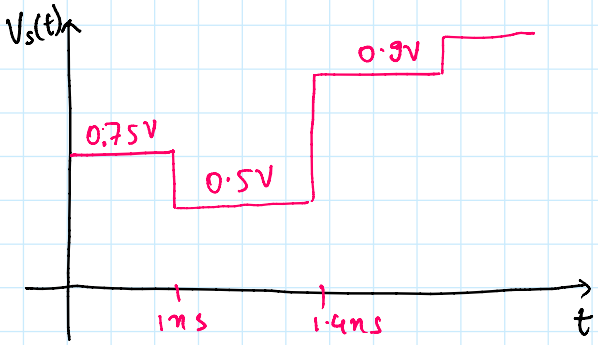
$$V_1^+A + V_1^-A = V_1^+B$$

$$V_1^+A + \Gamma_{AB} V_1^+A = V_1^+B$$

$$\boxed{V_1^+A\,(1 + \Gamma_{AB}) = V_1^+B}$$

Lattice Diagram




$V_s(t)$
0.75V
0.5V
0.9V
1ns
1.4ns
t