EE2025

Lecture 6/7

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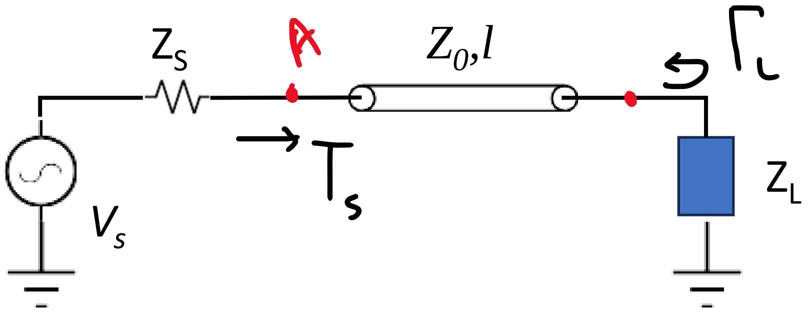
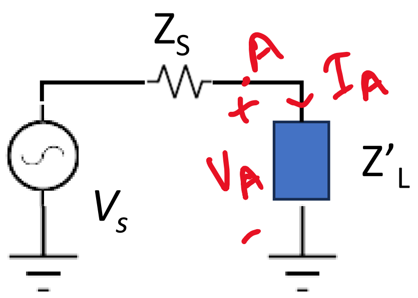
How to find V^+?





Power transfer

@ LOAD $\quad P_L = \frac{1}{2} \mathrm{Re}(V I^*)$ why?

$$V = V^+ + V^- = V^+ e^{j\beta l}\left[1 + \Gamma_L e^{-2j\beta l}\right]$$

$$I = I^+ + I^- = \frac{V^+}{Z_0} e^{j\beta l}\left[1 - \Gamma_L e^{-2j\beta l}\right]$$

$l = 0 \qquad P_L = \frac{1}{2} \mathrm{Re}\left[\frac{|V^+|^2}{Z_0}(1+\Gamma_L)(1-\Gamma_L)\right]$

$$= \frac{1}{2}\frac{|V^+|^2}{Z_0}\left\{1 - |\Gamma_L|^2\right\}$$

Power transfer

$$P_{inc} = \frac{1}{2} \mathrm{Re}\left[V^+ I^{+*}\right]$$

$$= \frac{|V^+|^2}{2Z_0}$$

$$P_{refl} = \frac{1}{2} \mathrm{Re}\left[V^- I^{-*}\right]$$

$$= - |\Gamma_L|^2 \frac{|V^+|^2}{2Z_0}$$

↑ traveling back to source

$$P_L = P_{inc} + P_{refl} = \frac{|V^+|^2}{2Z_0}\left(1 - |\Gamma_L|^2\right)$$

Power transfer

Power anywhere along the line

Complex power $P(l) = \frac{1}{2} V(l) I(l)^*$

$$= \frac{1}{2}\left[V^+ e^{j\beta l}\left(1+\Gamma_L e^{-2j\beta l}\right)\right]\left[\frac{V^+}{Z_0} e^{j\beta l}\left(1-\Gamma_L e^{-2j\beta l}\right)\right]^*$$

$$= \frac{1}{2}\frac{|V^+|^2}{Z_0}\left\{1 - |\Gamma_L|^2 + \mathrm{Im}\left(\Gamma_L e^{-2j\beta l}\right)\right\}$$

$$\mathrm{Re}[P(l)] = \frac{|V^+|^2}{2Z_0}\left(1-|\Gamma_L|^2\right)$$

"independent of 'l'"

$$\mathrm{Im}(P(l)) = \frac{|V^+|^2}{2Z_0}\,\mathrm{Im}\left(\Gamma_L e^{-2j\beta l}\right)$$

"reactive power"