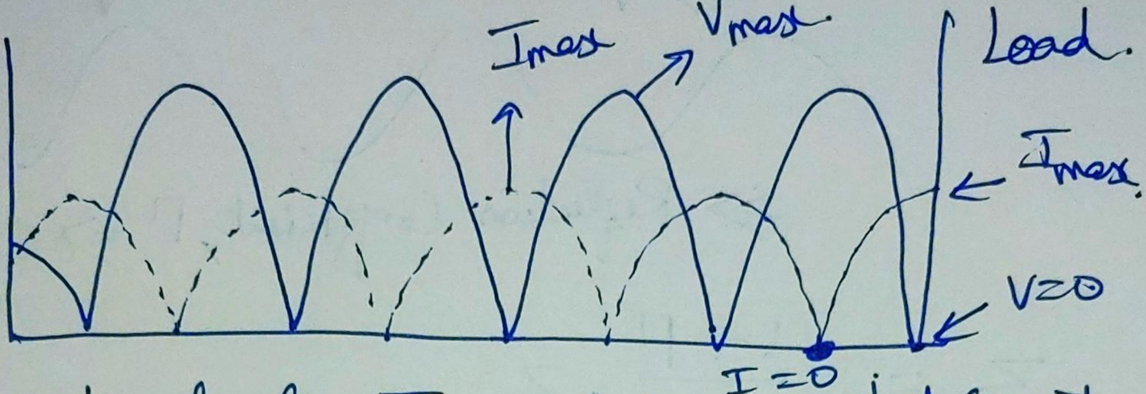
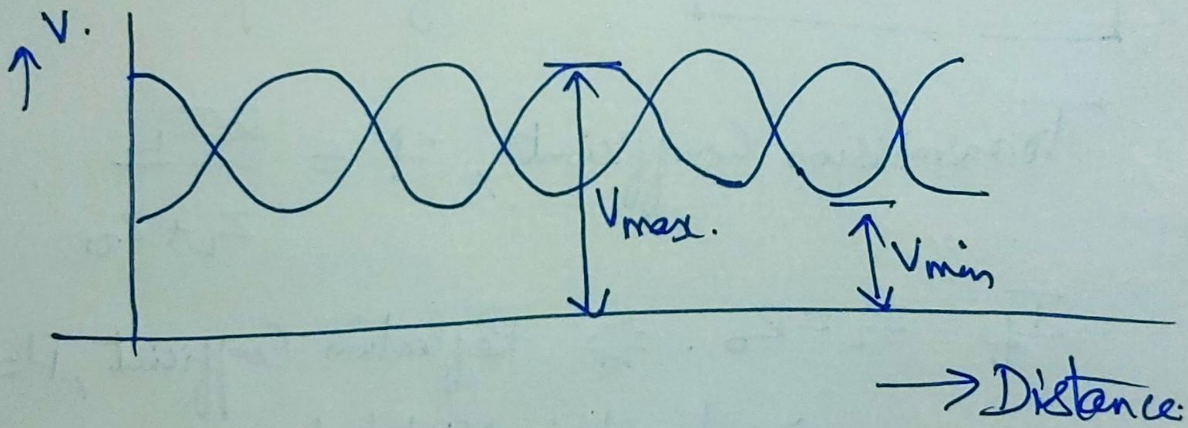


Lossless line Terminated in a short Circuit.

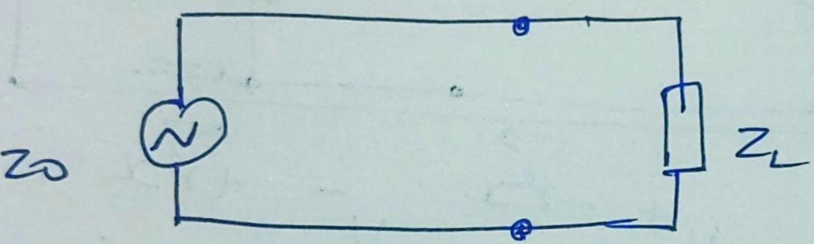
Standing Wave Ratio (SWR):-



VSWR

$$\text{VSWR} \Rightarrow \frac{V_{max}}{V_{min}} = \frac{1+|\Gamma|}{1-|\Gamma|}$$

$\Gamma \rightarrow$ Reflection Coefficient.



V_{max} :-

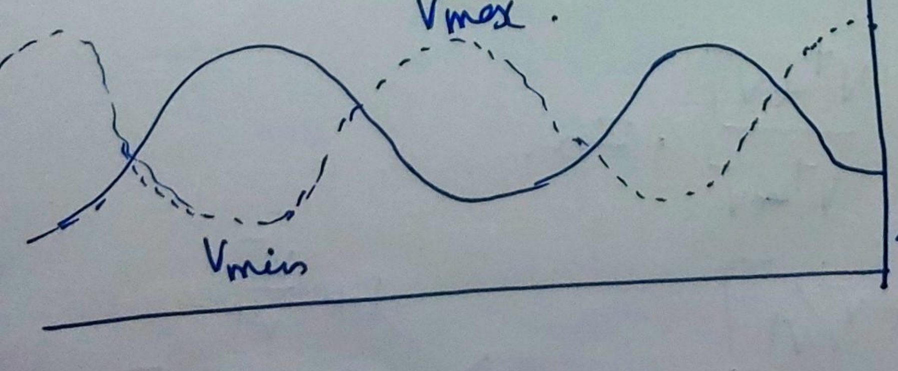
$$Z_{min} = \frac{-1}{2\beta}\left(\phi + (2m+1)\pi\right)$$

$m = 0, 1, 2, 3, \ldots$

V_{min} :-

$$Z_{max} = \frac{-1}{2\beta}\left(\phi + 2m\pi\right).$$

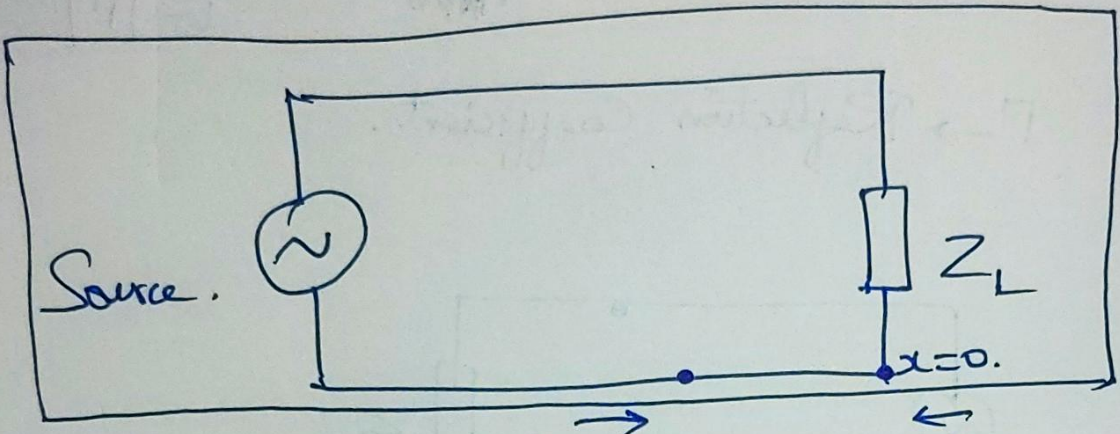
$m = 0, 1, 2, 3, \ldots$



$$Z_{max} = \frac{V_{max}}{I_{min.}} = Z_0 S$$

$$Z_{min} = \frac{V_{min}}{I_{max}} = \frac{Z_0}{S}$$

Reflection Co-efficient



$$V(x,t) = V^+ e^{-\gamma x} + V^- e^{+\gamma x}.$$

$$I(x,t) = I^+ e^{-\gamma x} + I^- e^{+\gamma x}.$$

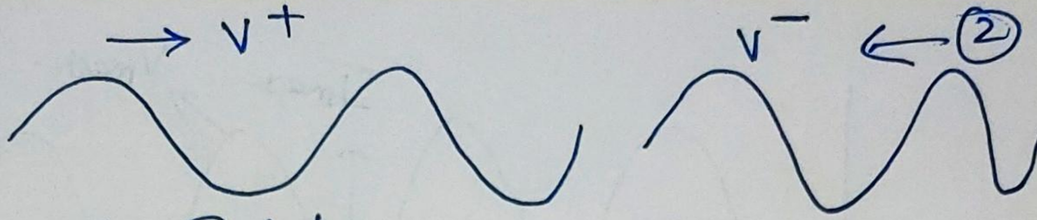
$$Z_0 = \frac{V^+}{I^+} \qquad -Z_0 = \frac{V^-}{I^-}$$

$$I(x,t) = \frac{V^+}{Z_0} e^{-\gamma x} + \frac{V^-}{-Z_0} e^{+\gamma x}$$

At $x=0$

$$Z_L = \frac{V}{I} = \frac{V^+ + V^-}{V^+ - V^-} \cdot Z_0.$$

$$Z_L = \frac{V^+\left[1 + V^-/V^+\right]}{V^+\left[1 - V^-/V^+\right]} \times Z_0 \Rightarrow \frac{1 + \frac{V^-}{V^+}}{1 - \frac{V^-}{V^+}} \cdot Z_0.$$



⇒ Reflection Coefficient, $\Gamma \Rightarrow \frac{V^-}{V^+}$.

$$Z_L = \frac{1+\Gamma}{1-\Gamma} \cdot Z_0.$$

$$\boxed{\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0}.}$$ ⇒ Reflection Coefficient interms of Impedance.

Transmission Coefficient, $\tau = \frac{2Z_L}{Z_L + Z_0}$.

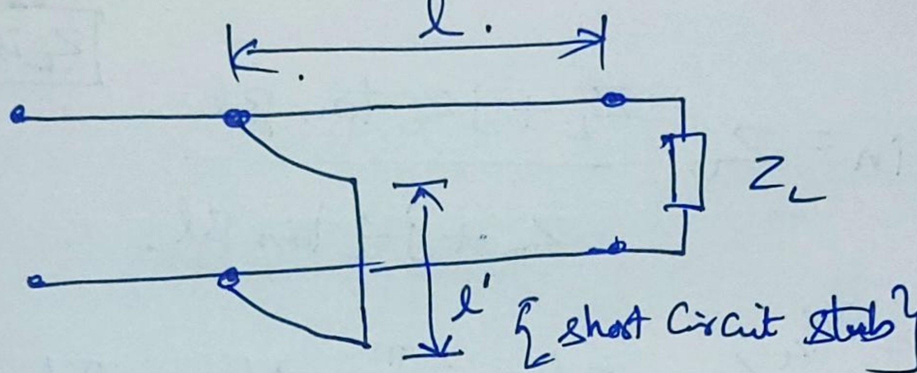
If $Z_L = Z_0$. ⇒ Reflection Coefficient, $\Gamma = 0$.

⇒ Load is Matched.

⇒ Max^{m} power is Transfered to the load.

STUB MATCHING.

To reduce Reflection, Impedance matching should be done.



The characteristic Impedance, Z_0 should be matched with the load to ensure maximum power transfer & also to withstand loss to standing waves.

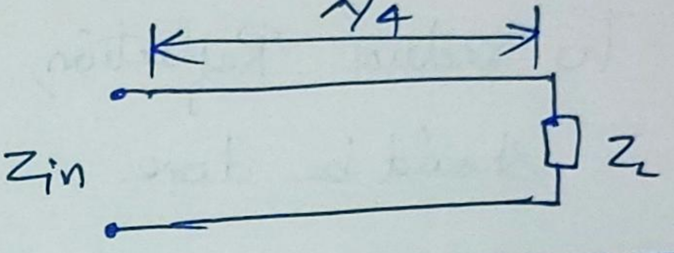
The reflected waves (reflected power) can damage the source.

High VSWR occurs due to Impedance mismatch between Source & Load.

(5)

Quarter wave Transformer.

$l = \lambda/4$.



$\boxed{Z_L \text{ is Resistive}}$

$$Z_{in} = Z_0 \frac{Z_L + jZ_0 \tan \beta l}{Z_0 + jZ_L \tan \beta l}.$$

$l = \lambda/4$; $\quad \beta l = \frac{2\pi}{\lambda} \cdot \lambda/4 = \pi/2$.

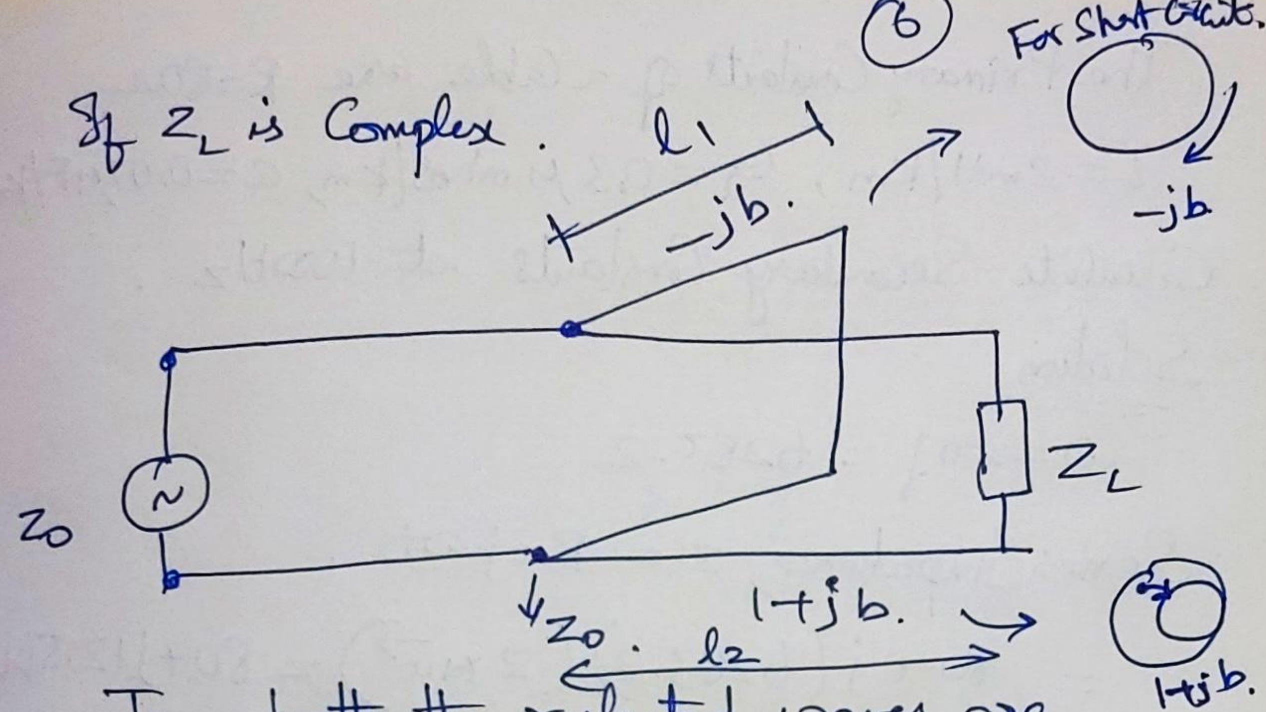
$\tan \beta l = \tan \frac{\pi}{2} = \infty$

$$\Rightarrow Z_{in} = \frac{Z_0 \cdot \tan \beta l \left\{ \frac{Z_L}{\tan \beta l} + jZ_0 \right\}}{\tan \beta l \left\{ \frac{Z_0}{\tan \beta l} + jZ_L \right\}}$$

$$Z_{in} = Z_0 \left[\frac{jZ_0}{jZ_L} \right] \Rightarrow \boxed{Z_{in} = \frac{Z_0^2}{Z_L}}$$

⑥

If Z_L is Complex.



If both the reflected waves are out of phase and & of equal in amplitude,

$\Rightarrow$ both the reflected waves get Cancelled.

$\Rightarrow$ Reflection is Zero

$\Rightarrow$ Impedance is Matched.

$$Y = \frac{1}{Z_L} \Rightarrow g + jb.$$

$l \to$ length (distance) between stub & Load.

$Y = \underline{1} + jb$. at the stub. (Resistance part becomes 1).

$\Rightarrow Y_{eq} = 1 + jb - jb = \underline{1}$.

T. Line Problem :-

The Primary Constants of a Cable are $R = 80\Omega$

$L = 2mH/Km$, $G = 0.3\,\mu$ mhos/Km, $C = 0.07\,\mu F/Km$,

Calculate Secondary Constants at 1000Hz.

Solution

$\omega = 2\pi f = 6283.2$

Series Impedance, $Z = R + j\omega L$.

$= 80 + j(6283.2)(2\times10^{-3}) = 80 + j12.566$

$= 80.98\angle 8.927^\circ$

Shunt Admittance, $Y = G + j\omega C$.

$= (0.3\times10^{-6}) + j(6283.2)(0.07\times10^{-6})$

$= 0.3\times10^{-6} + j4.398\times10^{-4} \Rightarrow 4.398\times10^{-4}\angle 89.96^\circ$

characteristic Impedance, $Z_0 = \sqrt{\frac{Z}{Y}} = 429\angle -40\,\Omega$

propagation Constant, $\gamma = \sqrt{Z \cdot Y}$

$\gamma = 0.1227 + j\,0.1434$.

$$\boxed{\begin{array}{l} \alpha = 0.1227 \text{ nepers/Km} \\ \beta = 0.1434 \text{ radians/Km} \end{array}}$$