SNS COLLEGE OF ENGINEERING

(Autonomous)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

19EC502 – TRANSMISSION LINES AND ANTENNAS

III YEAR/ V SEMESTER

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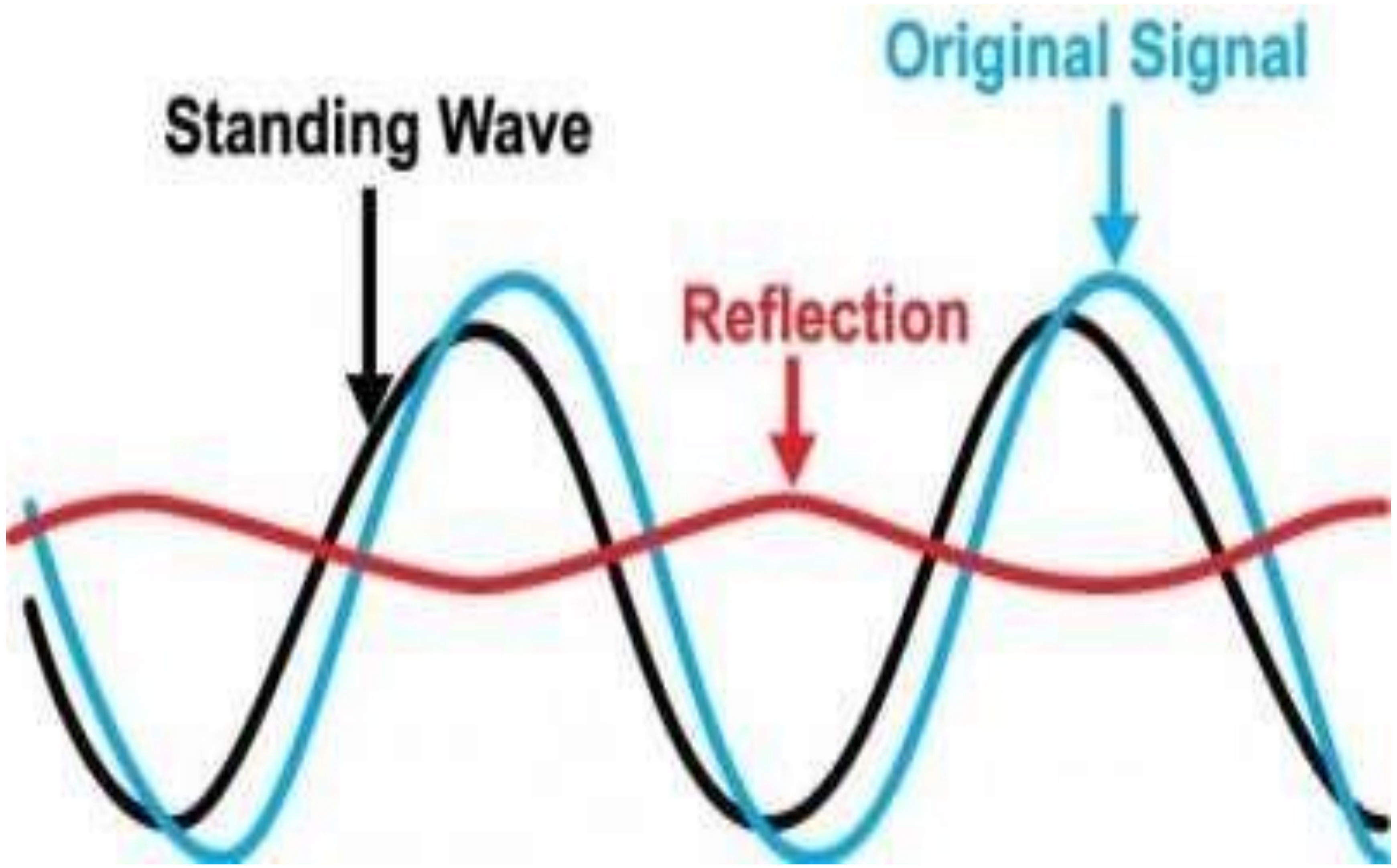
UNIT 1 – TRANSMISSION LINE THEORY

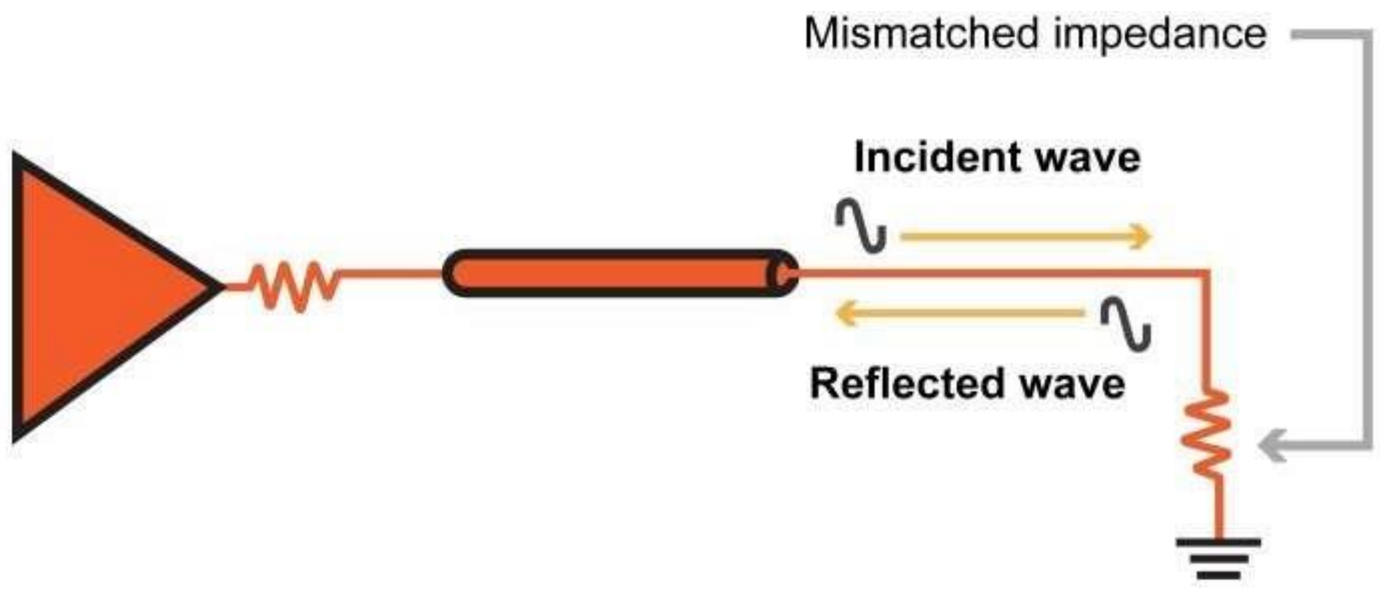
TOPIC – IMPEDANCE MATCHING & QUARTER WAVE LINE

WHAT DO YOU INFER FROM THE DIAGRAM ?



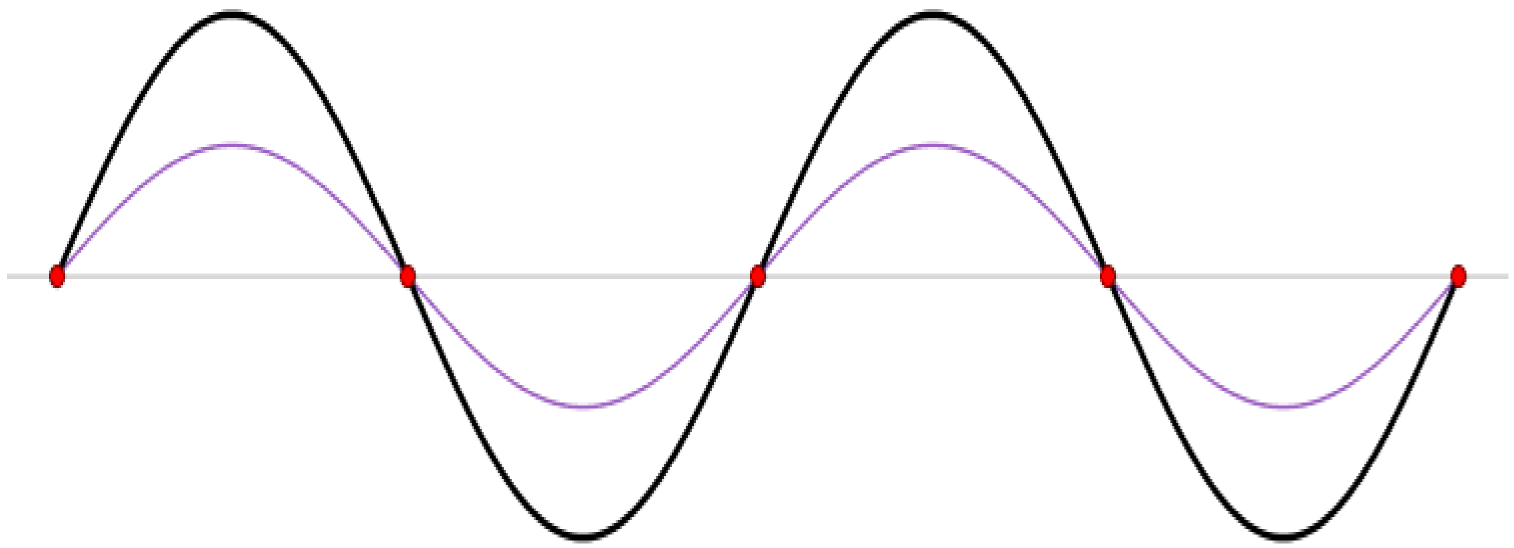
IMPEDANCE MISMATCH AND EFFECTS

- Load impedance is not matched with the characteristic impedance of the transmission line, reflections occur
- This allows the load to absorb the wave energy resulting in power loss



IMPEDANCE MISMATCH AND EFFECTS

- Reflections are problematic because they reduce the amount of power that can be transferred from source to load
- Reflections also lead to standing waves
- The high-amplitude portions of a standing wave can damage components or cables

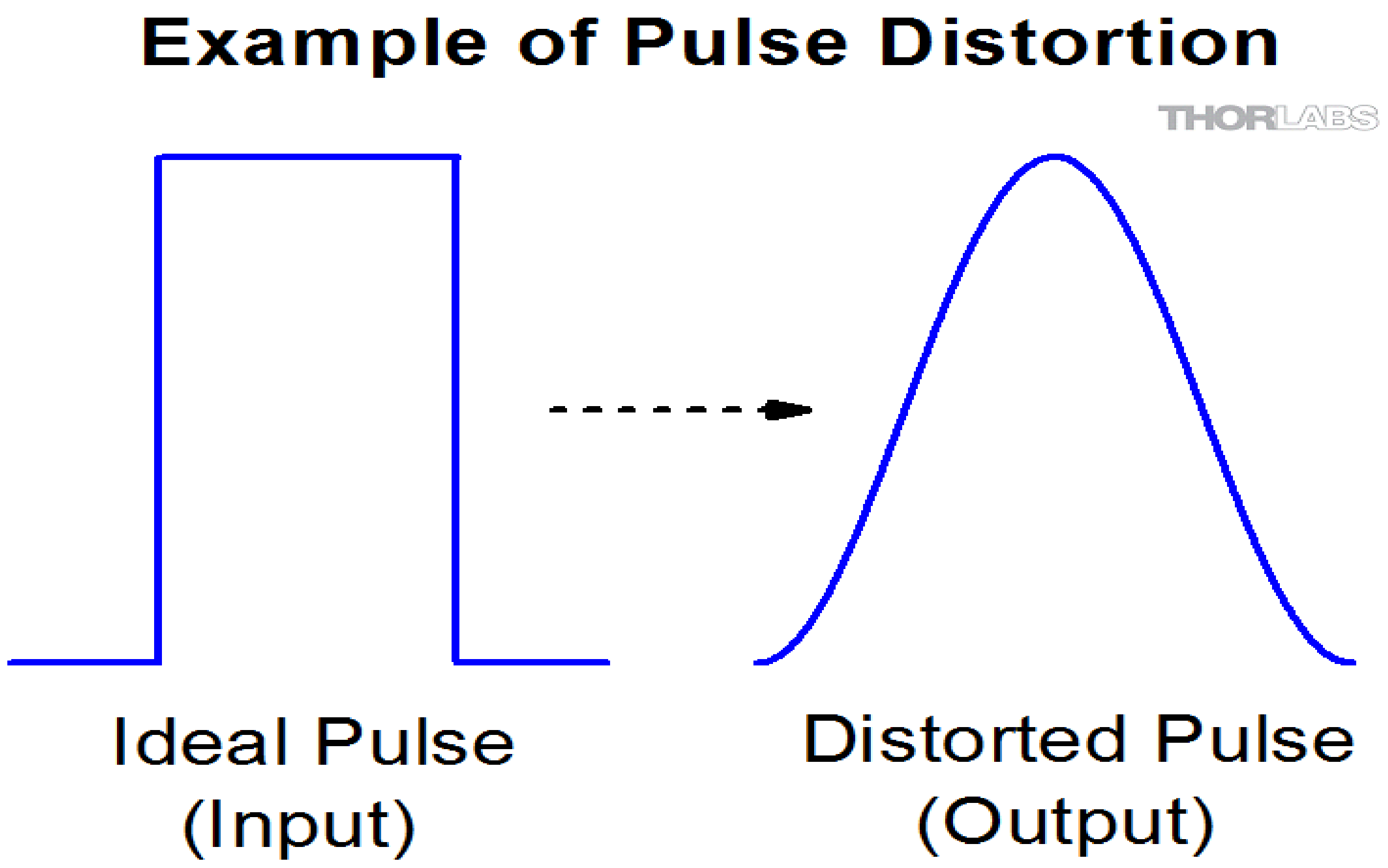


IMPEDANCE MISMATCH AND EFFECTS

- In applications like TV picture transmission, reflection make impairment of picture quality due to ghost images.

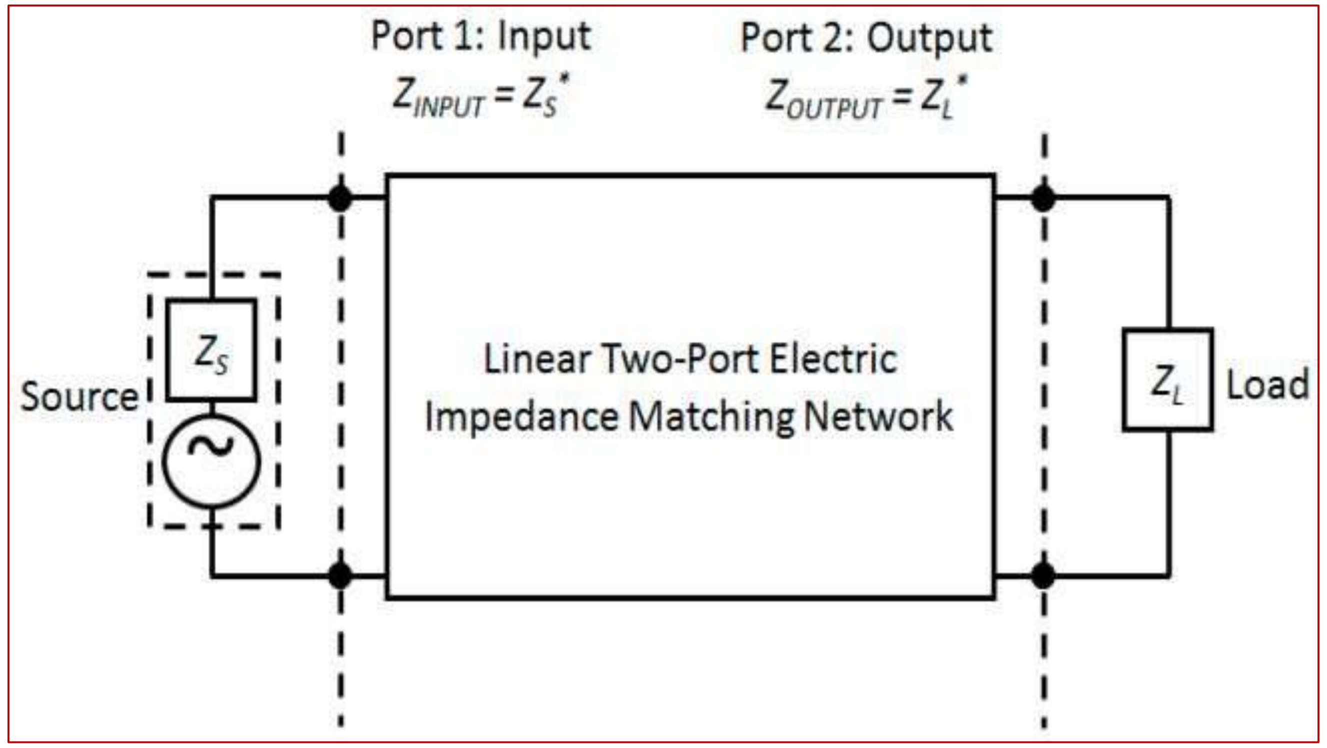
IMPEDANCE MISMATCH AND EFFECTS

- In applications like transmission of pulses, pulse shape distortion occurs
- Problem of frequency stability
- Signal strength get reduced which reduces signal-to-noise ratio



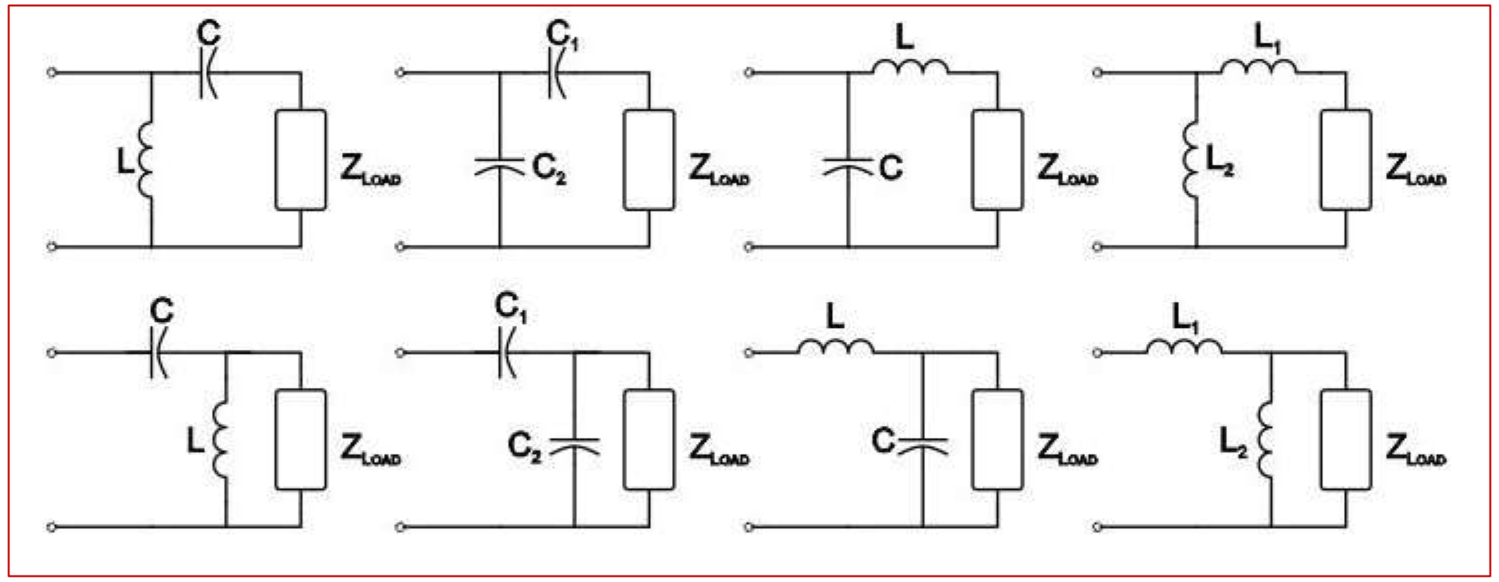
IMPEDANCE MATCHING NETWORKS

- Impedance matching networks are impedance transformers
- They transform the load impedance to the characteristic impedance of the line or
- To transform the line impedance to equal source impedance to provide impedance matching



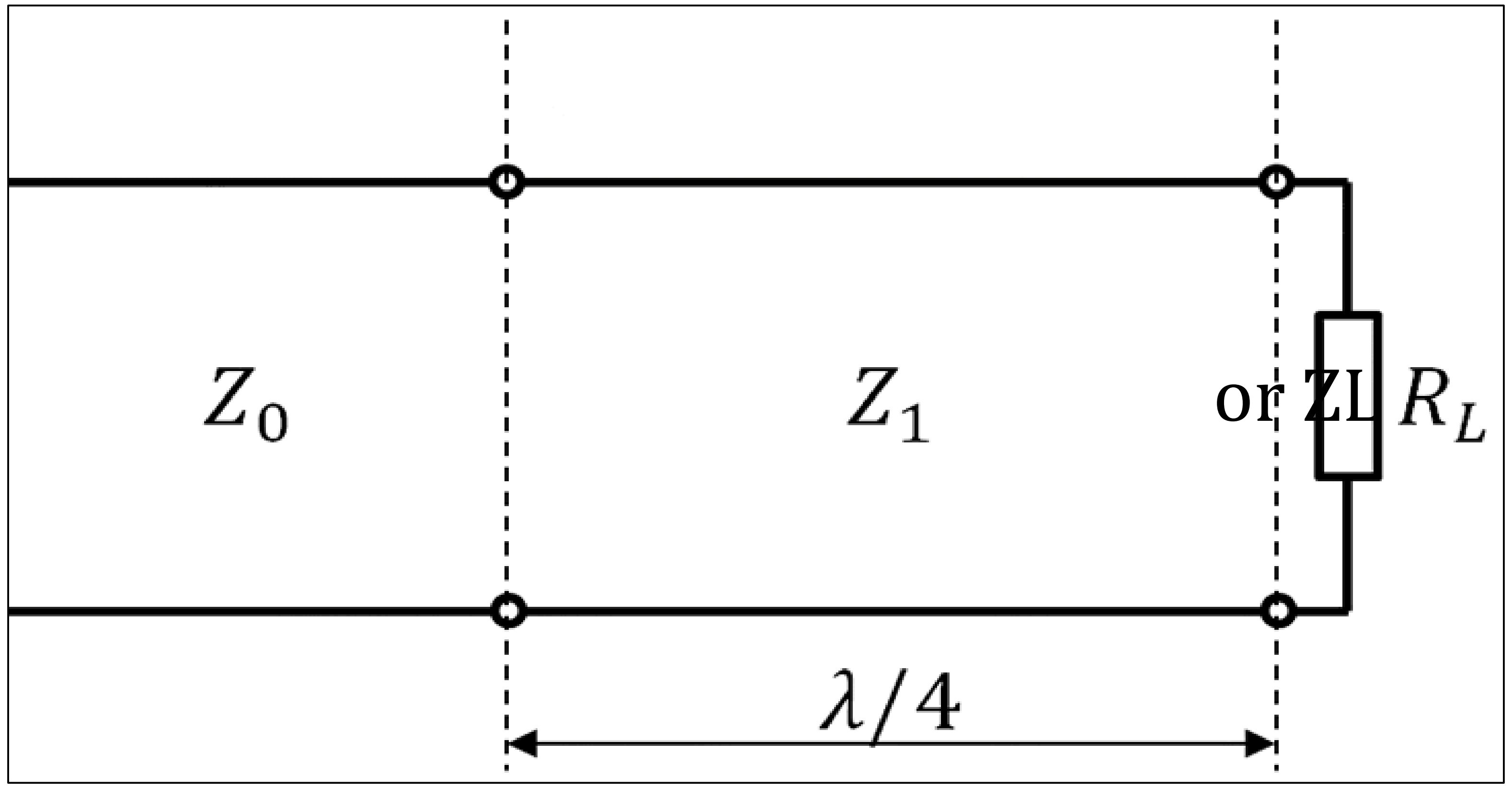
IMPEDANCE MATCHING NETWORKS - TYPES

- Using inductance or capacitance and a section of transmission line
- Using L-C combination
- Using quarter wave transformers
- Using half wave line and eighth wave lines
- Using short circuited stubs



IMPEDANCE MATCHING NETWORKS – QUARTER WAVE TRANSFORMER

- Fig shows a lossless transmission line with characteristic impedance Z connected to load ZL
- Since Z_0 ≠ ZL , a quarter wave transformer is inserted for impedance matching.
- Length of quarter wave transformer is λ/4
- Input impedance of the transformer is Zs = $R_{0\,2}/Z_R$



IMPEDANCE MATCHING NETWORKS – QUARTER WAVE TRANSFORMER

$$Z_s = Z_0 \left[\frac{Z_R + jR_0 \tan \beta s}{R_0 + jZ_R \tan \beta s} \right]$$

Dividing by $\tan \beta s$

$$Z_s = R_0 \left[\frac{\frac{Z_R}{\tan \beta s} + jR_0}{\frac{R_0}{\tan \beta s} + jZ_R} \right]$$

$$\beta s = \frac{2\pi}{\lambda} \times \frac{\lambda}{4_2} = \pi/2$$

$$\therefore Z_s = R_0 \left[\frac{\frac{Z_R}{\tan \pi/2} + jR_0}{\frac{R_0}{\tan \pi/2} + jZ_R} \right]$$

$$\tan \pi/2 = \infty$$

$$Z_s = R_0 \left[\frac{jR_0}{jZ_R} \right] = \frac{R_0^2}{Z_R}$$

$$\boxed{Z_s = \frac{R_0^2}{Z_R}}$$

QUARTER WAVE TRANSFORMER - APPLICATIONS

- Used as a transformer
- Used as an impedance inverter
- Used to couple a transmission line to a resistive load
- Used if the load is not pure resistance
- Used as an insulator