SNS COLLEGE OF ENGINEERING

(Autonomous)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

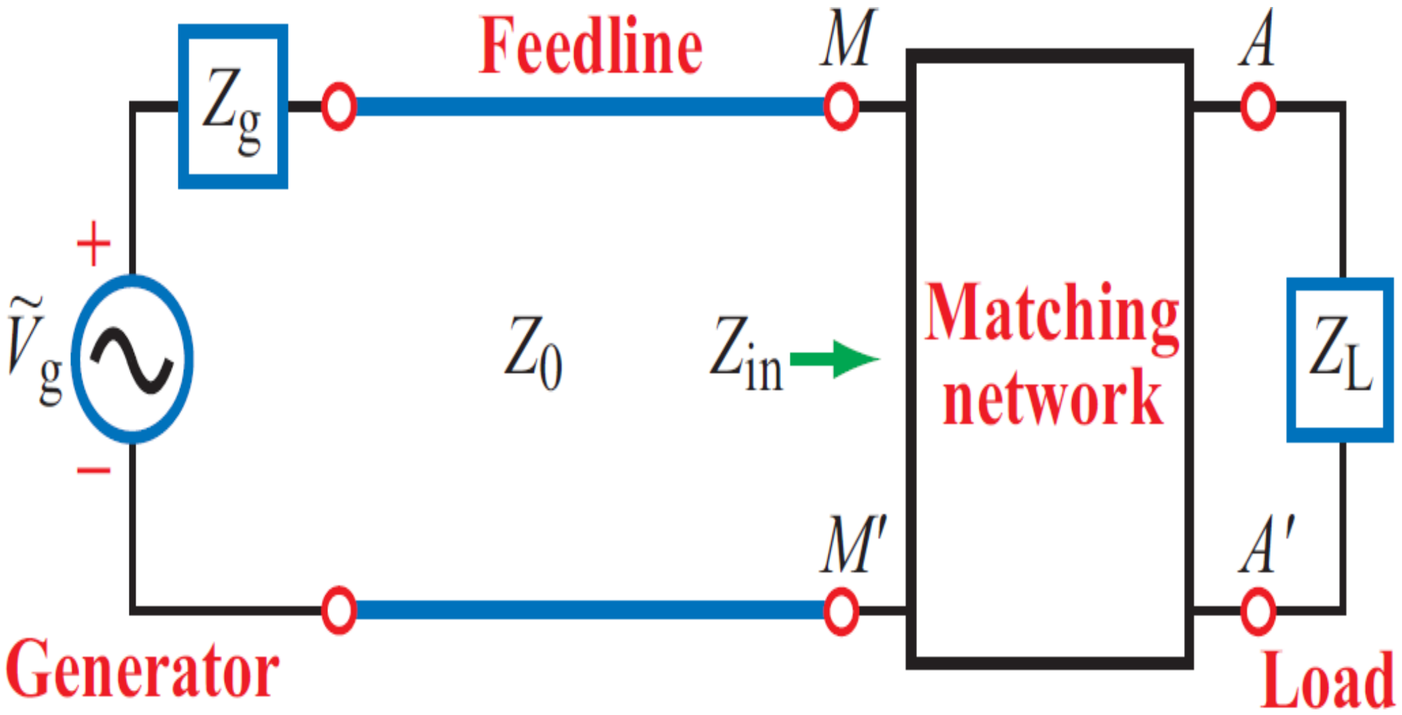
19EC502 – TRANSMISSION LINES AND ANTENNAS

III YEAR/ V SEMESTER

UNIT 1– TRANSMISSION LINE THEORY

TOPIC – SINGLE STUB MATCHING

MATCHING NETWORKS



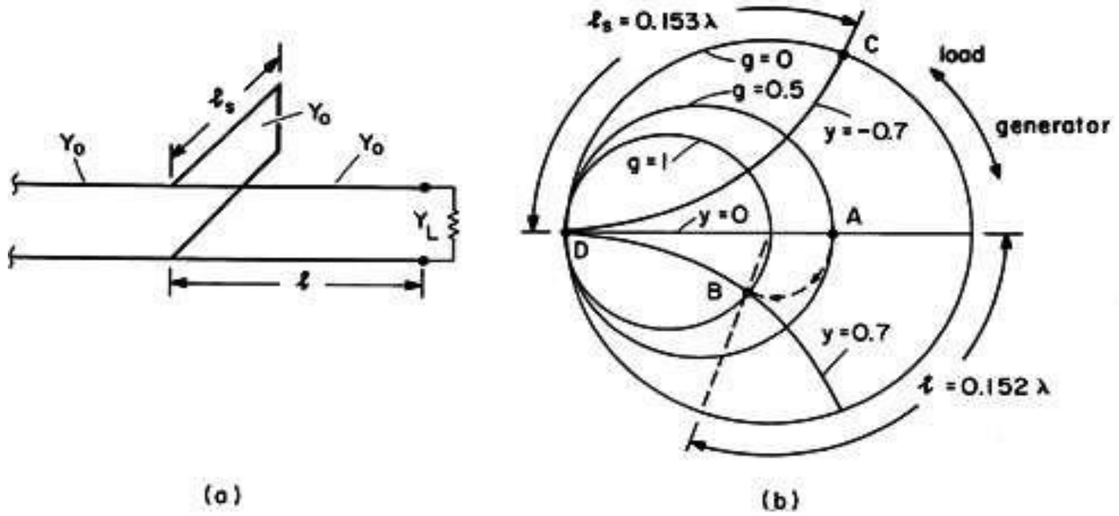
What is the purpose of matching networks of a transmission line?

MATCHING NETWORKS

- When a high frequency line is terminated in its characteristic impedance R_0 , it is operated as a smooth line
- Under such conditions,
  - there will be no reflections
  - maximum power delivered to the load
  - increased efficiency
- But in practice the loads such as antennas do not provide resistances equal to R_0 of the line
- So it is necessary to add some of the impedance matching networks between the line and load

STUB MATCHING

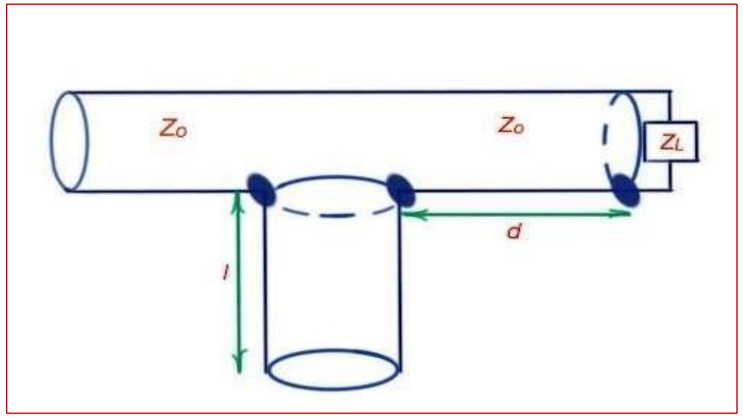
- One of the impedance matching is to use open or short circuited stubs
- A stub of suitable length is connected in parallel with the line at a certain distance from the load
- Because of parallel connection of stub, it is convenient to work with admittances

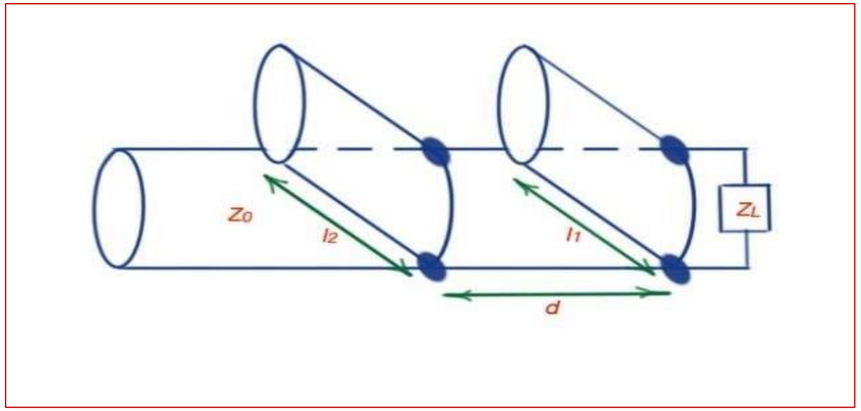


STUB MATCHING - TYPES

1. **Single stub matching** - A stub is connected in parallel to the transmission line at a fixed distance from load

2.Double stub matching - A type of matching where two stubs are shunted to main transmission line on a fixed distance



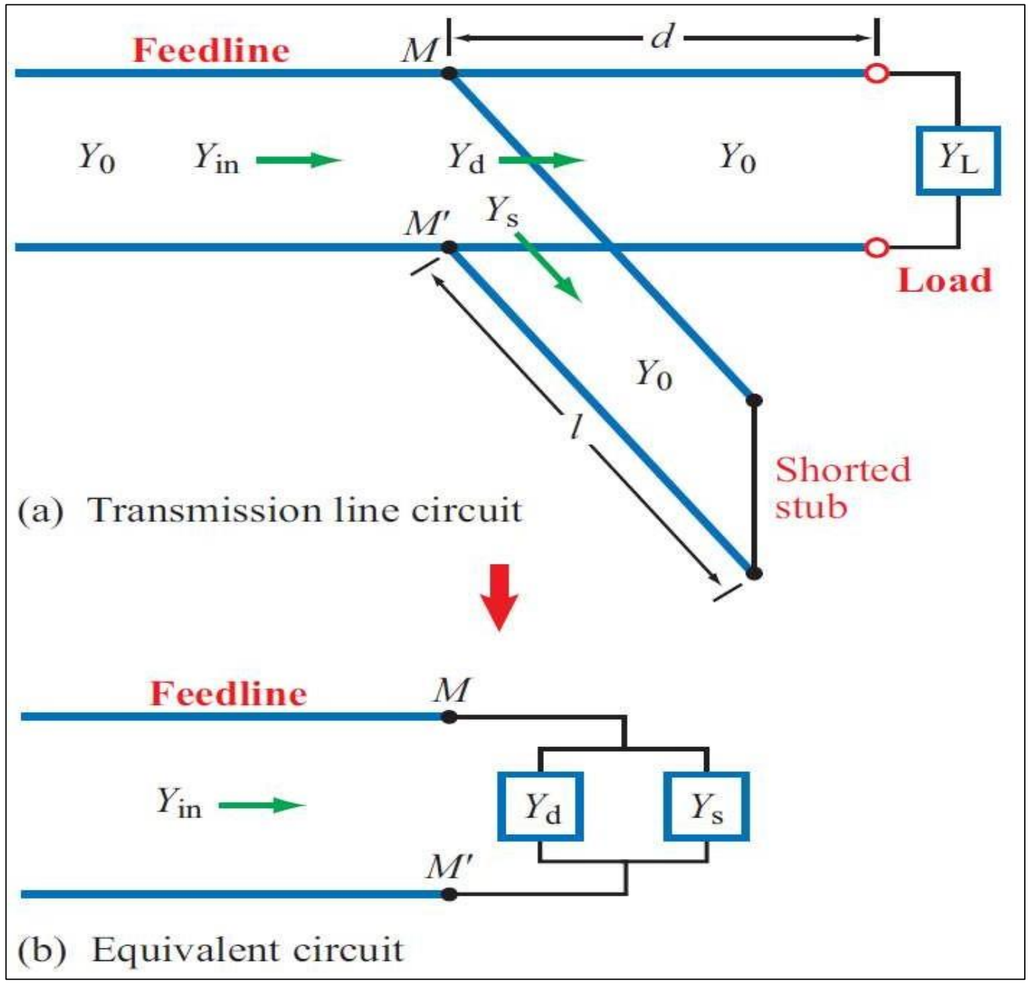


SINGLE STUB MATCHING - PRINCIPLE

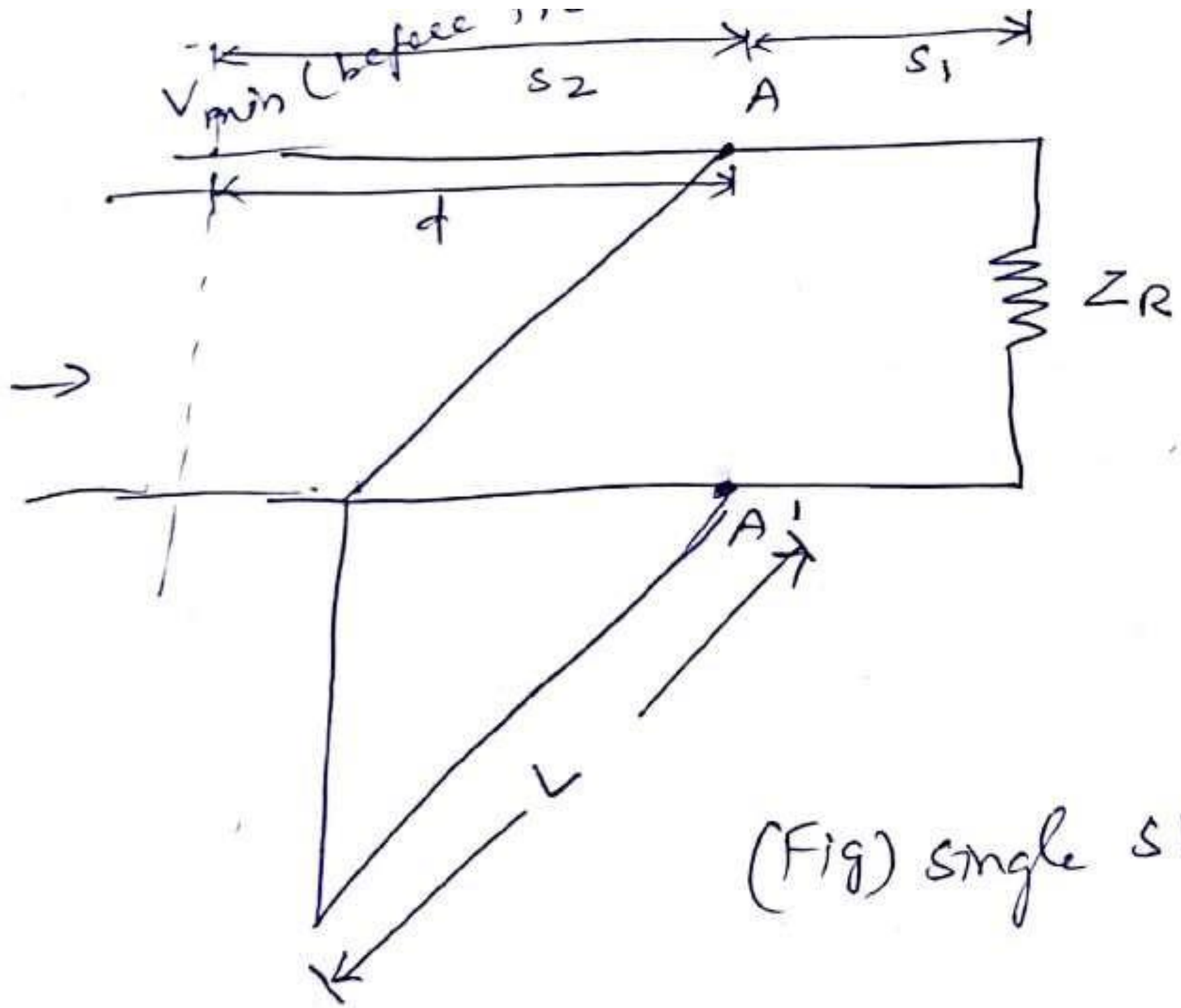
- The input impedance at any point on a line is given by
  $Z_S = R_0 \pm jX$
- The input admittance is
  $$Y_S = G_0 \pm jB$$
- Then the short circuited stub of $\mp jB$ is connected at that point across the transmission line
- Then the total admittance is given by,
  $$Y_S = G_0 \pm jB \mp jB = G_0$$
  $$Z_S = R_0$$
- Thus the line from the source to the point is then terminated in R_0. It act as a smooth line

SINGLE STUB MATCHING – DESIGN PARAMETERS

- **Design parameters**
  - The point of stub connection
  - Length of the stub



SINGLE STUB MATCHING - DIAGRAM



(Fig) single stub matching.

LENGTH OF THE STUB

$$L = \frac{\lambda}{2\pi} \tan^{-1}\left(\frac{\sqrt{1-|k|^2}}{2|k|}\right)$$

(or)

$$L = \frac{\lambda}{2\pi} \tan^{-1}\frac{\sqrt{s}}{s-1}$$

This is the length of the stub to be placed d meters towards the load from a point at which a Vmin existed before the attachment of the stub

DISTANCE OF THE STUB

$$d = \pm \frac{\cos^{-1}\left(\frac{S-1}{S+1}\right)\frac{\lambda}{4}}{\pi}$$

The stub should be connected at this distance from d measured from either direction from a Vmin nearest to the load

SINGLE STUB MATCHING - PROBLEM

A 75 Ohm lossless line is to be matched to a 100-j80 Ohms load with a shorted stub. Calculate the distance from the load, the stub length, and the necessary stub admittance.

Answer: Change z_L to admitance: Find d=distance to circle with real=1 as:

d=.4338- .3393=0.094l or

.0662-.1607 =0.094l (both yield same d)

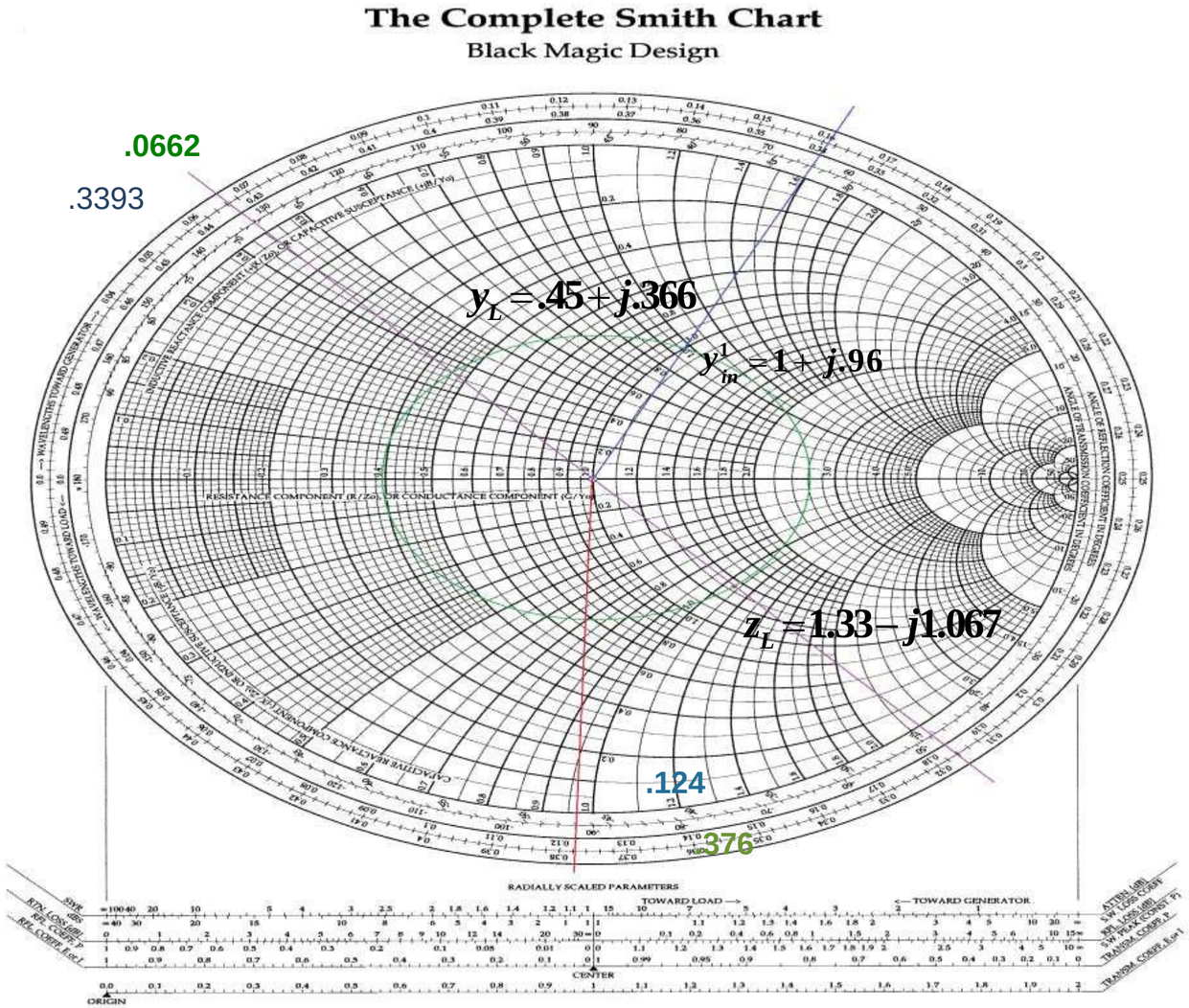
[or next intersection i.e. 1-jb :d=0.272l,]

Short stub:.25l-.124l=0.126l

Or 0.376l-.25l= 0.126l (both yield same distance)

With y_{stub}= -j.96/75 *=-j.0128 mhos

SINGLE STUB MATCHING - STEPS



SINGLE STUB MATCHING – ASSIGNMENT PROBLEM

A load impedance ZL= 25-j50 Ohms is connected to a 50 Ohm transmission line. Insert a shunt element to eliminate reflections towards the sending end of the line. Insert a shunt element to eliminate reflections towards the sending end of the line.

Specify the insert location d (in wavelengths), the type of element, and its value, given that f =100 MHz

ADVANTAGES OF SHORT CIRCUITED STUB OVER OPEN CIRCUITED STUB

- The length of short circuited stub can be easily changed but it is not easy in an open circuited stub
- Because of the shorting plate at the end mechanical rigidity of a short circuited stub is better than an open circuited stub
- The open circuit in the open circuited stubs do not behave like a true open circuit
- Poses fabrication problem

THANK YOU