Microwave Techniques

Impedance Matching - Single Stub Tuning

Prof. Dr. Gökhan Çınar
Autumn 2016

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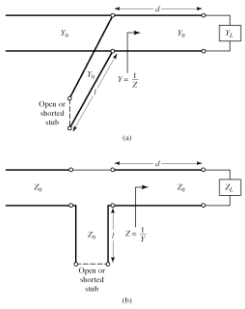
ELECTRICAL AND ELECTRONICS ENGINEERING

Single Stub Tuning



- Another popular matching technique uses a single O-C or S-C terminated transmission line (a stub) connected either in parallel or in series with the TL.
- Tuning circuit is very convenient because the stub can be fabricated as part of the
- transmission line media of the circuit, and lumped elements are avoided.
- Shunt stubs are preferred for microstrip line or stripline, while series stubs are preferred for slotline or coplanar waveguide.

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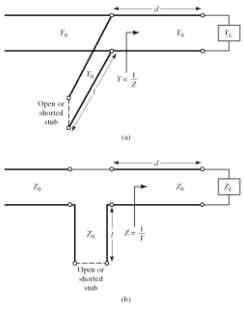

- In single-stub tuning, two adjustable parameters are d (*the distance of the stub position to the load*) and l (*length of the stub*).
- For the shunt-stub case, the task is to select d so that the admittance, Y, seen looking into the line at distance d from the load is of the form $Y_0 + jB$. Then the stub susceptance is chosen as $-jB$, resulting in a matched condition.
- For the series-stub case, the distance d is selected so that the impedance, Z, seen looking into the line at a distance d from the load is of the form $Z_0 + jX$. Then the stub reactance is chosen as $-jX$, resulting in a matched condition.

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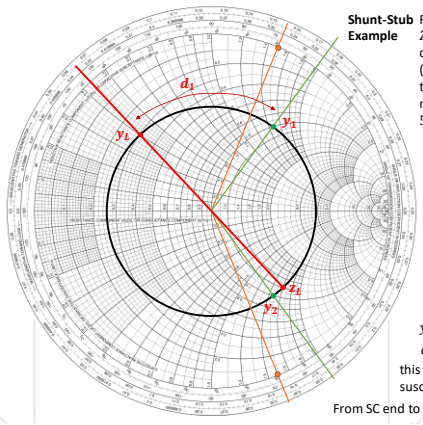


Shunt-Stub Example For a load impedance $Z_L = 60 - j80\ \Omega$, design two single-stub (short circuit) shunt tuning networks to match this load to a $50\ \Omega$ line.

$z_L = 1.2 - j1.6$

$y_L = 0.3 + j0.4$

$y_1 = 1.0 + j1.47$

$d_1 = 0.110\lambda$

this stub needs a susceptance of $-j1.47$

From SC end to line:

$l_1 = 0.095\lambda$

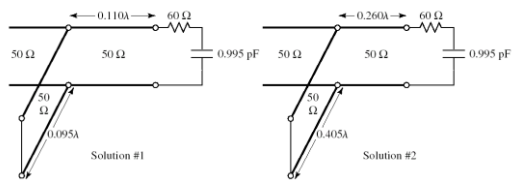
$y_2 = 1.0 - j1.47$

$d_2 = 0.260\lambda$

this stub needs a susceptance of $j1.47$.

From SC end to line: $l_2 = 0.405\lambda$

Single Stub Tuning Example



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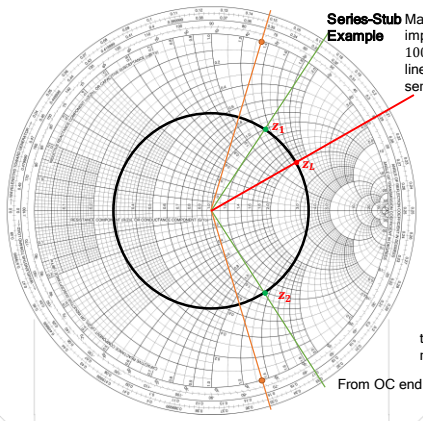


Series-Stub Example Match a load impedance of $Z_L = 100 + j80\ \Omega$ to a $50\ \Omega$ line using a single series open-circuit stub.

$z_L = 2.0 + j1.6$

$z_1 = 1.0 + j1.34$

$d_1 = 0.464\lambda$

this stub needs a reactance of $-j1.34$

From OC end to line:

$l_1 = 0.103\lambda$

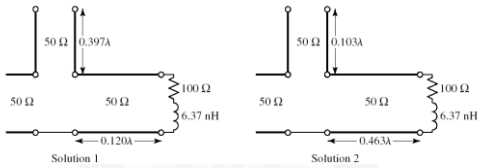
$z_2 = 1.0 - j1.34$

$d_2 = 0.120\lambda$

this stub needs a reactance of $j1.34$.

From OC end to line: $l_2 = 0.397\lambda$

Single Stub Series Example



Single Stub Exercise 1

A load impedance $Z_L = 100 + j80\ \Omega$ is to be matched to a $75\ \Omega$ line using a single shunt-stub tuner. Find two designs using open-circuited stubs.

Repeat the problem for short-circuited stubs.

Single Stub Exercise 2

A load impedance $Z_L = 90 + j60\ \Omega$ is to be matched to a $75\ \Omega$ line using a single series-stub tuner. Find two designs using short-circuited stubs.

Repeat the problem for open-circuited stubs.