Single stub tuning

* Single stub tuning may be used to match any load impedance with positive real part to feeder transmission line
* Single stub tuning is easily implemented on printed circuits and is frequently used in amplifiers, oscillators.

Geometry of single stub tuned circuit

\[ d \]

\[ 2_0, \beta_0 \]

\[ c \]

\[ 2_0, \beta_0 \]

\[ 2s \]

\[ 2L \]

\[ 2s \]

\[ 2s \] - selected as either short circuit (0) or open circuit (oo)

a) Shunt stub

b) Parallel stub
Explanation of matching procedure:

1) Shunt stub (admittance matching)

2) Design the stub so that its length L creates susceptance equal to the susceptance right of the stub, but of the opposite sign. That is, design stub susceptance to cancel the susceptance of the impedance right of the stub.

3) Series stub (impedance matching)
1) Use section of TX line length \( d \) to make the impedance right of the stub to one of two points on the unit impedance circle.

2) Design reactance of the stub to cancel the reactance of the section right of the stub.

**Example 2.6. Single stub shunt-tuning**

\[
2L = 20 - j15.52 \\
2o = 50 \Omega
\]

\[
2L = \frac{21}{20} = \frac{(20-j15)}{50} = 0.4 - j0.3
\]

\[
y_L = \frac{1}{2L} = 1.6 + j1.2
\]
Two solutions

Distance $d_1$ to the solution $y_1$

$$d_1 = (0.836 - 0.196)\,\lambda = 0.64\,\lambda$$

Distance $d_2$ to the second solution

$$d_2 = [(0.5 + 0.164) - 0.196]\,\lambda = 0.468\,\lambda$$

Note: there is actually infinite number of solutions at distances given by $d_1, d_2 + k\,\lambda/2$, $k = 1, 2, 3, 4, \ldots$. Usually, it is desired to keep watching close to the load.

The two solutions are given as

$$y_1 = 1 - j1.061$$
$$y_2 = 1 + j1.061$$

Therefore, the first solution requires shunt with admittance $+j1.061$ and the second one requires shunt with admittance $-j1.061$.

If the open-circuit shunt is used $(y = 0)$

$$l_1 = 0.13\,\lambda \quad \text{(compensates y_1)}$$

$$l_2 = 0.37\,\lambda \quad \text{(compensates y_2)}$$

If the short-circuit shunt is used $(y = \infty)$

$$l_1 = (0.25 + 0.13)\,\lambda = 0.37\,\lambda$$

$$l_2 = (0.37 - 0.25)\,\lambda = 0.13\,\lambda$$
Homework 4

Problems: 2.21, 2.22, 2.24 & 2.26.

* Ask students to review section 3.1 for next class. Section 3.1 covers basics of random variables and random processes. It would be assumed that the concepts in section 3.1 are well known for the rest of the course.

Additional references: