

## 5.3 - Double-Stub Tuning

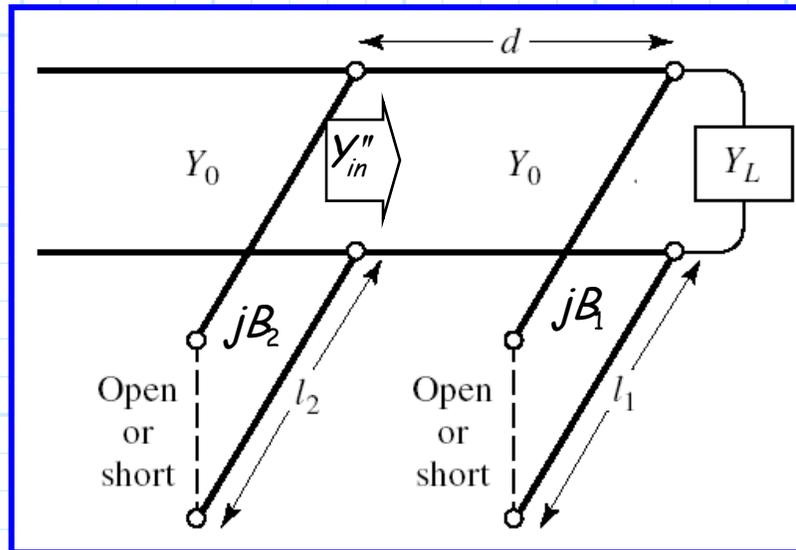
**Reading Assignment:** *pp. 235-240*

Alternative to the **single**-stub tuner is the **double**-stub tuner.

**HO: THE DOUBLE-STUB TUNER**

# Double Stub Tuning

Another way to build a matching network is with a **double stub tuner**:



In this design,  $d$  is a **fixed** length (typically,  $d = \lambda/8$ ), whereas lengths  $l_1$  and  $l_2$  are **design parameters**.

**Q:** Why are  $l_1$  and  $l_2$  design parameters, but *not* length  $d$ ?

**A:** Because the lengths  $l_1$  and  $l_2$  can be **easily altered**—the matching network is physically **tunable**!

## Design Procedure

1. Set  $jB_1$  such that  $\text{Re}\{Y''_{in}\} = Y_0$ , i.e.,

$$\text{Re} \left\{ Y_0 \frac{(Y_L + jB_1) + jY_0 \tan \beta d}{Y_0 + j(Y_L + jB_1) \tan \beta d} \right\} = Y_0$$

or equivalently:

$$\operatorname{Re} \left\{ \frac{G_L + j(B_L + B_1 + Y_0 \tan \beta d)}{Y_0 - (B_L + B_1) \tan \beta d + j G_L \tan \beta d} \right\} = 1$$

where  $Y_L = G_L + jB_L$ .

**Problem:** There may be no solution  $jB_1$  that satisfies this equation! There exists **some** load impedances  $Z_L$  ( $Y_L$ ) that **cannot** be matched with a double stub tuner.



These loads are said to lie in the scary **forbidden region** (eq. 5.21). We will find that these load impedances have **real** (resistive) parts that are **large** (e.g.,  $R_L \gg Z_0$ ).

2. Set  $jB_2$  such that:

$$\operatorname{Im}\{Y_{in}'' + jB_2\} = 0$$

or equivalently:

$$B_2 = -\operatorname{Im}\{Y_{in}''\}$$

The resulting input admittance is thus:

$$Y_{in} = Y_{in}'' + jB_2 = Y_0 \quad (\text{real})$$

The design equations are provided on pp. 240, **OR** we can use a Smith Chart (see **example 5.4**) to find the solutions!