7.6 – Coupled-Line Directional Couplers

Reading Assignment: *pp. 337-348*

Q: *The Quadrature Hybrid is a 3dB coupler. How do we build couplers with **less coupling**, say 10dB, 20dB, or 30 dB?*

A: Directional couplers are typically built using **coupled lines.**

HO: COUPLED LINE COUPLERS

Q: *How can we **design** a coupled line couplers so that is an **ideal** directional coupler with a **specific** coupling value?*

A: **HO: ANALYSIS AND DESIGN OF COUPLED-LINE COUPLERS**

Q: *Like all devices with quarter-wavelength sections, a coupled line coupler would seem to be inherently **narrow band**. Is there some way to **increase coupler bandwidth**?*

A: **Yes!** We can add more coupled-line sections, just like with **multi-section** matching transformers.

HO: MULTI-SECTION COUPLED LINE COUPLERS

Q: *How do we **design** these multi-section couplers?*

A: All the requisite design examples were provided in the last handout, and there are two good design examples on pages 345 and 348 of your textbook!

Coupled-Line Couplers

Two transmission lines in **proximity** to each other will **couple** power from one line into another.

This proximity will **modify** the electromagnetic fields (and thus modify voltages and currents) of the propagating wave, and therefore **alter** the **characteristic impedance** of the transmission line!

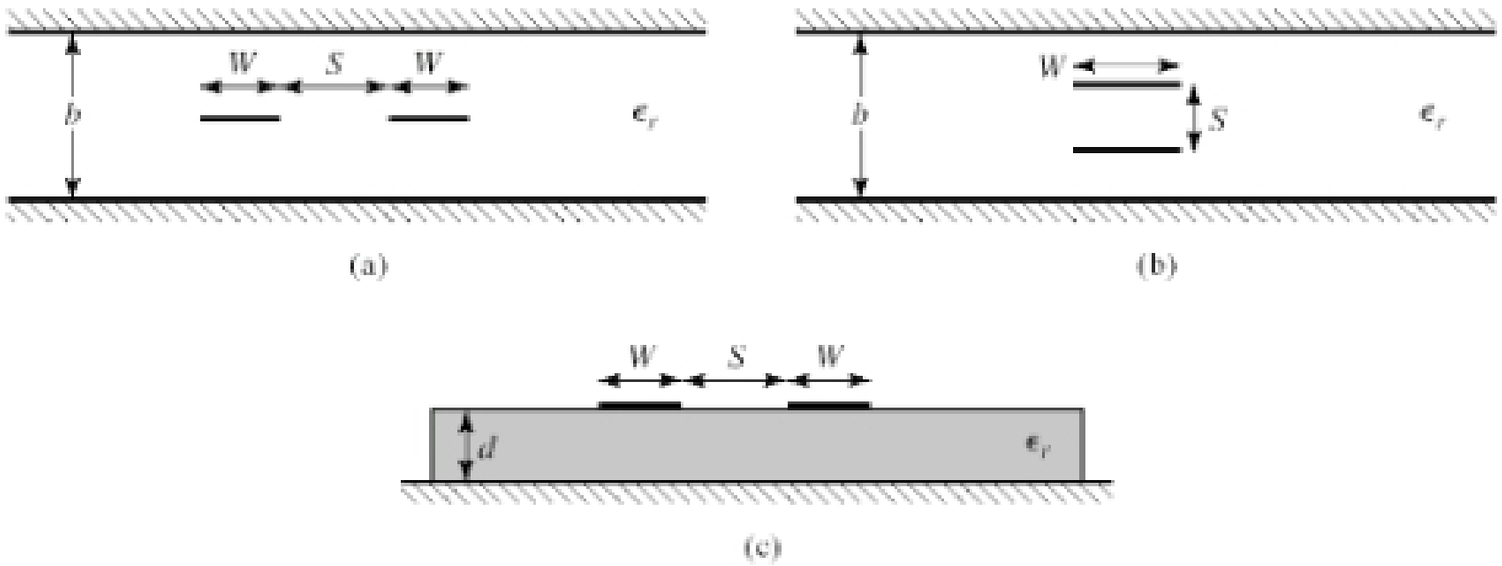


Figure 7.26 (p. 337)
Various coupled transmission line geometries. (a) Coupled stripline (planar, or edge-coupled). (b) Coupled stripline (stacked, or broadside-coupled). (c) Coupled microstrip.

Generally, speaking, we find that this transmission lines are **capacitively coupled** (i.e., it appears that they are connected by a capacitor):

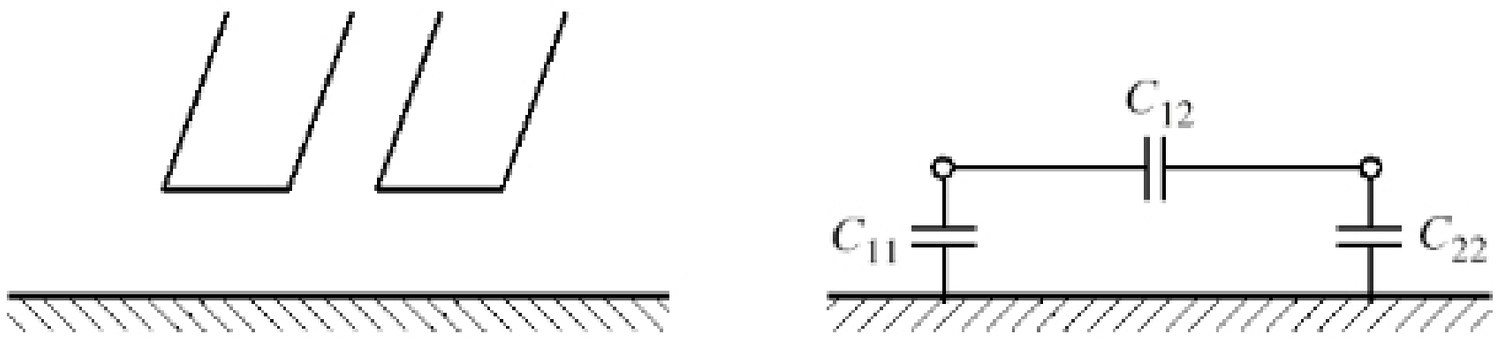
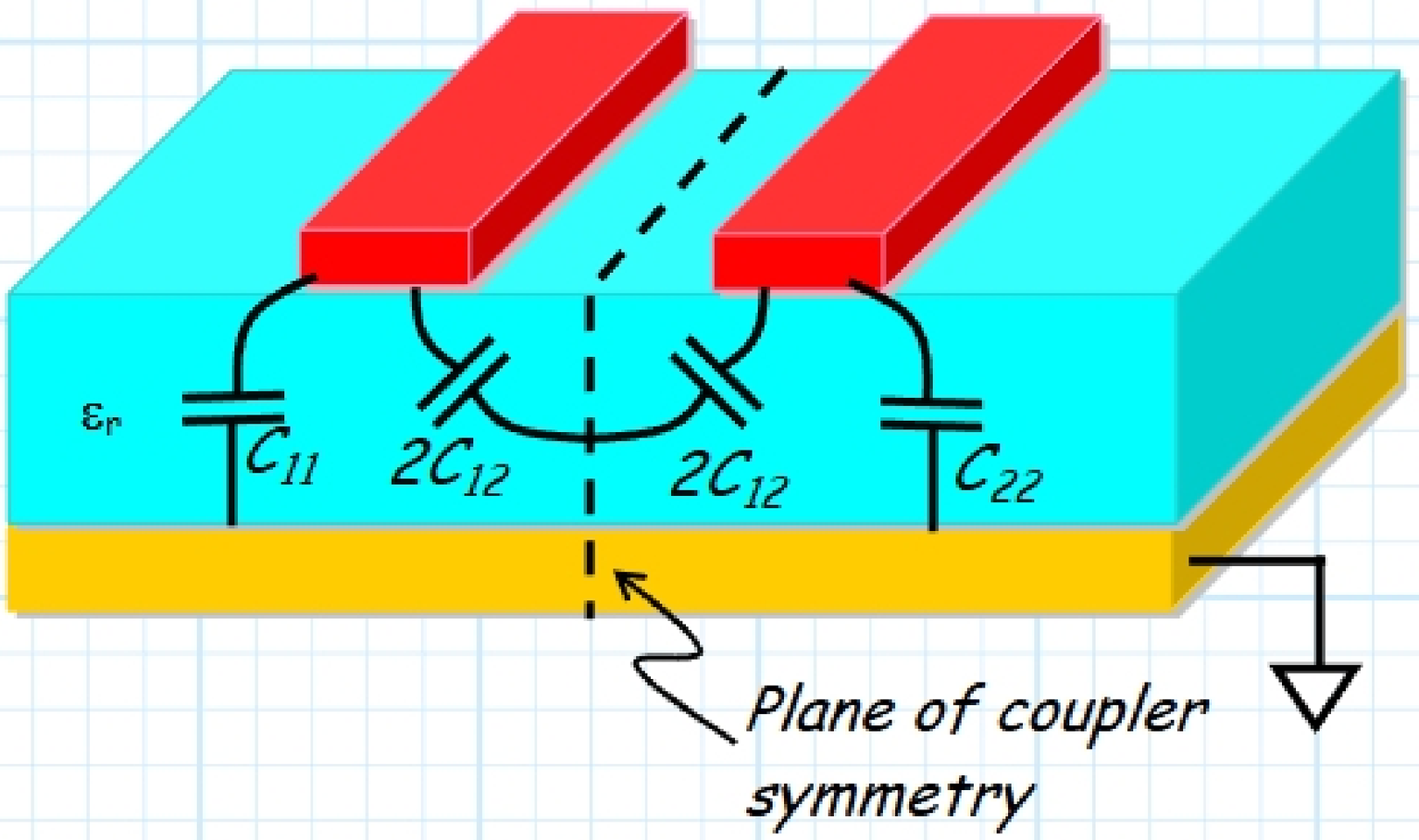


Figure 7.27 (p. 337)
A three-wire coupled transmission line and its equivalent capacitance network.

If the two transmission lines are **identical** (and they typically are), then $C_{11} = C_{22}$.

Likewise, if the two transmission lines are identical, then a plane of circuit **symmetry** exists. As a result, we can analyze this circuit using **odd/even mode** analysis!



Note we have divided the C_{12} capacitor into **two series** capacitors, each with at value 2 C_{12}.