

## 7.5 - The Quadrature Hybrid

**Reading Assignment:** pp. 333-336

There are **two** different types of ideal **4-port 3dB** couplers: the **symmetric** solution and the **anti-symmetric** solution. The symmetric solution is called the **Quadrature Hybrid**.

### HO: THE QUADRATURE HYBRID

The Quadrature Hybrid possesses  **$D_4$  symmetry**—it has **two** planes of bilateral reflection symmetry.

**Q:** *So?*

**A:** This fact leads to circuit analysis procedure that is an extension of odd-even mode analysis. **Instead** of 2 modes (odd-even), the circuit can be expressed as a superposition of **4 modes!**

**Q:** *Four modes?! That's **twice** as many as 2 modes; that sounds like twice as much work!*

**A:** Nope! It turns out that analyzing each of the four modes is simple and direct—much easier than analyzing the odd and/or even mode. As a result, this 4-mode analysis is much easier than the odd-even mode analysis.

### HO: A QUAD-MODE ANALYSIS OF THE QUADRATURE HYBRID