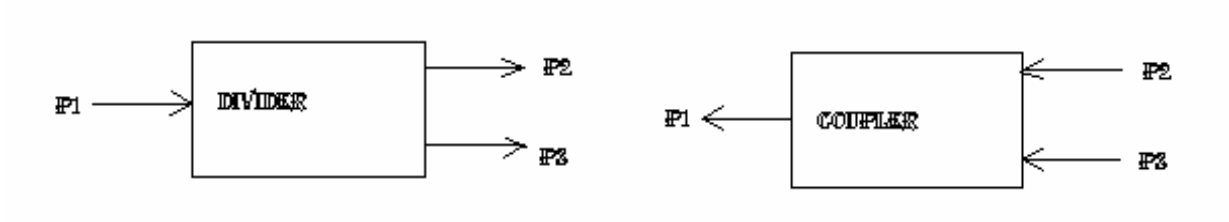
ECE 6130 -- Power Dividers and Couplers

Text Section 7-1

How do you design a T-junction power divider?
What is a circulator, and how does it work (with respect to the input / output fields)?

Power Dividers / Couplers:

3-Port (T-Junction)



General : 3-Port S-parameters

$$[S] = \begin{bmatrix} S_{11} & S_{12} & S_{13} \\ S_{21} & S_{22} & S_{23} \\ S_{31} & S_{32} & S_{33} \end{bmatrix}$$

Issues:

1) Matched Ports (Sii = 0)

$$[S] = \begin{bmatrix} 0 & S_{12} & S_{13} \\ S_{21} & 0 & S_{23} \\ S_{31} & S_{32} & 0 \end{bmatrix}$$

2) Reciprocal (symmetric S)

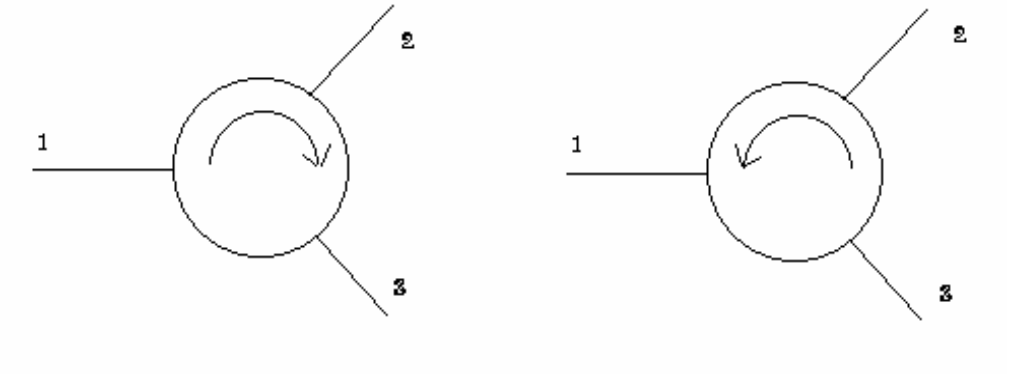
$$[S] = \begin{bmatrix} 0 & S_{12} & S_{13} \\ S_{12} & 0 & S_{23} \\ S_{13} & S_{23} & 0 \end{bmatrix}$$

3) Lossless (unitary S)

$S_{13}^{*}\, S_{23} = 0$ So two of (S_{12}, S_{23}, S_{13})
$S_{23}^{*}\, S_{12} = 0$
$S_{12}^{*}\, S_{13} = 0$

$|S_{12}|^2 + |S_{13}|^2 = 1$ But then these can't be satisified.
$|S_{12}|^2 + |S_{23}|^2 = 1$
$|S_{13}|^2 + |S_{23}|^2 = 1$

So, the choice is you can have 2 of three, and this defines the type of power divider / coupler you get.



CIRCULATOR (Matched and Lossless, But not reciprocal)

$$[S] = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \qquad [S] = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{bmatrix}$$