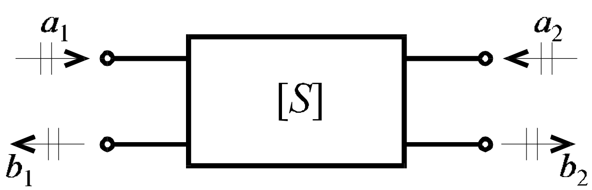
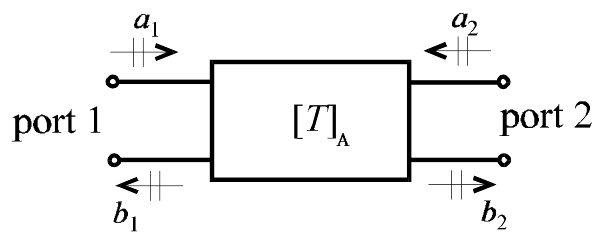
Working with S-parameters

- For network computations it is easier to convert from the S-matrix representation to the **chain scattering matrix** notation

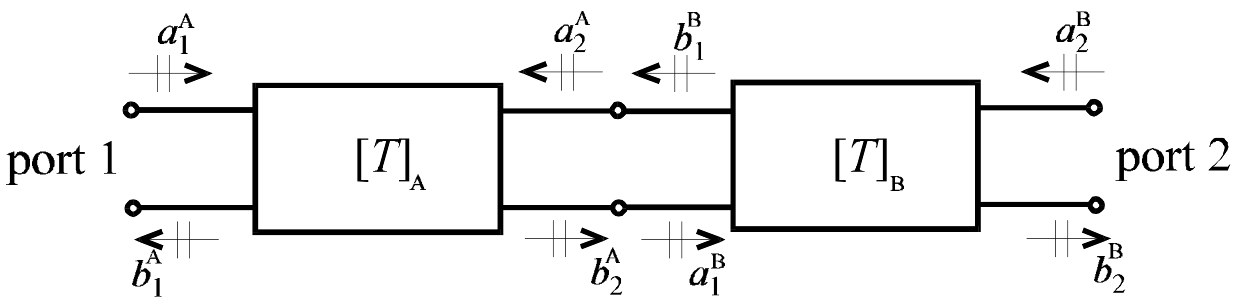




$$\begin{Bmatrix} b_1 \\ b_2 \end{Bmatrix} = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix} \begin{Bmatrix} a_1 \\ a_2 \end{Bmatrix} \longrightarrow \begin{Bmatrix} a_1 \\ b_1 \end{Bmatrix} = \begin{bmatrix} T_{11} & T_{12} \\ T_{21} & T_{22} \end{bmatrix} \begin{Bmatrix} b_2 \\ a_2 \end{Bmatrix}$$

$$T_{11} = 1/S_{21}, T_{21} = S_{11}/S_{21}, etc.$$

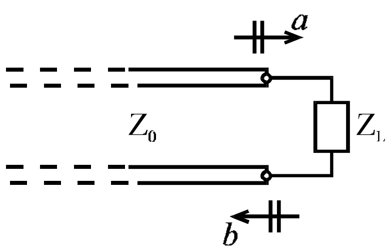
- Advantage: cascading just like in the ABCD form

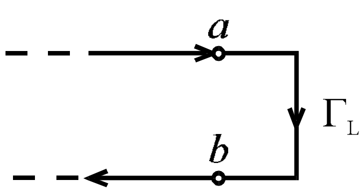


$$\boxed{\begin{Bmatrix} a_1^A \\ b_1^A \end{Bmatrix} = \begin{bmatrix} T_{11}^A & T_{12}^A \\ T_{21}^A & T_{22}^A \end{bmatrix} \begin{bmatrix} T_{11}^B & T_{12}^B \\ T_{21}^B & T_{22}^B \end{bmatrix} \begin{Bmatrix} b_2^B \\ a_2^B \end{Bmatrix}}$$

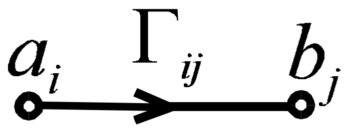
Signal flow chart computations

Complicated networks can be efficiently analyzed in a manner identical to signals and systems and control.

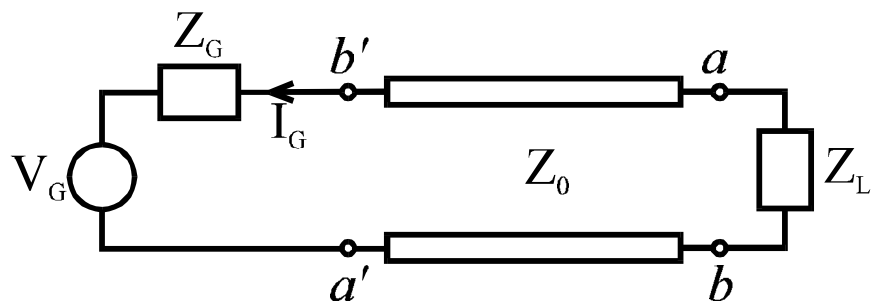




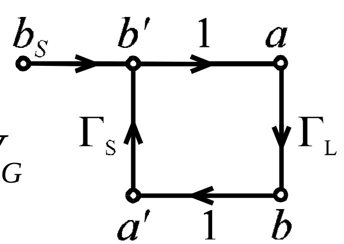
in general

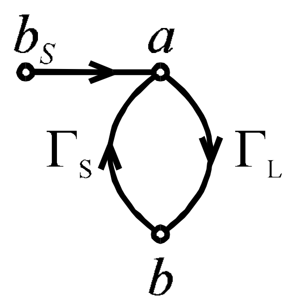


Arrangement for flow-chart analysis

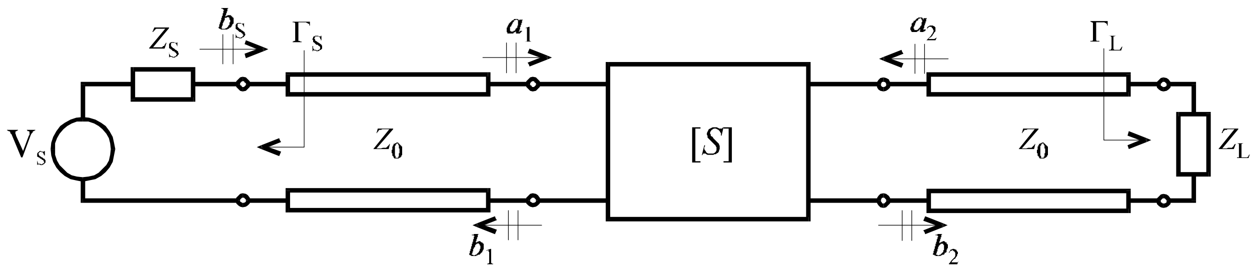


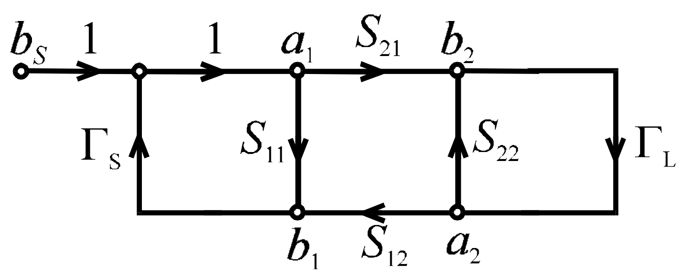
$$b_S = \frac{\sqrt{Z_0}}{Z_G + Z_0} V_G$$



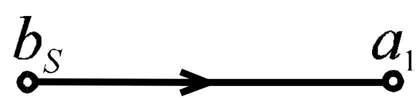


Analysis of most common circuit



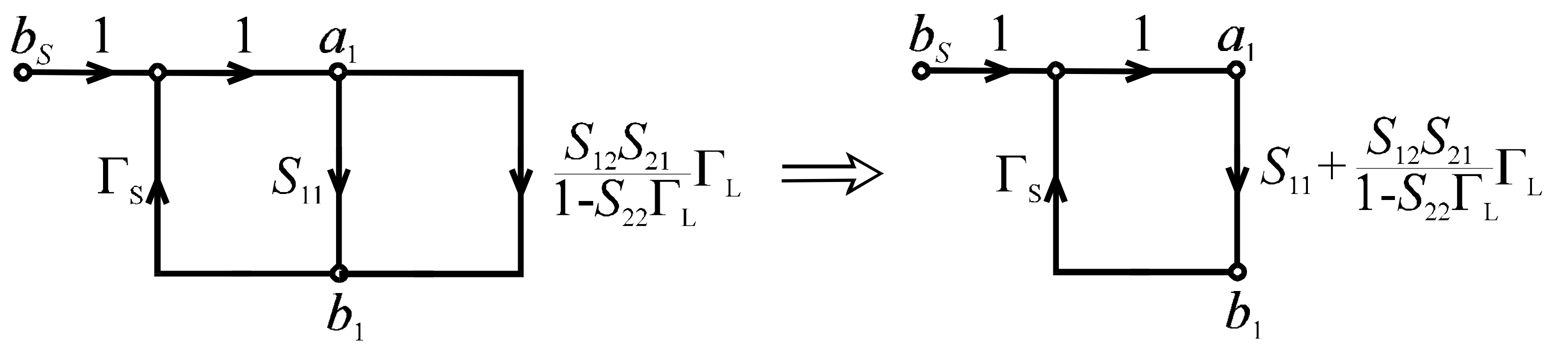


Determination of the ratio



$$a_1/b_S \rightarrow \frac{1}{1-\left(S_{11}+\frac{S_{12}S_{21}}{1-S_{22}\Gamma_L}\Gamma_L\right)\Gamma_S}$$

Important issue: what happens to the S_{11} parameter if port 2 is not properly terminated?



$$\boxed{\Gamma_{in} = \frac{b_1}{a_1} = S_{11} + \frac{S_{12}S_{21}}{1 - S_{22}\Gamma_L}\Gamma_L}$$

Note: Only $\Gamma_L = 0$ ensures that the S_{11} can be measured!