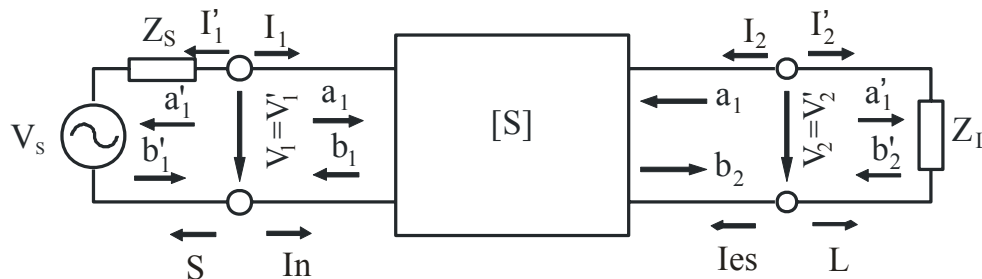


Amplificatoare de Microunde

Proiectarea unui singur etaj

Cîştigurile în putere ale unui diport



$$G = \frac{P_L}{P_{in}} = \frac{|S_{21}|^2 (1 - |\Gamma_L|^2)}{(1 - |\Gamma_{in}|^2) |1 - S_{22}\Gamma_L|^2}$$

➤ Reflexii nule $\Gamma_L = \Gamma_S = 0$

$$G_A = \frac{P_{avL}}{P_{avS}} = \frac{P_L |_{\Gamma_L = \Gamma_{ies}^*}}{P_{in} |_{\Gamma_{in} = \Gamma_S^*}} = \frac{|S_{21}|^2 (1 - |\Gamma_S|^2)}{|1 - S_{11}\Gamma_S|^2 (1 - |\Gamma_L|^2)}$$

$$G_T = |S_{21}|^2$$

$$G_T = \frac{P_L}{P_{avS}} = \frac{|S_{21}|^2 (1 - |\Gamma_S|^2) (1 - |\Gamma_L|^2)}{|1 - \Gamma_S\Gamma_{in}|^2 |1 - S_{22}\Gamma_L|^2}$$

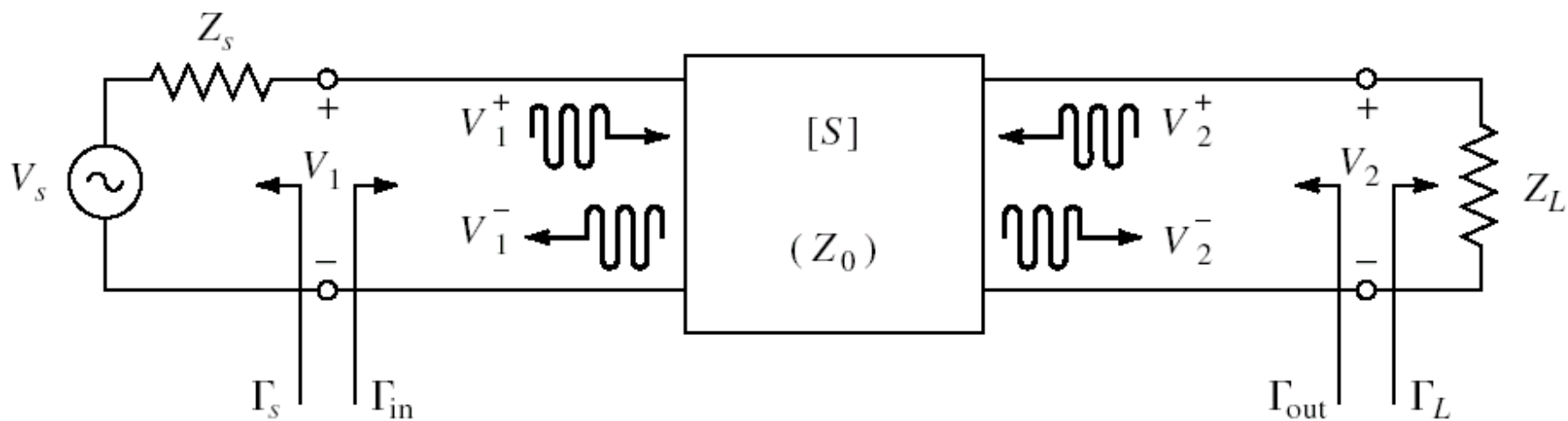
Dispozitiv unilateral $S_{12} = 0$

$$\Gamma_L = \frac{Z_L - Z_0}{Z_L + Z_0} \quad \Gamma_S = \frac{Z_S - Z_0}{Z_S + Z_0}$$

$$G_{TU} = \frac{|S_{21}|^2 (1 - |\Gamma_S|^2) (1 - |\Gamma_L|^2)}{|1 - \Gamma_S S_{11}|^2 |1 - S_{22}\Gamma_L|^2}$$

$$\Gamma_{in} = \frac{Z_{in} - Z_0}{Z_{in} + Z_0} = S_{11} + \frac{S_{12}S_{21}\Gamma_L}{1 - S_{22}\Gamma_L}$$

$$\Gamma_{ies} = \frac{Z_{ies} - Z_0}{Z_{ies} + Z_0} = S_{22} + \frac{S_{12}S_{21}\Gamma_S}{1 - S_{11}\Gamma_S}$$



$$V_1^- = S_{11}V_1^+ + S_{12}V_2^+ = S_{11}V_1^+ + S_{12}\Gamma_L V_2^-,$$

$$V_2^- = S_{21}V_1^+ + S_{22}V_2^+ = S_{21}V_1^+ + S_{22}\Gamma_L V_2^-.$$

$$\Gamma_{in} = \frac{V_1^-}{V_1^+} = S_{11} + \frac{S_{12}S_{21}\Gamma_L}{1 - S_{22}\Gamma_L} = \frac{Z_{in} - Z_0}{Z_{in} + Z_0},$$

$$\Gamma_{out} = \frac{V_2^-}{V_2^+} = S_{22} + \frac{S_{12}S_{21}\Gamma_s}{1 - S_{11}\Gamma_s}.$$

$$V_1 = V_S \frac{Z_{in}}{Z_S + Z_{in}} = V_1^+ + V_1^- = V_1^+ (1 + \Gamma_{in}). \quad V_1^+ = \frac{V_S}{2} \frac{(1 - \Gamma_S)}{(1 - \Gamma_S \Gamma_{in})}.$$

$$P_{in} = \frac{1}{2Z_0} |V_1^+|^2 (1 - |\Gamma_{in}|^2) = \frac{|V_S|^2}{8Z_0} \frac{|1 - \Gamma_S|^2}{|1 - \Gamma_S \Gamma_{in}|^2} (1 - |\Gamma_{in}|^2)$$

$$P_L = \frac{|V_2^-|^2}{2Z_0} (1 - |\Gamma_L|^2) \quad P_L = \frac{|V_1^+|^2 |S_{21}|^2 (1 - |\Gamma_L|^2)}{2Z_0 |1 - S_{22} \Gamma_L|^2} = \frac{|V_S|^2 |S_{21}|^2 (1 - |\Gamma_L|^2) |1 - \Gamma_S|^2}{8Z_0 |1 - S_{22} \Gamma_L|^2 |1 - \Gamma_S \Gamma_{in}|^2}.$$

$$G = \frac{P_L}{P_{in}} = \frac{|S_{21}|^2 (1 - |\Gamma_L|^2)}{(1 - |\Gamma_{in}|^2) |1 - S_{22} \Gamma_L|^2}.$$

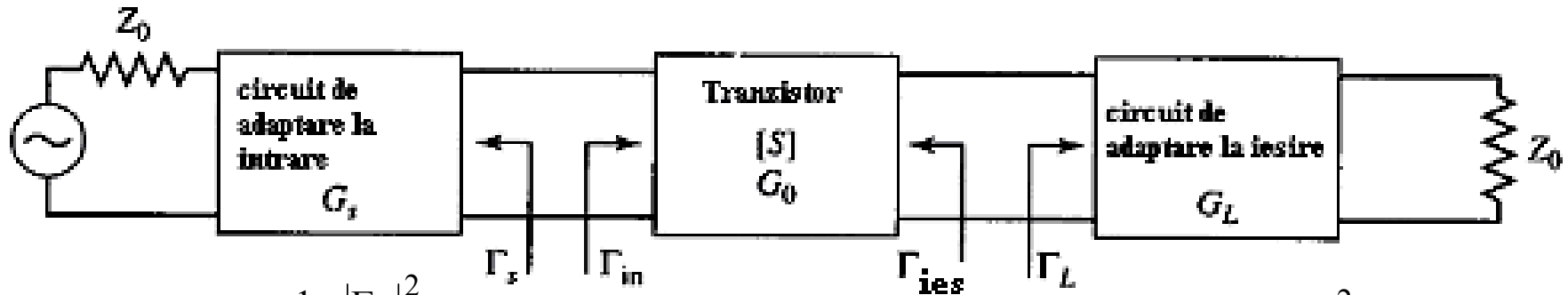
$$P_{avs} = P_{in} \Big|_{\Gamma_{in} = \Gamma_S^*} = \frac{|V_S|^2}{8Z_0} \frac{|1 - \Gamma_S|^2}{(1 - |\Gamma_S|^2)}.$$

$$P_{avn} = P_L \Big|_{\Gamma_L = \Gamma_{out}^*} = \frac{|V_S|^2 |S_{21}|^2 (1 - |\Gamma_{out}|^2) |1 - \Gamma_S|^2}{8Z_0 |1 - S_{22} \Gamma_{out}^*|^2 |1 - \Gamma_S \Gamma_{in}|^2} \Big|_{\Gamma_L = \Gamma_{out}^*}. \quad P_{avn} = \frac{|V_S|^2}{8Z_0} \frac{|S_{21}|^2 |1 - \Gamma_S|^2}{|1 - S_{11} \Gamma_S|^2 (1 - |\Gamma_{out}|^2)}.$$

$$G_A = \frac{P_{avn}}{P_{avs}} = \frac{|S_{21}|^2 (1 - |\Gamma_S|^2)}{|1 - S_{11} \Gamma_S|^2 (1 - |\Gamma_{out}|^2)}.$$

$$G_T = \frac{P_L}{P_{avs}} = \frac{|S_{21}|^2 (1 - |\Gamma_S|^2) (1 - |\Gamma_L|^2)}{|1 - \Gamma_S \Gamma_{in}|^2 |1 - S_{22} \Gamma_L|^2}.$$

Schema bloc a unui amplificator cu un tranzistor



$$G_S = \frac{1 - |\Gamma_S|^2}{|1 - \Gamma_S \Gamma_{in}|^2}$$

$$G_0 = |S_{21}|^2$$

$$G_L = \frac{1 - |\Gamma_L|^2}{|1 - S_{22} \Gamma_L|^2}$$

$$G_T = G_S G_0 G_L$$

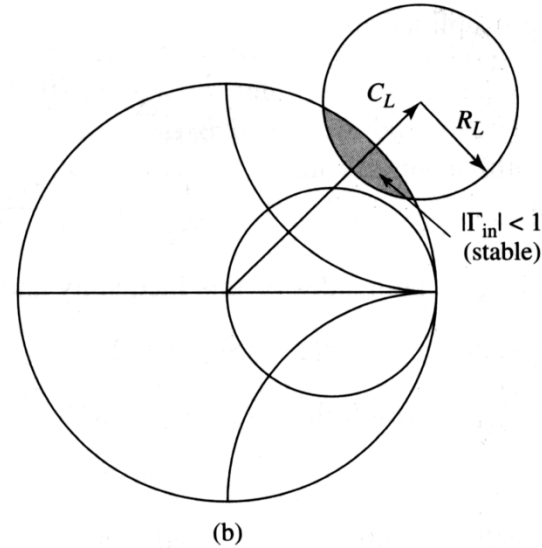
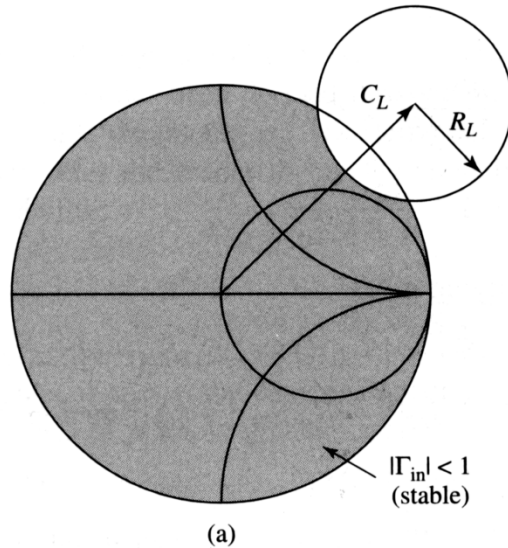
Stabilitatea

- **Stabilitatea necondiționată:** circuitul este necondiționat stabil dacă $|\Gamma_{in}| < 1$ și $|\Gamma_{ies}| < 1$ pentru orice impedanță pasivă a sarcinii și sursei.
- **Stabilitatea condiționată:** circuitul este condiționat stabil dacă $|\Gamma_{in}| < 1$ și $|\Gamma_{ies}| < 1$ doar pentru un anumit interval de valori pentru impedanța pasivă a sarcinii și sursei.

Cercurile de stabilitate

cercul de stabilitate la ieșire : $|\Gamma_{in}| = 1$ cercul de stabilitate la intrare $|\Gamma_{ies}| = 1$

$$C_L = \frac{(S_{22} - \Delta S_{11}^*)^*}{|S_{22}|^2 - |\Delta|^2} \quad R_L = \frac{|S_{12}S_{21}|}{\left| |S_{22}|^2 - |\Delta|^2 \right|} \quad C_S = \frac{(S_{11} - \Delta S_{22}^*)^*}{|S_{11}|^2 - |\Delta|^2} \quad R_S = \frac{|S_{12}S_{21}|}{\left| |S_{11}|^2 - |\Delta|^2 \right|}$$



$$|\Delta| < 1$$

$$K = \frac{1 - |S_{11}|^2 - |S_{22}|^2 + |\Delta|^2}{2|S_{12}S_{21}|} > 1$$

$$\mu = \frac{1 - |S_{11}|^2}{|S_{22} - S_{11}^*\Delta| + |S_{12}S_{21}|} > 1$$

$$|\Gamma_{\text{in}}| = \left| S_{11} + \frac{S_{12}S_{21}\Gamma_L}{1 - S_{22}\Gamma_L} \right| < 1,$$

$$\left| S_{11} + \frac{S_{12}S_{21}\Gamma_L}{1 - S_{22}\Gamma_L} \right| = 1,$$

$$|\Gamma_{\text{out}}| = \left| S_{22} + \frac{S_{12}S_{21}\Gamma_S}{1 - S_{11}\Gamma_S} \right| < 1.$$

$$|S_{11}(1 - S_{22}\Gamma_L) + S_{12}S_{21}\Gamma_L| = |1 - S_{22}\Gamma_L|.$$

$$\Delta = S_{11}S_{22} - S_{12}S_{21}, \quad |S_{11} - \Delta\Gamma_L| = |1 - S_{22}\Gamma_L|$$

$$|S_{11}|^2 + |\Delta|^2|\Gamma_L|^2 - (\Delta\Gamma_L S_{11}^* + \Delta^*\Gamma_L^* S_{11}) = 1 + |S_{22}|^2|\Gamma_L|^2 - (S_{22}^*\Gamma_L^* + S_{22}\Gamma_L)$$

$$(|S_{22}|^2 - |\Delta|^2)\Gamma_L\Gamma_L^* - (S_{22} - \Delta S_{11}^*)\Gamma_L - (S_{22}^* - \Delta^* S_{11})\Gamma_L^* = |S_{11}|^2 - 1$$

$$\Gamma_L\Gamma_L^* - \frac{(S_{22} - \Delta S_{11}^*)\Gamma_L + (S_{22}^* - \Delta^* S_{11})\Gamma_L^*}{|S_{22}|^2 - |\Delta|^2} = \frac{|S_{11}|^2 - 1}{|S_{22}|^2 - |\Delta|^2}.$$

$$\left| \Gamma_L - \frac{(S_{22} - \Delta S_{11}^*)^*}{|S_{22}|^2 - |\Delta|^2} \right|^2 = \frac{|S_{11}|^2 - 1}{|S_{22}|^2 - |\Delta|^2} + \frac{|S_{22} - \Delta S_{11}^*|^2}{(|S_{22}|^2 - |\Delta|^2)^2},$$

$$\left| \Gamma_L - \frac{(S_{22} - \Delta S_{11}^*)^*}{|S_{22}|^2 - |\Delta|^2} \right| = \left| \frac{S_{12}S_{21}}{|S_{22}|^2 - |\Delta|^2} \right|.$$

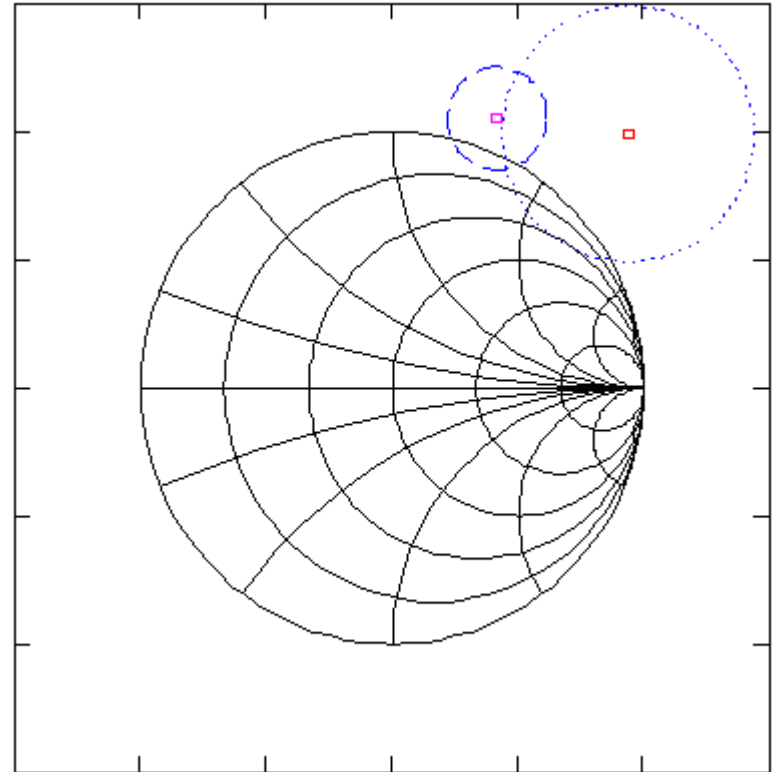
Exemplu

$$S = \begin{bmatrix} 0.894e^{-j60.6^\circ} & 0.02e^{j62.4^\circ} \\ 3.122e^{j123.6^\circ} & 0.781e^{-j27.6^\circ} \end{bmatrix}$$

$$\Delta = S_{11}S_{22} - S_{21}S_{12} = 0.696 \angle -83^\circ$$

$$K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{12}S_{21}|} = 0.607$$

$$\mu = 0.86$$



$$C_L = \frac{(S_{22} - \Delta S_{11}^*)^*}{|S_{22}|^2 - |\Delta|^2} = 1.361 \angle 47^\circ$$

$$C_S = \frac{(S_{11} - \Delta S_{22}^*)^*}{|S_{11}|^2 - |\Delta|^2} = 1.132 \angle 68^\circ$$

$$R_L = \frac{|S_{12}S_{21}|}{|S_{22}|^2 - |\Delta|^2} = 0.5$$

$$R_S = \frac{|S_{12}S_{21}|}{|S_{11}|^2 - |\Delta|^2} = 0.199$$