

EE 3113

INTRODUCTION TO RF

CIRCUIT DESIGN

Lecture Notes for A-term 1999

LECTURE 25

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Stability of active device

$$\left. \begin{array}{l} |\Gamma_L| < 1, |\Gamma_S| < 1 \\ |\Gamma_{in}| < 1, |\Gamma_{out}| < 1 \end{array} \right\} \text{Stability factor (p. 502)}$$

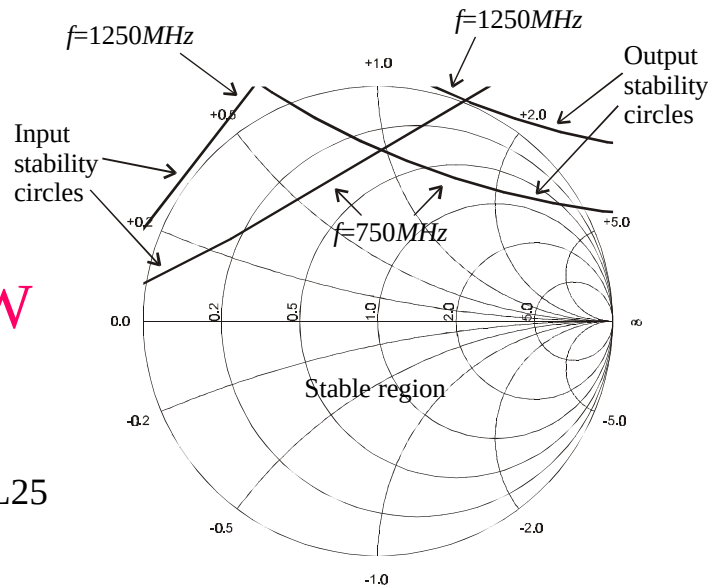


$$k = \frac{1 - |S_{11}|^2 - |S_{22}|^2 + |S_{11}S_{22} - S_{12}S_{21}|^2}{2|S_{12}||S_{21}|}$$

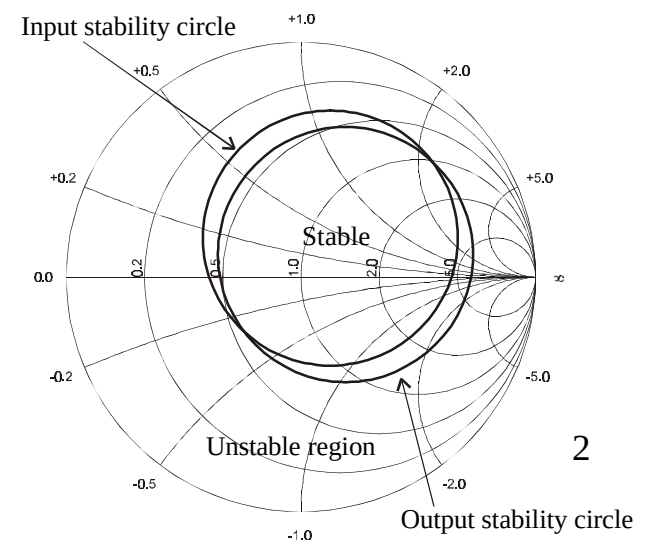
If not unconditionally stable

BFG505W

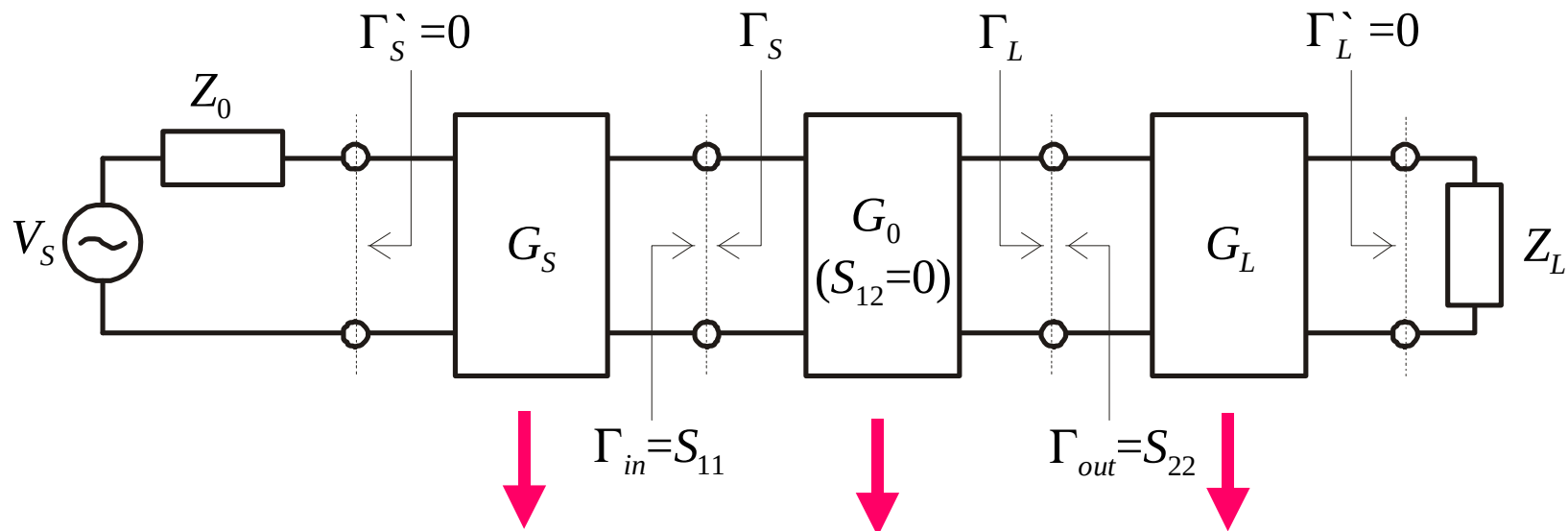
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or



Constant Gain Amplifier



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

$$G_{TU} (dB) = G_S (dB) + G_0 (dB) + G_L (dB)$$

Constant gain circles in the SC

$$G_{S_{\max}} = \frac{1}{1 - |S_{11}|^2} \longrightarrow g_S = \frac{G_S}{G_{S_{\max}}} = \frac{1 - |\Gamma_S|^2}{|1 - \Gamma_S S_{11}|^2} (1 - |S_{11}|^2)$$

normalize

$$G_{L_{\max}} = \frac{1}{1 - |S_{22}|^2} \longrightarrow g_L = \frac{G_L}{G_{L_{\max}}} = \frac{1 - |\Gamma_L|^2}{|1 - \Gamma_L S_{22}|^2} (1 - |S_{22}|^2)$$

$$g_i = \frac{G_i}{G_{i_{\max}}} = \frac{1 - |\Gamma_i|^2}{|1 - \Gamma_i S_{ii}|^2} (1 - |S_{ii}|^2)$$

This can be written
as a circle equation

(see [page 511](#))

Circle equation and graphical display

$$(\Gamma_i^R - d_{g_i}^R)^2 + (\Gamma_i^I - d_{g_i}^I)^2 = r_{g_i}^2$$

$$d_{g_i} = \frac{g_i S_{ii}^*}{1 - |S_{ii}|^2 (1 - g_i)}$$

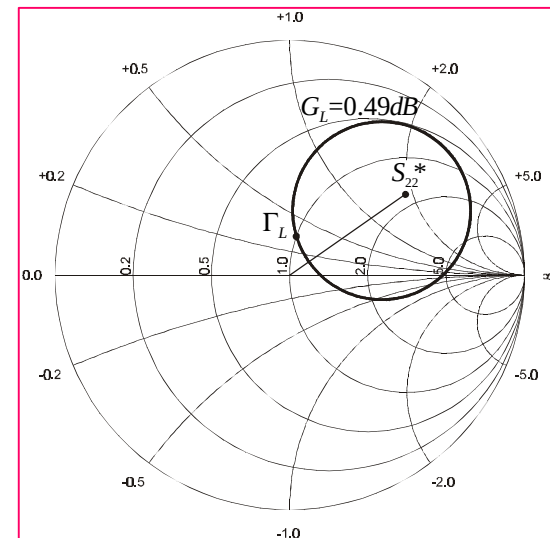
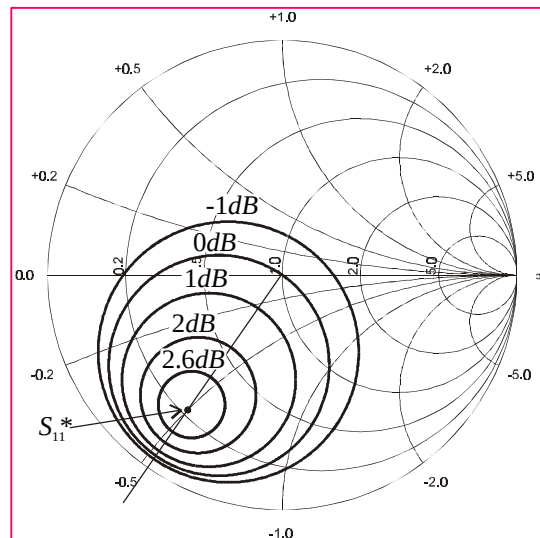
$$r_{g_i} = \frac{\sqrt{1 - g_i} (1 - |S_{ii}|^2)}{1 - |S_{ii}|^2 (1 - g_i)}$$

Constant source gain circles

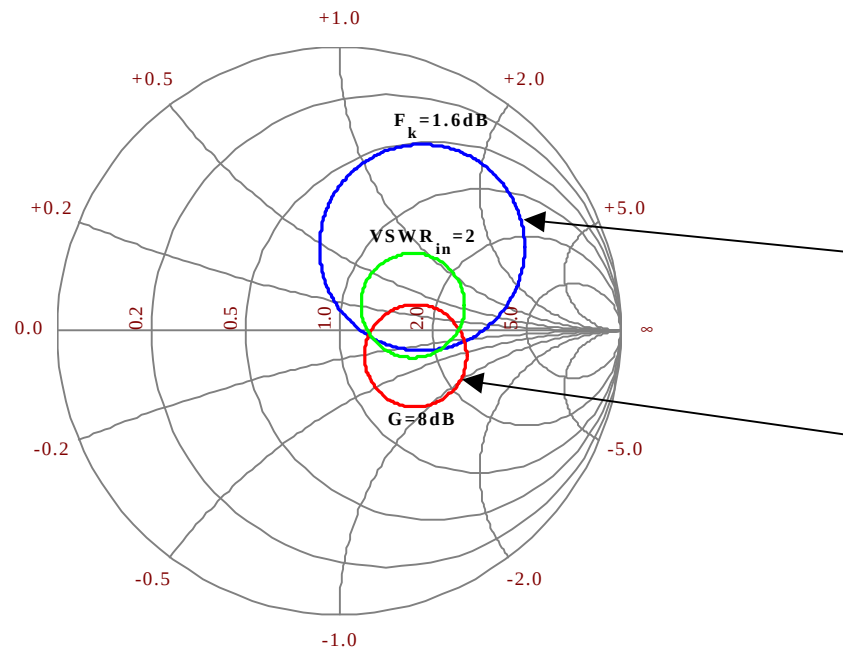
Constant load gain circle

See Ex. 9.7
(p. 512)

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Trade-off between gain and noise



Maximum gain and minimum noise figure are mutually exclusive

Noise figure

Constant gain

