HSB
Hochschule Bremen
City University of Applied Sciences

MICROWAVE CIRCUITS AND SYSTEMS

SS 2018

MILESTONE 2

STABILITY NETWORK

Date: 30/05/2018

by

Shinde Mrinal Vinayak (Matriculation No.: 5021349)
Yama Sanath Kumar (Matriculation No.: 5021383)
Karthik Nagaraj (Matriculation No.: 5020058)

guided by

Prof. Dr. -Ing. S. Peik

Contents

Aim

- To design a stability network
- Redesign with stability network and micro-strip lines included
- To sketch the location the location of stability circles S and L in the smith chart.
- To produce stimulation results of amplifier with transistor and ideal lines (S - Parameter sweep, Stability - μ sweep)

Theory and Calculations

0.1 Stability Network

The stability of the network depends on the source and load matching Γ_{in} and $\Gamma_{out}$and the stability of the amplifier depends on source and load reflection coefficients i.e Γ_S and Γ_L of the circuit. As per the design methodology we are using unconditional stability that is $|\Gamma_S| < 1$ and $|\Gamma_L| < 1$ for all passive source and load impedance. The following two tests are done to check the stability:

0.1.1 *k*-Δ test

$$k = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{12}S_{21}|} = 1.029 \tag{1}$$

$$\Delta = S_{11}S_{22} - S_{12}S_{21} = 0.53\angle 189.82^\circ \tag{2}$$

as $k > 1 and |\Delta| < 1$, amplifier is unconditionally stable at 4 GHz

0.1.2 $\mu-$ parameter test

$$\mu = \frac{1 - |S_{11}|^2}{|S_{22} - \Delta S_{11}^*| + |S_{12}S_{21}|} = 1.0695 \tag{3}$$

as $\mu > 1$, unconditional stable network.

0.2 Stability Circle

0.2.1 Output Stability

$$C_L = \frac{(S_{22} - \Delta S_{11}^*)^*}{|S_{22}|^2 - |\Delta|^2} = 0.92\angle 64.41^\circ \tag{4}$$

$$R_L = \frac{(S_{22} - \Delta S_{11}^*)^*}{|S_{22}|^2 - |\Delta|^2} = 1.993 \tag{5}$$

0.2.2 Input Stability

$$C_S = \frac{(S_{11} - \Delta S_{22}^*)^*}{|S_{11}|^2 - |\Delta|^2} = 3.01\angle 47.02^\circ \tag{6}$$

$$R_S = \frac{(S_{12} - \Delta S_{21}^*)^*}{|S_{11}|^2 - |\Delta|^2} = 4.029 \tag{7}$$

Simulations

0.3 Stability Circuit

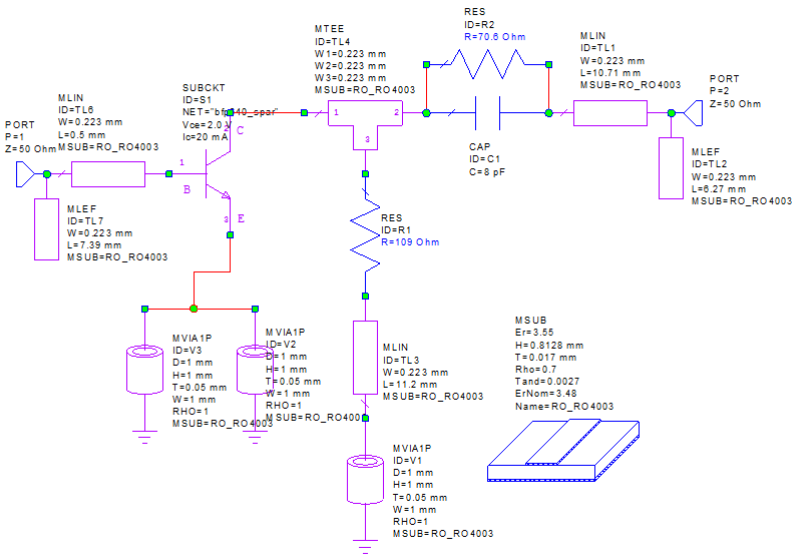

Figure 1: Stability Circuit

0.4 Response

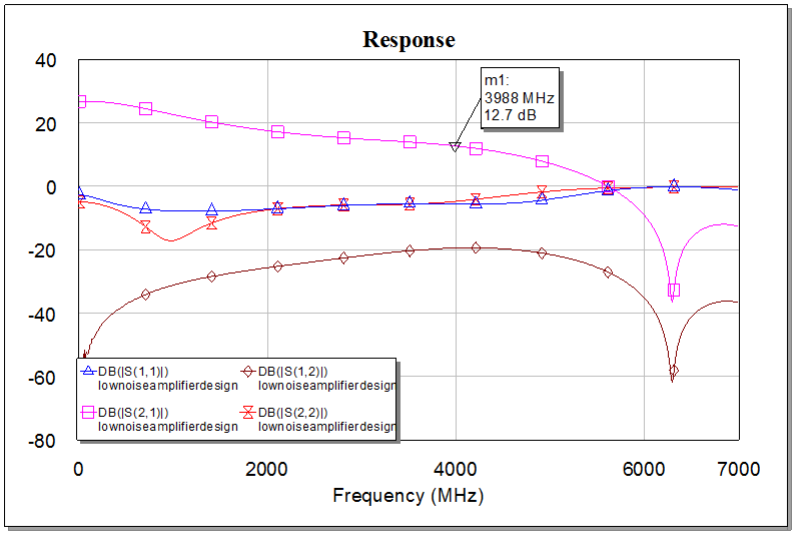

Figure 2: Response

0.5 Stability Circle

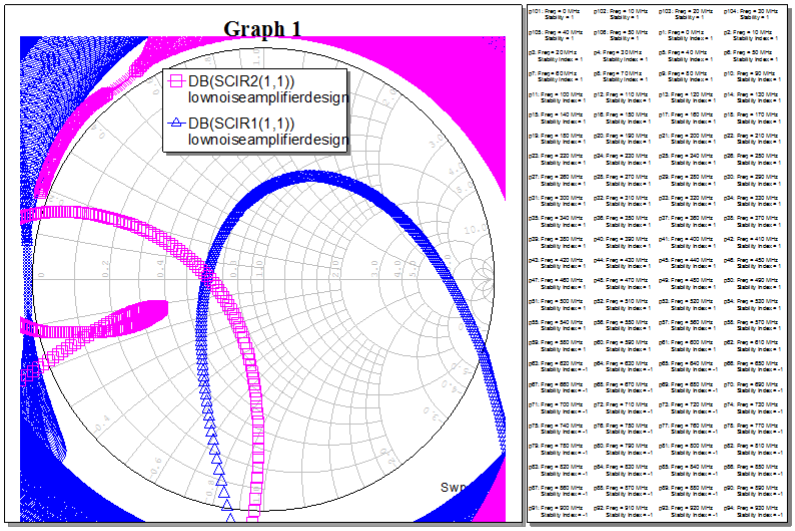

Figure 3: Stability Circle

0.6 Stability Curve

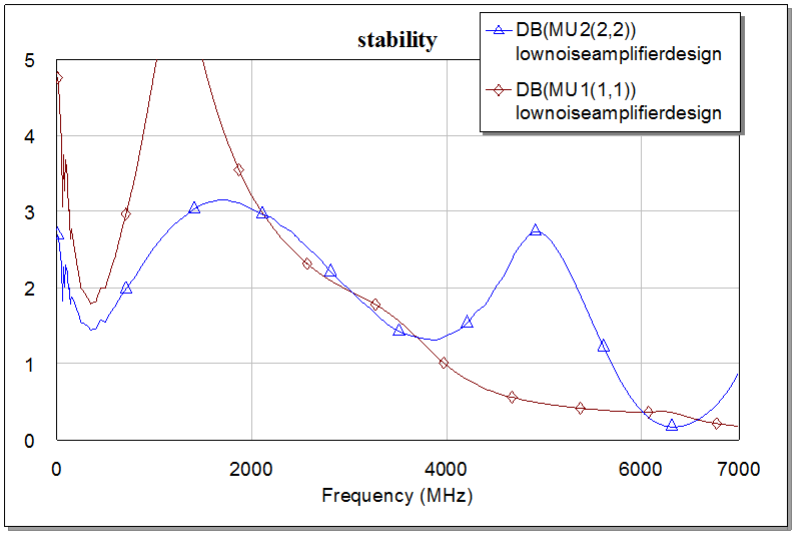

Figure 4: Stability Curve