HSB
Hochschule Bremen
City University of Applied Sciences

MICROWAVE CIRCUITS AND SYSTEMS

SS 2018

MILESTONE 2

STABILITY NETWORK

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by

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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)

Chapter 1

Theory and Calculations

1.1 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:

1.1.1 *k*-Δ test

$$k = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{12}S_{21}|} = 1.029 \tag{1.1}$$

$$\Delta = S_{11}S_{22} - S_{12}S_{21} = 0.53\angle 189.82^\circ \tag{1.2}$$

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

1.1.2 $\mu-$ parameter test

$$\mu = \frac{1 - |S_{11}|^2}{|S_{22} - \Delta S_{11}^*| + |S_{12}S_{21}|} = 1.0695 \tag{1.3}$$

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

1.2 Stability Circle

1.2.1 Output Stability

$$C_L = \frac{(S_{22} - \Delta S_{11}^*)^*}{|S_{22}|^2 - |\Delta|^2} = 0.92\angle 64.41° \tag{1.4}$$

$$R_L = \frac{(S_{22} - \Delta S_{11}^*)^*}{|S_{22}|^2 - |\Delta|^2} = 1.993 \tag{1.5}$$

1.2.2 Input Stability

$$C_S = \frac{(S_{11} - \Delta S_{22}^*)^*}{|S_{11}|^2 - |\Delta|^2} = 3.01\angle 47.02° \tag{1.6}$$

$$R_S = \frac{(S_{12} - \Delta S_{21}^*)^*}{|S_{11}|^2 - |\Delta|^2} = 4.029 \tag{1.7}$$

Chapter 2

Simulations

2.1 Stability Circle

2.2 Stability Curve

2.3 Stability Circuit