A method for the design of low-noise amplifiers in the frequency of 8GHz (Short paper)

Solmaz Malmir[1], Mina Jalilvand[2]
1- Young Researchers Club, Toyserkan Branch, Islamic Azad University, Toyserkan, Iran.
Email: Malmir_s2002@yahoo.com (Corresponding author)
2- Young Researchers Club, Toyserkan Branch, Islamic Azad University, Toyserkan, Iran.
Email: Jalilvandmina@yahoo.com

Received: August 7, 2012 Revised: August 25, 2012 Accepted: September 1, 2012

ABSTRACT:
Low-noise amplifiers (LNA) are considered one of the essential components of telecommunication wireless receiver. Since their performance will determine the system performance in the noise. In this paper with software Microwave office, a low-noise amplifier has been designed and simulated at the center frequency of 8 GHz with 10 dB of gain and noise figure less than 1.5dB in operating point 2 V and 10mA.

KEYWORDS: Low-noise amplifier, noise figure, input reflection coefficient, output reflection coefficient

1. INTRODUCTION

Low-noise amplifier is a special type of electronic amplifier, which is used in communication systems to amplify the signal from the antenna, In order to reduce the amplitude of the signal to the lowest possible value.

Next stages Noise are reduced by the use of LNA. But the LNA noise is injected directly into the received signal. Therefore a prerequisite for low noise amplifiers is while that amplifies the signal; add very little the noise and disturbance, to recover the signal in next level to take place effectively.

To have Minimum Noise in Amplifier must be a great boost to the first stage. So at the first stages uses of FETs and HEMTs. It also can be used to decentralize Amplifiers (distributed) on the first stage. Decentralized amplifiers require high current to the starting, which are inefficient in terms of energy, but as well as reduce noise [2].

2. CIRCUIT DESIGN

Block diagram low noise Amplifier is displayed in Figure 1.

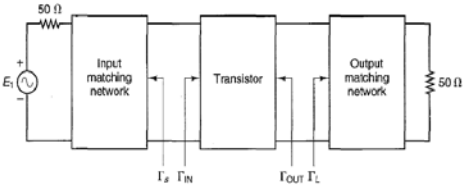

Fig.1 .Block diagram of a low-noise amplifier [1]

In general, do the following steps for designing an LNA:

- Select a high frequency transistor.
- Input and output matching circuit design
- Optimization

Transistor network is characterized using its S parameters. So after selecting transistors and finding S-parameter by its associated, we import transistors in software environment.

Our choice is called NE23383. The S-parameter in 8 GHz frequency and voltage and current at V_{DS}=2v, I_D=10mA is considered. After drawing circles stability of the transistor, a point to consider as Γs.

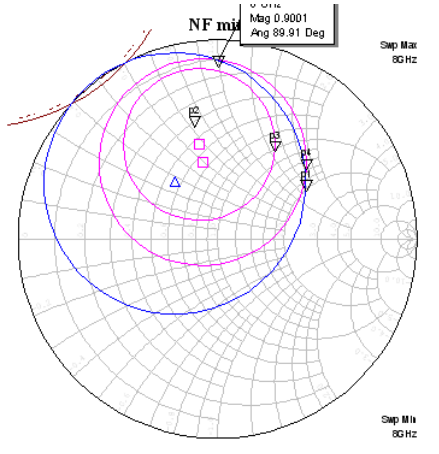

Fig.2 .Stability circles

$\Gamma_s = 0.9001 \angle 89.91$

The following formulas are used to determine ΓL.

$$\Gamma_L = S_{22} + \frac{S_{12}S_{21}\Gamma_S}{1 - S_{11}\Gamma_S} \quad (1)$$

$$\Gamma_L = \Gamma_{out}^* \quad (2)$$

After calculation, we obtain $\Gamma_L = 0.3858 \angle 148.78$.

2.1. Input matching circuit design

Now, we design the input matching circuit. After drawing the circuit with lengths Tune can reach up to Γ_S.

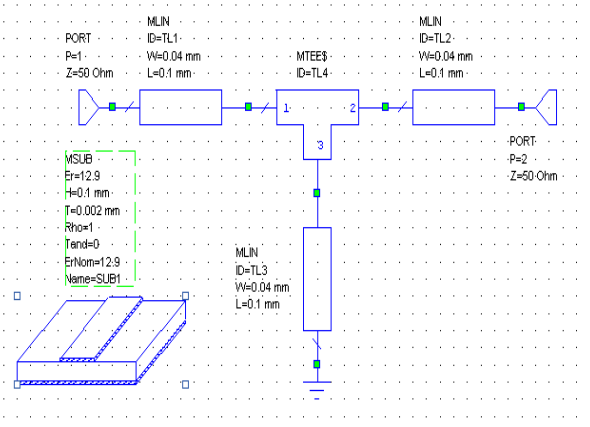

Fig.3 .The input matching circuit

2.2. Output matching circuit design

As before, the output matching circuit in a schematic design explains. After drawing the circuit with lengths Tune can reach up to Γ_L.

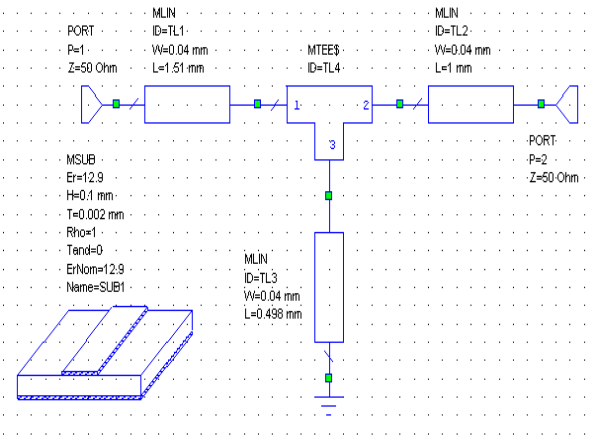

Fig.4 .The output matching circuit

3. OPTIMIZATION

This step creates a new schematic and the lengths are chosen to be optimal. You can set the permissible noise levels for the design, which in this article we have considered the noise is less than 1.5dB. The following figure shows the lengths after optimization have changed.

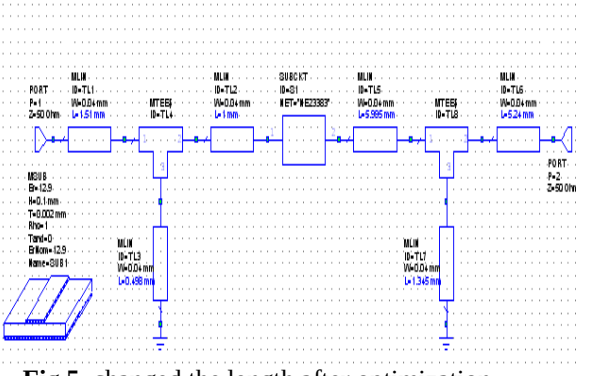

Fig.5. changed the length after optimization

4. CONCLUSION

In this paper, a low noise amplifier using transistor NE23383 8GHz frequency and voltage and current at V_{DS} = 2v I_D = 10mA was designed.

As can be seen the amplifier has a gain is almost constant in a wide frequency range, that is a good feature for use in specific applications.

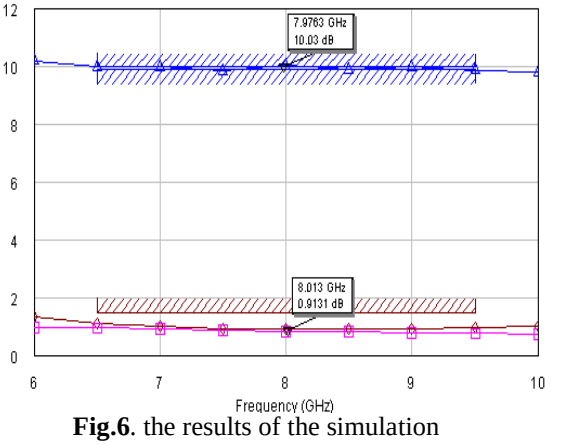

Fig.6. the results of the simulation

REFERENCES

[1] Guillermo Gonzalez, **"Microwave Transistor Amplifiers Analysis and Design,"** *Second Edition, pp. 384-410, 1996.*

[۲] شمس الدینی، شیما، بطحایی، ندا، حجت کاشانی، فرخ، **"طراحی تقویت کننده کم نویز در باند فرا پهن با استفاده از تکنولوژی CMOS"**، چهاردهمین کنفرانس دانشجویی مهندسی برق ایران، دانشگاه صنعتی کرمانشاه، ۱۵-۱۷ شهریور ۱۳۹۰.