

# **RF CAD LABORATORY BASED PROJECT ON 10GHz LNA FOR AMATEUR RADIO OPERATION**

Submitted By

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# **PROBLEM STATEMENT**

**Designing of a 10GHz Low Noise Amplifier for Amateur Radio Operation.**

## ACKNOWLEDGEMENT

*It is difficult to acknowledge the precious debt of knowledge and learning. But we can only repay it through our gratitude. I, Asish Nayak, a M.tech student in RF and Microwave Engineering , would like to convey my heartfelt gratitude to my professor **Dr. M.V Kartikeyan** , for blessing us with his immense knowledge of Microwave Engineering and being a constant source of inspiration for me.*

*I would also like to thank Mr. **Mr. Sai Haranadh(PhD Scholar, IIT Tirupati)** for his valuable instruction and support through this project by clarifying my doubts and guiding me with his novel ideas.*

*Regards,*

**Asish Nayak**

**M.Tech RF and Microwave Engineering (2022 batch)**

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# INTRODUCTION

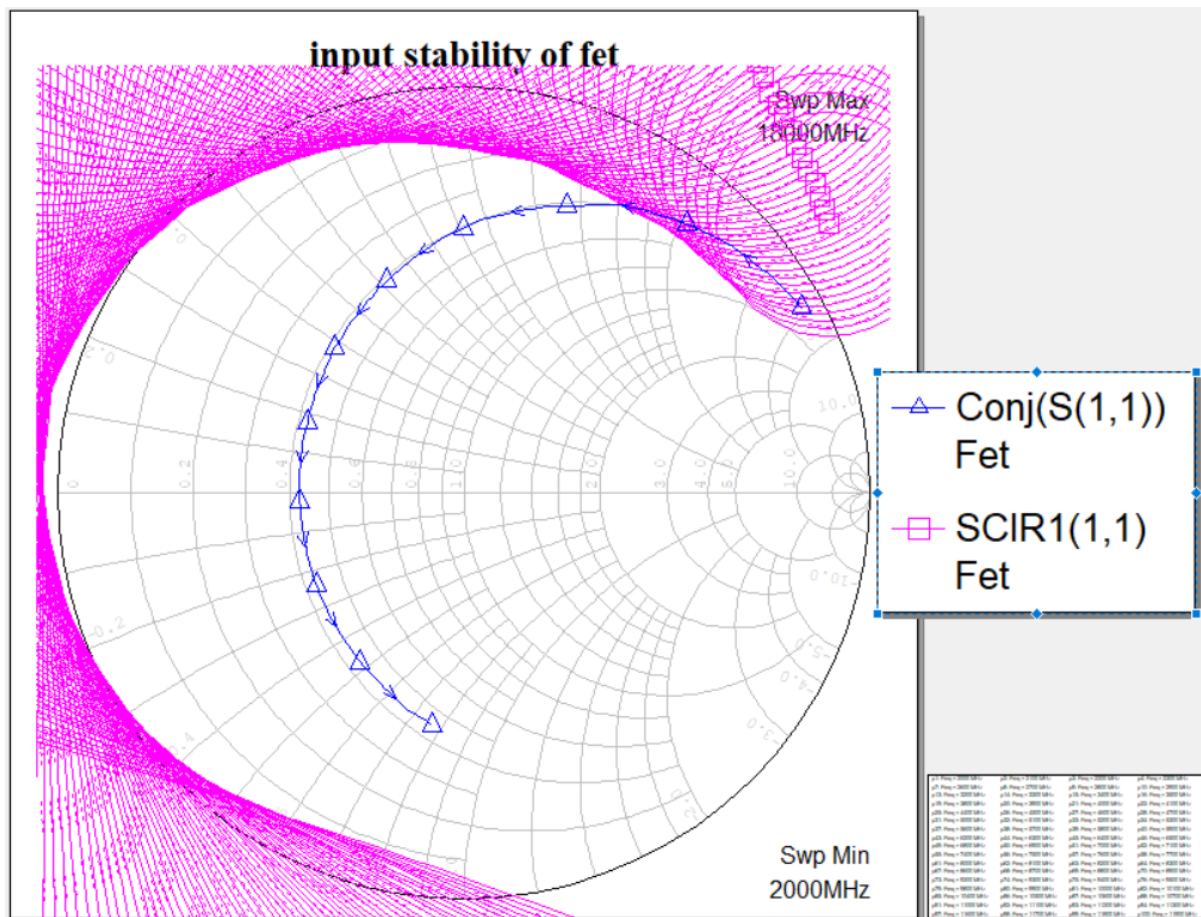
*The design of 10GHz ham radio station was originally discussed within the amateur radio community but one of the missing key block was a good low noise-amplifier. It will generally amplify both low amplitude signal along with some noise. The LNA was designed to operate from 12V with at least 18dB gain and less than 2dB noise figure and unconditional stability.*

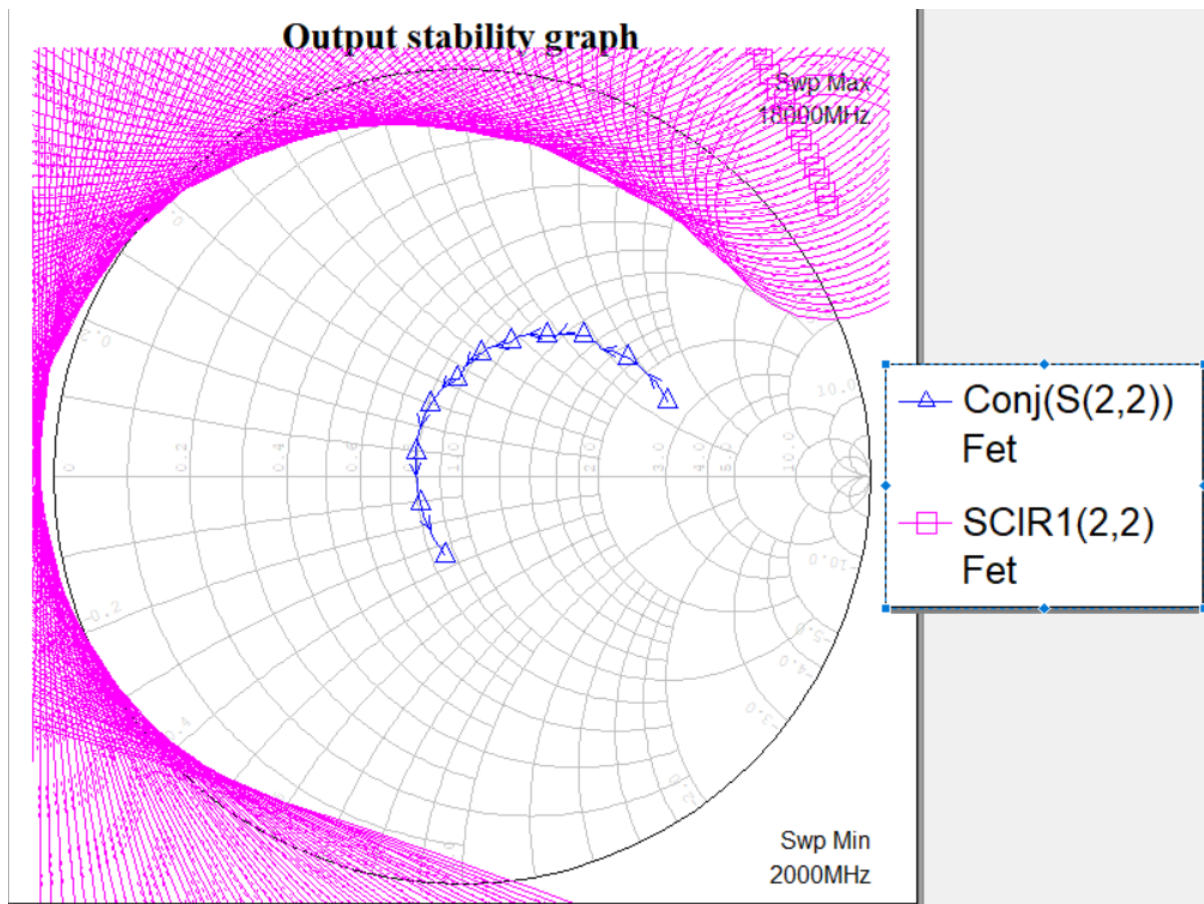
*The software that has been used in this project is **Cadence Microwave Office**. The whole circuit is designed on a patch of **Rogers R04003C** substrate of dielectric constant ( $3.38 \pm 0.05$ ) and height 1.6mm. Sheets of this material is available in six different dielectric thicknesses. For our LNA, we chose 0.508mm.*

*For conductor, we chose the Hammond 1590LLB cast aluminum package as it was readily available for low cost. For amplifier, we chose Renesas NE3503M04 which is a pseudomorphic high electron mobility transistor (pHEMT) candidate for two stage LNA.*

# DESIGN AND IMPLEMENTATION USING AWR

*This design of LNA will utilize FETs operating with 15 to 20mA drain current. In order to get insight into stability tradeoffs in the LNA, it was worthwhile looking into inherent stability behavior of these FETs. The following plots suggest that series loss at input and shunt loss at output will increase stability.*

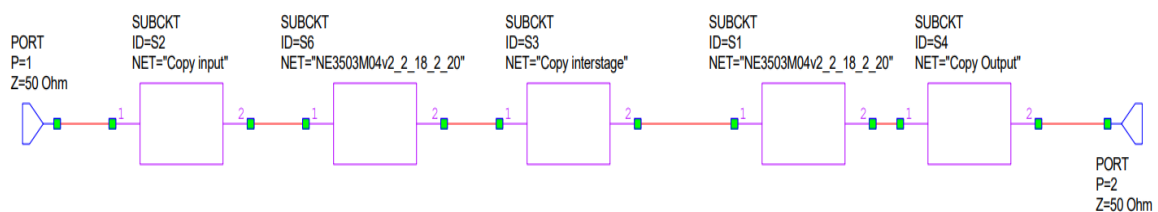




*Initially, a single stage LNA was designed as a building block for two stage LNA. The interstage of two stage LNA was cascade of an output from stage-1 and input from stage-2 with phase rotation line inserted between them.*

*Following is the awr schematic of two stage 10GHz LNA:*

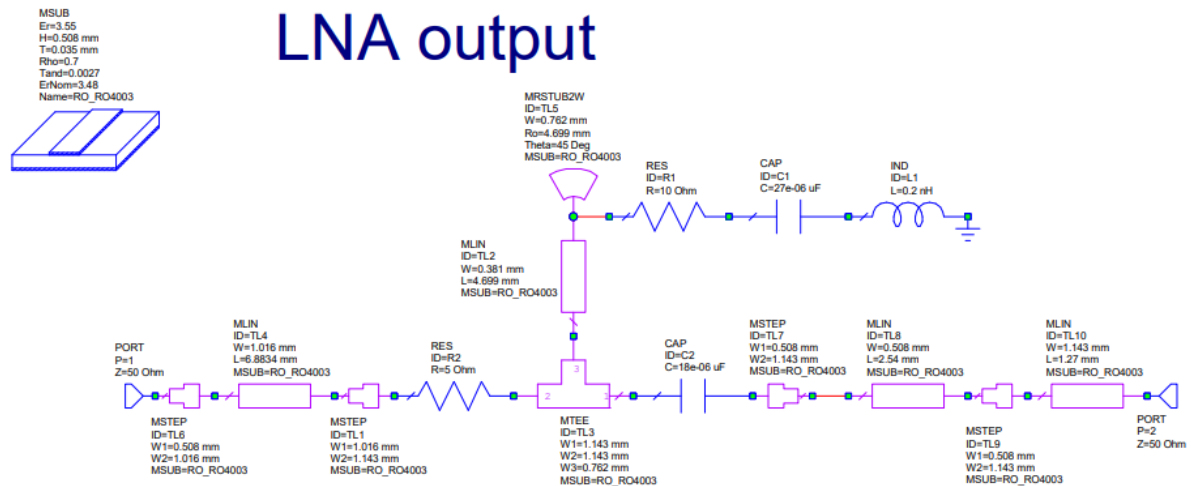
## 10GHz LNA



## LNA input stage

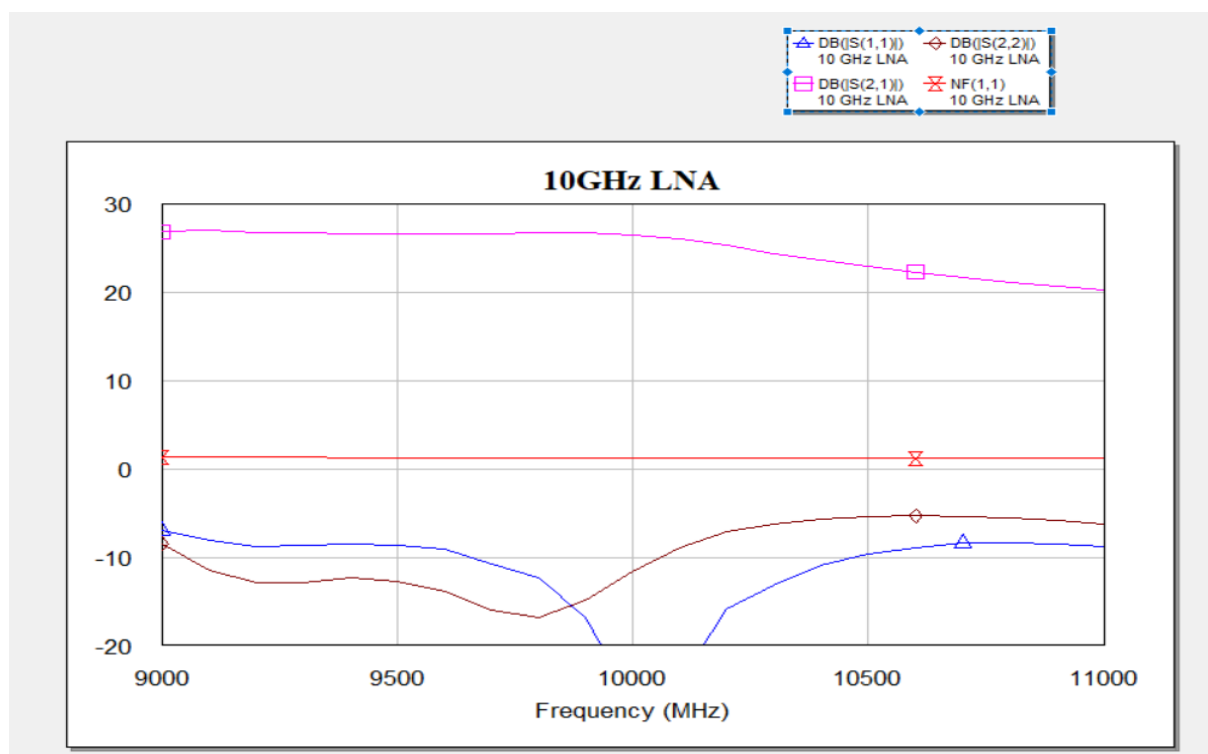
## LNA interstage

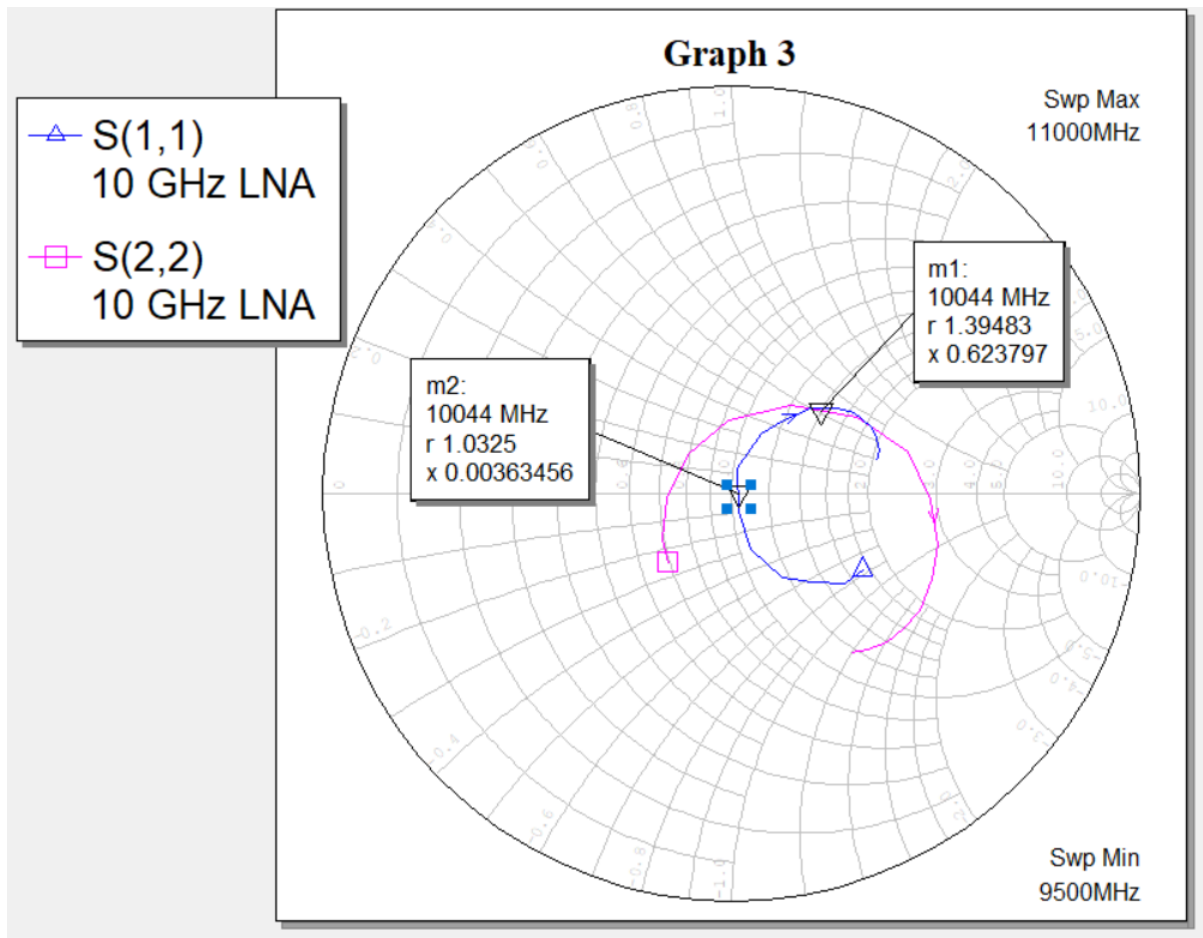




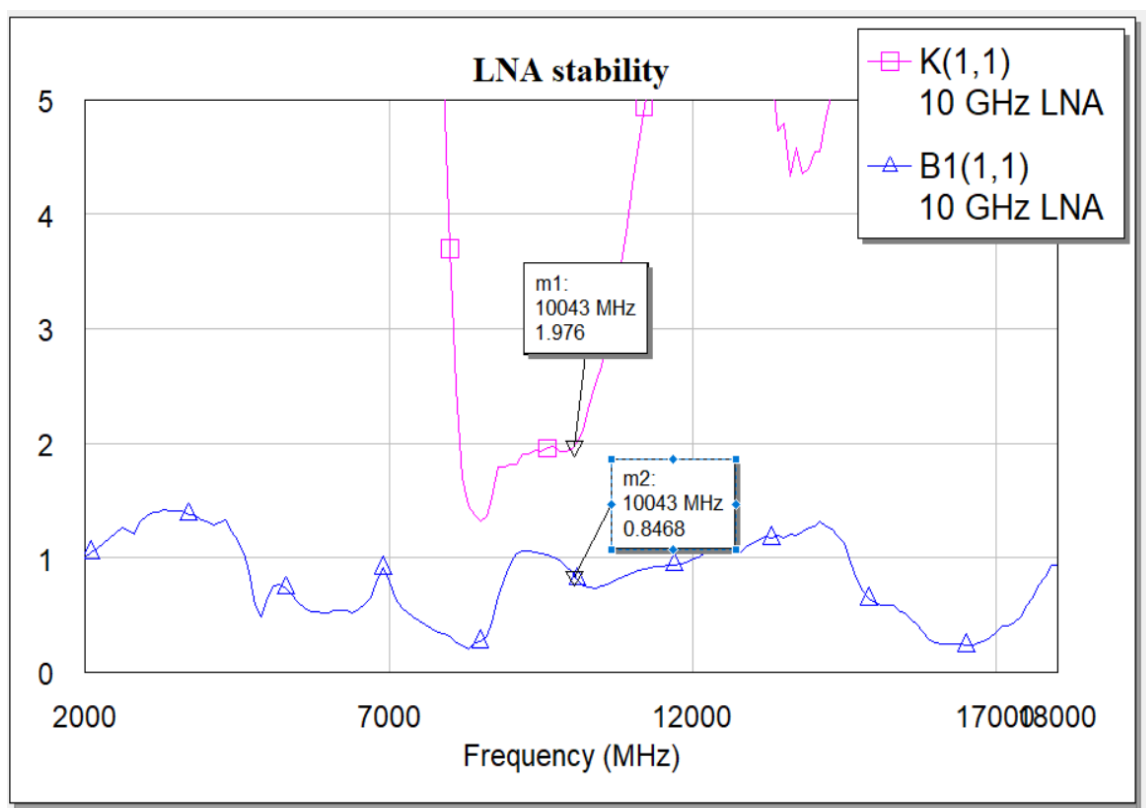
## RESULTS

Following figure shows the overall simulated gain, port match, and noise performance. The frequency range that was of greatest interest for ham radio operation was 10.043GHz.





*For unconditional stability, the rollet's factor ( $K$ ) had to be greater than one and the B1 parameter had to remain positive.*



## CONCLUSION AND REFERENCES

*Hence, the 10 GHz LNA for Amateur radio operation has been designed. Now it can easily reduce noise figure for Amateur radio receiver to much extent with bandwidth being increased twice.*