International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-3, September 2019

Design of High Stability Factor Lna using Cascade Mosfet at 850MHz Rf Frequency

S.Shiyamala, M.Sai Ganesh

Abstract: Controlling noise is the primary effort in any amplifier. LNA (Low Noise Amplifier) will control the noise in front panel of amplifier stage as per FRISS law. Instead of single MOS in LNA, cascaded the MOS generates the stability factor in a better way in 850MHz RF frequency at load impedance of 50Ω. But additionally capacitor inserted cascaded MOS will pull down the stability factor. **Cascasded MOS LNA have a stability factor of 1.387 and Noise Figure(dB) of 0.518**

Index Terms*: LNA, *Stability factor, cascade MOS, Noise Figure .

I. INTRODUCTION

Heng-Ming Hsu et.al[1], proposed an inductive feedback procedure executed in the ultra-wide-band low noise amplifier(UWB LNA). Utilizing the system, the proposed circuit improves the bandwidth speed as well as decreases the noise figure. Hiu Fai Leung et.al[2], had proposed an epic transformerfeedback featuring noise cancellation and wideband input matching showed in a wideband differential LNA for (SDR) software-defined-radio applications. Actualized territory of 0.32mm^2 in 0.13µm CMOS, the LNA model estimates a wideband information coordinating S11 of not exactly 1.2GHz to 6.6GHz of - 10dB,least noise figure(NF)of 1.8dB while devouring 1.2Vsupply at 11mA. Ravinder Kumar et.al[3], havd proposed a single stage low noise amplifier (SLNA) design with low noise and high gainutilizing inductive source degeneration(ISD) topology in frequency scope of 3 GHz to 7 GHz and furthermore utilize the devices like active biasing. A scope of device like capacitors and inductors are utilized to accomplish 50 Ω information impedance with a low noise factor. The structure procedure is stimulated by utilizing Advance Design System (ADS) and executed 0.18 µm CMOS in TSMC innovation. A single stage low noise amplifier has a deliberate noise figure(NF) 2.2 dB for frequency 5.0 GHz and forward gain 25.4 dB. Xiaohua Yu et.al[4],had exhibited a reconfigurable multimode low-noise amplifier (RM LNA) equipped for single-band(SB), and simultaneous dual band(DB), ultra-wide band(UWB) activity. It is the first revealed LNA equipped for SB, simultaneous DB, and UWB operation and is among the biggest data transfer capacities detailed in the literature. This is accomplished with a novel reconfigurable multimode information coordinating system that normally incorporates a switched multitap transformer into an inductively deteriorated regular source amplifier.It gives one of the least difficult LNA answers for reconfigurable radios and the topology is a decent contender for cognitive radioand SDR. Meng-Ting Hsun et.al[5], had exhibited a low power UWB LNA on common source(CS) topology.To shape a cascode structure to lessen the power utilization the current-reused method is used. Zipeng Chen et.al[6],Proposed atuneable low-noise amplifier (t-LNA)1.0-5.0GHz in 65nm is displayed, which utilizes common gate (CG) topologyof double input to lessen the noise figure (NF) and out-of-band obstruction. The automatic frequency calibration systembased on amplitude detectionis proposed to beat the impacts of the procedure variety with minimal additional expense. Namrata Yadav et.al[7], has proposed an articulated for a LNA with minimum noise performance and high gain for Global Positioning System (GPS) application. The design and it is simulated in cadence design tools of UMC90 technology. The topology is single ended LNAs designed for isolation purpose cascaded transistor is used; the common gate transistor is used to control common source transistor. By the sub-threshold region, the single ended(SE) cascode topology is operated and the gain was increased. Mahsa Keshavarz Hedayati et.al[8], In his paper exhibits a plan technique has reduced low noise amplifier(LNA) of 33-GHzfor applications of 5G acknowledged in LP CMOS of 28-nm. In light of the novel arrangement of difficulties displayed by cutting edge nanoscale CMOS, the accentuation is put here on the streamlining of plan and format methods for active and passive components within the sight of thorough metal thickness guidelines and other back-end-of-the-line (BEOL) challenges.Every single passive element of transmission lines, pads and inductors are structured and streamlined with full wave recreations to adapt to the severe metal thickness standards and other referenced BEOL difficulties has innovation for a tasteful mm-wave execution. Juan Luis Castagnola et.al [9],

Manuscript published on 30 September 2019
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exhibited another procedure for structuring a cascode low commotion enhancer utilizing the dispersing parameters together with the gm/ID of the transistors. A CMOS 65 nm innovation was picked to show the legitimacy of this procedure. Typically there are two different ways to plan a LNA, the first of them is to configuration searching for maximum gain and the other is to search for the minimum noise figure.

In this work the two approximations were completed. The rest of the paper is organized as follows: In section II, concept of low noise amplifier is discussed. In section III, various techniques used in LNA is discussed in section IV.

In section V, the parameters of LNA is compared based on the result. Finally section 6 contains the conclusions.

II. Low Noise Amplifier – An Intro

As per FRISS law, noise controlled in a first stage of any system produces a better result. Fig 1 represents the schematic representation of satellite onboard receiver.

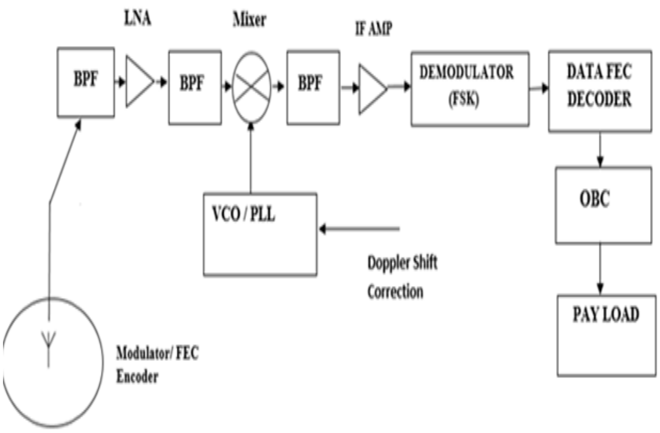

Fig. 1.Satellite receiver block diagram

Fig 2 shows thee trade off parameters in LNA. Stability factor is the prime parameter as compare with noise figure and power gain.

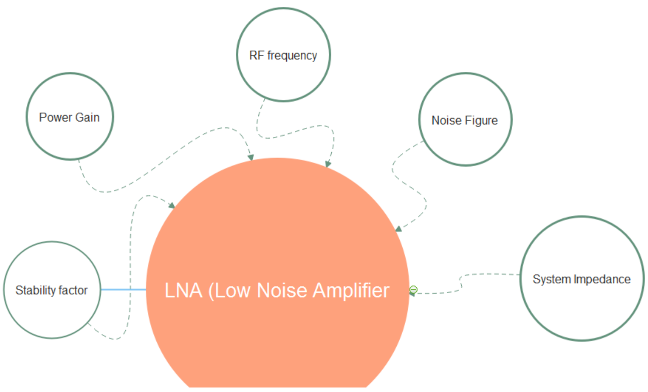

Fig.2. Schematic representation of various factors affecting LNA

III. Cascade LNA using ADS

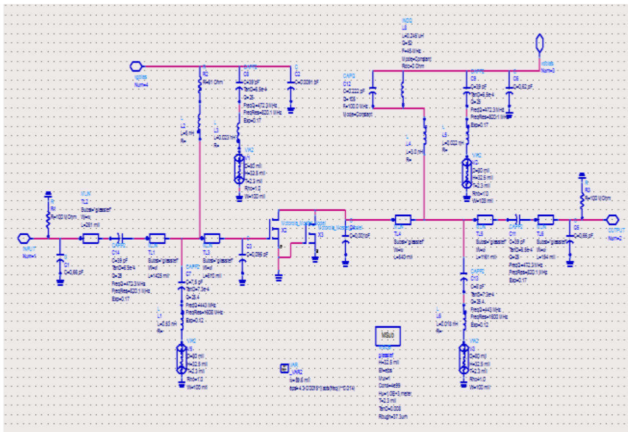

Fig.3. Cascaded LNA design

In general, number of stages gets increased in the sense, gain also will be improved. Fig 3 shows the cascaded MOSFET model. In addition, to improve the characteristics of MOSFET, capacitors are adder in cascade MOS, but it minimize the stability factor due to additional leakage power.

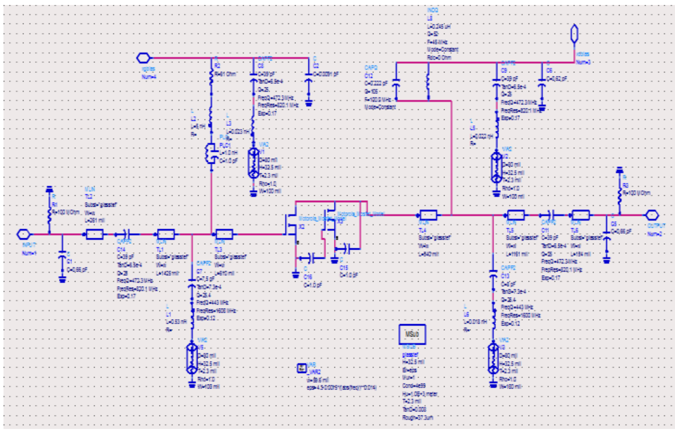

Fig.4. Capacitor coupling Cascasded MOS LNA

IV. Result and Discussion

With the help of ADS software thoroughly check the characteristics of LNA in various techniques viz. cascade MOS and Capacitor coupling Cascasded MOS LNA.

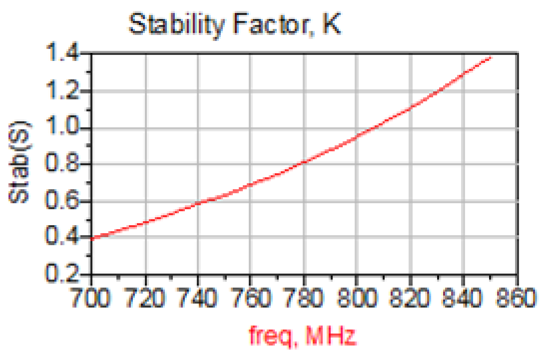

Fig.5. Stbility gain factor (K) for cascaded MOS

International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-3, September 2019

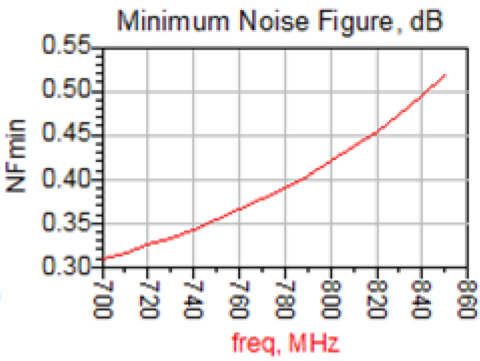

Fig.6. Noise figure for cascaded MOS

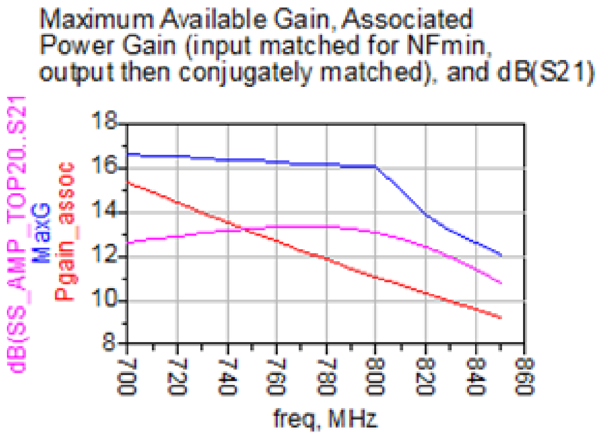

Fig.7. Power gain for cascaded MOS

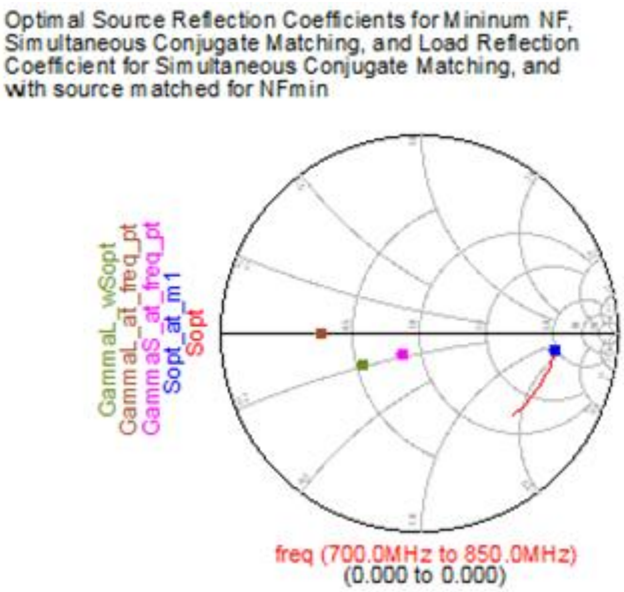

Fig.8. Smith chart representation for cascaded MOS about reflection coefficient

Table: 1 Comparison of S parameters for various techniques at 850MHz RF frequency using Motrolla MOSFET

Technique	S11 (dB)	S12 (dB)	S21 (dB)	S22 (dB)
Single MOS LNA	**-10.11**	**-19.44**	**12.05**	**-8.37**
Cascasded MOS LNA	**-12.991**	**-20.69**	**10.79**	**-6.26**
Capacitor coupling Cascasded MOS LNA	**-13.84**	**-20.58**	**10.90**	**-5.97**

Table: 2 Comparison of matching gain for various techniques at 850MHz RF frequency and system impedance 50Ω using Motrolla MOSFET

Technique	Power Gain (dB)	Zsource	Zload
Single MOS LNA	13.070	28-j12	21+j5
Cascasded MOS LNA	12.037	40-j8	16+j0.1
Capacitor coupling Cascasded MOS LNA	12.247	39-j0.2	15+j0.2

Table: 3 Comparison of stability factor (K) and noise figure for various techniques at 850MHz RF frequency using Motrolla MOSFET

Technique	**Stability factor (K)**	**Noise Figure(dB)**
Single MOS LNA	1.196	0.494
Cascasded MOS LNA	1.387	0.518
Capacitor coupling Cascasded MOS LNA	1.342	0.519

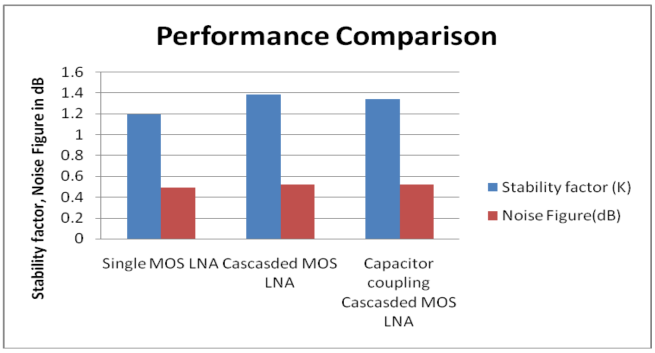

Fig.8. Performance comparison of LNA with various techniques

V. CONCLUSION

LNA design is a crucial part in an amplifier. Various factors affecting the LNA are RF frequency, temperature, paracitic capacitance etc. This paper dealt , stabilty factor (K>1) is good for cascaded MOS LNA compare with single MOS LNA and capacitor coupling cascaded MOS LNA. Material selection of MOSFET will give a better result in future.

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