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DESIGN OF LNA FOR WI -MAX APPLICATIONS

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ABSTRACT

There are various technologies are used in the field of wireless communication the basic factor for all technology needed to support high speed data. In general all wireless communication users dement is high data rate with low cost RFIC designs. Several researches are experience difficulties to design transceiver front end for RF application. Design of transmitter path is easy compare to receiver path design due to interference levels are horribly less in case of transmitter because of signal level. It is happen due to RFIC design used higher operating frequency path of receiver conjointly experiencing the interior noises within communication system. The performance of communication system depends on transceiver which should have Low noise amplifiers.

Keywords: RFIC Designs, LNA, Transceiver Front, Wireless Communication.

I. INTRODUCTION

In Current Scenario audio Video based message are widely used by the user for this type of message transmission required more data rate to provide better service and it is also necessary for next generation wireless communication. The cellular or Mobile telephony and wireless local area networks (WLANs) are the two prime directions in recent years, realization of fully integrated system-on-a-chip (SoC) has become a major interest in receiver front end design architectures while retaining low cost. This is the main reason for the Complementary Metal-Oxide Semiconductor (CMOS) technology to be very popular in RF circuit designs.

The interest has grown towards technologies which can offer higher data rates in large global areas. Wi-Max can provide wide range, large bandwidth and lower cost of data rates. IEEE 802.16 standards are named as Wireless MAN by IEEE. It is eventually known as Wi- MAX. Wi-MAX Forum cited 2.3, 2.5 and 3.5GHz frequencies for standardization. A significant amount of research work has been done at 2.5GHz, because of its widespread global usage. Though, not much amount of work is stated in research or industrial for 3.5GHz, though it is much needed spectrum in many other uses, especially for the reason of the authorizing requirements.

II. METHODOLOGY

Among the different LNA design types, the cascode LNA design is most widely used technique which is shown in Fig 1 This LNA improves the technical hitches of inductively degenerated CS LNA like progress in reverse isolation, Output matching network, noise figure etc. The inductively degenerated cascade LNA gives us

- Improved noise performance in the narrow band applications.
- Provides good isolation between the input and output.
- Ls and Lg are used to make impedance matching at the input.
- Output load matching can be obtained by proper tuning of the load inductor Ld and capacitor Cout

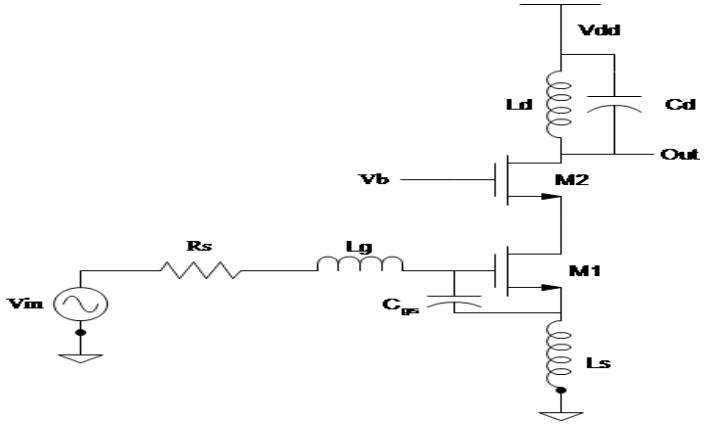

Fig 2: Architecture of Simple cascode LNA

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Principle of operation

The cascode LNA structure is the chosen structure because it can easily satisfy both noise and power gain requirements. The topology used here in this design is single ended cascode structure with inductive degeneration method for improved Noise Figure and input matching. By breaking down the gate width into smaller widths that are connected in parallel, the resistance at the gate terminal of input transistor can be reduced. This reduces gate resistance and increases the Cgs. The cascode structure provides higher output impedance and reduces the Miller effect. An output grounded source buffer drives the load for proper output matching. The design is seen in Fig.4.2. The best matching to achieve desired Operating Gain, Noise Figure, and IIIP3 do not occur simultaneously. The Architecture of the 3.5 GHz LNA is shown in Fig 3

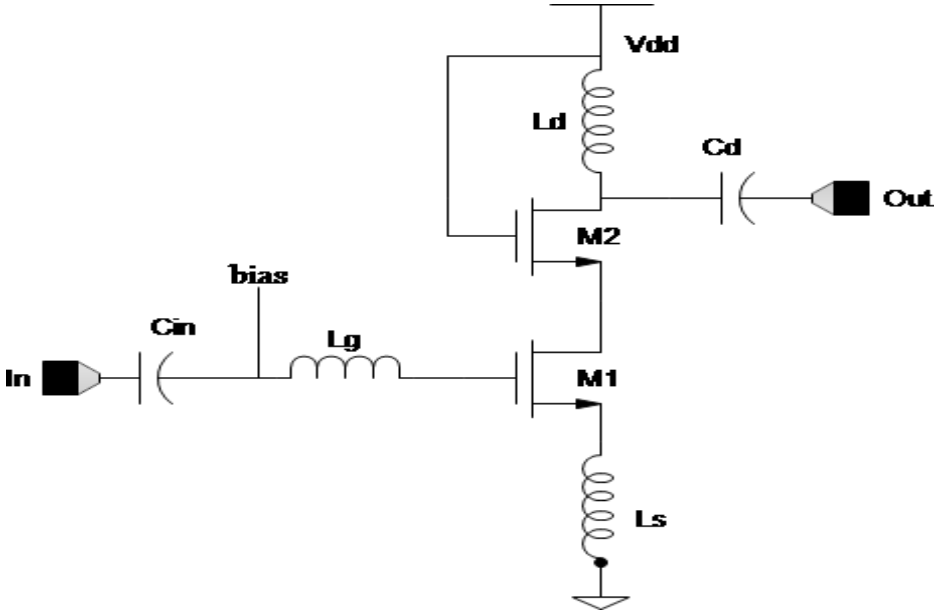

Fig 3: Schematic of Designed cascode LNA at 3.5GHz

III. MODELING AND ANALYSIS

The cascode LNA is the most preferred design among LNAs. Because it can provide low noise along with better gain at a time. Still, this Cascode topology suffers from the noise contributed by parasitic capacitances of transistors M1 and M2 [8]. Also we find difficulty in match and tune the load concurrently with the limited inductor and capacitor values

To minimize this noise, a series resonance inductor[8] is placed in between CS - CG stages as shown in thus at that particular node, inductor removes the parasitic capacitance at the given frequency. Same concept is used at gate of the transistor M2.

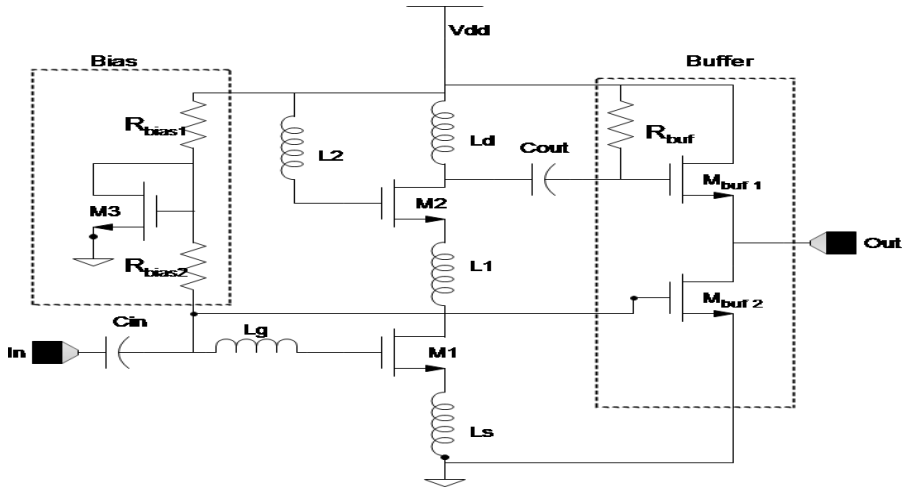

Fig 4: Enhanced Architecture of cascade CMOS LNA

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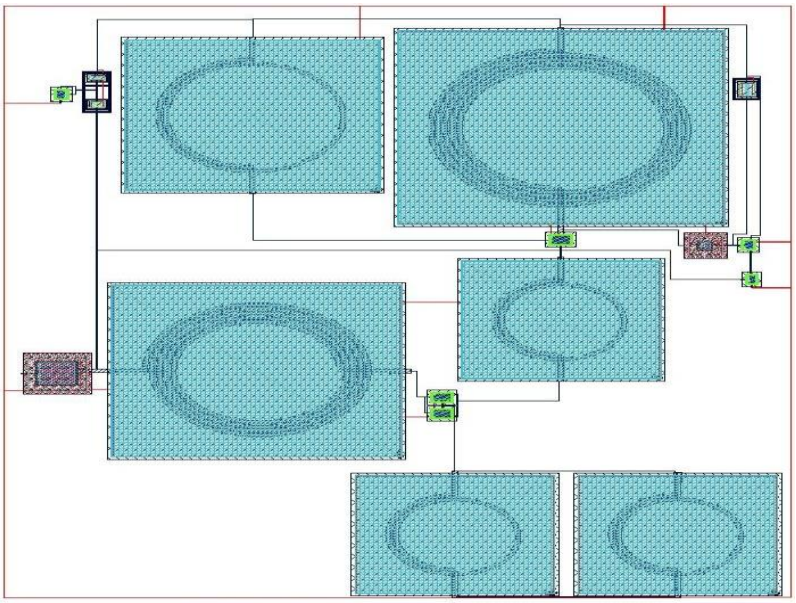

Fig 5: Layout of the proposed LNA

IV. RESULTS AND DISCUSSION

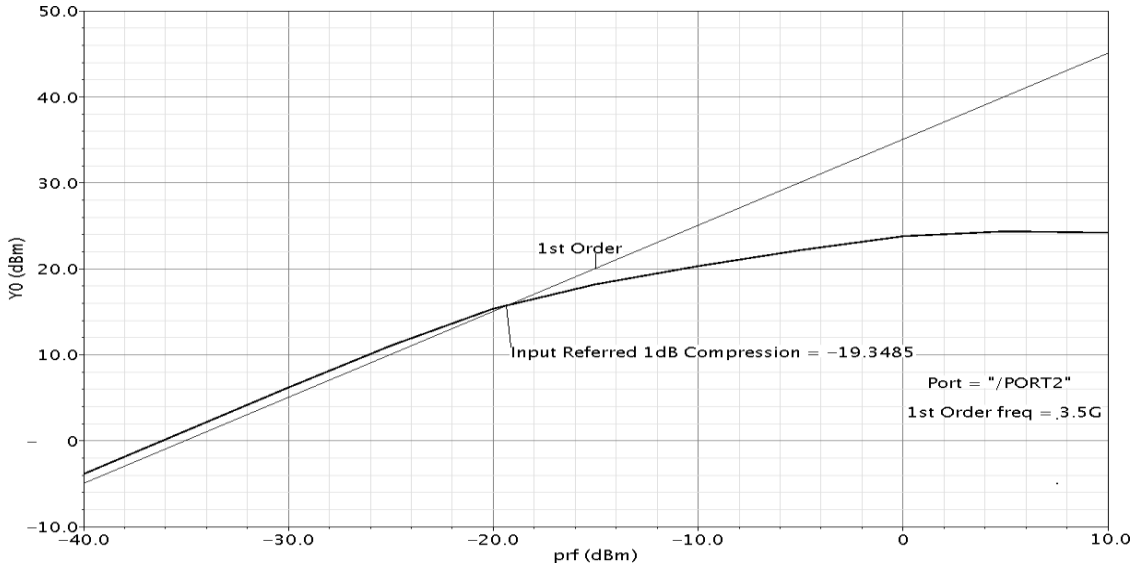

Fig 6: Simulation of 1 – dB compression point (Post layout)

This design presents a 3.5 GHz LNA design using UMC 0.18µm CMOS technology. This enhanced cascade LNA requires a supply voltage of 1.8V and draws a current of 10.5mA, consumes 18.9 mw power, at 3.5GHz, this LNA has NF of 2.557dB, with input return loss of -14.06dB, output return loss of -15.86dB, and Forward gain of 26.88dB. This LNA performance shows high gain, with low NF. 1dB compression point of this design is -9.017dBm, means no gain compression for the received signals below compression point level. A two tone test is done to this LNA to observe the intermodulation, observed IIP3 is - 4.1913dBm. This LNA can be used for high gain and low noise wireless applications. The performance summary is listed in Table 1.

Table 1

PARAMETER	Simple CascodeLNA	Enhanced Cascode LNA	
		Schematic	Post layout
S11(dB)	-25.53	-14.06	-8.39
S12(dB)	-39.61	-46.82	-52.2

S21(dB)	20.15	26.88	23.9
S22(dB)	-9.033	-15.86	-22.56
NF(dB)	2.749	2.557	3.771
NF min (dB)	2.194	2.21	2.956
1dB compression(dBm)	-17.8695	-9.017	-14.354
IIP3(dBm)	-11.9093	-4.1913	-6.7891

V. CONCLUSION

In this Thesis, the design of high gain source degenerated CMOS cascade LNA and its enhanced version are discussed. A Differential LNA model with the same concept at 3.5GHz for Wi-MAX applications is presented. This designs were implemented in Cadence 0.18µmc RF CMOS technology. All the designs operate with the 1.8 V supply voltage. These LNAs give high gain, low noise figure with proper input and output matching, also the inter modulation is reduced to an extent. These LNAs can be used in applications where high gain and low noise figure are needed.

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