Design of CMOS Based Differential LNA and Mixer for ZigBee Application: A Survey

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Abstract: Low Noise Amplifier is an electronic enhancer that opens up a low power motion without essentially debasing its flag to commotion proportion. It is designed to minimize the additional noise. The cascode is a two phase speaker made out of a transconductance enhancer took after by a present support. The characteristics of cascode LNA are higher information – yield disconnection, higher information impedance, higher yield impedance, higher pick up or higher transfer speed. Noise figure determines efficiency of particular LNA which results in better reception of signal. This paper describes a survey on differential low noise amplifier and mixer design for ZigBee applications.

Keywords — Gain, Noise Figure, ZigBee

I. INTRODUCTION

A low-commotion intensifier (LNA) is an electronic enhancer that is utilized to enhance signs of low quality, for the most part from a reception apparatus where signals are scarcely unmistakable and ought to be opened up without including any clamor, generally essential data may be lost. LNAs are a standout amongst the most essential circuit parts introduce in radio and other flag beneficiaries. The principle necessity of Low Noise Amplifier is low clamor figure and high pick up. To decide the proficiency of Low Noise Amplifier is low clamor figure and high pick up. To decide the proficiency of Low Noise Amplifier, parameters like pick up, commotion figure, steadiness and linearity are dissected. Due to the advantages of low cost and high integration, CMOS technology is widely used in Low Noise Amplifier design. In earlier days 0.35 µm CMOS and 0.18 µm CMOS technologies are used.

Due to the resulting advantages of reduced chip size, 0.13 µm technology is used nowadays. It covers the frequency range of many popular wireless products such as Cell phones, GPS, GNSS and Bluetooth. The complete design of Low Noise Amplifier consists of three main sections, namely Principle transistor area, Input coordinating system and the Output coordinating system. The first step in designing LNA is the selection of Transistor. They chose transistor must accomplish high increase, low clamor figure and high IIP3 Performance.

RF execution of the LNA depends by numerous factors as:
- Recurrence
- DC Biasing and Power Dissipation
- Stability
- Info and Output Matching
- Format and Grounding
- EM Shielding
- Supply decoupling
- Temperature

![Fig. 1 Fundamental LNA](image)

The picked DC predisposition circuit should display stable warm execution and diminish the impact of hFE spread. The resistive criticism plan is the most straightforward type of DC biasing that satisfies all the significant necessities. Two inclination criticism courses of action are conceivable: one with a blend of \( R_c \) and \( R_o \) furthermore, a moment one with straightforward \( R_e \) and \( C_e \) mix. The characteristics of different configuration of LNAs are shown in table1.
Table 1: Common qualities of various setups of High-Frequency GaAs FET LNAs

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Common Source (CS)</th>
<th>Common Gate (CG)</th>
<th>Cascode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise Figure</td>
<td>Best</td>
<td>Better</td>
<td>Great</td>
</tr>
<tr>
<td>Gain</td>
<td>Direct</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>Limit</td>
<td>Very Wide</td>
<td>Wide</td>
</tr>
<tr>
<td>Stability</td>
<td>Remuneratio regularly required</td>
<td>RF Decoupling of the Gate is Important</td>
<td>Good</td>
</tr>
<tr>
<td>Reverse Isolation</td>
<td>Lower</td>
<td>Moderate</td>
<td>Best</td>
</tr>
</tbody>
</table>

II LITERATURE SURVEY

Yuan-Wen Hsiao et al (2008) propounded a novel for 5GHz differential low noise amplifier (LNA) based on 130nm CMOS process. For ESD protection design, to quickly bypass ESD current by using ESD transport and ESD brace gadget are embedded between the differential info cushions. This design provides 18dB power gain and noise figure of 2.62dB and it is based on human body model (HBM). The experimental results provides astounding RF execution and high ESD strength all the while.

Xiaohua Fan et al. (2008) depicted about Capacitive Cross Coupling Technique. The Common Gate Low Noise Amplifier accomplishes wideband info impedance coordinating however it experiences lessened commotion execution. To defeat this issue a capacitive cross coupling method is utilized. Here a clamor inductor consolidated with the capacitive cross coupling strategy is proposed for Common Source-Common Gate (CS-CG) two phases LNA to enhance the commotion execution and linearity execution of the differential course LNA. The CS organize is intended to accomplish the info impedance coordinating and to acquire best commotion execution. The course transistor acts as a Common Gate arrange. It is essentially intended to lessen the Miller impact of the parasitic door deplete cover capacitance in the Common Source transistor. The improved input-output isolation and output impedance are also obtained here. But this method provide low gain.

Chen Ming Li et al. (2011) examined about SFBB Technique. FBB method is chiefly used to lessen the power utilization and size of Low Noise Amplifier. In this paper, a low-control low-commotion intensifier using SFBB system for wideband application is proposed. A ultra-low power self-inclination approach is utilized as a part of SFBB method, which enhances the execution of traditional FBB system. SFBB procedure needs an extra inclination circuit to give supply to the mass terminal of the MOSFET to get a forward mass source predisposition. The SFBB method is utilized to diminish supply voltage and recoveries extra predisposition circuit which prompts low power utilization. The immediate coupling strategy between the initial two phases is likewise used to spare predisposition circuits. But this technique create stability problem.

Anuj Madan et al (2012) introduced 0.95dB for a 5GHz CMOS LNA. Inductively degenerated cascode topology was used in SOI substrate. It is combined with passives in high Q and floating body transistor. These are produced superior linearity performance and noise figure at 5GHz. In low noise amplifier, gain value is 11dB and the dc power is 12mW was achieved. It is upheld in 802.11a WLAN applications. In SOI body contact strategy, RF execution is clarified and execution of entomb regulation is moved forward.

Muhammad Khurram et al. (2012) talked about Current Reuse Technique. The Current Reuse Technique is for the most part used to give same predisposition current in the circuit and to diminish control utilization. By stacking two NMOS gadgets (or one NMOS and one PMOS gadget) one can accomplish the current reuse system. It improves the general Trans-conductance of the circuit which thus limits the MOSFET clamor. In this paper the Current Reuse Technique is utilized by sharing the predisposition current between the trans-conductance (gm)boosting and UWB flag opening up stages. This method provide high gain and low power consumption. But increases phase noise and generate stability problem.
Vaithinathan.V et al (2012) have propounded a Ultra Wide Band(UWB) applications in light of two Low Noise Amplifiers(LNA's). One is utilized without criticism topology and other is shunt fractional input topology. In this paper 90nm CMOS innovation is utilized for dissecting the execution parameters, for example, control pick up, commotion figure and so on , working at 1V control supply.

Kusan-Hsiu et al. (2013) described the technique Resistive Feedback. The resistive feedback amplifier topology gives the advantage of design simplicity. While keeping the upside of simple and solid info coordinating of a resistive input topology, it takes an additional preferred standpoint of gm-boosting as in inductively worsened topology. The pickup of the LNA increments by the Q-factor of the arrangement RLC input system, and its commotion figure (NF) is lessened by a comparable factor. It requires small die area and helps achieving low noise figure compared to the other amplifier topologies. Current reuse is implemented along with resistive feedback. This reduces the requirement of current and thereby helps reduces power consumption of the circuit. But this Resistive Feedback technique provide increase noise figure.

Dr. Siva Agora Sakthivel Murugan et al. (2013) described about parallel to series matching network technique. Matching network is an essential part of RF circuit design. Matching network is mainly used While keeping the upside of simple and solid info coordinating of a resistive input topology, it takes an additional preferred standpoint of gm-boosting as in inductively worsened topology. The pickup of the LNA increments by the Q-factor of the arrangement RLC input system, and its commotion figure (NF) is lessened by a comparable factor.

J.Sam Hamidon et al(2014) presented single stage low noise amplifier(LNA) design based on the technique of L-matching networks. This technique is used for WIMAX applications. The L-matching network consists of lump reactive elements at the input and output terminals. In this design, we achieve 18.34dB of power gain and 1.34dB of noise figure. Moreover, -16.25dB of input reflection and -7.52dB of output return loss. In this method the amplifier records the bandwidth in the range of 1.24GHz.

The different existing systems are talked about in the writing overview. The existing techniques have the drawback of low gain, increased noise figure, large chip size and stability problem. The comparison of existing methods are shown in table 2.

### Table 2: Performance Analysis of Existing Methods

<table>
<thead>
<tr>
<th>Technology</th>
<th>Topology</th>
<th>Freq (GHz)</th>
<th>NF (dB)</th>
<th>Pdc (mW)</th>
<th>Gain (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.18um (SOI)</td>
<td>Single-ended</td>
<td>5.0</td>
<td>0.95</td>
<td>12.0</td>
<td>12.0</td>
</tr>
<tr>
<td>0.18um (CMOS)</td>
<td>Fully-differential</td>
<td>5.7</td>
<td>3.65</td>
<td>14.4</td>
<td>14.5</td>
</tr>
<tr>
<td>0.13um (CMOS)</td>
<td>Fully-differential</td>
<td>5.0</td>
<td>2.62</td>
<td>10.3</td>
<td>18.0</td>
</tr>
<tr>
<td>0.18um (CMOS)</td>
<td>IPD-differential</td>
<td>5.2</td>
<td>2.1</td>
<td>10.0</td>
<td>15.5</td>
</tr>
<tr>
<td>0.13um (CMOS)</td>
<td>Fully-differential</td>
<td>5.2</td>
<td>2.9</td>
<td>8.0</td>
<td>21.0</td>
</tr>
<tr>
<td>0.13um (CMOS)</td>
<td>Differential</td>
<td>5.0</td>
<td>2.16</td>
<td>10.3</td>
<td>16.2</td>
</tr>
<tr>
<td>0.09um (CMOS)</td>
<td>Differential</td>
<td>5.8</td>
<td>1.7</td>
<td>19.6</td>
<td>12.0</td>
</tr>
</tbody>
</table>

### III CONCLUSION

In this paper an extensive survey on gain enhancement technique is reviewed using Differential Low Noise Amplifier (LNA). Various techniques for gain enhancement are discussed in this paper. The overview paper speaks to different methods utilized for expanding the pickup and lessening the commotion figure for ZigBee applications.

### ACKNOWLEDGMENT

At first, I thank Lord Almighty to give knowledge to complete the survey. I would like to thank my colleagues, family and friends who encouraged and helped us in preparing this literature survey.
REFERENCES


