IMPORTANT DATES -

Scopus®

Organized by

Institute of Engineering & Management, Kolkata

and

University of Engineering & Management, Kolkata and Jaipur

Along with NIT, Calicut

In association with

Vijnan Bharati, Vivekananda Vijnan Mission, West Bengal Chapter of Vijnan Bharati and Vijnan Bharati Mumbai supported by SMART Society, USA.

And Supported by

SMART Society, USA

WE ARE HONOURED TO HAVE

Prof. Anil Sahasrabudhe

Chairman of National Educational Technology Forum (NETF), chairman of EC National Assessment and Accreditation Council (NAAC) and Chairman NBA, Ex-Chairman of AICTE

AS THE CHIEF GUEST OF THE IRTM 2024

- **19th-21st November, 2025 Conference Dates**
- **5th Septmber, 2025 Full paper submission**
- **20th October, 2025 Acceptance Notification**
- **5th November, 2025 Camera-ready copy due**
- **5th November, 2025 Presentation Submission**
- **5th November, 2025 Registration**

Register Here

IRTM 2024

[IRTM 2024] Your paper #1571087231 ('Design and Simulation of a Low Power OTA Based Low Noise Amplifier Using Cadence Virtuoso')

2 messages

<irtm2024-chairs@edas.info> Mon, 28 Oct 2024 at 10:57
To: Indranil Maity <indranil.maity@iem.edu.in>, Ankit Biswas <ankitbiswas594@gmail.com>, Prawesh Sharma <praweshsharma9091@gmail.com>

Dear Dr. Indranil Maity:

Congratulations - your paper #1571087231 ('Design and Simulation of a Low Power OTA Based Low Noise Amplifier Using Cadence Virtuoso') for IRTM 2024 has been **accepted** and will be presented in the session titled __.

The reviews are below or can be found at 1571087231.

IRTM 2024 1

Comments for reviewers: write at least 100 words regarding this review

1. Remove the hyperlinks from authors' email IDs.
2. Include few more recent references 2020 onwards.
3. Provide a table listing the performances of other LNAs reported in recent literature and mention how your design improves the performance further.

IRTM 2024 2

Comments for reviewers: write at least 100 words regarding this review

paper can be accepted

Regards,
The conference chairs

Indranil Maity <indrasanu026@gmail.com> Mon, 28 Oct 2024 at 11:06
To: Ankit Biswas <ankitbiswas594@gmail.com>, Prawesh Sharma <praweshsharma9091@gmail.com>

---------- Forwarded message ---------
From: **Indranil Maity** <indranil.maity@iem.edu.in>
Date: Mon, Oct 28, 2024 at 11:04 AM
Subject: Fw: [IRTM 2024] Your paper #1571087231 ('Design and Simulation of a Low Power OTA Based Low Noise Amplifier Using Cadence Virtuoso')
To: indrasanu026@gmail.com <indrasanu026@gmail.com>

From: EDAS Conference Manager <help@edas.info> on behalf of irtm2024-chairs@edas.info <irtm2024-chairs@edas.info>
Sent: Monday, October 28, 2024 10:57 AM
To: Indranil Maity <indranil.maity@iem.edu.in>; Ankit Biswas <ankitbiswas594@gmail.com>; Prawesh Sharma <praweshsharma9091@gmail.com>
Subject: [IRTM 2024] Your paper #1571087231 ('Design and Simulation of a Low Power OTA Based Low Noise Amplifier Using Cadence Virtuoso')

Design and Simulation of a Low Power OTA based Low Noise Amplifier using Cadence Virtuoso

Indranil Maity
Department of Electronics & Communication Engineering (ECE)
Institute of Engineering & Management (IEM)
University of Engineering & Management (UEM)
Kolkata, India
E-mail:
indrasanu026@gmail.com

Ankit Biswas
Department of Electronics & Communication Engineering (ECE)
Institute of Engineering & Management (IEM)
Kolkata, India
E-mail:
ankitbiswas594@gmail.com

Malay Gangopadhyaya
Department of Electronics & Communication Engineering (ECE)
Institute of Engineering & Management (IEM)
University of Engineering & Management (UEM)
Kolkata, India
E-mail:
malay.ganguly@iem.edu.in

***Abstract*—In this work, a low power, Low Noise Amplifier (LNA) has been designed using a two-stage fully differential operational transconductance amplifier (OTA). This LNA was constructed for high-gain, low power, low-noise performance, and wide-bandwidth, making it suitable for communication systems, RF front-ends, and sensor interface applications. The OTA achieved a high gain of 73.6 dB with a cut-off frequency of 16.5 MHz, and 1.45 GHz of unity gain frequency, making it suitable for broadband communication systems. The LNA achieved a gain of 73.2 dB, with a cut-off frequency of 15.99 MHz, and a unity gain bandwidth of 1.428 GHz, making it highly effective in lower frequency bands, such as audio and RF signals. The LNA demonstrated remarkable low-noise properties, with the Signal to Noise Ratio (SNR) of 56.26 dB, and the noise values were significantly reduced, the input referred noise values decreased to 23.911 nV/√Hz at 1 MHz frequency, whereas the output referred noise values decreased to 389.019 nV/√Hz at 1 MHz frequency. The most noteworthy characteristic of the established low noise amplifier (LNA) is its significant minimal power consumption, which remains at just 53.91 µW. This makes it remarkably energy efficient and ideal for battery-driven frameworks and compact gadgets. The suggested LNA network was applied in Cadence Virtuoso using 90 nm CMOS technology with an input voltage source of 1.8 V.**

Keywords— Operational Transconductance Amplifier (OTA), Low Noise Amplifier (LNA), High gain, Cut-off frequency, Low power consumption, Signal to Noise Ratio (SNR)

I. INTRODUCTION

The Operational Transconductance Amplifiers (OTAs) have appeared as essential elements in analog circuit framework, specifically for applications that requires less power and high efficiency. The efficiency, consistency, and energy optimization of OTAs have significantly improved in the past few years, remarkably addressing the requirements of biomedical devices and compact technology. OTAs are usually used in integrated circuits which play a crucial role in diverse applications like switched capacitor circuits, voltage regulators, and biomedical devices. They are very crucial components because of their flexibility and effectiveness [1]. Complementary Metal Oxide Semiconductor (CMOS) technology is broadly applied for applying OTAs, specifically in radio transmitter networks for wireless transmission systems. CMOS technology delivers benefits like improved technology scaling, higher integration levels, and reduced cost, making it a common option for developing OTAs for various applications, incorporating communication receivers, neural recording, ECG systems, and wearable healthcare devices [2-5]. A low noise amplifier (LNA) amplifies weak signals, suppresses noise in the signal and it is located at the analog front end of transmission instruments to minimize additional noise [6]. The LNA contributes as a significant component in the communication systems, it plays a crucial role in signal amplification, enhancing signal quality, and facilitating reliable data transmission, even in environments where signals are weak or susceptible to interference [7]. The challenge in designing a low noise amplifier comes from the need to meet several parameters at once, and the performance of a LNA is largely determined by the characteristics of the transistor used, the parameters can be achieved by optimizing the behaviors of the transistor used in the amplifier [8-11]. Due to increasing demand for high precision and low signal level biomedical applications, such as neural and ECG signal acquisition, LNA designs become increasingly important. In these biomedical devices, the amplitude of the signal is exceptionally low, making low power, low-noise amplifiers are imperative for accurate detection and processing. To ensure reliable performance in sensitive applications, specifically for biomedical front-end systems, the LNAs are designed to focus on achieving both low noise and low power consumption [12-16]. The current trend in modern LNA design is to prioritize low-power operation, catering to the requirements of portable and wearable devices. Multiple studies have specifically focused on amplifiers for medical imaging, ECG monitoring, and neural recordings, where reducing noise and maximizing power efficiency are crucial. These designs strive to meet the demanding needs of high precision and low noise while minimizing power consumption, to facilitate the prolonged use of biomedical devices [17-22]. Ozbek et al. [23] developed an innovative ultra-low power, low-noise design for implantable medical devices, consuming micro watt level power. This breakthrough design ensured extended operation in battery or inductively powered implants, with a tunable front-end to adapt to varying signal strength, ensuring consistent performance. By effectively balancing low power consumption with high sensitivity, this design significantly extended the operational lifetime of devices such as cochlear implants, neural recording devices, and pacemakers. Udupa et al. [24] focused on the vital task of minimizing noise in ECG systems for accurate millivolt-level bio-signal detection. Their low-power, low noise amplifier not only enhanced signal integrity but also maintained efficient power consumption for portable devices. Abaya et al. [25] designed a two-stage OTA with high gain, stability, and low noise, making it ideal for amplifying weak signals in portable medical devices. Panchal et al. [26] drew

[9] I. Maity, D. Acharya, K. Huang, P. Chung, M. Ho, and P. Bhattacharyya, "A comparative study on performance improvement of ZnO nanotubes-based alcohol sensor devices by Pd and rGO hybridization," IEEE Transactions on Device and Materials Reliability, vol. 65, no. 8, pp. 3528-3534, Jun. 2018.

[10] M. K. Chaubey, Y. Liu, Y.-C. Chang, P.-C. Wu, H.-H. Tsai, and S. S. H. Hsu, "A GM-Boosting inductorless Noise-Canceling low noise amplifier in 40-Nm CMOS for quantum applications," International Microwave Symposium, Jun. 2024.

[11] H. Yu, Y. Chen, C. C. Boon, P.-I. Mak, and R. P. Martins, "A 0.096 mm^2 1–20-GHz triple-path noise- canceling common-gate common source LNA with dual complementary pMOS–nMOS configuration," IEEE Transactions on Microwave Theory and Techniques, vol. 68, no. 1, pp. 144–159, Jan. 2020.

[12] Dalila Laouej, Houda Daoud and Mourad Loulou, "A Very Low Power Delta Sigma Modulator Using Optimized Bulk Driven Telescopic OTA for Biomedical Devices," Information Technologies and Electronics Laboratory National Engineering School of Sfax, Sfax, Tunisia.

[13] B. Yun, D. -W. Park, H. U. Mahmood, D. Kim and S. -G. Lee, "A D-Band High-Gain and Low-Power LNA in 65-nm CMOS by Adopting Simultaneous Noise- and Input-Matched G_{max}-Core," IEEE Transactions on Microwave Theory and Techniques, vol. 69, no. 5, pp. 2519-2530, May 2021.

[14] I. Maity, K. Ghosh, H. Rahaman, P. Bhattacharyya, "Tuning of electronic properties of edge oxidized armchair graphene nanoribbon by the variation of oxygen amounts and positions," Journal of Materials Science Materials in Electronics, vol. 28, pp. 9039–9047, 2017.

[15] M. K. Chaubey, Yeke Liu , Po-Chang Wu , Hann-Huei Tsai , Shawn S.H. Hsu, "A miniature 10 MHz-3 GHz sub-1-dB NF cryogenic inductorless noise-canceling low-noise amplifier for qubit readout," IEEE MTT-S International Microwave Symposium - IMS, San Diego, CA, USA, pp. 668- 671, Jun. 2023.

[16] Dhruval Patel, "Low noise amplifier for an electro-cardiogram integrated circuit analog front end," M.S. thesis, Department of Electrical and Electronic Engineering, California State University, Sacramento, 2013.

[17] T. Kulej and F. Khateb, "A 0.3-V 98-dB Rail-to-Rail OTA in 0.18 µm CMOS," IEEE Access, vol. 8, pp. 27459–27467, Feb. 2020.

[18] I. Maity, H. Nagasawa, T. Tsuru, and P. Bhattacharyya, "Correlation Between Ammonia Selectivity and Temperature Dependent Functional Group Tuning of GO," IEEE Transactions on Nanotechnology, vol. 20, pp. 129 136, Dec. 2020.

[19] Chia-Jen Liang , Ching-Wen Chiang ,Jia Zhou, Rulin Huang ,Kuei-Ann Wen, Mau-Chung Frank Chang, and Yen-Cheng Kuan, "A 0.6-V VDD W-Band Neutralized Differential Low Noise Amplifier in 28-nm Bulk CMOS," IEEE Microwave and Wireless Components Letters, vol. 31, no. 5, May 2021.

[20] Y. Yang, "Design of Low-Power Low-noise CMOS ECG amplifier for smart wearable device," Journal of Physics Conference Series, vol. 1642, no. 1, Sep. 2020.

[21] H.-W. Choi, S. Choi, and C.-Y. Kim, "Ultralow-Noise figure and high gain Ku-Band bulk CMOS Low-Noise amplifier with Large-Size transistor," IEEE Microwave and Wireless Components Letters, vol. 31, no. 1, pp. 60–63, Nov. 2020.

[22] I. Maity, P. Bhattacharyya, "Room temperature acetone sensing performance of rGO-ZnO nanotubes binary hybrid structure," Sensor Letters, vol. 17, no. 6, pp. 417–422, Jun. 2019.

[23] Berkay Ozbek et al., "A 9.03 µW Low Noise Highly Tunable Analog Front-End for Fully Implantable Cochlear Prosthesis," IEEE Biomedical Circuits and Systems, Oct. 2022.

[24] Sharanya S. Udupa et al., "ECG Analog Front-End in 180 nm CMOS Technology," International Conference on Intelligent Computing, Instrumentation and Control Technologies, vol. 8, pp. 327–330, Jul. 2017.

[25] Tanya Vanessa F. Abaya et al., "Design of Two-Stage Fully Differential Operational Transconductance Amplifier Using a Standard 0.35µm CMOS Process," Asian Journal of Engineering and Technology (AJET), vol. 07, Feb. 2019.

[26] S. Panchal, S. I. T, S. Uniyal and S. Tantry, "Design and Implementation of Low Noise Amplifier and Variable Gain Amplifier for ECG Systems," IEEE 7^{th} International conference for Convergence in Technology (I2CT), Mumbai, India, pp. 1-6, 2022.

Certificate of Participation

This certificate is proudly awarded to

ANKIT BISWAS

from

IEM KOLKATA

has actively participated in the
4TH INTERNATIONAL CONFERENCE ON

INTERDISCIPLINARY RESEARCH IN TECHNOLOGY & MANAGEMENT - 2024

held from 5th-7th December 2024

Satyajit Chakrabarti

DR. SATYAJIT CHAKRABARTI
DIRECTOR, INSTITUTE OF
ENGINEERING & MANAGEMENT