# TRANS-IMPEDANCE AMPLIFIER: MIXED SIGNAL DESIGN RESEARCH PROJECT SYNOPSIS

Ammar Younas
Senior Lecturer in Commercial Law. Westminster International University in Tashkent. Uzbekistan
doctorammaryounas@gmail.com

**Abstract:** In this project, the switched capacitor topology has been used in which TIA acts as a low pass filter to remove high frequency noise. Additionally, the requirement of a larger area demanded for a high gain resistance $R_f$ also precludes its use for our current 65nm CMOS technology.

**Keywords:** Transimpedance Amplifier, Biosensors, Voltage Converter

## Introduction:

In electronics, a trans-impedance amplifier (TIA) is a current to voltage converter most often implemented using an operational amplifier. The TIA can be used to convert current output of a Gieger-Muller Tube, Electrochemical Amperometric Biosensors and Photodetectors etc. to a usable voltage. Current to voltage converters are used with sensors that have a current response that is more linear than the voltage response. This is the case with biosensors where it is not uncommon for the current response to have better than 1% linearity over a wide range of light input. TIA presents a low impedance to the biosensor and isolates it from the output voltage of the operational amplifier.

In its simplest form TIA has a large impedance feedback resistor $R_f$ which sets the value of the gain of the amplifier with the value equal to $R_f$ because the amplifier is used in an inverting configuration. In addition to this, there are several other topologies for TIA each suitable for a particular application.

## Circuit Diagram:

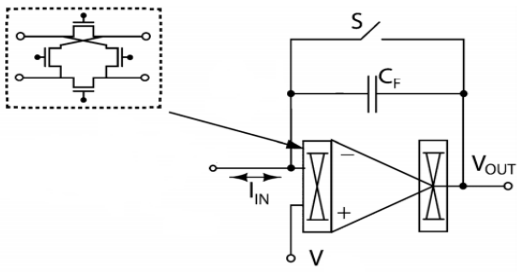


**Fig 1.** Circuit diagram of the chosen topology from the work of Hamed and Roman [1].

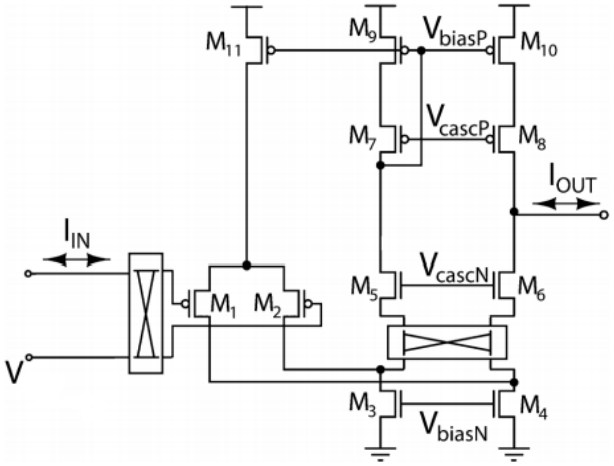


**Fig 2.** Circuit schematic diagram of the OTA within the TIA

**TABLE 1:** DESIRED CHARACTERISTICS

| **Name** | **Desired Value** |
|---|---|
| Technology | 65nm CMOS |
| Supply Voltage | 1V |
| Chopping Frequency | 4kHz |
| Power Consumption | < 500nW |
| Input Current Noise | < 0.2pA/√Hz |
| Input Current Range | 2nA - 4μA |
| Dynamic Range | > 65dB |

**TABLE 2:** TRANSISTOR SIZING

| **Transistor** | **W/L ($\mu m$)** |
|---|---|
| $M_{1,2}$ | $8 \times 1/0.4$ |
| $M_{3,4}$ | $1 \times 0.5/5$ |
| $M_{5,6}$ | $4 \times 0.5/4$ |
| $M_{7,8}$ | $8 \times 0.5/4$ |
| $M_{9,10}$ | $2 \times 0.5/0.5$ |
| $M_{11}$ | $4 \times 1/4$ |
| $M_S$ | $4 \times 1/0.13$ |

Capacitor value = C = 10pF

**Comments:**

The mentioned values of transistors and capacitor are tentative. Exact values of the component sizing will be available once we start assembling the project in Cadence. Performance analysis will help us optimize the sizing.

**Reference**:

[1] HM Jafari, R Genov, "Chopper-stabilized bidirectional current acquisition circuits for electrochemical amperometric biosensors", IEEE Transactions on Circuits and Systems, pp. 1149-1157 (2013)