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# A 22nm CMOS Implementation of Class AB Bulk Driven OTA Method at 0.2V

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**ABSTRACT:** The power consumption has become a main issue in low voltage (LV) low power (LP) integrated design. By using bulk driven OTA (Operational Trans-conductance Amplifier), it eliminates Threshold Voltage  $V_{th}$ , and also it offers small amount of Power usage. In the Miller Zero compensation technique of multipath method will required low voltage driven with a combination of non-tailed differential bulk driven. In the proposed OTA architecture was developed at 22nm CMOS technology using 0.2V at 100 KHz frequency, finally this work as developed in Tanner EDA tool, and proved the area, delay and power consumption are less.

**KEYWORDS** -Low voltage, Low power, OTA, Tanner EDA.

## I. INTRODUCTION

An operational trans-conductance amplifier (OTA) is used to convert an input voltage to an output current. They are primarily voltage-to-current amplifiers. OTAs represent a voltage-controlled current source (VCCS). Their transconductance parameter is controlled by an external, amplifier-bias current and expressed in term of input voltage. Because an OTA's output impedance is high. voltage-controlled current sources (VCCS), OTAs represent an ideal transistor due to variation of current with temperature. It holds the transconductance, however, OTAs remain relatively constant with temperature. Like a transistor, an OTA has three terminals:

- a high-impedance input or base
- a low-impedance input/output or emitter
- collector

### Applications of OTA

OTAs are widely used in Radio Frequency (RF), intermediate frequency (IR), and high-performance video applications. When used as electronic building blocks, OTAs also be used as automatic gain control (AGC) amplifiers, fast control loop amplifiers, and control amplifiers for capacitive sensors and active filters, light emitting diode (LED) driver circuits for fiber optic transmissions, integrators for fast pulses, and as current-controlled oscillators. Additional applications for OTAs include timers, multiplexers, sample-and-hold circuits, video and broadcast equipment, high-speed data acquisition devices, and communications equipment.

### Class AB amplifier

Class AB is the combination of both class A and class B. It gives high efficiency output of class B configuration along with the low distortion of class A. The amplifier which gives an output which follows the corresponding input signal. It is sufficient to large load is connected. In the class AB amplifier, each of the transistor will conduct between 180 and 360 degrees of the time depending on the amount of current output and pre-biasing.



II.EXISTING SYSTEM

There has been an increase in the plan of ultralow-voltage (ULV) and ultralow-power (ULP) analogue circuits. This new trend is mainly provided by the increasing in demand for power-efficient solutions. That are utilized in medical implantable or wearable gadgets, remote sensor hubs, and different applications. Low stockpileVoltageVdd that allows decreasing the dissipated power of both, analogue and digital portion [1]. The operational transconductance amplifier (OTA) is most widely used analogue building blocks in CMOS circuits [8].

The bulk of the conventional gate-driven (GD) MOS differential pair can also be used as a control terminal to lower the threshold voltage [3]. It provides common-mode control, ultimately removing the need of tail current generator, and increasing the ICMR. Moreover, the forward bulk biasing increases the intrinsic voltage gain of short-channel MOS transistors in the ULV environments shown [11].

A new solution for deep sub-0.5-V OTA is described [7]. The Bulk driven non tailed differential stage with the multipath Miller zero cancellation compensation (MMZCC) technique, a simple class AB power-efficient ULV structure has been obtained with rail-to rail ICMR [9]. The resulting structure of OTA:

- compact, simple in design
- For achieving better power efficiency do not usage of auxiliary circuits (like replica bias).

DISADVANTAGES

- low trans conductance
- lower voltage gain
- larger input noise and offset

III.PROPOSED SYSTEM

In the proposed system, Bulk Driven method is used. As the power supply voltagesVdd are decrease, threshold voltage does not reduce in same proportion. This is the major problem in analogue design, where transistorsare in saturation region usually preferred to results higher transconductances, lower noise and overall better performance. Operating the MOS through the bulk-terminal allows the planfor extremely low-supply voltage circuits. Thebody-driven MOSFET is very close to junction-field -effect-transistor (JFET). The signal is given to the body and the source and current passes from the source to drain is regulated by the reverse bias applied on the bulk. The gate-source voltage of the MOS is fixed and is set to turn the MOSFET on. The features of Bulk-driven transistors are:

- Low-voltage low-power utilization of the circuits.
- Simple in design and acceptable characteristics.

By achieving Low voltage conditions, several techniques are:

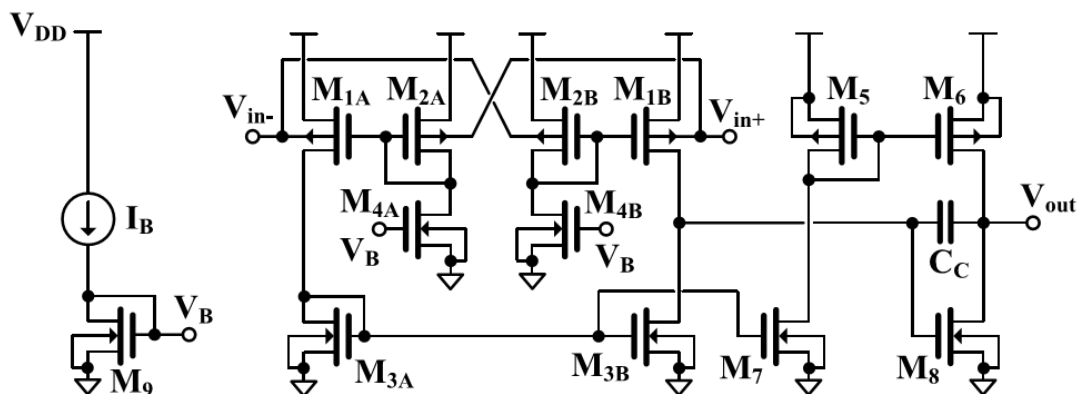


Figure 1: CMOS Schematic of the proposed OTA

- **Complementary input stage:** This is the traditional approach to implement a rail-to-rail input stage is obtained by connecting in parallel a p-channel and n-channel differential pair. It requires additional circuits which run the transistor bias currents to gives a stable transconductance. This technique is not preferable for extremely lower supply voltages.



- **Dynamic level shifter:** This technique used to approach to obtain a min-max input stage level shifters require large on-chip area.
- **Bulk driven:** Input signal is applied to bulk of the information gadget while the gate is biased to create a conducting channel between the source and drain the input devices operate in conducting region even for rail-to-rail input normal mode range. This approach eliminates  $V_{th}$  requirement in the input signal path. Hence it is preferable for ultra-low supply voltages.

A bulk driven  $M_{1A,B}$  - $M_{3A,B}$  used as input stage of proposed OTA. Differential inputs  $vin+$  and  $vin-$  are applied across the bulk terminal of  $M_{1A}$  and  $M_{1B}$ . PMOS transistors  $M_{2A}$  and  $M_{2B}$  are arranged in cross coupled manner, which helps the improvement of gain. Bias current source  $I_B$  is arranged to generate  $V_B$  bias voltage. Output stage comprises of  $M_5$  -  $M_8$  transistors. Both  $M_5$ - $M_6$  are common source transistors enhances transconductance of output stage. It also helps to work on the stability of OTA for enormous capacitive loads. Drain current of  $M_3$  is mirrored to the output through the current mirrors  $M_3$ - $M_7$  and  $M_5$ - $M_6$ , thus increasing the current sourced to the load. To obtain class AB operation at output stage, the differential response is given to  $M_8$ .  $M_8$  transistor which provides the sinking current ability. Using Tanner EDA tool, OTA architecture was developed at 22nm CMOS technology using 0.2V at 100 KHz frequency. It gives better performance and requires less area, power consumption.

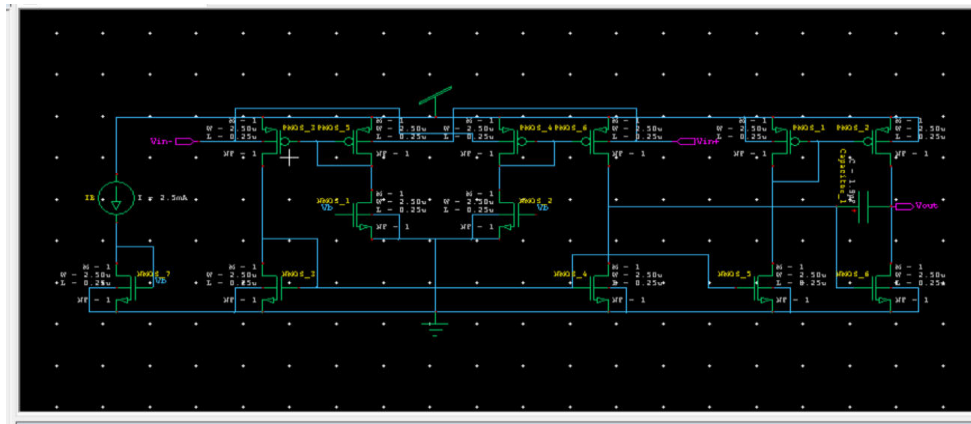


Figure 2: Schematic of Bulk Driven OTA

### ADVANTAGES

- Less power consumption
- Less area
- High gain
- Less delay

### IV. TRANSIENT ANALYSIS

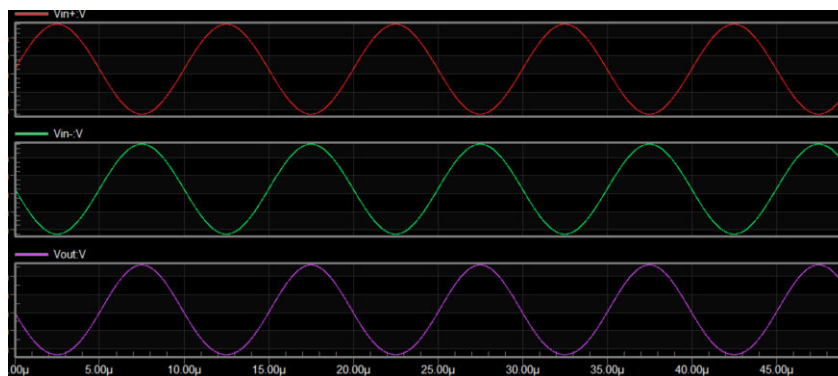
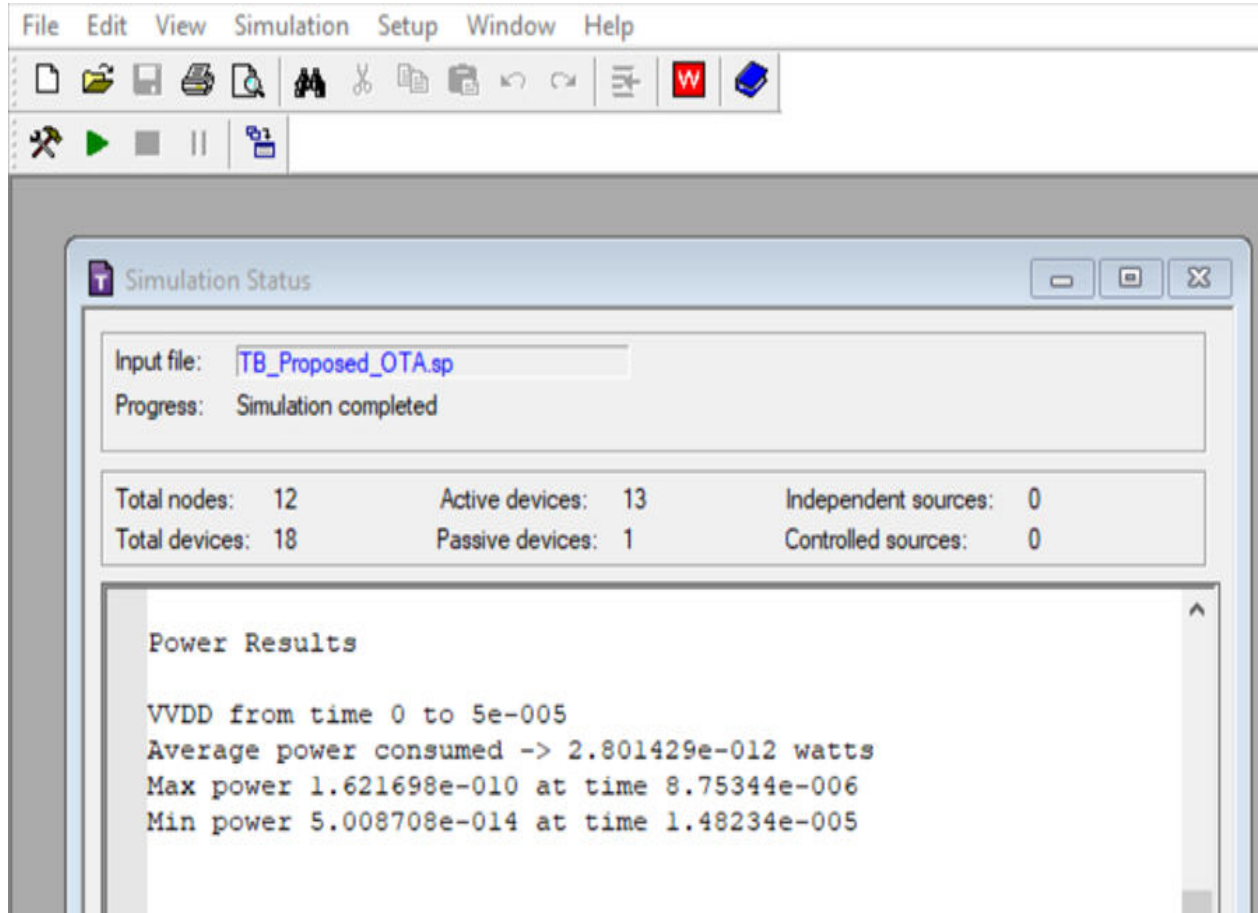


Figure3: Transient analysis





**Power Result:**



**Figure 4: Power consumption output**

**Comparison:**

	<b>Existing (180nm)</b>	<b>Proposed(22nm)</b>
MOSFETs	13	13
Area(um)	2.340	0.286
Input Voltage (V)	0.3	0.2
Average Power Consumption (pW)	4.588	2.825
Delay(us)	83.03	8.76

**Table 1: Comparison Table**

**V.CONCLUSION**

In this paper, an operational transconductance amplifier (OTA) and bulk driven technique are discussed. As the supply voltages are decrease, threshold voltage does not reduce in the same proportion. This is the major problem in analogue design. By using Bulk driven method that eliminates threshold voltage requirement in input signal, this is preferable for ultra-low supply voltages.

Operating the MOS through the bulk-terminal allows the plan of extremely low-supply voltage circuits. By using Bulk Driven technique that gives better performance and its gain is more. Also, overall Area, delay and power consumption are also improved.



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