IMPLEMENTATION OF A 0.3V DIFFERENTIAL DIFFERENCE AMPLIFIER

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Abstract: In This Work we are presented A new silicon realization of an ultra-low-voltage and ultra-low-power differential-difference amplifier (DDA). The circuit combines the idea of non-tailed bulk-driven differential pairs with a partial positive feedback used for voltage gain boosting. The DDA operates from VDD ranging from 0.3 to 0.5 V.

Index terms – Bulk-driven, differential difference amplifier, low-voltage CMOS, low-power CMOS.

Introduction:

In Recent years there is an increased interest in design of ultra-low-voltage (ULV) and ultra-low-power (ULP) analog and mixed-signal circuits. This new trend is mainly associated with the development of medical implants and autonomous sensor nodes supplied with non-conventional energy sources.The design of high-performance analog circuits with supply voltages (VDD) of the order of several saturation voltages of an MOS transistor (VDSsat) is a real challenge for analog designers.

The circuit is implemented in "TANNER TOOLS" (16.0V) with 45nm technology and supplied with VDD ranging from 0.3 to 0.5V.For differential difference amplifier we are having cmos structure and current mirror circuite . first we need to know what is cmos and what is current mirror circuit.cmos: combination of pmos and nmos is called cmos . the cmos circuite is also called as invertor. Current mirror circuit: A current mirror is a circuit designed to copy a current through one active device by controlling the current in another active device of a circuit .

Proposed system:

Circuit Description:

The schematic of the DDA circuit proposed in this work and its circuit symbol are shown in Figs.1a. and 1b. respectively. The DDA has two input ports and its output voltage is described by the following equation:

$$Vo = Av[(Vpp-Vpn)-(Vnp-Vnn)]$$

Where Av is the open-loop differential voltage gain. The particular realization of DDA described in this work consists of an input operational transconductance amplifier (OTA) (M1-M10) and a class A output stage (M11,M 12). The capacitance CC is used for frequency compensation. The input OTA consists of two gain stages, namely, an input differential amplifier (M1-M8), and a differential to single-ended converter (M9M10), which also provides voltage gain.

Let us consider the pair M1-M2 with Vnp = Vnn = Vicm. Which YJ8U76 means if the circuit is active or inactive Vnp and Vnn are always equal to zero.

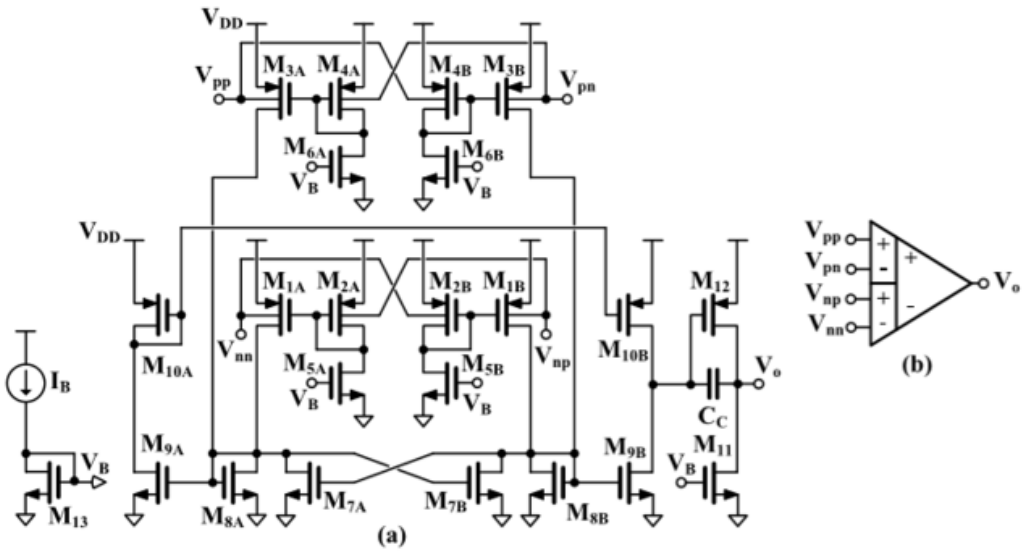

Fig 1 : (a) The proposed DDA(Differential Difference Amplifier) (b) Circuit Symbol

Implementation and simulation results:

We are implementing this work in "TANNER TOOLS"(16.0V) with 45nm technology. Differential difference amplifier acts as voltage follower. Which is one of the main application of DDA.

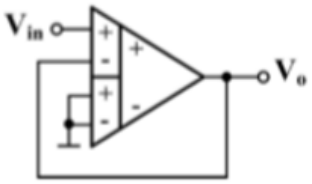

Fig 2: DDA configured as Voltage Follower

We already note that the Vdd ranging from 0.3v to 0.5v so we are verified this in 0.3v and 0.5v

Fig 6: Block diagram and truth table for existing system

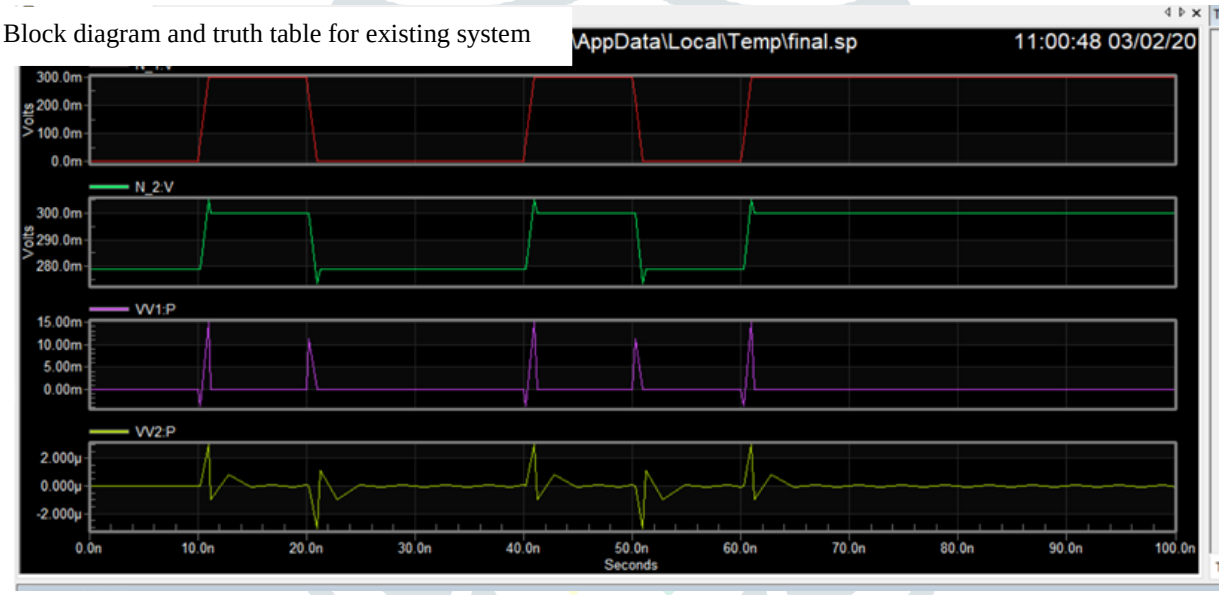

Fig 3: Simulation results when Vdd is 0.3v (DDA as Voltage Follower)

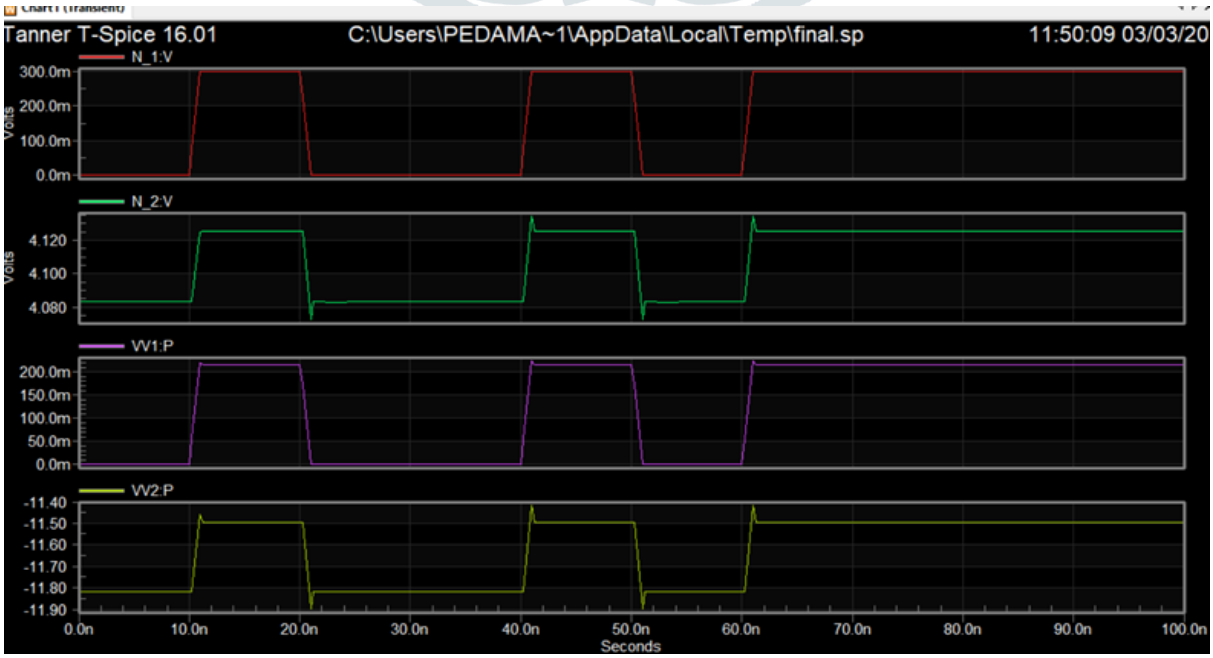

Fig 4: Simulation results when Vdd is 0.5v (DDA as Voltage Follower)

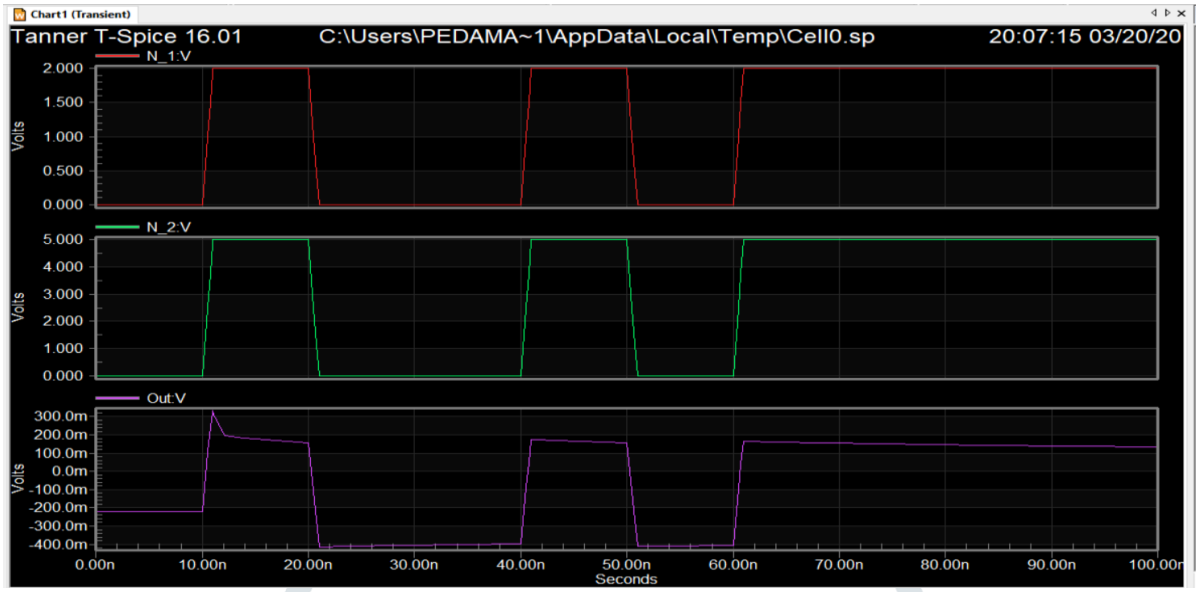

Fig 5: Simulation results for proposed system (Differential Difference Amplifier)

Table :performance analysis

Parameter	**[10][d)]**	**[11]**	**Proposed**
Process [µm]	0.05	0.18	0.192
V_{DD}, [V]	0.4	0.3	0.3
P_{diss}, [µW]	31.8	0.022	0.0003
A_{VO}, [dB]	58.6	>60	>60
GBW, [MH_z]	2.31	$1.85e^{-3}$	$1.1e^{-008}$
Phase margin, [^{0}]	50	67	69
Average SR, [V/ms]	117	1.55	1.62
C_1, [pF]	20	20	20
Thermal noise, [$nV/Hz^{1/2}$]	139	2580	2582
V_{DD}/V_{TH}	1.43	0.6	0.6
FOM_1,[1/V]	81.3	168	170
FOM_2,[-]	42.2	141	151

Advantages:

1. It has noise cancellation property
2. Can reduce external interferences
3. The nature of this amplifier is linear
4. The amplifiers help to increase CMRR Which further helps to avoid unwanted signal

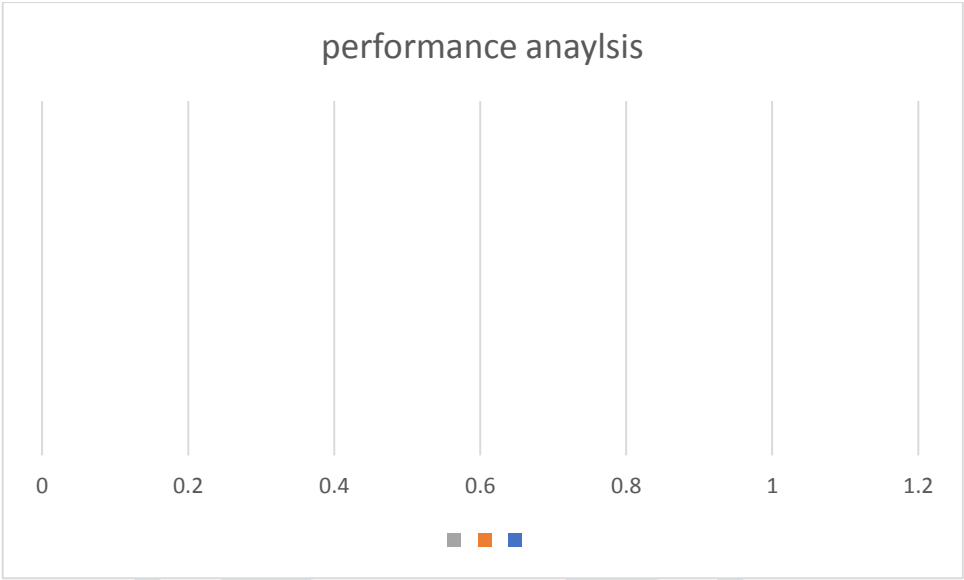

Fig 6: final analysis

Disadvantages:

1. Complexity
2. Proper biasing needed

Applications:

1. As a Voltage follower
2. Balun /instrumentation amplifier
3. Floating current source
4. Common mode feedback that does not load the outputs
5. RF amplifier gain control
6. Used as a Precision rectifier

Conclusion:

This project presents a high-performance architecture for sub 0.5-V BD DDA. The proposed solution exploits the non-tailed differential pairs to allow its operation under extremely low supply voltages. In this project we are implementing the DDA circuit by using the tool "TANNER TOOLS" with 45nm technology.

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