

# Design of High Speed & Power Optimized Sense Amplifier using Deep Nano CMOS VLSI Technology

Mr. Chandrahas Sahu<sup>1</sup>, Raja Jhariya<sup>2</sup>

<sup>1</sup>Asistant Professor (ETC) SSGI (FET), SSTC Bhilai, Chhattisgarh, India

<sup>2</sup>M Tech Research Scholar SSGI(FET), Bhilai CSVTU University, Chhattisgarh, India

## ABSTRACT

during this paper we've designed quicker & Power economical Sense electronic equipment for CMOS SRAM exploitation VLSI Technology i.e. primarily schematic of sense electronic equipment is intended & simulated exploitation ADS (Advanced style System). The sense electronic equipment then enforced & analyzed at chip level exploitation Microwind three.1- a layout editor. The forty five nm & thirty two nm technologies are accustomed analyze performance of Sense electronic equipment. Our focuses are to scale back the scale, to enhance the ability consumption and additionally to enhance the time interval of sense electronic equipment.

**KEYWORDS:** CMOS SRAM, Sense Amplifier, Microwind, ADS, layout. Etc

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## INTRODUCTION

CMOS technology scaling are a main drive force of the industry during this era and additionally provided a path toward each quicker and denser integration. The CMOS transistors factory-made nowadays area unit twenty times quicker and occupy terribly less space than those designed twenty years past. the amount of parts per chip and also the system performance is rising exponentially over the last twenty years. because the length of channel is reduced, the performance of the junction transistor improves, the facility per switch event decreases, and also the density improves chemical compound thickness ( $T_{ox}$ ), {transistor| junction transistor |electronic transistor |semiconductor device| semiconductor unit| semiconductor} length ( $L_g$ ) and transistor dimension ( $W$ ) were scaled by a continuing issue ( $1/k$ ) so as to supply a delay improvement of  $1/k$  at constant power density. As a consequence of continuing density scaling, options area unit moving ever nearer to elementary dimensions This paper presents constant scaling effects of technologies i.e. 45nm & 32nm exploitation The layout of sense electronic equipment being analyzed& it proves the scaling impact on CMOS devices i.e. the dimensions of the sense electronic equipment decreases, because the density of junction transistor will increase the facility consumption will increase at chip level, The interval additionally decreases i.e. speed of the sense electronic equipment will increase because the time decreases, the frequency will increase.

## A. Sense Amplifier:-

A sense electronic equipment is a component of the scan electronic equipment that is employed once knowledge is needed to be scan from the memory; the most role of sense electronic equipment is to sense the low power signals from a bit line i.e. one or zero keep in an exceedingly memory cell, and additionally amplify the tiny voltage to needed logic levels therefore the knowledge may be understood properly by logic outside the memory There ar 2 main classes of sense amplifiers Differential sense amplifiers, additionally referred to as voltage mode sense amplifiers, and non differential amplifiers, additionally referred to as current mode sense amplifiers. The differential sense electronic equipment is usually used as a result of there's no static current flow when the electronic equipment latches, which is able to cause reduction in power. Also, it's straightforward and reliable . The circuit shown in Fig. one is that the sense electronic equipment accustomed scan knowledge from the cell. The electronic equipment consists of a differential combine (Transistors money supply and M2) with a full of life current mirror load (M3 and M4) and a biasing current supply (M5). As presently because the SE signal goes HIGH, the sense electronic equipment senses the acceptable distinction between the BIT associate degreed ~BIT voltages and produces an output voltage. The interval of the memory, that is outlined

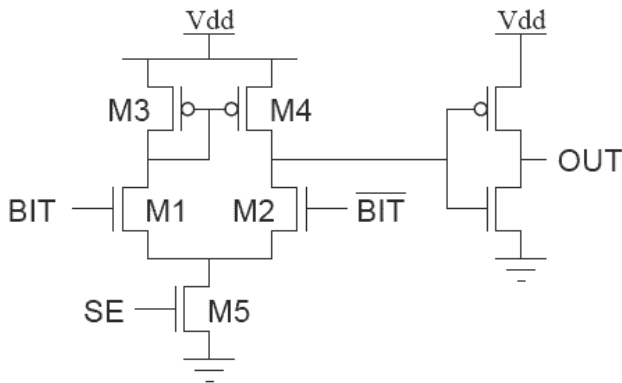


Fig.1-The sense amplifier

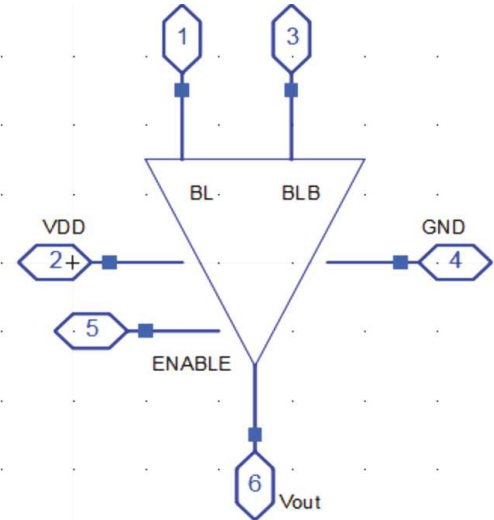


Fig.3- Symbol

**B. Microwind Software:**

MICROWIND is integrated EDA computer code in encompassing IC for styles from conception to completion, permits chip designers to style on the far side their imagination. MICROWIND in integrates historically separated back-end associate degreed front-end chip style into an integrated flow, fast {the style| the planning| the look} cycle and reduced design complexities. The forty five nm technology made-up in 2007 & because the time between the initiation of the scan operation and also the output, in the main keen about the performance of the sense electronic equipment? therefore the style of the sense amplifier is that the main criteria for {the style| the planning| the look} of recollections Advanced style System is that the leading electronic design automation software system within the world for RF, microwave, and high speed digital applications.

**Key Benefits of ADS:**

1. Application-specific-Design promotes years of expertise in an easy-to-use interface.
2. ADS are supported exclusively or months earlier than others by leading industry and foundry partner.

it's effective Gate length of thirty nm whereas The thirty two nm technology made-up in 2009 & it's effective Gate length of twenty seven nm Compared to 45-nm technology, the 32-nm technology offers half-hour increase in change performance, half-hour less power consumption, double higher density, two occasions reduction of the outpouring between supply and drain and thru the gate compound. At every lithography scaling, the linear dimensions square measure roughly reduced by an element of zero.7, and therefore the square measure as are reduced by issue of two. Smaller cell sizes cause higher integration density that has up to per mm<sup>2</sup> in forty five nm & thirty two nm technology.

**C. IMPLEMENTATION USING ADS :**

The Fig. a combine of shows the circuit diagram of sense equipment designed in ADS. to substantiate that this is often split equally, the PMOS devices monetary resource and M4 ought to be sized identically. The NMOS devices monetary resource and monetary resource ought to even be sized identically. Hence dimension of PMOS devices monetary resource & M4 area unit elite of concerning a combine of.5 um and multiplication issue (M) is four to possess dimension of 10.0 um (i.e. 2.5 \* four = 10) & length zero.35 um. Likewise, every the NMOS monetary resource & monetary resource even have identical filler i.e. dimension of concerning a combine of.5 um and multiplication issue (M) could be a combine of to possess dimension five}.0 um (i.e. 2.5 \* a combine of = five) & length zero.35 um. A biasing current provide (M5) has dimension twenty.0 um & length zero.13 um. The Fig. 3 shows the image of Sense equipment. This image has all internal components shown in Fig. 2. we are going to merely use this image for the simulation of Sense equipment directly or this image is utilized in SRAM vogue for reading the data any. The Fig. four shows the simulation results in ADS. It shows the undulation of BL, BLB, Vout& ~Vout (i.e. output of Associate in Nursing Inverter). The BL & BLB input voltages ar exactly opposite to each completely different i.e 1800 half shift. The sense equipment senses the excellence between these voltages & produces Associate in nursing output voltage (Vout). From the graph it's determined that the output voltage undulation of sense equipment shown in inexperienced color has less amplitude i.e. one v than required level i.e. 1.2 v.

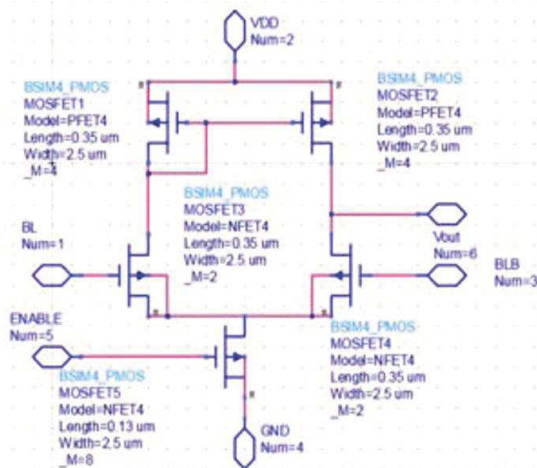


Fig. 2-The circuit diagram of sense amplifier designed in ADS

**D. Implementation N practice MICROWIND 3.1:**

The Fig. 5 shows. The Layout of Differential Voltage Sense equipment designed practice Microwind code. The circuit diagram for this layout shown in Fig.1. Now, The Layout has two PMOS (M3, M4) connected back to back, the drain & provide ar shown in blue & the N-well of PMOS shown in dotted inexperienced that's connected to Vdd. the provision of every PMOS is connected to Vdd. Gate of every PMOS's is created of Polysilicon (Red) & those ar connected to each completely different & then to drain-drain affiliation of PMOS (M3) & NMOS (M1) any by Poly - Metal instrumentation. The layout of two NMOS (M1 & M2) is to boot connected back to back. Drain {of every of every} NMOS is connected to innocent of each PMOS that's shown in blue color i.e. Metal. Input BL & BLB is given to gate i.e polysilicon

(red) of cash provide & monetary resource severally. Presently the provision of NMOS is connected to each completely different & then connected to innocent of NMOS (M5) i.e biasing current provide. The provision of M5 then connected to ground. The amendment i.e Vdd signal is given to gate of M5. The Layout of sense equipment is ready for simulation. but to increase the voltage level of sense equipment, Associate in Nursing converter is connected at the output. thence layout to boot has an extra PMOS & NMOS structure. The gate & drain of every the electronic transistor ar connected to each completely different shown in red & blue color severally. The provision & N-well of PMOS is connected to Vdd. &The provider of NMOS is connected to ground. The output of sense electronic ercome. additionally by mistreatment low equipment V out is connected to input of Associate in Nursing electrical converter.

channel length between drain & source of every transistor is being reduced i.e. speed of the sense amplifier increases & Now, As the time decreases, the frequency increases by 400%.

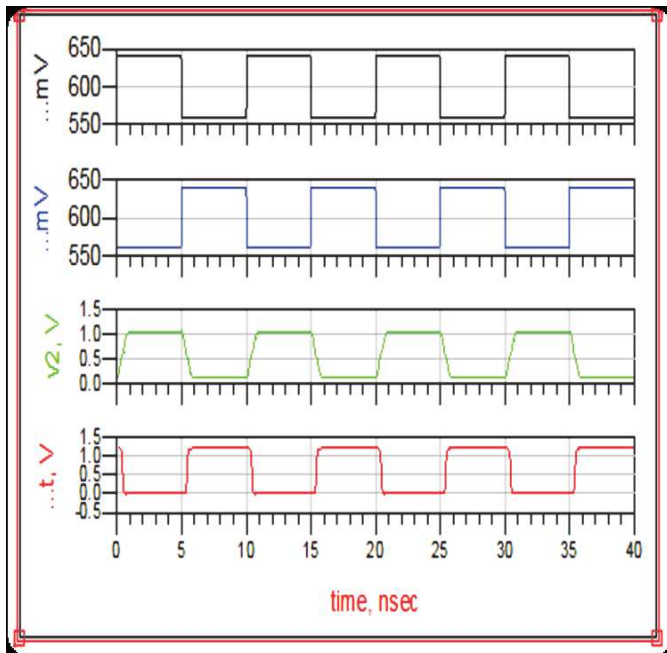


Fig.4- simulation result

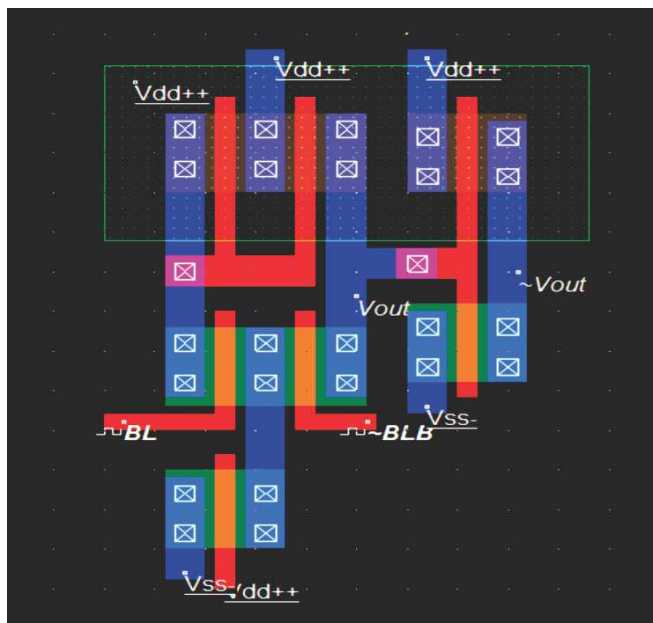


Fig.5-layout Design

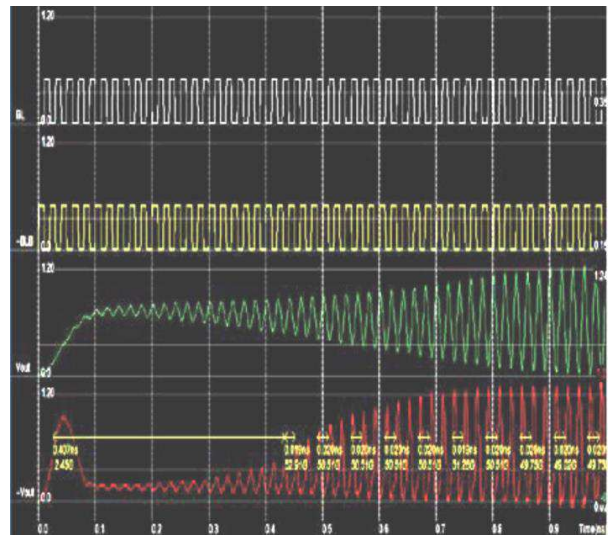


Fig. 6 Simulation results in 32 nm technology

The output voltage of an Inverter is  $\sim V_{out}$  This Layout is implemented in both technology i.e. 45nm & 32 nm to analyze the scaling effect. In 45nm the dimension of layout achieved are  $1.20 \mu\text{m} * 1.70 \mu\text{m} = 2.04 \mu\text{m}^2$  & In case of 32 nm technology the dimension of layout achieved are  $0.960 \mu\text{m} * 1.280 \mu\text{m} = 1.228 \mu\text{m}^2$ .

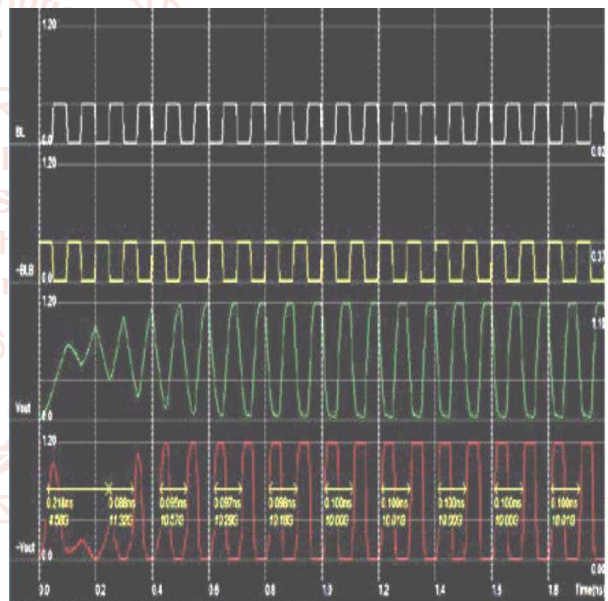


Fig. 7 Simulation results in 45 nm technology

The Fig. six shows the simulation results of sense electronic equipment in 45 nm technology. It shows the input of sense electronic equipment i.e. (white) & BLB (Yellow), the output voltage of sense electronic equipment in inexperienced & the output of AN electrical converter in Red. The gain of AN electrical converter is extremely high therefore it's connected across the output of sense electronic equipment to extend the extent of output voltage. The Fig. seven shows the simulation results of sense electronic equipment in thirty two nm technology. It conjointly shows BL, BLB, V out &  $\sim V$  out. The Fig. eight shows the 3 dimensional read of layout of sense electronic equipment with AN electrical converter. It shows all the processes i.e. from initial substrate to passivation etching to be dispensed on atomic number 14 wafer to style I.C. of sense electronic equipment. The Table one shows the comparative analysis of sense electronic equipment layout implementation in forty five nm & thirty two nm technology. It presents as technology scales down i.e.

forty five nm to 32 nm. the dimensions of the layout of sense electronic equipment decreases by 40% i.e. semiconductor density will increase on same house. the facility consumption will increase by eighteen actually because range of transistors are a lot of on less house to consume a lot of power. The Access360time conjointly decreases by seventy five nothing .TABLE I

#### COMPARATIVE ANALYSIS OF TWO TECHNOLOGIES

Sr. no	Parameter	45nm	32nm	Percent
1	Size	2.04 $\mu\text{m}^2$	1.228 $\mu\text{m}^2$	40%
2	Power Consumption	0.083 mW	0.104 mW	18%
3	Access Time	0.095 ns	0.020 ns	75%
4	Frequency	10 GHz	50 GHz	400%

#### CONCLUSION:

The projected Sense electronic equipment has been designed in normal a hundred and eighty nm technology. the look of projected sense electronic equipment has been done on the premise of the characteristics of varied sense amplifiers. The latch sort sense electronic equipment has been found to be best sense electronic equipment among these. The performance of latch sense electronic equipment has been more increased by uninflected its input by inserting the pass transistors. This sort of sense electronic equipment may be employed in the SRAM for achieving high speed with low power. This sense electronic equipment circuit achieves a face value of sensing delay of zero.15 ns and average power of zero. 2 mW, for the bit line capacitance of one pF and provide voltage of one.8 V. These simulated results indicate that the designed sense electronic equipment has been four-hundredth quicker than latch sort sense electronic equipment with none if increment in power consumption. The designed sense electronic equipment has been compared with the present sense amplifiers. Here great deals of enhancements are discovered in sensing delay with regard to variation in bit line capacitance or power supply. This Paper has illustrated improvement within the performance of the Sense electronic equipment for CMOS SRAM. The circuit is meant & simulated within the ADS (Advanced style System). The simulation result shows that the desired output voltage i.e. 1.2V is on the market when addition of associate electrical converter at the output & having identical transistors i.e. PMOS & NMOS within the circuit. This circuit is enforced at Layout level victimization MICROWIND three.1 software. during this package forty five nm & thirty two nm technologies area unit accustomed style Layout & simulation results area unit analyzed with the impact on size i.e reduced by four-hundredth, Power Consumption reduced cumulatively at cell level ,Access Time is reduced by seventy five once I.e. speed will increase and Frequency is additionally will increase by four-hundredth. Hence, it's discovered that the performance of the sense electronic equipment has been improved drastically. It conjointly proves that the technology scaling can have large impact ontransist or performance. to possess higher results currently our future work can concern the 22-nm technology.

Future Scope- just in case of sense electronic equipment the little distinction between the bit lines is amplified to the complete digital level. Therefore there is also an opportunity of false shift of output thanks to tiny offset voltage at the

input. By using offset compensation techniques this drawback may be overcome. Conjointly by victimization low power and high speed logic techniques such as Multi Threshold CMOS (MTCMOS) and Variable threshold CMOS (VTCMOS) the power dissipation can be further reduced and the speed of circuit can be further enhanced.

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