

# Implementation of 3 Bit Flash ADC performed in eSim

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**Abstract**— Analog to Digital Converter becomes a very important part in Real life it is a type of mixed-signal. The Flash ADC signal is the fastest signal conversion speed among all of the ADCs and it is used in high bandwidth applications. Actually, The flash ADC contains no clock signal that's why the maximum number of clock pulses that is required for conversion is '1'. This paper represents the implementation of a 3-bit Flash ADC with low operating voltage and less power consumption comparator along with a priority encoder. This is designed in eSim which is an open-source EDA Tool in which Ngverifier feature is used for designing this mixed-signal using 180nm technology. In this tool, we are going to break this circuit into two parts one is analog and the other one is digital. The analog part is done in Ngspice and the digital part is done in Verilog and makerchip which in combination with each other provide the NgVeri (in Mixed mode).

**Keywords**— Flash ADC, Digital, Analog, mixed signal, eSim tool.

## I. INTRODUCTION

A flash ADC is the Analog to Digital Converter and it is also known as the fastest of all types of ADC. As we all know that as day by day the use of technology is increasing in our daily life and at the same time the modern communication increases. So, as in real life, we are dealing with the analog signals but actually, when we talk about machines it can be of any type which we are using in our daily life for example laptops, computers and mobile phone is also a type of machine, etc. then we come to know about that machine used digital signals and most of the machines used nowadays are working on the digital signals. So, to convert the real-world analog signal data into digital signal data we use Analog to Digital Converter. So, this becomes a part of our life that wherever analog signal is converting into digital signal their Analog to digital converter block is used. So, It is a type of mixed integrated signal in which the data from analog signal is converted into the digital signal.

A flash ADC is the Analog to Digital Converter and it is also known as the fastest of all types of ADC but at the same time, it requires complex circuitry. It is thus often used for high-speed applications and this circuit is also known as Parallel comparator type ADC. It consists of Comparators, the ladder of a resistor network and the priority encoder. The General Flash ADC takes  $2^N-1$  Comparators for "N" no. of bits in which there are  $2^N$  resistors are required and  $(2^N \times N)$  Priority Encoder are required which increases its power consumption as no. of bits are increasing respectively. Each comparator comprises a reference voltage that is 1 LSB higher than that of the one given below it in the chain. The comparator is sometimes called a thermometer code because for a given input, all the comparators below a particular point will have their input voltage higher than their reference voltage and hence there, is "1" Logic output comes and vice-versa. Therefore, it behaves as analogous to a mercury thermometer. It is used in satellite communication, radar processing, etc.

## II. REFERENCE CIRCUIT DETAILS

In this paper, we are going to design a 3 Bit Flash Analog to Digital Converter. As we are taking 3 bits it means that a total of 7 comparators and 8 resistors are required also, the Priority Encoder which is used for 3-bit Flash ADC is  $8 \times 3$ . All the resistors are connected in series with an input voltage to scale down its voltage as voltages are distributed among each resistor accordingly by using the voltage divider rule. This resistor network gives voltage reference to the input of comparators respectively. When two resistors are connected in series,

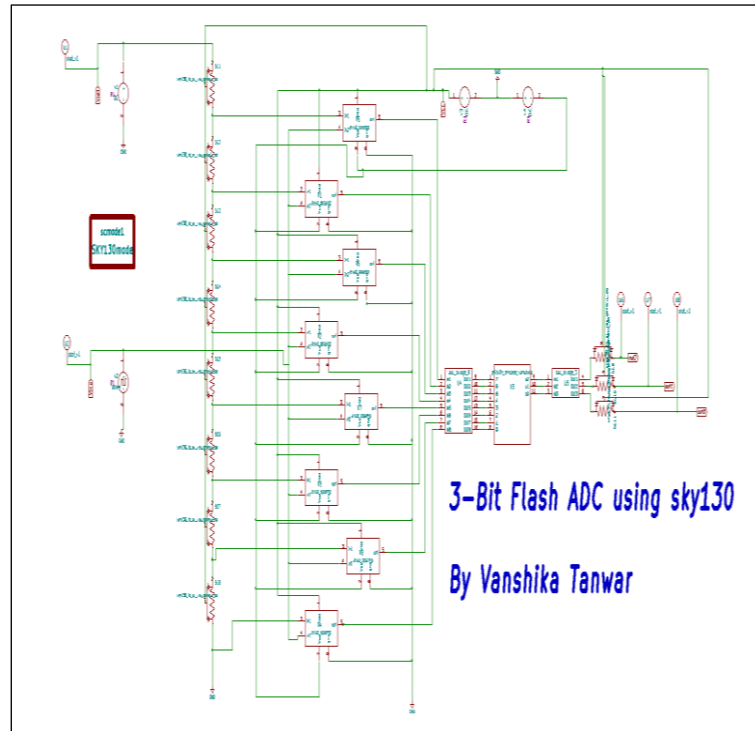
$$\rightarrow V_{out} = R_2 \times V_{in} / (R_1 + R_2)$$

Here, the comparators used is analog in nature which is made up of opamp and is used to either compare two analog voltages or input voltage with reference voltage (say  $V_{ref}$ ). The analog input which is need to be converted is connected to the non-inverting terminal (positive end) of the comparator and voltage reference is connected to the inverting terminal (negative end) of the comparator.

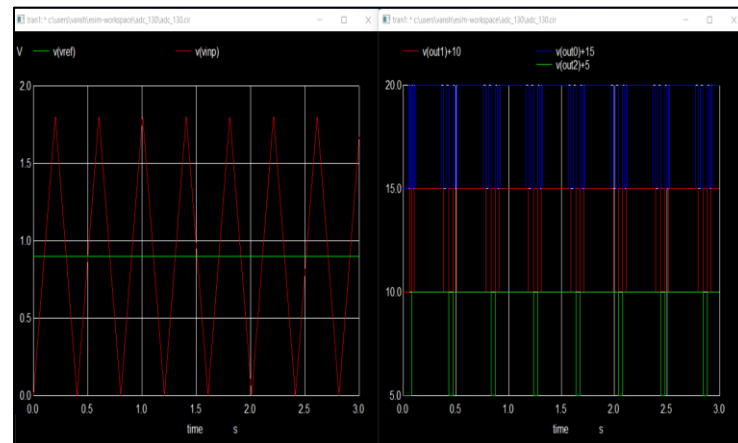
$$\text{If } V > V_{-}, V_{out} = 1 \text{ and If } V < V_{-}, V_{out} = 0$$

Now, all the outputs of the comparator becomes inputs of the encoder it means that the input of the priority encoder depends on the output of comparator and the Encoder gives the digital output of input when two or more than two inputs are high at the same time, it produces the binary code of the input which has Highest Priority. For example suppose 3 input lines of the encoder are high at the same time, then priority will be given to the third input and hence the corresponding binary code output will be generated.  
So, this is how a 3 bit Flash ADC works.

## III. REFERENCE CIRCUIT DESIGN



## IV. REFERENCE WAVEFORM



## IV. REFERENCE PAPER

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