Circuit Simulation Project

https://esim.fossee.in/circuit-simulation-project

Name of the participant : Boddu Ajay

Title of the circuit: Design and Implementation of 3-bit High Speed Flash ADC

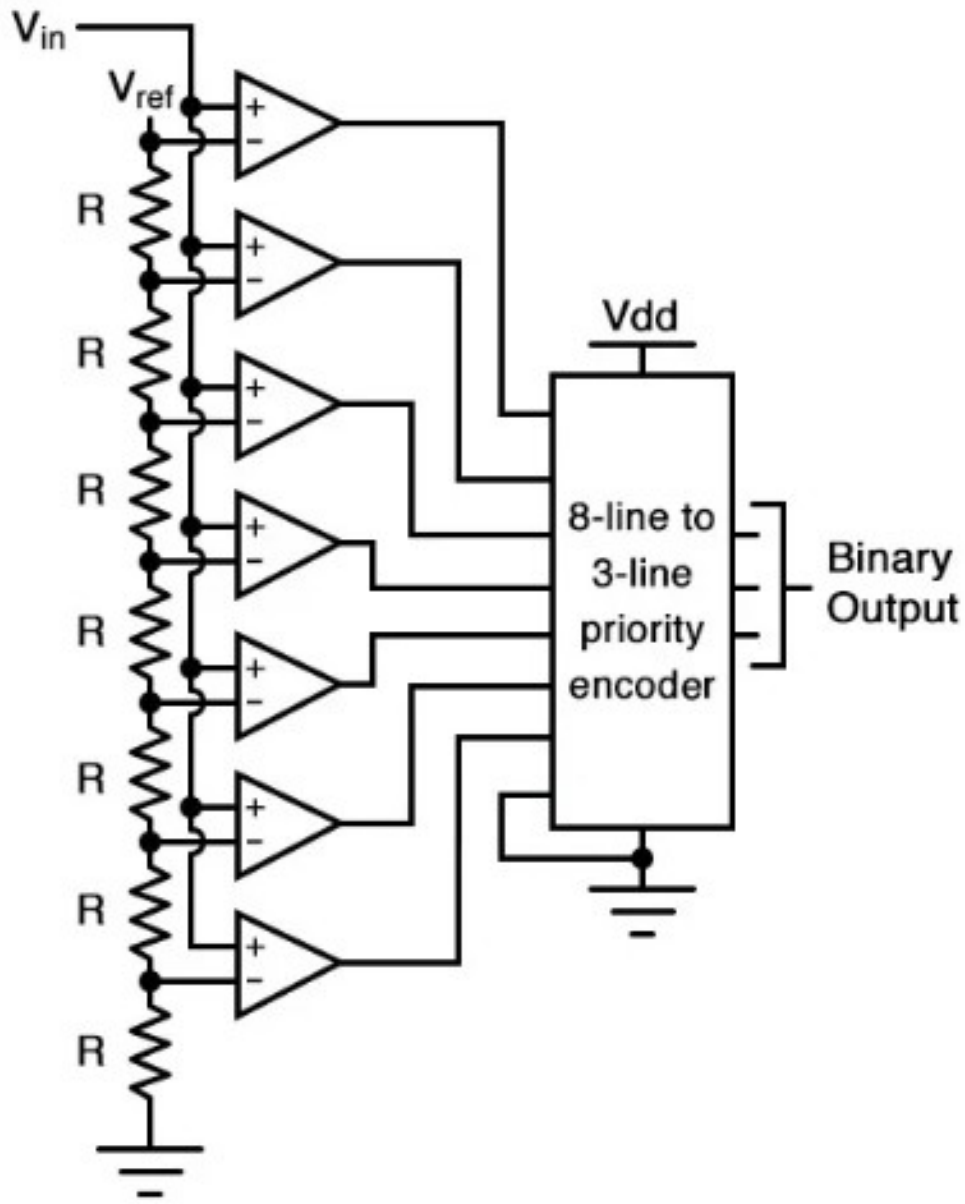
Circuit Description :

Analog-to-Digital Converters (ADCs) play a critical role in modern electronic systems by converting real-world analog signals into digital data for processing in microcontrollers, digital signal processors, and computing systems. Among various ADC architectures, the Flash ADC is the fastest, making it ideal for high-speed applications such as data acquisition, communication systems, and biomedical instrumentation.

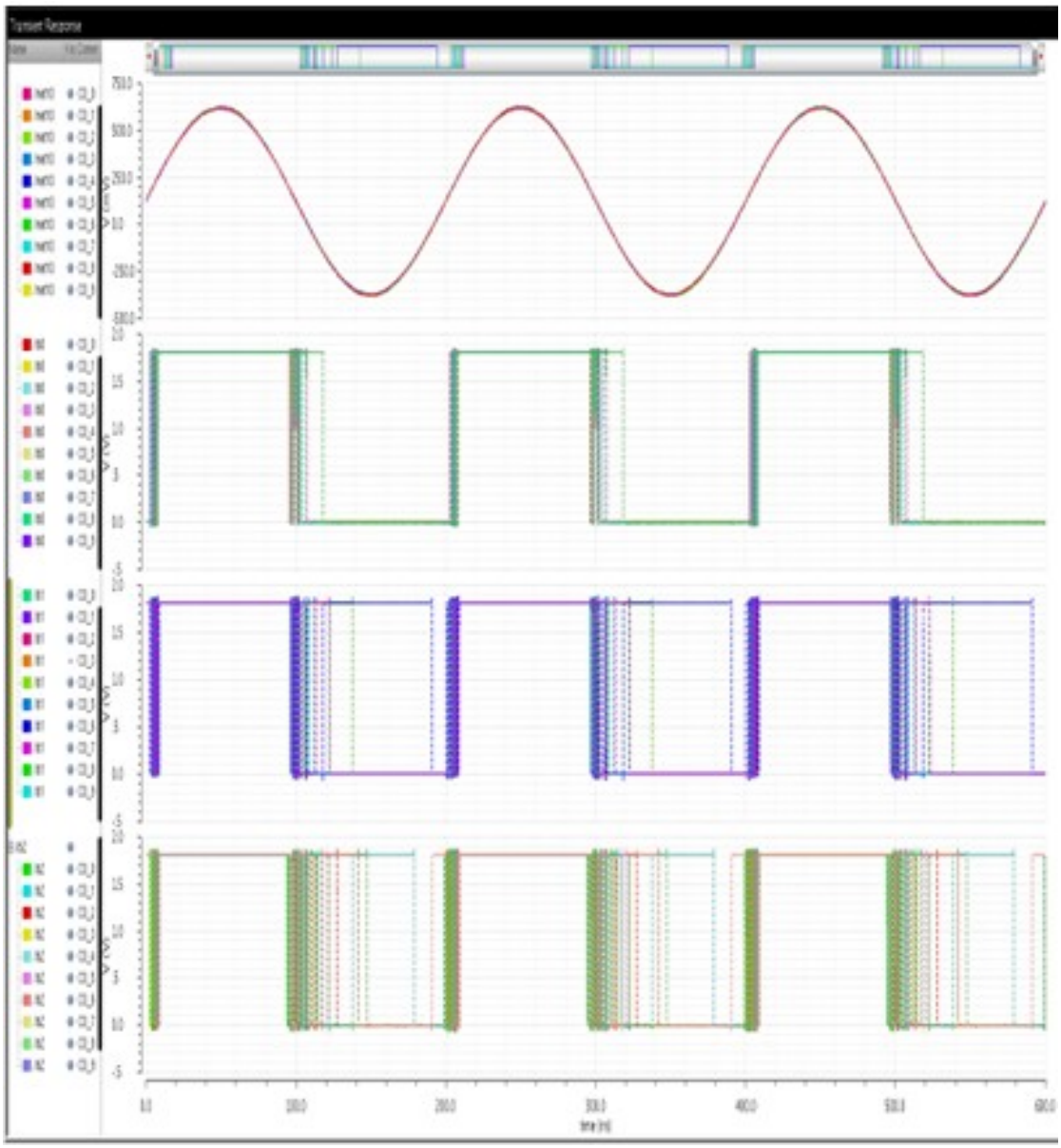
This project focuses on designing and simulating a 3-bit Flash ADC using eSim, an open-source EDA tool. The design consists of a resistor ladder network, a comparator array, and a priority encoder. The resistor ladder generates reference voltages, which are compared against the analog input using comparators, and the resulting signals are encoded into a 3-bit digital output using a Verilog-based priority encoder. The entire system will be verified through NGSPICE simulations for the analog components and MakerChip simulations for the digital logic.

The proposed 3-bit Flash ADC can be applied in high-speed data conversion systems, communication interfaces, and biomedical signal acquisition.

Circuit Diagram(s) :



Expected Output of 3-bit Falsh ADC :



Working Principle of 3-bit Flash ADC

A 3-bit Flash ADC is a high-speed analog-to-digital converter that directly converts an analog input into a 3-bit digital output using a parallel comparator architecture. It is one of the fastest ADC types due to its fully parallel operation. The working principle consists of the following key components:

1. **Resistor Ladder Network:**
    - A series of resistors forms a voltage divider that generates seven reference voltages for a 3-bit ADC.
    - These reference voltages are spaced equally between 0V and Vref, providing thresholds for the comparators.
2. **Comparator Array:**
    - The ADC uses seven comparators, each comparing the analog input voltage (Vin) with a corresponding reference voltage.
    - If Vin is higher than a reference voltage, the comparator outputs a logic '1'; otherwise, it outputs '0'.
    - This results in a thermometer code, where the output transitions from all '0's to all '1's as Vin increases.
3. **Priority Encoder:**
    - The thermometer code is processed by a priority encoder, which converts it into a 3-bit binary code corresponding to the analog input level.
    - The encoder ensures that the highest-order active comparator determines the final binary output.

References :

Title of the paper : Design & Impementation of 3-Bit High Speed Flash ADC for Wireless LAN Applications

Name of the Journal/Publication : International Journal of Advanced Research in Computer and Communication Engineering

Authors :

1. Mirza Nemath Ali Baig — CMR Engineering College

2. Rakesh Ranjan — University of Petroleum and Energy Studies

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