# LOW POWER WAKE UP COMPARATOR

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## ➢ ABSTRACT

Low power consumption is very important in modern electronic systems, especially in battery operated devices. In this project, a low power wake-up comparator is designed to reduce unnecessary power usage. The system remains in sleep mode most of the time and wakes up only when an input signal crosses a fixed threshold. This helps in saving energy and increasing battery life. The proposed design is simple, efficient, and suitable for low power embedded applications. The circuit is designed and simulated using eSim software.

## ➢ INTRODUCTION

In recent years, the use of battery operated and portable electronic devices has increased rapidly. These devices need to work for a long time using limited power sources. Most embedded systems do not work continuously and remain idle for a long period. Keeping the entire system active during this idle time causes unnecessary power consumption. To solve this problem, low power wake-up systems are used.

A wake-up system allows the main processor to stay in sleep mode when there is no activity. Only a small low power block keeps monitoring the input signals. When a required event occurs, the system wakes up and starts operating. Comparators are commonly used in wake-up circuits because they consume very less power and provide fast response.

In this project, a low power wake-up comparator is designed to detect external signals. The comparator compares the input signal with a reference value and generates a wake-up signal when the threshold is crossed. Priority logic can be used when multiple wake-up sources are present. This helps the system respond to important events first. The proposed design focuses on reducing power consumption while maintaining reliable performance. The complete system is designed and simulated using eSim software.

## ➢ PURPOSE OF LOW POWER COMPARATOR

- To continuously monitor input signals with very low power consumption
- To detect threshold crossing events accurately
- To wake up the main system only when required
- To reduce overall energy usage of the system
- To enable fast response from sleep mode
- To support battery-operated and energy-harvesting systems
- To improve system lifetime and efficiency

## ➢ WORKING PRINCIPLE

The low-power wake-up system operates in two main modes: sleep mode and active mode**.** During sleep mode**,** the main processing unit, memory, and peripheral blocks are powered down or placed in low-leakage states to conserve energy. Only the low-power wake-up comparator remains active.

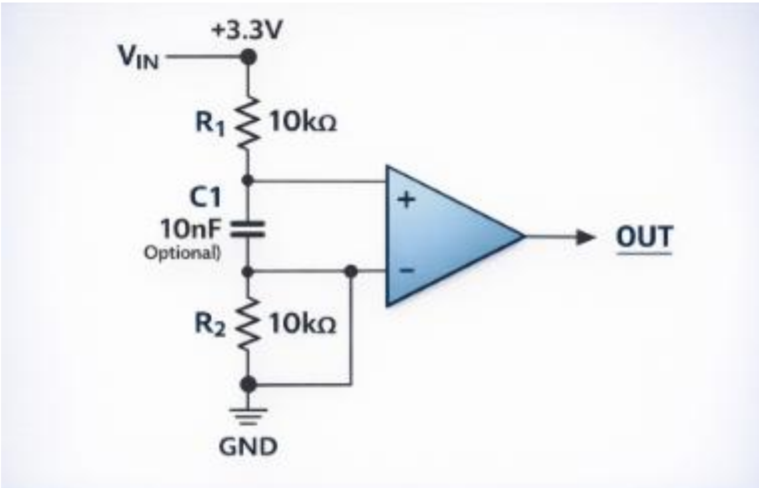
The comparator continuously compares the incoming sensor or external signal with a predefined reference voltage, which can be generated using a resistor voltage divider**.** For example, two resistors are connected in series between a supply voltage and ground, and the midpoint provides the reference voltage to the comparator. This reference represents the minimum threshold required to trigger a valid event. As long as the input signal remains below the threshold, the comparator output stays inactive, and the system continues in sleep mode.

A pull-up resistor is often connected to the comparator output to ensure a defined logic level when the output is not actively driven. When the input signal exceeds the reference voltage, the comparator output changes state. This output is fed to wake-up logic, which may include priority encoding or control circuitry. If multiple wake-up sources are present, priority logic ensures that the highest priority event is selected.

Once a valid wake-up signal is generated, the control unit enables the system clock and power supply to the main processor. The processor then reads the wake-up source information and executes the required task. After completing the operation, the system can return to sleep mode to save power.

This working principle ensures minimal power consumption during idle periods while maintaining fast and reliable wake-up response**.**

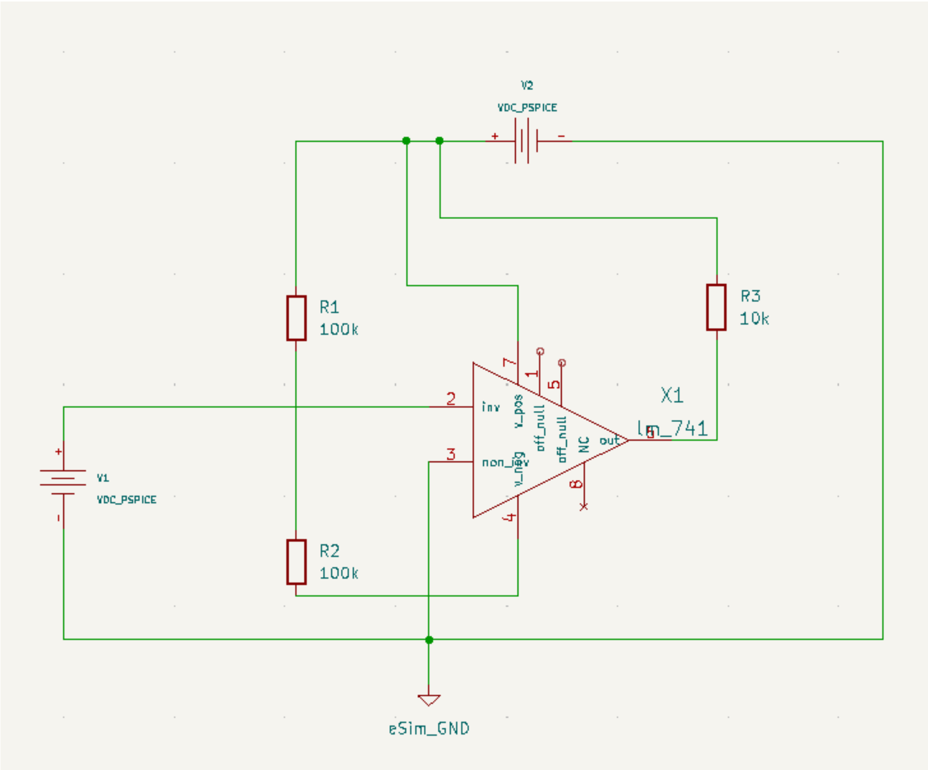
CIRCUIT DIAGRAM:




## ➢ PROPOSED SYSTEM

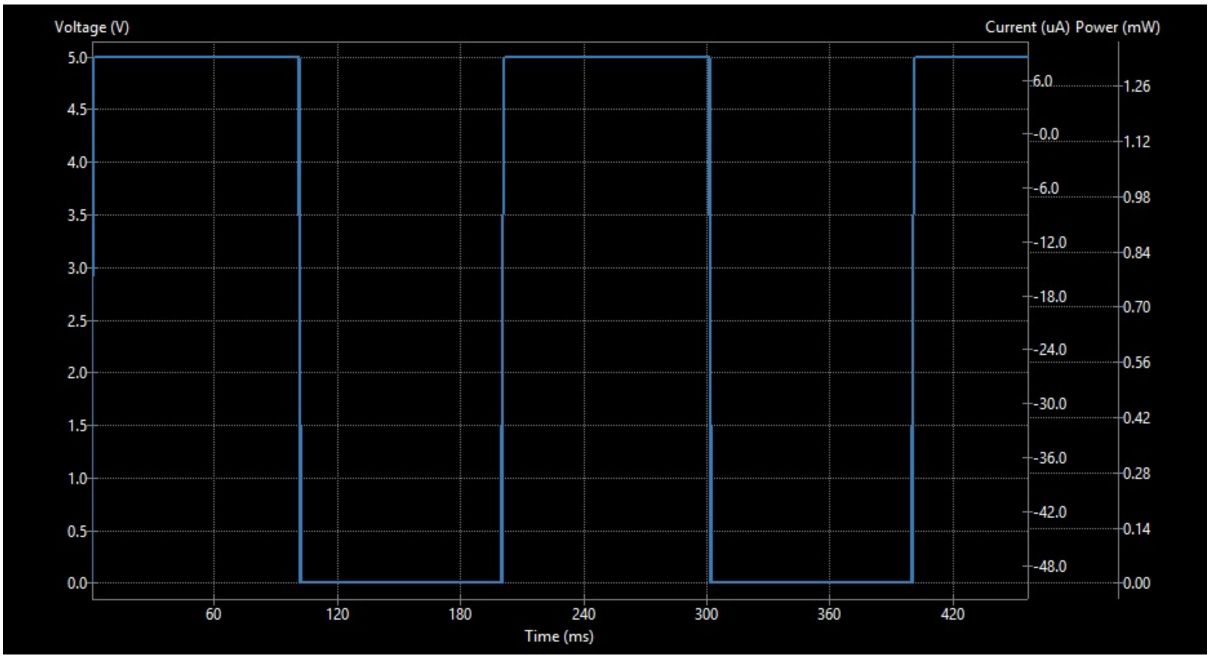
- A low power comparator continuously monitors external inputs
- Priority-based logic selects the most critical wake-up event
- Main processor remains in sleep mode during idle periods
- Wake-up signal activates CPU only when required
- Entire system is designed and verified using eSim

- eSIM CIRCUIT:

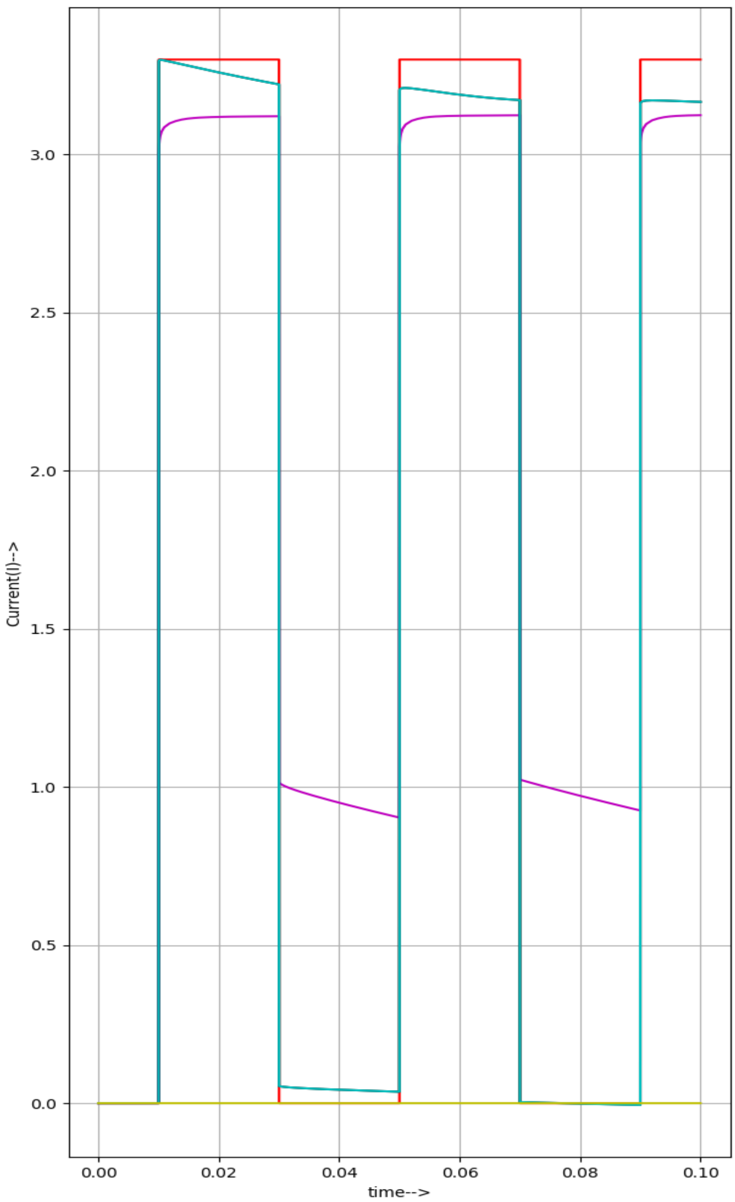


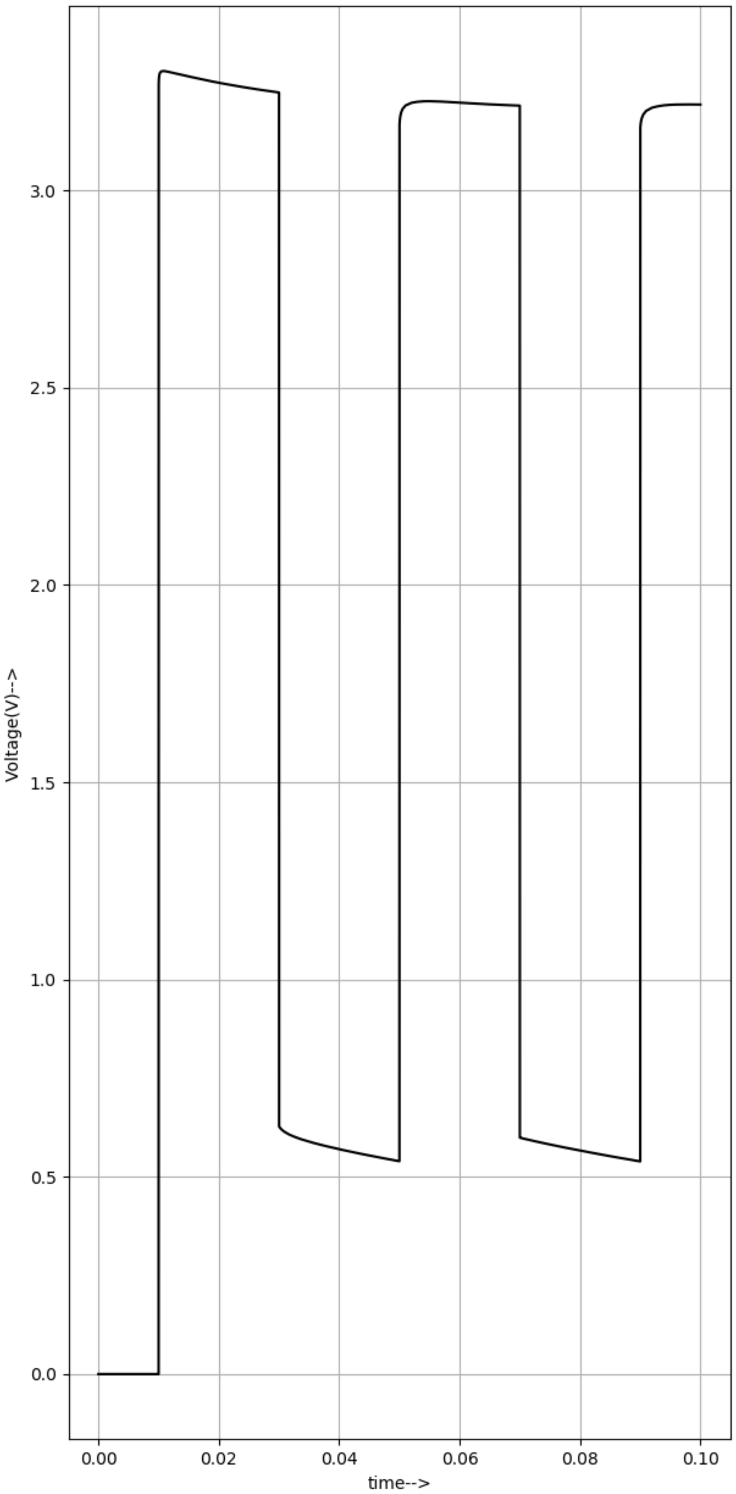

Figure(a):Low power wake up comparator using eSim

- INPUT WAVEFORM:

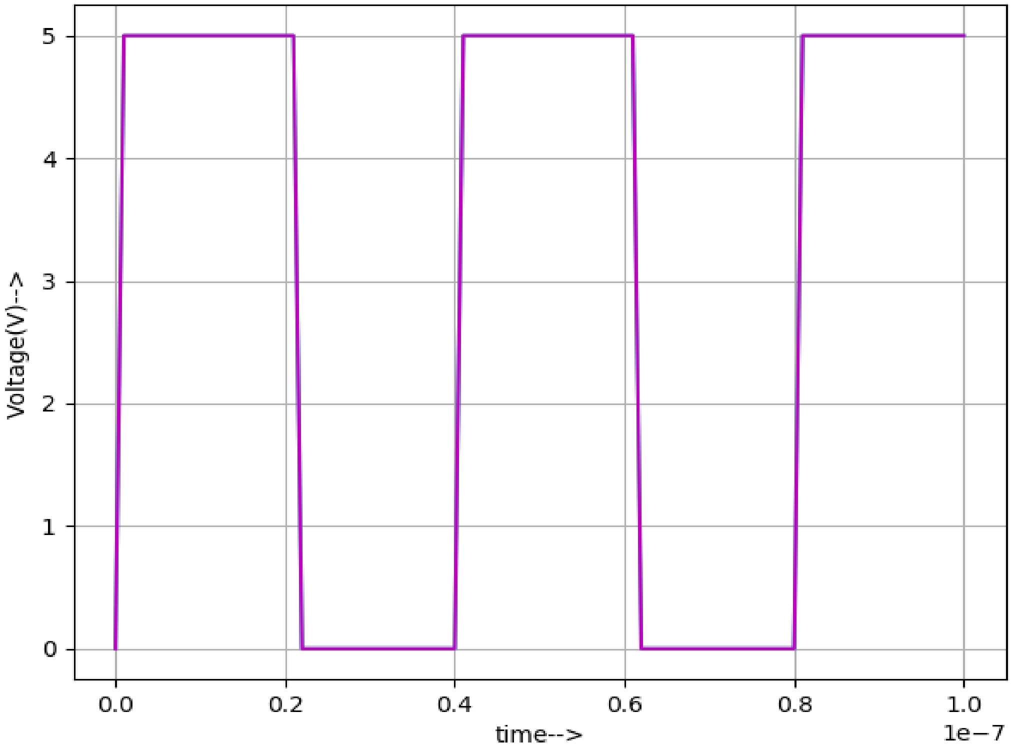


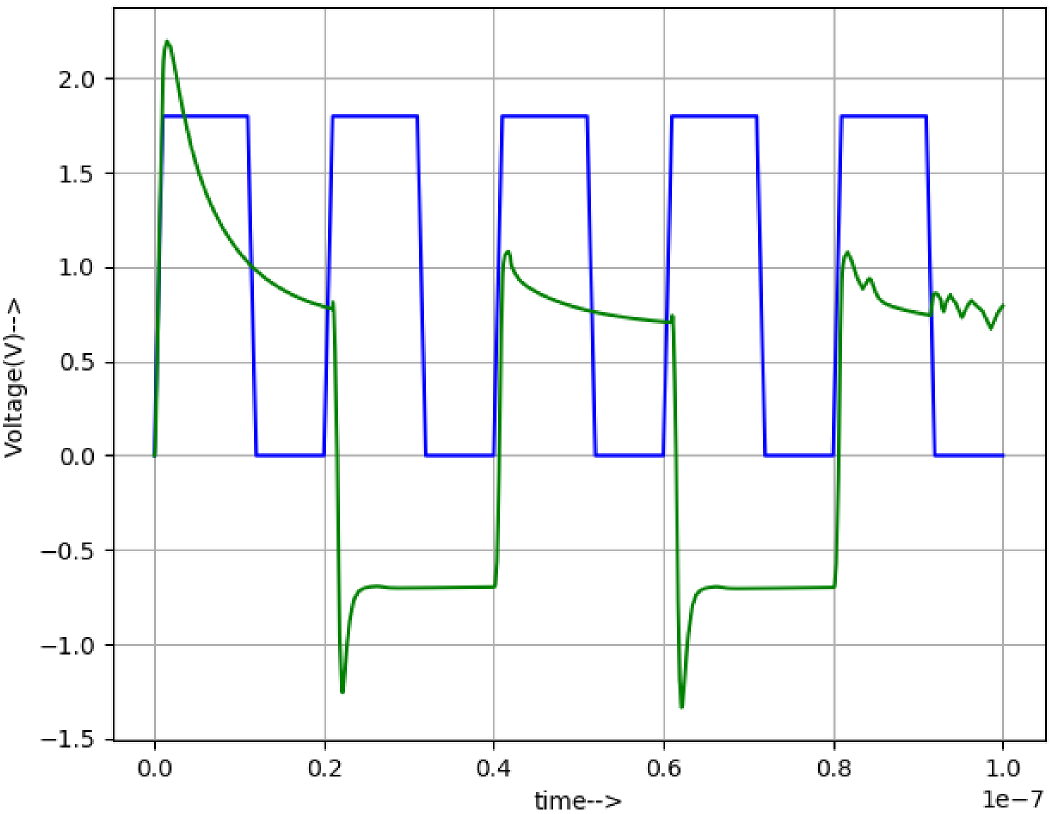
- OUTPUT WAVEFORM:





Voltage(V)-->
time-->
0.0
0.5
1.0
1.5
2.0
2.5
3.0
0.00
0.02
0.04
0.06
0.08
0.10


Voltage(V)-->
time-->
1e−7


Voltage(V)-->
time-->
1e−7

## APPLICATIONS OF LOW POWER WAKE-UP COMPARATOR

- Internet of Things (IoT) devices
- Wearable electronics and medical sensors
- Wireless sensor networks
- Battery-powered embedded systems
- Smart home and automation systems
- Energy-harvesting and remote monitoring devices

## CONCLUSION

This project demonstrates an efficient low power wake-up comparator based system for energy-constrained applications. By keeping the main processor in sleep mode and activating it only when required, significant power savings are achieved. The use of comparator-based detection ensures fast and accurate wake-up response. Priority logic further enhances system reliability by handling critical events first. The proposed design is simple, scalable, and suitable for modern low-power systems. Simulation results obtained using eSim validate the correct operation of the system. Overall, the design is well suited for IoT and embedded applications requiring long battery life.

## REFERENCE:

Khorami and M. Sharifkhani, "High-Speed Low-Power Comparator," *AEU-International Journal of Electronics and Communications*, Elsevier, vol. 70, no. 7, pp. 886–894, 2016.

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