



Battery Level Indicator Using BC 547 Transistor

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1 Abstract

This report presents the design and working of a battery level indicator circuit using a BC 547 NPN transistor, Zener diodes, and LEDs. The circuit is designed to indicate whether the battery voltage is below or above 12V. The system uses Zener diodes for voltage regulation and a transistor for switching between two LEDs (White and green) to indicate the battery status. The report explains the circuit's working principle, component selection, and practical implementation. This report presents the design and working of a battery level indicator circuit using a BC 547 NPN transistor, Zener diodes, and LEDs. The circuit is designed to indicate whether the battery voltage is below or above 12V. The system uses Zener diodes for voltage regulation and a transistor for switching between two LEDs (White and green) to indicate the battery status. The report explains the circuit's working principle, component selection, and practical implementation.

2 Introduction:

Battery level indicators are essential components in electronic systems, serving the critical function of monitoring the voltage levels of batteries to ensure their proper operation and longevity. In many applications, such as portable devices, automotive systems, and power supply units, it is crucial to know whether a battery is adequately charged or if it requires recharging. Over-discharging or overcharging a battery can lead to reduced battery life, performance degradation, or even failure, making battery level monitoring an indispensable feature.

This report focuses on the design and implementation of a simple yet effective battery level indicator circuit using a BC 547 NPN transistor, Zener diodes, and light-emitting diodes (LEDs). The circuit is designed to indicate whether the battery voltage is below or above a specific threshold, in this case, 12V. The choice of 12V is common in many electronic applications, particularly in automotive and portable power systems.

The circuit operates by using Zener diodes to create a reference voltage and a BC 547 transistor as a switch to control the LEDs. When the battery voltage is below 12V, a white LED glows, indicating a low battery condition. Conversely, when the battery voltage exceeds 12V, a green LED glows, signaling that the battery is sufficiently charged. This simple visual indication allows users to quickly assess the battery's status without the need for complex measurement tools. The design is cost-effective, utilizing readily available components, and is easy to implement, making it suitable for a wide range of applications.

3 Applications:

Portable Devices: Smartphones, Tablets, and Laptops: Monitoring battery levels to ensure the device does not run out of power unexpectedly.

Power Banks: Indicating the charge level of the power bank to inform users when it needs recharging. **Automotive Systems: Car Batteries:** Monitoring the voltage level of car batteries to ensure they are adequately charged and functioning properly.

Electric Vehicles (EVs): Providing an indication of the battery charge level to prevent over-discharging, which can damage the battery. **Power Supply Units:**

Uninterruptible Power Supplies (UPS): Indicating the battery status in UPS systems to ensure backup power is available during outages.

Solar Power Systems: Monitoring the charge level of batteries used in solar power systems to optimize energy storage and usage.

4 State of the Art

Below is a table summarizing the evolution including their timeline, price, design, and pros. article array

Timeline vs Price vs Design Comparison

State of the Art in Battery Level Indicators

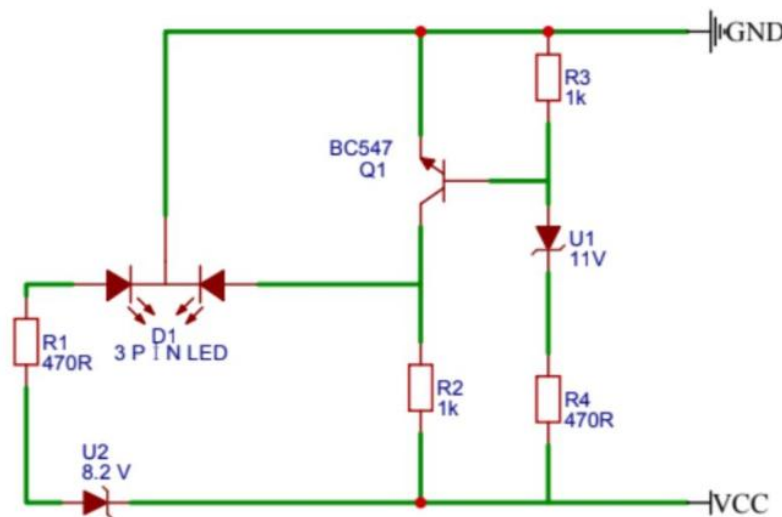
Year	Technology	Price	Pros	Cons	Reference Links
2008	LED + Resistor (Basic)	₹80 – ₹400	Simple, low-cost	No precision, limited thresholds	Electronics Hub Guide
2012	Zener Diode + Transistor	₹250 – ₹650	Reliable, no microcontroller	Fixed thresholds, less flexible	Circuit Digest Tutorial
2015	Op-amp Comparator	₹400 – ₹800	Better accuracy, adjustable	Requires calibration	All About Circuits
2017	Arduino/ATmega	₹800 – ₹1,600	Programmable, multi-level	Overkill for simple applications	Instructables Project
2019	ESP32 + IoT	₹1,200 – ₹2,500	Wireless monitoring, cloud data	Complex, power-hungry	Random Nerd Tutorials
2021	Fuel Gauge IC (MAX17048)	₹400 – ₹1,200	High precision, LiPo support	Requires I2C/SPI interface	Adafruit Product
2023	AI-Powered Predictors	₹1,600+	Predictive analytics, SOH tracking	Expensive, R&D ongoing	IEEE Research Paper (example)

Table 1: State of Art: Timeline vs Price vs Design with Pros \cons.

5 Design Requirements:

design requirements Battery Level Indicator:

- Voltage Range: The circuit should indicate battery voltages below and above 12V.
- Components:
 - BC 547 NPN Transistor
 - 6.5V Zener Diodes (3)
 - White and Green LEDs
 - 470 and 1K Resistors
- Functionality:
 - White LED glows when battery voltage is below 12V.
 - Green LED glows when battery voltage is above 12V.



Reference Circuit Diagram

6 Working Principle:

- The battery level indicator circuit using a BC 547 transistor and Zener diodes operates by comparing the battery voltage to a reference voltage created by the Zener diodes. When the battery voltage is below 12V, the Zener diodes do not conduct, keeping the transistor off, which allows the white LED to glow, indicating a low battery condition. When the battery voltage exceeds 12V, the Zener diodes conduct, turning on the transistor, which then turns off the white LED and turns on the green LED, indicating a fully charged battery. This simple mechanism provides a clear visual indication of the battery's status, making it an effective solution for monitoring battery voltage levels.

7 Software Implementations:

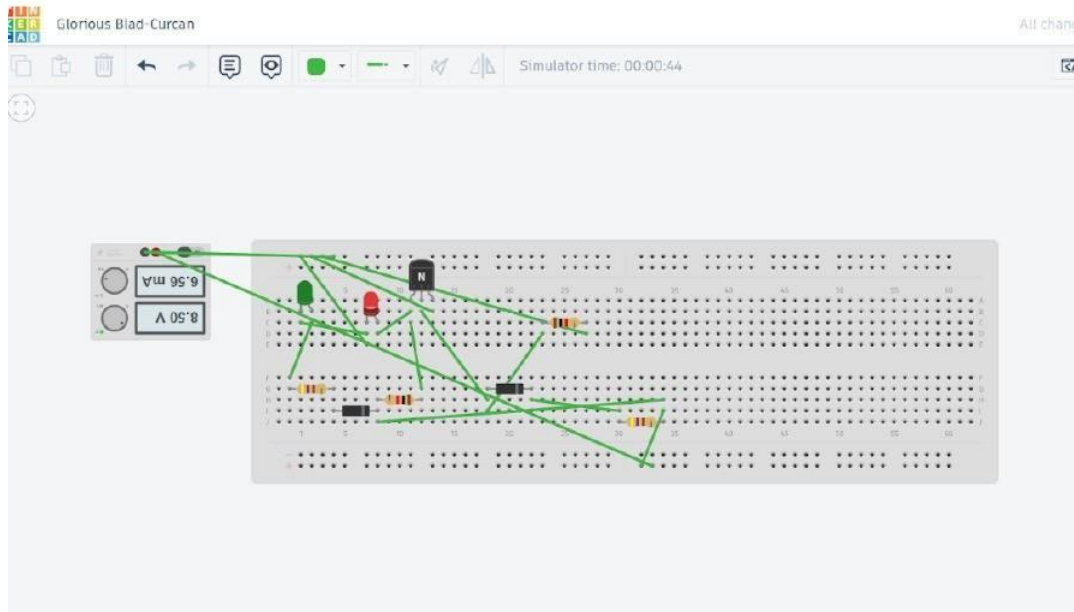


Figure 1: TinkerCAD implementation, LED Indicator

8 Battery level more than 12v

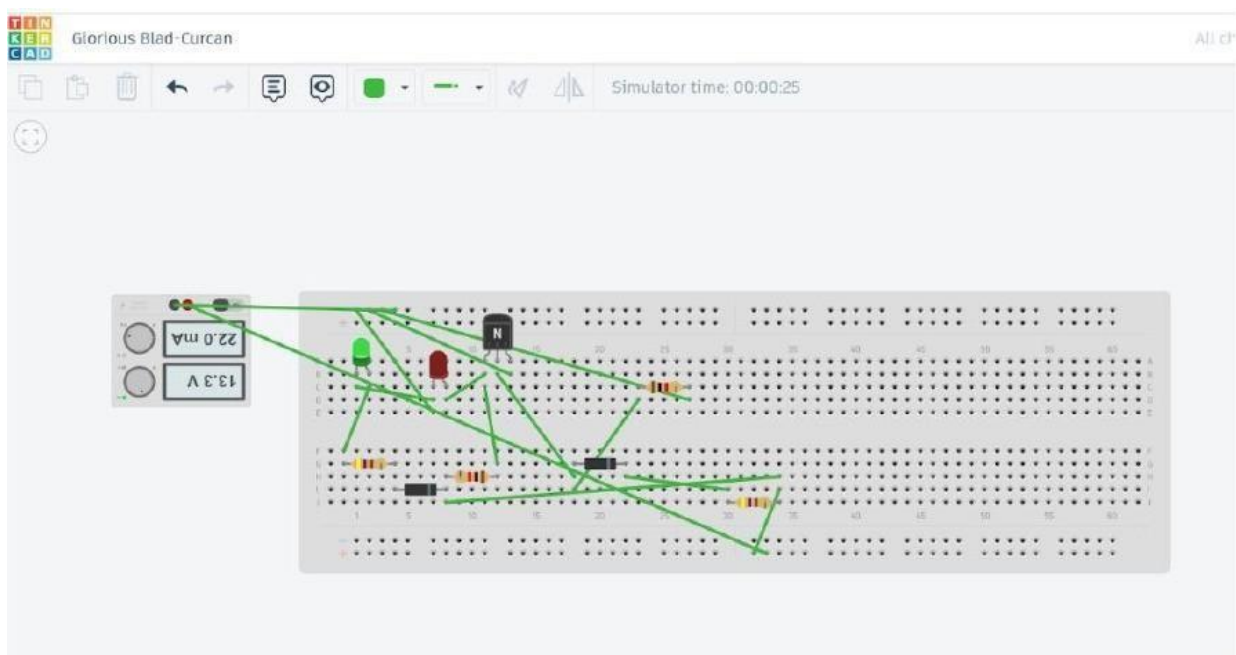


Figure 2:LED Indicator

9 Hardware Implementations:

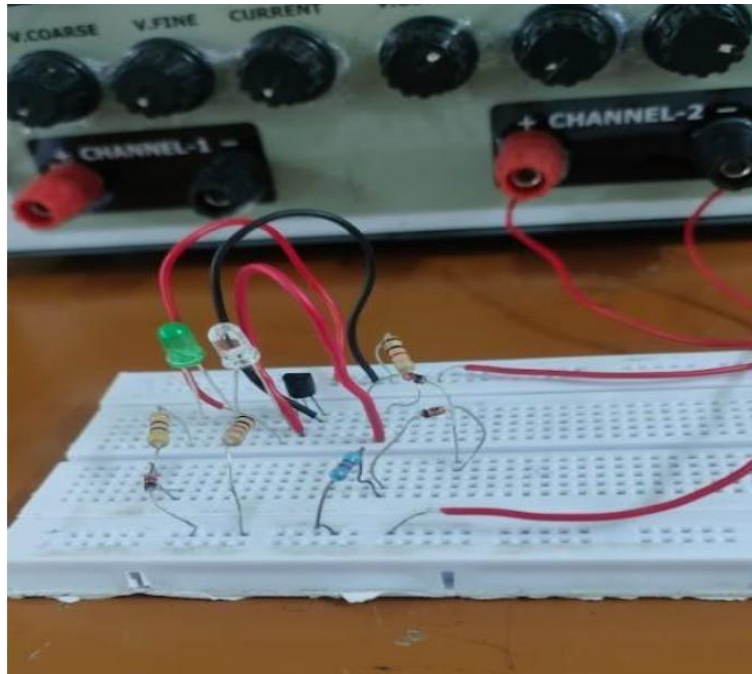


Figure : Hardware implementation

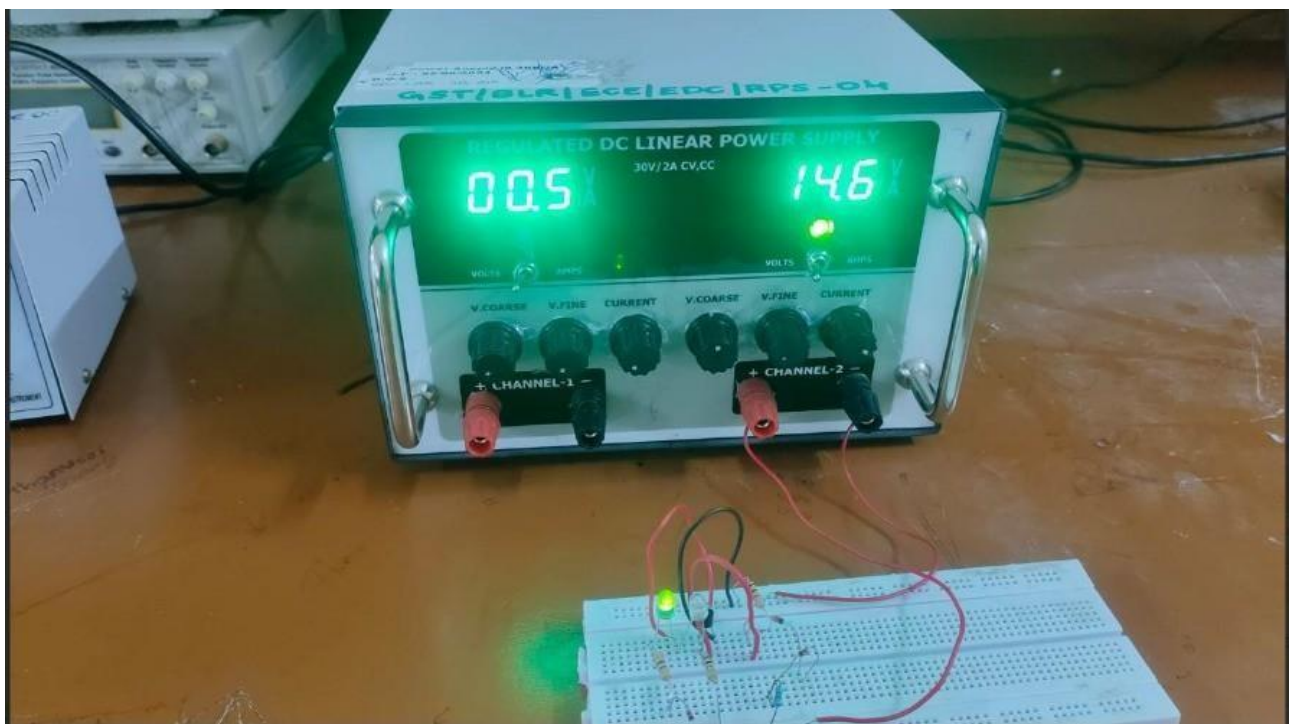


Figure 4: Battery Level is more than 12v

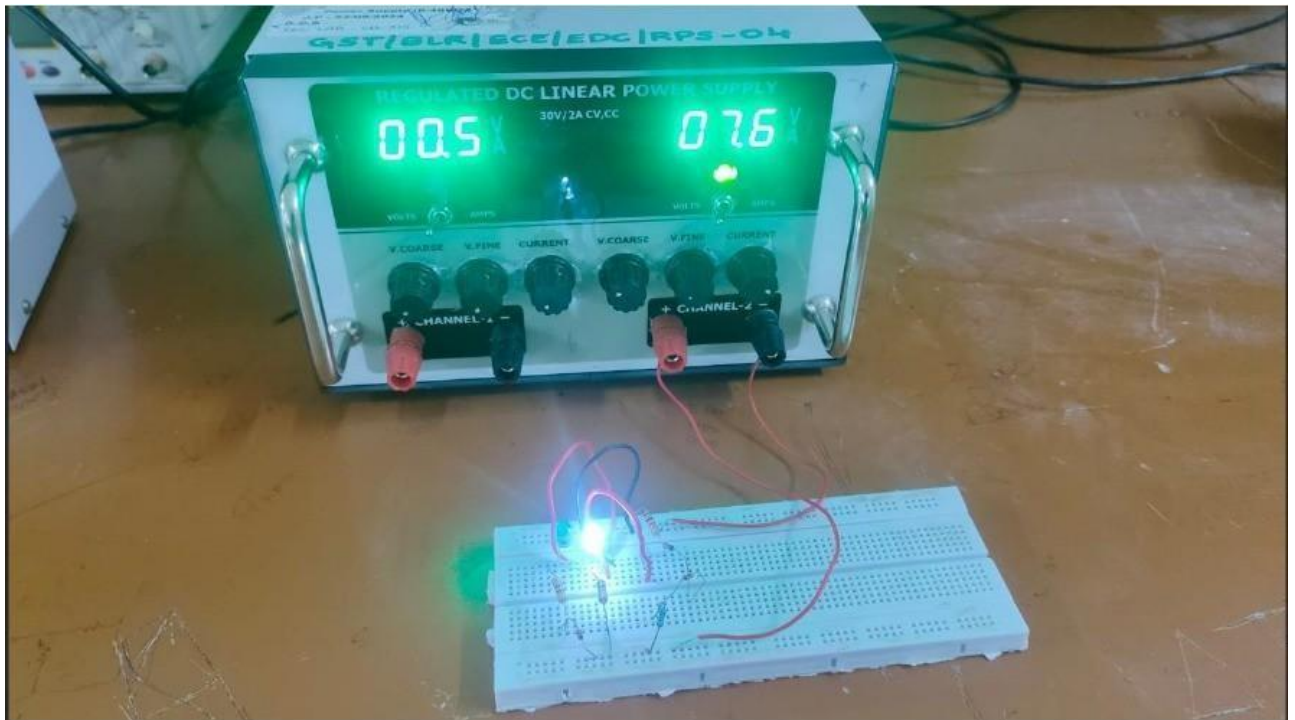


Figure 5: Battery Level is Less than 12v

10 Video Link:

There is a Google Drive Link: https://drive.google.com/drive/folders/1nVOEoxj-fe3qsuDKRbRs1q7CKCv-_H4M?usp=drive_link

11 Conclusion:

The battery level indicator circuit using a BC 547 transistor and Zener diodes is a simple, cost-effective, and reliable solution for monitoring battery voltage levels. The circuit successfully distinguishes between battery voltages below and above 12V, providing clear visual indications through white and green LEDs. Its straightforward design, using readily available components, makes it easy to implement in various applications such as portable devices, automotive systems, and power supply units. While the circuit is effective for basic voltage monitoring, future improvements could include adding more voltage levels for indication or integrating microcontrollers for advanced battery management. Overall, this project demonstrates a practical and efficient approach to battery voltage monitoring, ensuring the proper functioning and longevity of batteries in electronic systems.

12 References

- <https://solderingmind.com/battery-level-indicator-using-bc-547-transistor/>