

Battery Monitoring System



Purpose & Application

The Battery Monitoring System is specifically designed to address the challenges faced by operators of boom lifts and scissor lifts, which commonly use 6V batteries connected in series to provide a total output of 24V. These vehicles are often second-hand and typically lack any built-in battery voltage display or monitoring system. As a result, operators have no way of knowing when to charge the vehicle, the current State of Charge (SOC) of the battery, or if the battery is overheating.

This system was developed to solve these problems by providing real-time monitoring of each battery's voltage, SOC, and temperature. It enables operators to track the battery's health and performance, ensuring they are alerted when charging is necessary, when the SOC is too low or high, or if the battery temperature exceeds safe limits. This ultimately enhances the operational efficiency, safety, and longevity of boom lifts and scissor lifts, preventing unexpected downtime and costly battery damage.

Overview

The **Battery Monitoring System** is a robust, highly precise, and versatile solution designed for continuous monitoring of multiple batteries in a series configuration. It is integrated with an ATmega328P microcontroller and is capable of handling various battery types, ensuring

accurate real-time data and performance tracking. The system provides a user-friendly interface for monitoring key parameters like voltage, temperature, state of charge (SOC), and alarm notifications when readings fall outside safe operating ranges. With its compact design and reliability, this system is ideal for industrial and commercial applications where accurate battery management is critical.

Features

1. Microcontroller Integration (ATmega328P)

- The system is powered by the ATmega328P microcontroller, ensuring high-speed processing, energy efficiency, and precise control over all monitoring functions.
- Provides stable operation for continuous battery monitoring and data collection.

2. Universal Battery Compatibility

- Can connect to any type of battery, making it a versatile solution for various applications.
- Suitable for batteries in series configurations (up to 4 batteries).

3. Voltage Monitoring for Multiple Batteries

- Continuously monitors the voltage of up to four batteries connected in series.
- Displays individual battery voltages on an **LCD screen** for real-time updates.
- Displays the **total voltage** of the series-connected batteries, allowing for easy assessment of the overall system status.

4. State of Charge (SOC) Calculation

- Calculates and displays the **State of Charge (SOC)** for each individual battery.
- Provides accurate insights into how much charge remains in each battery, assisting with battery management and maintenance.

5. Temperature Monitoring

- Monitors the **temperature** of the batteries using an integrated **temperature sensor**.
- Displays the battery temperature in real-time on the LCD.
- Alarm triggers if the temperature exceeds safe operating limits (0°C to 70°C).

6. Alarm System for Parameter Out-of-Range

- The system includes an **in-built buzzer alarm** and an **indicating lamp** to alert the user when any monitored parameter (voltage, SOC, temperature) goes out of its predefined safe range.

- Automatically triggers an alarm when battery voltage is either too low or too high, ensuring system protection.
- The alarm helps prevent overcharging, undercharging, or overheating issues, preventing potential damage to the battery or the overall system.

7. LCD Display for Real-Time Monitoring

- **LCD screen** provides a clear and easy-to-read interface displaying:
 - Individual battery voltages
 - Total voltage of the battery series
 - State of Charge (SOC)
 - Battery temperature
- User-friendly display that allows the operator to assess the health and performance of the battery system at a glance.

8. Calibration Option

- The system includes a **calibration option** that allows users to calibrate the parameters (voltage, temperature, SOC) for increased accuracy.
- The calibration ensures that measurements remain precise over time, even in varying environmental conditions.

9. Reverse Polarity Protection

- The system is designed with **reverse polarity protection**, preventing damage to the hardware if the battery connections are reversed during installation.
- Ensures reliability and safety of the system under any installation condition.

10. Continuous Operation

- The system has been tested to work continuously for more than **50 days**, demonstrating its durability and reliability for long-term use in demanding applications.

11. Compact Design

- The monitoring system has a **compact form factor**, making it suitable for integration into tight spaces and various types of industrial setups.
- Its small size does not compromise on performance, maintaining a high level of reliability.

12. Temperature Range

- The system operates within a **temperature range of 0°C to 70°C**, ensuring stability and consistent performance in a variety of environmental conditions.

13. User-Friendly Interface

- Designed to be intuitive and easy to operate, the system offers a simple user interface with clearly marked controls and displays.
- The system's ease of use reduces training time for operators and enhances productivity.

14. Indicating Lamp for Alarm

- In addition to the buzzer alarm, an **indicating lamp** provides a visual warning when any parameter falls out of range, ensuring clear communication of critical status changes to users.

15. Industrial-Grade Reliability

- Built for **industrial-grade applications**, this system is designed to withstand harsh conditions and provide reliable performance over long periods.
- It ensures optimal battery life and safe operation in critical applications.

Tests Performed

1. Long Duration Test

- The system has successfully passed **continuous operation tests**, running for over 10 days without failure, ensuring its capability for long-term use in industrial environments.

2. Temperature and Voltage Range Tests

- The system has been tested to handle extreme voltage and temperature variations, operating efficiently between **0°C to 55°C** without any compromise on performance.

3. Reverse Polarity Test

- Extensive testing has been conducted on the reverse polarity protection circuit, ensuring that the system remains safe and functional even if battery connections are mistakenly reversed.

Technical Specifications

- **Microcontroller:** ATmega328P
- **Voltage Monitoring Range:** 0V to 60V per battery (configurable based on battery type)
- **Temperature Monitoring Range:** 0°C to 55°C
- **Display:** 16x2 or 20x4 LCD Screen (depending on configuration)
- **State of Charge (SOC):** Calculated based on voltage readings and battery type
- **Alarm System:** In-built buzzer and indicating lamp
- **Power Supply:** Typically 5V DC, powered by the monitored battery pack
- **Reverse Polarity Protection:** Yes
- **Operating Temperature:** 0°C to 55°C
- **Continuous Operation Time:** Tested for 50+ days
- **Calibration:** Available for voltage, SOC, and temperature sensors

Installation and Setup

1. **Connect the Batteries:** Connect the batteries in series as per the system's configuration.
2. **Connect Power Supply:** Connect the power supply to the monitoring unit.
3. **Calibration:** Perform calibration (if necessary) using the calibration function.
4. **System Initialization:** Power on the system and verify that all battery voltages, temperature, and SOC are being displayed correctly.
5. **Set Thresholds:** Set safe voltage, temperature, and SOC ranges based on the battery specifications.
6. **Monitor and Maintain:** Regularly check the LCD for real-time updates and ensure the system is operating within the safe parameters.