IoT Smart Switch for Vehicle Battery Control

Technical Specification Document - Issued: January 15, 2025

Project Overview

This document outlines the technical specifications for a smart IoT-enabled switch designed to remotely control the connection between a vehicle's 12V battery and its electrical system. This switch is designed to enhance battery life, enable remote vehicle control, and prevent parasitic battery drain.

1. Relay Module

- Type: Automotive-grade SPST or DPDT mechanical relay
- Coil Voltage: 12V DC
- Load Voltage: Up to 14V DC (vehicle battery)
- Current Handling: Minimum 100A continuous
- Control Signal: 3.3V / 5V logic-compatible

2. Microcontroller Unit (MCU)

- Model: ESP32
  - Integrated Wi-Fi (802.11 b/g/n)
  - Integrated Bluetooth 4.2 BLE
  - 32-bit dual-core CPU
  - Deep sleep support for power conservation
- Alternate Option: ESP8266 (Wi-Fi only, single core)

3. Power Management

- Input Voltage: 12V DC from vehicle battery
- Step-Down Converter: Buck converter to 3.3V or 5V
  - Recommended module: LM2596 or MP1584
- Optional: TP4056 LiPo charge controller with backup battery

4. Connectivity

- Wi-Fi: For MQTT-based cloud communication

- Bluetooth (BLE): For direct local app control
- Optional Cellular Expansion: SIM800L or LTE module for remote control without Wi-Fi

5. Enclosure & Physical Design

- Material: ABS Plastic or Aluminum Alloy
- IP Rating: IP65 or higher (dustproof and weather-resistant)
- Mounting: 4-point screw flange
- Dimensions: ~100mm x 60mm x 30mm
- LED Indicators: Power, Status (optional)
- External Ports:
  - 12V Power IN
  - 12V Load OUT
  - USB-C or Micro-USB for firmware/debug
  - BLE/Wi-Fi antenna (internal or external)

6. Software & Firmware

- Firmware Base: Arduino IDE / ESP-IDF
- Communication Protocol:
  - MQTT (via Wi-Fi)
  - BLE characteristics for app control
- OTA Updates: Supported via Wi-Fi
- Security: TLS support for MQTT, password-protected BLE services

7. Safety Features

- Flyback diode across relay coil
- Inline fuse on power input
- Reverse polarity protection
- Manual override toggle switch (optional)

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8. Target Use Cases

- Long-term vehicle storage
- Fleet vehicle power control
- Emergency remote disconnect
- Battery management systems for RVs and trailers

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Confidentiality Notice