# Test Procedure for PCB Design Final v28

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This test procedure outlines the necessary tests, criteria, and methods for validating the operation of the components and modules in the provided schematic. This procedure ensures the system operates as expected under different conditions and meets all specifications.

## 1. Overview

The schematic involves the following key components and systems:

1. Voltage regulators for 24V, 7.4V, and 3.3V power distribution.

2. SIM7080G communication module with UART and GPIO interfaces.

3. ESP32 microcontroller module for logic control and I/O management.

4. LiPo battery management system (BMS).

5. Peripherals such as sensors, switches, and connectors.

## 2. Test Requirements

Each component will be tested to ensure individual and integrated functionality. Tests will include:

• Power-on tests for voltage rails and regulators.

• UART communication tests between ESP32 and SIM7080G.

• GPIO control verification.

• BMS operation under load conditions.

• Sensor functionality check.

# 3. Test Procedures

## 3.1 Power Distribution Tests

Objective: Verify correct voltage levels at key points.

Procedure:

1. Power the circuit with 24V input.

2. Measure the output voltage at 7.4V regulator using an oscilloscope.
   Verify output remains stable at the expected voltage level.

3. Measure the output voltage at 3.3V regulator using an oscilloscope.
   Verify output remains stable at the expected voltage level.

4. Verify output stability over 5 minutes.

Pass Criteria: Voltage remains stable within ±5% of expected values.

## 3.2 UART Communication Test

Objective: Ensure proper communication between ESP32 and SIM7080G.

Procedure:

1. Connect the ESP32 and SIM7080G via UART interface.

2. Send AT commands from the ESP32 to SIM7080G.

3. Validate responses from SIM7080G.

Pass Criteria: Correct responses to all AT commands.

## 3.3 GPIO Control Test

Objective: Verify GPIO functionality for external control.

Procedure:

1. Configure GPIO pins on the ESP32.

2. Use test program to send square wave to each pin on J4.

3. measure J4-1 through J4-13 excluding J4-8 using an oscilloscope and verify presence of square wave.

4. Use test program to send square wave to each pin on J6.

5. measure J6-1 through J6-3 using an oscilloscope and verify presence of square wave.

Pass Criteria: square wave present at every pin.

## 3.4 Battery Management System (BMS) Test

Objective: Validate the BMS functionality under load.

Procedure:

1. remove 24v input to allow the battery circuit to provide backup power to the circuits.

2. Measure voltage at U5-2 and verify the presence of stable 3.3v.

3. allow the battery to provide power for 10 minutes.

4. measure voltage at 7.4v test point. This voltage should slowly decrease as battery discharges.

5. while monitoring the oscilloscope voltage level, reapply 24v. verify the voltage increases slightly when 24v input power is applied.

Pass Criteria: voltage increase on 7.4v TP.

### 3.5 Sensor Functionality Test

Objective: Check the operation of the onboard temperature sensor.

Procedure:

1. Power the temperature sensor circuit.

2. Use a bag of ice to lower the temperature.

3. observe the ESP32 serial interface. Verify a corresponding temperature drop.

Pass Criteria: Temperature change observed.

## 4. Conclusion and Sign-off

This test plan ensures all components in the schematic are verified for functionality, communication, and performance. Empirical data will be collected during each test and documented in the final report.

## Appendix: Test Data Recording

### 3. Power Distribution Tests

| TEST | EXPECTED VALUE | MEASURED VALUE | PASS | FAIL |
|---|---|---|---|---|
| **3.1.2** | 7.4v | | | |
| **3.1.3** | 3.3 | | | |
| **3.2** | Data Exchange | | | |
| **3.3.3** | Square Wave | | | |
| **3.3.5** | Square Wave | | | |
| **3.4.5** | Voltage Increase | | | |
| **3.5.3** | Temp Change | | | |