

Critical Assessment Document

Harsh Environment Sensor Board

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Abstract:

The Harsh Environment Sensor Board is a small PCB built to sense different kinds of data and communicate across cellular networks. It is built to be used in a multitude of different harsh environments where strong vibrations, differential temperature, and liquids are commonplace. The purpose of this document is to explain our multiple test cases and their outcomes.

Test Case One: Power Distribution

To ensure that our PCB can work properly off battery power, we conducted power distribution tests. These tests made sure that with 24 Volts of input, we were receiving output voltage of 7.4V and 3.3V at different parts of the board. After running the system for 5 minutes with constant power at these output regulators, voltage remained stable within 5% of expected values, passing this test.

Test Case Two: UART Communication

To ensure proper communication between the ESP32 and SIM7080G components on our PCB, we conducted UART communication tests. We connected the two devices through the UART interfaces and sent AT commands between them to validate their ability to send and receive responses. After testing a variety of commands, we obtained all the correct responses from the SIM7080G to pass this test.

Test Case Three: GPIO Control

For test case three, we needed to verify GPIO functionality for external control. First, we configured the GPIO pins and used a test program to send a square wave to each pin on J4. By using an oscilloscope, we measured from J4-1 through to J4-3 to verify the presence of the square wave. We also performed this test to each pin on J6 to verify that there was a square wave. This test passed due to the square wave being present at every pin on the GPIO.

Test Case Four: Battery Management System (BMS)

To validate the BMS functionality under load, we performed test case four by removing the 24v input into the PCB to allow the battery circuit to turn on and provide backup power to the board. We then measured the voltage at U5-2 and verified that there was a stable 3.3 volts. After letting the battery run for 10 minutes to test stability, we measured the voltage at the 7.4v test point and noted when the voltage decreased due to battery discharge. Finally, we reconnected the 24v input and measured that voltage increased back normal levels. We passed this test case due to the voltage increasing on the 7.4-volt test point.

Test Case Five: Sensor Functionality Test

To test the main functionality of the board, we needed to check the operation of the onboard temperature sensor. By powering the temperature sensor circuit and using a bag of ice to lower the temperature, we were able to observe and verify on the ESP32 serial interface a corresponding temperature drop. We passed this test case due to observing a temperature change.

Summary:

The Harsh Environment Sensor Board is a solution to portable sensors and communication devices that can withstand extreme environmental factors. It can perform its sensor functions and communicate with operators in places with high amounts of vibration, water, and temperatures. By going through these 5 test cases, we were able to verify that the sensor board works as intended by testing its power distribution, UART communications, sensor functionality, GPIO control, and its battery management system. By always ensuring that each of these parts of the PCB work, the Harsh Environment Sensor Board will be useable in the field for any sensing operations it may be needed for.