Temperature Sensing Fan with Adjusted Airflow as Temperature Increases/Decreases

Test Plan

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Document History

Revision History

Revision	Changes	Date
1	First Draft	11/29/17
2	Appendix Added	11/29/17
3	References Added	11/30/17
4	Final Draft	11/30/17

Table of Contents

Introduction

The Temperature Sensing Fan is a very low cost device that can be used to monitor a relatively small area that may be prone to overheating. The fan will continuously monitor the ambient temperature surrounding it. The fan will adjust its speed accordingly to try and keep the surrounding area from getting too hot. The fan will also conserve power by turning off or slowing down when the temperature decreases. The main purpose of this device is to prevent computer related hardware from overheating. This test plan will allow our engineering design team to thoroughly document our testing procedures so that our design will function exactly as specified.

Objective

The purpose of this test plan is to outline all of our testing procedures that went into the design of our prototype temperature sensing fan. This documentation will ensure that the temperature sensing fan will be tested for proper operating power and ambient temperature sensing and cooling.

Scope

This document will address all of the necessary procedures for testing our device. The test plan includes all of the final operational, functional, and performance requirements.

Strategy

The best way to test the design is to break it up into different features that can be tested independently. The most logical test to run first would be a power supply test. The power supply that will be used for this board is a 9 volt dc battery. The 9 volts from the supply needs to be stepped down to 5 volts dc with a voltage regulator to power the MCU, temperature sensor, and the fan motor.

Once the power supply has been properly tested the other components can be tested. A continuity test of all contact points on the board will need to be done to insure that all components are wired correctly and all pin assignments are connected to the correct devices. Once proper continuity is confirmed the temperature sensor can be tested by reading the voltage output. The voltage output should adjust linearly with ambient temperature. The motor circuit can be tested mostly by observation but also checking to see that it is receiving the proper amount of voltage and current to insure proper PWM.

The final test that will need to be performed is software testing. The software controls the entire operation of the fan. Proper testing will need to be done to make sure that the fan is adjusting speed appropriately at each unique operating point. The software was originally written on an initial breadboard design. Expectations are that only minimal adjustments will need to be made to the software for proper functionality.

References

- ATTiny85 MCU Reference Manual
- Temperature Sensor (Microchip Technology MCP9700A-E/TO)
- Voltage Regulator (L78L33ACZ ST Microelectronics)
- Motor (DC 4.2V 46500RPM 6x14mm Coreless Motor)
- GitHub Practicum website

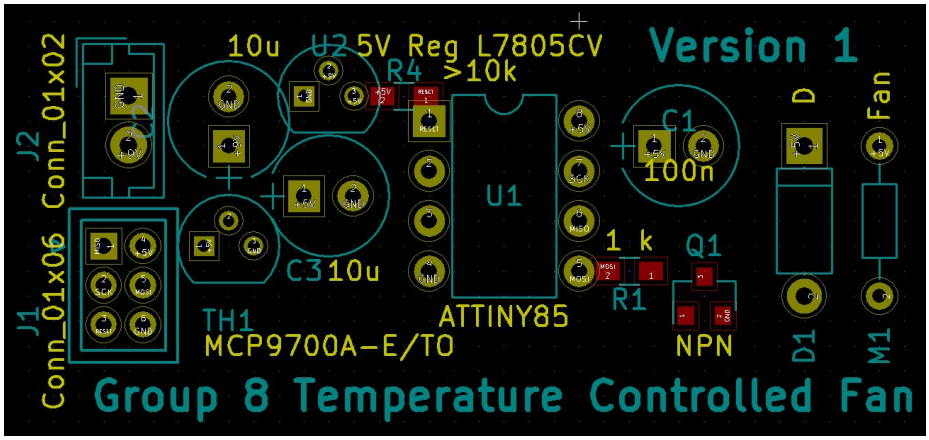

Figure 1: Temperature Controlled Fan Circuit Layout

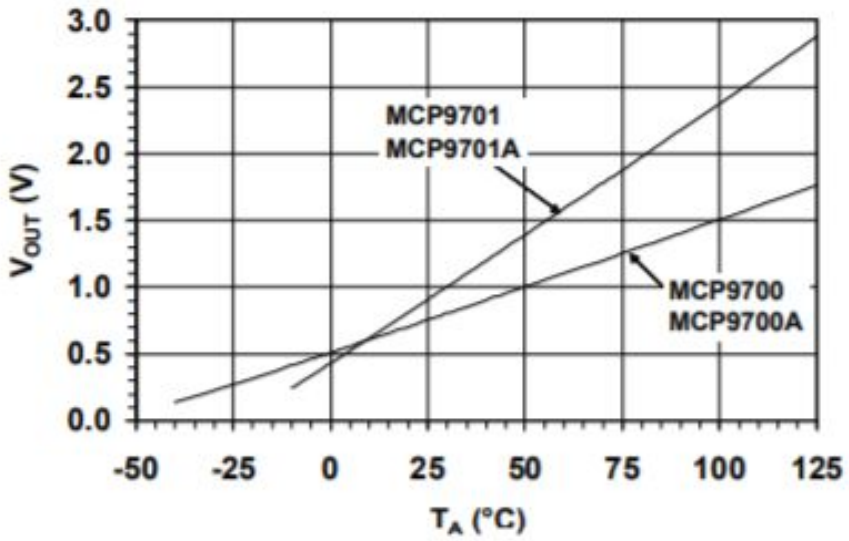

Figure 2: Temperature vs. Voltage Output for the MCP9700/MCP9701 (temperature sensor)

Test Items

Equipment

1. Power supply
2. 9V batteries
3. Oscilloscope
4. Multimeter
5. Hair dryer for temperature testing
6. Thermometer
7. External LEDs for testing operating points
8. Arduino/AVR Dragon

Resources

1. Test Engineers
2. Educational background in Electrical/Computer Engineering
3. Breadboard Circuit Prototypes
4. Reference Manuals (MCU, Temp Sensor, Motor, Voltage Regulator)
5. PC interface
6. Arduino/AVR IDE

Documentation

1. Test case documents (Appendix A)

Personal

1. A technician needs to be familiar with circuit analysis and a digital multimeter
2. Programmers need to have familiarity with the c language and the AVR Dragon with Atmel Studio

Features that Require Testing

1. Ambient Temperature Measurements
2. Software Calibration

System Tests

Test Setup

All test cases along with test IDs are listed in this section of the test plan. All of the testing equipment required to perform these tests was located or was brought in and installed in the capstone lab at Portland State University. Only the batteries, hair dryer, and thermometer were required to be brought in separately.

Component Testing

1. Power Supply Test
2. Temperature Sensor Test
3. Continuity Test
4. Motor Test

Integration Testing

1. Reading from Temperature Sensor
2. Motor Power Consumption

Interface Testing

1. Visual Inspection of Fan/Motor Speed
2. Software Testing

Appendix

Test Case Documentation

Power Supply Test (ID: PST)

Test Writer	Mitchell James Pyle		
Test Case Name	Power Supply Test	**Test ID**	PST
Description	Test the power supply voltage and voltage regulator to ensure a proper 5 volts is supplied to the MCU, Motor, and Temperature Sensor.	**Type**	Black Box **X** White Box ☐
Tester Information			
Name of Tester		**Date**	
Hardware Version		**Time**	
Setup	The temp controlled fan module will be powered on using 9 volts dc using either a 9-volt battery or hooking up a DC supply with 9-volt output.		
Additional Equipment	9-volt Battery, Multimeter, Circuit board		

Step	**Action**	**Expected Result**	**Pass / Fail / NA**	**Comments**
1	Connect the 9-volt battery or 9-volt DC supply to the module.	Nothing should happen.		
2	Test 9-volt node connection before voltage regulator with multimeter.	A voltage reading around 9 volts should appear on the multimeter.		
3	Test 5-volt node after voltage regulator with multimeter	A voltage reading between 0 and 5 volts should appear on the multimeter.		
Overall Test Results				

Continuity Test (ID: CT)

Test Writer	Mitchell James Pyle		
Test Case Name	Continuity Test	**Test ID**	CT
Description	Test all of the contact nodes in the blank circuit board for proper continuity.	**Type**	Black Box **X** White Box ☐
Tester Information			
Name of Tester		**Date**	
Hardware Version		**Time**	
Setup	Our PCB without components hooked up to it will be required for this test. Continuity will be tested based on the circuit board layout in Figure 1. (References)		
Additional Equipment	Multimeter, Circuit board		

Step	**Action**	**Expected Result**	**Pass / Fail / NA**	**Comments**
1	Check that the pin header matches up with the pins on the MCU.	The multimeter will beep when proper continuity is detected.		
2	Check that all the connections for motor circuit have proper continuity.	The multimeter will beep when proper continuity is detected.		
3	Check that the 3 pins on the temperature sensor are routed properly.	The multimeter will beep when proper continuity is detected.		
Overall Test Results				

Temperature Test (ID: TT)

Test Writer	Mitchell James Pyle			
Test Case Name	Temperature Test		**Test ID**	TT
Description	Test the output voltage from the temperature sensor at different temperatures.		**Type**	Black Box **X** White Box ☐
Tester Information				
Name of Tester		**Date**		
Hardware Version		**Time**		
Setup	The temperature controlled fan module will be powered on using 5 volts dc with the temperature sensor connected.			
Additional Equipment	Power Supply, Multimeter, Hair dryer, PCB, Temperature Sensor, Thermometer			

Step	**Action**	**Expected Result**	**Pass / Fail / NA**	**Comments**
1	Use a multimeter to read the voltage output on the temperature sensor at ambient.	The voltage reading on output should be between 0.5-1V.		
2	Increase the ambient temperature using a hair dryer.	The voltage output should increase according to Figure 2. (References)		
3	Allow the ambient temperature to cool down by shutting off the hair dryer.	The voltage output should decrease according to Figure 2.		
Overall Test Results				

Motor Test (ID: MT)

Test Writer	Mitchell James Pyle		
Test Case Name	Motor Test	**Test ID**	MT
Description	Test that the fan motor turns on and off appropriately and adjusts its speed according to the temperature sensor output.	**Type**	Black Box **X** White Box ☐
Tester Information			
Name of Tester		**Date**	
Hardware Version		**Time**	
Setup	The temperature controlled fan module will be powered on using 5 volts dc with the temperature sensor and motor connected.		
Additional Equipment	9-volt DC Supply, Multimeter, Hair dryer, PCB, Temperature Sensor, Fan Motor, Thermometer		

Step	Action	Expected Result	Pass / Fail / NA	Comments
1	Test that appropriate power is being supplied to the motor by connecting multimeter between power supply and motor.	The motor should draw 0.4 Amps at no load, 0.95 Amps when stalled, and 0.12 Amps when running normally.		
2	Test that the fan motor turns on at a set temperature (voltage output from temp sensor).	After the sensor reads the desired voltage, the motor should turn on		
3	Test that fan motor speed increases appropriately with temperature increase using a hair dryer.	The motor should increase speed as temperature increases.		
4	Test that fan motor speed decreases appropriately with temperature decrease and eventually shuts off.	The motor should decrease speed and eventually turn off.		

Overall Test Results		