Team Avalanche Test Plan

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# Overview

This document is to serve as the test plan for Team Avalanches capstone project for electrical and computer engineering program. In this document we will cover top down testing and well and bottom up unit tests for our avalanche transmitter.

# Top Down Testing

In this section of the test plan we will cover the top down testing method for the system. We will analyze the system as a whole and test based on the assumption the system is working. There will be subtests to test the system in various places to ensure proper signal tracing through the system.

# Top Down Test Plan

| Date test is completed |  |
| --- | --- |
| Tester name and role |  |

## Purpose

The purpose of this test is to test that the system for the avalanche transmitter is working properly. It is also to test the robustness of the system. The test will walk you through a full system test including testing the system as a whole but also various subsystems through test points included in the test plan.

## Equipment Needed

* System Equipment
  + Most recent updated software from Team Avalanche Github repository
  + Power supply/Battery circuit
  + Microcontroller/Clock generator circuit (with below items connected)
    - Battery indicator circuit
    - Transistor circuit
    - Amplifier circuit
    - Filter circuit
    - Antenna circuit
* Test Equipment
  + This is the test infrastructure needed operate your system, possibly in “test mode”
  + Screwdriver with phillips head small to medium sized
  + Multimeter
  + Oscilloscope
  + Digital DC power supply
  + Function generator
  + Receiver/Transceiver that detects 457 kHz range
  + Spectrum Analyzer
  + Vector Network Analyzer (VNA)
* Other Equipment
  + Static free area
  + Basic safety equipment
  + Device to record test outcomes
  + Laptop

## Pre-Test Setup

1. Prepare work space for testing
   1. Clean area
   2. Layout circuit
2. Collect all materials needed and begin testing in a lab
   1. Including all test equipment listed above
   2. Including all other equipment listed above
3. Power on all test equipment

## Top Down Test Steps

1. Open IP65 case
2. Ensure the batteries are properly seated in the battery pack
3. Test the battery power   
    Press the battery indicator button
   * 1. Green light should show for full charge
     2. Yellow light will show for medium charge
     3. Red light will show for low charge
4. Turn the power to the system on.
   1. Move the power switch to the on position
5. (If needed) Flash the latest software to the microcontroller.
   1. Get the latest software from the Team Avalanche repository
   2. Plug the microcontroller into laptop using usb
   3. Use IDE to upload latest software version to the microcontroller
6. Once the circuit is functioning check the output frequency and range. This can be tested by using an oscilloscope or transceiver that can detect 457 kHz frequency.
   1. Ensure the frequency being emitted is 457 kHz and the range is under 30 m.
7. Use an oscilloscope to test the voltage and signal going into the antenna.
   1. Ensure it matches the desired value of 3 V.
8. Test the output of the filter to ensure no extra harmonics or frequencies are being output into the world.
   1. We are looking for a 457 kHz signal with 1000 ms duty cycle total + or - 100 ms and on time is greater than 70 ms and off time is 400 ms or greater..
9. Test the input and output of the amplifier with an oscilloscope.
   1. Ensure proper gain value is observed.
10. Use an oscilloscope to test the output of the transistor.
    1. signal frequency should be observed at 457 kHz
    2. duty cycle should be observed at 1000 ms duty cycle total + or - 100 ms and on time is greater than 70 ms and off time is 400 ms or greater..
11. Test the output of the signal generation chip and the microcontroller.
    1. Ensure frequency is 457kHz
12. Test the antenna tuning by connecting the tank circuit to S1 and the other end to ground
    1. Set the VNA to S11 and measure the reflection frequency of the antenna. Make sure the reflection is at 457kHz
13. Test the trigger signal on the output of the microcontroller
    1. Ensure the signal is 2 V to 3.5 V to trigger the transistor
    2. Duty cycle should be 1000 ms duty cycle total +/ - 100 ms and on time is greater than 70 ms and off time is 400 ms or greater.
14. Test the output of the power supply.
    1. Voltage is between 3 V and 6 V.
15. Test the battery system
    1. Ensure the battery is seated properly and does not fall out or become dislodged.
16. Test the battery indicator circuit.
    1. Ensure it properly reads the voltage of 5 volts or higher. For full battery charge.
    2. Ensure it properly reads the voltage of 3 volts to 5 volts. For medium battery charge.
    3. Ensure it properly reads the voltage of 0 volts to 2 volts. For low battery charge.
17. Finally let the system run and transmit for 200 hrs.
    1. Record voltage of the power supply and the output of the battery indicator every 12 hours.

## Post-Test Teardown

1. Power down the system
2. Close IP64 case
3. Pack in a safe place and avoid dropping the unit.

## Top-down Test Plan Conclusions / Discussion

Please put any further comments or notes about the test below. This section is to record any anomalies, issues, or conclusions that arise. Please also include a simple summary of how the test went and if there are any special considerations.

# Bottom Up Test Plan

This section of the test plan will cover the bottom up testing method for the system. We will analyze each subsystem individually. We will also analyze each subsystem's corresponding inputs and outputs to ensure proper functionality and reliability of each subsystem.

Subsystem tests to perform

* Power supply subsystem test
* Microcontroller and clock generator circuit subsystem test
* Transistor circuit subsystem test
* Amplifier circuit subsystem test
* Filter circuit subsystem test
* Antenna circuit subsystem test

| **Test Author: Ken Sutter, Phil Nevins, Allan Bakira, Rob Torres, Dmitrii Fotin** | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Test Case Name:** | | Power supply subsystem test | | | **Test ID #:** | | | #1 |
|  | **Description:** | | This test is designed to ensure its working at proper operating voltage for the circuit. The test will also test the battery indicator by testing the power supply at various levels of charge and seeing if the indicator is accurate or not. Finally a robustness test to ensure the power supply will power the circuit for 200 hours. | | | **Type:** | | | □ white box  □ black box  □ \_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **Tester Information** | | | | | | | | | |
|  | **Name of Tester:** | |  | | | **Date:** | | |  |
|  | **HW/SW Version:** | | 1.2 | | | **Time:** | | |  |
|  | **Setup:** | | Use a multimeter or oscilloscope to take measurements. Use a timer to measure time. | | | | | | |
| **T E S T** | **INPUTS** | | | **EXPECTED OUTPUTS** | | **P**  **A**  **S**  **S** | **F**  **A**  **I**  **L** | **N/A** | **Comments** |
|
| 1 | 4 AA batteries in battery holder | | | 3 volts to 6 volts output | |  |  |  |  |
| 2 | Batteries input 5 volts or higher | | | Battery indicator reads full | |  |  |  |  |
| 3 | Batteries input 3 volts to 5 volts | | | Battery indicator reads medium | |  |  |  |  |
| 4 | Batteries input 0 volts to 2 volts | | | Battery indicator reads medium | |  |  |  |  |
| 5 | Connect the power supply to full circuit and let it run for 200 hrs. | | | Runs for 180+ hours. | |  |  |  |  |
|  | **Overall test result:** | | | | |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Test Case Name:** | | Microcontroller and clock generator circuit subsystem test | | | **Test ID #:** | | | #2 |
|  | **Description:** | | This test is designed to test the output of the microcontroller and clock generator circuit. The goal of this test is to ensure proper output signal of this subsystem. | | | **Type:** | | | □ white box  □ black box  □ \_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **Tester Information** | | | | | | | | | |
|  | **Name of Tester:** | |  | | | **Date:** | | |  |
|  | **HW/SW Version:** | | 1.2 | | | **Time:** | | |  |
|  | **Setup:** | | Use power supply to apply power to the microcontroller and clock generator circuit. Use an oscilloscope to take output measurements. | | | | | | |
| **T E S T** | **INPUTS** | | | **EXPECTED OUTPUTS** | | **P**  **A**  **S**  **S** | **F**  **A**  **I**  **L** | **N/A** | **Comments** |
|
| 1 | 3.3 volts to power the microcontroller and clock generator circuit. | | | Signal of 2 V to 3.5 V to trigger the transistor | |  |  |  |  |
| 2 | 3.3 volts to power the microcontroller and clock generator circuit. | | | Duty cycle of 1000 ms +/ - 100 ms. On time is greater than 70 ms.  Off time is 400 ms or greater. | |  |  |  |  |
| 3 | 3.3 volts to power the microcontroller and clock generator circuit. | | | Clock generator frequency is 457 kHz. | |  |  |  |  |
| 4 |  | | |  | |  |  |  |  |
|  | **Overall test result:** | | | | |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Test Case Name:** | | Transistor circuit subsystem test | | | **Test ID #:** | | | #3 |
|  | **Description:** | | This test is designed to test the transistor circuit. We will be testing the output of the transistor as well as the trigger input to ensure proper switching and output signal. | | | **Type:** | | | □ white box  □ black box  □ \_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **Tester Information** | | | | | | | | | |
|  | **Name of Tester:** | |  | | | **Date:** | | |  |
|  | **HW/SW Version:** | | 1.2 | | | **Time:** | | |  |
|  | **Setup:** | | Use an oscilloscope to take output measurements.Use frequency generator or microcontroller for input signals. | | | | | | |
| **T E S T** | **INPUTS** | | | **EXPECTED OUTPUTS** | | **P**  **A**  **S**  **S** | **F**  **A**  **I**  **L** | **N/A** | **Comments** |
|
| 1 | Signal of 2 V to 3.5 V to trigger the transistor | | | Frequency of 457 kHz. | |  |  |  |  |
| 2 | Clock generator frequency is 457 kHz. | | | Frequency of 457 kHz.  Duty cycle of 1000 ms +/ - 100 ms. On time is greater than 70 ms.  Off time is 400 ms or greater. | |  |  |  |  |
| 3 |  | | |  | |  |  |  |  |
| 4 |  | | |  | |  |  |  |  |
|  | **Overall test result:** | | | | |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Test Case Name:** | | Amplifier circuit subsystem test | | | **Test ID #:** | | | #4 |
|  | **Description:** | | This test is designed to test the output of the amplifier circuit. This test will also test the gain of the circuit to ensure its in proper range for signal amplification. | | | **Type:** | | | □ white box  □ black box  □ \_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **Tester Information** | | | | | | | | | |
|  | **Name of Tester:** | |  | | | **Date:** | | |  |
|  | **HW/SW Version:** | | 1.2 | | | **Time:** | | |  |
|  | **Setup:** | |  | | | | | | |
| **T E S T** | **INPUTS** | | | **EXPECTED OUTPUTS** | | **P**  **A**  **S**  **S** | **F**  **A**  **I**  **L** | **N/A** | **Comments** |
|
| 1 | Input 457 kHz signal | | | 457 kHz signal output  3 V output  Gain of 2.0 | |  |  |  |  |
| 2 |  | | |  | |  |  |  |  |
| 3 |  | | |  | |  |  |  |  |
| 4 |  | | |  | |  |  |  |  |
|  | **Overall test result:** | | | | |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Test Case Name:** | | Filter circuit subsystem test | | | **Test ID #:** | | | #5 |
|  | **Description:** | | This test is designed to test the various frequencies emitted by the circuit. This test will also test the filter circuit to ensure it is properly filtering out the harmonics not necessary for our signal. | | | **Type:** | | | □ white box  □ black box  □ \_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **Tester Information** | | | | | | | | | |
|  | **Name of Tester:** | |  | | | **Date:** | | |  |
|  | **HW/SW Version:** | | 1.2 | | | **Time:** | | |  |
|  | **Setup:** | | Use an oscilloscope and spectrum analyzer to take output measurements. Use a function generator or micro controller for input signals. | | | | | | |
| **T E S T** | **INPUTS** | | | **EXPECTED OUTPUTS** | | **P**  **A**  **S**  **S** | **F**  **A**  **I**  **L** | **N/A** | **Comments** |
|
| 1 | Input 457 kHz signal | | | 457 kHz signal with no harmonic frequencies. | |  |  |  |  |
| 2 |  | | |  | |  |  |  |  |
| 3 |  | | |  | |  |  |  |  |
| 4 |  | | |  | |  |  |  |  |
|  | **Overall test result:** | | | | |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Test Case Name:** | | Antenna circuit subsystem test | | | **Test ID #:** | | | #6 |
|  | **Description:** | | This test is designed to test the antenna circuits operation. This test will also test the range of the signal transmission as well and signal accuracy and strength. | | | **Type:** | | | □ white box  □ black box  □ \_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **Tester Information** | | | | | | | | | |
|  | **Name of Tester:** | |  | | | **Date:** | | |  |
|  | **HW/SW Version:** | | 1.2 | | | **Time:** | | |  |
|  | **Setup:** | | Use a VNA and spectrum analyzer to take tuning measurements of the subsystem. Use a function generator or micro controller for input signals. For the final test use a production avalanche transceiver to detect the signal. | | | | | | |
| **T E S T** | **INPUTS** | | | **EXPECTED OUTPUTS** | | **P**  **A**  **S**  **S** | **F**  **A**  **I**  **L** | **N/A** | **Comments** |
|
| 1 | Connect antenna tank circuit to port 1 and ground on a VNA | | | A reflected signal with a significant dip 457kHz | |  |  |  |  |
| 2 | Input 457 kHz signal (Function Generator) to transmitter and set transceiver to search mode | | | Able to receive 457 kHz signal and hear beeping from the transceiver | |  |  |  |  |
| 3 | Input 457 kHz signal (Battery Pack) and set transceiver to search mode | | | Able to receive 457 kHz signal and hear beeping from the transceiver 0 m to 30m away | |  |  |  |  |
| 4 |  | | |  | |  |  |  |  |
|  | **Overall test result:** | | | | |  |  |  |  |