**A.Appendix**

# A.1TestCaseDocuments

A.1.1BTC1

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| TestWriter | | Nathaniel Dusciuc | | | | | | |
| TestCaseName | | Power regulator test | | | | TestID |  | |
| Description | | Verifying voltage levels of power rails and voltage regulator, over a range of supply voltages from 3.3v to 5v. | | | | Type | BlackBoxWhiteBox |  |
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| TesterInformation | | | | | | | | |
| NameofTester | |  | | | | Date |  | |
| HardwareVersion | |  | | | | Time |  | |
| Setup | | Populate all the power circuitry hardware on the PCB. Connect a 5v power supply limited to 50mA max to the battery input terminal. Connect voltage probe to power rail. | | | | | | |
| AdditionalEquipment | | Oscilloscope, Current limiting power supply | | | | | | |
| Step | Action | Expected Result | Pass | Fail | N/A | Comments | | |
| 1 | Apply logic 1 to the enable pin (p5) on the power regulator (U3). | 3.3v on power rail and current consumption in single-digit mA range. |  |  |  |  | | |
| 2 | Change power supply to 3.3v | Approximately 3.3v on power rail. |  |  |  |  | | |
| 3 | Increase current limit of power supply to 150mA. | Approximately 3.3v on power rail and no major change in current consumption. |  |  |  |  | | |
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| TestWriter | | Nathaniel Dusciuc | | | | | | |
| TestCaseName | | Power on circuit test | | | | TestID |  | |
| Description | | Verify the on button behavior. | | | | Type | BlackBoxWhiteBox |  |
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| TesterInformation | | | | | | | | |
| NameofTester | |  | | | | Date |  | |
| HardwareVersion | |  | | | | Time |  | |
| Setup | | Place button header on PCB and connect button breakout board to main PCB. Connect a 5v power supply limited to 50mA max to the battery input terminal. Attach probe to the enable pin (p5) of the power regulator (U3). | | | | | | |
| AdditionalEquipment | | Oscilloscope, Current limiting power supply | | | | | | |
| Step | Action | Expected Result | Pass | Fail | N/A | Comments | | |
| 1 | Center button press (short) | Logic 1 |  |  |  |  | | |
| 2 | Center button press (short) | Logic 1 (no change) |  |  |  |  | | |
| 3 | Center button press (long) | Logic 0 |  |  |  |  | | |
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| Test Writer | | Nathaniel Dusciuc | | | | | | |
| Test Case Name | | USB power defeat circuit test | | | | Test ID |  | |
| Description | | Verify correct logic output levels when USB is plugged in and when it is not plugged in. | | | | Type | BlackBoxWhiteBox |  |
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| Tester Information | | | | | | | | |
| Name of Tester | |  | | | | Date |  | |
| Hardware Version | |  | | | | Time |  | |
| Setup | | Connect a 5v power supply limited to 50mA to the battery input terminal. Connect voltage probe to power rail. Turn on power by pressing the center button. | | | | | | |
| Additional Equipment | | Oscilloscope, Current limiting power supply | | | | | | |
| Step | Action | Expected Result | Pass | Fail | N/A | Comments | | |
| 1 | Connect 5V power to USB inlet. | GND on power rail. |  |  |  |  | | |
| 2 | Disconnect USB power. | 3.3v returns to power rail after a short delay. |  |  |  |  | | |
| 3 | Connect 4.0V power to USB inlet. | GND on power rail. |  |  |  |  | | |
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| Test Writer | | Nathaniel Dusciuc | | | | | | |
| Test Case Name | | Charge controller test | | | | Test ID |  | |
| Description | | Verify the charge controller is outputting | | | | Type | BlackBoxWhiteBox |  |
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| Tester Information | | | | | | | | |
| Name of Tester | |  | | | | Date |  | |
| Hardware Version | |  | | | | Time |  | |
| Setup | | Connect a 3.3v power supply limited to 50mA in series with a current probe connected to the battery input terminal. Turn on power by pressing the center button. | | | | | | |
| Additional Equipment | | Oscilloscope, Current limiting power supply | | | | | | |
| Step | Action | Expected Result | Pass | Fail | N/A | Comments | | |
| 1 | Connect a 5V power supply to the USB power inlet. | .Current flowing toward the “battery” power supply. |  |  |  |  | | |
| 2 | Raise the “battery” power supply voltage to 5V. | Current flow reduces as “battery” power supply approaches 4.95v and then shuts off above 4.95v. |  |  |  |  | | |
| 3 | Reduce the “battery” power supply voltage to 3.3V | Current begins to flow again when the “battery” power supply voltage drops below 4.85v. |  |  |  |  | | |
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| Test Writer | | Nathaniel Dusciuc | | | | | | |
| Test Case Name | | Button debounce/functionality test | | | | Test ID |  | |
| Description | | Verify that all 5 button presses provide a clean steady logic 0 at their respective GPIO pins. | | | | Type | BlackBoxWhiteBox |  |
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| Tester Information | | | | | | | | |
| Name of Tester | |  | | | | Date |  | |
| Hardware Version | |  | | | | Time |  | |
| Setup | | Populate debounce circuitry and the pull-up resistors for the button. Connect a 5v power supply limited to 50mA. Turn on power by pressing the center button. | | | | | | |
| Additional Equipment | | Oscilloscope, Current limiting power supply | | | | | | |
| Step | Action | Expected Result | Pass | Fail | N/A | Comments | | |
| 1 | Connect voltage probe to GPIO pins\* and press button. | Logic steps from high to low with no voltage bounce. |  |  |  |  | | |
| 2 |  |  |  |  |  |  | | |
| 3 |  |  |  |  |  |  | | |
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\*UP = pin 39, Down = pin 40, Right = pin 41, Center = pin 42, Left = pin 43

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| Test Writer | | Nathaniel Dusciuc | | | | | | |
| Test Case Name | | Sensor module test | | | | Test ID |  | |
| Description | | Verify that the sensor module is sensing the magnetic field and outputting the correct logic levels. | | | | Type | BlackBoxWhiteBox |  |
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| Tester Information | | | | | | | | |
| Name of Tester | |  | | | | Date |  | |
| Hardware Version | |  | | | | Time |  | |
| Setup | | Connect a 5v power supply limited to 50mA to the battery input terminal. Turn on power by pressing the center button. Populate sensor header and circuitry. Connect sensor module to sensor header on main PCB. Connect voltage probe to MCU pin 29 | | | | | | |
| Additional Equipment | | Magnet, Oscilloscope, Current limiting power supply | | | | | | |
| Step | Action | Expected Result | Pass | Fail | N/A | Comments | | |
| 1 | Place neodymium magnet in front of sensor module (If no result use the other pole of the magnet). | Logic low. |  |  |  |  | | |
| 2 | Remove magnet | Logic high. |  |  |  |  | | |
| 3 |  |  |  |  |  |  | | |
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| Test Writer | | Nathaniel Dusciuc | | | | | | |
| Test Case Name | | MCU hardware test | | | | Test ID |  | |
| Description | |  | | | | Type | BlackBoxWhiteBox |  |
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| Tester Information | | | | | | | | |
| Name of Tester | |  | | | | Date |  | |
| Hardware Version | |  | | | | Time |  | |
| Setup | | Place MCU on main PCB and all related circuitry. Connect a 5v power supply limited to 10mA to the battery input terminal. | | | | | | |
| Additional Equipment | | Oscilloscope, Current limiting power supply | | | | | | |
| Step | Action | Expected Result | Pass | Fail | N/A | Comments | | |
| 1 | Slowly increase current limit of power supply to 55mA. | The current being supplied should not exceed 50mA. |  |  |  |  | | |
| 2 | Connect voltage probe to power pins\*. | 3.3v dc without ripple or deviation. |  |  |  |  | | |
| 3 | Connect voltage probe to pin 1 | 0.6\*supply voltage (v) |  |  |  |  | | |
| 4 | Connect voltage probe to pin 5 or 6. | 8MHz signal |  |  |  |  | | |
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\*Pins 9,24,36,48

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| Test Writer | | Linyi | | | | | | |
| Test Case Name | | ST-Link Interface Verified | | | | Test ID |  | |
| Description | | Make sure the ST-link can connect the computer and MCU, and successfully download the code. | | | | Type | BlackBoxWhiteBox |  |
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| Tester Information | | | | | | | | |
| Name of Tester | |  | | | | Date |  | |
| Hardware Version | |  | | | | Time |  | |
| Setup | | Correctly connect the ST-Link to the board, then read the MCU from uVersion and load the “Hello World!” procedure to the MCU. | | | | | | |
| Additional Equipment | |  | | | | | | |
| Step | Action | Expected Result | Pass | Fail | N/A | Comments | | |
| 1 | Connect the ST-Link to the board, including SWDIO, SWCLK, GND and RESET. (Connect the 3.3V VDD to test also) | The LCD should be turn on when the ST-Link plug into computer. |  |  |  |  | | |
| 2 | Check if uVersion have connected to the ST-Link | The ST-Link have connected to the computer. |  |  |  |  | | |
| 3 | Load a “Hello World!” procedure to the MCU and make it show on the LCD | The LCD shows “Hello World!” |  |  |  |  | | |
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| Test Writer | | Linyi | | | | | | |
| Test Case Name | | User Program Test | | | | Test ID |  | |
| Description | | Verify that the user can operate the bottom then setting the system correctly. | | | | Type | BlackBoxWhiteBox |  |
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| Tester Information | | | | | | | | |
| Name of Tester | |  | | | | Date |  | |
| Hardware Version | |  | | | | Time |  | |
| Setup | | Download the User program to the MCU and test Up, Down, Left, Right and Select bottom separately. | | | | | | |
| Additional Equipment | |  | | | | | | |
| Step | Action | Expected Result | Pass | Fail | N/A | Comments | | |
| 1 | Download the User Program to MCU. | Show information about enter the radius. |  |  |  |  | | |
| 2 | In the User Setting Mode, try to use all the button | Check if the button function act like below:  Up and Down: change the number  Left and Right: change the position  Select: Save the radius and jump to next mode |  |  |  |  | | |
| 3 | Try all the button when is not in User Setting Mode | Check if the button function act like below:  Up and Down: change the speed unit  Left and Right: change the mode  Select: do nothing |  |  |  |  | | |
| 4 | Try change the mode back to User Setting Mode, and enter another radius to verified the code again | Enable to re-enter the User Setting Mode and change the radius. |  |  |  |  | | |
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