Lucky Charge Test Procedure

AUGUST 18 2008 - V1.0

Power Test

Test purpose

The purpose of this test is to power up the board to allow for firmware programming and to check for power shorts that may occur due to:

- Solder short
- Misplaced component
- Incorrect orientation of component
- Damaged component

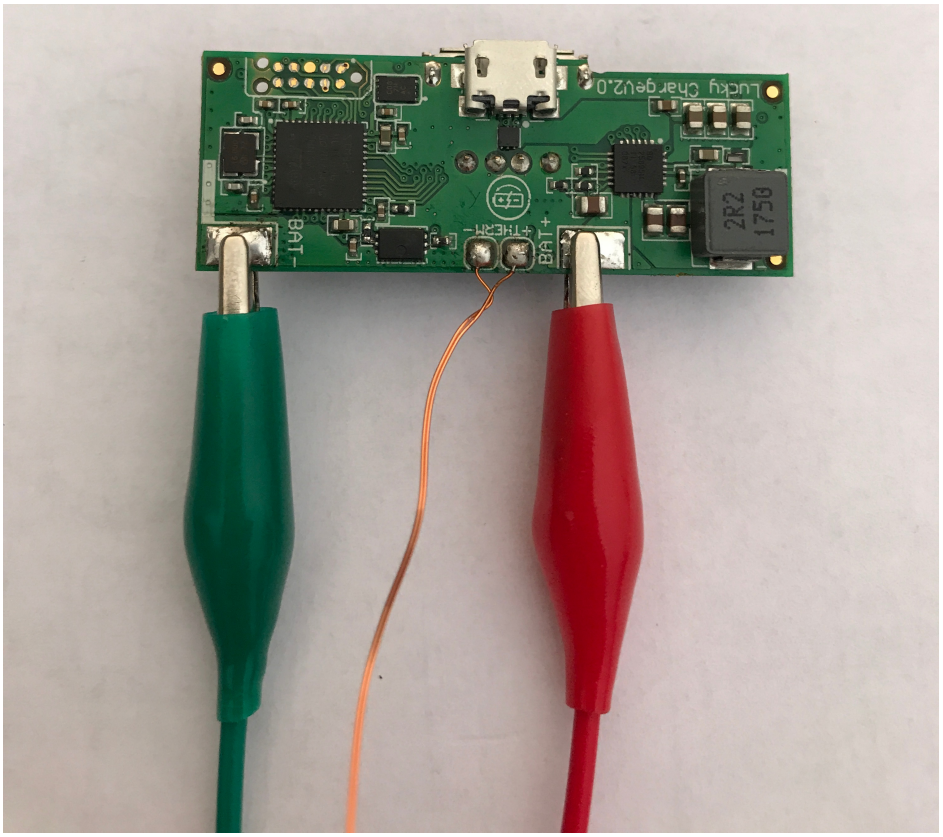
Equipment

- Power supply set to 3.7VDC with a current limit of 200mA
- 2 x Alligator clips to connect power supply to PCBA.
- Lucky charge PCBA with battery disconnected.
- Multimeter

Notes:
An over-current condition exists if the PCBA draws more than 50mA on power up in the following steps.

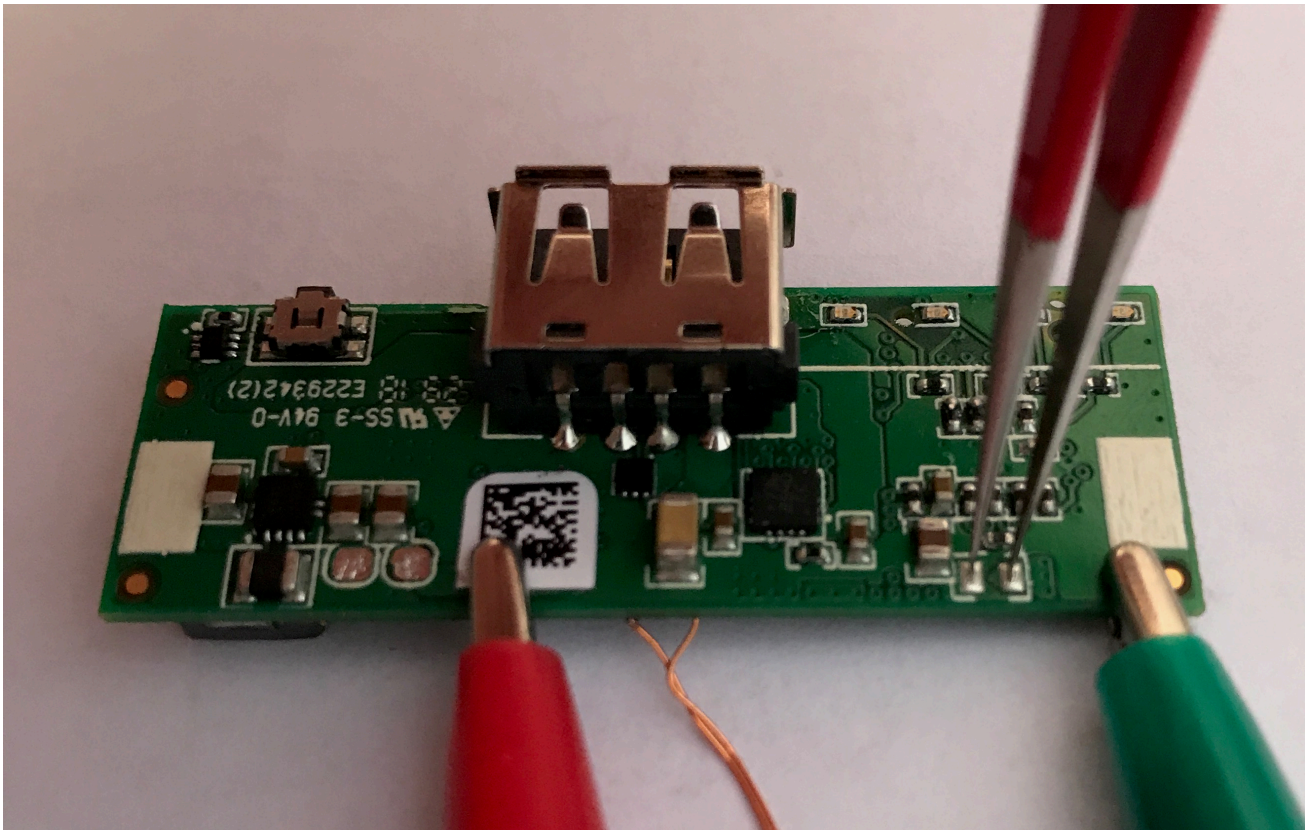
Instructions

1. Connect current limited power supply to PCBA at 3.7VDC. 3.7VDC+ connects to the BAT+ terminal. GND connects to the BAT- terminal.



2. Turn on power supply output.
3. Check for over-current condition.
4. If no over-current condition exists continue to next step, otherwise fail board due to power short.

5. Connect tweezers between the two pads on PCBA as indicated in picture for a minimum of 5 seconds. This will power up the board.



6. Check for over-current condition.
7. If no over-current condition exists continue to next step, otherwise fail board due to power short.
8. Measure the 3.3VDC rail at the test point shown in the image. This voltage should be between 3VDC and 3.5VDC. If no voltage is measured (or very low voltage ~0.5V) try to short the two pads with the tweezers again.
9. Once the 3.3VDC power rail has been confirmed continue to firmware update the board in the next section.

Loading Firmware

Test purpose

The purpose of this section is to load firmware onto the device and run the self-test program that is built into the firmware.

Equipment

- Power supply set to 3.7VDC with a current limit of 200mA
- 2 x Alligator clips to connect power supply to PCBA.
- Lucky charge PCBA with battery disconnected.
- STLink V2 programmer - https://www.digikey.ca/product-detail/en/stmicroelectronics/ST-LINK-V2/497-10484-ND/2214535
- TAG-Connect Pogo Pin Programming Header TC2050-IDC-NL - https://www.digikey.ca/product-detail/en/tag-connect-llc/TC2050-IDC-NL/TC2050-IDC-NL-ND/2605367
- Adapter board TC2050-ARM2010 - https://www.digikey.ca/product-detail/en/tag-connect-llc/TC2050-ARM2010/TC2050-ARM2010-ND/3528170
- Windows computer with the STM32 ST-LINK utility installed - https://www.st.com/en/development-tools/stsw-link004.html
- Latest version of Lucky Charge Firmware hex file.

Notes:
Connect the STLink programmer, the adapter board and pogo pin programming header together into one assembly.

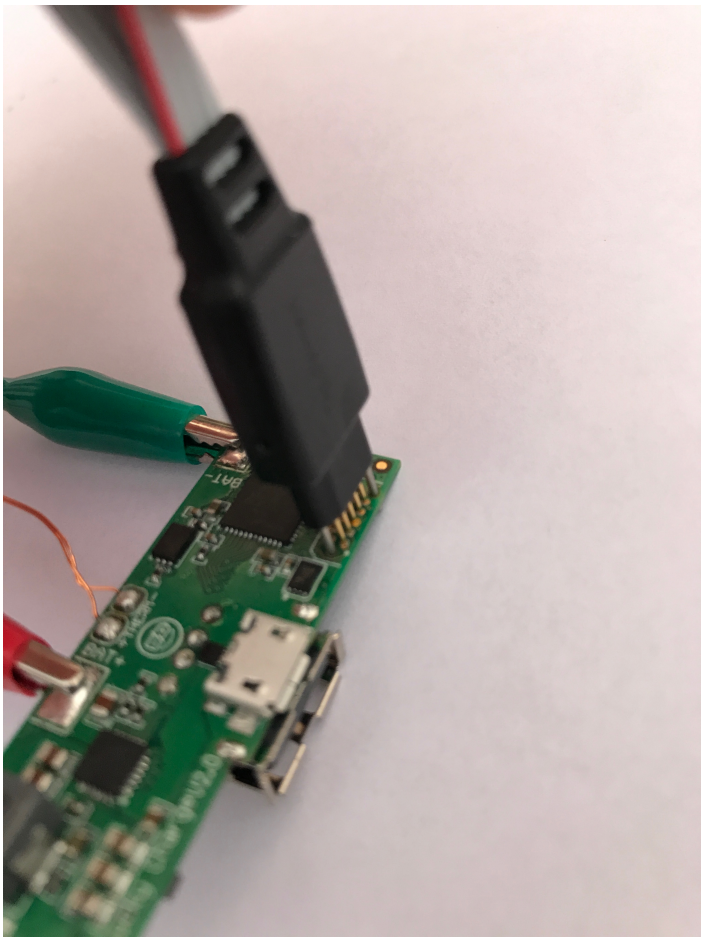
Open the hex file with the ST-LINK utility by going to File > Open.
Connect to the processor with the ST_LINK utility by going to Target > Connect.
Program the processor with the ST-LINK utility by going to Target > Program & Verify.

Additional information for the ST-LINK software is available here: https://www.st.com/content/ccc/resource/technical/document/user_manual/e6/10/d8/80/d6/1d/4a/f2/CD00262073.pdf/files/CD00262073.pdf/jcr:content/translations/en.CD00262073.pdf

The pogo pin programming header is directional with 3 Pins. It is spring loaded and presses against the pads on the PCB. The programming port can be seen in the image below.

Instructions

1. Connect the programming header to the PCBA as shown in the below image. A jig may be used to support the PCBA while holding the programmer. The programmer must be pressed firmly onto the board and held there for the duration of the programming sequence.



2. Connect the STLink software to the processor. If the processor does not connect check the programming header connection. If the processor still does not connect check that the 3.3V rail is powered as done in the previous test. If the processor still does not connect then it may be damaged or have a soldering issue.
3. Load the firmware with the STLink software. Wait for the download to complete.
4. After the download has completed disconnect the programming header.
5. At this time the blue LED lights may or may not turn on. If they do not turn on Power cycle the board by disconnecting the power supply and reconnecting it. Then press and hold the small onboard power button for a minimum of 2 seconds.
6. The blue LED lights should turn on. If they do not turn on try to reprogram the board or try to press the small onboard power button again.
7. Once the lights come on continue to the next step for the test firmware validation.

Test Firmware Validation

Test purpose

The purpose of this section is to run the board test firmware and validate it's results.

Equipment

- Power supply set to 3.7VDC with a current limit of 200mA
- 2 x Alligator clips to connect power supply to PCBA.
- Lucky charge PCBA with battery disconnected and firmware loaded.

Notes:
The test firmware is ran automatically when the board first boots. The firmware may be ran over again by powering the unit off and then powering it back up. This may be done by power cycling the board or by pressing the small onboard power button.

The micro USB cable should be plugged into the USB charge adaptor. It is used to provide power to the battery pack for charging.

Instructions

1. Power up the board and validate that all 4 blue LEDs turn on after each other. If an LED does not light up during the boot up sequence then it is likely faulty.
2. After all 4 LEDs sequence on the board will perform a self check and either display an error on the LEDs or go into its normal operating mode. An error is indicated by flashing of an error code on the LEDs as indicated in the table below. If an error code is present fail the device test and mark down the code for diagnostics and rework.

LED1	LED2	LED3	LED4	Fault	Description
Off	**Off**	**Off**	**Off**	No fault	No issues
				I2C Charger Chip	Charge chip component is not communicating or it has a GPIO issue from the MCU. Check components U2 and U3.
				Apple Authentication Chip	Apple authentication chip is not communicating. Check components U4 and U3.
				USB Output	USB output switch GPIO are not responding correctly. Check components U6 and U3.
				LED issue	Internal LED test indicates an LED may be shorted. This is not an absolute test. Check the LEDs and component U3.

3. If no error code is present the device will display the battery level.
4. If all checks pass continue to final assembly. If any checks fail, diagnose and rework the boards as required.

Final Assembly

Test purpose

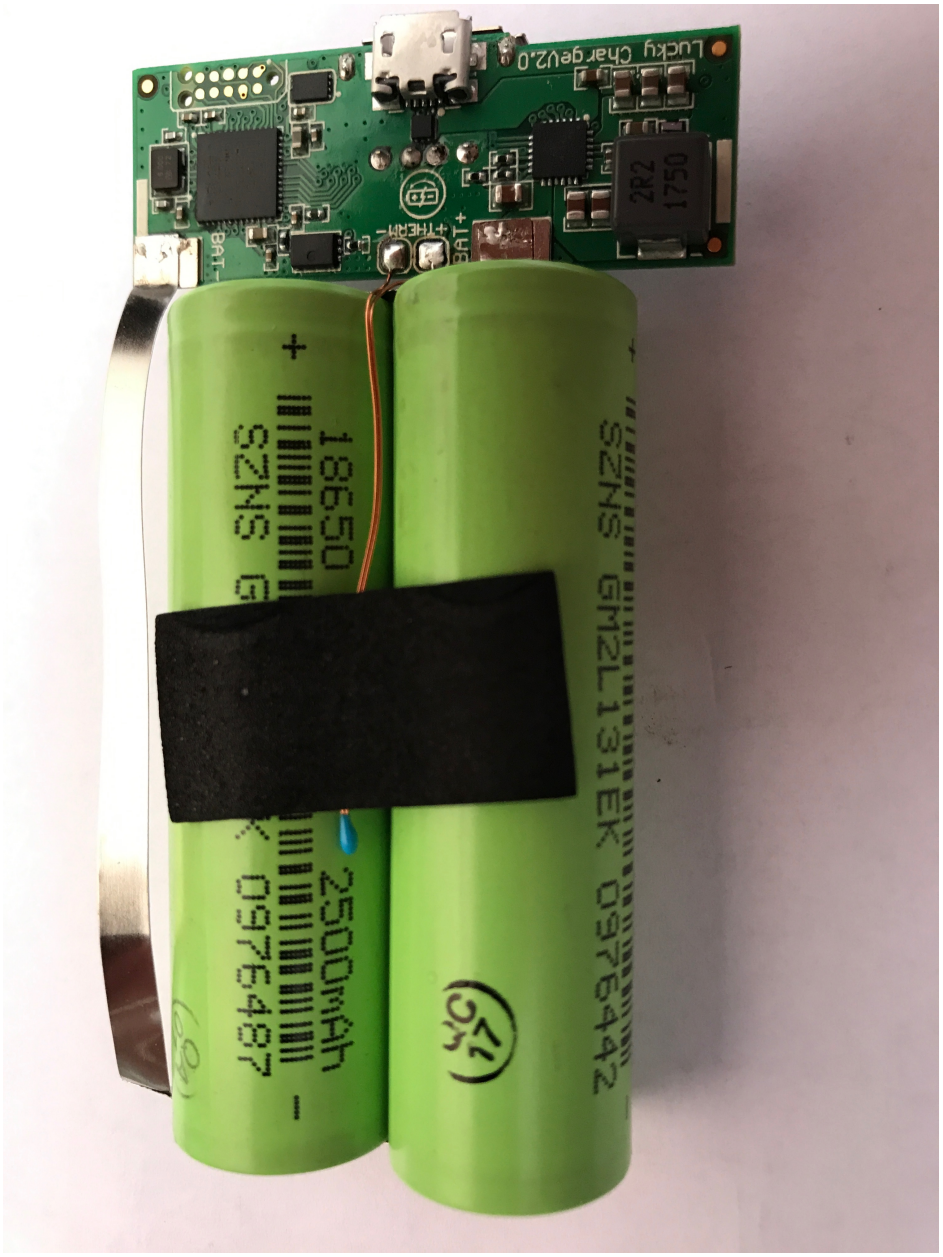
Complete assembly of the PCBA with the battery pack and final validation.

Equipment

- Lucky charge PCBA.
- Lucky charge battery pack.
- USB charge adaptor with a micro USB cable
- USB test cable (a USB cable that has been cut to expose the 5V and GND wires) This cable may include a resistive test load in parallel of 5 to 10 ohms (5W minimum).
- Multimeter

Instructions

1. Disconnect the power supply from the previous testing steps.
2. Solder the battery pack onto the PCBA. Careful this is a live circuit with high current capabilities. See image below for reference. Pay attention to the polarity of the battery pack and make sure to match it up to the PCB indication of polarity BAT+ and BAT-.



3. Position the temperature sensor between the two battery cells and secure with a piece of Kapton tape or alternative. The goal is to keep surface contact between the battery pack and the temperature sensor.

4. Hardware assembly is now complete and a final validation test will be performed.
5. Turn the board on by pressing the on board power button for a minimum of 1 second. The leds should boot and indicate the battery percentage.
6. Plug the micro USB cable into the battery pack. After 2 to 5 seconds the LEDS should begin to flash a rolling sequence. This indicates that an external charge source is detected. If the LEDs do not begin to flash their is an issue with the charge detection either due to a faulty micro USB connector or a soldering issue with the charge chip. Fail the unit for rework.
7. Unplug the micro USB connector, after 2 to 5 seconds the blue LEDs should return to displaying the battery level.
8. Plug in the USB test cable into the boards USB output port. Make sure the devices LEDs stay on when the cable is inserted. Check that the voltage output at the test cables test points is between 4.5VDC and 5.3VDC. If the voltage is out of range fail the unit.
9. If all checks pass the hardware testing is complete and the circuit board may be assembled into the final enclosure. If any checks fail, diagnose and rework the boards as required.