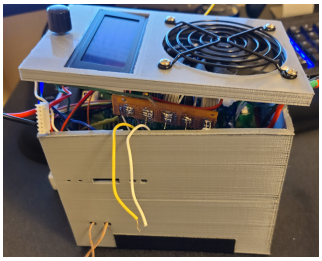
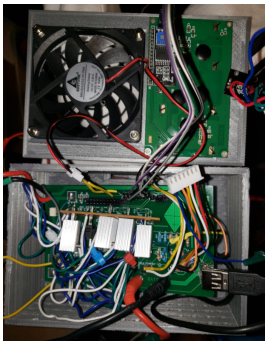
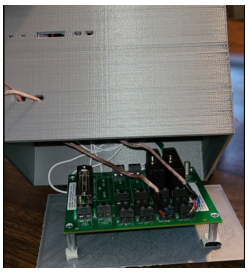
The LiPo Crew







6S LiPo Battery Charger

User Manual

DATAFORTH®

NORTHERN ARIZONA UNIVERSITY | College of Engineering, Informatics, and Applied Sciences

Introduction

We are pleased that you have chosen the Lipo Crew for your business needs. There is a strong need for lithium polymer battery chargers, as evidenced by the increasing demand for high voltage output applications in Electric vehicles. Our team provides you here a powerful system for managing the charging process that has been custom-designed to meet your needs. Some of the key highlights include Dataforth's signal conditioning unit paired with their thermocouple to provide the most accurate temperature measuring of the pack to ensure safety, user-settable fault conditions to allow you to determine when the charging will begin, how long it will charge for, and under what conditions should the charging stop. The purpose of this user manual is to help you, the client successfully uses and maintain the LiPo battery charging product in your business context going forward. We aim to make sure that you can benefit from our product for many years to come!

As the demand for high output voltage applications in portable situations increases, so will the need for the maintenance of the most effective battery chemistry type. In the case of EV's the most popular type of battery chemistry is the lithium polymer, this is due to their high energy density and have a high power-to-weight ratio, high energy efficiency, good high-temperature performance, and low self-discharge. Although that chemistry performs the best, it comes with dangers that require special attention to the instability of the battery cells themselves. To maintain the stability and longevity of the battery, our team chose to have multiple checks around the system to maintain the safety of the user. For example, specific lines of code in the charging algorithm were made to implement and ensure we could control when the battery charges in the constant voltage phase or when it should enter the constant current phase. Another way in which we check for a safety hazard is checking the temperature of the battery pack itself using Dataforth's signal conditioning unit along with their thermocouple to ensure accuracy of temperature. These were both made possible through the use of the MSP430 in which handles all of the communication between the temperature sensors and will cut off or reduce voltage and current as necessary.

Our team broke up the project into four main subsystems in which we worked on in pairs. The first subsystem covered the charging algorithm which was strictly software orientated. This system was crucial for the success of the project because it controlled when the battery would receive a charge, the rate of charge, and the time of charge. Due to safety concerns, we took the average of all the cells, and if the average was over 4.0V the charging algorithm would stop the constant current phase and switch to constant voltage for the last stage of charging. The second subsystem consisted of a thermal system in which two thermocouples, along with the signal conditioning unit provided by our client, communicate to the MSP430 their temperature reading of the battery pack. This information is then taken and used to generate the average of the two individual temperature readings to account for any fluctuations in their respective readings. Conveniently the average temperature of the battery pack is then displayed onto the LCD on a timed interval and displayed for five seconds every other 5 seconds. The third subsystem is the

battery charging circuit which utilized LM317T voltage regulators to provide the constant current and constant voltage charge to the battery. By using 2 regulators our system can output a current of 2.35A for our constant current charge. The system's constant voltage output utilized a single regulator to output a total of 25.2V of charge voltage to the battery. The final subsystem references the user interfacing software and hardware as described in the user manual under "Configuration and use." In terms of hardware, an LCD and rotary encoder are used for the user interface. As the LCD displays the information the rotary encoder is used to navigate the screens options. For the software portion of this subsystem, it allows for user-settable fault conditions and alarms as well as a battery status indicator for user coherence.

Product Features

- 6S battery balance port plug
- Main charging port plug
- 5 V DC regulated fan
- LCD w/ rotary encoder
- Battery Discharge Port
- Alclorol 30V 10A power supply
- MSP430FR6989 Microcontroller for charge control/algorithms
- LM317 voltage/current regulation
- 2 x Thermocouples with signal conditioning unit
- DW01A battery protection IC

Specifications

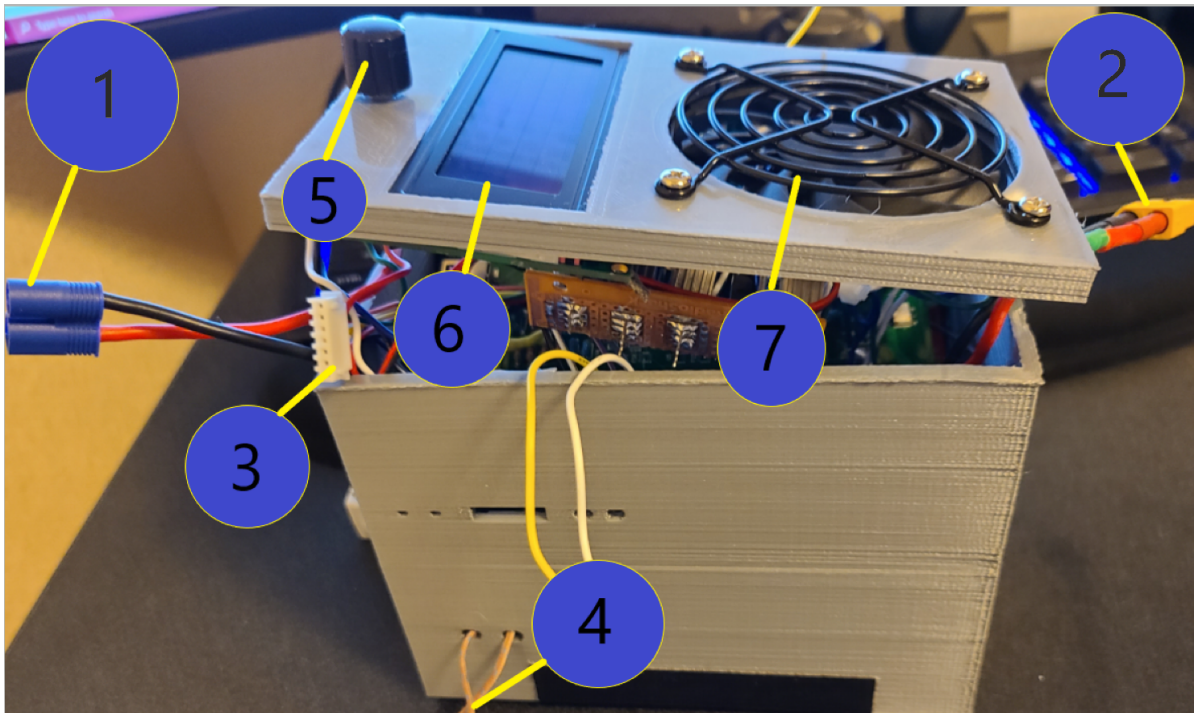
Size: 160 x 109 x 110mm
Battery Chemistry: Lithium Polymer (LiPo) ONLY
Battery Cells: Constructed for 6S batteries ONLY
Power supply input: 115V AC
Power supply output: 25.8V DC
Output Wattage: 38.7W
Charging Voltage: 25.2V
Charging Current: 2.35A (1250 - 1300mAh batteries)
Overdischarge Voltage: 3.8V
Overcharge Voltage: 4.2V
Overcharge current: 125mA

Safety Instructions

1. For indoor use only.

2. Do not use any power source that does not have a legal manufacturing license.
3. Use only 6S Lithium Polymer Batteries. No other battery chemistry or cell count will be compatible with this device.
4. Be sure to plug the battery into the charge ports before applying the power supply.
5. Recommended use of a LiPo battery fireproof safe bag while using this product.

Components



[1] Main battery plug **[2] Power supply connector** **[3] Battery Balance Port**

[4] 2 x Thermocouples **[5] Rotary Encoder** **[6] LCD** **[7] 5V DC Fan**

Installation

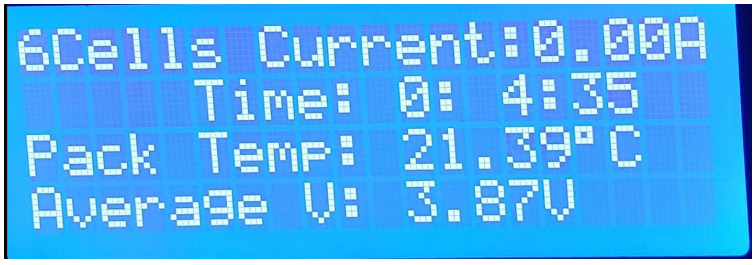
1. Before starting, verify that the power supply [2] is not connected to the product.
2. Connect a healthy 6S LiPo battery to the balance port [3] and the main battery plug [1].
3. Connect your power supply output coms to the power supply connectors [2].
4. Plugin the 25.8V power supply to a US 115V AC outlet.

5. Upon startup, the LCD [6] will flash on and the device is ready to be used.

Configuration and Use

1. Power On
    1.1. The LCD [6] will turn on and asks to “Enable Fault Condit:”
        1.1.1. Using the Rotary encoder [5], twist clockwise or counterclockwise to navigate through the two available options; “Yes” or “No.” Press the rotary encoder firmly to select the desired option.
        1.1.2. If “Yes” is selected: On the next display, temperature tolerance levels on the battery can be set between 40 - 45℃.
            1.1.2.1. The last display will allow for the total charging time to be set between 5 - 60 minutes.
        1.1.3. If “No” is selected: On the next display, “Temperature” will be set at a default temperature of 45℃ with a default charge time of 60 minutes.
2. Charging
    2.1. As soon as the fault conditions have been set the charging process will activate.
    2.2. During the charge, the LCD will display the two screens shown below [1] and [2].
        2.2.1. Display 1, will show the voltages of each cell, how many cells are connected, and the *current (non-functional). This screen will be displayed for 6 seconds before switching to [2].
        2.2.2. Display 2, will show the overall time of charge, the pack temperature, the number of cells connected, the average voltages of the cells, and the *current (non-functional). This screen will be displayed for 6 seconds before switching to [1].

[1] Display 1



[2] Display 2

3. Fault Conditions, Battery Fully charged, and Extra Displays.
    3.1. The “Connect Battery” [3] fault condition will trigger for circumstances where the battery is disconnected, not connected properly, or if a cell voltage is detected to be ≤ 3.0V.
    3.2. The battery fully charged display shown in [4] will trigger when the battery is determined to be fully charged. This will occur when one cell reaches 4.2V.

3.2.1. This screen can also be triggered if the battery charge time limit has been met even if the battery is not fully charged.

3.2.2. If this screen [4] is shown you may now safely remove the battery from the charger.

3.3. The “Temp Limit Reach, CC & CV Disabled” will be displayed when the temperature falls outside the temperature range limits of 40 - 45℃.

[3] Connect Battery

[4] Battery Fully Charged

Maintenance

Please read the user manual carefully before operating this device. This product is only intended to be used as a 6S LiPo battery charger. Any other battery cell counts or battery chemistries can and will result in multiple safety hazards such as battery explosions, fires, destruction of the product, user harm, dismemberment, and even death.

As of now due to the multiple grounding errors that occurred when implementing our PCB to our design the product, as it stands, is fully functional without any battery protection or battery balancing and we DO NOT recommend connecting ANY type of faulty or unhealthy battery for any reason. Please connect only brand new or pre balanced 6S LiPo Battery packs to this device. Before proceeding with the operation of this product all wires and batteries must be routed correctly to avoid unnecessary shorts in the circuit. Furthermore, to preserve the integrity of the device, avoid damage to the product’s external and internal features. This product must also be dry at all times and be kept in a room-temperature environment. The LiPo Crew also recommends the use of the Alclorol 30V 10A power supply when using this product.

Troubleshooting

1. If a system reset is needed, a simple disconnection of the power supply from the outlet or the product will reset the entire charger.
2. If any errors still persist, disassemble the top cover from the main product and check that all of the metal contacts on the wires are not touching.
3. For charging and display errors use the MSP430 Code provided and reconfigure the code using Code Composer Studio software.

User Manual Conclusion

The presented 6S LiPo battery charger was designed and manufactured by the LiPo Crew. The team's final design, however, is fully functional without any battery balancing or protection due to the initial grounding and tracing errors on our PCB. Although the battery may not have any protection,operation of this device is still achievable with a brand new, healthy, and/or pre balanced 6S LiPo battery pack..

Overall, our product uses high-end products, of which the majority was provided by Dataforth Corporations in-house inventory. With Dataforth being a world-leading data acquisition and signal conditioning unit, their products allow for high accuracy, great efficiency, and true reliability within our battery charging design.

Again, the purpose of this user manual is to help you, the client successfully uses and maintain the LiPo battery charging product in your business context going forward. The LiPo crew's goal is to provide a safe and efficient 6S LiPo Battery charging system and this product when in full working condition, accomplishes that goal. In the end, please read each section of this user manual carefully before operation for your safety and satisfaction is our top priority.