
# HEATED BATTERY

## USER MANUAL

Revision: 1.0

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2023

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# RECORD OF REVISION

| Revision No. | Description | Date |
|---|---|---|
| 1.0 | First official release | 20.04.2023 |
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# TABLE OF FIGURES

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# 1 SAFETY NOTICE

Carefully read these safety instructions and warnings prior to using, discharging or charging the batteries. Lithium Polymer batteries are volatile. Failure to read and follow these instructions may result in fire, personal injury, or property damage.

By purchasing and using this battery, the buyer and user assumes all risks associated with this product. Manufacturers, distributors, and retailers assume no liability for any bodily injury(s) and/or property damage that may occur when failing to comply with the warning and safety guidelines in this manual.

This product is to be used only by EOS C personnel that have successfully graduated from the training course and are qualified to operate the EOS C system.

# 2 WARNINGS, CAUTIONS, AND NOTES

UAVs of any kind are dangerous and can cause severe injury. Please read, understand, and follow the instructions.

Throughout the manual warnings and cautions are used to highlight various important procedures. They are defined as:

**⚠ WARNING**

**AN OPERATING PROCEDURE, INSPECTION, REPAIR, OR MAINTENANCE PRACTICE, WHICH IF NOT CORRECTLY FOLLOWED, COULD RESULT IN PERSONAL INJURY, OR LOSS OF LIFE.**

**CAUTION**

AN OPERATING PROCEDURE, INSPECTION, REPAIR, OR MAINTENANCE PRACTICE, WHICH IF NOT STRICTLY OBSERVED, COULD RESULT IN DAMAGE OR DESTRUCTION OF EQUIPMENT.

**NOTICE**

An operating procedure, inspection, repair, or maintenance condition or action, etc., which is deemed essential to highlight.

# 3 BATTERY

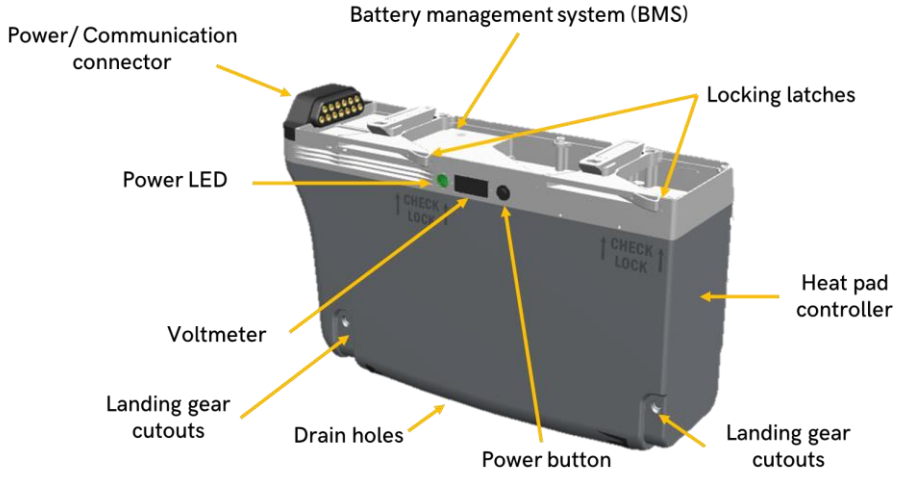



Figure 1 Battery

| | |
|---|---|
| Part number | 118113 |
| Dimensions | L: 273mm W: 87,4mm H: 1172mm |
| Weight | 4 kg |
| Battery Pack Configuration | 6s1P |
| Nominal capacity | 32 000 mAh @ 0.5 c Discharge |
| Maximum voltage | 26.1 V (cell 4.35 V) |
| Storage voltage | 22.8 V (cell 3.8 V) |
| Charging time (10A charger) | 3-4 hours |
| Charging time with pre-heat (10A charger) | 3-6 hours |

Before handling the battery, verify that the power LED is off! The heated battery can be charged with both chargers: with pre-heating (Part number 118433) and without pre-heating (Part number 106965 and 115470) functionality.

## 3.1 POWER/ COMMUNICATION CONNECTOR

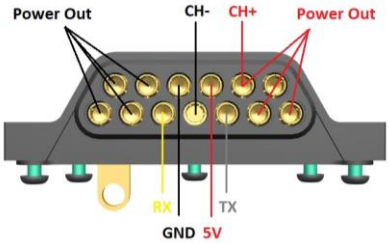



Figure 2 Power/ Communication connector

- Power to the aircraft (Power out)
- Charging input (CH+/CH-)
- Communication pins (BMS, heat pad controller, and aircraft: RX, TX, 5V, GND)

## 3.2 POWER LEDS

The power LED indicates the state of the battery output. When the power LED is GREEN, the battery output (BMS) is live. The power LED will be automatically activated when the charger is connected and will not turn off until the charger cable is disconnected from the battery.

To power on the battery, press and hold the button for more than 3 seconds until the power LED turns GREEN. To turn the battery off, push and hold the power button for more than 3 seconds until the LED turns off.

Never leave the battery (BMS) on when not in use (LED GREEN).

**⚠ CAUTION**

NEVER CONNECT THE BATTERY TO THE AIRCRAFT WITH THE BATTERY IN THE ON STATE (LED IS GREEN), AS POSSIBLE DAMAGE TO THE POWER CONNECTORS CAN OCCUR.

THE CHARGER CAN BE CONNECTED TO THE BATTERY WHEN THE BATTERY IS ON (OUTPUT IS LIVE AND POWER LED IS ON), BUT THIS IS NOT ADVISED.

After removing the battery from the charger, check that the power LED switches OFF. If the LED does not switch OFF, then press the button and hold to turn it OFF manually. If a night flight is required, the power LED can be covered with tape, but additional care should be taken to ensure the battery is powered. After landing, remove the tape again.

During charging the status of the LED is as follows:

| | |
|---|---|
| Power LED blinking | Battery heating is switched off or the battery does not support heating. |
| Power LED is permanently ON | Heating is activated |

## 3.3 STORAGE MODE

When the battery has not been used or charged for 6 days, the battery will automatically go into storage mode. The battery will automatically be discharged to its long-term storage levels.

**NOTICE**

Do not leave batteries in the charging case for discharging. It will shorten battery life.

## 3.4 VOLTMETER

The voltmeter indicates the voltage of the battery. To display the voltage of the battery, press the power button for less than 3 seconds. The voltmeter is a fast indicator to show if the battery is full (26.1 ± 0.2 V) or if it is in storage mode (22.8 ± 0.2 V).

## 3.5 POWER BUTTON

The power button will enable or disable the battery power output as well as indicate the voltage of the battery. The press button logic is as follows:

| Action | Description |
|---|---|
| Press and hold the power button for more than 3 seconds while the battery is turned off. | BMS and heat pad controller is enabled, the output becomes live, voltmeter and Power LED indicator turns on. |
| Press the power button for 1 to 3 seconds while the battery is turned off. | BMS enables only the Voltmeter. The power output remains off. |
| Press and hold the power button for more than 3 seconds while the battery is on. | BMS, battery output, voltmeter, and Power LED turns off. |

## 3.6 BATTERY MANAGEMENT SYSTEM (BMS)

The BMS measures the voltage of each cell and controls its load.

Also, it reads the data of the 3 temperature sensors (located inside the battery). BMS will discharge a fully charged battery to its storage mode, if not used for 6 days.

Storage mode voltage = 22.8± 0.2 V

## 3.7 HEAT PAD CONTROLLER

The heat pad controller controls the battery's internal heat pad. The battery has 3 internal heat pads between the cells as well as a temperature sensor. The heat pad controller performs heat pad checks every 90 seconds, where it heats each pad for 10 milliseconds and verifies if that pad consumes at least

20W when switched on. The user can preheat the battery only using the charger. The preheating goal temperature is 40°C.

When charging the battery, the charger will automatically preheat the battery first if the preheating button is turned ON.

Preheating consumes 100W of power.

During the flight, the heat pad controller is monitoring the battery cells' temperature. It will activate the heating once the cell's temperature drops lower than 18°C.

If the battery is connected to the aircraft with the cells temperature below 18°C, the controller will heat it back up to 18°C.


A battery with an inner temperature lower than 18°C will heat up itself using its own energy, which will reduce the overall flight time.

# 4 CHARGER

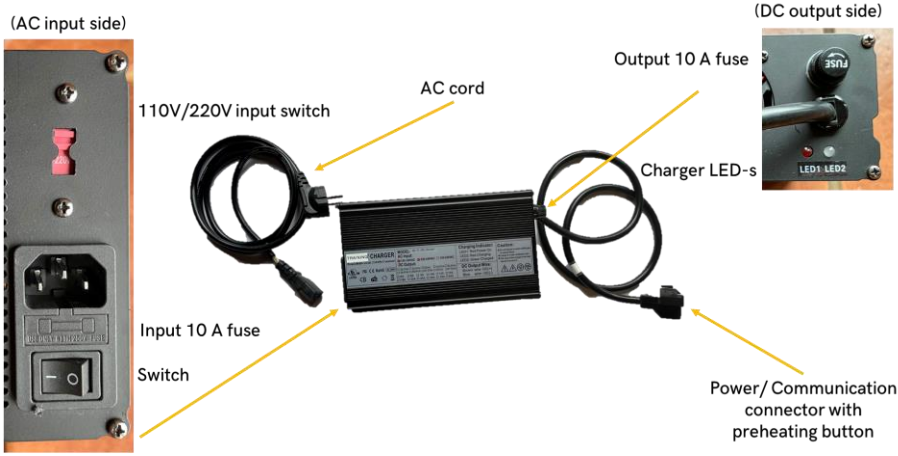



Figure 3 Charger

| | |
|---|---|
| Part number | 118433 |
| Input AC voltage | 110/220 Volts |
| Output DC voltage | 26.1 Volts |
| Power consumption | 260 Wats |

A charger is used to preheat and charge the battery. A charger with a preheating function can also be used with batteries that do not have preheating features.

# 4.1 POWER/ COMMUNICATION CONNECTOR WITH PREHEATING BUTTON

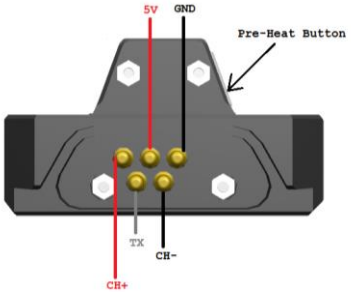



Figure 4 Charger connector with pre-heat function

The charger connector has a preheat button. To use the preheat function, the preheat button must be powered ON. To check preheat button status, the charger needs to be powered ON.

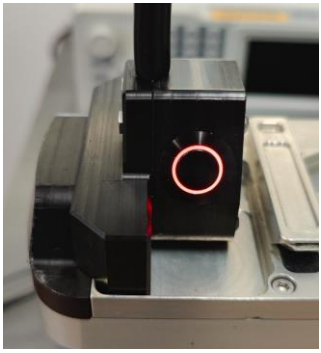


Figure 5 Charger connector pre-heat button

The charger connector preheat button LED is red -> preheat is ON.

The charger connector preheat button LED is OFF -> preheat is switched OFF or the battery does not have heating.

**NOTICE**

Pre-Heat will automatically turn itself OFF after 6 hours of Charging/Heating. If the battery is fully charged and preheat is enabled, the heater will continue heating the battery for 6 hours. If the battery is empty (3.3v Per cell) the battery will be charged for 4-5 hours and will preheat the battery 6 hours from the start of the charge.

## 4.2 CHARGER LEDS

The charger has 2 LED lights. LED 1 (red) indicates that the charger is powered ON. LED 2 (green or red) indicates if the battery is full (green) or is being charged/preheated (red).


Figure 6 Charger LED-s

# 5 CHARGING PROCEDURE

## 5.1 BEFORE CHARGING/ DISCHARGING

1. Inspect the battery for any damage. Do not charge a damaged battery.
2. Inspect the battery for battery fluid leaks. Do not charge a leaking battery.
3. Inspect the voltage for each battery cell after the flight from GCS. If the cell voltage is significantly lower than the normal voltage (3. 3V per cell) or the voltage of each cell has more than a 1V difference, the battery may be in defective condition. Do not charge the battery (contact support@threod.com)
4. Verify the lithium polymer charger is in good condition.

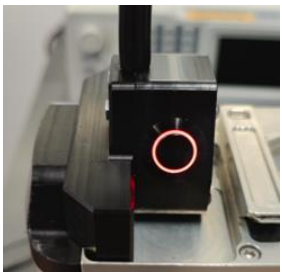
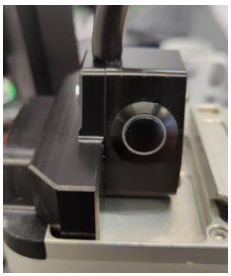
## 5.2 CHARGING/ DISCHARGING THE BATTERY

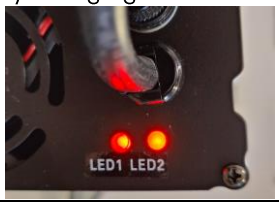
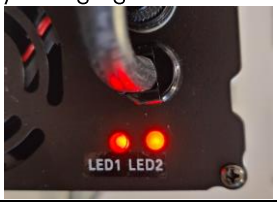
**⚠ CAUTION**

FOLLOW THE INSTRUCTIONS TO SETUP THE CHARGING STATION. FAILURE TO DO SO MAY CAUSE A FIRE, WHICH MAY RESULT IN SERIOUS PERSONAL INJURY AND PROPERTY DAMAGE.

1. The horizontal clearance radius for the charging area should be at least 2 m.
2. Never leave a battery totally unattended while charging (for instance overnight).
3. Ensure there are no combustible materials near the charging area.
4. In case of fire disconnect the electrical cable from the electrical outlet immediately.

# 5.3 CHARGING STEPS

| | Battery with pre-heating | Battery without pre-heating |
|---|---|---|
| 1 | Connect the charger to the AC outlet. | Connect the charger to the AC outlet. |
| 2 | Power ON the charger  | Power ON the charger  |
| 3 | Ensure the charger is operating normally:<br>LED1 – RED - Charger Power ON<br>LED2 - Green Not Charging   | Ensure the charger is operating normally:<br>LED1 – RED - Charger Power ON<br>LED2 - Green Not Charging   |
| 4. | Press the pre-heating button on the charger's connector (if required). The button LED will turn RED.  The BMS power LED is ON. | Press the pre-heating button on the charger's connector (if required). The button LED must remain OFF.  BMS power LED flashes with 1-second intervals. |

| | | |
|---|---|---|
| 5. | Battery charging<br>  | Battery charging<br>  |
| 6. | Battery fully charged:<br>Charger LED 2 may flash between Colors (RED & GREEN), or stay permanently GREEN.<br>  <br>The charger cooling fan may work occasionally.<br>Verify the battery voltage by pressing the power button for 1-3 seconds.<br>  <br>BMS LED will always be permanently ON. | Battery fully charged<br>  <br>The charger cooling fan will stop working.<br>Verify the battery voltage by pressing the power button for 1-3 seconds.<br>  <br>BMS power LED Flashes with 1-second interval. |
| 7. | Remove the charger cable from the Battery.<br>Battery BMS LED turns OFF immediately.<br>  | Remove the charger cable from the Battery.<br>Battery BMS LED turns OFF immediately.<br>  |

## 5.4 DISCONNECTING THE CHARGER

1. Remove the Power/ Communication connector from the battery.
2. Check if the power indication LED is OFF. If needed, do it manually.
3. Switch OFF the charger.
4. Disconnect the charger from the AC outlet.

## 5.5 BATTERY BALANCING

Over time and usage, batteries can go out of balance. It is allowed to balance the battery with a cell voltage difference of 0.06 up to 0.2 Volts. If balancing is needed, follow the steps:

1. Disable battery heating functionality if available.
2. Write down the initial battery voltage.
3. Connect the battery to the charger, write down the start time.
4. Charge for 8h.
5. After 8h disconnect the battery charger, write down the end time.
6. Check and write down the battery voltage.
7. Wait for at least 2h or continue the next day.
8. Connect the battery to the charger and keep it until fully charged.
9. Write down the battery voltage after charge.
10. Check battery balance with the "Battery Insider" application.

# 6 STORAGE PRECAUTIONS

1. Constantly check the condition of the battery (battery voltage 22.2-23.4V) inside the storage container at least once a month. Do not leave the battery unattended for longer than 3 months.
2. Do not put any combustible materials close to the storage container.
3. Store batteries in a location at the temperature of 20°C ±5°C with humidity of 65% ±20% only.
4. Verify the battery is in good condition before storage.

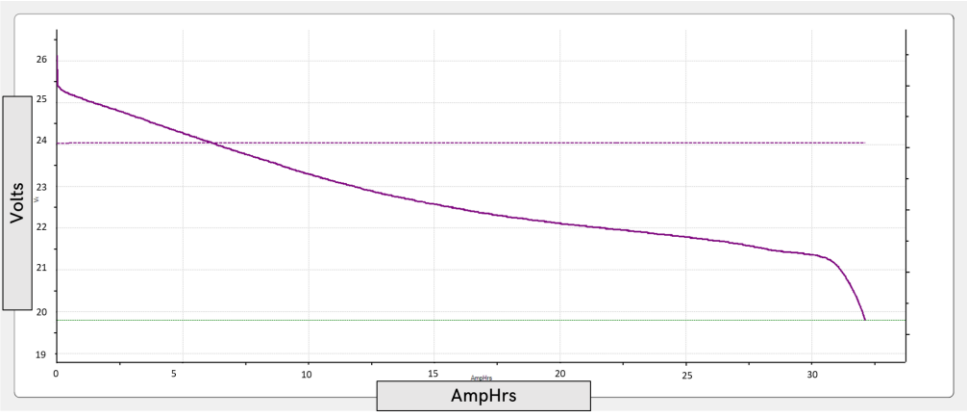
# 7 LITHIUM POLYMER BATTERY WARNINGS

1. Never charge a lithium polymer battery with a charger designed for NiCd, NiMH, or any other type of battery chemistry. Use ONLY the charger provided by Threod Systems. Failure to do so may cause premature battery degradation or start a fire, which may result in personal injury and/or property damage.
2. Battery charging and observation should occur in an isolated safe location.
3. Inspect the battery before charging/discharging, and the storage process. Check for damage, leaks, broken connectors, and swollen batteries. Check the battery voltage. Normal cell voltage should be between 3.3 - 4.35 V per cell. If the voltage is significantly less than the normal voltage (less than 3.3 V per cell), do not charge/discharge the pack.
4. Do not use batteries that lost 30% or more of their capacity.
5. Do not leave LiPo (Lithium Polymer) batteries unattended during the charging/discharging process. During the charging/discharging process, the user should monitor the process constantly and react to potential problems that may occur.
6. Do not continue to use damaged batteries. Damaged batteries should be disassembled. Follow the steps in the paragraph0. BMS and battery shells can be reused (contact support@threod.com). Send damaged batterie cells to a certified recycling and disposal facility as soon as possible.
7. After the flight, allow the battery to cool down to below 30°C before charging! Never exceed 60°C during the charging/discharging process.
8. Short-circuiting the battery can cause fires! If the battery was accidentally short-circuited, the battery needs to be placed in a safe area for observation for approximately 30 minutes.

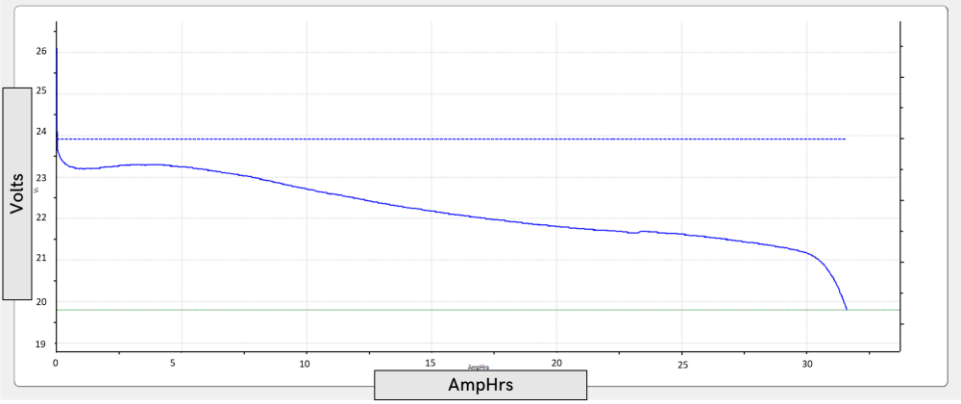
9. Never perform any modification on the battery!
10. Use the battery with care and avoid puncture to the battery. Puncturing a LiPo battery will cause a fire.
11. Never store the battery pack inside a vehicle if the internal temperature exceeds 48°C.
12. Never expose a battery to direct sunlight or heat for extended periods of time. Exposing batteries to temperatures greater than 60°C for an extended period (more than 30 minutes) may result in damage to the batteries and fire.
13. In case of a crash, remove the battery and carefully inspect the battery for any damage. The battery should be placed in a safe area for observation for at least 30 minutes after a crash. If there is any damage to the battery, safely dispose of the battery.
14. Do not expose LiPo cells to water or moisture at any time.
15. Do not assemble LiPo cells or pre-assembled packs together with other LiPo cells or packs.
16. Always store LiPo batteries in a secure location away from children.
17. Do not allow the electrolytes to get into contact with the eyes or the skin. Wash affected areas immediately if they came in contact with electrolytes. Do not alter or modify the connectors or wires of the LiPo battery pack.
18. Do not have contact with a leaky/damaged battery directly.
19. Do not charge/discharge the battery outside of the recommended temperature range (Charge: 0C to 43C degrees; Discharge: 0C to 60C Degrees)
20. Do not continue the charging/discharging process, if at any time you witness a battery starting to swell up, stop the charging/discharging process immediately! Disconnect the battery and place it in a safe observation area for approximately 30 minutes. Continuing to charge a battery that has swollen may result in a fire.

# 8 PERFORMANCE DATA

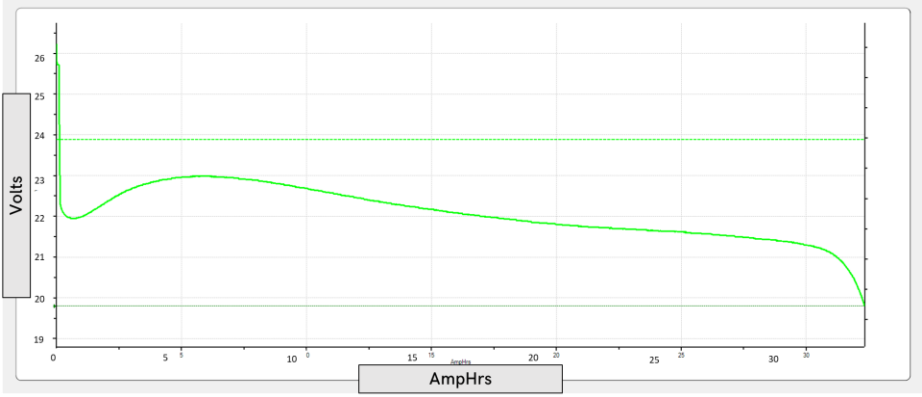
1. Discharging with 40A [ambient temperature +40°C]. Voltage Drop 26v-25.4v (0.6V).



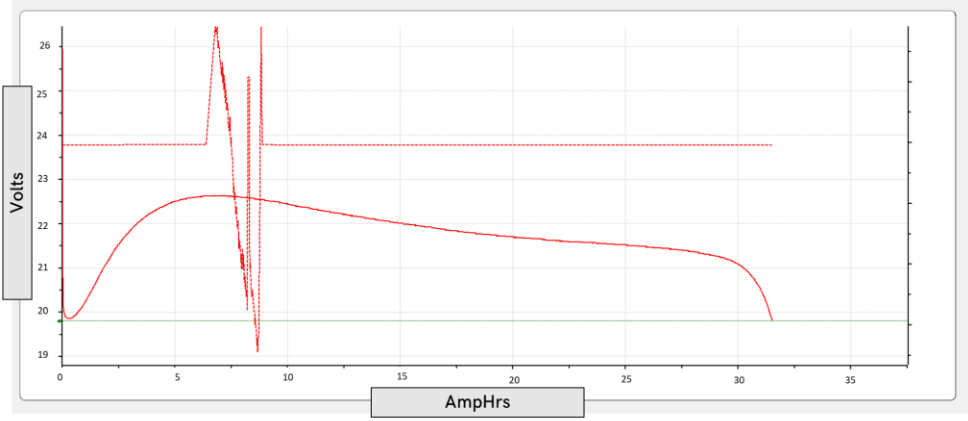

2. Discharging with 40A [ambient temperature 0°C]. Voltage Drop 26v-23.2v (2.8V).



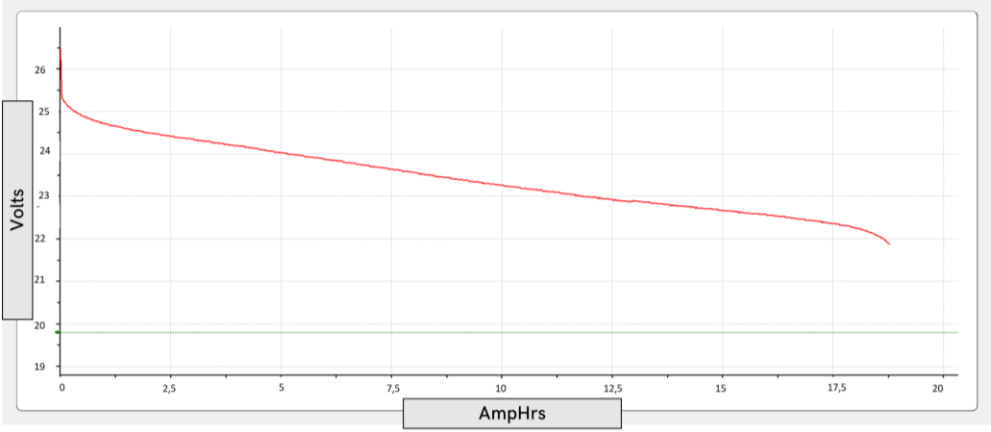
3. Discharging with 40A [ambient temperature -10°C]. Voltage Drop 26v-22v (4V).

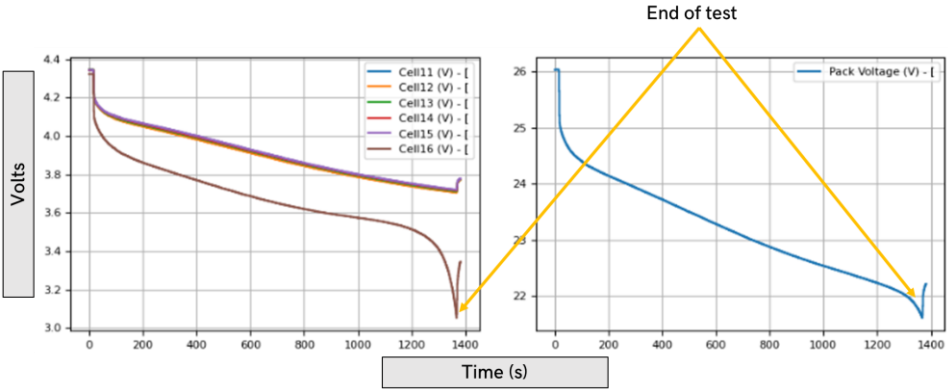



4. Discharging with 40A [ambient temperature -20°C]. Voltage Drop 26v-20v (6V).



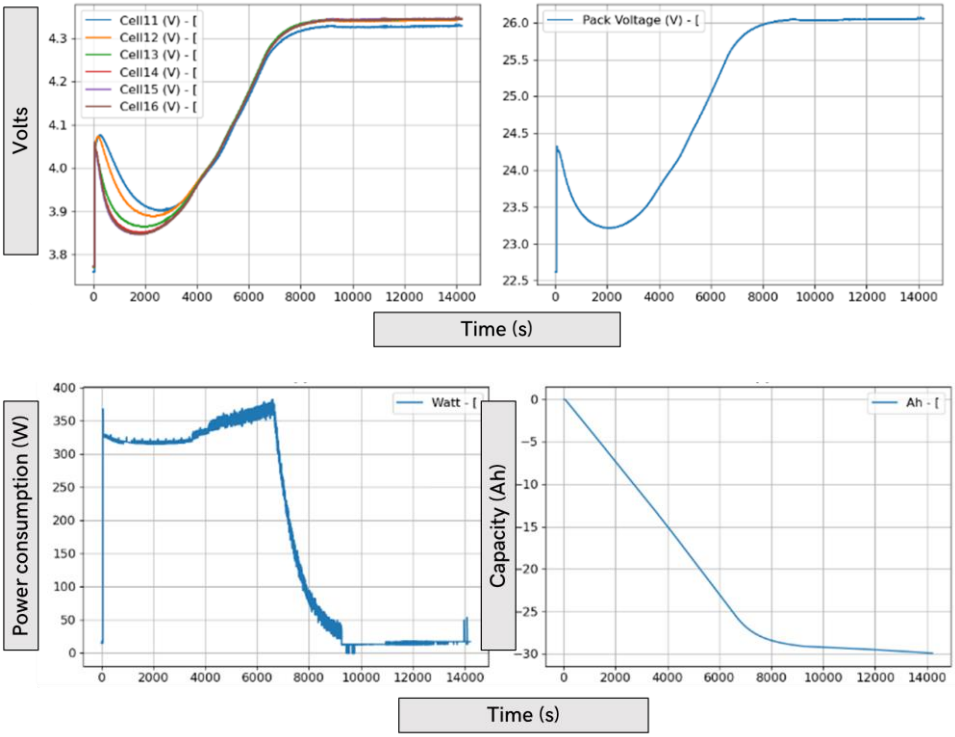
5. Cell difference error [constant 50A discharge, 22°C room temperature, 1+ year old battery]



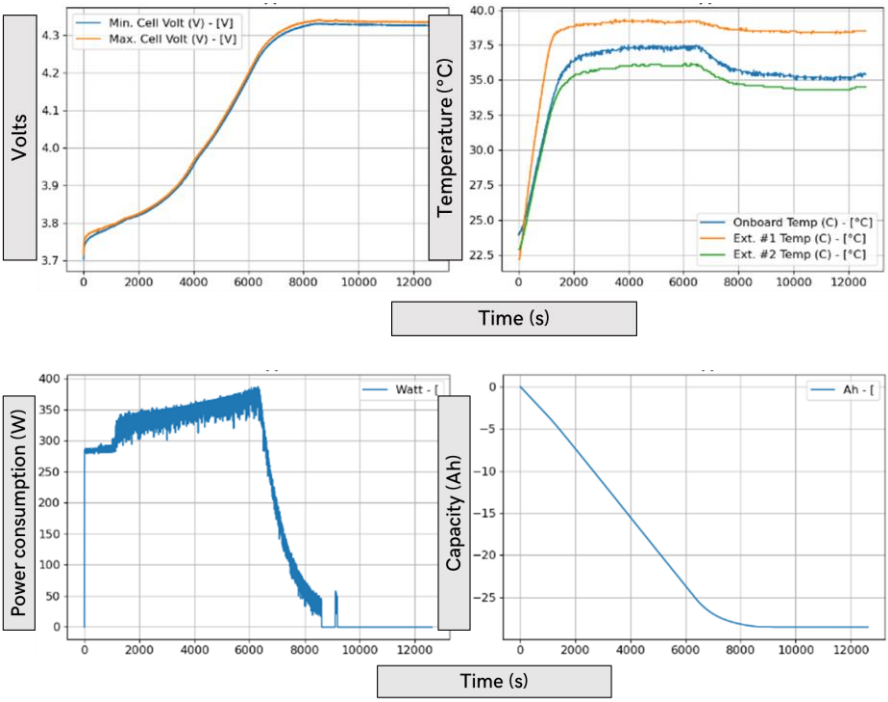

More than a 0.2V difference between cells can lead to a fatal crash. The safe capacity to use was no more than 17Ah.

6. Preheat, charge 0-100% [-15°C to +40°C]



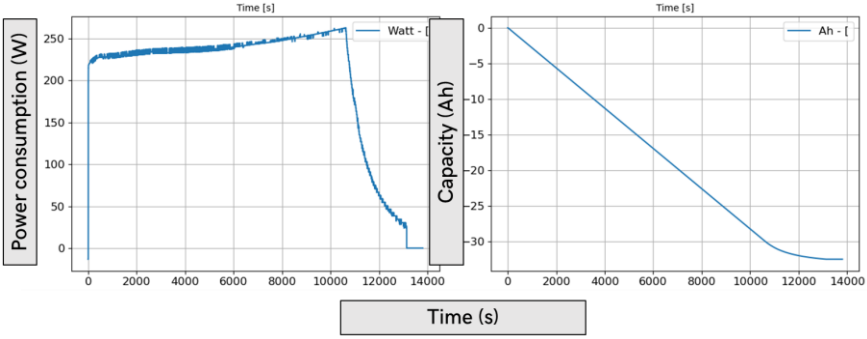

Charging between -15°C…40°C takes 66 minutes to Pre-Heat. 2… 3.5A will be consumed by the pre-heating (20%-30% of the charging current will go to preheat for the first 60+ minutes). Loss of flight capacity may be around 6% or more.

7. Preheat, charge storage to full (3.7 to 4.35 V) [In room temperature]



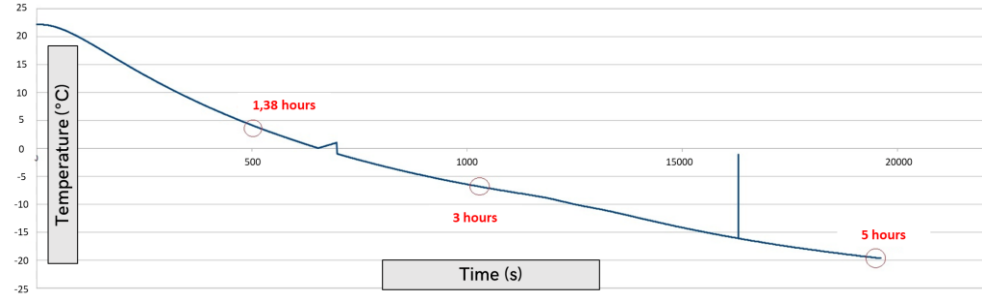

Storage to full battery with Pre-Heat enabled takes 2.22 hours (22°C to 40°C with 15A charging current). Average charging is 330 Watts.

8. Battery charging without Pre-heat (3.3 to 4.35 V) [In room temperature]




Average consumption 220-265 Watts. Charging battery from empty to full takes 3h 36min.

9. Battery cooldown without consumption [ambient temperature -30°C].

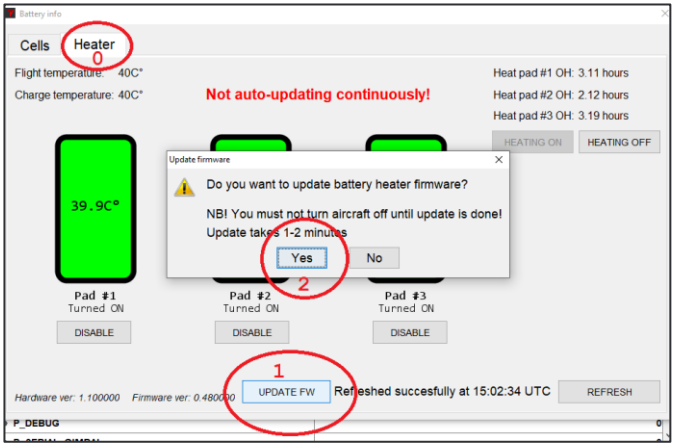


# 9 FIRMWARE UPDATE

1. Unzip the following two files from the "batheat ver.XX.zip" into the Autopilot SD card:
   batheat.crc
   batheat.img

If these files are already in SD Card overwrite both the files.

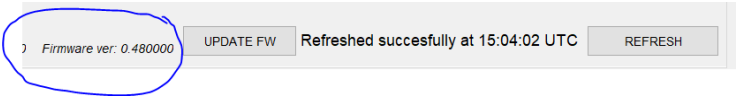
2. Insert the SD Card into the aircraft and close the SD card hatch.
3. Power ON the aircraft and create connection.
4. Open the GCS software and open the Battery window.
5. Open Heater and then click UPDATE FW



6. Wait for the monitor notifications window, which will show "CAN Component 150 not responding". Wait for 1 to 3 minutes to see if the update was successful. It will be mentioned in the yellow highlighted message.


7. If the Update was successful, reboot the aircraft and create a connection again.

The firmware version number (batheat ver.XX) will be shown in the GCS battery heater tab.



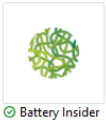
# 10 BATTERY INSIDER

The Battery Insider application allows access to the Battery Management System (BMS). With the Battery Insider software t is possible to inspect the battery. Use the BMS access cable (part number 109755) to connect the BMS with Battery Insider.

Figure 7 BMS access cable

Follow these steps to connect:

1. Connect the BMS access cable to computer.
2. Start the Battery Insider application.




3. Connect the BMS access cable to the battery.

**CAUTION**

DO NOT CHANGE ANY VALUES IN BMS WITHOUT THREOD SYSTEMS PERMISSION (CONTACT SUPPORT@THREOD.COM)!

The "Live Data" window tab shows the current state of the battery.

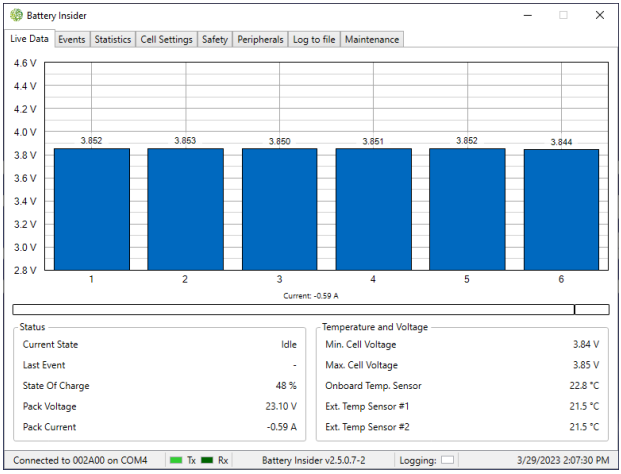



Figure 8 Battery Insider Live Data

The "Events" tab shows warnings and faults. If the Ground Control Station (GCS) is notifying the operator about the BMS, more detailed info is available here. To check these events, power OFF the battery on the aircraft. Disconnect the battery from aircraft and connect it to the computer with BMS access cable. Open the "Events" tab.

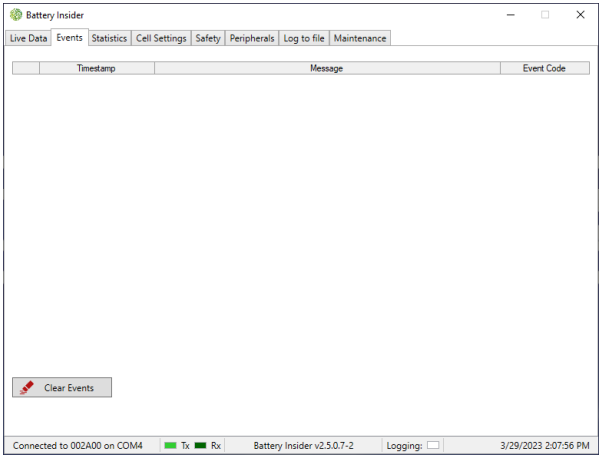



Figure 9 Battery Insider Events window

After connecting or disconnecting an external current sensor (e.g. battery cells) to BMS, it may undergo an incorrect state (e.g. Under-Voltage Fault after the initial connection of the cells).

To recover the BMS from the incorrect state, a BMS restart (under "Maintenance" tab) is required.

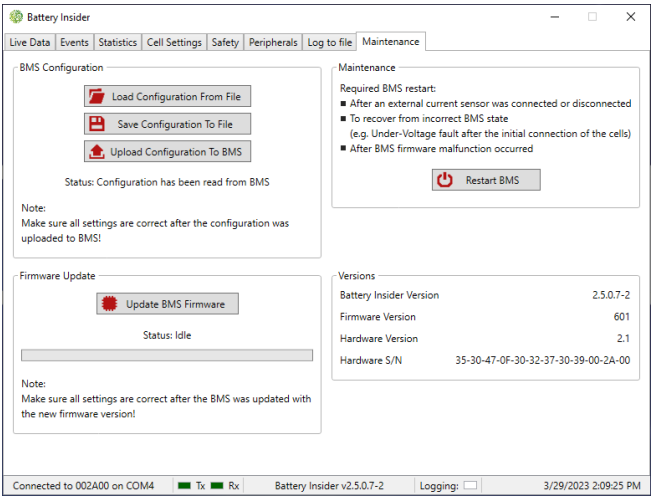
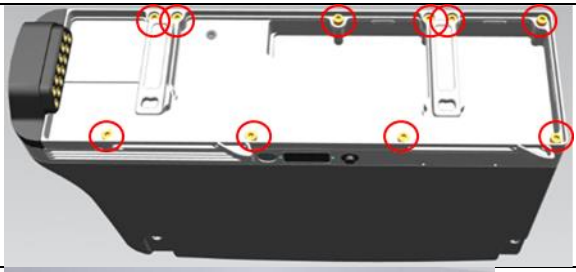
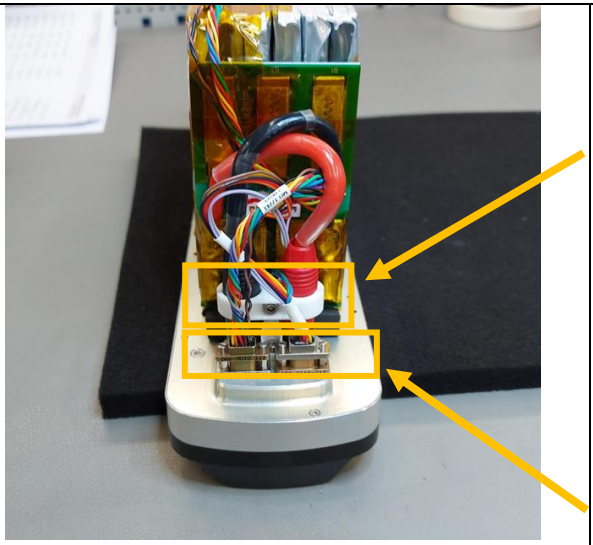
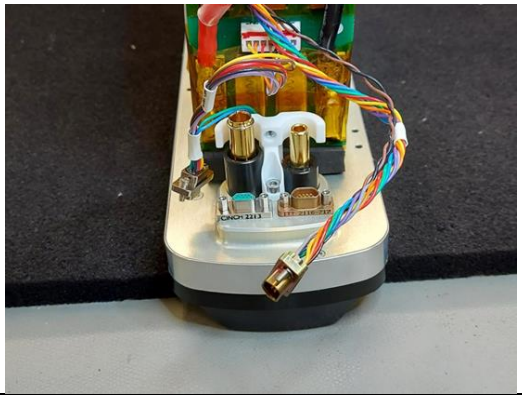



Figure 10 Battery Insider Maintenance window

# 11 BMS REMOVAL

| Photo / Schematics | No | Activity |
|---|---|---|
| | 1. | Prepare tools. |
|  | 2. | 1) Open the bolts (HEX2,5).<br><br>2) Remove the battery top plate. |
|  | 3. | Turn battery upside down and carefully remove the outer shell. |



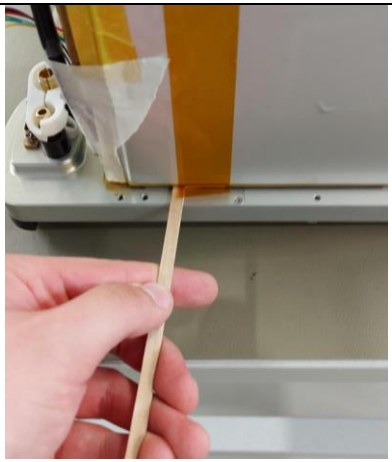


4. Remove the 2 bolts holding Micro D connectors in place.

Remove the main power connectors holder.
NB! The lower nut may start to twist with the bolts. Use a small pliers to help.

NB! Disconnect the main power wires after removal of the Micro D connectors.

**Keeping the main power wires connected without the Micro D can damage BMS!**

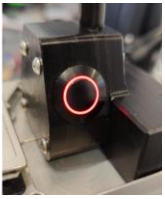
| | | |
|---|---|---|
|  | 5. | Battery cells and BMS are attached to each other with 2-sided tape. The easiest way to remove the 2-sided tape without damaging the cells, is to use an ice cream wooden stick. |

**⚠ WARNING**

ALL WORK ON THE BATTERY ASSEMBLY HAS TO BE DONE WITH EXTREME CAUTION! DAMAGE OR PUNCTURE TO THE BATTERY MAY RESULT IN A FIRE!

# 12 USEFUL INFO

1. Connect the battery to the computer with the USB cable and launch the "Battery Insider" application. To establish connection, press the BMS power button for 1 second.
2. Do not activate the battery preheating function if charger power is not present.

3. If Heat Controller loses connection to the BMS/Autopilot the BMS output will be live (BMS output will be live, but the Power LED will be turned OFF). Heat Controller controls the Power LED.


4. Do not connect a powered-ON battery to an aircraft (make sure the battery is turned OFF). Leave at least 10 seconds pause between charging and connecting it to the aircraft.
5. Pre-Heat will automatically turn itself off after 6 hours of Charging/Heating. If the battery is full and Pre-heat is enabled, the heater will heat the battery for 6 hours.
6. "Battery Insider" may present "charging" and "fully charged" count incorrectly. (Do not blindly trust these numbers).

| | |
|---|---|
| Charging Count | 141 |
| Fully Charged Count | 128 |