

S-Series First Level Training



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1 Introduction

This document is intended to serve as a first level training for Flux Power batteries. Specific troubleshooting will not be covered in this document; however there already exist online tools and documents for specific troubleshooting for each battery. Those tools and their locations will also be referenced in this document. Different versions of batteries will also be referenced by their Battery Management System (BMS) versions and serial numbers.

2 S-Series

The S-Series batteries consist of the following: S8 BMS1, S8 BMS2, and S24. These batteries are currently operating in electric pallet jacks.

2.1 S-8 (BMS 1)

2.1.1 First Level Components

The figure below is of the outside of a fully assembled S8 BMS1 battery. All S8 BMS1 batteries will have a serial number starting with a 160-, 170-, or 180-. The serial number of the battery can be found on the battery's I.D. plate which is located on the top face of the battery.

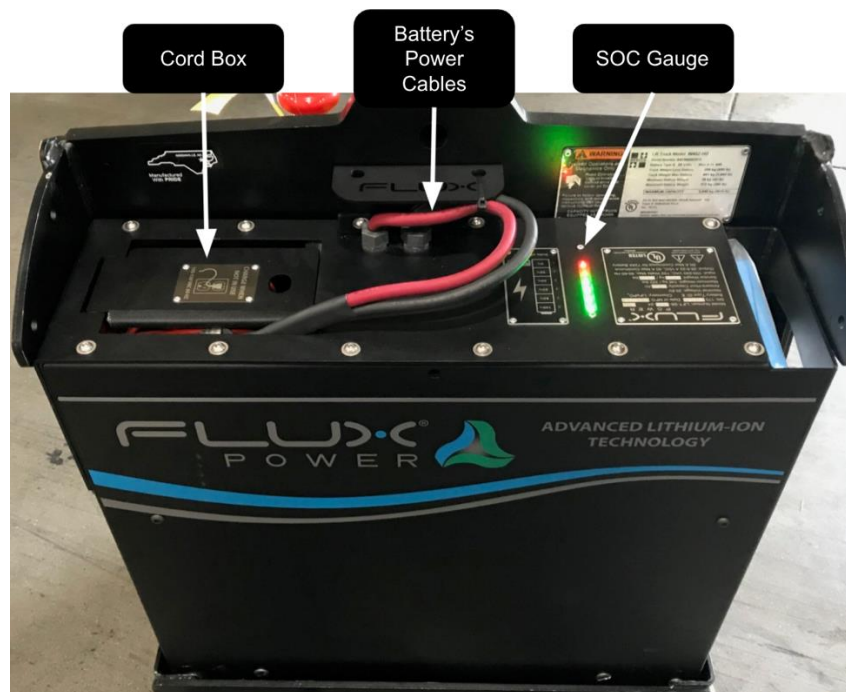


Figure 1: First Level Components of S8 BMS1

The first level components of an S8 BMS1 are found on the outside of the battery. Below is a brief description of each component and their function.

- State of Charge (SOC) Gauge: A set of 6 LEDs which are used to display the battery's current SOC % and any Device Trouble Codes (DTCs) that may be present. The SOC is shown by the solid set of lights. Any DTC present is shown by that LED light flashing.

- Battery's Power Cables: Connect to the truck and provide power to it. These are equipped with SB 175A connectors. The color of the connector is dependent on the color of the connector on the truck.
- Cord Box: Housing for the battery's extension cable, communications port, circuit breaker, and A.C. inlet. It has a small flap to access those items. It is held onto the body of the battery by 16 screws (12 on top and 4 on the side).
- Communications Port (in Cord Box): Battery's 12-pin connector used to communicate with the battery through a device with the appropriate software. Not all pins of the 12-pin connector are populated. Pins are numbered 1-12 in a clockwise manner. Use the image below as a reference and note its location to the A.C. inlet for reference.

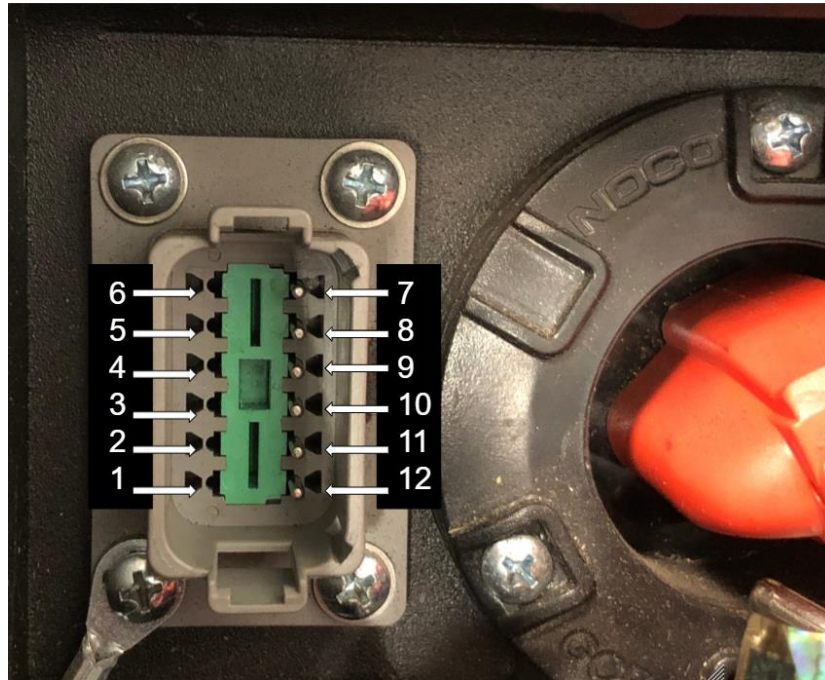


Figure 2: Communications Port's pin numbering

- Circuit Breaker (in Cord Box): Used to turn the battery ON and OFF. To turn the battery ON push the yellow tab inside. To turn the battery OFF press on the red button to make the yellow tab sticks out.

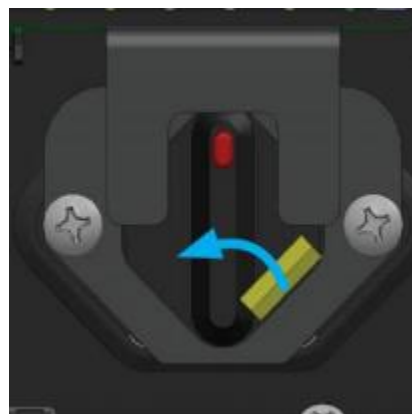


Figure 3: Circuit Breaker

- A.C. Inlet (in Cord Box): A three prong inlet for the female end of an extension cable to plug in to charge the battery.

2.1.2 Reading Device Trouble Codes (DTC)s

The 6 LEDs on the top the battery will indicate the SOC percentage of the battery and any DTCs that may be present.

The SOC percentage of the battery is represented by solid LEDs. For reference, there is an additional plaque to the side the 6 LEDs that numbers the LEDs 1-6 and assigns each number a SOC percentage. Flux Power recommends that the battery not be allowed to go below 30%, or LED 2.

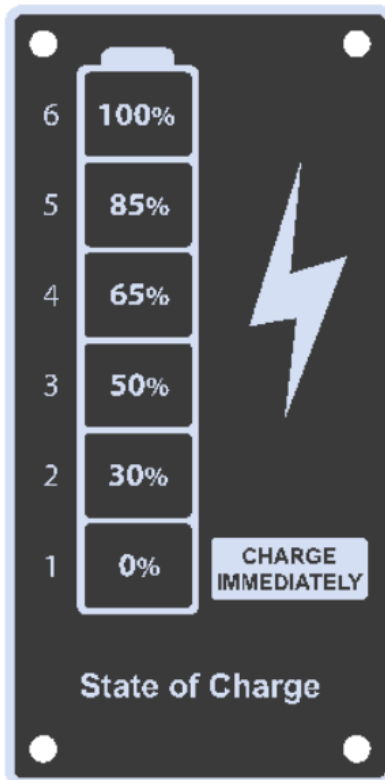


Figure 4: SOC percentage labeling plaque

When a DTC is present, the LED associated with that DTC will flash multiple times. Each DTC is described below.

Fault Description	Cause and Required Duration to Trigger	Fault Protection	LED Indicator	Service Required?	Fault Resolution
Low Cell	Cause: at least one cell has reached a voltage value at or below 2.80V Duration to trigger: immediate	Contactors Opens	LED 1	No	Plug the battery in to charge. If the battery is allowed to remain in this overdischarged state for long, then service will be required to be able to charge it. A loose cell tap connection can also present a false cell voltage reading and cause a false DTC.
Low SOC %	Cause: the SOC % has reached 5% or lower Duration to trigger: immediate	Contactors Opens	LED 1	No	Plug the battery in to charge. If the battery is allowed to remain in this overdischarged state for long, then service will be required to be able to charge it. A loose cell tap connection can also present a false cell voltage reading and cause a false DTC.

Electronics Hardware Failure	Cause: an issue with the BMS has prevented the battery from charging and discharging Duration to trigger: immediate	Contactors Opens	LED 3	Yes	An authorized technician will need to connect to the battery in order to resolve the DTC.
Exceed Temperature Range	Cause: the cell temperatures have either gotten too high or too low. The upper and lower thresholds vary for charging and discharging states. They can be seen below Charging: 33F (lowest) and 147F (highest) Discharging: 32F (lowest) and 147 (highest) Duration to trigger: immediate	Contactors Opens	LED 4	No	Allow the pack to either cool down or warm up. A warmer ambient temperature and heavy use can increase the cells' temperature. The quickest way to cool down the battery is to turn it off through the circuit breaker. A colder ambient temperature and lack of use (leaving pack off in cold warehouse overnight) can lower the cell's temperature. The quickest way to warm up the battery is to leave it turned on and charging. A loose connection on the thermistors can also present a false cell temperature reading and cause a false DTC.
Exceed Current Range	Cause: the current going through the battery has exceeded the thresholds for charging and discharging states. They can be seen below. Charging: 1000A (highest) Discharging: -1000A (lowest) Duration to trigger: immediate	Contactors Opens	LED 5	No	Connect the appropriate charger and cycle the circuit breaker OFF, then ON
Low Cell Imminent	Cause: at least one cell has reached a voltage value of 2.95V. Duration to trigger: immediate	None	LED 6	No	Plug the battery in to charge. If the battery is allowed to remain in this overdischarged state for long, then service will be required to be able to charge it. A loose cell tap connection can also present a false cell voltage reading and cause a false DTC.

2.1.3 Discharging the Battery

The battery is discharged through its power cables. This battery is equipped with a single contactor that is in line with the red positive power cable. Therefore, the black negative cable is always grounded. The color of the plastic connector on the power cables must match the color of the connector on the truck.

If there are no DTCs present, the contactor should be closed, and the truck will turn ON. A voltmeter will display the battery's voltage at the power cables. If there are no DTCs present, and the truck does not turn on, then an authorized technician will need to work on the battery.

2.1.4 Charging the Battery

The battery is charged through its A.C. inlet. Batteries with a serial number of 160- will be equipped with a current unregulated internal charger. It will output at a constant 24A-28A charge current. Batteries with a serial number of 170- and 180- will be equipped with smart internal chargers. The charge current will vary based on the pack voltage.

If there are no DTCs present, the battery should charge when plugged into an A.C. power source. The LEDs on the SOC gauge will indicate charging through a scrolling sequence. The LEDs will light up and stay on one by one from LED 1-6. They will all then stay solid for a second, flash to the current SOC percentage, and the scrolling sequence will start over. Once all 8 cells reach 3.42V, then the battery's SOC percentage will reset to 100%. Once at least one cell reaches 3.60V the internal charger will stop charging as a safety measure. If there are no DTCs present, and the battery does not charge, then an authorized technician will need to work on the battery.

2.2 S-8 (BMS 2)

2.2.1 First Level Components

The figure below is of the outside of a fully assembled S8 BMS2 battery. All S8 BMS2 batteries will have a serial number starting with a 200-. The serial number of the battery can be found on the battery's I.D. plate which is located on the top face of the battery.

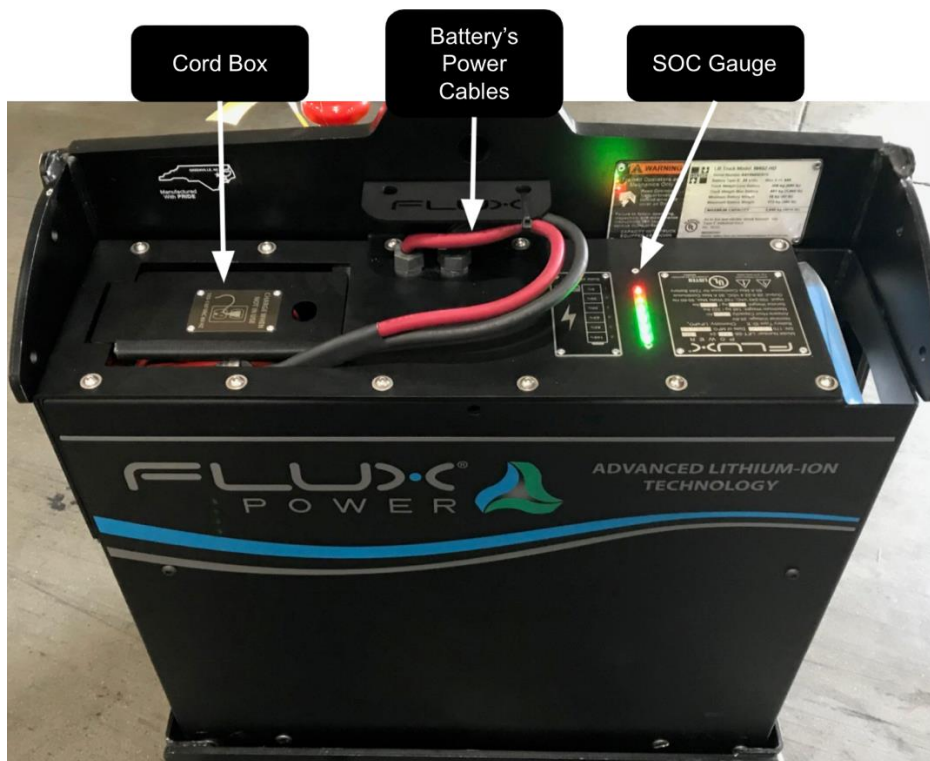


Figure 5: First Level Components of S8 BMS2

The first level components of an S8 BMS1 are found on the outside of the battery. Below is a brief description of each component and their function.

- State of Charge (SOC) Gauge: A set of 6 LEDs which are used to display the battery's current SOC % and any Device Trouble Codes (DTCs) that may be present. The SOC is shown by the solid set of lights. Any DTC present is shown by that LED light flashing.
- Battery's Power Cables: Connect to the truck and provide power to it.

- Cord Box: Housing for the battery's extension cable, communications port, circuit breaker, and A.C. inlet. It has a small flap to access those items. It is held onto the body of the battery by 16 screws (12 on top and 4 on the side).
- Communications Port (in Cord Box): Battery's 12-pin connector used to communicate with the battery through a device with the appropriate software. Not all pins of the 12-pin connector are populated. Pins are numbered 1-12 in a clockwise manner. Use the image below as a reference.

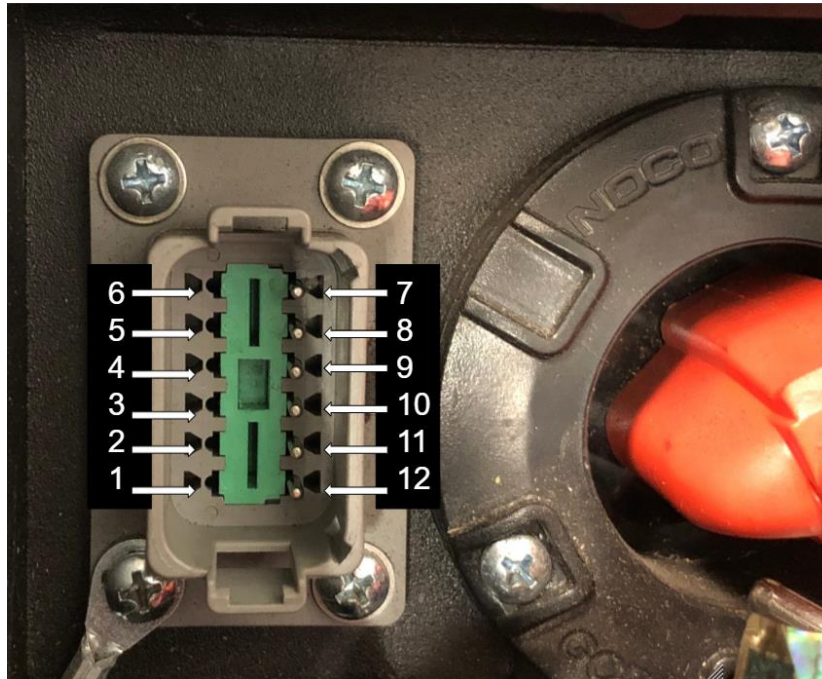


Figure 6: Communications Port's pin numbering

- Circuit Breaker (in Cord Box): Used to turn the battery ON and OFF. To turn the battery ON push the yellow tab inside. To turn the battery OFF press on the red button to make the yellow tab sticks out.

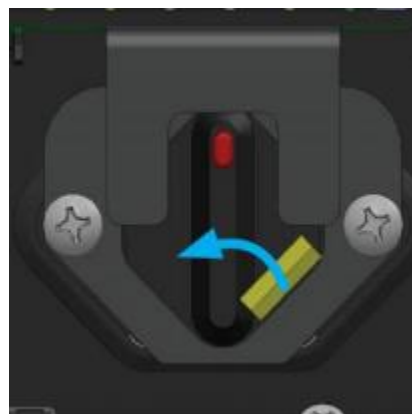


Figure 7: Circuit Breaker

- A.C. Inlet (in Cord box): Plug the female end of an extension cable in to charge the battery.

2.2.2 Reading Device Trouble Codes (DTC)s

The 6 LEDs on the top the battery will indicate the SOC percentage of the battery and any DTCs that may be present.

The SOC percentage of the battery is represented by solid LEDs. For reference, there is an additional plaque to the side the 6 LEDs that numbers the LEDs 1-6 and assigns each number a SOC percentage. Flux Power recommends that the battery not be allowed to go below 30%, or LED 2.

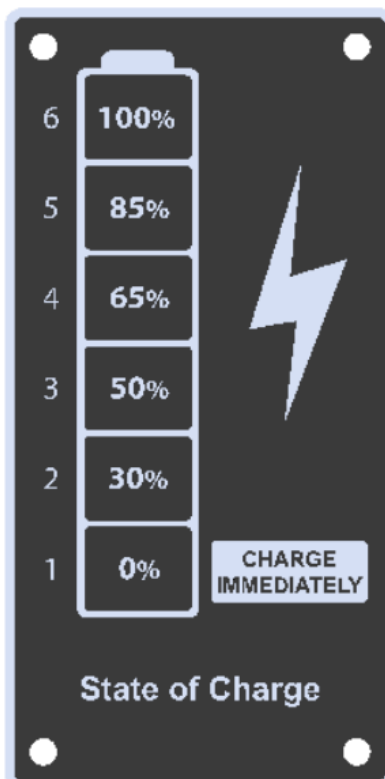


Figure 8: SOC percentage labeling plaque

When a DTC is present, the LED associated with that DTC will flash multiple times. Each DTC is described below.

Fault Description	Cause and Required Duration to Trigger	Fault Protection	LED Indicator	Service Required?	Fault Resolution
Low Cell	Cause: at least one cell has reached a voltage value at or below 2.80V Duration to trigger: immediate	Contactors Open	LED 1	No	Plug the battery in to charge. If the battery is allowed to remain in this overdischarged state for long, then service will be required to be able to charge it. A loose cell tap connection can also present a false cell voltage reading and cause a false DTC.
Low SOC %	Cause: the SOC % has reached 5% or lower Duration to trigger: immediate	Contactors Open	LED 1	No	Plug the battery in to charge. If the battery is allowed to remain in this overdischarged state for long, then service will be required to be able to charge it. A loose cell tap connection can also present a false cell voltage reading and cause a false DTC.
Electronics Hardware Failure	Cause: an issue with the BMS has prevented the battery from charging and discharging	Contactors Open	LED 3	Yes	An authorized technician will need to connect to the battery in order to resolve the DTC.

	Duration to trigger: immediate				
Exceed Temperature Range	<p>Cause: the cell temperatures have either gotten too high or too low. The upper and lower thresholds vary for charging and discharging states. They can be seen below</p> <p>Charging: 33F (lowest) and 147F (highest)</p> <p>Discharging: 32F (lowest) and 147 (highest)</p> <p>Duration to trigger: immediate</p>	Contactor Opens	LED 4	No	Allow the pack to either cool down or warm up. A warmer ambient temperature and heavy use can increase the cells' temperature. The quickest way to cool down the battery is to turn it off through the circuit breaker. A colder ambient temperature and lack of use (leaving pack off in cold warehouse overnight) can lower the cell's temperature. The quickest way to warm up the battery is to leave it turned on and charging. A loose connection on the thermistors can also present a false cell temperature reading and cause a false DTC.
Exceed Current Range	<p>Cause: the current going through the battery has exceeded the thresholds for charging and discharging states. They can be seen below.</p> <p>Charging: 1000A (highest)</p> <p>Discharging: -1000A (lowest)</p> <p>Duration to trigger: immediate</p>	Contactor Opens	LED 5	No	Connect the appropriate charger and cycle the circuit breaker OFF, then ON
Low Cell Imminent	<p>Cause: at least one cell has reached a voltage value of 2.95V.</p> <p>Duration to trigger: immediate</p>	None	LED 6	No	Plug the battery in to charge. If the battery is allowed to remain in this overdischarged state for long, then service will be required to be able to charge it. A loose cell tap connection can also present a false cell voltage reading and cause a false DTC.

2.2.3 Discharging the Battery

The battery is discharged through its power cables. This battery is equipped with a single contactor that is in line with the red positive power cable. Therefore, the black negative cable is always grounded. The color of the plastic connector on the power cables must match the color of the connector on the truck.

If there are no DTCs present, the contactor should be closed, and the truck will turn ON. A voltmeter will display the battery's voltage at the power cables. If there are no DTCs present, and the truck does not turn on, then an authorized technician will need to work on the battery.

2.2.4 Charging the Battery

The battery is charged through its A.C. inlet. The battery will be equipped with a smart internal charger. The charge current will vary based off the pack voltage.

If there are no DTCs present, the battery should charge when plugged into an A.C. power source. The LEDs on the SOC gauge will indicate charging through a scrolling sequence. The LEDs will light up and stay on one by one from LED 1-6. They will all then stay solid for a second, flash to the current SOC percentage, and the scrolling sequence will start over. If there are no DTCs present, and the truck does not turn on, then an authorized technician will need to work on the battery.

2.3 S24

2.3.1 First Level Components

The figure below is of the outside of a fully assembled S24 battery. All S24 batteries will have a serial number starting with a 200-. The serial number of the battery can be found on the battery's I.D. plate which is located on the top face of the battery.

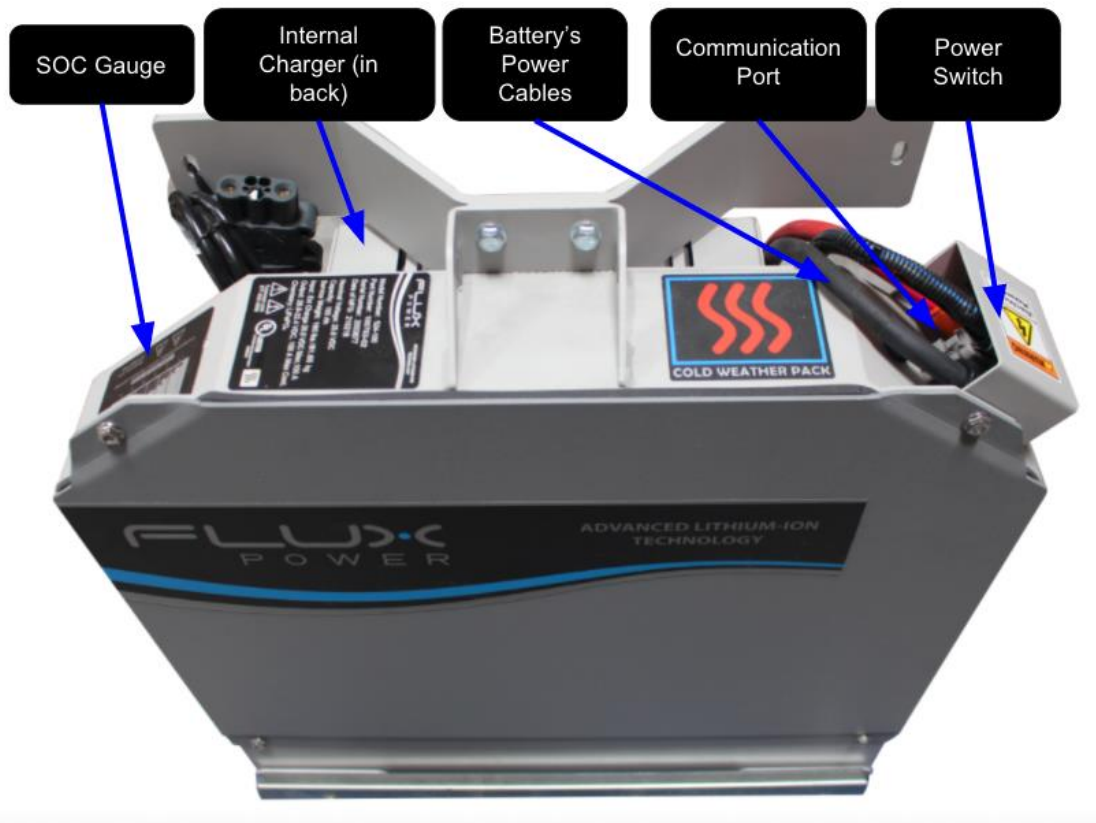


Figure 9: First level components S24

The first level components of an S24 are found on the outside of the battery. Below is a brief description of each component and their function.

- State of Charge (SOC) Gauge: A set of 6 LEDs which are used to display the battery's current SOC % and any Device Trouble Codes (DTCs) that may be present. The SOC is shown by the solid set of lights. Any DTC present is shown by that LED light flashing.
- Battery's Power Cables: Connect to the truck and provide power to it. These are equipped with SB 175A connectors. The color of the connector is dependent on the color of the connector on the truck. Depending on the dealer, these power cables may already be connected to the inside of the truck at arrival.
- Power Switch: A green power button that is used to turn the battery ON and OFF. The switch lights up when the battery is ON.



Figure 10: Green push button

- Communications Port (in Cord Box): Battery's 12-pin connector used to communicate with the battery through a device with the appropriate software. Not all pins of the 12-pin connector are populated. Pins are numbered 1-12 in a clockwise manner. Use the image below as a reference and note its location to the A.C. inlet for reference.

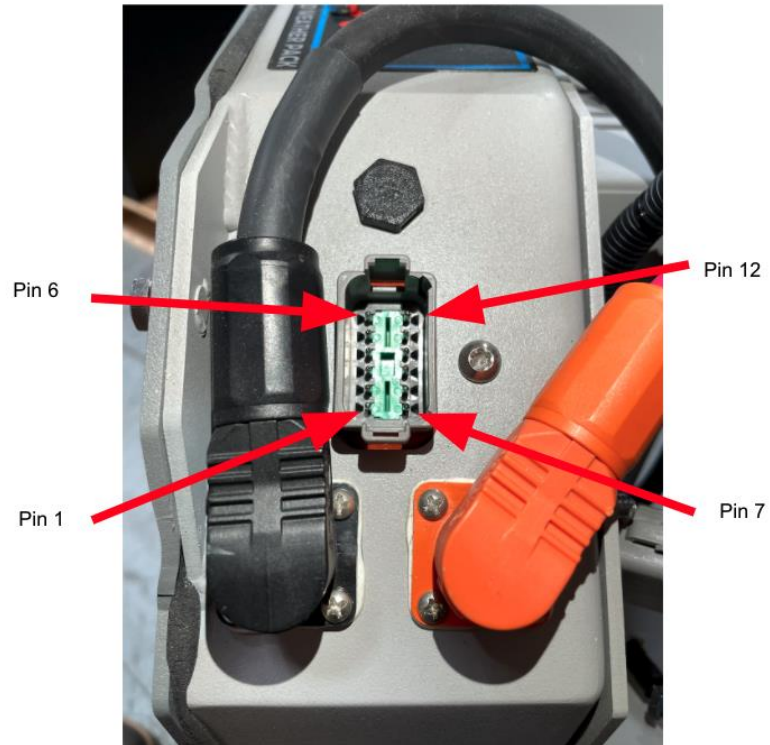


Figure 11: Communications Port's pin numbering

- On-board Charger: The battery is equipped with a charger on the back face of the battery underneath a cover. A black extension cord comes out of the cover to plug into an A.C. power source to charge the battery. There are also manufactured slits on the opposite side the cover over the charger to view any lights present on the charger.

2.3.2 Reading Device Trouble Codes (DTC)s

The 6 LEDs on the top the battery will indicate the SOC percentage of the battery and any DTCs that may be present.

The SOC percentage of the battery is represented by solid LEDs. For reference, there is an additional plaque to the side the 6 LEDs that numbers the LEDs 1-6 and assigns each number a SOC percentage. Flux Power recommends that the battery not be allowed to go below 30%, or LED 2.

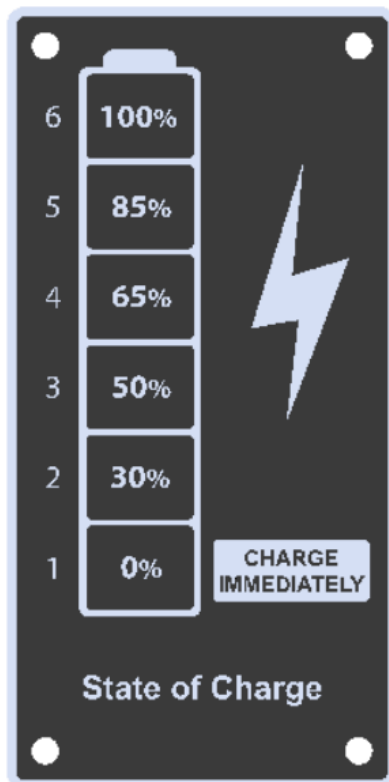


Figure 12: SOC percentage labeling plaque

When a DTC is present, the LED associated with that DTC will flash multiple times. Each DTC is described below.

Fault Description	Cause and Required Duration to Trigger	Fault Protection	LED Indicator	Service Required?	Fault Resolution
Low Cell	Cause: at least one cell has reached a voltage value at or below 2.80V Duration to trigger: immediate	Contactor Opens	LED 1	No	Plug the battery in to charge. If the battery is allowed to remain in this overdischarged state for long, then service will be required to be able to charge it. A loose cell tap connection can also present a false cell voltage reading and cause a false DTC.
Low SOC %	Cause: the SOC % has reached 5% or lower Duration to trigger: immediate	Contactor Opens	LED 1	No	Plug the battery in to charge. If the battery is allowed to remain in this overdischarged state for long, then service will be required to be able to charge it. A loose cell tap connection can also present a false cell voltage reading and cause a false DTC.
Electronics Hardware Failure	Cause: an issue with the BMS has prevented the battery from charging and discharging Duration to trigger: immediate	Contactor Opens	LED 3	Yes	An authorized technician will need to connect to the battery in order to resolve the DTC.

Exceed Temperature Range	<p>Cause: the cell temperatures have either gotten too high or too low. The upper and lower thresholds vary for charging and discharging states. They can be seen below</p> <p>Charging: 33F (lowest) and 147F (highest)</p> <p>Discharging: 32F (lowest) and 147 (highest)</p> <p>Duration to trigger: immediate</p>	Contactor Opens	LED 4	No	Allow the pack to either cool down or warm up. A warmer ambient temperature and heavy use can increase the cells' temperature. The quickest way to cool down the battery is to turn it off through the circuit breaker. A colder ambient temperature and lack of use (leaving pack off in cold warehouse overnight) can lower the cell's temperature. The quickest way to warm up the battery is to leave it turned on and charging. A loose connection on the thermistors can also present a false cell temperature reading and cause a false DTC.
Exceed Current Range	<p>Cause: the current going through the battery has exceeded the thresholds for charging and discharging states. They can be seen below.</p> <p>Charging: 1000A (highest)</p> <p>Discharging: -1000A (lowest)</p> <p>Duration to trigger: immediate</p>	Contactor Opens	LED 5	No	Connect the appropriate charger and cycle the circuit breaker OFF, then ON
Low Cell Imminent	<p>Cause: at least one cell has reached a voltage value of 2.95V.</p> <p>Duration to trigger: immediate</p>	None	LED 6	No	Plug the battery in to charge. If the battery is allowed to remain in this overdischarged state for long, then service will be required to be able to charge it. A loose cell tap connection can also present a false cell voltage reading and cause a false DTC.

2.3.3 Discharging the Battery

The battery is discharged through its power cables. This battery is equipped with a single contactor that is in line with the red positive power cable. Therefore, the black negative cable is always grounded. The color of the plastic connector on the power cables must match the color of the connector on the truck. Depending on the dealer, these power cables may already be connected to the inside of the truck at arrival.

If there are no DTCs present, the contactor should be closed, and the truck will turn ON. A voltmeter will display the battery's voltage at the power cables. If there are no DTCs present, and the truck does not turn on, then an authorized technician will need to work on the battery.

2.3.4 Charging the Battery

The battery is charged through its black extension cord. The battery will be equipped with a smart internal charger. The charge current will vary based off the pack voltage.

If there are no DTCs present, the battery should charge when plugged into an A.C. power source. The LEDs on the SOC gauge will indicate charging through a scrolling sequence. The LEDs will light up and stay on one by one from LED 1-6. They will all then stay solid for a second, flash to the current SOC percentage, and the scrolling sequence will

start over. If there are no DTCs present, and the truck does not turn on, then an authorized technician will need to work on the battery.

3 Flux Power Contact Details

Flux Power Inc.

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Fax: 760-741-3535

Email: Support@fluxpower.com

Web: www.fluxpower.com

WARNING – Risk of Fire – No User Serviceable Parts