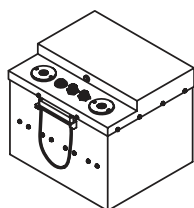
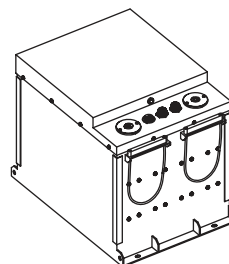


# Operating Manual



**44-24-2800**



**42-48-6650**

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## 1. Safety

### 1.1 Warnings, Cautions, Notes and Symbols

| ▲ WARNING   |
|---|
| Important information regarding possible personal injury. |

| ▲ CAUTION  |
|--|
| Important information regarding possible equipment damage. |

| ▲ NOTE  |
|---|
| Additional information concerning important procedures and features of the battery. |

### 1.2 General Warning

| ▲ CAUTION  |
|--|
| It is important to operate the device with care to avoid undesirable consequences. |



Do not throw battery in the garbage. Do not dispose in fire.



Use personal protective equipment when working with batteries.



Additional information concerning important procedures and features of the battery. Read all the instructions before installation, operation and maintenance.



This product must be recycled and is made of recycled products.

| ▲ CAUTION   |
|---|
| Do not disassemble or modify the battery. If the battery housing is damaged, do not touch exposed contents. |

### 1.3 Fire Risk

| ▲ WARNING  |
|--|
| Risk of fire - No user serviceable parts inside. |

- The AES Battery has a Battery Management System (BMS) with integrated solid state relay to reduce the risk of fire.
- Primary suppression for a lithium battery fire is water, the secondary suppression is CO<sub>2</sub>, powder and halon.

### 1.4 Electric Shock Risk

| ▲ WARNING   |
|---|
| For wet and electrically uninsulated working conditions, electric shock risk is high, and can cause injury and death. |

| Model      | Nominal System Voltage | Maximum System Voltage |
|------------|------------------------|------------------------|
| 44-24-2800 | 24 V                   | 29.2 V                 |
| 42-48-6650 | 48 V                   | 58.4 V                 |

## 1.5 Chemical Risk

**▲ WARNING**

Lithium batteries are a chemical risk if misoperated, mishandled or abused.

## 1.6 Do's

- Do protect terminals from short circuit before, during, and after installation
- Do wear electrically insulated gloves
- Do use electrically insulated tools
- Do wear eye protection
- Do wear safety toe boots / shoes
- Do handle battery carefully
- Do secure battery safely
- Do always assume battery terminals are energized

## 1.7 Do Not's

- Do not immerse battery in water
- Do not lift or carry the battery during usage or operation
- Do not operate or store battery outside of operating limits
- Do not short circuit battery
- Do not puncture battery
- Do not expose battery to flames, or incinerate
- Do not open battery case or disassemble battery
- Do not wear rings, watches, bracelets or necklaces when handling or working near battery
- Do not drop or crush battery
- Do not lift battery by the terminal cables
- Do not vibrate battery
- Do not expose battery to water or other fluids
- Do not expose battery to direct sunlight
- Do not dispose of battery
- Do not connect with other types of batteries
- Do not expose battery to high temperatures
- Do not install with other battery types or brands

## 1.8 DC Motor Connection

Direct connection to DC motors, without proper safety protection including motor controllers, and external motor voltage clamping systems (such as high power anti-parallel diodes or braking resistor systems), may result in damage to the internal battery pack protection system which may result in unsafe situations. Please consult Discover Battery technical support before directly connecting any motor loads.

## 1.9 Transportation

If the battery is not installed in equipment, it must be transported in the original package or equivalent.

Batteries are tested according to UN Handbook of Tests and Criteria, part III, sub section 38.3 (ST/SG/AC. 10/11/Rev.5). For transport the batteries belong to category UN3480, Class 9.

## 2. Battery Operating Limits

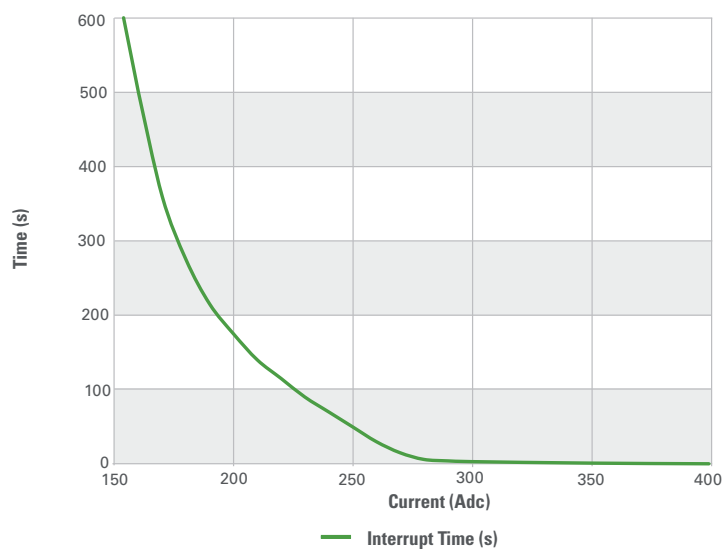
### 2.1 Maximum Battery Operating Limits

The battery should not be operated outside the Maximum Operating Limits, the BMS will open its internal relay and disconnect the battery if any of the following limits are exceeded.

| Maximum Operating Limits          | 44-24-2800                  | 42-48-6650      |
|-----------------------------------|-----------------------------|-----------------|
| Continuous Charge Current*        | 110 Adc                     | 130 Adc         |
| Continuous Discharge Current*     | 110 Adc                     | 130 Adc         |
| Charge Voltage                    | 27.2 V                      | 54.4 V          |
| Operating Voltage (Min / Max)     | 22.4 V / 29.2 V             | 44.8 V / 58.4 V |
| Charge Temperature (Min / Max)    | 0°C / 45°C (32°F / 113°F)   |                 |
| Discharge Temperature (Min / Max) | -20°C / 50°C (-4°F / 122°F) |                 |
| Storage Temperature (Min / Max)   | -20°C / 45°C (-4°F / 113°F) |                 |

\* Effects of AC Ripple must be taken into consideration when sizing and configuring your system.

**Nominal Interruption Time - Peak Current Characteristic of Discover BMS**



**▲ NOTE!**

Intentional bypassing of BMS to operate the battery outside maximum and minimum limits voids warranty.

## 2.2 Recommended Battery Operating Limits

Although the battery is capable of performing up to the Maximum Battery Operating Limits noted, the following settings are recommended to maximize battery health and account for unforeseen external conditions.

| Recommended Operating Settings   | 44-24-2800  | 42-48-6650 |
|----------------------------------|-------------|------------|
| Max Continuous Charge Current    | < 78 A      | < 92 A     |
| Max Continuous Discharge Current | < 78 A      | < 92 A     |
| Charge Voltage (Bulk/Absorb)     | 27.2 V      | 54.4 V     |
| Charge Voltage (Float)           | 26.8 V      | 53.6 V     |
| Low Voltage Disconnect           | 24 V        | 48 V       |
| Operating Temperature            | 20°C (68°F) |            |

### 3. Design Features & Components

#### 3.1 Battery Management System (BMS)

##### BMS Monitors

- Cell module voltage
- Battery voltage
- Battery current
- Battery temperature
- Battery state of charge (SOC)

##### Module Balancing

- BMS performs balancing of cell modules

##### Protection & Fault Management

- BMS sounds buzzer when fault limits are reached
- BMS generates fault when maximum operating limits are reached
- Fault events cause switch to open and battery to shut down after a 120s delay

##### Communication Ports

- BMS has an isolated USB and CAN communication.

##### Data Logging

- Monitoring data
- Fault and warning events
- Logged data is accessed using AES Dashboard software via the USB port (Win32, Win64 supported)

#### 3.2 Fuse

Fuse provides back-up over-current protection.

- A blown fuse requires replacement by a qualified installer - contact your Discover installer.

#### 3.3 Terminals

Terminals are button-type, M8 female.

### 4. Handling

**▲ WARNING!**

Read Safety Section before handling the battery.

- Battery should be set to off
- Battery cables should be disconnected
- Battery terminals should be protected
- Battery handle should be used to lift battery
- Battery should be handled by two people or mechanical lift equipment
- Do not lift or carry the battery during usage or operation

### 5. Installation

**▲ WARNING!**

Read Safety Section before installing the battery.

**▲ CAUTION!**

Do not install AES LiFePO<sub>4</sub> batteries in series. Select the appropriate AES battery model for the voltage of your system.

### 5.1 Tools

- Insulated tools must be used
- Voltmeter
- Post cleaner and wire brush
- Personal protective equipment

### 5.2 Battery Location

Locate the batteries close to the inverter in order to minimize the length of the battery cables. Care should be taken to ensure adequate clearance above the batteries is maintained for access to both battery and inverter connections and disconnects. A Discover AES Wall-Mount Bracket (p/n 950-0018) is available for use with AES Battery model 42-48-6650.

AES Battery performance and service life will be optimized when they are operated in an ambient temperature of 15°C to 25°C (59°F to 77°F). Care should be taken to ensure that the battery's temperature is > 0°C (32°F) during charging.

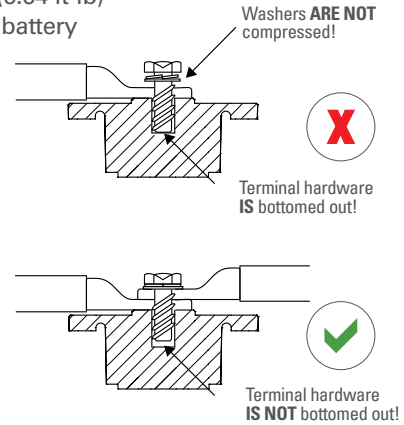
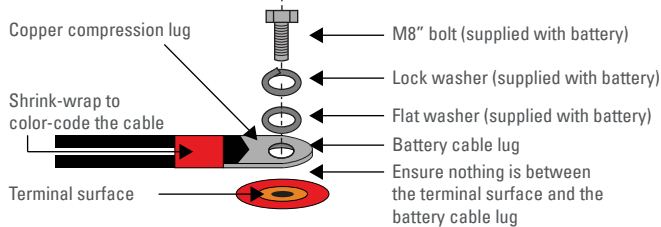
### 5.3 Securing Battery

- Battery can be strapped in place with non-conductive nylon straps
- Battery may have hold down brackets at the base of the battery
- A Discover AES Wall-Mount Bracket (p/n 950-0018) is available for use with AES Battery model 42-48-6650

### 5.4 Installation

Battery cables must be sized to the specifications required by the inverter charger, and must be installed in accordance with the standards set by the authority having local jurisdiction. Do not use or install a battery temperature sensor.

- Confirm that battery is set to OFF
- If the battery circuit has a disconnect - open the disconnect to isolate battery
- Cable connection points should always be kept clean
- Broken, frayed, brittle, kinked or cut cables should never be used
- Secure the new battery - be careful not to ground the terminals to any metal mounting, fixture, or body part
- Connect battery cables - connect the ground cable last to avoid sparking
- Terminals are button-type, M8 female - recommended torque is 9.0 Nm (6.64 ft-lb)
- If the battery circuit has a disconnect - close disconnect to reconnect the battery
- Set the battery to ON



**▲ NOTE!**

All cable ends must be connected to battery terminals without any washers between terminal bushings and cable ends.

Terminal burnout is caused by:

- Discharge currents exceeding allowable limits
- Improper cable installation
- Improper cable sizing
- Improper terminal torque

**▲ NOTE!**

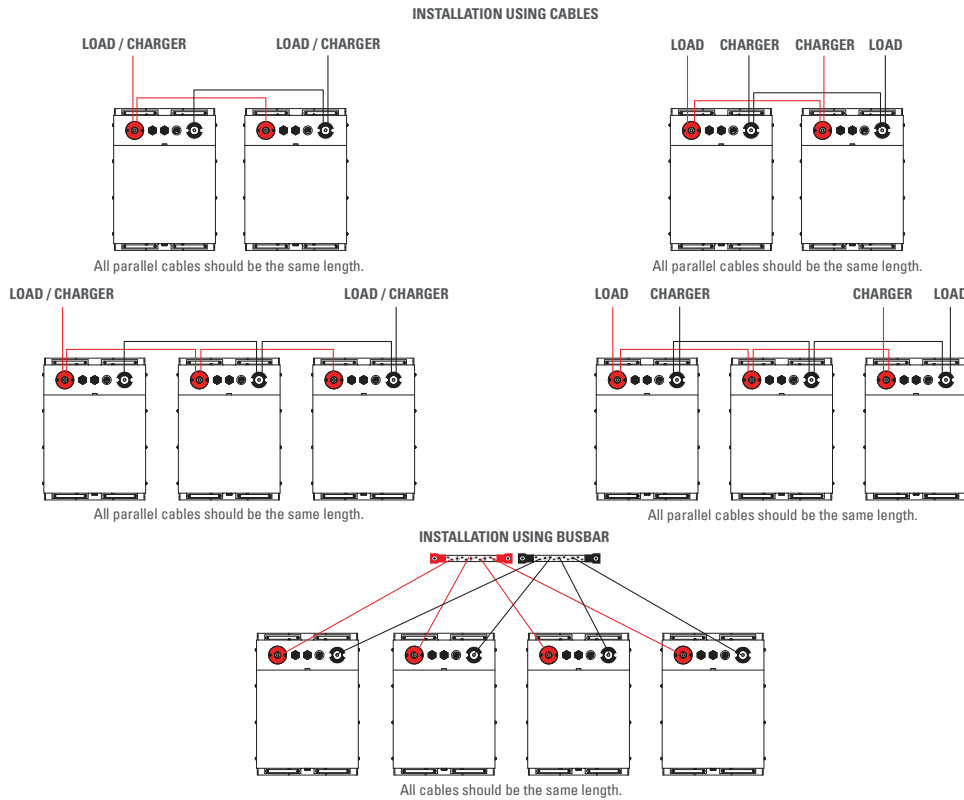
Without exception, product experiencing terminal burn out will not be warranted.

### 5.5 Parallel Battery Wiring

To ensure proper balancing and load sharing between parallel batteries refer to the wiring diagram below. Lithium batteries are very sensitive to voltage and undersized battery cables will impede battery and system performance. The thickness (cross section) of cable used should exceed the recommended minimum for the inverter charger installation whenever possible.

Five or more batteries in parallel should be installed using a busbar configuration. In a busbar configuration all battery cable sets should be the same length regardless of the battery's proximity to the busbar (or combiner box).

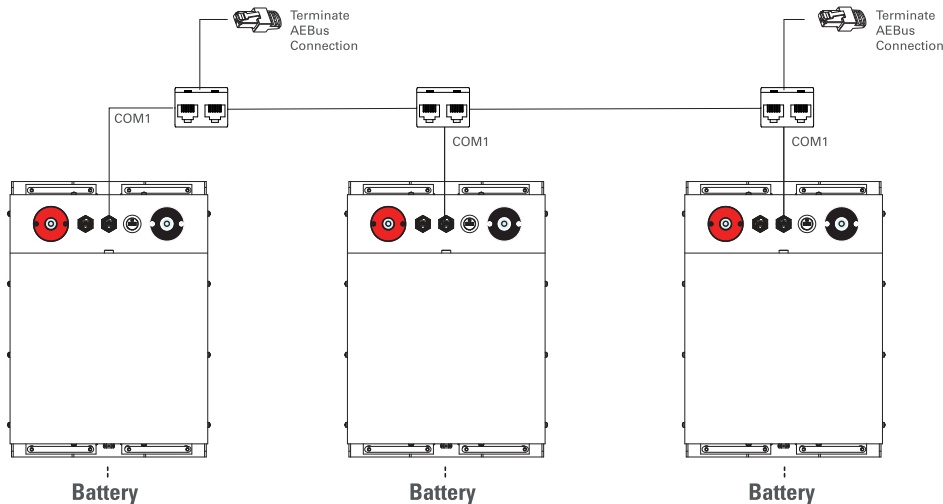
Actual wiring requirements may vary. Consult with the authority having local jurisdiction.



## 6. Networking

### 6.1 AEBus Network

The AEBus is utilized by all networked AES batteries to coordinate all voltage, temperature, and current data. Network Terminators are required for proper functioning of the AES network. Care should be taken to ensure they are installed.



## 6.2 Configuration with Power Conversion and Monitoring Devices

AES batteries must be set up to work with Power Conversion and Monitoring devices in either an Open Loop or Closed Loop configuration. The charge and discharge settings in a Open Loop configuration are set up through the controller for the Power Conversion device at the time of installation. In a Closed Loop configuration, charge and discharge settings are dynamically controlled by the BMS of the AES Battery over a connection with the Power Conversion device network. Closed Loop communication with a Power Conversion device network requires the use of a LYNK Gateway Communication device (p/n 950-0015) available from Discover Battery.

For Closed Loop and Open Loop configuration details please refer to the appropriate Application Note for your Power Conversion device available from the Discoverbattery.com website, or contact your Discover Battery provider for assistance.

**Note:** Schneider Electric Conext branded devices communicate over Xanbus forming a Closed Loop configuration using the Xanbus port located on the AES battery and do not require the use of a LYNK Gateway Communication device (p/n 950-0015). Refer to Application Note 885-0013 Closed Loop Integration with Xanbus Enabled Schneider Electric Conext Products, for detailed instructions.

## 7. Operation

**▲ CAUTION!**  
Review operating limits.

### 7.1 On–Off / Reset

- To set the battery to ON press and hold switch for 2-3 seconds
- To set the battery to OFF press and hold switch for 2-3 seconds



### 7.2 Charging

Before charging the battery make sure to read and understand the instructions that come with the Power Conversion device. Never attempt to charge a battery without first reviewing and understanding the instructions for the Power Conversion device being used. Do not use or install a battery temperature sensor.

**▲ CAUTION!**  
Always make sure the chargers charging curve meets the battery's charging requirement; never charge a visibly damaged battery; never charge a frozen battery.

1. Connect the Power Conversion device's charger leads to the battery.
2. Ensure the charger and battery side connections are tight.
3. Set the charger to ON
4. Set the battery to ON

**▲ CAUTION!**  
**NOT ALL CHARGERS ARE CAPABLE OF CHARGING LITHIUM BATTERIES**  
CONFIRM that your chosen charger is incapable of producing transient spikes that exceed the published terminal voltage limits for the battery.

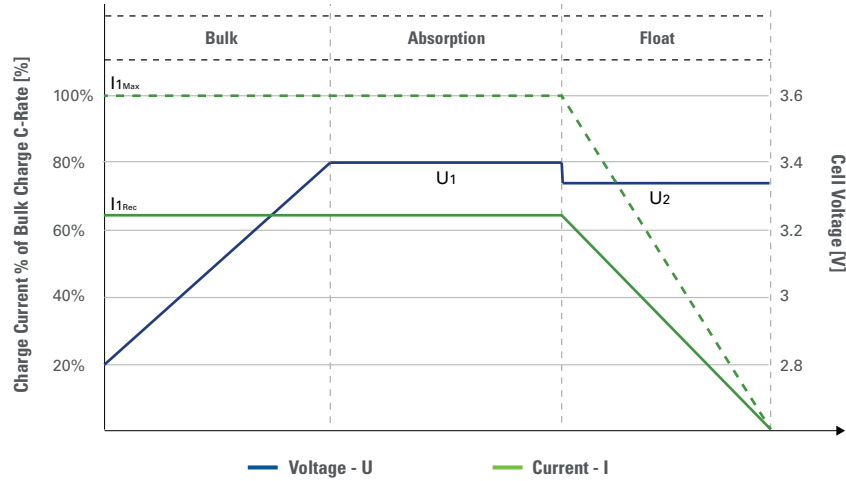
Spikes are fast, short duration electrical transients in voltage (voltage spikes), current (current spikes), or transferred energy (energy spikes) in an electrical circuit. Voltage spikes usually happen when the AC/DC adapter is plugged in, or charge current is cut off quickly. Multi voltage chargers are constructed using transformers that may be capable of producing spikes that exceed the maximum ratings of the Discover AES Battery. You must ensure that the charger being supplied:

- Meets the recommended charge curve
- Incapable of exceeding Discover's maximum terminal voltages



### 7.3 Charge Curve

1. Charge at constant current to 3.4V per cell module (Bulk).
2. Maintain constant voltage 3.4V per cell module (Absorption).
3. Terminate when charge current drops below 2A.
4. Optional Float at 3.35V per cell module (Float).



**▲ CAUTION!**  
Do not charge battery higher than 3.4V per cell module.

**▲ NOTE!**  
Recommended charge current is 0.5C

| Model      | Cell Modules in Series | I1              | U1     | Termination Charge Current | U2     |
|------------|------------------------|-----------------|--------|----------------------------|--------|
| 44-24-2800 | 8S                     | 110 Adc maximum | 27.2 V | I2 ≤ 2 A                   | 26.8 V |
| 42-48-6650 | 16S                    | 130 Adc maximum | 54.4 V |                            | 53.6 V |

### 7.4 Discharging

- Set the battery to ON
- Set the load to ON
- Recommended low voltage cut off: 24V | 48V

**▲ NOTE!**  
Do not discharge battery below recommended minimum operating voltages.

**▲ NOTE!**  
Do not discharge battery at rates greater than recommended operating currents.

## 7.5 Storage

Systems should be stored out of direct sunlight in compliance with the following temperature conditions:

|                             |              |
|-----------------------------|--------------|
| Minimum Storage Temperature | -20°C / -4°F |
| Maximum Storage Temperature | 45°C / 113°F |

Batteries should be put into storage at 80% SOC and checked monthly to ensure the SOC does not fall below 20%. At 20% SOC the battery will self discharge in approximately 2 months.

### ▲ CAUTION!

Do not store a discharged battery. Recharge battery after every use. Batteries that have self-discharged to a severely discharge state are not recoverable.

## 8. Protection & Faults

- BMS generates faults when maximum operating limits are reached.
- BMS sounds a buzzer when fault limits are triggered.
- BMS monitors the following information for faults and warning:
  1. Cell module voltage
  2. Battery current
  3. Battery temperature

### ▲ NOTE!

Refer to device technical specification tables at the end of this manual for Fault Limits.

## CORRECTIVE ACTIONS

|   |  |
|---|--|
| High Temperature                                    | <ul style="list-style-type: none"> <li>• Stop discharge or charge</li> <li>• Leave the battery to cool</li> </ul>  |
| Low Temperature                                     | <ul style="list-style-type: none"> <li>• Stop discharge or charge</li> </ul>   |
| High Voltage  | <ul style="list-style-type: none"> <li>• If charging, stop the charge</li> <li>• Confirm proper charge algorithm is being used</li> </ul>  |
| Low Voltage   | <ul style="list-style-type: none"> <li>• Do not discharge the battery - if any discharge current is detected, this will force the battery into Low Voltage Fault</li> <li>• Charge the battery in Low Voltage Recovery - if no charge current is detected within 2 minutes the BMS will set the battery to OFF</li> </ul>  |
| Over Current  | <ul style="list-style-type: none"> <li>• Reduce current</li> </ul>   |
| Low SOC   | <ul style="list-style-type: none"> <li>• Stop discharge</li> <li>• Charge the battery</li> </ul>   |
| Inaccurate SOC displayed by Power Conversion system | <ul style="list-style-type: none"> <li>• Battery voltage based SOC calculations provided by Power Conversion systems do not work properly with Lithium battery voltage.</li> <li>• Use a Discover CAN Bus Battery Discharge Indicator (p/n 950-0005, 950-0006, 950-0007) to display accurate SOC. To communicate accurate SOC in a closed loop Power Conversion system use a Discover LYNK Communications Gateway device (p/n 950-0015)</li> </ul> |

## 9. Service & Maintenance

Batteries should be carefully inspected on a regular basis in order to detect and correct potential problems before they do harm. This routine should be started when the batteries are first received.

### 9.1 Inspection

- Inspect for cracks in the battery casing
- Check battery terminals and connections to make sure they are clean, free of dirt, fluids and corrosion
- All battery cables and their connections should be tight, intact, and NOT broken or frayed
- Replace any damaged batteries
- Replace any damaged cables
- Ensure correct torque is used for the terminal bolts

### 9.2 Firmware Updates

Consult Discover's website for the latest firmware. If an firmware update is require, ensure this is done by a qualified installer.

## 10. Troubleshooting

### 10.1 Battery Will Not Turn On

|             |  |
|-------------|--|
| Symptom     | Does the battery turn on for a short time then turns itself off? |
| Description | The battery is likely in a low voltage or low SOC.               |
| Action      | Connect to charger and turn on the battery.                      |

|             |   |
|-------------|---|
| Symptom     | Was the battery left on or stored for extended periods of time?   |
| Description | The battery will turn itself off at 5% SOC. If left sitting at a low SOC, the battery may have discharged itself completely and cannot be used. |
| Action      | Do not use. Replace and recycle.  |

|             |  |
|-------------|--|
| Symptom     | Does the battery appear to turn on, but has no voltage at its terminals? |
| Description | The battery fuse is likely blown.  |
| Action      | Replace fuse. Contact Discover for support.                              |

## 11. Recycling and Disposal

Batteries must not be mixed with domestic or industrial waste. Discover's Advanced Energy Systems are recyclable and must be processed through a recognized recycling agency or dealer. Please contact Discover<sup>®</sup> or your servicing dealer for details.



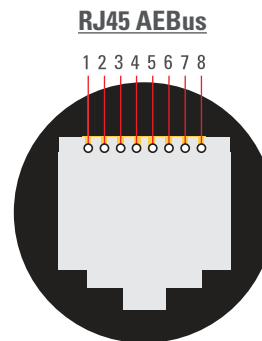
## 12. 44-24-2800 TECHNICAL SPECIFICATIONS

| Electrical Specifications        |  |
|----------------------------------|--|
| Nominal Voltage                  | 25.6V  |
| Charge Voltage                   | 27.2V  |
| Maximum Voltage                  | 29.2V  |
| Minimum Voltage                  | 20V  |
| Nominal Capacity                 | 110 Ah   |
| Nominal Energy                   | 2816 Wh  |
| Max Continuous Charge Current    | 110 Adc  |
| Max Continuous Discharge Current | 110 Adc  |
| Fuse                             | 150 A Internal Fuse. Provides backup over-current protection |
| Cell Chemistry                   | LiFePO <sub>4</sub>  |
| Cell Modules                     | 8S 22P   |
| Self-Discharge 25°C / 77°F       | < 3% per month (battery off)                                 |

| Fault Limits                           |                                    |
|--|------------------------------------|
| OverTemperature - Discharge Protection | > 60°C/140°F for 120s              |
| OverTemperature - Charge Protection    | > 60°C/140°F for 120s              |
| LowTemperature - Discharge Protection  | < -20°C/-4°F for 120s              |
| LowTemperature - Charge Protection     | < -20°C/-4°F for 120s              |
| Over Voltage Protection                | > 3.7 V in any cell module for 60s |
| Under Voltage Protection               | < 2.5 V in any cell module for 5s  |
| Over Current Protection                | > 150 Adc                          |

| Mechanical Specifications   |  |
|-----------------------------|--|
| Battery Dimensions (HxWxD)  | 276 x 347.5 x 329.5 mm                                       |
| Battery Weight              | 40 kg  |
| Shipping Dimensions (HxWxD) | 470 x 430 x 390 mm   |
| Shipping Weight             | 48.4 kg  |
| Terminal                    | M8   |
| Terminal Hardware           | M8 Stainless Steel Bolt, Flat Washer, Lock Washer (Supplied) |
| Terminal Torque             | 9.0 Nm +/- 3   |
| Case Material               | Powder Coated Cold Rolled Steel                              |
| Enclosure IP Rating         | IP 55  |
| Charge Temperature Range    | 0°C/45°C (32°F/113°F)  |
| Discharge Temperature Range | -20°C/50°C (-4°F/122°F)                                      |
| Storage Temperature Range   | -20°C/45°C (-4°F/113°F)                                      |

| Operational Specifications      |  |
|---------------------------------|--|
| Battery Management System (BMS) | Integrated, with Solid State Relay (SSR)   |
| Cell Balancing                  | Passive balancing when Cell Voltage > 3.35 V   |
| Non-Volatile Memory             | Yes  |
| Lifetime Logged Data            | <ul style="list-style-type: none"> <li>• Time</li> <li>• High/low average cell module voltage</li> <li>• Balancing, Fault and Relay State</li> <li>• Battery SOC, Current, Voltage, Temperature</li> <li>• Charge Energy In/Out</li> </ul> |
| Communication Ports             | <ul style="list-style-type: none"> <li>• Isolated USB</li> <li>• Isolated CAN (AEBus)</li> <li>• Isolated XANBUS</li> </ul>  |
| Communication Connectors        | USB Type A Female RJ45 Jack x2   |



|       |                |
|-------|----------------|
| Pin 3 | AEBus CAN GND  |
| Pin 4 | AEBus CAN Low  |
| Pin 5 | AEBus CAN High |
| Pin 6 | AEBus + 5V     |

| Regulatory Approvals | UN 38.3, IEC 62133, UL 2271, UL 1973 |
|----------------------|--------------------------------------|
|----------------------|--------------------------------------|

**UN38.3 PASSED**  
TRANSPORT SAFETY CERTIFIED



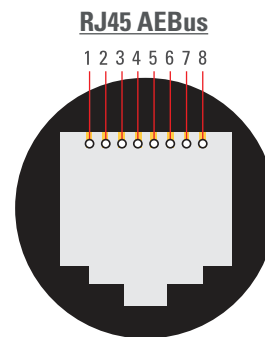
### 13. 42-48-6650 TECHNICAL SPECIFICATIONS

| Electrical Specifications        |  |
|----------------------------------|--|
| Nominal Voltage                  | 51.2 V   |
| Charge Voltage                   | 54.4 V   |
| Maximum Voltage                  | 58.4 V   |
| Minimum Voltage                  | 40 V   |
| Nominal Capacity                 | 130 Ah   |
| Nominal Energy                   | 6656 Wh  |
| Max Continuous Charge Current    | 130 Adc  |
| Max Continuous Discharge Current | 130 Adc  |
| Fuse                             | 150 A Internal Fuse. Provides backup over-current protection |
| Cell Chemistry                   | LiFePO <sub>4</sub>  |
| Cell Modules                     | 16S 26P  |
| Self-Discharge 25°C / 77°F       | < 3% per month (battery off)                                 |

| Fault Limits                           |                                    |
|--|------------------------------------|
| OverTemperature - Discharge Protection | > 60°C/140°F for 120s              |
| OverTemperature - Charge Protection    | > 60°C/140°F for 120s              |
| LowTemperature - Discharge Protection  | < -20°C/-4°F for 120s              |
| LowTemperature - Charge Protection     | < -20°C/-4°F for 120s              |
| Over Voltage Protection                | > 3.7 V in any cell module for 60s |
| Under Voltage Protection               | < 2.5 V in any cell module for 5s  |
| Over Current Protection                | > 150 Adc                          |

| Mechanical Specifications   |  |
|-----------------------------|--|
| Battery Dimensions (HxWxD)  | 375 x 347.5 x 471.5 mm                                       |
| Battery Weight              | 87 kg  |
| Shipping Dimensions (HxWxD) | 570 x 440 x 570 mm   |
| Shipping Weight             | 98.9 kg  |
| Terminal                    | M8   |
| Terminal Hardware           | M8 Stainless Steel Bolt, Flat Washer, Lock Washer (Supplied) |
| Terminal Torque             | 9.0 Nm +/- 3   |
| Case Material               | Powder Coated Cold Rolled Steel                              |
| Enclosure IP Rating         | IP 55  |
| Charge Temperature Range    | 0°C/45°C (32°F/113°F)  |
| Discharge Temperature Range | -20°C/50°C (-4°F/122°F)                                      |
| Storage Temperature Range   | -20°C/45°C (-4°F/113°F)                                      |

| Operational Specifications      |  |
|---------------------------------|--|
| Battery Management System (BMS) | Integrated, with Solid State Relay (SSR)   |
| Cell Balancing                  | Passive balancing when Cell Voltage > 3.35 V   |
| Non-Volatile Memory             | Yes  |
| Lifetime Logged Data            | <ul style="list-style-type: none"> <li>• Time</li> <li>• High/low average cell module voltage</li> <li>• Balancing, Fault and Relay State</li> <li>• Battery SOC, Current, Voltage, Temperature</li> <li>• Charge Energy In/Out</li> </ul> |
| Communication Ports             | <ul style="list-style-type: none"> <li>• Isolated USB</li> <li>• Isolated CAN (AEBus)</li> <li>• Isolated XANBUS</li> </ul>  |
| Communication Connectors        | USB Type A Female RJ45 Jack x2   |



|       |                |
|-------|----------------|
| Pin 3 | AEBus CAN GND  |
| Pin 4 | AEBus CAN Low  |
| Pin 5 | AEBus CAN High |
| Pin 6 | AEBus + 5V     |

| Regulatory Approvals | UN 38.3, IEC62133, UL 2271, UL 1973 |
|----------------------|-------------------------------------|
|----------------------|-------------------------------------|

**UN38.3 PASSED**  
TRANSPORT SAFETY CERTIFIED

