

# Discover<sup>®</sup>

# ADVANCED ENERGY

Lithium Ion Battery

## APPLICATION NOTE:

### OPEN LOOP INTEGRATION WITH OUTBACK POWER

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## OVERVIEW

There are some notable differences when configuring your Discover AES installation versus conventional lead acid batteries. This Application Note provides information about the integration of Discover AES Lithium batteries with OutBack Power systems and related components.

OutBack Power reference documents:

- MATE3 Programing Guide

Discover reference documents:

- Discover Energy 808-0004 42-48-6650 Data Sheet
- Discover Energy 808-0005 44-24-2800 Data Sheet
- Discover Energy 805-0001 Product Manual

Visit [discoverbattery.com](https://discoverbattery.com) for the most recent version of published documents.

Certain configuration, installations, service, and operating tasks should only be performed by qualified personnel in consultation with local utilities and/or authorized dealers. Qualified personnel should have training, knowledge, and experience in:

- Installing electrical equipment
- Applying applicable installation codes
- Analyzing and reducing hazards involved in performing electrical work
- Installing and configuring batteries

No responsibility is assumed by Discover Battery for any consequences arising out of the use of this material.

## 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 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.

- Battery has a Battery Management System (BMS) with integrated solid state relay to reduce fire risk.
- Primary suppression for lithium battery fires is water. 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.

### 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, 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 pack protection system which may result in unsafe situations. Please consult Discover 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, Packaging Group II.

## 2. MAXIMUM OPERATING LIMITS

### 2.1 Maximum Battery Operating Limits

The battery should not be operated outside these operating limits. The BMS will open its internal relay and disconnect the battery if any of these 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.

▲ **NOTE!**

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

2.2 Recommended Battery Operating Settings

Although the battery is capable of performing at higher operating limits, 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
Low Voltage Disconnect	24 V	48 V
Operating Temperature	20°C (68°F)	

3. Installation

▲ **WARNING!**

Read Safety Section before installing the battery.

▲ **CAUTION!**

Do not install batteries in series. Select the appropriate AES battery model for the voltage of your system.

3.1 Battery DC and Communication Connections

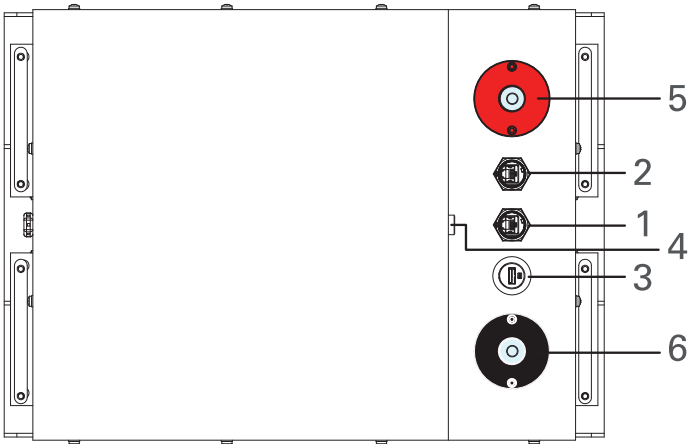


Figure 1. Discover AES terminal deck.

ITEM	DESCRIPTION
1	COM1 AEBus interface to connect to AES enabled devices
2	COM2 unused
3	USB interface for PC connectivity
4	On-Off when battery is enabled blue power light will be illuminated
5	Battery Positive (+) (red) DC terminal connects to the positive bus bar of the DC Switchgear
6	Battery Negative (-) (black) DC terminal connects to the negative bus bar of the DC Switchgear

### 3.2 Installation

- Check that battery is switched off
- If the battery circuit has a disconnect, open disconnect to isolate battery
- Clean cable connections. Broken, frayed, brittle, kinked or cut cables should be replaced
- Install and secure battery. Be careful not to ground the terminals to any metal mounting, fixture, or body part
- Connect battery cables. Connect ground cable last to avoid sparks
- Recommended terminal torque is 9.0 Nm (6.64 ft-lb)
- Close circuit disconnect (if open)
- Turn battery switch on

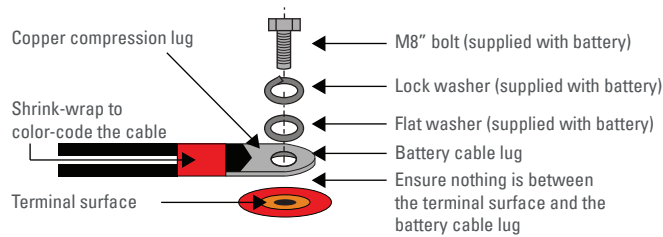


Figure 2. Terminal stack.

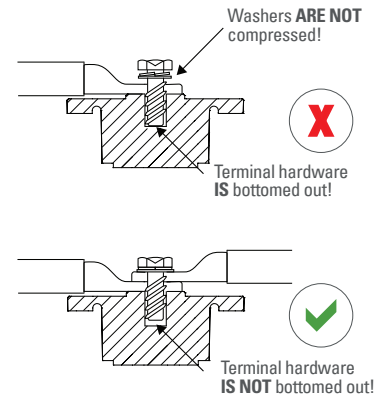


Figure 3. Proper hardware selection.

#### ▲ 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.

### 3.3 Battery Location

Locate the batteries close to the inverter in order to minimize the length of the battery cables. However, care should be taken to ensure adequate clearance above the batteries is maintained for access to both battery and inverter connections and disconnects.

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

### 3.4 Battery Connection and Parallel Wiring

To ensure proper balancing and load sharing between parallel batteries refer to the wiring diagram below. Actual wiring requirements may vary. Consult with your local authority having jurisdiction.

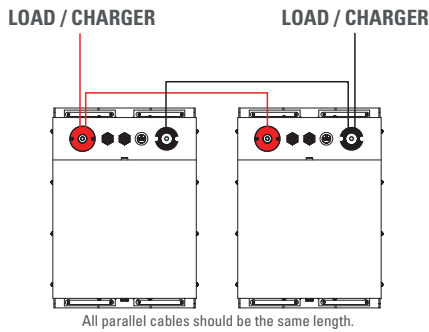


Figure 4. Two parallel batteries.

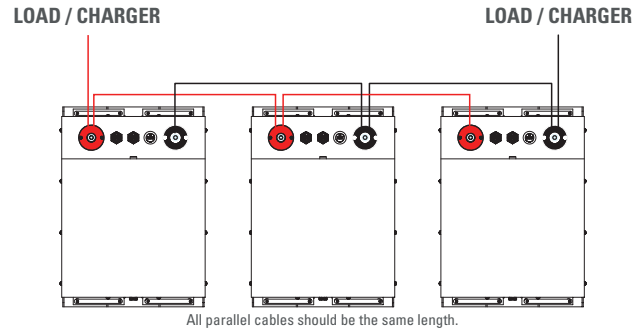


Figure 5. Three parallel batteries.

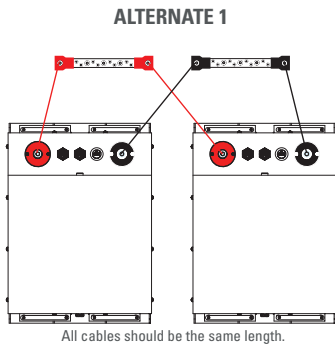


Figure 6. Two parallel batteries with DC terminal blocks.

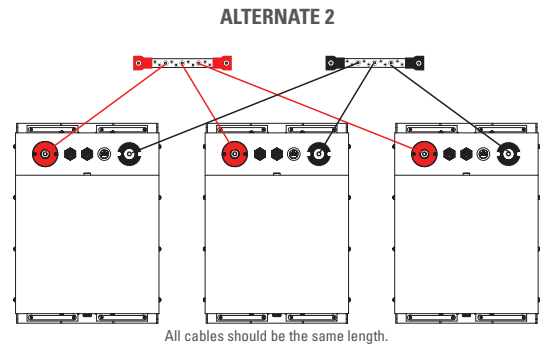


Figure 7. Three parallel batteries with DC terminal blocks.

## 4. Configuration Settings

### ▲ CAUTION!

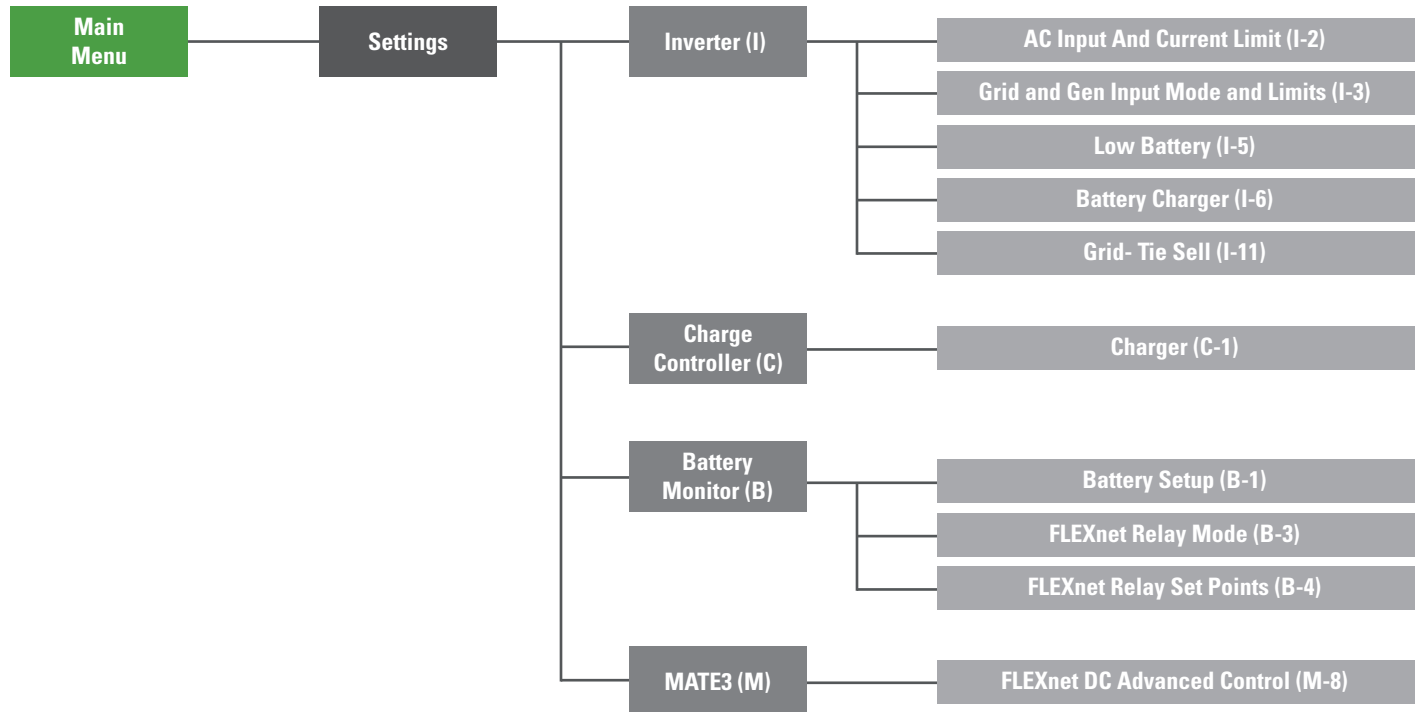
The OutBack Power Remote Temperature Sensor (RTS) should not be used with Discover AES lithium batteries as the temperature compensation functions will exceed the battery operating limits.

### 4.1 Access to Main Menu

Configuration of the system is performed in the MATE3 or MATE3s system display's Main Menu. To gain access to Main Menu a password is required.

1. From the home screen, press the LOCK key to bring up the 'Enter Password' screen.
2. Rotate the Control Wheel until the display shows the number 141.
3. Press the Center Button to accept the password.

## 4.2 MATE3 Menu Map



## 4.3 Inverter Programming Settings

Inverter Settings (I)	MATE3 Menu Location	44-24-2800	42-48-6650
Absorb Voltage	I-6	27.6 V	55.2 V
Absorb Time	I-6	0.1 hour <sup>(1)</sup>	0.1 hour <sup>(1)</sup>
Float Voltage	I-6	26.8 V	53.6 V
Float Time	I-6	Time = 0 (Disable)	Time = 0 (Disable)
Re-Float Voltage	I-6	25.0 V (Disable, leave at default)	50.0 V (Disable, leave at default)
Re-Bulk Voltage	I-6	25.2 V	50.4 V
AC Input Mode	I-3	Adjust as needed	Adjust as needed
Grid Tie - Sell Voltage	I-11	26.0 V	52.0 V
Charger AC Limit	I-2	12 A @ 240 V / 24 A @ 120 V	29 A @ 240 V / 58 A @ 120 V
Low Battery - Cut-Out Voltage	I-5	24.0 V <sup>(2)</sup>	48.0 V <sup>(2)</sup>
Low Battery - Cut-In Voltage	I-5	25.6 V	51.2 V

(1) Under lightly loaded conditions, OutBack Power charging devices may not regulate their voltage well and may cause voltage fluctuations that rise above the battery operating limits. The minimum Absorb time is 0.1 hour, or six minutes, to mitigate the risk of overcharging the batteries.

(2) The OutBack Power Low Battery Cut Out has a minimum 5 minute timer, which is not optimized for lithium battery integration. When the system has large loads the timer may prevent inverter low battery fault before the battery's internal BMS protects itself, causing the system to shut down. As a workaround to negate this feature the FLEXnet DC relay can be used to trigger a low voltage cutout with little or no delay (See section 4.7). The relay contacts are connected to the INVERTER ON/OFF terminals to turn the inverter off and prevent the battery from being over-discharged. See section 4.5 FLEXnet DC for recommended settings.



#### 4.4 Charge Controller Programming Settings

Charge Controller Settings (C)	MATE3 Menu Location	44-24-2800	42-48-6650
Absorb Voltage	C-1	27.8 V <sup>(3)</sup>	55.6 V <sup>(3)</sup>
Absorb Time	C-1	0.1 hour <sup>(1)</sup>	0.1 hour <sup>(1)</sup>
Float Voltage	C-1	27.0 V <sup>(3)</sup>	54.0 V <sup>(3)</sup>
Rebulk Voltage	C-1	25.2 V	50.4 V
Current Limits	C-1	110 A	130 A
Absorb End Amps	C-1	0 A	0 A

(1) Under lightly loaded conditions, OutBack Power charging devices cannot regulate their voltage well and may cause voltage fluctuations that rise above the battery operating limits. The minimum Absorb time is 0.1 hour, or six minutes, to mitigate the risk of overcharging the batteries.

(3) Set the Charge Controller Absorb and Float voltages 0.2Vdc (24V Nominal Systems) and 0.4Vdc (48V Nominal Systems) higher than inverter settings to prioritize charging from charge controller.

#### 4.5 FLEXnet Programming Settings

FLEXnet Settings (B)	MATE3 Menu Location	44-24-2800	42-48-6650
Battery Amps-hours	B-1	110 Ah <sup>(4)</sup> x # of batteries	130 Ah <sup>(4)</sup> x # of batteries
Charged Voltage	B-1	27.2 V, 1 min	54.4 V, 1 min
Charged Return Amps	B-1	5.5 A	6.5 A
Charge Factor	B-1	98%	98%
FLEXnet Relay Mode - Invert Logic	B-3	No	No
FLEXnet Relay Set Points - Voltage	B-4	High = 26.5 V Low = 24.8 V	High = 53.0 V Low = 49.6 V
FLEXnet Relay Set Points - SOC	B-4	High = 0% Low = 0%	High = 0% Low = 0%
FLEXnet Relay Set Points - Delay	B-4	High = 1 Low = 0	High = 1 Low = 0

(4) Adjust Batteries Amp-Hours to reflect the total installed capacity of the system.

#### 4.6 MATE3/MATE3s Programming Settings

MATE3 Settings (M)	MATE3 Menu Location	44-24-2800	42-48-6650
FLEXnet DC Advanced - Low SOC Warning Level	M-8	20%	20%
FLEXnet DC Advanced - Critical SOC Warning Level	M-8	10%	10%

#### 4.7 LBCO Work Around

When the LBCO 5 minute timeout feature is not compatible with your system operation the FLEXnet DC Battery Monitor can be used to trigger an appropriate low voltage cut-out response for lithium batteries in low state of charge operating regions.

The FLEXnet DC Battery Monitor relay can be connected to the INVERTER ON/OFF terminals to turn the inverter off and prevent the batteries from being discharged below the internal BMS protection values. Follow the settings advised above and connect the FLEXnet DC Battery Monitor to the Inverter following the figure below.

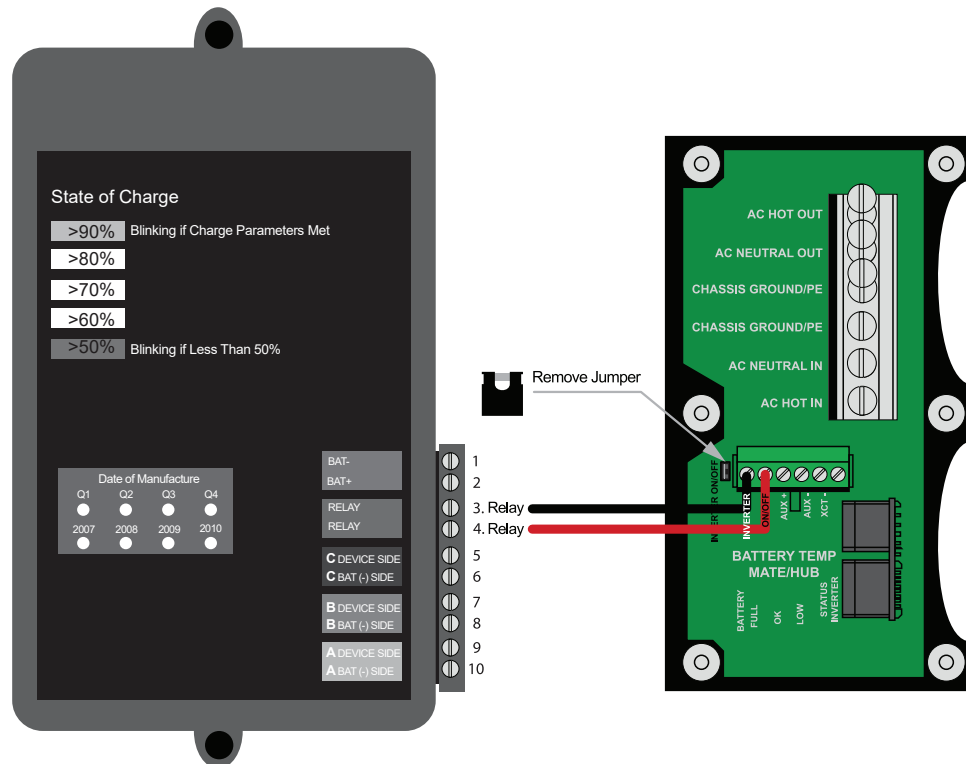


Figure 8. FLEXnet DC Battery Monitor to Inverter Wiring Diagram.