

# LYNK II

(950-0025)

## SOL-ARK USER MANUAL

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# 1.0 SAFETY

## 1.1 Audience

Configuration, installation, service, and operating tasks should only be performed by qualified personnel in consultation with local authorities having jurisdiction and 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
- Installing and configuring systems activated by relays

## 1.2 Warning, Caution, Notice and Note Messages

Messages in this manual are formatted according to this structure.

### **WARNING**

Important information regarding hazardous conditions that may result in personal injury or death.

### **CAUTION**

Important information regarding hazardous conditions that may result in personal injury.

### **NOTICE**

Important information regarding conditions that may damage the equipment but not personal injury.

### **NOTE**

Ad hoc information concerning important procedures and battery features not related to personal injury or equipment damage.

## 1.3 General Warnings

### WARNING

#### **ELECTRIC SHOCK AND FIRE HAZARD**

A lithium battery must be installed as specified. Do not disassemble or modify the battery. If the battery case has been damaged, do not touch exposed contents. There are no user-serviceable parts inside.

**Failure to follow these instructions may result in death or serious injury.**

### WARNING

#### **ELECTRIC SHOCK AND FIRE HAZARD**

Do not lay tools or other metal parts on top of the battery or across the terminals.

**Failure to follow these instructions may result in death or serious injury.**

### CAUTION

#### **ELECTRIC SHOCK**

Do not touch the energized surfaces of any electrical component in the battery system. Before servicing the battery, follow all procedures to fully de-energize the battery system and use safe handling procedures when handling the battery.

**Failure to follow these instructions may result in injury.**

Before using the battery and any power electronics, read all instructions and cautionary markings on all components and appropriate sections of their manuals.

- Use personal protective equipment when working with batteries.
- Do not dispose of the battery in fire.
- Promptly dispose or recycle used batteries following local regulations.
- Do not disassemble, open, crush, bend, deform, puncture or shred.
- Do not modify, re-manufacture, attempt to insert foreign objects into the battery, immerse or expose to water or other liquids, or expose to fire explosion or other hazards.
- Only use the battery for the system for which it is specified.
- Do not lift or carry the battery while in operation.
- When lifting a heavy battery, follow the appropriate standards.
- Only lift, move, or mount following local regulations.
- Take care when handling battery terminals and cabling.
- Only use the battery with a charging system that has been qualified for the system. The use of an unqualified battery or charger may present a risk of fire, explosion, leakage, or other hazards.
- Do not short circuit a battery or allow metallic conductive objects to contact battery terminals.

- Replace the battery only with another battery that has been qualified for the system. The use of an unqualified battery may present a risk of fire, explosion, leakage, or other hazards.
- Avoid dropping the device or battery. If the device or battery is dropped, especially on a hard surface, and the user suspects damage, take it to a service center for inspection.

## 1.4 Personal Protective Equipment

When handling or working near a battery:

- Use Personal Protective Equipment, including clothing, glasses, insulated gloves, and boots.
- Do not wear rings, watches, bracelets, or necklaces.

## 2.0 Documentation

This Application Note provides information about the integration of LYNK and AEBus network-enabled Discover Lithium Batteries using the LYNK II Communication Gateway with Sol-Ark inverter-chargers.

Before installation and configuration, consult the relevant product documentation, including Manuals, Application Notes, Installation and Configuration Guides.

### **Sol-Ark Documentation**

Visit <https://www.sol-ark.com/> for the most recent version of published documents.

### **Discover Battery Documentation**

Visit <http://discoverbattery.com> for the most recent version of published documents, including Discover Lithium battery user manuals and the LYNK II Communication Gateway User Manual (805-0033).

## 3.0 Overview

This manual provides general settings and is not a comprehensive guide to the programming and configuration of a specific installation. An installation may have unique conditions or use cases that require modification or adaptations of values. Installers must be capable of reviewing and adapting to the specifics of an installation and its specific use case and optimizing settings where needed.

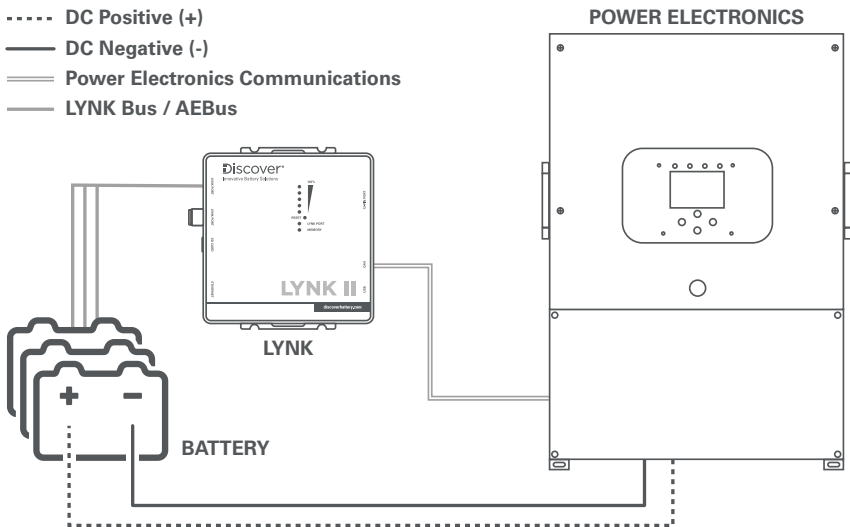
### 3.1 System Overview

The LYNK II Communication Gateway unlocks the full potential of a Discover Lithium battery by enabling the internal Battery Management System (BMS) to provide real-time data in a closed-loop configuration to other devices. In solar applications, this allows the world's best hybrid inverter-chargers and solar charge controller systems to optimize their control over the charging process. LYNK II also enables the remote monitoring of Discover Lithium battery SoC and data logging of multiple sites using the data monitoring services offered by off-grid inverter systems.

Discover Lithium batteries must be set up to work with power conversion and monitoring devices in either an open-loop or closed-loop configuration.

Discover Lithium battery charge, and discharge settings in an open-loop configuration are set up manually through the controller for the power conversion device at the time of installation. An open-loop configuration is commonly referred to as a 'lead-acid drop-in' replacement configuration.

In a closed-loop configuration, the BMS of the Discover Lithium battery sends battery status over a network data connection with the power conversion device. Power conversion devices use the Discover Lithium battery BMS data to finetune the output of their charger and deliver other functional controls based on battery voltage, temperature and percent State-of-Charge.



*Figure 1. System Overview*

### 3.2 Compatibility

LYNK II Communication Gateway is compatible with the following:

#### Discover Lithium Batteries

- AES  $\text{LiFePO}_4$ : 44-24-2800, 44-48-3000, 42-48-6650
- HELIOS ESS: 46-24-1560, 46-48-1540

#### Sol-Ark Outdoor Inverters

- Sol-Ark 5K-P
- Sol-Ark 8K-P
- Sol-Ark 12K-P
- Sol-Ark 15K-P

#### Sol-Ark Indoor Inverters (Legacy)

- Sol-Ark 8K Hybrid
- Sol-Ark 12K Hybrid

### 3.3 Minimum Battery System Capacity

Battery charge and discharge rates are managed automatically by the Discover Lithium Battery and Sol-Ark device. Using large solar arrays with battery banks that are too small can exceed the operating limits of the battery to charge and possibly lead to the BMS triggering over-current protection. Battery capacity must accept the maximum charge current of the system, or charging must be curtailed below the operating limit of the installed batteries. Derive this value by adding together the charge capacities of all inverter-chargers and solar charge controllers in the system. Additionally, battery peak capacity must support the surge requirements demanded by the load attached to the inverter. Match all inverter peak power values with the sum of all battery peak battery current values.

**Inverter Peak = (Inverter Surge Value) / (Inverter Efficiency) / (48V: Low Battery Cut-Off)**

Model	Inverter Peak	Charger Continuous Max <sup>3</sup>	42-48-6650 Minimum per inverter <sup>4</sup>	44-48-3000 Minimum per inverter <sup>5</sup>	46-48-1540 Minimum per inverter <sup>6</sup>
<b>Sol-Ark 5K-P</b>	345 A DC <sup>1</sup>	120 A DC	2	2	4
<b>Sol-Ark 8K-P</b>	345 A DC <sup>1</sup>	185 A DC	2	4	6
<b>Sol-Ark 12K-P</b>	345 A DC <sup>1</sup>	185 A DC	2	4	6
<b>Sol-Ark 15K-P</b>	518 A DC <sup>2</sup>	275 A DC	3	5	10

<sup>1</sup> Calculated based on Surge Power 16,000 VA (10s) and Efficiency 96.5% CEC, as published in Sol-Ark User Manuals (2022-05).

<sup>2</sup> Calculated based on Surge Power 24,000 VA (10s) and Efficiency 96.5% CEC, as published in Sol-Ark User Manuals (2022-05).

<sup>3</sup> As published in Sol-Ark User Manuals (2022-05).

<sup>4</sup> Discover AES 42-48-6650 Battery, Peak Power: 300 A DC (3 seconds), 130 A DC Continuous Charge, as published in Discover AES User Manual (2022-05).

<sup>5</sup> Discover AES 44-48-3000 Battery, Peak Power: 219 A DC (3 seconds), 57 A DC Continuous Charge, as published in Discover AES User Manual (2022-05).

<sup>6</sup> Discover HELIOS 46-48-1540 Battery, Peak Power: 90 A DC (3 seconds), 30 A DC Continuous Charge, as published in Discover AES User Manual (2022-05).

## 4.0 LYNK II CAN Hardware Termination and CAN Out PIN Configuration

### 4.1 LYNK II CAN Termination

#### NOTE

Disconnect power and all connections to LYNK II before attempting to configure header jumpers.

Jumpers are used to configure termination for AEBus and LYNK Network, and the CAN Out PIN assignments. Follow the **LYNK II User Manual (805-0033)** to learn how to access and configure the header board with jumpers.

Detailed PIN configurations are included in the LYNK II User Manual but are repeated here for convenience.

#### NOTE

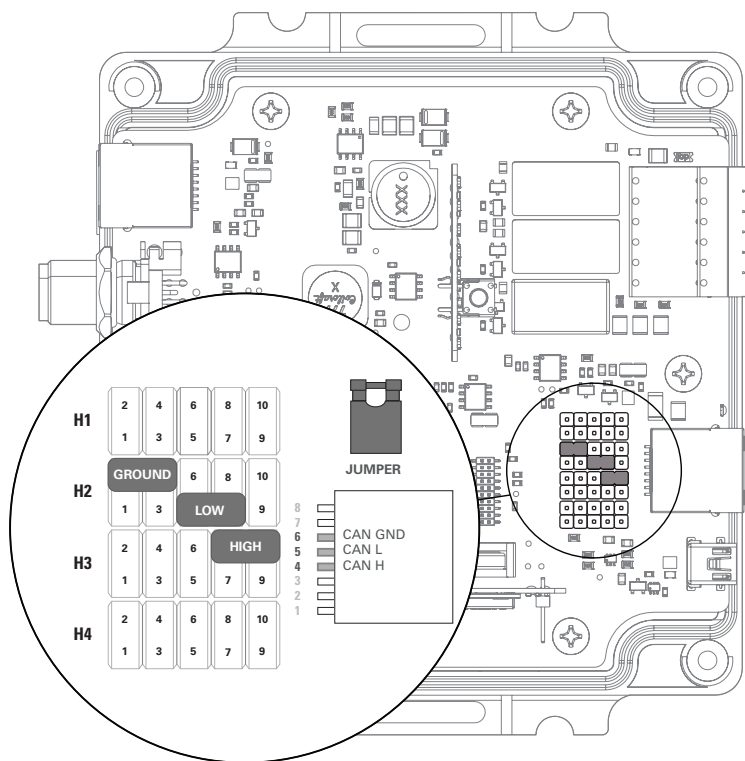
LYNK II terminates the AEBus and LYNK Network by default. Do not remove the termination jumper inside LYNK II unless instructed to do so by Discover Battery.

### 4.2 LYNK II CAN Out - RJ45 PIN Assignments for Sol-Ark Inverters

CAN signals (CAN H, CAN L, CAN GND) can be assigned to any PIN of the RJ-45 connector by adjusting the jumpers on the header board.

#### NOTE

There are different ground pin (CAN GND) assignments for the Sol-Ark indoor (Legacy) and outdoor inverter-chargers.

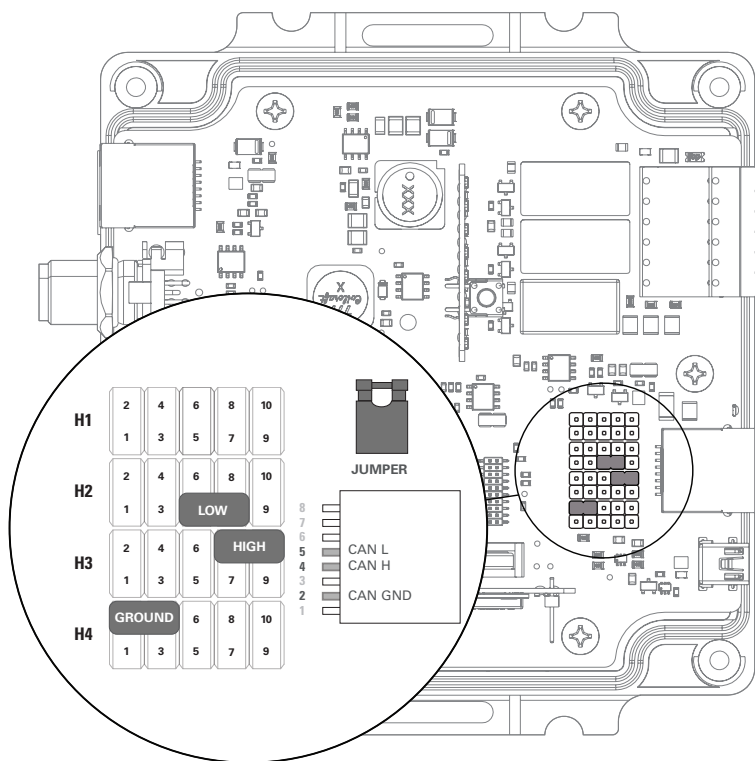


**Figure 2. Sol-Ark Outdoor CAN Pin Assignment**

#### 4.2.1 Sol-Ark Outdoor Inverter-Charger PIN Assignments

- 5K-P
- 8K-P
- 12K-P
- 15K-P

CAN Out	Header Jumper	RJ45 PIN
CAN L	H2 - 5 - 7	5
CAN H	H3 - 8 -10	4
CAN GND	H2 - 2 - 4	6



**Figure 3. Sol-Ark Indoor (Legacy) CAN Pin Assignment**

#### 4.2.2 Sol-Ark Indoor (Legacy) Inverter-Charger PIN Assignments

- 8K Hybrid
- 12K Hybrid

CAN Out	Header Jumper	RJ45 PIN
CAN L	H2 - 5 - 7	5
CAN H	H3 - 8 - 10	4
CAN GND	H4 - 2 - 4	2

# 5.0 Installing and Connecting LYNK II to the Sol-Ark Network

## 5.1 Networking Discover Lithium Batteries with LYNK II

### NOTE

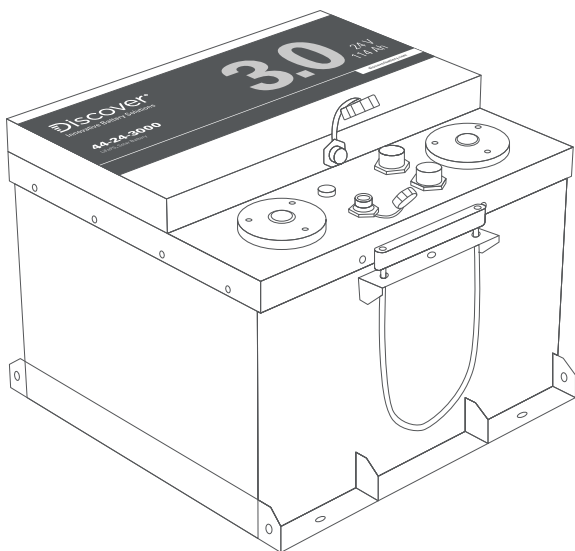
- Do not plug an AEBus RJ-45 network cable or terminator into the 10/100 Ethernet port of the LYNK II.
- Do not connect a CAT5 cable from the AEBus, LYNK or Ethernet ports of the LYNK II to a WAN or MODEM port of a network router.
- Turn OFF all devices before connecting cables.
- Mixing the LYNK Network with other networks may result in equipment malfunction and damage.

### NOTE

Unless specified by Discover Battery, power electronics must not be connected directly to the LYNK network or AEBus network.

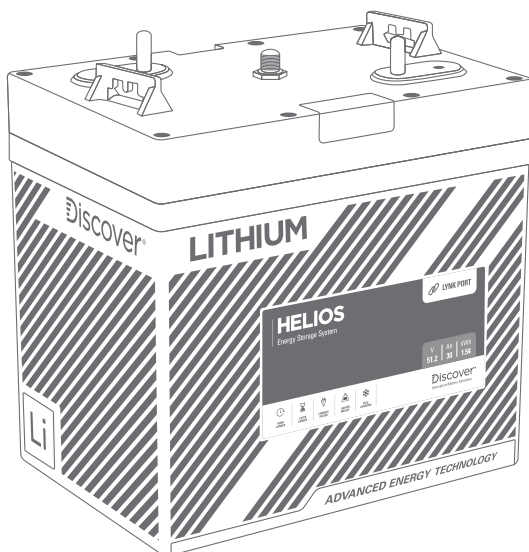
Refer to the **LYNK II Communication Gateway User Manual (850-0033)** for detailed instructions on network layouts, connections and terminations for compatible Discover Lithium battery models. Some key reminders are repeated here for convenience.

- At least one battery must be connected to the LYNK Port or AEBus Port on LYNK II.
- A network of batteries will communicate as one battery.
- No more than one network of batteries may be connected to LYNK II.
- Network termination is required for the system's proper functioning - note some batteries and devices may auto-terminate.
- LYNK II requires power from three possible sources (13-90 VDC power supply, AEBus Port, or LYNK Port enabled Discover Lithium batteries or a USB device).
- Discover Lithium batteries must be set to ON to supply power and communicate data with LYNK II.



**Figure 4. AES**

AES batteries are not internally terminated. LYNK II is internally terminated. When using LYNK II with an AEBus network, ensure that a terminator is installed at the end opposite LYNK II.



**Figure 5. Helios**

LYNK II and HELIOS ESS batteries are both internally terminated. When installing LYNK II with Helios batteries, no external termination is required.

## 5.2 Connecting LYNK II to the Sol-Ark Network

Before connecting LYNK II to the Sol-Ark network, ensure that all Sol-Ark devices use COMM firmware version 1.4.3.0 or higher. Also, ensure that the CAN out pins for LYNK II are configured correctly.

Insert one end of a CAT5 communication cable into the LYNK II CAN out port and the other end into the correct CAN port of the Sol-Ark inverter charger.

<b>NOTE</b>
Ensure that all Sol-Ark inverters are using COMM firmware version 1.4.3.0 or higher.

<b>NOTE</b>
There are different CAN port locations across Sol-Ark indoor (legacy) and outdoor models.

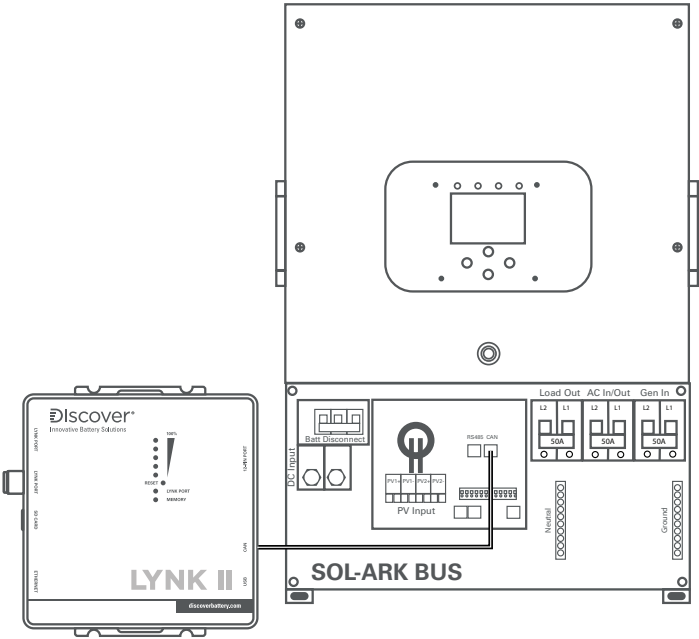
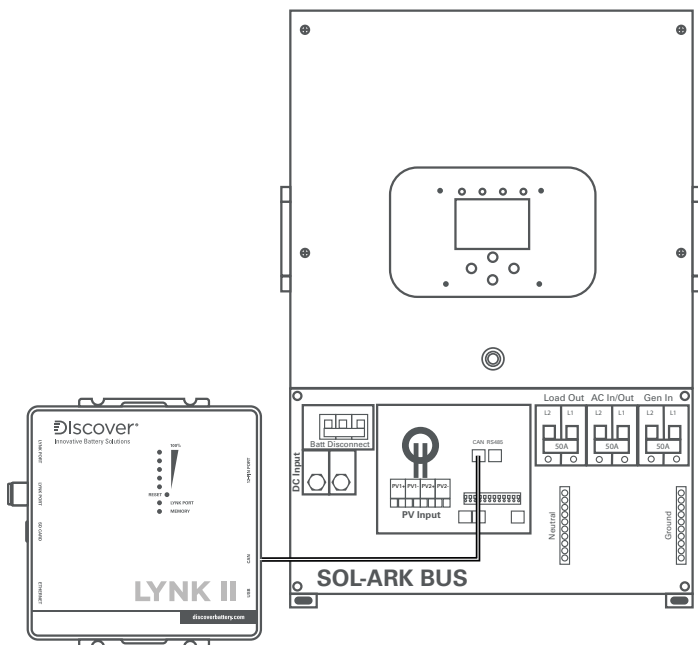
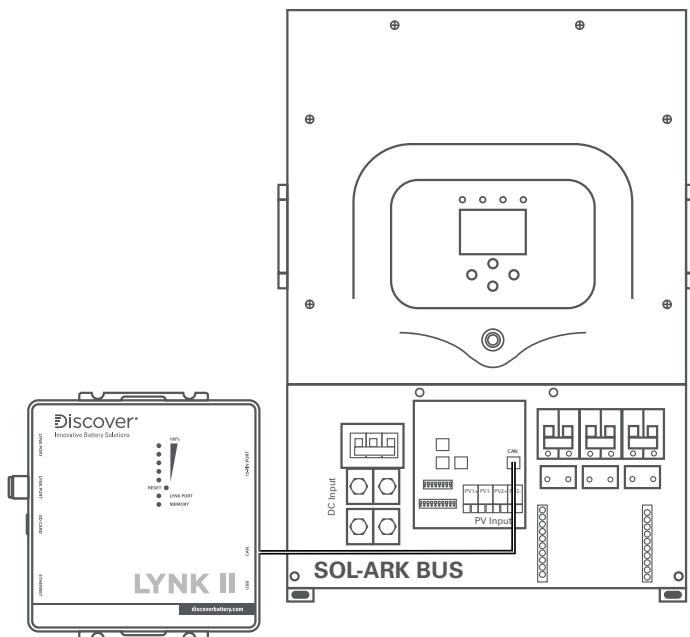


Figure 6. Indoor Sol-Ark 8K Hybrid (Legacy)



**Figure 7. Indoor Sol-Ark 12K Hybrid (Legacy)**



**Figure 8. Sol-Ark Outdoor 5K-P / 8K-P / 12K-P / 15K-P**

# 6.0 Enabling LYNK II to Communicate with Sol-Ark Devices

When properly connected to a closed-loop network and set to use the Sol-Ark protocol, LYNK II will transmit real-time parameters from the Discover Lithium battery, including voltage, current, temperature, state of charge and fault conditions to a Sol-Ark Inverter. LYNK II will also transmit charge voltage and current requests from the Discover Lithium battery to a Sol-Ark Inverter.

LYNK ACCESS software for 64-bit Windows 10 is required to configure LYNK II settings for closed-loop CAN communication with Sol-Ark inverters.

Users and installers should be aware that if communication between the LYNK II and inverter is lost for more than ten seconds, the inverter will safely stop operation, so long as the BMS Lithium Batt and the BMS\_Err\_Stop parameters are both enabled on the Sol-Ark inverter. The inverter will display an F58 BMS Communication Fault if communication is lost.

The Sol-Ark inverter will check every five minutes and resume close-loop operation if communication is reestablished. However, if communication cannot be reestablished, the Sol-Ark inverter will need to be manually converted to an open-loop configuration to resume operation. Therefore as a precautionary measure, it is recommended to program the Sol-Ark inverter with the correct voltage-based open-loop parameters before setting up the system to function in a closed-loop configuration.

The Sol-Ark inverter will operate in an open-loop configuration using voltage-based parameters if the BMS Lithium Batt parameter is disabled and the Use Batt V Charged parameter is enabled.

## NOTE

In a closed-loop configuration with the BMS Lithium Batt function enabled, the BMS\_Err\_Stop parameter must be enabled. If the BMS\_Err\_Stop parameter function is not enabled, the Sol-Ark inverter will continue to operate based on the last communicated battery values. Depending on the mode of operation at the time of communication fault and given enough time, the Sol-Ark inverter-charger will eventually put the attached battery into an overcharged or fully discharged state. When that occurs, either situation will trigger the Discover Lithium Battery BMS to self-protect and disconnect the battery from the system.

## NOTE

Neither Discover Lithium batteries nor LYNK II directly control Sol-Ark relay functions, generator starting or other grid-interactive features. These functions are controlled through the programming of the Sol-Ark inverter.

# 6.1 Setting the Sol-Ark Open-Loop Configuration

As a precautionary measure, it is recommended to program the Sol-Ark inverter with the correct voltage-based open-loop parameters before setting up closed-loop parameters.

If necessary, first configure Sol-Ark inverters to operate in parallel by establishing the inverter master/slave relationships and phase designations before setting the parameters for battery operation. Configuring the master inverter will cascade parameters and settings to the slave inverters.

## The Open-loop Configuration Procedure

Refer to the latest Discover Battery documentation for battery values and the latest Sol-Ark documentation for details on menu navigation and the setup procedure.

1. Set the Discover Lithium batteries to ON and set the inverter to ON.
2. Using the touch screen and keypad on the inverter, navigate from the SYSTEM SETUP menu to the BATT SETUP menu screen.
3. Enable and disable parameters according to the instructions in the tables below.
4. Set each variable parameter according to the instructions in the tables below
5. Touch the OK button to save all onscreen values - Ignore data displayed in GREY boxes.

### NOTE

Touch the Sol-Ark screen to:

- Navigate the Sol-Ark onscreen menus.
- Enable parameters.
- Activate the adjustment of values.
- Save all onscreen settings.

Values are adjusted using the keypad.

### NOTE

Enable parameters with a CHECKMARK, and disable parameters by leaving them unchecked. Touch a WHITE box onscreen to activate the adjustment of that value. Selecting parameters that have been enabled and disabled alters values that are available to be adjusted.

- A WHITE BOX indicates values that can be adjusted.
- A GREY BOX indicates values that cannot be adjusted, and any data displayed should be ignored.

## NOTE

If necessary, configure Sol-Ark inverters to operate in parallel before setting the parameters for battery operation.

### 6.1.1 Open-Loop - Batt Setup > Batt

Touch the BATT tab onscreen to start the programming sequence (**Figure 9.**).

- Touch the OK button to save all onscreen values - Ignore data displayed in GREY boxes.

Batt Setup	
Batt	Charge   Discharge   Smart Load
Batt Capacity	260 Ah <input checked="" type="checkbox"/> Use Batt V Charged
Max A Charge	185 A <input type="checkbox"/> Use Batt % Charged
Max A Discharge	185A <input type="checkbox"/> No Battery
TEMPCO	-0mV/C/Cell <input type="checkbox"/> BMS Lithium Batt 00
	<input checked="" type="checkbox"/> Activate Battery
<div>CANCEL OK</div>	

**Figure 9. Open-Loop Battery Setup > Batt Menu (Two 130Ah AES Batteries with 12K-P)**

Batt Setup > Batt	
Batt Capacity	Set to the number of Discover Lithium batteries x Ah capacity of each. For example, set to 260 Ah (2 x 130 Ah) for two AES 42-48-6650 batteries.
Max A Charge	<p>For a single inverter: set to the lesser of the inverter's max charge capacity, or the quantity of attached batteries, multiplied by the battery model's specific max charge rating. For example, a 12K-P inverter would be set to the lessor of the inverter's max charge rate of 185 A, or 260 A for two AES 42-48-6650 batteries rated at 130 A max charge each.<sup>1</sup></p> <p>For a three-phase system: set to the lessor of the max charge value for the master inverter, or the quantity of attached batteries, multiplied by the battery model's max charge rating, divided by the number of inverters. For example, the 12k-P master would be set to the lessor of the inverter's max charge rate of 185A, or 173 A for four AES 42-48-6650 batteries rated at 130 A max charge each (520 A divided by three inverters).</p>

Max A Discharge	<p>For a single inverter: set to the lesser of the inverter's max discharge capacity, or the quantity of attached batteries, multiplied by the battery model's specific max discharge rating. For example, a 12k-P inverter would be set to the lesser of the inverter's max discharge rate of 185 A, or 260 A for two AES 42-48-6650 batteries rated at 130 A max charge each.<sup>1</sup></p> <p>For a three-phase system: set to the lesser of the max discharge value for the master inverter, or the quantity of attached batteries, multiplied by the battery model's max charge rating, divided by the number of inverters. For example, the master 12k-P would be set to the lesser of the inverter's max charge rate of 185 A, or 173 A for a battery bank of four AES 42-48-6650 batteries rated at 130A Max Charge each (520 A divided by three inverters).</p>
TEMPCO	Set to 0 mv/C/Cell. <sup>2</sup>
Use Batt V Charged	Enable
Use Batt % Charged	Disable
No Battery	Disable
BMS Lithium Batt	Disable (Displays 00 value) <sup>3</sup>
Activate Battery	Enable
<p><sup>1</sup> The recommended value for Max A Charge is 75% of the rated maximum charge current for the battery.</p> <p><sup>2</sup> Discover Lithium batteries do not require temperature compensation. Setting TEMPCP to 0 mv/C/Cell will disable inverter-charger controlled temperature compensation.</p> <p><sup>3</sup> Setting the BMS Lithium Batt parameter to Disable confirms open-loop operation. Setting the parameter to Enable confirms closed-loop operation.</p> <p>The values and parameters used are for an assumed operating temperature of 25 deg C.</p>	

## 6.1.2 Open-Loop - Batt Setup > Charge

Touch the CHARGE tab onscreen to start the programming sequence (**Figure 10**).

- Touch the OK button to save all onscreen values - Ignore data displayed in GREY boxes.

**Batt Setup**

Batt	Charge	Discharge	Smart Load
StartV	48.0V	48.0V	Float V
Start%	10%	10%	Absorption V
A	185 A	185 A	Equalization V
<input checked="" type="checkbox"/> Gen Charge	<input checked="" type="checkbox"/> Grid Charge		30 Days
Generator Exercise Cycle Day & Time>>		Mon 08	:00 20min
<input type="checkbox"/> Gen Force	CANCEL	OK	

**Figure 10. Open-Loop Battery Setup > Charge (Two 130Ah AES Batteries with 12K-P)**

Batt Setup > Charge	
Gen Charge	Enable if charging from a generator is desired. <sup>1</sup> Note: The Gen Input Breaker must be connected to the output of an AC generator for this work.
Grid Charge	Enable if charging from the grid is desired. <sup>2</sup> Note: The Grid Input Breaker must be connected to input from the grid for this to work.
StartV	Set the value to the desired battery voltage that will trigger battery charging. The absolute minimum is 48 V.
Start%	Unavailable (Grey) in an open-loop configuration.
A	Set to the same Amp value that was used for Max A Charge. <sup>3</sup>
Float V	Set to 53.6 V
Absorption V	Set to 55.2 V <sup>4</sup>
Equalization V	55.2 V <sup>5</sup> 30 days 0.0 hours <sup>5</sup>
Gen Exercise Cycle Day & Cycle	Refer to Solar-Ark documentation.
Gen Force	Refer to Solar-Ark documentation.
<p><sup>1</sup>Left column options are for Gen Charge AutoStart values (Reference Sol-Ark documentation for more details on the generator AutoStart function.</p> <p><sup>2</sup>Right Column options are for Grid Charge values.</p> <p><sup>3</sup>If need be, this value is used to curtail the maximum current output of the charger.</p> <p><sup>4</sup>Absorption will stop at 2% of the set capacity of the battery bank and move to the float value.</p> <p><sup>5</sup>Lithium batteries MUST not be equalized. Using a value of 55.2 for Equalization V and zero for Hours ensures that the batteries will not be equalized.</p> <p>The values and parameters used are for an operating temperature of 25 deg C.</p>	

6.1.3 Open-Loop - Batt Setup > Discharge

Touch the DISCHARGE tab onscreen to start the programming sequence (Figure 11).

- Touch the OK button to save all onscreen values - Ignore data displayed in GREY boxes.

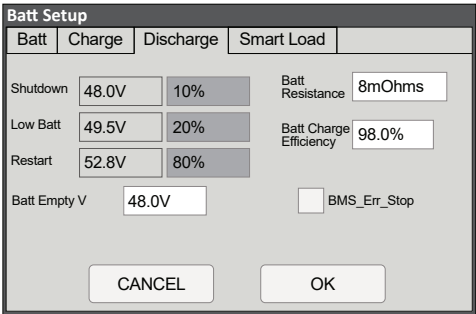


Figure 11. Open-Loop Battery Setup > Discharge (Two 130Ah AES Batteries with 12K-P)

Batt Setup > Discharge	
BMS_Err_Stop	Disable
Shutdown	48.0 V <sup>1</sup>
Low Batt	49.5 V <sup>1</sup>
Restart	52.8 V <sup>1</sup>
Batt Empty V	48.0 V
Batt Resistance	Set to: Ten mOhm divided by the number of batteries, plus the mOhm value of resistance for interconnection and homerun cabling. <sup>2</sup>
Batt Charge Efficiency	98.0 %
<div>1 Discharge state-of-charge percentage values are unavailable in an open-loop (voltage-based) configuration.</div> <div>2 This value should include cable and connection resistance. The formula is provided to assist with the calculation of a general value.</div> <div>The values and parameters used are for an operating temperature of 25 deg C.</div>	

6.2 Setting the LYNK II Communication Protocol for Sol-Ark

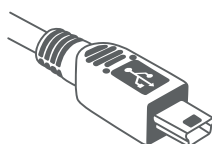
After establishing the open-loop configuration, the LYNK II Communication Protocol is set, followed by the Sol-Ark closed-loop configuration.

The Protocol Configuration Procedure

1. Download the current version of LYNK ACCESS software from the Discover Battery website to obtain the most up-to-date suite of available protocol

configurations.

2. Using a USB cable with a Type-B mini-plug, connect the 64-bit Windows 10 device running LYNK ACCESS software to the USB port on LYNK II. Ensure LYNK II is powered and connected to the correct Sol-Ark COM port.
3. Open LYNK ACCESS. Options for configuration and settings are found by selecting the LYNK tab.
4. Connect the LYNK II and open LYNK ACCESS. Ensure that you only have one LYNK device connected to the Computer.
5. Open LYNK ACCESS and select the LYNK tab. Select the blue gear icon in the upper right area of the CAN Settings tile.
6. Select the pre-configured Sol-Ark protocol to complete the closed-loop configuration for LYNK II. Click SAVE to confirm the configuration.



### NOTE

Saving configuration changes using LYNK ACCESS will automatically cause LYNK II to shut down and restart.

## 6.3 Setting the Sol-Ark Closed-Loop Configuration

### NOTE

In a closed-loop configuration with the BMS Lithium Batt function enabled, the BMS\_Err\_Stop parameter must be enabled. If the BMS\_Err\_Stop parameter function is not enabled, the Sol-Ark inverter will continue to operate based on the last communicated battery values. Depending on the mode of operation at the time of communication fault and given enough time, the Sol-Ark inverter-charger will eventually put the attached battery into an overcharged or fully discharged state. When that occurs, either situation will trigger the Discover Lithium Battery BMS to self-protect and disconnect the battery from the system.

### NOTE

It is recommended that the Sol-Ark inverter be programmed with the appropriate open-loop settings before enabling closed-loop communication.

Complete the Closed-loop configuration after establishing both the Sol-Ark open-loop configuration and the LYNK II Sol-Ark communication protocol. Ensure the Discover Lithium Batteries are networked with LYNK II and that the LYNK II is connected to the Sol-Ark network port.

If necessary, first configure Sol-Ark inverters to operate in parallel by establishing the inverter master/slave relationships and phase designations before setting the parameters for battery operation. Configuring the master inverter will cascade parameters and settings to the slave inverters.

## The Closed-loop Configuration Procedure

Refer to the latest Discover Battery documentation for battery values and the latest Sol-Ark documentation for menu navigation and details on the setup procedure.

1. Set the Discover Lithium batteries to ON and set the inverter to ON.
2. Using the touch screen and keypad on the inverter, navigate from the SYSTEM SETUP menu to the BATT SETUP menu screen.
3. Enable and disable parameters according to the instructions in the tables below.
4. Set each adjustable value according to the instructions in the tables below
5. Touch the OK button to save all onscreen values - Ignore data displayed in GREY boxes.

### NOTE

Touch the Sol-Ark screen to:

- Navigate the Sol-Ark onscreen menus.
- Enable parameters.
- Activate the adjustment of values.
- Save all onscreen settings.

Values are adjusted using the keypad.

### NOTE

Enable parameters with a CHECKMARK, and disable parameters by leaving them unchecked. Touch a WHITE box onscreen to activate the adjustment of that value. Selecting parameters that have been enabled and disabled alters values that are available to be adjusted.

- A WHITE BOX indicates values that can be adjusted.
- A GREY BOX indicates values that cannot be adjusted, and any displayed data should be ignored.

### NOTE

If necessary, configure Sol-Ark inverters to operate in parallel before setting the parameters for battery operation.

### 6.3.1 Closed-Loop - Batt Setup > Batt

Touch the BATT tab onscreen to start the programming sequence (**Figure 12**).

- Touch the OK button to save all onscreen values - Ignore data displayed in GREY boxes.

**Figure 12. Closed-Loop Battery Setup > Battery (Two 130Ah AES Batteries with 12K-P)**

Batt Setup > Batt	
Batt Capacity	Set to the number of Discover Lithium batteries x Ah capacity of each. (eg. Set to 260 Ah for two AES batteries, each rated 130 Ah capacity).
Max A Charge	<p>For a single inverter: set to the lesser of the inverter's max charge capacity, or the quantity of attached batteries, multiplied by the battery model's specific max charge rating. For example, a 12K-P inverter would be set to the lesser of the inverter's max charge rate of 185 A, or 260 A for two AES 42-48-6650 batteries rated at 130 A max charge each.<sup>1</sup></p> <p>For a three-phase system: set to the lesser of the max charge value for the master inverter, or the quantity of attached batteries, multiplied by the battery model's max charge rating, divided by the number of inverters. For example, the 12k-P master would be set to the lesser of the inverter's max charge rate of 185A, or 173 A for four AES 42-48-6650 batteries rated at 130 A max charge each (520 A divided by three inverters).</p>
Max A Discharge	<p>For a single inverter: set to the lesser of the inverter's max discharge capacity, or the quantity of attached batteries, multiplied by the battery model's specific max discharge rating. For example, a 12k-P inverter would be set to the lesser of the inverter's max discharge rate of 185 A, or 260 A for two AES 42-48-6650 batteries rated at 130 A max charge each.<sup>1</sup></p> <p>For a three-phase system: set to the lesser of the max discharge value for the master inverter, or the quantity of attached batteries, multiplied by the battery model's max charge rating, divided by the number of inverters. For example, the master 12k-P would be set to the lesser of the inverter's max charge rate of 185 A, or 173 A for a battery bank of four AES 42-48-6650 batteries rated at 130A Max Charge each (520 A divided by three inverters).</p>

TEMPCO	This value is disabled (grey) when BMS Lithium Batt is enabled.
Use Batt V Charged	Disable
Use Batt % Charged	Enable
No Battery	Disable
BMS Lithium Batt	Enable and set to 00 value2
Activate Battery	Enable
<p><sup>1</sup> The recommended value for Max A Charge is 75% of the rated maximum charge current for the battery.</p> <p><sup>2</sup> Setting the BMS Lithium Batt parameter to Enable confirms closed-loop operation. Ensure that a checkmark and 00 (CANBus Battery mode) is displayed.</p> <p>The values and parameters used are for an operating temperature of 25 deg C.</p>	

### 6.3.2 Closed-Loop - Batt Setup > Charge

Touch the CHARGE tab onscreen to start the programming sequence (**Figure 13**).

- Touch the OK button to save all onscreen values - Ignore data displayed in GREY boxes.

**Figure 13. Closed-Loop Battery Setup > Charge (Two 130Ah AES Batteries with 12K-P)**

Batt Setup > Charge	
Gen Charge	Enable if charging from a generator is desired. <sup>1</sup> Note: The Gen Input Breaker must be connected to the output of an AC generator for this work.
Grid Charge	Enable if charging from the grid is desired. <sup>2</sup> Note: The Grid Input Breaker must be connected to input from the grid for this to work.
StartV	Unavailable (Grey) in a closed-loop configuration.
Start%	Set to user preference based on battery State-of-charge as a percentage. The recommended minimum is 10%.

A	Set to the same Amp value that was set for Max A Charge. <sup>3</sup>
Float V	Value is communicated by BMS in a closed-loop configuration. Ignore the displayed value.
Absorption V	Value is communicated by BMS in a closed-loop configuration. Ignore the displayed value.
Equalization V	The function is disabled in a closed-loop configuration. Ignore the displayed value.
Gen Exercise Cycle Day & Cycle	Refer to Solar-Ark documentation.
Gen Force	Refer to Solar-Ark documentation.
<p>1 Left column options are for Gen Charge AutoStart values (Reference Sol-Ark documentation for more details on the generator AutoStart function.</p> <p>2 Right Column options are for Grid Charge values.</p> <p>3 If need be, this value is used to curtail the maximum current output of the charger.</p> <p>The values and parameters used are for an operating temperature of 25 deg C.</p>	

### 6.3.3 Closed-Loop - Batt Setup > Discharge

Touch the DISCHARGE tab onscreen to start the programming sequence (**Figure 14**).

- Touch the OK button to save all onscreen values - Ignore data displayed in GREY boxes.

**Batt Setup**

	Batt	Charge	Discharge	Smart Load
Shutdown	48.0V		10%	Batt Resistance 8mOhms
Low Batt	49.5V		20%	Batt Charge Efficiency 98.0%
Restart	52.8V		80%	
Batt Empty V	48.0V			<input checked="" type="checkbox"/> BMS_Err_Stop

CANCEL OK

**Figure 14. Closed-Loop Battery Setup > Discharge (Two 130Ah AES Batteries with 12K-P**

<b>Batt Setup &gt; Discharge</b>	
Shutdown	Set to user preference based on battery State-of-charge as a percentage. The recommended minimum is 10 % <sup>1</sup>
Low Batt	Set to user preference based on battery State-of-charge as a percentage. The recommended minimum is 20 % <sup>1</sup>
Restart	Set to user preference based on battery State-of-charge as a percentage. <sup>1</sup>
Batt Empty V	48 V
Batt Resistance	Set to: Ten mOhm divided by the number of batteries (plus mOhm value for cable resistance, if known). <sup>2</sup>
Batt Charge Efficiency	98.0 %
BMS_Err_Stop	Enable (Recommended) <sup>3</sup>
<p><sup>1</sup> A closed-loop configuration uses % state-of-charge. Discharge voltage values are not available.</p> <p><sup>2</sup> This value should include cable and connection resistance. The formula provided is to assist with the calculation of a general value.</p> <p><sup>3</sup> BMS_Err_Stop MUST be enabled to cause the inverter to stop operating if there is a communication error. If BMS_Err_Stop is disabled, the inverter will continue to operate using the last communicated battery values.</p> <p>The values and parameters used are for an assumed operating temperature of 25 deg C.</p>	

### 6.3.4 Batt Setup > Smart Load

Optional functionality. See Sol-Ark documentation for details on use and setup.

## NOTES

[illegible]