

Closed-Loop BMS Communication Integration Guide: Discover Energy Systems & Morningstar Corporation

Introduction:

With over four million units sold since 1993, Morningstar is recognized as the expert in charging technology throughout the solar industry. As solar-plus-storage becomes more prevalent in mainstream installations, battery chemistries are becoming more advanced—and battery makers are increasingly looking for ways to help their customers maintain and protect their long-term investment.

Morningstar's *Energy Storage Partner program (ESP)* makes it possible for selected premium battery partners to offer additional value and support for their customers by offering them a more proven, better documented and controlled storage system. With energy storage typically accounting for a very large share of the overall system's cost, ESP helps advanced chemistry battery manufacturers to provide the maximum level of assurance that system owners and operators need.

BMS Communication Integration with Morningstar ReadyBMS:

The Morningstar ReadyBMS builds "lithium DNA" into any system equipped with a Morningstar Integrated Series parent component equipped with ReadyRail/ReadyBlock expansion technology. It delivers true closed-loop control and communications with the Tier 2 lithium battery brands in Morningstar's Energy Storage Partner program, delivering total peace of mind with charger and battery working together in a system.



This document provides essential instructions and recommendations for implementing closed-loop control and communications with Discover lithium batteries using Morningstar's ReadyBMS accessory with Morningstar charge controllers.

The closed loop communication and integration was developed and tested in tandem between Discover and Morningstar to provide safe, effective charging of the batteries with the following capabilities:

- Improved charging control during absorption for high SoC with less stress on the battery
- Increased battery capacity
- Maintains better health of the battery
- Battery data monitoring including State of Charge (SoC) and State of Health

Battery Overview:

Discover Advanced Energy (AES) batteries allow for equipment design and functionality improvements and deliver productivity gains through enhanced cycling, charge time and weight reductions in stationary and mobile applications. Dramatic improvements in cycle life and charge efficiency combined with zero maintenance requirements provide the end user with significant cost of ownership savings. Some features and benefits are:

- Discover AES batteries are 15% more efficient than lead acid batteries, allowing for reduced charge times and greater utilization of renewable energy sources
- Deliver > 95% of their capacity at high and stable voltages, increasing equipment performance and reducing motor fatigue
- Discover AES batteries will not suffer negative effects from partial SOC
- Systems are 1/3 the weight of their lead acid battery equivalent
- Integrated Battery Management System to prevent abuse outside of current, voltage and temperature limits

LYNK II Communication Gateway

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. This configuration allows hybrid inverter-chargers and solar charge controller systems to optimize control over the charging process in solar applications. LYNK II also enables the remote monitoring of Discover Lithium battery SOC and data logging using the data monitoring services offered by Morningstar.

Discover offers several different 12V, 24V and 48V battery models that support closed loop operation with the LYNK II Communication Gateway and Morningstar's ReadyBMS platform. The following is a list of available battery models.

Battery Models:

AES LiFePO₄ Solar Stationary: 44-24-2800 (110Ah), 44-48-3000 (57Ah), 42-48-6650 (130 Ah)
AES LiFePO₄ Industrial Mobile: 14-24-2800 (110Ah), 14-48-3000 (57Ah), 12-48-6650 (130 Ah)
AES PROFESSIONAL: DLP-GC2-12V (120Ah), DLP-GC2-24V (60Ah), DLP-GC2-48V (30Ah)
AES RACKMOUNT: 48-48-5120 (100Ah), 48-48-5120H (100Ah) [19 Inch Rack Mount 3U]

Note: The battery bank capacity should accept the maximum charge current of the system. Derive this value by adding the charge capacities of all the solar charge controllers in the system. For information regarding battery bank configuration options and Minimum Battery Bank Capacity, please see the Discover LYNK II MORNINGSTAR MANUAL (805-0053).

ReadyBMS Setup Instructions:

The ReadyBMS is one of Morningstar's "ReadyRail Integrated Series" of accessory products. The ReadyBMS provides a communications interface over CANbus for implementing closed loop charging control between the GenStar MPPT controller (and other future Morningstar host device products) and Discover AES batteries using the LYNK II Communication Gateway.

Please refer to the BMSBlock Installation operation manual for complete installation instructions.

An 8-conductor straight-through **RJ-45 cable** (provided with the BMSBlock) is used to connect the Morningstar BMSBlock to the Discover LYNK II Communication Gateway. Attach one end of the RJ-45 cable to one of the RJ-45 ports on the BMSBlock and the other end to one of the CAN Ports of the Communication Gateway (do not connect the Cable to either of the Ethernet Ports on the Morningstar host device or LYNK II Communication Gateway).

LYNK II Communication Gateway:

The LYNK II Communication Gateway provides a CANBUS communications connection between the ReadyBMS and the Discover Energy Systems batteries. Discover provides a LYNK II Morningstar Manual that has complete instructions for setting up closed loop communications with Morningstar equipment. Also, please refer to the LYNK II Communication Gateway and Discover battery manuals for complete instructions with the Discover batteries and LYNK II Gateway.

Commissioning:

After the BMSBlock has been installed with the RJ-45 cable connected between the BMSBlock and LYNK II Gateway and battery, the system can be powered up and commissioned for Closed Loop operation via the local meter of the host device. See the Commissioning / Initial Configuration in the host device manual for commissioning instructions (section 3.5 for the GenStar MPPT controller manual). If the host device has already been commissioned it is necessary to perform a "Factory Reset" in order to recommission the device for closed-loop operation with the Discover battery (from the meter interface with the GenStar MPPT controller).

Host Device Local Meter Display Commissioning Steps

- Select Language
- Enable/ Disable Ethernet Writes (allows control commands and custom programming over Ethernet)
- Select System Voltage
- Set the UTC Time (Universal Time)
- Set the Local Time Offset for the time zone
- Select YES for BMS Block
- Select DISCOVER for BMS Type
- Battery Load (LVD) Profile - (see below)
- Reboot controller after commissioning

Load Control Settings:

After selecting the battery type, the last settings to be made during commissioning are the Low Voltage Disconnect (LVD) and Low Voltage Reconnect (LVR) load control settings. Morningstar offers three different LVD/LVR Load Profile presets for lithium batteries (specifically for 4, 8 and 16 cell LiFePO4 batteries like the Discover batteries).

6 - LiFePO4 - Low (12V, 24V, 48V) = 12.5V/ 13.15V , 25V/ 26.3V , 50V/ 52.6V

7 - LiFePO4 - Medium (12V, 24V, 48V) = 12.7V/ 13.25V , 25.4V/ 26.5V , 50.8V/ 53V

8 - LiFePO4 - High (12V, 24V, 48V) = 12.85V/ 26.6V , 25.7V/ 26.6V , 51.4V/ 53.2V

If using custom LVD/LVR settings, the minimum custom settings for LVD/ LVR should be no lower than 12V/ 13V, 24V/ 26V or 48V/ 52V.

Due to the possibility of self-discharge overnight, systems with a higher self consumption should be configured with higher LVD/LVR settings. This may include systems that include inverters or other types of higher self-consumption equipment that remains connected when the battery voltage gets low.

Additional settings:

After the host device has been commissioned there are additional settings that can be applied. On either the digital display or in LiveView, the 3-digit Installer Password (141) can be used to access the installer setup. Please see the host device manual for details regarding LiveView Setup along with the MeterMap if using the meter for custom settings.

Charger Settings:

Once the host device has been commissioned there are no charge settings that can be implemented. However, the following settings that can be found in the Charger Setup screens can be used

- Battery Size Ah capacity (LiveView or Meter)
- SoC LED Transitions
- Battery Current Limit

Both Voltages and SoC values can be entered for the SoC LED Transition values. With the ReadyBMS Block installed and configured, battery SoC indications will be based on an actual battery SoC percentage from the BMS. Since the SoC LED transitions are based on SoC the voltage values can be ignored.

Recommended SoC LED Transition Settings:

Green/ Yellow when below 75-80%

Yellow when below 50-60%

Yellow/ Red when below 25-40%

Open Loop Configuration Information:

It is recommended to configure the Morningstar/ Discover system with closed loop operation. However, if for some reason the BMS communication is not working (the BMS LYNK II communications fails) it is possible to use open loop settings. In order to switch over from Closed loop to Open Loop custom settings it is necessary to perform a “Factory Reset” in order to recommission the device (from the meter interface with the GenStar MPPT controller). Please see the Morningstar Discovery Compatibility Technote for details regarding charge settings for further details on custom settings.

<https://www.morningstarcorp.com/wp-content/uploads/morningstar-discovery-compatibility-technote.pdf>

Operation:

The closed loop operation of the Genstar (and other future Morningstar host equipment) is implemented with control signals sent to the controller from the Discover BMS. This will include control of the following charging parameters.

- Target regulation voltage
- Maximum charge/ load currents
- Disable charging/ load

The closed-loop operation has been fully tested with the GenStar MPPT controller and meets all of the requirements specified by Discover. When used with the GenStar MPPT controller, the Genstar will charge to the requested voltage using up to the requested current. If the requested charge current is 0A, then the GenStar will not provide any current to the battery but can still power the GenStar load output with power from the PV array input to maintain 0A.

Morningstar ReadyShunt and ReadyRelay Integration:

For systems that include an external load or external charging source, independent from the GenStar MPPT controller, installing a ReadyShunt is recommended in order to maintain the requested current from the Discover BMS. Please refer to the ReadyShunt Installation operation manual for complete instructions.

When a ReadyShunt Block is installed with a Net Shunt for the battery circuit the GenStar MPPT controller is able to limit the charge current to battery as requested by the BMS using the net shunt current. There must be no load or charge circuits connected between the Net Shunt and the battery.

A ReadyRelay Block can be used to control power to the connected load or to control external charging sources. Please refer to the ReadyRelay Installation operation manual for complete instructions.

For load control the ReadyRelay can be configured to turn a load relay OFF in the event of a low voltage condition. Once the reconnect voltage threshold has been reached, the GenStar can re-enable the load.

There are External Source Control (ESC) settings that can be used with the ReadyRelay to control external charging sources also. It is recommended to use a SoC threshold or voltage threshold Stop Charging settings to achieve the desired charging from the external source and prevent overcharging of the battery.

Disclaimer:

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