Battle Born & Morningstar

Introduction:

With over four million 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. This document is intended to provide essential information and recommendations for integrating Morningstar charge controllers with the Energy Storage Partner's batteries. Proper integration of these products is dependent upon successful implementation of the custom settings outlined in the sections below. These settings are the result of cooperation between manufacturers and have been agreed upon by both parties.

Battery Overview:

Battle Born Batteries are made in Reno, Nevada – the Battle Born State. Our batteries are the height of lithium ion technology. We only use LiFePO4 (Lithium Iron Phosphate) in our packs, this is the safest and most reliable chemistry of lithium ion available. They outperform and outlast all other batteries in their class and below their class (lookin' at you, lead acid batteries). The best part? They're easy on the planet and your wallet.

Green energy is not a trend to us. It's not a marketing ploy to exploit for sales. We make our renewable, sustainable green energy batteries because they're simply better than anything else out there, including other green batteries.

Compare the specs on our batteries to that grungy, lead acid one in your vehicle and it's easy to see. Our batteries weigh less, last for more cycles, and they're made from 100% safe, non toxic, renewable energy that can be charged and discharged over and over again (at a faster rate than any other battery). Not to mention the unbeatable price.

Battle Born website: https://battlebornbatteries.com

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Benefits include:

- At least double the power in the same physical space of lead acid.
- Can be discharged 100% vs lead acid recommended 50% depth of discharge.
- Can be installed indoors with no hydrogen gases generated, also no terminal corrosion.
- About 1/5 the weight of a lead acid battery, resulting in a significant weight reduction over your current battery bank.
- Output voltage is flat during most of the discharge cycle, increasing efficiency of your system.
- Can be charged up to 5 times faster than lead acid.
- Last 10 times longer than lead acid.
- Holds a charge for up to 1 year (without a load) without the need for a trickle charger. Great for unattended storage.

Models: BB10012, BB10012H, BBGC2, BBGC2H, BB1250 G24, BB1275 G24, BB8D, BBGC3, BB5024
Voltages: 12V, 24V
Amp Hour Capacities: 50-270Ah

Note: Battle Born Batteries are capable of being connected in series up to 48V. For more information regarding battery bank configuration options, please refer to the Battle Born manual and Installation guides or contact Battle Born.

For optimal integration, the recommended settings (based on 12V nominal values) are as follows:
MSView Configuration Files Download

<u>Critical Settings</u>:
Absorption Voltage = 14.40 V
Absorption Time = 20 minutes per 100Ah of capacity
Temperature Compensation = 0.0 V/degC (Disabled)
Float/Float Voltage/Timeout = Enable/13.60 V/30 min (Float stage not required while battery is in storage)
Equalize = Not enabled
Battery HVD/High Voltage Disconnect/Reconnect = Enable/14.6 V/13.5 V
Load LVD (Low Voltage Disconnect) = 12.25-12.7V (set higher to prevent a BMS LVD - see note)
Load LVR (Low Voltage Reconnect) = 13.0-13.25V (set higher for higher LVD settings)

Note:
The performance of systems using these settings may vary depending on use conditions and application.
Lithium batteries include a Battery Management System (BMS) that can implement an internal battery disconnect in the event of an internal fault, high or low temperatures, high or low battery voltages or other conditions.
It is important that proper low voltage load disconnect settings are used to prevent over-discharging due to self-consumption of the controller and other devices. This can cause a BMS low voltage disconnect which will disable charging in the morning.

In case of a battery cell high voltage condition during charging the BMS may disconnect the battery internally. This is not likely to happen with the settings provided. If this does occur the batteries will rebalance after several full charges.

Damage to the controller due to a battery disconnect during charging is typically not covered under warranty. Incidental damage to loads is also not covered under warranty.

Monitoring of the system with Morningstar Live View or MSView is recommended to determine if adjustments to the settings may be considered.

Optional Recommended Settings:

Absorption Ext = Not enabled

Low Battery Temperature Foldback = Optional (High limit = 5 degC, Low limit = 0 degC)

Battery Service Reminder = 365 days (Full charge required for individual series-connected batteries to ensure bank remains balanced)

Float Cancel = Not enabled

Max Regulation Limit = Not enabled

Battery Current Limit = Optional (Max recommended charge current = 1C)

Delay Before Load LVD = 1-10 min (can be higher with higher LVD settings and/or colder temperatures)

Load Current Compensation: Default = 0.001 Ω (V/A), should be calculated based on 0.35/Ah (Reduces Load LVD based on size of load with respect to battery Ah capacity)

Load HVD/High Voltage Disconnect/Reconnect: Enable/15.00 V/14.60 V (May help to protect loads from potentially harmful voltage spikes that can be caused by external charging sources continuing to operate during battery removal)

Battery Charge LED Indications (Not intended for accurate SoC measurement):

- LED G –> G/Y 75%+ = 13.5 V
- LED G/Y –> Y 50% - 74% = 13.3 V
- LED Y –> Y/R 25% - 49% = 13.15 V
- LED Y/R –> R 10% or below = 12.8 V

These settings are available for the Morningstar controllers listed below:

12-24V systems:

ProStar MPPT: Charge and Load control (includes low temperature foldback)

SunSaver MPPT

ProStar (PWM) Gen 3 Charge and Load control (includes low temperature foldback)

12-48V systems:

TriStar MPPT: Charge control only

TriStar MPPT 600V: Charge control only

TriStar [PWM]: Charge or Load control

Communications hardware required for programming Custom Settings with MSView:

ProStar MPPT, ProStar (Gen 3), SunSaver MPPT

UMC-1 USB MeterBus Adapter- http://www.morningstarcorp.com/products/usb-meterbus-adapter/

MSC PC RS-232 MeterBus Adapter- http://www.morningstarcorp.com/products/pc-meterbus-adapter/

EMC-1 Ethernet MeterBus Converter- http://www.morningstarcorp.com/products/ethernet-meterbus-converter/

TriStar, TriStar MPPT, TS-MPPT-600V

Includes an RS-232 port for connection to a PC.

EMC-1 Ethernet MeterBus Converter http://www.morningstarcorp.com/products/ethernet-meterbus-converter/

Tripp Lite U209-000-R USB / Serial DB-9 (RS-232) Adapter Cable (not available from Morningstar)

All TS-MPPT-60 (150V and 600V) models also include an Ethernet port and EIA-485 port.

MSView Software Download: http://www.morningstarcorp.com/msview/

MSView Configuration Files: https://www.morningstarcorp.com/wp-content/uploads/2019/01/Battle-Born-MSView-Configuration-Files.zip

Other links:

Morningstar Best Practices by Battery Chemistry

Morningstar Custom Settings Info Pages

IMPORTANT:

Battle Born Batteries and Morningstar Corporation are separate companies with unaffiliated ownership.

Neither Battle Born Batteries nor Morningstar Corporation make any warranties explicit or implied with this product information. Morningstar makes no representation or assumption of liability regarding the charging requirements for any type of battery or model.

Some of the material being presented may be based on information that has been provided by other parties such as battery specs and operational parameters.

Performance may vary depending on use conditions and application.