

# Deploying OutBack Equipment with Lithium-ion Batteries

With the growing availability and decreasing cost of lithium-ion batteries, they are more frequently used in solar + storage systems where daily cycling is part of the duty cycle. While OutBack Power's Radian and FXR inverters, as well as the FLEXMax charge controllers, were designed for lead-acid batteries, they can also be paired with many of the 48 V<sub>DC</sub> lithium-ion batteries currently available. OutBack Power continues to test the most popular batteries and publish specific application notes with recommended settings based on those tests. This application note is intended to provide general guidelines for batteries that have not been tested by OutBack. *As such, please note that the company cannot claim responsibility for any damage done by or to batteries that are deployed using the information found here.*

## Battery Management Systems

Lithium-ion battery systems all require some form of battery management system (BMS) to maintain appropriate current and voltage to each of the cells. The BMS may or may not require active communication with the inverter and/or charge controllers. When required, the path of communication is typically via a standard protocol such as CANBUS or MODBUS, although the commands and information exchanged are often specific to the BMS or battery brand.

BMS types that require active communication with the power electronics, such as the LG RESU line, can be used with OutBack's SkyBox True Hybrid Energy System — but only after specific programming and testing has been completed. These batteries should not be deployed outside of specifically recommended pairings, as the battery will likely not function without the right signal from the inverter.

Fortunately, many of the nominal 48 V<sub>DC</sub> lithium-ion batteries available today are designed as “drop-in lead-acid replacement” units with a fully self-contained BMS that requires no external communications. SimpliPhi and Blue Ion are good examples of the type of lithium-ion battery system that can be deployed successfully with OutBack's Radian and FXR systems. For these and similar batteries, the typical charge and discharge parameters used for lead-acid batteries can be adjusted using the MATE3s to optimize performance. OutBack Power expanded the range of programmable battery settings several years ago in our most popular products. See the end of this application note for a list of equipment that can be used with this type of BMS.

## State of Charge Monitoring

The FLEXnet DC (FN-DC) monitors state of charge (SOC) using an amp-hour calculation. This calculation is highly dependent on the initial voltage drop (as seen when placing a large load on a battery bank) and the subsequent rate of discharge. Because lithium batteries have a very flat voltage profile and deliver the same amount of energy regardless of the rate of discharge, this calculation often becomes inaccurate. Therefore, only voltage set points should be used when programming the inverter and related functions (ex. – AGS, relay on/off, etc.).

## Application Note

### Caveats

- High-Voltage batteries are not compatible with currently available OutBack equipment. Use only batteries with a nominal voltage of 24 or 48 Vdc.
- Under certain conditions, the in-rush current of a Radian can be up to 1,000 amperes. This exceeds the limit for short term discharge of many batteries. In this case, a pre-charge circuit that charges the inverter capacitors before shutting the battery breaker is recommended.
- The operating temperature range for lithium batteries is typically narrower than that of lead-acid batteries. If replacing a lead-acid battery bank with lithium, ensure the environment is within the new acceptable temperature band.

### Equipment Compatibility

#### Inverters

SkyBox: All versions compatible

Radian 8048A/4048A: All versions compatible

Radian 7048E/3048E: Firmware versions 001.005.003 and higher are compatible

Radian 8048/4048: Not compatible

FXR series: All versions compatible

GTFX/GVFX/GFX series: Not compatible

M-series: Not compatible

#### Charge Controllers

FM Series: All versions compatible<sup>1</sup>

MX Series: Not compatible

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<sup>1</sup> Float charging cannot be disabled on charge controllers. When alone in a system (no inverter) the charge controllers enter a 'silent' state between the end of the absorb stage and the beginning of the float stage.

Setting the float voltage to just above the re-bulk voltage will maximize this time.

# Application Note



## About OutBack Power

OutBack Power is a leader in advanced energy conversion technology. OutBack products include true sine wave inverter/chargers, maximum power point tracking charge controllers, and system communication components, as well as circuit breakers, batteries, accessories, and assembled systems.

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## Other

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