Lithionics Battery®

NeverDie® Advanced BMS V9 – User Guide

UL Ratings

UL 508 - Contactor

UL 991 - BMS

UL 1998 - BMS

UL 1973 - System

R3 2/07/2024 FW V9.0.04

NEVERDIE®
LITHIUM+ELECTRONICS = LITHIONICS BATTERY

MiniBMS®
TECHNOLOGY

OptoLoop®
TECHNOLOGY

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Safety Precautions

- All electrical work should be performed in accordance with local and national electrical codes.
- Voltage is present at the battery terminals, use insulated tools and gloves while working on the system.
- Always turn off equipment connected to the system in addition to turning OFF the Power switch provided on the system to isolate the batteries from other electrical circuits, before performing any repairs or maintenance on the system.
- Always use proper wire sizes to connect the system to inverters, chargers, or other equipment.
- Always use crimped connections to connect to the battery terminals.
- Read and follow the inverter, charger, or other equipment manufacturers safety precautions prior to connecting the system to that equipment.

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Overview

The main purpose of the NeverDie® BMS is to protect the battery by disconnecting it from the rest of the system when it detects any potentially harmful conditions, as well as provide emergency energy reserve by saving part of the battery's capacity during normal use. An additional function of the Advanced BMS is to gather battery data and send it over a digital interface to a mobile application or computer system for data logging and analysis, as well as display real time data on user interface screens.

Installation

Since Lithionics Battery offers countless battery configurations, this document will not cover detailed installation steps and assumes that the Battery and BMS are already installed. Please refer to your specific installation guide or contact Lithionics Battery for installation assistance. **NOTE: Do NOT attempt to bypass the BMS or tap any loads directly from any battery modules, as it could lead to permanent battery damage and voids your battery warranty!**

BMS Power On/Off/Reset Button with Status LED

Remote Power On/Off/Reset Button with Status LED (optional)

NeverDie® BMS has a blue ring Status LED indicator integrated into the Power On/Off/Reset button on the unit itself and in some cases, there is also an optional remote Power On/Off/Reset button with a Status LED indicator installed at an easily accessible location. Please refer to your specific installation to locate this button.

Status LED modes:

- **OFF**. BMS is turned off and battery power is disabled.
- **ON**. BMS is turned on, and battery power is on.
- **Rapid Blinking**. BMS is in a warning, or an alarm state and battery power is disabled or about to be disabled. Usually accompanied by an audible buzzer sound inside the BMS.
- **Short Blinking**. BMS is in the low power sleep mode after reaching the Reserve Voltage or the Low Voltage state.

BMS Operation

Due to shipping laws and regulations, your battery may be received at a partial state-of-charge (typically 50%). The battery needs to be fully charged before use. This is necessary to calibrate the state-of-charge meter.

Powering On. To turn the battery power on, briefly press the power button for one second. The power button status light will illuminate solid on to confirm the battery is powered on and operating normally. You may notice an audible "thunk" sound of the internal contactor switching on.

Powering Off. Be sure to shut down any high amperage loads prior to turning the battery power off. To turn the battery power off, press and hold the power button for 3 seconds. The power button status light will turn off to confirm that battery power is off. You may notice an audible "thunk" sound of the internal contactor switching off.

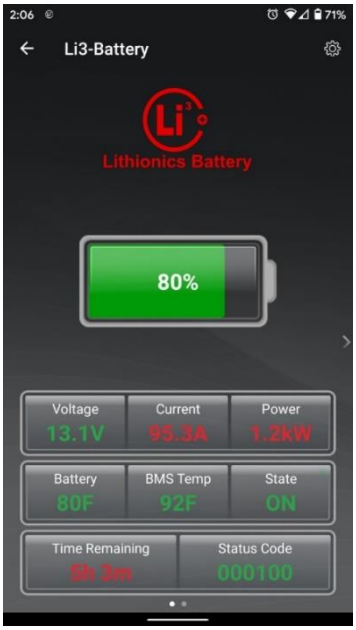
Resetting Power after a BMS Protection Event. If the battery gets discharged to the NeverDie Reserve level or the Low Voltage Cutoff level, or BMS detects a fault or an abnormal operating condition, then it will turn off battery power. The battery power can then be reset by pressing the power button for one second.

Discharging. Discharging may be performed at any time the system is powered on. The NeverDie® Reserve feature allows the system to have a reserve amount of energy left in the battery. Once the system is discharged to approximately 10% state-of-charge, power will be turned off to leave a reserve amount of energy still left in the battery. The battery will also disconnect power if the voltage, amperage, or temperature limits are exceeded during discharge. To enable the remaining reserve energy of the system, press the BMS power button for 1 second. **Once the reserve energy is enabled the battery should be charged as soon as possible.**

***WARNING* - If the reserve energy is used and the battery module is left in a deeply discharged state without immediate charging, the battery module may become permanently damaged.**

Charging. The charging device(s) connected to the Lithium Battery System must be programmed per the recommended charge settings. Using an improper charger or charge settings could result in undesirable battery performance and accelerated wear. The battery will disconnect power if the voltage, amperage, or temperature limits are exceeded during charging. Please note that voltage rise during bulk charge stage is very slow, followed by a fast voltage rise at the end of charge. Once the charge is completed, the voltage drops down to a resting level. This behavior is normal and should not cause any concerns.

Using the Bluetooth App



Lithionics Battery® has developed the **Lithionics Battery® Monitor** app for iOS and Android mobile platforms, which displays real time battery information. The battery must be turned on via the Power button before the Bluetooth connection can be made. When the battery is turned off, Bluetooth is also powered off to save energy. This app can be downloaded for free at the Apple App Store or the Google Play Store for your iOS or Android device.

To connect Bluetooth:

1) The battery must be in the ON position.
2) Bluetooth must be enabled on your device.
3) Open the Lithionics Battery® Monitor App and accept location permissions.
4) Under the Device List, select the battery you would like to monitor (the device name is identified by the battery serial number).

Once the Bluetooth connection is made to the battery, the **Battery Info** screen automatically displays. This screen provides useful information such as the battery state-of-charge percentage, voltage, current, power, internal cell temperature, BMS temperature, power state and estimated time remaining.

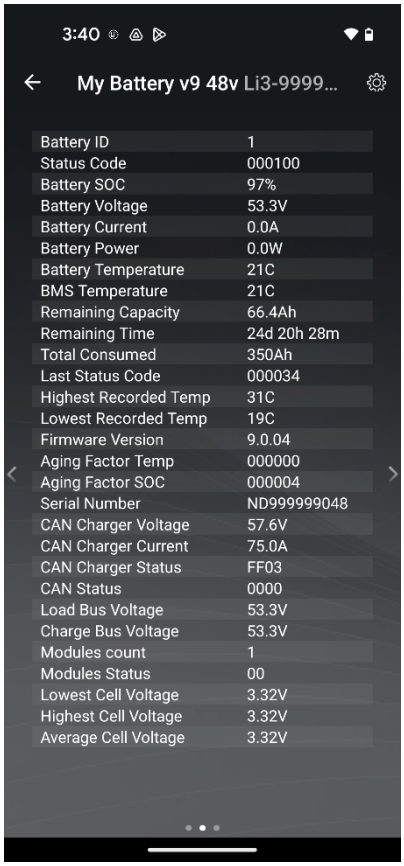
The red color of the Current, Power and Time Remaining indicates that battery is being discharged. The green color of the same values indicates that battery is charging, with "+" sign added to the Current for additional indication of charging.

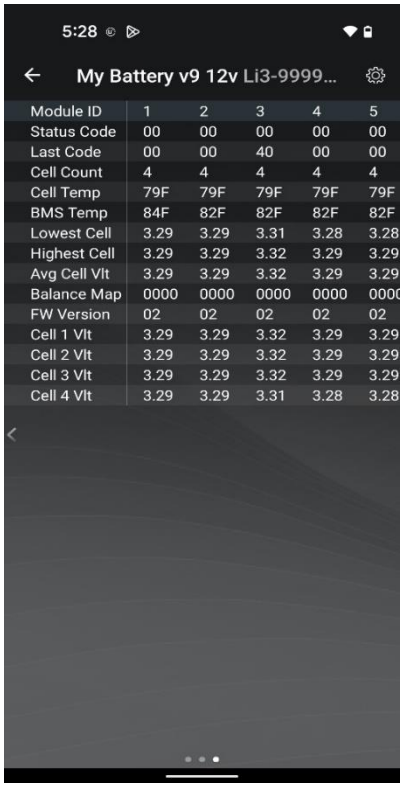
The green or red coloring of the Voltage, Temperature and State values indicates normal (green) or abnormal (red) operational range, such as low/high voltage or low/high temperature.

Touching on the Status Code at the bottom automatically opens the Status Code reader screen. The **Status Code Reader** screen of the app makes it easy to visualize the status by observing the color-coded table, see example to the left. Each active description is color coded in green or red, where green indicates normal conditions and red indicates faults or critical conditions requiring attention, such as immediate need to charge the battery.

Other important features in the app are **BMS Firmware Update, Data Logging, Bluetooth Security PIN, Custom Battery Name**, etc. These features can be accessed via the Settings screen, by touching the gear icon in the upper right corner of the main screen. See **Lithionics YouTube channel** for multiple videos showing how to use the Lithionics Battery Monitor App.

BMS Troubleshooting





Swipe left screens with advanced troubleshooting data

Lithionics Battery Monitor app has additional screens with advanced technical data, which is useful when troubleshooting battery issues. To access the **Battery Details** screen swipe to the left on the main app screen. You should see a screen like the one shown here.

When contacting Lithionics Battery for support, please take a screenshot of this screen and send it to your support contact.

Module(s) Voltage data

Most Lithionics Battery systems are built as modular assemblies, with series/parallel connected battery modules and an external NeverDie® BMS unit. In such a modular architecture, troubleshooting comes down to checking voltages of individual modules and checking continuity of all connections. A healthy and well-maintained battery would exhibit the same or very similar voltages on all modules of the same configuration, so if you see one module's voltage is significantly different from the other modules, it could indicate an imbalance in the State of Charge between modules, which causes unexpected BMS events, since BMS protects the individual cells in the difference modules.

You can also swipe left from the Battery Details screen to access Modules Details screen, where all individual cell voltages and other parameters are listed for each module.

When contacting Lithionics Battery for support, please take a screenshot of the Modules Data screen and send it to your support contact.

Collecting and analyzing battery data logs

The Lithionics Battery Monitor app has an automatic data logging function, which records battery data into a log file whenever the app is connected to the BMS. While troubleshooting battery issues it's recommended to have the app connected to the BMS before, during and after the event(s) which are being analyzed. This allows Lithionics support team to plot the real time data and observe changes in battery values while battery related events are taking place. Log files are saved on the mobile device where the app is installed and can be accessed even after the events are recorded. Log files are listed and sorted by date, where file name indicates the battery serial number and date/time when the log was started. Log files can be emailed to Lithionics support team directly from the mobile device, swipe left on the log file entry to access Share icon, then select Email app. To learn more about collecting and sharing data logs, please refer to this YouTube video https://youtu.be/c6eWrdzmTR0?si=ftBuKHF63jCaVDls

Module(s) Status LED

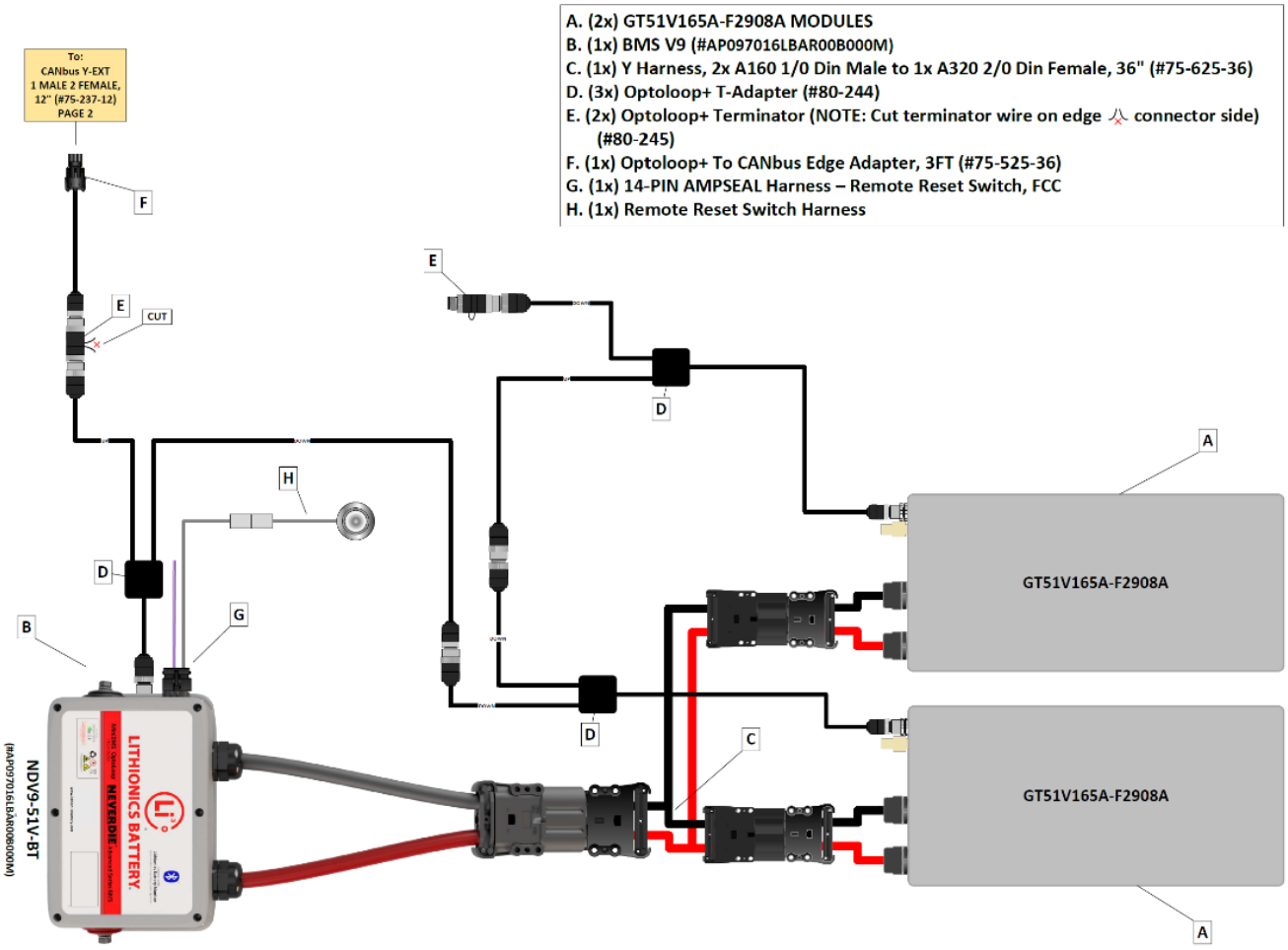
Each battery module has its own small red Status LED which can be useful for battery troubleshooting. It provides heartbeat blink patterns with 1 second intervals. The following table describes the meaning of each blink pattern.

Battery State	LED pattern	LED Blink pattern over time
Recent Alarm, all OK	Long blink	
All OK	Short blink	
Balancing	Slow flash	
LVC	Solid OFF	
HVC, Temp or BMS Fault	Rapid blink	
		< 1 second > < 1 second > < 1 second > < 1 second >

- **Recent Alarm, all OK**. Indicates that currently all cells are within normal operating conditions, but there has been an abnormal event in the last 30 minutes. This helps troubleshoot brief events after their recovery.
- **All OK**. Normal heartbeat pattern when battery module is operating properly.
- **Balancing**. Indicates that BMS has activated the balancing function, and that battery module is at the final charging stage.
- **LVC**. Indicates that one or more cells inside the module are deeply discharged and their voltage is below normal range. Battery module must be re-charged ASAP to avoid cell damage. If re-charging fails, the module must be serviced by Lithionics Battery.
- **HVC, Temp or BMS Fault**. Indicates that one or more cells inside the module are outside normal operating conditions, such as overcharge, over or under temperature, or BMS board indicates an internal fault. Further troubleshooting is needed to determine the exact root cause, see datalogging instructions on the previous page.

IonBus® data connections

Each battery module has a M12 8 pin connector used to transmit cell data to the NeverDie® BMS. If your system has multiple battery modules, then M12 connections are daisy-chained with special terminators attached to each end of the network. All these connections are critical to system operation and should be checked for any loose or broken connection during troubleshooting. Refer to your system installation guide for specific wiring diagram, but the example diagram below can be referenced to understand how IonBus® connections are made.



Decoding Critical Fault states and possible corrective actions.

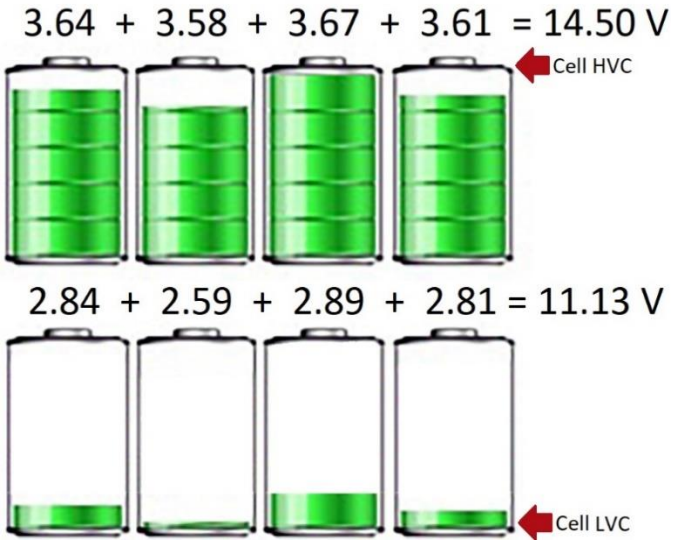
The table below lists the most critical fault codes, possible root causes and corrective actions.

Status Code Flag	BMS Protective Function	Activation Trigger	Possible root cause and corrective action
High Voltage State	**High Voltage Cutoff**	Battery Voltage => 3.70 VPC or any Cell Voltage => 3.80 V	One or more charge source(s) is overshooting target charge voltage. Check your charge source settings and try to slightly reduce charge voltage. Confirm by measuring voltage with DVM at battery terminals. Charge sources could be alternator regulator, solar charge controller, inverter/charger, etc.
Low Voltage State	**Low Voltage Cutoff**	Battery Voltage <= 2.80 VPC or any Cell Voltage <=2.80 V	Battery has been deeply discharged, completely depleted. Immediately start charging with any available charge source and stop any loads to prevent further discharge until battery reaches nominal voltage. If necessary, short press Power button to wake-up the BMS to start charging.
Reserve Range	**NeverDie Reserve**	Cell Voltage <= 3.14 V (adjusted lower under heavier load)	Battery has been discharged to approx. 10% SOC and turned off to preserve remaining charge. Short press Power button to turn the battery power back on to access remaining reserve, but also start charging the battery with any available charge source ASAP.
OptoLoop Open	**OptoLoop Cell Monitor**	Cell Voltage > 3.80 V Cell Voltage < 2.50 V	Cell level monitoring circuit indicates one or more cells are out of normal operating range. Check continuity of OptoLoop monitoring circuit between the BMS and battery module(s). If battery is also in LVC or HVC states, follow corrective actions for those states, otherwise contact your battery supplier for support.
High Temp State	**High Temperature Cutoff**	Battery Temperature > 60°C	Battery temperature is too high. Try to cool down the battery by increased airflow, avoid direct sunlight, reduce charge/discharge rate to prevent internal heat buildup.
Low Temp State	**Low Temperature Cutoff**	Battery Discharge Temp < -20°C Battery Charge Temp < 0°C	Battery temperature is too low. Try to warm up the battery by any available heat source. Be careful to avoid overheating or melting of the battery casing.
Overcurrent State	**Overcurrent Protection**	Battery Current > 400 A* *Actual value depends on specific battery model and capacity	Battery current exceeded allowed safety rating. Reduce loads to bring the current down to rated levels. Short press Power button to reset the protection state.
Aux Contact Error	**Contactor State Fault**	Contactor State Mismatch	Possible damage detected inside BMS contactor, such as tack welded contacts due to surge or inrush of current. Hold Power button for 10 sec to turn the BMS off, then short press to restart the BMS to see if problem clears up. If problem persists, contact your battery supplier for support.
Contactor Flutter	**Contactor Flutter protection**	10 cycles in 5 min	Frequent repeated cycling of BMS contactor could indicate a wiring issue or other defect in the system, so BMS stops operating until issue is investigated and resolved. Hold Power button for 10 sec to turn the BMS off, then short press to restart the BMS to see if problem clears up. If problem persists, contact your battery supplier for support.
Temp Sensor Error	**Missing Temp Sensor Data**	Module(s) are not reporting cell data	Possibile wiring issue with IonBus circuit between the BMS and battery module(s). Check for proper connection, restart the BMS to see if problem clears up. If problem persists, contact your battery supplier for support.
Pre-Charge Error	**Pre-charge relay-resistor circuit**	Load Voltage does not rise to Battery Voltage within 5 seconds	When Pre-Charge feature is engaged, voltage at inverter DC terminals is expected to rise fast to battery voltage at initial BMS power up. If additional DC loads prevent expected voltage rise, BMS throws this error. Contact your battery supplier for advise on changing Pre-Charge settings or reduce initial DC load to allow completion of Pre-Charge sequence.
Battery Protection	**Battery Safety Protection**	Combined with other protective functions	This state is typically combined with other protective states to lock the BMS in the safe mode requiring manual intervention and investigation. Check for other fault flags and problems, then try to restart the BMS to clear the fault state.

Understanding Battery Voltages

It's important to understand some common terms describing a lithium battery's operation, which are often used in detailed feature descriptions further in this document. It also helps to visualize a charge/discharge graph of a typical lithium battery, to see various voltage points and how they relate to state of charge.

- **VPC – Volts Per Cell**. A Lithium Battery contains several cells connected in series. Battery voltage is the sum of all cell voltages. LiFePO4 chemistry cells are 3.2VPC nominal (i.e., average voltage during discharge). A typical 12V battery has 4 cells in series, also known as a "4S" configuration. Respectively, a 24V battery is 8S, while 51V batteries are 16S. Since the BMS monitors and acts at the individual cell level it's more common to refer to cell level voltages, abbreviated as VPC. For example, a fully charged and rested cell is at 3.4VPC, which means a 12V (4S) battery would be resting at 13.6V.



Picture on the left illustrates the cell level and the pack level voltages. Due to manufacturing tolerances and environmental factors individual cell voltages may not always be the same, so the BMS must employ both cell level (MiniBMS®) and pack level (NeverDie® BMS) triggers for protection events such as HVC and LVC. Our BMS also works to minimize those voltage differences in a process called "balancing", which occurs at the end of each full charge cycle.

Pack level triggers are more conservative than cell level triggers to allow for some natural imbalance in cell voltages at the top and the bottom of the charge/discharge cycle. BMS events are triggered on both cell level and pack level, whichever happens first.

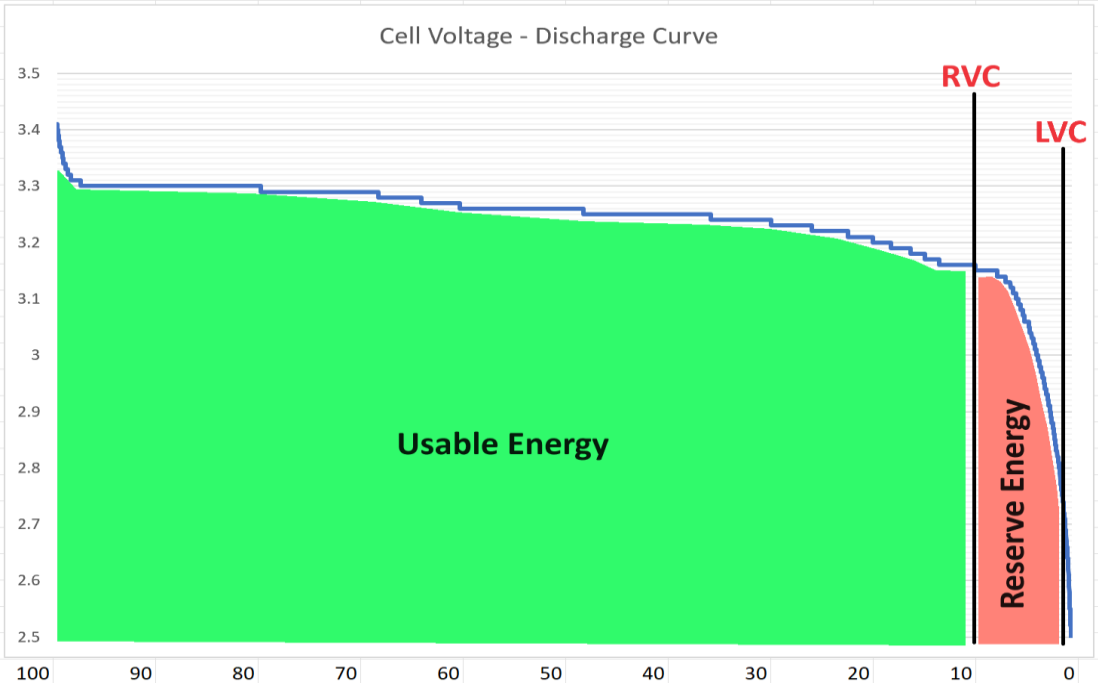
In a 12V battery, for example, pack level and cell level triggers are:

HVC Pack Level = 14.80 V
HVC Cell Level = 3.80 VPC
LVC Pack Level = 11.20 V
LVC Cell Level = 2.50 VPC

- **Charge / Discharge Curve**. One of the main advantages of a Lithium battery compared to a Lead Acid battery is its flat charge/discharge curve. This means the battery voltage stays relatively constant for most of the charge/discharge cycle, with sharp "knees" on both ends where voltage rises and drops very fast. Constant voltage means stable power is supplied to loads, making them operate more efficiently. However, this also renders voltage-based SOC (state-of-charge) measurement useless. Voltage based SOC estimates can only be done at the upper and lower "knees" where voltage change is more pronounced. See the Charge and Discharge Curves below with explanations of usable and reserve power.

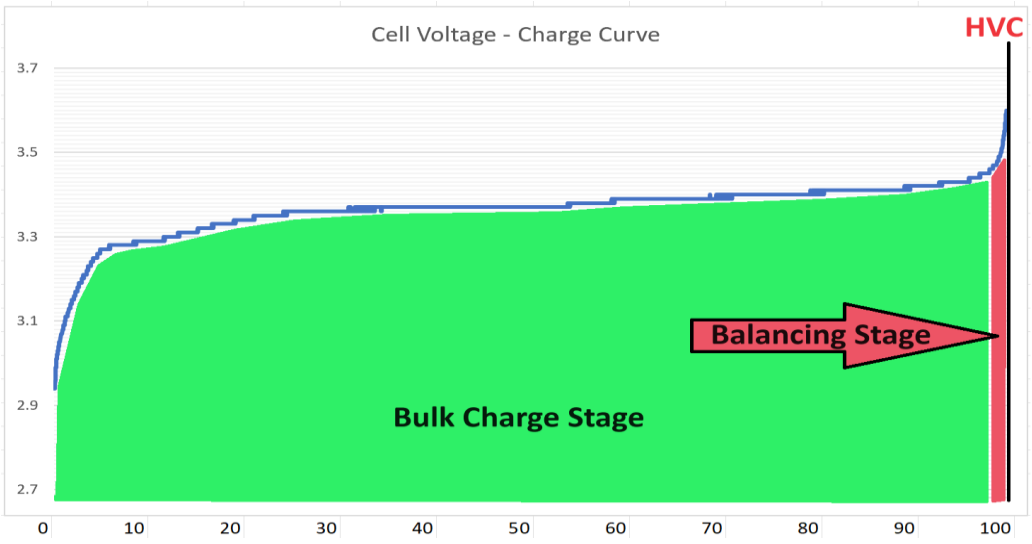
- **RVC – Reserve Voltage Cutoff**. Typically set to 3.14VPC on voltage based BMS trigger. At this level the BMS would shut off the battery power allowing the NeverDie® Reserve Power capacity to be stored in the battery for an emergency, such as engine cranking. The area shaded red in the picture below represents the Reserve Energy and it's approximately 10% of total usable capacity, or 10% SOC.

- **LVC – Low Voltage Cutoff**. Typically set to 2.8VPC at the pack level and 2.5VPC at the cell level. At this voltage the battery is almost fully discharged, so the BMS shuts off the battery to prevent damage due to over-discharge. To compensate for voltage sag under heavy load, LVC is reduced by 0.1VPC per 1C rate of discharge, up to 0.3VPC limit at 3C rate.



- **HVC – High Voltage Cutoff**. Typically set to 3.7VPC. At this voltage level the cell is not taking any more charge, so voltage rise becomes exponential and if left unchecked would cause permanent damage to the battery. The BMS shuts off the battery when any cell reaches this level, allowing voltage to rest down.

- **Balancing Stage**. As the battery nears the end of charge the cells enter the upper knee of the charge curve, where voltage rise becomes faster and faster. Due to individual manufacturing differences between cells, some cells reach this stage earlier than others, causing voltage imbalances between cells. While not harmful in the short term, in the long term such an imbalance could become more and more pronounced, which eventually reduces the useful capacity of the battery. To counteract this process the BMS performs cell balancing by slightly discharging the higher voltage cells (a process called "shunting"), this allows the lower cells time to catch up. This process is similar to "equalization" in a Lead Acid battery but requires more precision and controlled by the BMS on an individual cell level.



Advanced BMS features

Previous chapters described the most common BMS protective functions related to high and low voltages and temperatures. Lithionics NeverDie® BMS also includes several advanced features, which might affect system operation. Some of these features are optional and depend on your specific system design and configuration. We don't recommend an average user to modify these features unless consulted with professional installer or with Lithionics support team. Below is a detailed description of advanced BMS features and how they affect the state of the power contactor inside the BMS.

- **AC Sense / External 12V Power** – this optional feature allows to power the BMS using an external 12V AC/DC power supply, which is wired to the same AC grid connection as the inverter-charger or a dedicated AC charger. This helps to automatically power up the BMS which is sitting in the low power sleep mode due to deeply discharged battery. Since this external 12V power comes from the AC grid, the BMS assumes that charging will begin immediately, so it closes the contactor even if the battery is in the Low Voltage state. This allows charging to continue even while the BMS is in the Alarm state until voltage climbs above Low Voltage level, and the Alarm stops. See the AMPSEAL Connector page below for details on how to wire the external 12V supply to pin 13 and GND.
- **Dual Stage Power-Up** – Some applications may require dual stage Power-Up, where BMS waits for a separate command to close the contactor. This mode allows BMS to be powered up and transmit telemetry data independent of battery power On/Off state. It could be useful in remote or industrial applications where BMS telemetry is critical even when battery power is turned off. This mode can be enabled in the BMS configuration if desired, using command **$PWRUP=0.** If BMS is configured for the dual stage power up, then the first button press will turn on the BMS and second press will turn on the battery power. In this mode the BMS is powered off by holding the Power button for 10 seconds while turning off the battery power.
- **Reserve Voltage Cutoff (RVC)** – NeverDie® function. During discharge the BMS will open its contactor, disconnecting the battery power when battery reaches the RVC level, which allows the battery to store energy reserve. The RVC level is defined by cell voltage of 3.14 VPC (automatically adjusted lower under heavier load), which corresponds to

approximately 10% SOC. Once the battery is in the RVC state you can access the reserve capacity by a short press of the Power button. If desired, the RVC function can be disabled by setting **$RVC=0** in the BMS' Configuration.

- **Field Control Circuit (FCC)** – if your BMS is wired to your alternator's field or regulator circuit, it will disable the alternator's output by opening this circuit when HVC condition is detected, to protect the battery from being overcharged. The BMS will open this circuit 2 seconds prior to opening the main contactor, allowing alternator field to discharge which protects the alternator's diodes from potential damage. This circuit can also be used to disable other charge sources, such as solar controllers or inverter/charger's charge function.
- **Over-Current Protection** – The BMS will limit maximum continuous charge or discharge current to enforce safe operating limits as stated in the battery datasheet. If BMS detects continuous current above preset limit for over 2 minutes, BMS will open the contactor to prevent potentially unsafe operation. **NOTE: This function does not replace the safety requirement of fusing power circuits. Make sure the battery is always properly fused according to local electrical safety code.**
- **Short Circuit Protection** – The BMS will detect a possible short circuit event if the battery voltage drops below 1.75VPC, immediately disconnecting the contactor. The contactor will stay open until the BMS is power cycled or Power button is held down for 10 seconds to reset the BMS, or charge voltage is applied to the BMS.
  NOTE: The lithium battery is capable of significant power output and may maintain the voltage level during a short circuit event, producing a very large current, capable of melting or welding connection points and damaging cables and connectors. Even if the BMS detects short circuit and tries to open the contactor, the contactor itself might weld under such large current. Make sure the battery connection is always properly fused and does not rely on the BMS alone for short circuit protection!
- **Automatic Generator Start/Restart (AGSR On/Off)** – if your BMS is wired to your generator's start circuit, it will close the circuit to start the generator when voltage drops below 3.19VPC or SOC percentage drops below the "AGSR On" level set in BMS Configuration, whichever comes first. The AGSR circuit will open when the voltage rises above 3.5VPC after 15-minute delay, which simulates a Constant Voltage charge stage. You can also set "AGSR Off" level in the BMS Configuration if your application requires only partial generator-based charge, which can be later supplemented by solar or other renewable energy sources. This allows for maximum fuel saving and reduced wear on the generator.
- **Pre-charge Control** – The purpose of this feature is to reduce inrush current when closing the contactor into a capacitive load, such as an inverter or motor controller. When the BMS is commanded to close the contactor, it will first close a small pre-charge relay in series with a pre-charge resistor, which limits the current to a safe low level. Such a small current will safely charge the capacitive load, reducing voltage across main the contactor, then the BMS will close the main contactor without high inrush current. Pre-charge timing and voltage threshold are configurable, allowing fine tuning of the process in complex systems with mixed capacitive and resistive loads. If at the end of pre-charge timer voltage threshold has not been reached, BMS will not close the contactor and will set **PRECHARGE FAULT** status flag for troubleshooting purposes. This protects the system in case of pre-charge circuit failure or short circuit at the Load side of the BMS. **NOTE: If load resistance is very low (such as a high-power resistive load bank) then the BMS will mistake it for a short circuit. In this case you must disable the pre-charge control feature as it was not designed for resistive loads.**
- **Auxiliary Contacts** – This feature is part of the special type of contactors used inside the BMS unit, which has mechanically coupled aux contacts on the same arm as the main contacts. This allows monitoring for possible welding of the contactor in high power systems. The BMS monitors the state of aux contacts when changing the state of the main contactor to make sure there is a match between actual and the expected state of the contactor. If there is a mismatch, the BMS will attempt to unstick the contactor by repeatedly pulsing the coil up to 10 times. If not successful, the BMS will set the **AUX FAULT** status flag for troubleshooting purposes. During normal operation the BMS will set **AUX STATE** flag to indicate current state of aux contacts, which can be interpreted as the actual state of the main contactor.
- **Contactor Flutter detection** – if any abnormal condition, such as loose wiring or faulty equipment causes the BMS to turn contactor on/off 10 times in a 10-minute period, then the BMS will enter the Power Off state, preventing contactor flutter. Once the problem is investigated and addressed, hold down Power button for 10 seconds to reset the BMS, to return to normal operation.
- **Alarm Circuit** – An optional wiring circuit from the BMS which can provide an audible or visual alert when BMS detects any trouble with the battery.
- **Lockout Voltage detection** – if an incorrectly configured charge source, such as solar controller or inverter/charger set to higher battery voltage is applied to the BMS, it will detect wrong voltage range and will prevent from closing the contactor, protecting the battery from wrong charge source.

AMPSEAL Connector

The NeverDie® BMS has a 14 pin AMPSEAL Connector on its side wall (for internal BMS models, this is located on the lid on most batteries), which can be used to wire BMS's auxiliary circuits to other components in the energy storage system. This allows implementation of additional BMS functions listed below. The scope of this document is only to list AMPSEAL pins and their functions. Please contact your battery supplier or Lithionics Battery for specific wiring diagrams and technical assistance to make sure these pins are used as intended and prevent internal damage to the BMS unit. Pay close attention to electrical specs and fusing requirements for each circuit.

AMPSEAL-14 Pinout

Pin	Function	Description	Details
1	FCC 1	Alternator Field Control Circuit wire 1	dry contact, up to 24VDC 2A, needs ext. fuse
2	FCC 2	Alternator Field Control Circuit wire 2	dry contact, up to 24VDC 2A, needs ext. fuse
3	AGSR 1	Automatic Generator Start/Restart wire 1	dry contact, up to 24VDC 2A, needs ext. fuse
4	AGSR 2	Automatic Generator Start/Restart wire 2	dry contact, up to 24VDC 2A, needs ext. fuse
5	Reset Button 2	Reset button wire 2	15V 5mA normally open push button circuit
6	Alarm Out Neg	Alarm output negative wire	low side protected FET switch, 1A load limit
7	Reset Button 1	Reset button wire 1	15V 5mA normally open push button circuit
8	LED Green	Tri-Color LED Pod - Green signal	15V 5mA LED driver, internally 3k limited
9	AUX Input	Auxiliary input signal (E-Stop)	15V 5mA input for custom BMS functions
10	RS232 RX	RS232 RX signal	+/- 5V RS232 signal
11	RS232 TX	RS232 TX signal	+/- 5V RS232 signal
12	LED Red	Tri-Color LED Pod - Red signal	15V 5mA LED driver, internally 3k limited
13	+12V Ext Pwr Input	AC sense / External power positive wire	BMS ext. power, needs 11-18VDC 3A supply
14	GND	Common Ground for all non-isolated circuits	Tied to battery negative with 8A internal fuse

Lithionics Battery supplies a mating wiring harness for the Ampseal connector, part number **75-H3-EBR**, which includes commonly used functions listed above. For additional harnesses contact Lithionics Battery Support.