



Lithionics Battery®

# GTO Series Installation Manual

## \*Model Numbers

GTO12V660A-E2609-DIN

GTO51V330A-F3020-DIN

GTO24V330A-E2609-DIN

GTO51V330A-E2609-DIN

\*See Table 1 for model number details



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LITHIUM+ELECTRONICS = LITHIONICS BATTERY

**MiniBMS**®  
TECHNOLOGY

**OptoLoop**®  
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## Important Safety Guidelines

This guide contains important safety instructions for the GTO Series Battery System that must be followed during installation procedures. Completely read this manual and become familiar with all system components before attempting installation. **Save this installation manual for future reference.**

*The following symbols and messages are used to identify potential hazards or to clarify the procedure.*



The **CAUTION** symbol indicates a hazardous situation which, if not avoided, could result in moderate or minor injury.



The **DANGER** symbol indicates a hazardous situation which, if not avoided, will result in death or serious injury.

## Safety Information

1. **Before using the Battery System, read all instructions and cautionary markings on the unit, the BMS, and all appropriate sections of this manual.**
2. The information in this manual is intended for qualified personnel. Qualified personnel have training, knowledge, and experience in:
  - Selecting and using Personal Protective Equipment (PPE).
  - Installing electrical equipment.
  - Applying all applicable local and national installation codes.
  - Analyzing and reducing the hazards involved in performing electrical work.
3. Use of accessories not recommended or sold by the manufacturer may result in a risk of fire, electric shock, or injury to persons.
4. To avoid the risk of fire and electric shock, make sure that existing wiring is in good condition and that wire is not undersized. Do not operate the battery system with damaged or substandard wiring.
5. Do not operate the battery system if it has been damaged in any way.
6. This unit does not have any user-serviceable parts. Do not disassemble the battery system except where noted for connecting wiring and cabling. Attempting to service the unit yourself may result in a risk of electrical shock or fire. Internal cells remain charged after all power is disconnected.
7. To reduce the chance of short-circuits, always use insulated tools when installing or working with this equipment.
8. Remove personal metal items such as rings, bracelets, necklaces, and watches when working with electrical equipment.



#### HAZARD OF ELECTROLYTE VAPOR

- The battery module may emit a *non-toxic* pressurized electrolyte vapor if punctured.
- Electrolyte vapor may cause temporary minor breathing congestion.
- Electrolyte vapor can decrease visibility in closed compartments.



#### HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices.
- Always turn OFF all 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.
- Do not operate the system if it has received a sharp blow, been dropped, has cracks or openings in the enclosure.
- Do not disassemble any part of the system. Internal cells remain charged after all power is disconnected.
- Do not operate the system with damaged or substandard wiring.
- Always use proper wire sizes to connect the system to inverters, chargers or other equipment.
- Voltage is present at the connector and output terminals. Always ensure that the BMS output terminals have the insulated protective boots in place.
- Always use crimped connections to connect to the output terminals.
- Always use a properly rated voltage sensing device to confirm all circuits are de-energized.



#### HAZARD OF HEAVY EQUIPMENT

- Use two people to lift and mount the battery module.
- Always use proper lifting techniques during installation to prevent injury.
- Do not lift the battery module by its power or signal wires as they will become damaged.

If the system is operated outside of its limits and/or used in combination with non-original components without authorization, the warranty is void.

Do not expose this unit to direct sunlight, external heat sources or submersion in any liquid. This product is designed for closed compartment use only. Damage to any part of the battery system caused from direct sunlight, external heat sources or submersion in any liquid will not be covered by the product warranty.

The Battery Module and BMS is tested to comply with UN DOT 38.3, the testing requirement for Lithium Batteries per Part III; of the UN Recommendations on the TRANSPORT OF DANGEROUS GOODS (Manual of Tests and Criteria, Fifth revised edition); [ST/SG/AC.10/11/Rev.5].

This Battery Module contains no mercury and is RoHS Compliant. Please consult your local municipal authority for proper disposal.

## Consignes de Sécurité Importantes

Ce guide contient des instructions de sécurité importantes pour le système de batterie des séries GTO qui doivent être suivies lors des procédures d'installation. Lisez entièrement ce manuel et familiarisez-vous avec tous les composants du système avant de tenter l'installation. **Conservez ce manuel d'installation pour référence future.**

*Les symboles et messages suivants sont utilisés pour identifier les dangers potentiels ou pour clarifier la procédure.*



Le mot **ATTENTION** indique une situation potentiellement dangereuse, laquelle, si elle n'est pas évitée, pourrait entraîner des blessures mineures ou modérées.



Le mot **DANGER** indique une situation dangereuse imminente, laquelle, si elle n'est pas évitée, entraînera de graves blessures, voire la mort.

## Information sur la Sécurité

1. **Avant d'utiliser le système de batterie, lisez toutes les instructions et les avertissements sur l'unité, le BMS et toutes les sections appropriées de ce manuel.**
2. Les informations contenues dans ce manuel sont destinées au personnel qualifié. Le personnel qualifié possède une formation, des connaissances et une expérience en:
  - Sélection et utilisation des équipements de protection individuelle (EPI).
  - Installation d'équipements électriques.
  - Appliquer tous les codes d'installation locaux et nationaux applicables.
  - Analyser et réduire les risques liés à l'exécution des travaux électriques.
3. L'utilisation d'accessoires non recommandés ou vendus par le fabricant peut entraîner un risque d'incendie, de choc électrique ou de blessures corporelles..
4. Pour éviter tout risque d'incendie et d'électrocution, assurez-vous que le câblage existant est en bon état et que le fil n'est pas sous-dimensionné. Ne pas faire fonctionner le système de batterie avec un câblage endommagé ou de qualité inférieure.
5. N'utilisez pas le système de batterie s'il a été endommagé de quelque manière que ce soit.
6. Cet appareil ne contient aucune pièce réparable par l'utilisateur. Ne démontez pas le système de batterie, sauf indication contraire pour le câblage et le câblage. Tenter de réparer l'appareil vous-même peut entraîner un risque d'électrocution ou d'incendie. Les cellules internes restent chargées une fois que toute l'alimentation est coupée.
7. Pour réduire les risques de courts-circuits, utilisez toujours des outils isolés lors de l'installation ou de l'utilisation de cet équipement.
8. Retirez les objets métalliques personnels tels que bagues, bracelets, colliers et montres lorsque vous travaillez avec des équipements électriques.

**ATTENTION****RISQUE DE VAPEUR D'ÉLECTROLYTE**

- Le module de batterie peut émettre une vapeur d'électrolyte sous pression *non toxique* s'il est perforé.
- Les vapeurs d'électrolyte peuvent causer une congestion respiratoire mineure temporaire.
- La vapeur d'électrolyte peut diminuer la visibilité dans les compartiments fermés.

**ATTENTION****RISQUE DE CHOC ÉLECTRIQUE, D'EXPLOSION OU D'ARC ÉLECTRIQUE**

- Appliquer un équipement de protection individuelle (EPI) approprié et suivre des pratiques de travail électrique sûres.
- Éteignez toujours tous les équipements connectés au système en plus de désactiver l'interrupteur d'alimentation fourni sur le système pour isoler les batteries des autres circuits électriques, avant d'effectuer toute réparation ou maintenance sur le système.
- N'utilisez pas le système s'il a reçu un coup violent, s'il est tombé, s'il présente des fissures ou des ouvertures dans le boîtier.
- Ne démontez aucune pièce du système. Les cellules internes restent chargées une fois que toute l'alimentation est déconnectée.
- N'utilisez pas le système avec un câblage endommagé ou de qualité inférieure.
- Utilisez toujours des câbles de taille appropriée pour connecter le système aux onduleurs, chargeurs ou autres équipements.
- Une tension est présente au niveau du connecteur et des bornes de sortie. Assurez-vous toujours que les bornes de sortie BMS ont les bottes de protection isolées en place.
- Utilisez toujours des connexions serties pour vous connecter aux bornes de sortie.
- Utilisez toujours un dispositif de détection de tension correctement évalué pour confirmer que tous les circuits sont hors tension.

**ATTENTION****RISQUE D'ÉQUIPEMENT Lourd**

- Utilisez deux personnes pour soulever et monter le module de batterie.
- Utilisez toujours des techniques de levage appropriées lors de l'installation pour éviter les blessures.
- Ne soulevez pas le module de batterie par ses fils d'alimentation ou de signal car ils seront endommagés.

Si le système est utilisé en dehors de ses limites et / ou utilisé en combinaison avec des composants non originaux sans autorisation, la garantie est nulle.

N'exposez pas cet appareil à la lumière directe du soleil, à des sources de chaleur externes ou à une immersion dans un liquide. Ce produit est conçu pour une utilisation à compartiment fermé uniquement. Les dommages à toute partie du système de batterie causés par la lumière directe du soleil, des sources de chaleur externes ou une submersion dans un liquide ne seront pas couverts par la garantie du produit.

Le module de batterie et le BMS sont testés pour se conformer à UN DOT 38.3, l'exigence de test pour les batteries au lithium selon la partie III; des Recommandations des Nations Unies sur le TRANSPORT DES MARCHANDISES DANGEREUSES (Manuel d'épreuves et de critères, cinquième édition révisée); [ST/SG/AC.10/11/Rev.5].

Ce module de batterie ne contient pas de mercure et est conforme RoHS. Veuillez consulter les autorités municipales locales pour une élimination appropriée.

# 1. System Specifications

## 1.1 Operating Specifications

Table 1 GTO Series

System Model	GTO12V660A-E2609-DIN	GTO24V330A-E2609-DIN	GTO51V330A-E2609-DIN	GTO51V330A-F3020-DIN
Module QTY & Model	1x GTO12V660A-E2609-DIN-12HK-UL	1x GTO24V330A-E2609-DIN-12HK-UL	2x GTO51V165A-E2609-DIN-12HK-UL	2x GTO51V165A-F3020-DIN-12HK-UL
Capacity	660Ah	330Ah	330Ah	330Ah
Nominal Voltage	12.8V	25.6V	51.2V	51.2V
Recommended Charging Voltage	14.4V	28.8V	57.6V	57.6V
Maximum Charging Voltage	14.4V	28.8V	57.6V	57.6V
Overcharge Voltage Protection	14.8V	29.6V	29.6V	59.2V
Over-discharge Voltage Protection	11.6V	23.2V	46.4V	46.4V
Standard Charging Current	300A	300A	150A	150A
Maximum Charging Current	300A	300A	150A	150A
End of Charging Current	33A	16.5A	16.5A	16.5A
Standard Discharging Current/Load	300A	300A	150A	150A
Maximum Discharge Current/Load	300A	300A	150A	150A
System Impedance at BMS Power Terminals	1.32mΩ	1.52mΩ	5.50mΩ	5.80mΩ
Ibf Bolted Fault Current at Nominal Voltage (N4)	9,697A	16,842A	4,655A	4,414A
Maximum Charging Temperature Range (N1)	0-25 (32-77°F)			
Maximum Discharging Temperature Range (N1)	-30-25 (-22-77°F)			
Module Dimensions	26.0" x 8.3" x 10.5"	26.0" x 8.3" x 10.5"	26.0" x 8.3" x 10.5"	30.0" x 20.2" x 4.9"
Module Weight (N2)	130lbs (59kg)	130lbs (59kg)	130lbs (59kg)	150lbs (68kg)
BMS Case Dimensions (N3)	11.25" x 6.96" x 4.1" (286 x 177 x 104mm)			

Notes for Table 1:

(N1) Maximum charging and discharging rates apply depending upon the ambient temperature and duty cycle of the system. UL1973 tests of maximum charge and discharge current were performed at 25°C/77°F.

(N2) Does not include the power cable's weight as its length varies per application.

(N3) Does not include the power cable, main power connector, or terminals. Please see [www.lithionicsbattery.com](http://www.lithionicsbattery.com) for dimensions.

(N4) "Bolted Fault Current" per NFPA-70E. See section 1.2 for details.

### 1.2 Arc Flash Energy Specifications

- An arc flash is the light and heat produced from an electric arc supplied with sufficient electrical energy to cause substantial damage, harm, fire, or injury.
  - An example of an arc flash event could be a direct short circuit caused by a metallic object such as a tool bridging between the positive and negative of an energized circuit.
  - Table 2 below quantifies the hazard level of arc flash energy that each battery system is capable of producing.

Per NFPA 70E D.5.1 "Maximum Power Method"

$$I_{arc} = 0.5 \times I_{bf}$$

$$IEm = 0.01 \times V_{sys} \times I_{arc} \times T_{arc} / D^2 \quad (\text{Arc Flash Energy})$$

Table 2

Tarc= 70ms fuse clearing time	Configuration	Vsys	Impedance mΩ	Ibf, calc.	Iarc	IEm cal/cm <sup>2</sup>	3x IEm cal/cm <sup>2</sup>	Distance where IEm=1.2 (Arc Boundary), inches.	Hazard level
	GTO12V660A-E2609-DIN	12.8	1.32	9697	4848	0.014	0.041	2	0
	GTO24V330A-E2609-DIN	25.6	1.52	16842	8421	0.016	0.047	2	0
	GTO51V330A-E2609-DIN	51.2	5.50	9309	4655	0.013	0.039	2	0
	GTO51V330A-F3020-DIN	51.2	5.80	8828	4414	0.058	0.173	4	0

Hazard/risk classification as per NFPA 70E-2000

Category	Energy Level	Typical PPE Examples
0	N/A	Non-melting, flammable materials (e.g. untreated cotton, wool, rayon, etc.)
1	5 cal/cm <sup>2</sup>	FR shirt and FR pants
2	8 cal/cm <sup>2</sup>	Cotton underwear plus FR shirt & pants
3	25 cal/cm <sup>2</sup>	Cotton underwear plus FR shirt & pants plus FR coverall
4	40 cal/cm <sup>2</sup>	Cotton underwear plus FR shirt & pants plus double layer switching coat and pants

### 1.3 Manufacturing Date Code Format

- MMDDYYYY001
  - MM: Month of Manufacture
  - DD: Day of that Month
  - YYYY: Year of Manufacture
  - 001: Sequence of Battery Produced on That Day
- Example: 01012023001 = manufactured on January 1, 2023 and it was the first battery produced on that day.

## 2. System Installation

### 2.1 Short Circuit Protection

- The battery system must be protected by a DC fuse. The models listed in this document were evaluated and tested by Underwriter Laboratories with external fuses as noted. UL Listed Class J or Class T Fuse, rated per the table below. The fuse is to be provided downstream of the BMS before the load or supply in all cases. The fuse should be used with a UL Listed fuse holder. The use of any other fuse or non-fuse voids the UL Listing of the models.

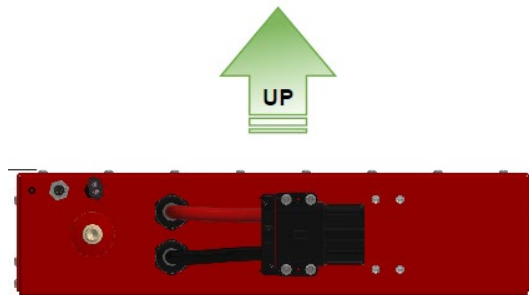
- Examples of approved:

Model	Fuse	Fuse Holder	Current Rating
GTO12V660A-E2609-DIN	Littelfuse	Littelfuse	350A
GTO24V330A-E2609-DIN	JLLN-350	LFT304001CS	
GTO51V165A-E2609-DIN	Littelfuse	Littelfuse	150A
GTO51V165A-F3020-DIN	JLLN-150	LFT302001CS	

- Fuse placement must be directly after the positive power terminal on the BMS. (Fuse placement may be controlled by other industry standards such as ABYC or RVIA.)

### 2.2 Battery Module and NeverDie BMS Unit Environment and Mounting Orientation

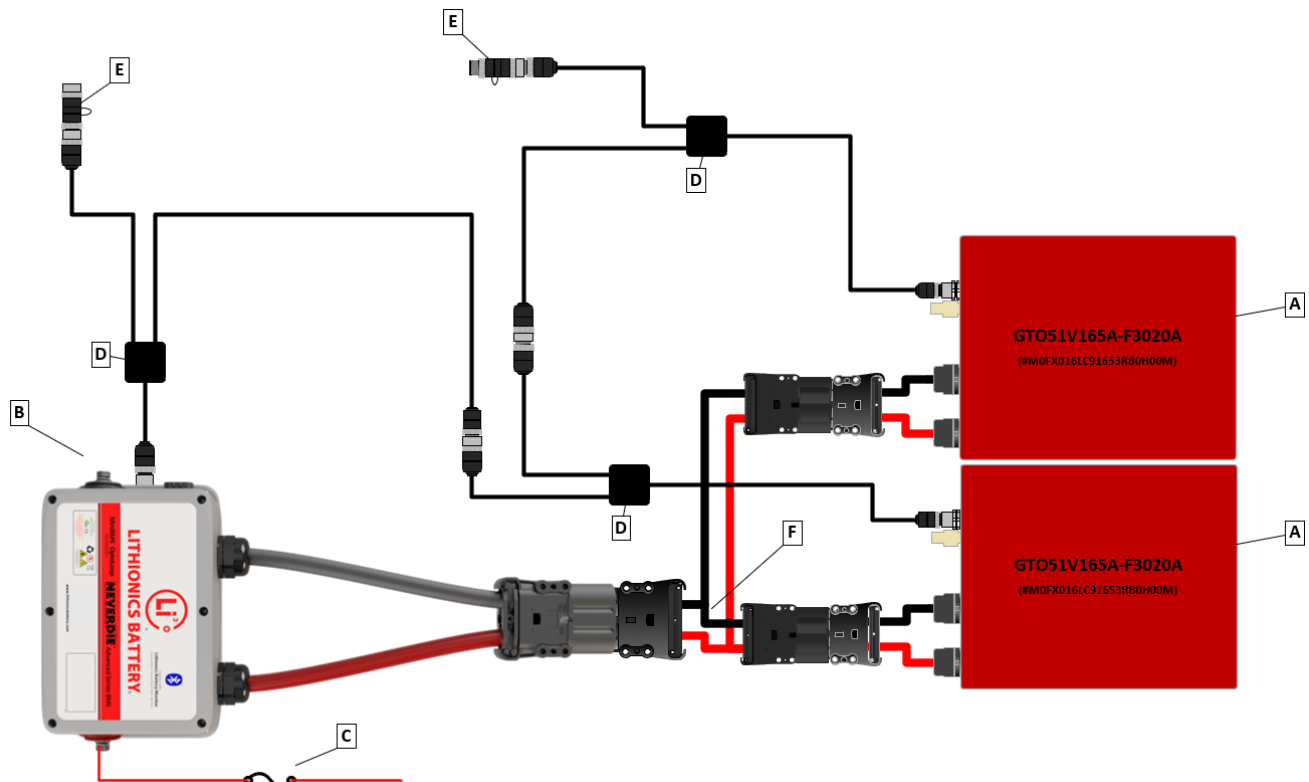
- The Battery Module and BMS Unit should be mounted in an environment that does not receive direct sunlight, pressurized water, or road debris.
- To avoid power interruption, your installation may need to consider controlling the ambient operating temperature.
- The BMS Unit can be mounted in any orientation as long as all of its features are accessible.
- Ensure that the BMS Unit is located in close proximity to the Battery Module so that all connectors can be mated in the following steps.
- Mount the Battery Module in an upright position, i.e. black lid faces up.
  - Other orientations are NOT permitted and will void the warranty.
  - In the case of the GTO51V165A-F3020-DIN mounting orientation, it must be mounted as shown:





### 2.3 IonBus® Data and Power Connections

- The Lithionics Battery IonBus® is a data communication network used as a backbone for the distributed energy storage system (ESS) design, which consists of one or more battery modules and an external NeverDie® BMS unit.



- A. (2x) GTO51V165A-F3020A-DIN-12HK-UL Modules
  - Each module has a single circular 8-pin IonBus® port.
- B. (1x) Advanced Series BMS
  - The BMS has a single circular 8-pin IonBus® port.
- C. Fuse connected to BMS Positive Output Terminal
- D. (3x) Optoloopt+ T-Adapters (#80-244)
  - Align the connectors and connect the “M” side to the Module or BMS.
    - Rotate the 2 nuts of the connector to tighten together until it stops.
  - Daisy-chain the “Up” and “Down” sides together.
- E. (2x) Optoloopt+ Terminator
  - Install one at each end of the daisy-chained T-Adapters
    - Rotate the 2 nuts of the connector to tighten together until it stops.
- F. (1x) Y Harness, 2x A160 1/0 Din Male to 1x A320 4/0 Din Female, 20" (#75-625-20)
  - Connects the 2 battery modules in parallel to the BMS.
  - Align the connectors and connect them together.
  - Use 2 zip ties to bind the connectors together so that they may not separate during operation.

### 2.5 NeverDie BMS Unit Power Terminals

- Connect the BMS Unit Power Terminals to your DC bus, both Positive (Red) and Negative (Black).
  - Use correctly sized wire conductors for the application.
  - Torque the terminals to 108-132in-lbs (12.2-14.9N-m).
  - Do not stack ring terminals together, use a sub-busbar if necessary for multiple ring terminal connections.
  - Never place the stainless-steel washer between the Power Terminal and ring terminal lug (see Figure 1 on Page 7).

## 2.6 Pressure Vent

- It is recommended to install a ventilation hose onto the pressure vent barb when the Battery Module is in a location with poor ventilation to atmosphere.
  - The hose shall direct the gases to the atmosphere.

## 2.7 BMS Unit I/O Connector

- Some systems have a rectangular I/O connector to extend the BMS Unit features remotely such as remote Power/Reset switch, LED indicator, or serial datalogging. Be sure to connect the I/O connector if so equipped.

## 2.8 Initial Charge Cycle

- Initially the system must be FULLY charged once to calibrate the BMS Unit to the Battery Module. Please read and follow the next section to perform this.

# 3. System Operation

## 3.1 Powering the System On

- Short-press the Power switch for 1 second.
  - The switch will illuminate once power is enabled.
  - You may notice an audible “thunk” noise of the internal contactor switching on.
  - Check that there is voltage at the Power Terminals with a voltmeter.

## 3.2 Powering the System Off

- Long-press the Power switch for 3 seconds.
  - The switch will cease to illuminate once power is disabled.
  - You may notice an audible “thunk” noise of the internal contactor switching off.
  - Check that there is 0V at the output terminals with a voltmeter.

## 3.3 Charging

- The charging device(s) connected to the Lithium Battery System must be programmed as per Table 1.
- Charging may be performed at any time the system is powered On.
  - **NOTE** – The Lithium Battery System will disconnect power if the voltage, amperage, or temperature limits are exceeded during charging.
  - Only use a Lithionics Battery approved charging source. Please contact Lithionics Battery for charger approval.

## 3.4 Initial Charging Cycle

- The initial charging cycle is required as it calibrates the NeverDie BMS to the Battery Module(s) for accurate State of Charge percentage (SoC) monitoring.
- During the initial charging cycle, the system must reach a voltage level that is equal to the Standard Full Charging Voltage indicated in Table 1.
- Enable the charging device(s) so that they may complete a charge cycle. It is recommended to not have any discharge loads active during the initial charging cycle, especially towards the end of charging.

## 3.5 Discharging

- Discharging may be performed at any time the system is powered On.
  - **NOTE** - The Lithium Battery System will disconnect power if the voltage, amperage, or temperature limits are exceeded during discharging.
- The NeverDie feature allows the system to have a “reserve” amount of energy left in the battery. Once the system is discharged to 12.0V or 10% State of Charge (SoC), whichever comes first, power will be disabled to leave a “reserve” amount of energy still left in the battery.
- To enable the remaining reserve energy of the system, short-press the Power switch for 1 second.
  - **NOTE** - Once the reserve range 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 will become permanently damaged.

### 3.6 System Storage Procedure

- Storing your battery at the correct specifications is important as it keeps the battery in the healthiest state possible for the fastest deployment when needed.
- If the Lithium Battery System will not be in use for greater than 2 weeks, it is recommended to enable system storage.
- Storage mode is simply an appropriately charged system with the BMS in the Powered Off state.
- To enable System Storage:
  - Perform a full charge cycle, ensure that the System voltage reaches the Standard Full Charging Voltage indicated in Table 1.
  - Power off the System, long-press the Power switch for 3 seconds. Check that the switch is no longer illuminated. Check that there is 0V at the Power Terminals with a voltmeter.

Table 3

<b>Storage Temperature &amp; Humidity Range</b>	< 1 Month	-4~95°F (-20~35°C), 45~75%RH
	< 3 Months	14~86°F (-10~30°C), 45~75%RH
<b>Long Term Storage</b>	If the battery needs to be stored for > 3 months the voltage should be 13.2V for a 12V battery (or 3.3V x number of cells in series) (~50%SOC) and stored at the recommended storage specifications shown above. Additionally, the battery needs at least one charge-discharge-recharge to 50% SOC cycle every six months.	
<b>Self-discharge rate</b>	≤3% per month	

#### Storage conditions < 3 months:

1. Fully charge the battery.
2. Turn the battery **OFF** by the Power/Reset switch.
3. Store the battery in an environment according to the specifications shown above.

#### Storage conditions > 3 months:

1. Reduce the battery SOC to 3.3V/cell which is 50% ±10% SOC.  
**NOTE** - See table 4 below for total voltage calculation.
2. Turn the battery **OFF** via the Power/Reset switch.
3. Store the battery in an environment according to the specifications shown in table 3 above.
4. Every 6 months charge the battery to 100% SOC, then discharge the battery to LVC, then charge it to 50% ±10% SOC.

Table 4

Battery Voltage	Number of Cells	~50% SOC Voltage
12V	4	13.2
24V	8	26.4
48V	15	49.5
51V	16	52.8

**NOTE** – For further system installation and operation please refer to the *Advanced Series User Guide* available at: <http://www.lithionicsbattery.com/user-guides/>

Figure 1: BMS Power Terminals Hardware

