A LithiumWerks Product

# Manual

Version
October 2018


## LITHIUM BATTERY
## SB12V1200Wh-M

12.9V/90Ah
Lithium Iron Phosphate

# User Manual SB12V1200Wh-M Lithium Iron Phosphate battery

Dear customer,

This is the user manual of the Super B Epsilon battery. A Li-ion battery that outperformances conventional batteries in all areas and saves up to 70% in space and weight. By utilizing advanced chemistry and system design, the Super B Epsilon provides enormous power and energy reserves for full freedom on the go. And with the free BeInCharge app for iPhone and Android, you always know the exact state and conditions of the Li-ion battery.

This manual contains all the information necessary to install, use and maintain the Li-ion battery. We kindly ask you to read this manual carefully before using the product. In this manual, the Super B Epsilon SB12V1200Wh-M Li-ion battery will be referred to as: the Li-ion battery. This manual is meant for the installer and the user of the Li-ion battery. Only qualified, certified personnel may install and perform maintenance on the Li-ion battery. Please consult the index at the start of this manual to locate information relevant to you.

The boundaries of its use, as described in this manual should always be upheld. The Li-ionbattery may not be used in medical or in aviation related applications. The Li-ion battery may not be used for any purposes other than described in this manual. Using the Li-ion battery for any other purpose will be considered improper use and will void the warranty of the product. Super B cannot be held responsible for any damage caused by improper, incorrect or unwise use of the product. Read and understand this manual completely before using the product.

During the use of the product, user safety should always be ensured, so installers, users, service personnel and third parties can safely use the Li-ion battery. This is the original manual, keep it in a safe location! Please consult www.super-b.com for the latest version of all manuals.

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SUPER B
A LithiumWerks Product

# Table of content

# 1. Introduction

## 1.1. Product description

The SB12V1200Wh-M is a Lithium Iron Phosphate rechargeable battery. The unique combination of state-of-the art technology and smart software makes this Li-ion battery a robust, safe and easy to use energy storage solution.

Compared to conventional lead acid batteries, the Super B Epsilon saves up to 70 % in space and weight. It offers fast charging, is very efficient, has extremely high performance and is maintenance free.

Moreover, the Super B Epsilon uses exceptionally safe lithium iron phosphate (LiFePO4) technology. With its integrated battery management system the Li-ion battery is protected from deep discharging, overcharging and overheating. Eliminating the need for an external safety relay means the Li-ion battery is very easy to install.

The Super B Epsilon also has integrated battery monitoring which provides details about its status such as voltage, current, temperature, state of charge and time remaining. Hands-on monitoring is possible via Bluetooth, external monitoring devices and LED indicators inform you about the actual status of your Li-ion battery. The free BeInCharge app provides 24/7 information about the state of charge, time to go and status of the Li-ion battery.

Potential applications of this Li-ion battery include: Recreation vehicles service battery, marine service battery, energy storage solutions.

In Appendix I, the Declaration of Conformity for the Li-ion battery is given.

## 1.2. Glossary of Terminology

| | |
|---|---|
| BMS: | Battery Management System |
| Charge cycle: | A period of use from fully charged, to fully discharged, and fully recharged again |
| Endurance Life-cycle: | The products maximum lifespan, achieved by following the guidelines presented in this manual |
| LiFePO4 | Lithium Iron Phosphate |
| SoC: | State of Charge |
| CCCV | Constant Current - Constant Voltage |
| DoD | Depth of Discharge |

Table 1. Glossary of terminology

## 1.3. Used symbols

The following icons will be used throughout the manual:

⚠ **Warning!** A warning indicates severe damage to the user and/or product may occur when a procedure is not carried out as described.

⚠ **Caution!** A caution sign indicates problems may occur if a procedure is not carried out as described. It may also serve as a reminder to the user.

# 2. Product specifications

## 2.1. Product features

- Replacement for lead acid LN5 batteries
- Traction battery
- Lithium Iron Phosphate (LiFePO4): Safe lithium technology
- High performance, even under extreme conditions
- Integrated BMS (Battery-Management system)
- Superior abuse tolerance
- Fast charging and discharging
- Very efficient
- Maintenance free
- Terminals for 95mm² wire connection / M8 flat terminal with automotive terminal post with rotation lock
- Integrated protection device for maximum protection and safety
- 200A max continuous discharge
- Peak power (30s) 350 A
- Charge current regulator, for safe low temperature charging
- Wireless communication interface: Bluetooth
- Wired communication interfaces: CANopen
- Battery monitoring / History Storage
- Adaptive cell balancing
- Low self-discharge
- Free mobile application for iOS and Android: BeInCharge, to know the state and conditions of the Li-ion battery

## 2.2. General product specifications

| | |
|---|---|
| Product name | Super B Epsilon, SB12V1200Wh-M |
| Producer | Super B |
| Battery type | Lithium Iron Phosphate (LiFeP04)/traction battery |
| EAN number | 8718531361317 |
| Cycle life | > 2000 (0.3C continuous discharge, DoD 100%) |

Table 2. General product specifications

*The cycle life value given above is an indication at 23°C. Battery cycle life depends strongly on temperature and the applied charging and discharging loads. For more information on the cycle life of theLi-ion battery, appendix II may be consulted.

## 2.3. Technical specifications

| | |
|---|---|
| Mass: | 12.5 kg (+ /- 5%) |
| Ingress protection rating: | IP52 |

Table 3. Technical specifications

### 2.3.1. Battery designation

| | |
|---|---|
| Battery designation according to IEC 61960: | 4IFpR19/66-60 |

Table 4. Battery designation

### 2.3.2. Electrical properties (23°C)

| | |
|---|---|
| Open Circuit Voltage* | 13.2V dc |
| Nominal voltage ** | 12.9V dc |
| Rated capacity | 90Ah / 1152Wh |
| Charge method | CCCV |
| Charge voltage | 14.3V... 14.6V |
| End-of-discharge voltage | 8V dc |
| Charge current | Max 90A (1C) |
| Discharge current continuous | 200A |
| Discharge current 30 seconds | 350A |

Table 5. Electrical properties (23 °C)

* Open Circuit Voltage at 50% SoC, no load

** Nominal voltage (V) at 50% SoC, 0.2C discharge

More information on the Li-ion battery's performance may be found in Appendix II.

## 2.3.3. Dimensions (LN5)

| | |
|---|---|
| Height (H): | 190 mm |
| Width (W): | 353 mm |
| Thickness (T): | 175 mm |

Table 6. Dimensions

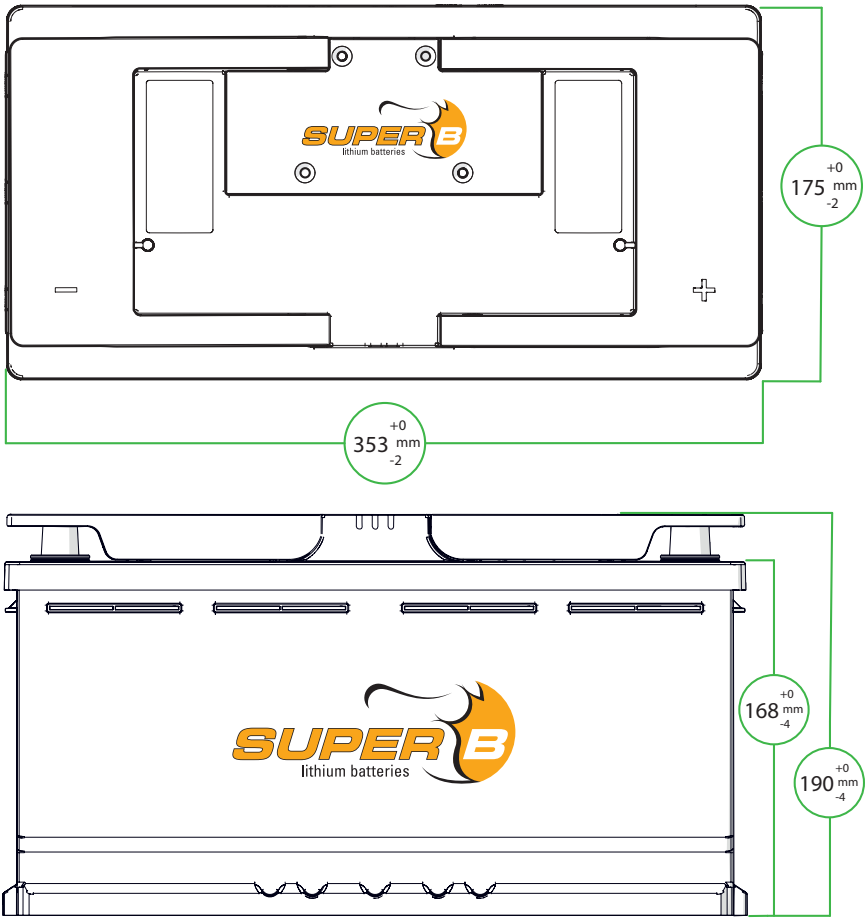



Figure 1. Dimensions

## 2.4. Environmental conditions

⚠ **Warning!** The Li-ion battery may only be used in conditions specified in this manual. Exposing the Li-ion battery to conditions outside the specified boundaries may lead to serious damage to the product and/or the user.

Use the Li-ion battery in a dry, clean, dust free, well ventilated space. Do not expose the Li-ion battery to fire or water or solvents.

When the batteries are placed in an enclosed environment without air circulation, it is advised to provide 2 ventilation holes of 100mm x 100mm each, to prevent heat built-up.

| | |
|---|---|
| Recommended charge temperature range | -10°C to +45°C* |
| Discharging operating temperature range | -20°C to +60°C* |
| Short term (<1 month) storage temperature range | -10°C to +35°C |
| Long term (>1 month) storage temperature range | 23 ± 5°C |
| Relative humidity | 10-90% |
| Vibrations and shocks | According UN38.3 |

Table 7. Environmental conditions

* When temperature is < 0ºC and > 45ºC performance will be degraded. (see Appendix II)

## 2.5. Required tools

- 13mm Hexagon socket wrench
- Torque wrench
- Combined 2.5mm / 6mm Allen hex key (included with Li-ion battery)

## 2.6. Components

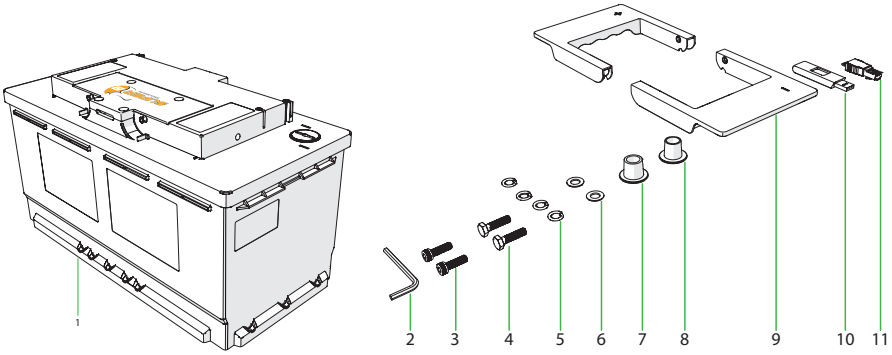



Figure 2. Components

1. (1x) Super B SB12V1200Wh-M Li-ion battery
2. (1x) Tool (combined 2.5mm/6mm Allen key)
3. (2x) Allen Bolt M8 x 20mm
4. (2x) Hex bolt M8 x 16mm
5. (4x) Spring washer M8
6. (2x) Plain washer M8
7. (1x) Removable automotive battery pole positive
8. (1x) Removable automotive battery pole negative
9. (2x) Removable handles
10. USB stick (manual)
11. RJ45 CAN Termination resistor

## 2.7. Connections, indicators and battery controls

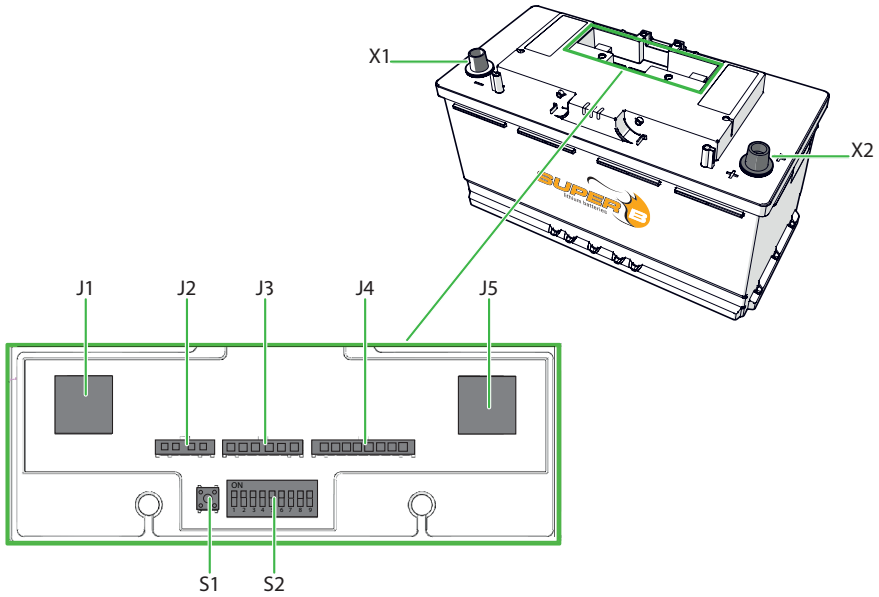



Figure 3. Connections, indicators and battery controls

J1: RJ45 (CAN1)
J2: Inputs 4 Pins
J3: Monitor 6 Pins
J4: Outputs 8 Pins
J5: RJ45 (CAN2)
S1: Push Button
S2: Configuration switch
X1: Battery Terminal up to 1x 95mm2 wire connection or standard automotive terminal
X2: Battery Terminal up to 1x 95mm2 wire connection or standard automotive terminal

### 2.7.1. J1 / CAN1 (RJ45)

| PIN # | Service description | Function |
|---|---|---|
| 1 | CAN High | Communication |
| 2 | CAN Low | Communication |
| 3 | CAN Ground | Communication |
| 4 | Not Connected | - |
| 5 | Not Connected | - |
| 6 | CAN Shield | EMC |
| 7 | Not Connected | - |
| 8 | CAN Power | Looped through and not used by Li-ion battery |

Table 8. CAN 1 / J1 interface

### 2.7.2. J2 Inputs (WR-MPC3 3mm Male Header)

| PIN # | Service description | Function Range | Range |
|---|---|---|---|
| 1 | IN 1A | For future use | + (0...60Vdc) |
| 2 | IN 1B | For future use | - |
| 3 | IN 2A | Storage mode (See chapter 7) | + (0...60Vdc) |
| 4 | IN 2B | Storage mode (See chapter 7) | - |

Table 9. Inputs J2

### 2.7.3. J3 Monitor (WR-MPC3 3mm Male Header)

| PIN # | Service description | Function | Range |
|---|---|---|---|
| 1 | Battery + | Power | + (5... 18Vdc) |
| 2 | State of Charge | SOC Indication | 0...10Vdc |
| 3 | Not Connected | - | - |
| 4 | Not Connected | - | - |
| 5 | LIN | Communication | -45...+45Vdc |
| 6 | Battery - | Power | - |

Table 10. Monitor J3

### 2.7.4. J4 Outputs (WR-MPC3 3mm Male Header)

| PIN # | Service description | Function | Range |
|---|---|---|---|
| 1 | OUT 1A | Generator control | -60...+60Vdc |
| 2 | OUT 1B | Generator control | -60...+60Vdc |
| 3 | OUT 2A | Inverter control | -60...+60Vdc |
| 4 | OUT 2B | Inverter control | -60...+60Vdc |
| 5 | OUT 3A | For future use | -60...+60Vdc |
| 6 | OUT 3B | For future use | -60...+60Vdc |
| 7 | OUT 4A | For future use | -60...+60Vdc |
| 8 | OUT 4B | For future use | -60...+60Vdc |

Table 11. Outputs J4

### 2.7.5. J5 / CAN 2 (RJ45)

| PIN # | Service description | Type of signal to the product |
|---|---|---|
| 1 | CAN High | Communication |
| 2 | CAN Low | Communication |
| 3 | CAN Ground | Power |
| 4 | Not Connected | - |
| 5 | Not Connected | - |
| 6 | CAN Shield | EMC |
| 7 | Not connected | - |
| 8 | CAN Power | Looped through and not used by Li-ion battery |

Table 12. CAN 2 / J5 interface

### 2.7.6. S1 Push button

| Service description | Type of signal to the product | Range |
|---|---|---|
| Switch | Input | High / Low |

Table 13. Switch S1

## 2.7.7. S2 Configuration Switch

For functions see software release document.

| | CAN | | | Undefined / Spare | | | | | Protocol |
|---|---|---|---|---|---|---|---|---|---|
| | Switch 1 | Switch 2 | Switch 3 | Switch 4 | Switch 5 | Switch 6 | Switch 7 | Switch 8 | |
| 1 | Off | Off | Off | Off | Off | Off | Off | Off | CAN communication disabled* |
| 2 | Off | On | Off | Off | Off | Off | Off | Off | CAN open |

Table 14. CAN Protocol Configurations (* When CANopen is switched off, the Li-ion battery goes into power saving mode, see chapter 5.3)

## 2.7.8. X1 / X2, Battery terminals

| PIN # | Service description | Range | Function |
|---|---|---|---|
| 1 | Battery - Terminal | - | Minus supply of battery |
| 2 | Battery + Terminal | + (14.6Vdc) | Plus supply of battery |

Table 15. Battery terminal interface

## 2.7.9. Bluetooth

| Service description | Type of signal to the product | Range |
|---|---|---|
| Bluetooth | Communication | 10 meter (class 2) |

Table 16. Bluetooth

## 2.7.10. LED Indicators

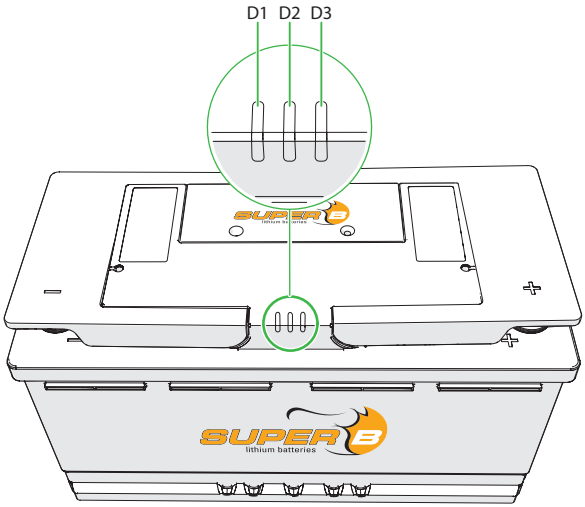



Figure 4. LED Indicators

| | D1 (Green)* | D2 (Yellow)* | D3 (Red)* | Mode |
|---|---|---|---|---|
| 1 | Off | Off | Off | Empty / Deep discharge/ Storage mode |
| 2 | Off | Off | On | Alarm mode |
| 3 | On | Off | Off | Operation mode |
| 4 | Off | On | Off | Warning mode |

Table 17. LED Mode
ds

When the Li-ion battery is in idle mode “not charging or discharging”, LED indicator flashes every 3 seconds) .
The Green and the Red leds will flash 3 times before the Li-ion battery goes to Empty/Deep discharge/ Storage mode.

## 2.7.11. Operation modes

**Empty mode**
The Li-ion battery voltage is below 10V.

**Deep discharge mode**
The Li-ion battery voltage is below 6V. The Li-ion battery is not usable anymore.

**Storage mode**
The Li-ion battery was set to storage mode manually.

**Alarm mode**
The BMS detects either an internal or external failure. If a critical alarm occurs during operation mode, the mode management function goes to alarm mode.

**Operation mode**
The Li-ion battery is fully operational. No error is detected.

**Warning mode**
The Li-ion battery parameters are out of specified limit(s)

## 2.7.12. System components operation modes dependencies

| Operating mode | Protective disconnect device | Communication* | BMS |
|---|---|---|---|
| Configuring mode | Open | Yes | Active |
| Operation mode | Closed | Yes | Active |
| Alarm mode | Open | Yes | Active |
| Empty / Deep discharge | Open | No | Inactive |
| Storage mode | Open / Closed | No | Sleep |

Table 18. System components operation modes dependencies (*communication is dependent of configuration switch setting)

## 2.8. Optional Components

| Description | Article name | EAN code |
|---|---|---|
| 4 pins 3 mm plug | WR-MPC3, Single Row Female Receptacle Housing, 4 pins, (3.00mm) WR-MPC3 micro power connector (4 positions) | 4200 000 0006 0 |
| 6 pins 3 mm plug | WR-MPC3, Single Row Female Receptacle Housing, 6 pins, (3.00mm) WR-MPC3 micro power connector (6 positions) | 4200 000 0005 0 |
| 8 pins 3 mm plug | WR-MPC3, Single Row Female Receptacle Housing, 8 pins, (3.00mm) WR-MPC3 micro power connector (8 positions) | 4200 000 0004 0 |
| 3 mm pins | WR-MPC3, Male Crimp Terminal, (3.00mm) WR-MPC3 micro power connector contact crimp Pin | 4200 000 0007 0 |
| RJ45 cable | SB RJ45 cable 1 m | 8718531361386 |
| RJ45 termination resistor | SB RJ 45 CAN terminator Epsilon | 8718531361331 |
| BM01 Battery monitor | SB BM01 12V | 8718531361041 |
| BM01 Epsilon Cable | SB BM01 cable Epsilon | 8718531361348 |
| Touch Display + Epsilon Cable | SB Touch display Epsilon + 5m cable | 8718531361454 |
| Push button | Push button | 8718531361515 |
| Auto restart | Auto restart | 8718531361508 |

Table 19. Optional components that can be used with the Li-ion battery

# 3. Safety guidelines and measures

## 3.1. General

- Do not short-circuit the Li-ion battery.
- Treat the Li-ion battery as described in this manual.
- Do not dismantle, crush, puncture, open or shred the Li-ion battery.
- Do not expose Li-ion battery to heat or fire. Avoid exposure to direct sunlight.
- Do not remove the Li-ion battery from its original packaging until required for use.
- In the event of the Li-ion battery leaking, do not allow the liquid to come in contact with the skin or eyes. If contact has been made, wash the affected area with copious amounts of water and seek medical advice.
- Do not use any charger other than that specifically provided for use with the Li-ion battery.
- Observe the plus (+) and minus (–) marks on the Li-ion battery and equipment and ensure correct use.

- Do not use any battery which is not designed for use with theLi-ion battery.
- Do not mix batteries of different manufacture, capacity, size or type within a device.
- Keep the Li-ion battery clean and dry.
- Secondary batteries need to be charged before use. Always use the correct charger and refer this manual for proper charging instructions.
- Do not leave the Li-ion battery on prolonged charge when not in use.
- After extended periods of storage, it may be necessary to charge and discharge the Li-ion battery several times to obtain maximum performance.
- Retain the original product documentation for future reference.
- Remove theLi-ion battery from the equipment when not in use.

⚠ **Warning!** Keep the Li-ion battery away from water, dust and contamination.

## 3.2. Disposal

Dispose of the Li-ion battery in accordance with local, state and federal laws and regulations.
Batteries may be returned to the manufacturer.
Do not mix with other (industrial) waste.

## 3.3. Safety symbols and markings on product

Several safety symbols and markings can be found on the product. These markings are displayed below. Never remove these markings!

The meanings of the symbols:

| | |
|---|---|
|  | Shield eyes |
|  | Note operating instructions |
|  | Battery acid |
|  | Explosive gas |
|  | No smoking, no naked flames, no sparks |
|  | Keep away from children |
|  | Dispose of the Li-ion battery in accordance with local, state and federal laws and regulations. Batteries may be returned to the manufacturer. Do not mix with other (industrial waste) |
|  | This product, or sections of this product can be recycled |

Table 20. Safety symbols

# 4. Installation

## 4.1. General information

⚠ **Warning! 12V systems only.** Never install multiple Li-ion batteries in series.
⚠ **Warning!** Never install or use a damaged Li-ion battery.
⚠ **Caution!** Do not reverse connect the power cables (polarity)

When connecting several batteries in parallel, always use batteries of the same brand, type, age, capacity and state of charge.

## 4.2. Unpacking

Check the Li-ion battery for damage after unpacking. If the Li-ion battery is damaged, contact your reseller or Super B. Do not install or use the Li-ion battery if it is damaged!

## 4.3. Preparing the Li-ion battery for use

⚠ **Warning!** Always remain within the limits indicated in chapter 2 during the use of the Li-ion battery.
⚠ **Caution!** The Li-ion battery stores fault conditions internally, like excessive charge current or deep discharge situations. Super B uses this information in the warranty process.
⚠ **Caution!** In case of an empty Li-ion battery shutdown, charge immediately.

### 4.3.1. Placement of the Li-ion battery

Before it is used, the Li-ion battery must be positioned in such a way that it will not move around in its compartment during use.
Use appropriate LN5 fastening brackets for mounting.

### 4.3.2. Set the Li-ion battery in normal operation mode

The Li-ion battery is pre-programmed in storage mode. Before it is used, the Li-ion battery must be set up in normal operation mode.
The Li-ion battery can be set to normal operation mode by one of the following procedures:

- Press the S1 Push button for 2 seconds.
- Connect the Li-ion battery to the charger (see Chapter 5.2 Charging).
  Charge the Li-ion battery before use.

## 4.4. Connection wires

Use appropriate wire for the connection wires to ensure no overheating or unnecessary losses occur. Use appropriate fuses matching the wires and load. See Appendix III for more details.

### 4.4.1. Connecting power cables with automotive type terminals

1. Connect the load or charger to the X2 (+) terminal of the Li-ion battery. (Figure 5)

⚠ **Warning!** Do not connect the X1 (-) terminal first as this may lead to short circuits.

2. Connect the load or charger to the X1 (-) terminal of the Li-ion battery. (Figure 5)
3. Ensure both contacts are tightened. (20nm)
4. Place the handle covers over the terminals. (Figure 6)

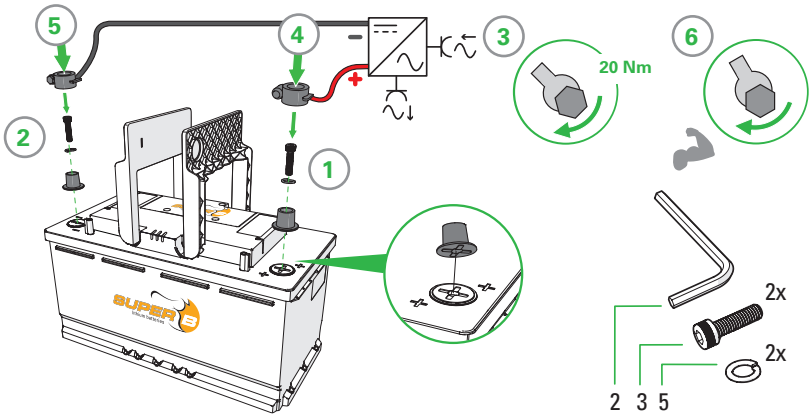



Figure 5. Connecting power cables with automotive type terminals

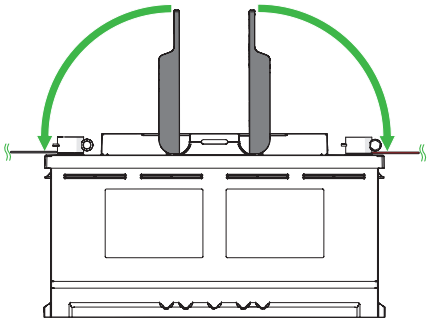


Figure 6. Place the handle covers over the terminals

### 4.4.2. Connecting shrink fit type of power cables

1. Remove the automotive power terminals. (Figure 7)
2. Connect the load or charger to the X2 (+) terminal of the Li-ion battery. (Figure 8)
   Use the included M8 bolt, spring washer and plain washer to connect the Li-ion battery cable.

⚠ **Warning!** Do not connect the X1 (-) terminal first as this may lead to short circuits.

3. Connect the X1 (-) terminal of the Li-ion battery. (Figure 8)
   Use the included M8 bolt, spring washer and plain washer to connect the Li-ion battery cable.
4. Ensure both contacts are tightened to 20Nm.
5. Place the handle covers over the terminals. (Figure 9)

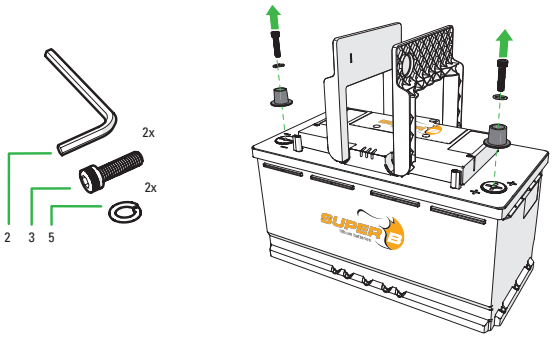



Figure 7. Remove the automotive power terminals.

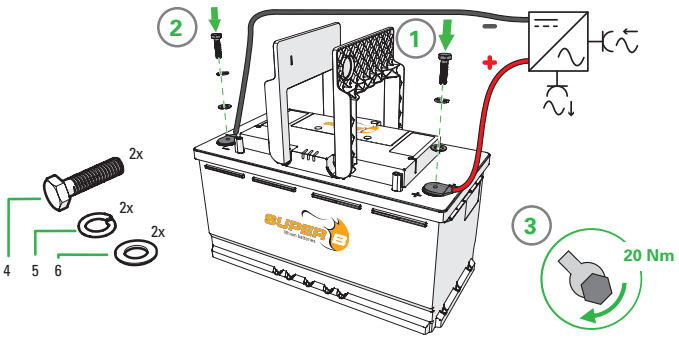



Figure 8. Connecting shrink fit type of power cables

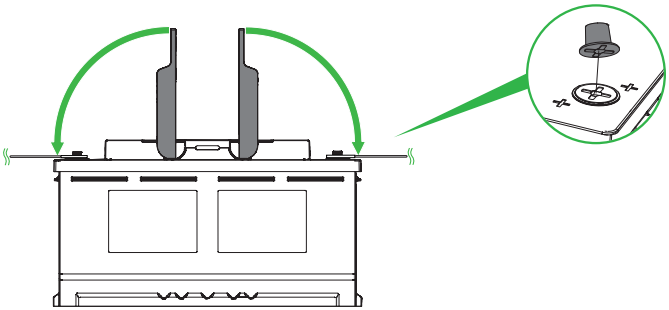


Figure 9. Place the handle covers the terminals

## 4.4.3. Connecting power cables with automotive type terminals and caps

1. Remove the handle covers.
   a) Lift the handles 30°. (Figure 10)
   b) Remove the handles by pulling them outwards. (Figure 11)
2. Connect the load or charger to the X2 (+) terminal of the Li-ion battery. (Figure 12)

⚠ **Warning!** Do not connect the X1 (-) terminal first as this may lead to short circuits.

3. Connect the load or charger to the X1 (-) terminal of the Li-ion battery. (Figure 12)
4. Ensure both contacts are tightened.
5. Place the accessory caps over the terminals. (Figure 13)

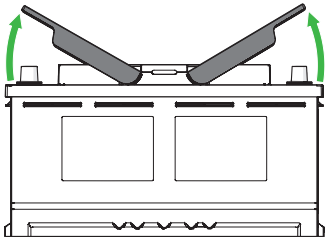


Figure 10. Lift the handles 30°.

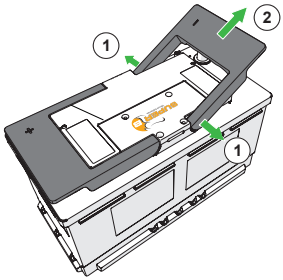



Figure 11. Remove the handles by pulling them outwards.

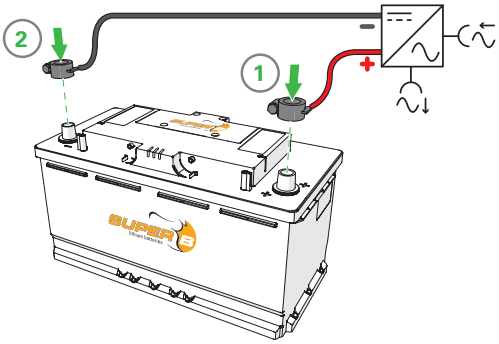



Figure 12. Connecting power cables with automotive type .

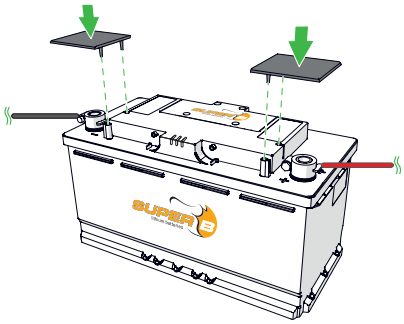


Figure 13. Place the accessory caps over thet terminals. Accessory caps are not provided by Super B

## 4.5. Connecting to the CAN interface (RJ45)

### 4.5.1. Connecting the data cables

The wired communication interface must be used in a bus network topology (Table 21). Do not use a ring- or a star topology. The wired communication interface specifications restrict the Bus length/Bus speed.

| Bus length (L) | Max. stub length (S) | Accumulated stub length |
|---|---|---|
| 250 m | 11 m | 55m |

Table 21. Wired network interface cable lengths

**CAN Cables**
Use a standard UTP cable to connect the Li-ion battery to your application.

**Termination Resistors**
A high-speed bus requires termination at the two ends of the bus.
Use termination resistors at the end nodes to impede reflections on the line. The value of this resistor should be +/- 120 ohms.

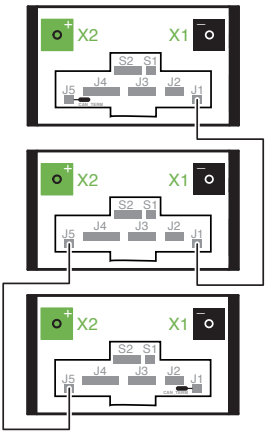



Figure 14. Example of connecting the data cables of 3 batteries (2x CAT5e FTP network cable, 2x RJ45 Terminators)

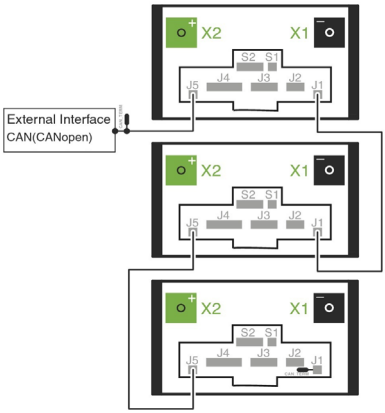



Figure 15. Example of connecting the data cables of 3 batteries with an external Interface (3x CAT5e FTP network cable, 2x RJ45 Terminators)

## 4.6. Connecting a charger to the Li-ion battery

**Warning!** Ensure you have completed all the previous steps described in chapter 4 before connecting the Li-ion battery to the charger.

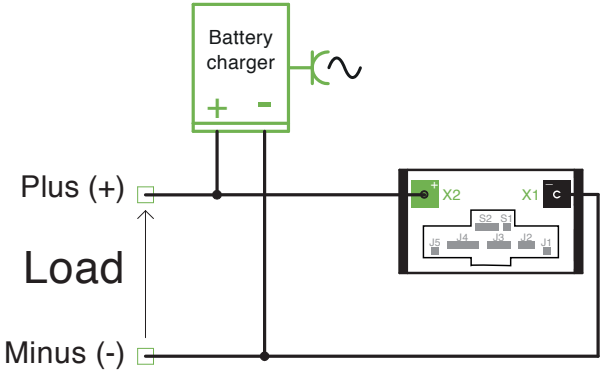



Figure 16. Connecting a charger to the Li-ion battery

## 4.7. Connecting batteries in parallel

The max. number of batteries in parallel is 8. To divide the current equally amongst batteries, use the schematic bellow:

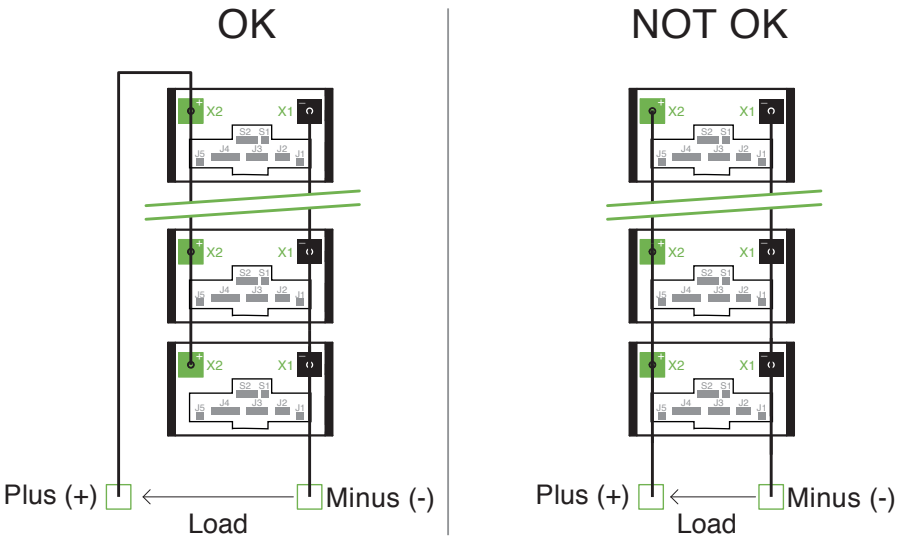



Figure 17. Connecting batteries in parallel

OK: Equally divided battery current.
All batteries contribute equally to the current into the load.

NOT OK: Current not equally divided.
Batteries closest to load will have the highest contribution to the current into the load.
Whereas batteries further away from load will have lesser current contribution.
Wear and tear will be higher on the battery close to the load.

During parallel connection the Li-ion batteries need to communicate via data cables.
To allow this the Li-ion batteries must be connected with UTP cables.
The CANopen network requires termination at the two ends of the bus (see chapter 4.5)
The CANopen network must be enabled from the S2 configuration switch. (see paragraph 2.7.7)

### Disconnecting a battery

1. Disconnect the negative wire from the X1 (-) terminal of the Li-ion battery.
2. Disconnect the positive wire from the X2 (+) terminal of the Li-ion battery.

# 5. Battery use

## 5.1. General information

⚠ **Warning!** Follow the safety guidelines and measures of chapter 3

## 5.2. Charging

⚠ **Warning!** Never charge the Li-ion battery with a charging current larger than 1C.
⚠ **Warning!** Stop charging in case the Li-ion battery switches into warning mode.
⚠ **Caution!** Charge before use.
⚠ **Caution!** Disconnect the charger from the Li-ion battery if it is not used for a long time.
⚠ **Caution!** To preserve the lifespan of the Li-ion battery, use a charger approved by Super B.

1. Connect the charger to the Li-ion battery as described in paragraph 4.6.
2. Charge the Li-ion battery in case of an empty shutdown or if the state of charge drops below 20% to preserve the lifespan of the Li-ion battery.

### 5.2.1. Charging rate

Super B Li-ion battery can be charged in approximately 1 hour. Displayed in Table 22 are the charge times for the Li-ion battery at different charge currents. Always use the indicated charge current and end of charge voltage during charging.

| Charging rate | | |
|---|---|---|
| | Time | Charge current |
| Maximum | 1 hour | 1C (90A) |
| Endurance lifecycle | 3 hours | C3 (30A) |

Table 22. Charging rates at different charge currents

## 5.2.2. Charging method

Super B recommends using the following charging method.

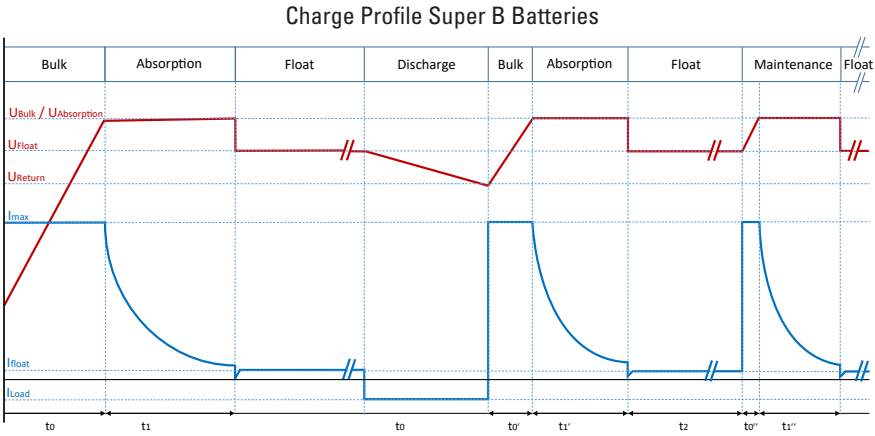



Figure 18. Charge curve

**Bulk phase**

In this phase the batteries are charged with a constant current up to the end of charge voltage (Ubulk), If UBulk is reached the charger will automatically switch to absorption phase. The maximum charge current (Imax) for Super B batteries is 1C, however for endurance cycle life Super B suggests to limit the current to C3 (1C = nominal battery capacity, C3 = 1/3 of nominal capacity). On some chargers the maximum charger active time (t0) can be programmed. Super B suggests setting t0 to: t0 = 2*(BTcap / Chcur)
Example: Battery capacity = 90Ah, Charger = 45A, Set to to a maximum of 2*(90/45) = 4 hours.

| Bulk Phase | | | |
|---|---|---|---|
| | Typical | Min | Max |
| Imax | - | - | 1C (90 A) |
| t0 | Depends on the battery SoC | - | 2*(BTcap / Chcur) |

Table 23. Bulk Phase

**Absorption phase**

In this phase the charge voltage must be maintained at UAbsorption to fully charge the Li-ion battery and set the SoC counter to 100%. see Table 24. This phase is finished when the SoC is indicating 100%.

| Absorption Phase | | | |
|---|---|---|---|
| | **Typical** | **Min** | **Max** |
| $U_{Absorption}$ | 14.4V DC | 14.3V DC | 14.6V DC |
| $t_1$ | 20 minutes | 10 minutes | 1 hour |

Table 24. Absorption Phase

**Float phase**

In this phase the charge voltage is set to UFloat.

| Float Phase | | | |
|---|---|---|---|
| | Typical | Min | Max |
| $U_{Float}$ | 13.8V DC | 13.6V DC | 14V DC |

Table 25. Float Phase

**Discharge phase**

In this phase the Li-ion battery is diacharged. As soon as the Li-ion battery voltage drops below UReturn for longer than 5 seconds the charging process must be repeated.

| Discharge Phase | | | |
|---|---|---|---|
| | Typical | Min | Max |
| $U_{Float}$ | 13.5V DC | 13.4V DC | 13.6V DC |

Table 26. Discharge Phase

**Maintenance phase**

Every t2 hours the batteries require a maintenance charge to fully charge the Li-ion battery and set the State of Charge (SoC) counter to 100%. Without this phase the Li-ion battery SoC can be inaccurate.

| Maintenance Phase | | |
|---|---|---|
| | Typical | Max |
| CANopen communication Enabled | 8 weeks | 15 weeks |
| CANopen communication Disabled | 13 weeks | 26 weeks |

Table 27. Maintenance phase

### 5.2.3. Battery balancing

The BMS automatically balances the cells if necessary. Balancing can take place during charging and idle mode and will not have an effect on the functionality of the Li-ion battery.

## 5.3. Li-ion battery self consumption

When CANopen communication is switched on, the Li-ion battery consumes more energy. (see paragraph 2.7.7 Configuration Switch)

| Communication setting | Li-ion battery self consumption |
|---|---|
| CAN communication enabled | 0.7 Ah per day |
| CAN communication disabled | 0.4 Ah per day |

Table 28. Li-ion battery self consumption

## 5.4. Battery History Recording

The complete Li-ion battery history is stored inside the battery and can be accessed by your reseller or by Super B.

# 6. Inspection, cleaning and maintenance

## 6.1. General information

⚠ **Warning!** Never attempt to open or dismantle the Li-ion battery! The inside of the Li-ion battery does not contain serviceable parts.

1. Disconnect the lithium battery from all loads and charging devices before performing cleaning and maintenance activities (see paragraph 4.8).
2. Place the enclosed protective caps over the terminals before cleaning and maintenance activities to avoid the risk of contacting the terminals.

## 6.2. Inspection

1. Inspect for loose and/or damaged wiring and contacts, cracks, deformations, leakage or damage of any other kind. If damage to the Li-ion battery is found, it must be replaced by a professional. Do not attempt to charge or use a damaged Li-ion battery. Do not touch the liquid from a ruptured battery.
2. Regularly check the Li-ion battery's state of charge. Li-ion battery will slowly self-discharge when not in use or whilst in storage. (see paragraph 5.3)
3. Consider replacing the Li-ion battery with a new one if you note either of the following conditions:
   - The Li-ion battery run time drops below 80% of the original run time.
   - The Li-ion battery charge time increases significantly.

## 6.3. Cleaning

If necessary, clean the Li-ion battery with a soft, dry cloth. Never use liquids, solvents, or abrasives to clean the Li-ion battery.

# 7. Storage

Follow the storage instructions in this manual to optimize the lifespan of the Li-ion battery during storage. If these instructions are not followed and the Li-ion battery has no charge remaining when it is checked, consider it to be damaged. Do not attempt to recharge or use it. Replace it with a new Li-ion battery.
See chapter 2.4 for storage temperature conditions.
The self-discharge of the Li-ion battery is 1-2% per month.

⚠ Warning! Always set the Li-ion battery in storage mode before storage.

The Li-ion battery can be set in storage mode via the BeInCharge mobile application the external “push button”.

1. Charge the Li-ion battery to > 80% of its capacity before storage.
2. Disconnect the Li-ion battery from all loads and, if present, the charging device.
3. Set the Li-ion battery in storage mode.
4. Place the terminal covers over the Li-ion battery’s terminals during storage.
5. Charge the Li-ion battery to > 80% of its capacity every 100 days. After charging set the Li-ion battery in storage mode again.

# 8. Transportation

## 8.1. General

Always check all applicable local, national, and international regulations before transporting a Li-ion Iron Phosphate battery.

Transporting an end-of-life, damaged, or recalled Li-ion battery may, in certain cases, be specifically limited or prohibited.
The transport of the Li-ion battery falls under hazard class UN3480, class 9. For transport over water, air and land, the Li-ion battery falls within packaging group PI965 Section II.


Use Class 9 Miscellaneous Dangerous Goods and UN Identification labels for transportation of Li-ion batteries which are assigned Class 9. Refer to relevant transportation documents. Li-ion batteries and Li-ion cells are regulated in the U.S. in accordance with Part 49 of the Code
of Federal Regulations, (49 CFR Sections 105-180) of the U.S. Hazardous Materials Regulations.
Visit www.iata.org for the complete transport regulations and packing instructions for this product. The relevant information for Li-ion batteries can be found under “Programs” > “Cargo” > “Dangerous goods (HAZMAT)”.

# 9. Disposal and recycling

## 9.1. General information

Always discharge the Li-ion battery before disposal. Use electrical tape or other approved covering over the Li-ion battery connection points to prevent short circuits.
Li-ion battery recycling is encouraged. Dispose of the Li-ion battery in accordance with local, state and federal laws and regulations. Batteries may be returned to the manufacturer.

**USA & Canada:**
Lithium Iron Phosphate batteries are subject to disposal and recycling regulations that vary by country and region. Always check and follow your applicable regulations before disposing of any battery. Contact Rechargeable Battery Recycling Corporation (www.rbrc.org) for U.S.A. and Canada, or your local battery recycling organization.

**EC**
Waste must be disposed of in accordance with relevant EC Directives and national, regional and local environmental control regulations. For disposal within the EC, the appropriate code according to the European Waste Catalogue (EWC) should be used.

**Other**
Many countries prohibit the disposal of waste electronic equipment in standard waste receptacles.

# 10. Troubleshooting

| Problem | Possible situation | Solution |
|---|---|---|
| The Li-ion battery cannot be discharged. | Li-ion battery is in operation mode Green LED is lit or flashing. (Chapter 2.7.10) | Check the installation of the Li-ion battery. |
| | Li-ion battery is in storage mode. No LED is lit or flashing (Chapter 2.7.10) | Charge the Li-ion battery or Press the S1 Push button for 1 second. |
| | Li-ion battery is in storage mode because it is empty. No LED is lit or flashing. (Chapter 2.7.10) | Charge the Li-ion battery. |
| | Li-ion battery is in storage mode because of high temperature. No LED is lit or flashing. (Chapter 2.7.10) | Disconnect the Li-ion battery from load/ charger and wait for it to cool down. |
| The Li-ion battery cannot be charged. | Li-ion battery is in operation mode. Green LED is lit or flashing.(Chapter 2.7.10) | Check the installation of the Li-ion battery. |
| | Li-ion battery is in alarm mode because the charging voltage is too high. Red LED is lit or flashing. (Chapter 2.7.10) | Verify that the charging voltage is within the Li-ion battery specifications. (Chapter 2.3.2) Discharge the Li-ion battery or press the S1 push button for 1 second. |
| | Li-ion battery is in alarm mode because of high temperature. Red LED is lit or flashing. (Chapter 2.7.10) | Disconnect the Li-ion battery from load/ charger and wait for it to cool down. |
| | Li-ion battery is in alarm mode because the temperature is too high Red LED is lit or flashing. (Chapter 2.7.10) | See appendix II table 31. Degraded charging performance for charging values in low temperatures. |
| The capacity of the Li-ion battery has decreased. | The cells within the Li-ion battery are not properly balanced or the Li-ion battery is worn out. | Perform one full charge (100% SoC) cycle to balance the cells. |

Table 29. Troubleshooting

# 11. Warranty and liability

11.1 Upon delivery the customer is obliged to immediately verify whether the products have been damaged during transport. In the event that any such damage has arisen, the customer must notify Super B therefore as soon as possible, in any event no later than three (3) days after delivery, by means of accurate, written statement, stating the damage and where possible a photograph. Failure to inspect the products and inform Super B within the stated time or the use of the products at any time shall be conclusive evidence that Super B has satisfactorily tendered delivery.

11.2 In the event that the customer demonstrates that any of the delivered products do not conform to the agreement, Super B (at its option, upon having received those products returned by the customer) has the option to either repair or replace such products by new products, or to refund the invoice value, exclusive of any dispatch costs.

11.3 Super B grants a three year limited warranty for damages caused by manufacturing defects starting at the time of delivery. Damages caused by manufacturing defects do not include damage resulting from (a) general wear and tear, (b) short circuit, (c) overcharging, (d) deep discharging, (e) overheating of Super B products (f) installation of the Super B product by persons unskilled to work with electro-technical devices or components, (g) any other wrongful use contrary to the Super B's user manual or the safety instruction, (h) any use contrary to the product specifications of that product; (i) any acts of force majeure.

11.4 Except as specified in the clause 11.3 Super B makes no warranty, whether express or implied, including without limitation any implied warranty of merchantability and fitness for a particular purpose or any warranty arising from any course of dealing, course of performance or usage of trade and specifically disclaims any representation or warranty that the product will meet customer's requirements, perform any specific function or achieve a desired result other than expressly stated by Super B in writing.

11.5 Any liability to the customer in any case ceases to apply in the event that the customer fails to notify Super B of the existence of the defect within ten (10) days of having discovered the defect, in writing, in order to enable Super B to investigate the damage. Some of Super B's products electronically store usage data, including charging/discharging data, in order to enable Super B to analyse such data retroactively when investigating damage.

11.6 Any liability of Super B for damage suffered by the customer is in any case limited to the invoice amount of the relevant products, unless such damage has been caused by gross negligence or willful misconduct of Super B.

Super B can never be held liable for (a) damage caused by any of the circumstances mentioned in clause 11.3, leading to damage to the Super B products or to any other device located near those products, or (b) consequential damage or (c) loss of profits or goodwill.

11.7 To the extent that a court determines that the limitation of liability as meant in clause 11.6 cannot be invoked against a particular claim for damages by the customer, Super B's liability for loss of property, damage to property, and bodily injury (including death) caused by the application of those particular Super B products shall in any event be limited to the amount actually paid out by Super B's insurance company to Super B in accordance with the insurance cover of that insurance policy for that particular type of damage. Super B has taken out insurance against certain risks, as described in the respective insurance policies. These policies contain a usual limitation of insurance payment to be paid out to Super B if, and to the extent that, the event is a covered event.

# Appendix I. Declaration of conformity

June 1, 2018

## *DECLARATION OF CONFORMITY*

| | |
|---|---|
| **Manufacturer Name:** | Super B Lithium Power b.v. |
| **Address:** | Expolaan 50<br>7556BE Hengelo<br>The Netherlands |
| **Product Description:** | Lithium Ion Energy / Traction Battery System |
| **Model Number(s) / Name(s):** | 8718531361317 SB12V1200Wh-M |

**This declaration of conformity is issued under the sole responsibility of the manufacturer.**

**The object of the declaration described above is in conformity with the relevant Union harmonization legislation, and carries the CE marking accordingly:**

Electromagnetic Compatibility (EMC) Directive 2014/30/EU
Radio Equipment Directive 2014/53/EU
Battery Directive 2006/66/EC
General Product Safety Directive 2001/95/EC
including their amendments

**and conforms with the following standards:**

IEC 62619:2017
IEC 62133:2012

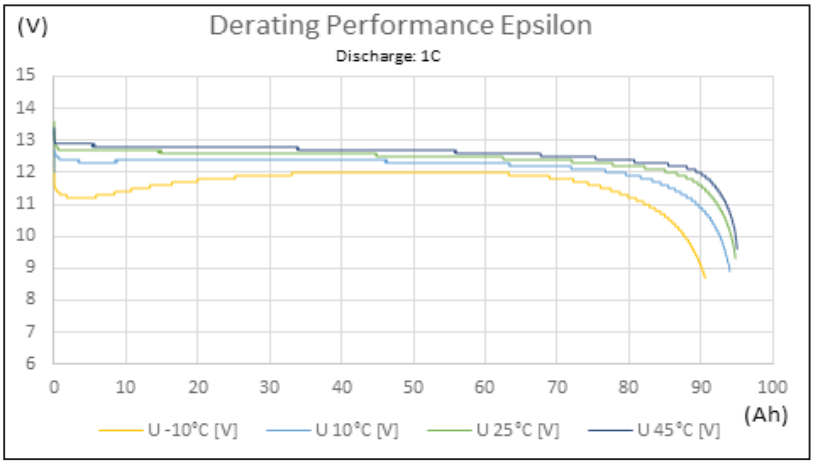
**This Declaration of Conformity applies to above-listed products placed on the EU market after:**

June 1, 2018 Hengelo
Date and Place of Issue

Marc Borgers, Chief Technology Officer

# Appendix II. Performance Graphs and tables

## Derating performance




| Charge current | Temperature |
|---|---|
| 400 mA | 0 °C |
| 8 A | > 45 °C |

Table 30. Degraded charging performance

# Appendix III. Conductor requirements

**Subject**
Use appropriate wire for the connection wires to ensure no overheating or unnecessary losses occur. Consult the SAE-J378 or ISO 10133:2012 standards to determine the appropriate wire properties. Use appropriate fuses matching the wires and load.
The below information is a summary extracted from the ISO10133:2012, reading the ISO ISO10133:2012 is recommended.

**Conductor requirements 12V d.c. system at 30 °C ambient temperature**
Allowable maximum current, in amperes, for single conductors at insulation temperature ratings. With a maximum voltage drop of 3%.

S is the conductor cross-sectional area, in square millimeters
I is the load current, in amperes
L is the length, in meters, of conductor from the positive power source to the electrical device and back to the negative source connection.

## Conductors at insulation temperature 105 °C:

| S / L | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 75 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0,75 | 16 | 8 | 5 | 4 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 22 | 11 | 7 | 5 | 4 | 4 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 1,5 | 33 | 16 | 11 | 8 | 7 | 5 | 5 | 4 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 2,5 | 45 | 27 | 18 | 14 | 11 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| 4 | 55 | 44 | 29 | 22 | 18 | 15 | 13 | 11 | 10 | 9 | 6 | 4 | 4 | 3 | 3 | 2 | 2 | 2 | 1 | 1 |
| 6 | 75 | 66 | 44 | 33 | 26 | 22 | 19 | 16 | 15 | 13 | 9 | 7 | 5 | 4 | 4 | 3 | 3 | 3 | 2 | 1 |
| 10 | 120 | 110 | 73 | 55 | 44 | 37 | 31 | 27 | 24 | 22 | 15 | 11 | 9 | 7 | 6 | 5 | 5 | 4 | 3 | 2 |
| 16 | 170 | 170 | 117 | 88 | 70 | 59 | 50 | 44 | 39 | 35 | 23 | 18 | 14 | 12 | 10 | 9 | 8 | 7 | 5 | 4 |
| 25 | 200 | 200 | 183 | 137 | 110 | 91 | 78 | 69 | 61 | 55 | 37 | 27 | 22 | 18 | 16 | 14 | 12 | 11 | 7 | 5 |
| 35 | 240 | 240 | 240 | 192 | 154 | 128 | 110 | 96 | 85 | 77 | 51 | 38 | 31 | 26 | 22 | 19 | 17 | 15 | 10 | 8 |
| 50 | 325 | 325 | 325 | 274 | 220 | 183 | 157 | 137 | 122 | 110 | 73 | 55 | 44 | 37 | 31 | 27 | 24 | 22 | 15 | 11 |
| 70 | 375 | 375 | 375 | 375 | 307 | 256 | 220 | 192 | 171 | 154 | 102 | 77 | 61 | 51 | 44 | 38 | 34 | 31 | 20 | 15 |
| 95 | 430 | 430 | 430 | 430 | 417 | 348 | 298 | 261 | 232 | 209 | 139 | 104 | 83 | 70 | 60 | 52 | 46 | 42 | 28 | 21 |
| 120 | 520 | 520 | 520 | 520 | 520 | 439 | 376 | 329 | 293 | 263 | 176 | 132 | 105 | 88 | 75 | 66 | 59 | 53 | 35 | 26 |
| 150 | 560 | 560 | 560 | 560 | 560 | 549 | 470 | 412 | 366 | 329 | 220 | 165 | 132 | 110 | 94 | 82 | 73 | 66 | 44 | 33 |

## Conductors at insulation temperature 85 - 90 °C:

| S / L | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 75 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0,75 | 16 | 8 | 5 | 4 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 22 | 11 | 7 | 5 | 4 | 4 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 1,5 | 30 | 16 | 11 | 8 | 7 | 5 | 5 | 4 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 2,5 | 40 | 27 | 18 | 14 | 11 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| 4 | 50 | 44 | 29 | 22 | 18 | 15 | 13 | 11 | 10 | 9 | 6 | 4 | 4 | 3 | 3 | 2 | 2 | 2 | 1 | 1 |
| 6 | 70 | 66 | 44 | 33 | 26 | 22 | 19 | 16 | 15 | 13 | 9 | 7 | 5 | 4 | 4 | 3 | 3 | 3 | 2 | 1 |
| 10 | 100 | 100 | 73 | 55 | 44 | 37 | 31 | 27 | 24 | 22 | 15 | 11 | 9 | 7 | 6 | 5 | 5 | 4 | 3 | 2 |
| 16 | 150 | 150 | 117 | 88 | 70 | 59 | 50 | 44 | 39 | 35 | 23 | 18 | 14 | 12 | 10 | 9 | 8 | 7 | 5 | 4 |
| 25 | 185 | 185 | 183 | 137 | 110 | 91 | 78 | 69 | 61 | 55 | 37 | 27 | 22 | 18 | 16 | 14 | 12 | 11 | 7 | 5 |
| 35 | 225 | 225 | 225 | 192 | 154 | 128 | 110 | 96 | 85 | 77 | 51 | 38 | 31 | 26 | 22 | 19 | 17 | 15 | 10 | 8 |
| 50 | 300 | 300 | 300 | 274 | 220 | 183 | 157 | 137 | 122 | 110 | 73 | 55 | 44 | 37 | 31 | 27 | 24 | 22 | 15 | 11 |
| 70 | 360 | 360 | 360 | 360 | 307 | 256 | 220 | 192 | 171 | 154 | 102 | 77 | 61 | 51 | 44 | 38 | 34 | 31 | 20 | 15 |
| 95 | 410 | 410 | 410 | 410 | 410 | 348 | 298 | 261 | 232 | 209 | 139 | 104 | 83 | 70 | 60 | 52 | 46 | 42 | 28 | 21 |
| 120 | 480 | 480 | 480 | 480 | 480 | 439 | 376 | 329 | 293 | 263 | 176 | 132 | 105 | 88 | 75 | 66 | 59 | 53 | 35 | 26 |
| 150 | 520 | 520 | 520 | 520 | 520 | 520 | 470 | 412 | 366 | 329 | 220 | 165 | 132 | 110 | 94 | 82 | 73 | 66 | 44 | 33 |

## Conductors at insulation temperature 70 °C:

| S / L | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 75 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0,75 | 16 | 8 | 5 | 4 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 20 | 11 | 7 | 5 | 4 | 4 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 1,5 | 25 | 16 | 11 | 8 | 7 | 5 | 5 | 4 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 2,5 | 35 | 27 | 18 | 14 | 11 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| 4 | 45 | 44 | 29 | 22 | 18 | 15 | 13 | 11 | 10 | 9 | 6 | 4 | 4 | 3 | 3 | 2 | 2 | 2 | 1 | 1 |
| 6 | 60 | 60 | 44 | 33 | 26 | 22 | 19 | 16 | 15 | 13 | 9 | 7 | 5 | 4 | 4 | 3 | 3 | 3 | 2 | 1 |
| 10 | 90 | 90 | 73 | 55 | 44 | 37 | 31 | 27 | 24 | 22 | 15 | 11 | 9 | 7 | 6 | 5 | 5 | 4 | 3 | 2 |
| 16 | 130 | 130 | 117 | 88 | 70 | 59 | 50 | 44 | 39 | 35 | 23 | 18 | 14 | 12 | 10 | 9 | 8 | 7 | 5 | 4 |
| 25 | 170 | 170 | 170 | 137 | 110 | 91 | 78 | 69 | 61 | 55 | 37 | 27 | 22 | 18 | 16 | 14 | 12 | 11 | 7 | 5 |
| 35 | 210 | 210 | 210 | 192 | 154 | 128 | 110 | 96 | 85 | 77 | 51 | 38 | 31 | 26 | 22 | 19 | 17 | 15 | 10 | 8 |
| 50 | 270 | 270 | 270 | 270 | 220 | 183 | 157 | 137 | 122 | 110 | 73 | 55 | 44 | 37 | 31 | 27 | 24 | 22 | 15 | 11 |
| 70 | 330 | 330 | 330 | 330 | 307 | 256 | 220 | 192 | 171 | 154 | 102 | 77 | 61 | 51 | 44 | 38 | 34 | 31 | 20 | 15 |
| 95 | 390 | 390 | 390 | 390 | 390 | 348 | 298 | 261 | 232 | 209 | 139 | 104 | 83 | 70 | 60 | 52 | 46 | 42 | 28 | 21 |
| 120 | 450 | 450 | 450 | 450 | 450 | 439 | 376 | 329 | 293 | 263 | 176 | 132 | 105 | 88 | 75 | 66 | 59 | 53 | 35 | 26 |
| 150 | 475 | 475 | 475 | 475 | 475 | 475 | 470 | 412 | 366 | 329 | 220 | 165 | 132 | 110 | 94 | 82 | 73 | 66 | 44 | 33 |

**Derating of conductors in ambient temperatures of 60 °C**

For conductors in 60 °C ambient, the maximum current rating in the above tables shall be derated by the factors below.

| Temperature rating of conductor insulation,°C | Multiply maximum current from Table by: |
|---|---|
| 70 | 0,75 |
| 85 – 90 | 0,82 |
| 105 | 0,86 |
| 125 | 0,89 |
| 200 | 1 |

Table 31. Derating of conductors


For more information, or to order documents, contact:

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The Netherlands

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E-mail: info@super-b.com
www: www.super-b.com

Manual October 2018