



Manual

Epsilon



LITHIUM BATTERY
SB12V1200Wh-M

12.8 V/90 Ah/1200Wh
(Lithium Iron Phosphate)

User Manual SB12V1200Wh-M Lithium Iron Phosphate battery

Dear customer,

This manual contains all the information necessary to install, use and maintain the Super B SB12V1200Wh-M Lithium Iron Phosphate Battery. We kindly ask you to read this manual carefully before using the product. In this manual, the SB12V1200Wh-M 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.

This is the original manual, keep it in a safe location!

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1. Introduction

1.1. Product description

The SB12V1200Wh-M is a Lithium Iron Phosphate rechargeable battery. Potential applications of this battery include: Recreation vehicles service battery, marine service battery, energy storage. The boundaries of its use, as described in this manual should always be upheld. The Li-Ion battery 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 battery for any other purpose will be considered improper use and will void the warranty of the product. Super B b.v. 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.

Super B provides a CE Declaration of Conformity (Appendix I) and a Certificate of Compliance (Appendix II) for the product. In accordance with CE guidelines, a design and manufacturing schedule is available. A Material Safety Data Sheet is also available.

The SB12V1200Wh-M complies with the following council directives:

- 2006/66/EC on Environmental EU Compliance
- 2004/108/EC (December 15, 2004) on Electromagnetic Compatibility

The SB12V1200Wh-M complies with the following standards:

- EMC: Emission - EN61000-6-3 (2007) +A1 (2001); Immunity - EN6100-6-2 (2005) + AC (2005)
- IEC 62133, Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications
- IEC 62619, SAFETY REQUIREMENTS FOR SECONDARY LITHIUM CELLS AND BATTERIES, FOR USE IN INDUSTRIAL APPLICATIONS
- UN38.3, Classification procedures, test methods and criteria relating to class 9, Lithium metal and lithium ion batteries
- IEC 62281, Safety of primary and secondary lithium cells and batteries during transport



During the use of the product, user safety should always be ensured, so installers, users, service personnel and third parties can safely use the product. The user must always have access to this manual; keep it in a safe accessible location.

1.2. Glossary of Terminology

Endurance Life-cycle:	The products maximum lifespan, achieved by adhering to the guidelines presented in this manual
Charge cycle:	A period of use from fully charged, to fully discharged, and fully recharged again.
SoC:	State of Charge
SoH:	State of Health
BMS:	Battery Management System
VMS:	Voltage Management System
EMS:	Energy Management System

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

- Drop-in replacement for lead acid LN5 batteries
- Traction battery
- Lithium Iron Phosphate (LiFePO4)
 - Safe lithium technology
 - Superior abuse tolerance
- Maintenance free
- Integrated BMS (Battery-Management system)
- Terminals for 95mm² wire connection / M8 flat terminal with automotive terminal post with rotation lock
- Integrated protection device for maximum protection and safety
- Safe and protected by integrated protection device
- 2000W/200A continuous discharge
- Peak power (30s) 3500W/350 A
- Fast charging
- Charge current regulator, for safe low temperature charging
- Wireless communication interface: Bluetooth
- Wired communication interfaces: CAN (J1939), LIN (CI-Bus), NMEA2000, CANopen

- Battery monitoring / History Storage
- Adaptive cell balancing
- Low self-discharge

2.2. General product specifications

Product name:	SB12V1200Wh-M
Producer:	Super B b.v.
Battery type:	Lithium Iron Phosphate (LiFePO4)
Product Lifespan:	+/-5 to 10 years or 1000-2000 cycles at 1C charge/discharge or up to 4000 cycles at C3 charge/discharge*

*The lifespan value given above is an indication at 25°C. Battery lifespan depends strongly on temperature and the applied charging and discharging loads. For more information on the lifespan of the battery, appendix III may be consulted.

2.3. Technical specifications

Mass:	12.5 kg (+/- 5%)
Ingress protection rating:	IP62

2.3.1. Battery/Cell designation

Battery designation according to IEC 61960:	4IFpR19/67-60
Battery designation according to IEC 62620:	IFpR19/67[60p4s]M/-10+60/90
Cell designation according to IEC 62620:	IFpR19/67/M/-10+60/90

2.3.2. Electrical properties (25°C)

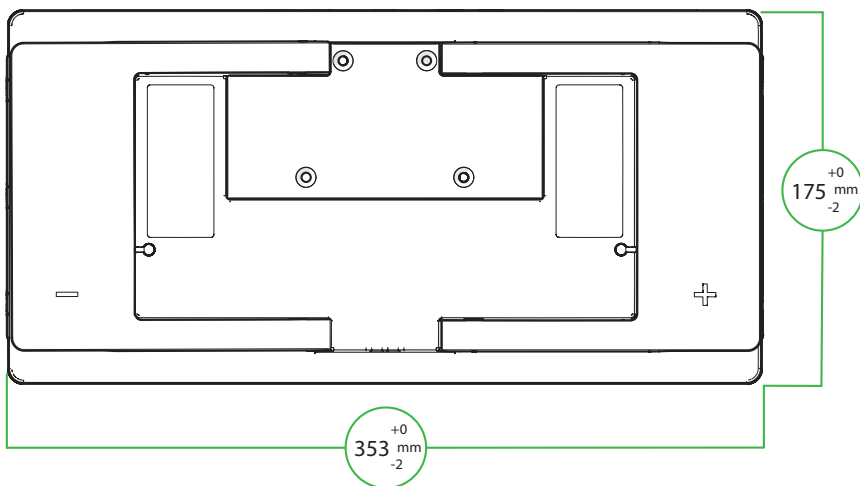
Open Circuit Voltage	13.2V dc
Nominal voltage	12.8V dc
Rated capacity	90Ah / 1152Wh
Charge method	Constant Current - Constant Voltage
Charge voltage	14.2V... 14.8V
End-of-discharge voltage	10V DC
Charge current	Max 90A (1C)
Discharge current continuous	200A
Discharge current 30 seconds	350A

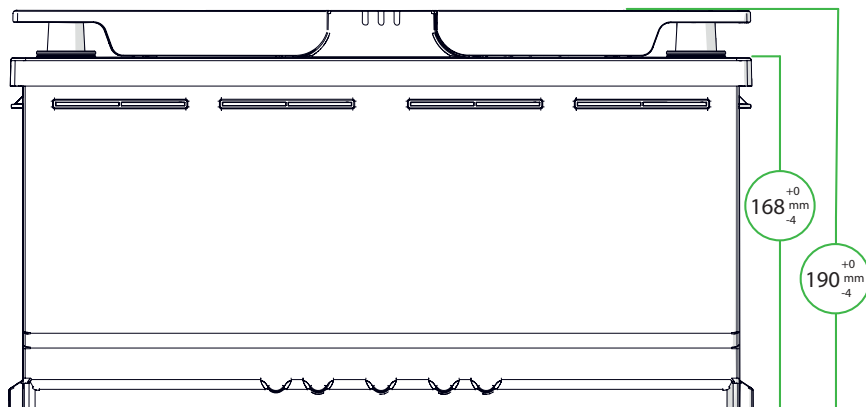
Discharge current 1 second	600A
Discharge performance at 20 °C (rated capacity)	90Ah / 1152Wh
Discharge performance at -20 °C (capacity)	59Ah / 755Wh
High rate discharge performance at 20 °C (capacity)	81Ah / 1024Wh
Short-circuit protection (20ms)	700A

More information on the battery's performance (cycles) may be found in Appendix III.

2.3.3. Dimensions(LN5)

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





2.4. Environmental conditions

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

Use the battery in a dry, clean, dust free, well ventilated space. Do not expose the 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.

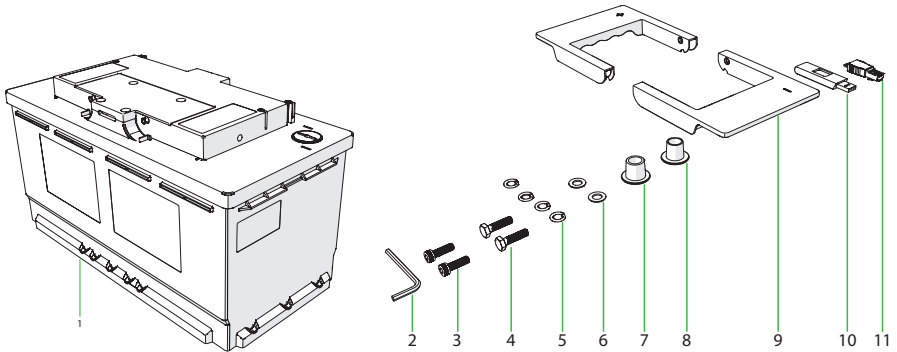
Operating temperature range	-40°C to +65°C*
Storage temperature range	-40°C to +65°C
Relative humidity	Between 5 and 85 %, non-condensing
Vibrations and shocks	According UN38.3 and IEC 6228

* When temperature is < 10°C or > 45°C performance will be degraded. (see Appendix III)

2.5. Required tools

- M13 Hexagon socket wrench
- Combined 2.5mm / 6mm Allen hex key (included with battery)

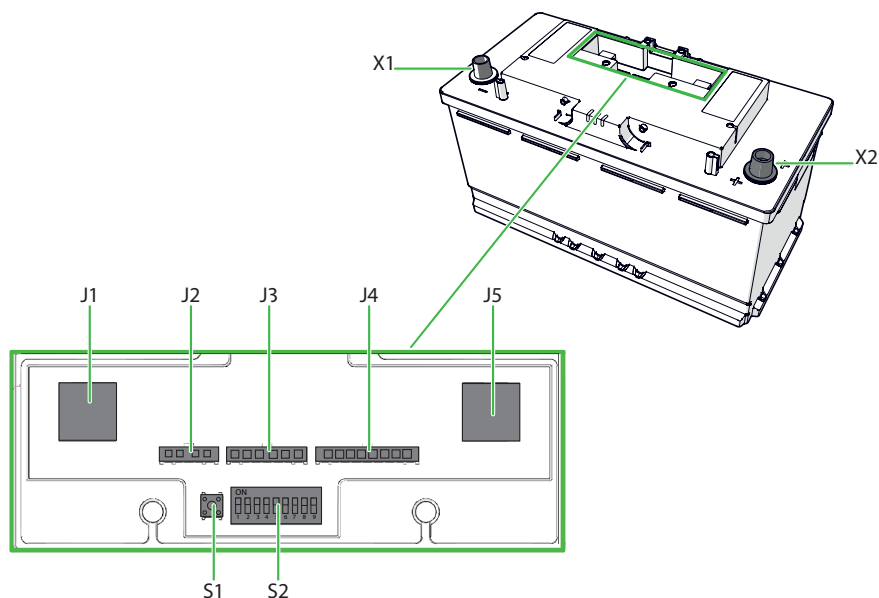
2.6. Components



1. (1x) Super B SB12V1200Wh-M Battery
2. (1x) Tool (combined 2.5mm/6mm Allen hex key)
3. (2x) Hex bolt M8 x 16mm
4. (2x) Bolt M8 x 20mm
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



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 1x 95mm² wire connection or automotive terminal

X2: Battery Terminal 1x 95mm² wire connection or automotive terminal

2.7.1. J1 / CAN1 (RJ45)

PIN #	Service description	Function
1	CAN H	Communication
2	CAN L	Communication
3	CAN GND	Communication
4	NC	
5	NC	
6	CAN Shield	EMC
7	NC	
8	CAN Power	Power

Table 1. CAN 1 / J1 interface

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

PIN #	Service description	Range	Function
1	IN 1A	+ (0...60Vdc)	NA
2	IN 1B	-	NA
3	IN 2A	+ (0...60Vdc)	Storage mode
4	IN 2B	-	Storage mode

Table 2. Inputs J2

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

PIN #	Service description	Range	Function
1	Battery +	+ (5... 18Vdc)	Power
2	State of Charge	0...10Vdc	SOC Indication
3	NC		
4	NC		
5	LIN	-45...+45Vdc	Communication
6	Battery -	-	Power

Table 3. Monitor J3

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

PIN #	Service description	Range	Function
1	OUT 1A	-60...+60Vdc	100mA (Generator)
2	OUT 1B	-60...+60Vdc	100mA (Generator)
3	OUT 2A	-60...+60Vdc	100mA (Inverter)
4	OUT 2B	-60...+60Vdc	100mA (Inverter)
5	OUT 3A	-60...+60Vdc	NA
6	OUT 3B	-60...+60Vdc	NA
7	OUT 4A	-60...+60Vdc	NA
8	OUT 4B	-60...+60Vdc	NA

Table 4. Outputs J4

2.7.5. J5 / CAN 2 (RJ45)

PIN #	Service description	Type of signal to the product
1	CAN H	Communication
2	CAN L	Communication
3	CAN GND	Power
4	NC	
5	NC	
6	CAN Shield	EMC
7	NC	
8	CAN Power	Power

Table 5. CAN 2 / J5 interface

2.7.6. S1 Push button

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

Table 6. Switch S1

2.7.7. Configuration Switch

For functions see software release document.

Service description	Type of signal to the product	Range
Switch 1	Input	On / Off
Switch 2	Input	On / Off
Switch 3	Input	On / Off
Switch 4	Input	On / Off
Switch 5	Input	On / Off
Switch 6	Input	On / Off
Switch 7	Input	On / Off
Switch 8	Input	On / Off

Table 7. Configuration Switch S2

	CAN			Undefined / Spare					Protocol
	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	Switch 6	Switch 7	Switch 8	
1	Off	Off	Off	-	-	-	-	-	No CANOpen*
2	On	Off	Off	-	-	-	-	-	J1939
3	Off	On	Off	-	-	-	-	-	CANOpen
4	Off	Off	On	-	-	-	-	-	NMEA2000
.									
.									
.									

Table 8. CAN Protocol Configurations (* When CANOpen is switched off, 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	-	Power
2	Battery + Terminal	+ (0...30Vdc)	Power

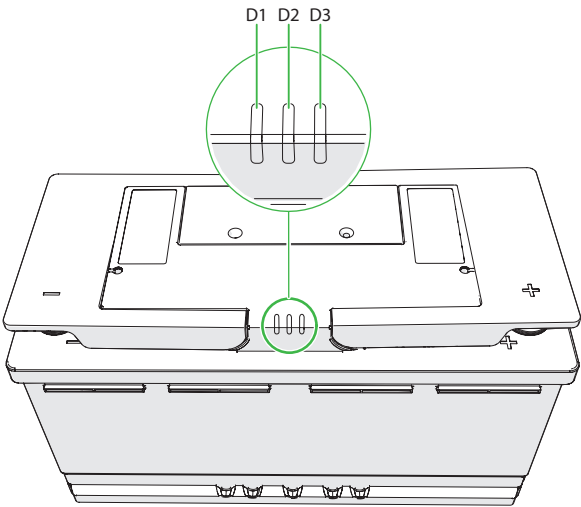
Table 9. Battery terminal interface

2.7.9. Bluetooth

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

Table 10. Bluetooth

2.7.10. LED Indicators



D1 (Green)*	D2 (Yellow)*	D3 (Red)*	Mode
Off	Off	Off	De-energized / shutdown mode
Off	Off	On	Degrade mode (reduced functionality)
On	Off	Off	Normal operation mode
On	On	Off	Warning
On	On	On	Configuration mode

Table 11. LED Mode (* When battery is in idle mode, LED indicator flashes every 3 seconds)

2.7.11. Operation modes

Configuring mode

The BMS device can receive, check and take into account additional configuration data sent by its main EMS/VMS device (master/slave relation).

Normal Operation mode

The device is fully operational. It means that no error is detected and that the device can execute its Control and Monitoring tasks.

Degraded mode

The BMS device detects either an internal or external failure. If a critical error occurs during Normal Operation mode, the mode management function goes to Degraded mode.

Shutdown mode

All BMS services are stopped.

De-energized mode

When the battery is in idle mode for a specified time the BMS shuts down all non-essential electronics to minimize the quiescent current.

2.7.12. System components operation modes dependencies

Operating mode	Protective disconnect device	Communication	BMS
Configuring mode	Open	Yes	Active
Normal Operation mode	Closed	Yes	Active
Degraded mode	Open	Yes	Active
De-energized mode	Open	No	Inactive
Shutdown mode	Open / Closed	No	Sleep

Table 12. System components operation modes dependencies

2.8. Optional Components

Description	Article name	Manufacturer	Manufacturer code	Super B code
4 pins 3 mm plug	WR-MPC3, Single Row Female Receptacle Housing, 4 pins, (3.00mm) WR-MPC3 micro power connector (4 positions)	Würth Elektronik GmbH & Co	662 004 013 322	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)	Würth Elektronik GmbH & Co	662 006 013 322	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)	Würth Elektronik GmbH & Co	662 008 013 322	4200 000 0004 0
3 mm pins	WR-MPC3, Male Crimp Terminal, (3.00mm) WR-MPC3 micro power connector contact crimp Pin	Würth Elektronik GmbH & Co	662 002 137 22	4200 000 0007 0
RJ45 cable	SB RJ45 cable 1 m			4200 000 0003 0
RJ45 termination resistor	SB RJ 45 CAN terminator Epsilon	Super B		4200 000 0001 0
Battery monitor	SB BM01 12-24V	Super B		9586 100 3119 0
BM01 Epsilon Cable	SB BM01 cable Epsilon	Super B		4200 000 0002 0

Table 13. Optional components that can be used with the Li-Ion battery

3. Safety guidelines and measures

3.1. General

- Do not dismantle, open or shred secondary cells or batteries.
- Do not expose cells or batteries to heat or fire. Avoid storage in direct sunlight.
- Do not short-circuit a cell or a battery. Do not store cells or batteries haphazardly in a box or drawer where they may short-circuit each other or be short-circuited by other metal objects.
- Do not remove a cell or battery from its original packaging until required for use.
- Do not subject cells or batteries to mechanical shock.
- In the event of a cell 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 equipment.
- Observe the plus (+) and minus (–) marks on the cell, battery and equipment and ensure correct use.
- Do not use any cell or battery which is not designed for use with the equipment.
- Do not mix cells or batteries of different manufacture, capacity, size or type within a device.
- Battery usage by children should be supervised.
- Seek medical advice immediately if a cell or a battery has been swallowed.
- Always purchase the battery recommended by the device manufacturer for the equipment.
- Keep cells and batteries clean and dry.
- Wipe the cell or battery terminals with a clean dry cloth if they become dirty.
- Secondary cells and batteries need to be charged before use. Always use the correct charger and refer to the manufacturer's instructions or equipment manual for proper charging instructions.
- Do not leave a battery on prolonged charge when not in use.
- After extended periods of storage, it may be necessary to charge and discharge the cells or batteries several times to obtain maximum performance.
- Retain the original product literature for future reference.
- Use only the cell or battery in the application for which it was intended.
- When possible, remove the battery from the equipment when not in use.
- Dispose of properly.

⚠ Warning! Keep the battery away from water, dust and contamination.

- ⚠ **Warning!** Do not crush or puncture the battery.
- ⚠ **Warning!** Never touch the battery contacts or allow (conductive) objects to touch the contacts.

3.2. Installation

- ⚠ **Warning! 12V systems only.** Never use the Li-Ion battery in systems with batteries in series.
- ⚠ **Caution!** Do not reverse connect the power cables (polarity)

3.3. Use

- ⚠ **Warning!** Do not overcharge the Li-Ion battery.
- ⚠ **Warning!** Never short circuit the battery.
- ⚠ **Caution!** This product can store fault conditions internally, like excessive charge current or deep discharge situations. Super B uses this information in the warranty process.
- ⚠ **Caution!** Do not operate battery beyond published maximum specifications.
- ⚠ **Caution!** In case of an under-voltage shutdown, charge immediately.
- ⚠ **Warning!** Always remain within the limits indicated in paragraph 2.3.2 during the use of the Li-Ion battery.

3.4. Disposal







Dispose of the 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.

3.5. 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

4. Installation

4.1. General information

-  **Warning!** Do not disassemble, crush, or puncture the Li-Ion battery.
-  **Warning!** Never install or use a damaged battery.

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

4.3. Preparing the battery for use

4.3.1. Placement of the 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 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 battery to the charger (see Chapter 5.2 Charging).
- Charge before use

4.4. Connection wires

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. See Appendix IV for more details.

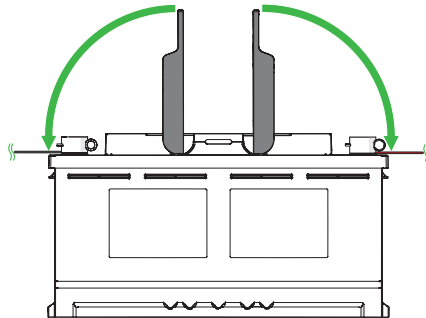
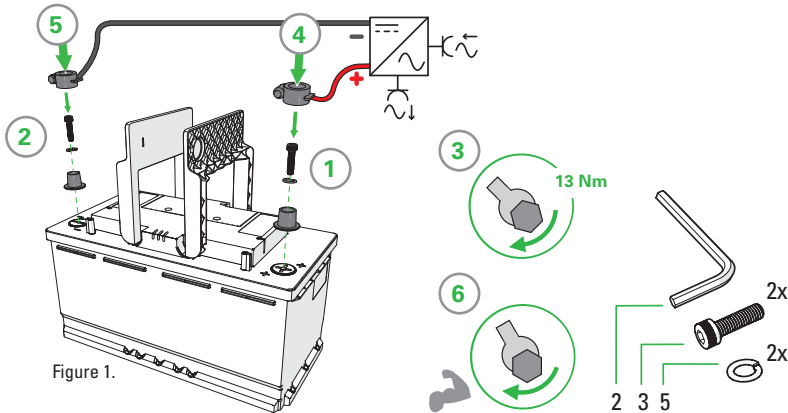
4.4.1. Connecting power cables with automotive type terminals

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

 **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 battery. (Figure 1)

3. Ensure both contacts are firmly tightened.
4. Place the handle covers over the terminals. (Figure 2)



4.4.2. Connecting shrink fit type of power cables

1. Remove the automotive power terminals. (Figure 3)
2. Connect the load or charger to the X2 (+) terminal of the battery. (Figure 4)
Use the included M8 bolt, spring washer and plain washer to connect the battery cable.
- ⚠ Warning!** Do not connect the X1 (-) terminal first as this may lead to short circuits.
3. Connect the X1 (-) terminal of the battery. (Figure 4)
Use the included M8 bolt, spring washer and plain washer to connect the battery cable.
4. Ensure both contacts are tightened to 13Nm.
5. Place the handle covers over the terminals. (Figure 5)

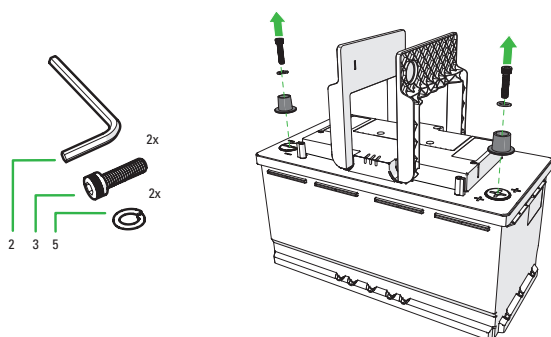


Figure 3.

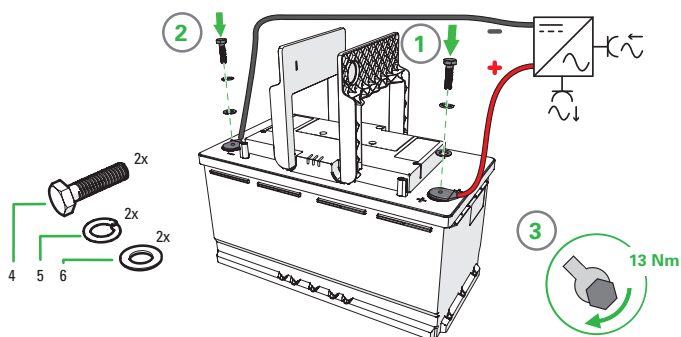


Figure 4.

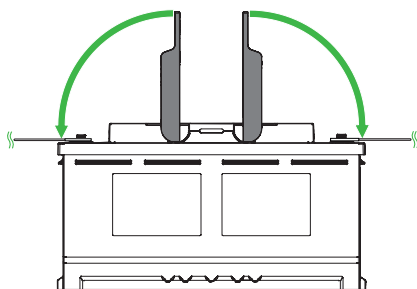


Figure 5.

4.4.3. Connecting power cables with automotive type terminals and caps

1. Remove the handle covers.
 - a) Lift the handles 30°. (Figure 6)
 - b) Remove the handles by pulling them outwards. (Figure 7)
2. Connect the load or charger to the X2 (+) terminal of the battery. (Figure 8)
- ⚠ 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 battery. (Figure 8)
4. Ensure both contacts are firmly tightened.
5. Place the accessory caps over the terminals. (Figure 9)

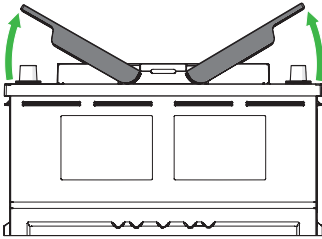


Figure 6.

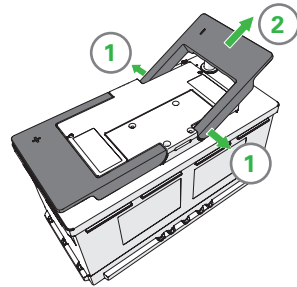


Figure 7.

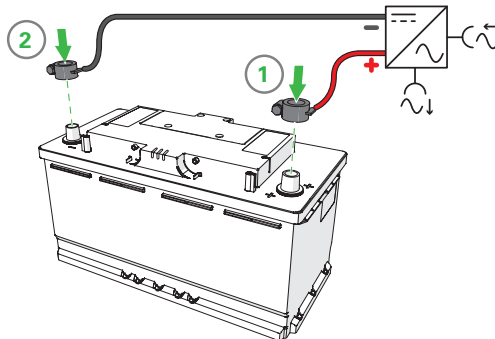


Figure 8.

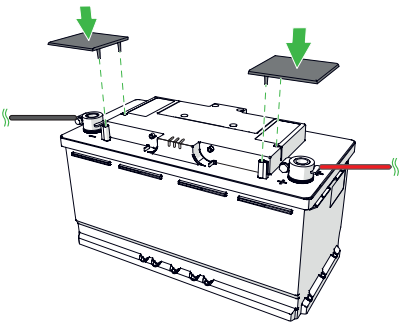


Figure 9.

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 13). 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 14. wired network interface cable lengths

CAN Cables

Use standard UTP cable to connect the 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 10. Example of connecting the data cables of 3 batteries (2x CAT5e FTP network cable, 2x RJ45 Terminators)

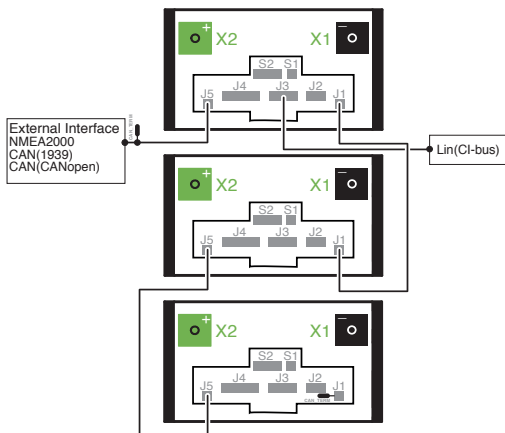


Figure 11. Example of connecting the data cables of 3 batteries with an external Interface (3x CAT5e FTP network cable, 2x RJ45 Terminators)

4.6. Connecting a charger to the battery

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

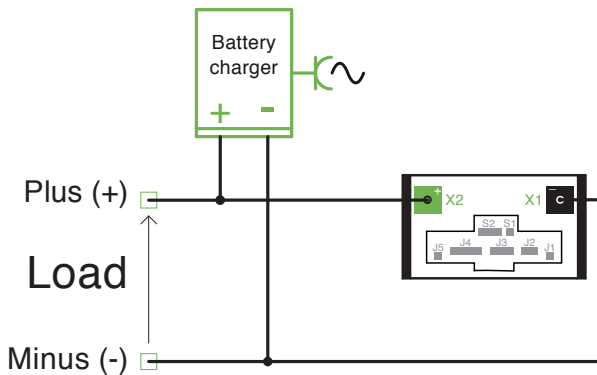


Figure 12. Connecting a charger to the battery

4.7. Connecting batteries in parallel

To divide the current equally amongst batteries, use the schematic bellow:

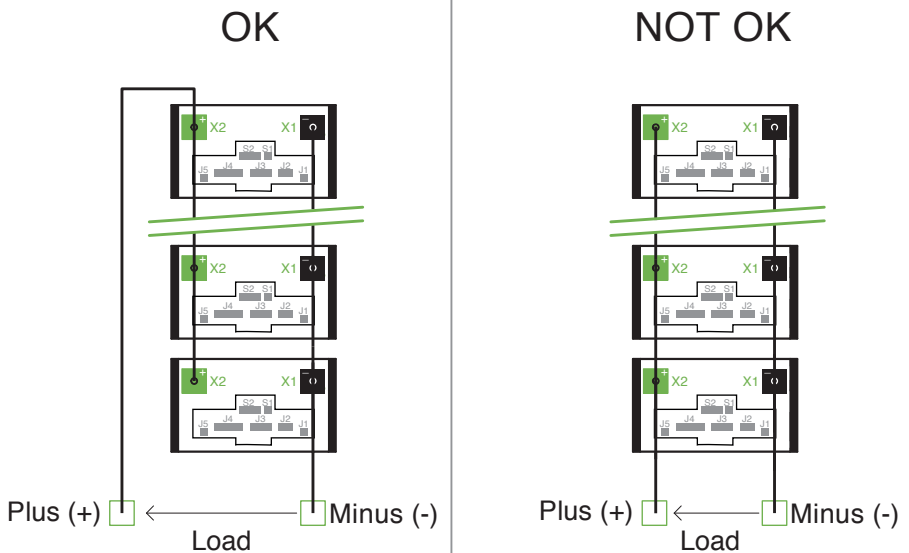


Figure 13. Connecting batteries in parallel

OK: Equally divided battery current.

All batteries contribute equally to the current into the load.

NOT OK: Current not equally divided.

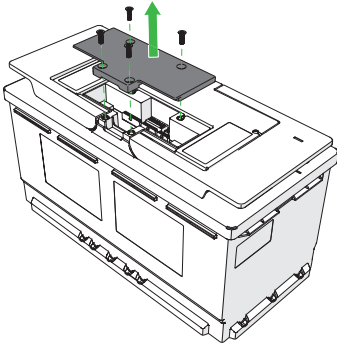
Batteries closest to load will have the highest contribution to the current into the load.

Whereas batteries further away from load will have lesser current contribution.

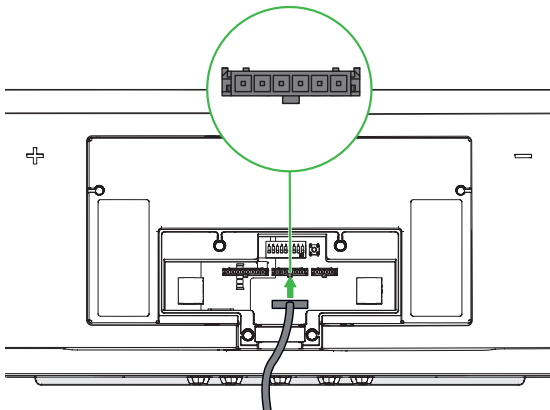
Wear and tear will be higher on the battery close to the load.

4.7.1. Connecting BM01 Super B battery monitor (optional)

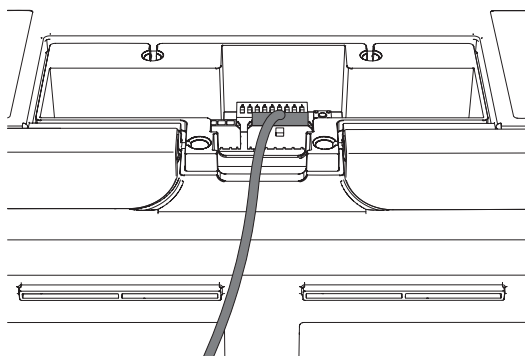
1. Remove the 4 screws from the terminal cover.



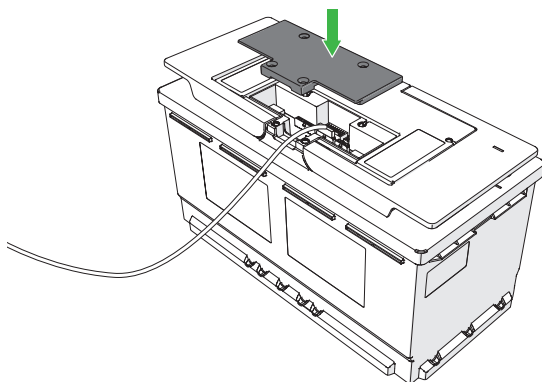
2. Connect the BM01 cable 3mm female header to the J3 Monitor.



3. Secure the BM01 cable.



4. Close the terminal cover.



4.8. Disconnecting a battery

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

5. Battery use

5.1. General information

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

5.2. Charging

⚠ Warning! Never overcharge the Li-Ion battery, this will permanently damage the battery. Always use a charger which automatically halts the charging process when the battery is full.

⚠ Warning! Stop the charging process if the battery gets too hot during charging

⚠ Warning! Never charge a battery with a charging current larger than 1C.

⚠ Caution! Charge before use

⚠ Caution! Disconnect the charger from the battery if it is not used for a long time.

⚠ Caution! To preserve the lifespan of the Li-Ion battery use a Super B charger or a charger approved by Super B. The use of other chargers, such as lead-acid chargers will shorten the lifespan of the Li-Ion battery. AGM / GEL chargers may be used if the charge voltages of the different charge states don't exceed the charge voltage limits of the battery.

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

5.2.1. Charging rate

Super B Lithium Iron Phosphate batteries can be charged in 1 hour. Displayed in Table 14 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			
Parameter	Time	Charge current	End of charge voltage
Maximum	1 hour	1C (90A)	14,6V +/- 0,2V DC
Endurance lifecycle	3 hours	C3 (30A)	14,6V +/- 0,2V DC

Table 15. Charging rates at different charge currents

5.2.2. Charging method

Super B recommends using this charging method since it aids in balancing the battery, prolonging the lifespan of the battery.

Charge Profile Super B Batteries

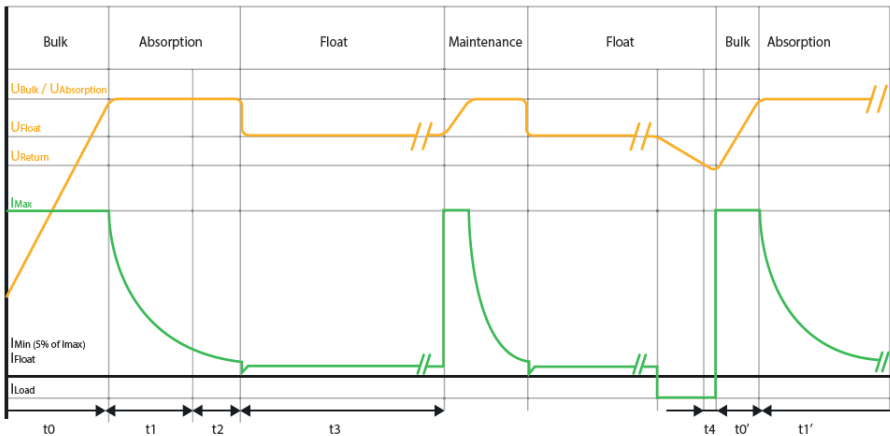


Figure 14. Charge curve

Bulk phase

In this phase the batteries are charged with a constant current up to the end of charge voltage (U_{bulk}). If U_{bulk} is reached the charger will automatically switch to absorption phase. The maximum charge current (I_{max}) 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).

Bulk Phase				
Parameter	Typical	Min	Max	Remark
U _{Bulk}	14,6V DC	14,2V DC	14,8V DC	-
I _{max}	-	-	1C	-
t ₀	-	-	-	Depends on the battery SOC

Table 16. Bulk Phase

Absorption phase

In this phase the charge voltage must be maintained at $U_{\text{Absorption}}$ to fully charge the battery. If the charger currents drop below 5% (I_{min}) of the 1C current the absorption phase can be maintained for t_2 minutes, see Table 16.

Absorption Phase				
Parameter	Typical	Min	Max	Remark
$U_{\text{Absorption}}$	14,6V DC	14,2V DC	14,8V DC	-
I_{min}	3% of 1C	-	5% of 1C	-
t_1	20 minutes	10 minutes	1 hour	-
t_2	10 minutes	5 minutes	30 minutes	-

Table 17. Absorption Phase

Float phase

In this phase the charge voltage is set to U_{Float} . If the battery voltage drops below U_{Return} for longer than t_4 seconds than the charging process has to be repeated.

Float Phase				
Parameter	Typical	Min	Max	Remark
U_{Float}	13,5V DC	13,4V DC	13,6V DC	-
t_4	60 sec	5 sec	120 sec	-

Table 18. Float Phase

Optional maintenance phase

If supported by the charger, every t_3 hours the charger can do a maintenance charge to make sure that the batteries are kept fully charged.

Maintenance Phase				
Parameter	Typical	Min	Max	Remark
t_3	720 hours	168 hours	4320 hours	-

Table 19. Maintenance phase

5.2.3. Battery balancing

During the batteries lifespan, the cells within the battery may be unbalanced due to high discharge currents and short float charge periods. This may result in a loss of capacity and overcharged cells.

The SB12V1200Wh-M automatically balances the cells if necessary. Balancing can take place during charging and idle mode.

5.3. Power saving mode

When CANopen communication is switched off by the S2 configuration switch, battery goes into power saving mode.

5.4. Battery History Recording

The complete 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 battery! The inside of the battery does not contain serviceable parts.

1. Disconnect the Li-Ion 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 battery is found, it must be replaced. Do not attempt to charge or use a damaged battery. Do not touch the liquid from a ruptured battery.
2. Regularly check the battery's state of charge. Lithium Iron Phosphate batteries will slowly self-discharge when not in use or whilst in storage.
3. Consider replacing the battery with a new one if you note either of the following conditions:
 - The battery run time drops below 80% of the original run time.
 - The 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.

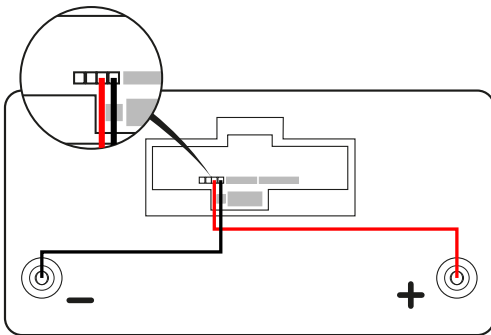
6.4. Maintenance

The Li-Ion battery is maintenance free. Charge the battery to approximately > 80% of its capacity at least once every year to preserve the battery's capacity.

7. Storage

Follow the storage instructions in this manual to optimize the lifespan of the 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 battery.

1. Disconnect the Li-Ion battery from all loads and, if present, the charging device.
2. To put the battery back in storage mode, 12V should be applied to pins 3/4 of connector J2. Where PIN3 is +12V and PIN4 is GND, as shown in the pictures.
3. Place the terminal covers over the battery's terminals during storage.
4. Store the battery in a cool and well ventilated space.
5. Avoid exposure of the battery to sunlight and/or UV radiation.
6. Charge the battery to > 80% of its capacity before storage.
7. Charge the battery to > 80% of its capacity every 100 days.



8. Transportation

8.1. General

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

Transporting an end-of-life, damaged, or recalled 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 battery falls within packaging group PI965 Section I.



Use Class 9 Miscellaneous Dangerous Goods and UN Identification labels for transportation of lithium ion batteries which are assigned Class 9. Refer to relevant transportation documents. Lithium batteries and lithium 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 Lithium batteries can be found under "Programs" > "Cargo" > "Dangerous goods (HAZMAT)".

9. Disposal and recycling

9.1. General information

Always discharge the battery before disposal. Use electrical tape or other approved covering over the battery connection points to prevent short circuits.

Battery recycling is encouraged. Dispose of the 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 battery cannot be discharged.	Battery is in normal mode Green LED is lit or flashing. (Chapter 2.7.10)	Check the installation of the battery.
	Battery is in shutdown mode. No LED is lit or flashing (Chapter 2.7.10)	Charge the battery or Press the S1 Push button for 2 seconds.
	Battery is in degrade mode Red LED is lit or flashing. (Chapter 2.7.10)	Charge the battery.
The battery cannot be charged.	Battery is in normal mode Green LED is lit or flashing.(Chapter 2.7.10)	Check the installation of the battery.
	Battery is in degrade mode Red LED is lit or flashing. (Chapter 2.7.10)	Discharge the battery.
The capacity of the battery has decreased.	The cells within the batteries are not properly balanced, causing them to discharge at different rates.	Perform one full charge cycle to balance the cells.
Green and Yellow LED is lit or flashing	Battery in Warning mode (Chapter 2.7.10)	State of charge is low, fully charge the battery
Cable assembly does not fit underneath standard battery cover (handles).	The connectors you are using are too big.	Use other smaller connectors or remove the handles and use the automotive type of covers.

Table 20. Troubleshooting

11. Warranty and liability

11.1 Upon delivery, the customer is obliged to immediately verify whether the products have been damaged during transport. The customer must notify Super B of such transport damage as soon as possible, in any event no later than within three (3) days of delivery, by means of an accurate, written statement, stating the damage and where possible a photograph.

11.2 If the customer demonstrates that the products do not conform to the agreement, Super B has the option to repair and/or replace the relevant products by new products when returned and/or to refund the invoice value, exclusive of any dispatch costs.

11.3 If the customer is a private individual not acting for or on behalf of any company or business, the customer has the right to return the product to Super B within seven (7) days of delivery. In this event, goods returned are only accepted if the product and its original packaging are free of damage, while the dispatch costs for returning the goods shall be at the customer's expense.

11.4 Super B shall use its best endeavors to manufacture reliable and safe products and to deliver these to the customer.

11.5 Super B grants a three-year limited warranty for manufacturing faults. 'Manufacturing faults' do not include damage caused as a result of (a) general tear and wear, (b) short circuit, (c) overcharging, (d) deep discharging, (e) a wrongful connection to engines and other devices, (f) any other wrongful use contrary to the user instruction; and (g) any use contrary to the product specifications of that product.

11.6 Any liability to the customer in any case ends if the customer fails to notify Super B of the existence of the defect within three (3) days of having discovered the defect, in writing, in order to enable Super B to investigate this.

11.7 Any liability of Super B for damage suffered by the customer is in any case limited to the invoice amount of the relevant products. Super B can never be held liable for consequential damage or losses of profits, unless such damage has been caused by gross negligence or willful misconduct of Super B.

11.8 To the extent that a court determines that the limitation of liability as meant in clause 11.7 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, namely for the application of Super B products in land vehicles and in aviation, respectively, each 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

Super B b.v.

Expolaan 50, 7556 BE, Hengelo (Ov), the Netherlands
+31 (0) 74-8200010, www.super-b.com

February, 2017

Declaration of Conformity

Product Number/Name/Description:

(1.2 kW LiFePO4) SB12V1200Wh-M (Lithium Ion Battery) 12.8V / 90Ah / 1200Wh (Energy / TractionBattery)

The undersigned hereby declares, on behalf of Super B b.v. Hengelo, the Netherlands, that the above-referenced product, to which this declaration relates, is in conformity with the provisions of:

IEC / EN	Transport	IEC 62281, Transportation IEC Compliance
	Environmental	Council Directive 2013/56/EC, Environmental EU Compliance
	EMC	Council Directive 2014/30/EU on Electromagnetic Compatibility
	UN DOT 38.3	Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria
	IEC 62281	Safety of primary and secondary lithium cells and batteries during transport
	IEC 62619	Safety requirements for secondary lithium cells and batteries, for use in industrial applications
	IEC 61000-6-2	Immunity standard for industrial environments

IEC / EN	Transport	IEC 62281, Transportation IEC Compliance
	IEC 61000-6-4	Emission standard for industrial environments
	IEC 61000-4-2	Testing and measurement techniques - Electrostatic discharge immunity test
	IEC 61000-4-3	Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test
	IEC 61000-4-4	Testing and measurement techniques – Electrical fast transient/burst immunity test
	IEC 61000-4-5	Testing and measurement techniques - Surge immunity test
	IEC 61000-4-6	Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
	IEC 60529	Degrees of protection provided by enclosures (IP Code)
	WEEE	EN 50419 (2006)
	Recycling	IEC 61429/A11 (1998)

The Technical Construction File required by this Directive is maintained at the corporate headquarters of Super B B.V., Expolaan 50, 7556 BE, Hengelo (Ov), the Netherlands.

M.H. Doornekamp

CTO

Appendix II. Certificate of Compliance

Super B b.v.

Expolaan 50, 7556 BE, Hengelo (Ov), the Netherlands
+31 (0) 74-8200010, www.super-b.com

February, 2017

Certificate of Compliance

Product Number/Name/Description:

(1.2 kW LiFePO4) SB12V1200Wh-M (Lithium Ion Battery) 12.8V / 90Ah / 1200Wh (Energy / TractionBattery)

The undersigned, on behalf of Super B b.v. Hengelo, the Netherlands, does hereby certify that the product listed above is compliant to:

IATA	Transport	SP 188 / PI965, Part II IATA , Packing instructions
	Transport	SP 230, Special provision
	Transport	UN DOT 38.3, The testing requirements for Lithium Batteries
IEC / EN	Environmental	Council Directive 2013/56/EC, Environmental EU Compliance
	EMC	Council Directive 2014/30/EU on Electromagnetic Compatibility
	UN DOT 38.3	Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria
	IEC 62281	Safety of primary and secondary lithium cells and batteries during transport
	IEC 62619	Safety requirements for secondary lithium cells and batteries, for use in industrial applications
	IEC 61000-6-2	Immunity standard for industrial environments
	IEC 61000-6-4	Emission standard for industrial environments

	IEC 61000-4-2	Testing and measurement techniques - Electrostatic discharge immunity test
	IEC 61000-4-3	Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test
	IEC 61000-4-4	Testing and measurement techniques – Electrical fast transient/burst immunity test
	IEC 61000-4-5	Testing and measurement techniques - Surge immunity test
	IEC 61000-4-6	Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
	IEC 60529	Degrees of protection provided by enclosures (IP Code)
	WEEE	EN 50419 (2006)
	Recycling	IEC 61429/A11 (1998)

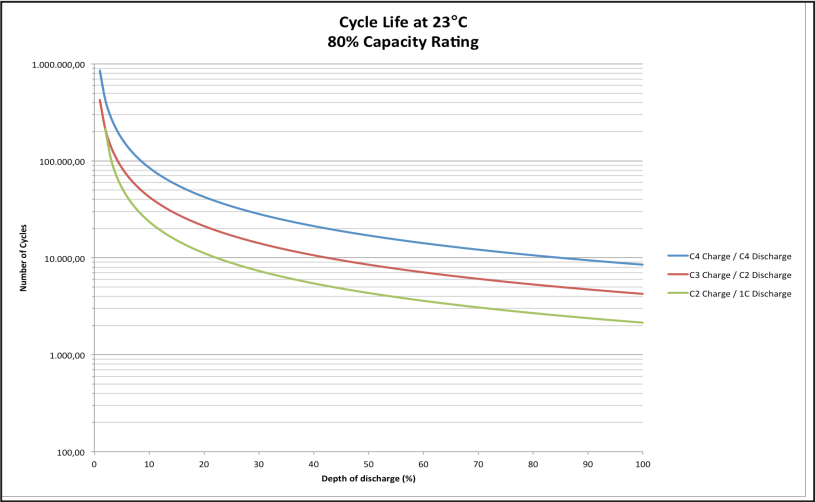
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M.H. Doornekamp

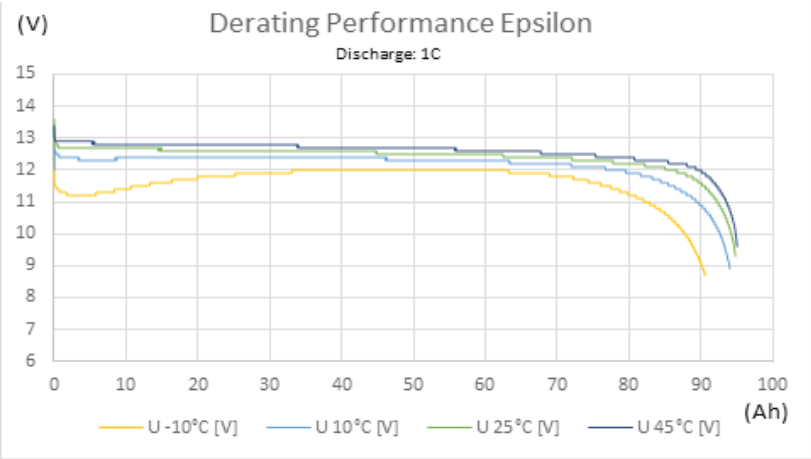
CTO

Appendix III. Performance Graphs

Depth of Discharge v/s Cycle life



Derating performance



Appendix IV. 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



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