

User Manual



Power Battery Lithium Plus

12 V 210 Ah | 12 V 340 Ah | LiFePO₄ Iron Phosphate Batteries

whisperpower.com

User Manual Lithium Plus 12 V 210 Ah - 12 V 340 Ah

Lithium Iron Phosphate batteries

Dear customer,

This manual contains all the information necessary to install, use and maintain the Whisper Power Lithium batteries. We kindly ask you to read this manual carefully before using the product. In this manual, the Lithium Power Plus 12 V 210 Ah or 12 V 340 Ah will be referred to as: the Lithium battery.

This manual is meant for the installer and the user of the Lithium battery. Only qualified, certified personnel may install and perform maintenance on the Lithium 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 Lithium battery may not be used in medical or in aviation related applications. The Lithium battery may not be used for any purposes other than described in this manual. Using the Lithium battery for any other purpose will be considered improper use and will void the warranty of the product. WhisperPower 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 Lithium battery. This is the original manual, keep it in a safe location! Please consult www.whisperpower.com for the latest version of all manuals.

Copyright© All rights reserved. Licensed software products are owned by WhisperPower or its subsidiaries or suppliers, and are protected by national copyright laws and international treaty provisions. WhisperPower products are covered by Dutch and foreign patents, issued and pending. Information in this publication supersedes that in all previously published material. Specifications and price change privileges reserved.

For more information, or to order documents, contact:

WhisperPower B.V.
Kelvinlaan 82
9207 JB Drachten
The Netherlands

E-mail: sales@whisperpower.com
www: www.whisperpower.com

Table of content

1.	Introduction	7
1.1.	Product description	7
1.2.	Intended use	7
1.3.	Glossary of Terminology	7
1.4.	Used symbols	7
2.	Product specifications	8
2.1.	Product features	8
2.2.	General product specifications	8
2.3.	Technical specifications	8
2.3.1.	Battery designation	8
2.3.2.	Electrical properties (23°C)	9
2.3.3.	Dimensions (±1mm)	9
2.4.	Environmental conditions	10
2.4.1.	Marine use	10
2.5.	Required tools	11
2.6.	Components	11
2.6.1.	List of components	11
2.7.	Connections, indicators and battery controls	12
2.7.1.	Con1 (Output for BI-Stable Relay)	12
2.7.2.	Con2 (I/O connection 7)	13
2.7.3.	Con3 (CANopen; 5-pin “micro” style connector)	13
2.8.	Peripheral equipment	13
2.8.1.	Obligatory	13
2.8.2.	Optional Components	14
3.	Safety guidelines and measures	15
3.1.	General	15
3.2.	Disposal	15
4.	Installation	16
4.1.	General information	16
4.2.	Unpacking	16
4.3.	Preparing the battery for use	16
4.3.1.	Placement of the battery	16
4.3.2.	Placement and removal of a fuse	17
4.4.	Connection wires	18
4.5.	Installing the mandatory Battery Disconnect device	18
4.5.1.	Connecting a bi-stable relay to the Lithium battery	18
4.5.2.	Connecting a normal relay as Battery Disconnect device	19
4.5.3.	Using the WP-WIB (WhisperPower Interface Box)	20

4.5.4.	Using the WP-BCI-C1 with a normal relay	20
4.6.	Connecting the Lithium battery to the load/charger	21
4.6.1.	Connecting a single Lithium battery to the load/charger	21
4.6.2.	Connecting a single Lithium battery to the load/charger	22
4.6.3.	Connecting Lithium batteries in series	24
4.6.4.	Connecting Lithium batteries in parallel	24
4.6.5.	Connecting Lithium batteries in series and parallel	25
4.7.	CANopen interface	26
4.7.1.	CAN Bus network topology	27
4.7.2.	Termination Resistors	27
4.7.3.	CAN bus power	27
4.7.4.	CAN balancing	28
4.8.	Disconnecting the Lithium battery	28
5.	Battery use	29
5.1.	General information	29
5.2.	Charging	29
5.2.1.	Charging rate	29
5.2.2.	Charging method	30
5.2.3.	Battery balancing	31
5.2.4.	Reading out the battery's State of Charge (SoC)	32
5.3.	Battery Monitoring Software	32
5.3.1.	Battery History Recording	33
6.	Inspection, cleaning and maintenance	33
6.1.	General information	33
6.2.	Inspection	33
6.3.	Cleaning	33
7.	Storage	34
8.	Transportation	34
8.1.	General	34
9.	Disposal and recycling	35
9.1.	General information	35
10.	Troubleshooting	36
11.	Warranty and liability	37

1. Introduction

1.1. Product description

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

The Lithium battery uses exceptionally safe Lithium Iron phosphate (LiFePO₄) technology. With its integrated battery management system the Lithium battery is protected from deep discharging, overcharging and overheating.



Caution! *External disconnect device is required!*

1.2. Intended use

The Lithium Power Plus Battery serves as a energy source of 12 V in power systems for recreational vehicles, commercial vehicles, leisure boats, commercial vessels and stationary applications. Potential applications of this Lithium battery include: off grid power supply, marine power supply, medium for (renewable) energy storage and (traction) battery for vehicles. Use as a starter battery is not possible. Up to 4 batteries can be connected in series or in parallel to increase the total capacity up to 840/1360 Ah. For more batteries in series or parallel always consult with WhisperPower.

1.3. Glossary of Terminology

BMS	Battery Managent 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.
BCI/WIB	Battery Communication Interface / Whisper interface box
LiFePO ₄	Lithium Iron Phosphate
SoC	State of charge
CCCV	Constant Current- Constant Voltage
DoD	Depth of Discharge

Table 1. Glossary of terminology

1.4. 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

- Traction battery
- Lithium Iron Phosphate (LiFePO4): Safe Lithium technology
- Integrated BMS (Battery Management System), external interruption device needed
- Glass fiber reinforced plastic (GRFP) Casing, Aluminum / PE sandwich side panels
- Terminals for 2 x 95mm² wire connection (2x M8 bolts) per terminal
- Integrated fuse, 32 V / 500 A
- Maximum continuous discharge (500 A – 210 Ah / 300 A – 340 Ah)
- Wired communication interface: CANopen
- Battery monitoring / History Storage
- Adaptive cell balancing
- Configurable in serial or parallel connection
- Output for bi-stable relay / latching relay

2.2. General product specifications

Article Number	40290209	40290219
Product name	Lithium Power Plus 12 V- 210 Ah	Lithium Power Plus 12 V- 340 Ah
Producer	Whisper Power	
Battery type	Lithium Iron Phosphate (LiFePO4) / Traction battery	
Cycle life	> 3500 (1C continuous discharge, DoD 100%)*	>4000 (100% DoD)

Table 2. General product specifications

*The cycle life value given above is an indication at 23°C. The Lithium battery cycle life depends strongly on temperature and the applied charging and discharging loads.

2.3. Technical specifications

Article Number	40290209	40290219
Mass	23 kg / 50 lbs	33kg/ 72,7 lbs
Ingress protection rating	IP50	IP50
Cell type/Chemistry	Prismatic LiFePo4	Prismatic LiFePo4

Table 3. Technical specifications

2.3.1. Battery designation

Article Number	40290209	40290219
Battery designation according to EC61960	IFpP/36/130/195/[2P4S]M/- 20+55/95	IFpP/41/173/205/[2P4S]M/- 30+60/95

Table 4. Battery

2.3.2. Electrical properties (23°C)

Open Circuit Voltage*	13.2 V dc	13.2 V dc
Nominal voltage**	12.8V dc	12.8V dc
Rated capacity	210 Ah	340 Ah
Energy	2688 Wh	4352 Wh
Charge method	CCCV / IUoUo	CCCV / IUoUo
Charge voltage	14.3V...14.6V	14.3V...14.6V
End-of-discharge voltage	8V dc	10V dc
Charge current	Max 210 A (1C)	Max 300 A
Discharge current continuous	500 A	300 A
Discharge current 10 seconds	800 A	900 A

Table 5. Electrical properties (23 °C)

- *Open Circuit Voltage at 50% SoC, no load
- **Nominal voltage (V) at 50%, SoC, 0.2C discharge

2.3.3. Dimensions (±1mm)

Height (H)	314 mm / 12.4 "
Width (W)	417 mm / 16.4 "
Thickness (T)	227 mm / 8.9 "

Table 6. Dimensions

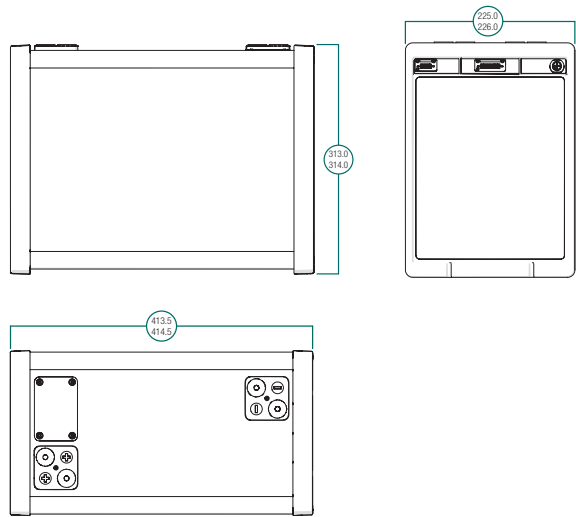


Figure 1. Dimensions

2.4. Environmental conditions



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

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

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

Recommended charge temperature range*	0°C to +45°C / 32°F to 113°F
Discharging operating temperature range	-10°C to +55°C / 14°F to 131°F
Short term (<1 month) storage temperature range	-20°C to +45°C / -4°F to 113°F
Long term (>1 month) storage temperature range	-0°C to +35°C / 32°F to 95°F
Relative humidity	10 - 90 %
Corrosion	Salt-contaminated atmosphere up to 1 mg salt per m ³ of air, at all relevant temperatures and humidity conditions. Applicable to equipment located in open air and made of material subject to corrosion.
Placement angle (continuously)	Up right
Vibrations and shocks	According UN38.3

Table 7. Environmental conditions
(*) Do not charge the Lithium battery below 0 °C / 32 F

2.4.1. Marine use

Parameter	Class	Location
Temperature	A	Machinery spaces, control rooms, accommodation, bridge
Humidity	B	All locations except as specified for location A
Vibration	A	On bulkheads, beams, deck, bridge
EMC	B	All locations including bridge and open deck

Table 8. Marine use

2.5. Required tools

- 13mm Hexagon socket wrench
- Torque wrench
- TORX key for fuse cover

2.6. Components

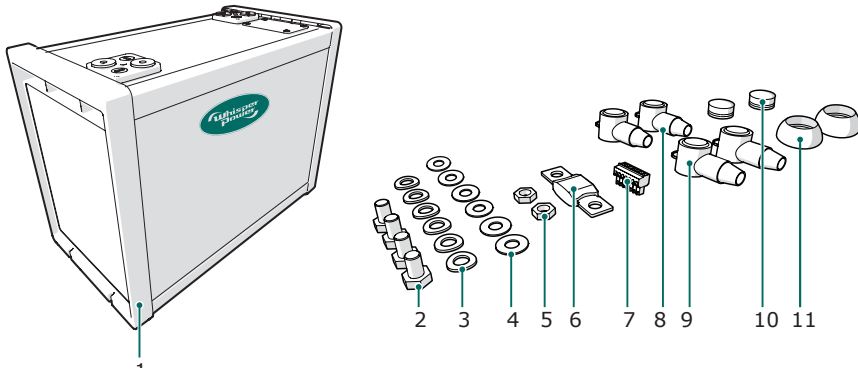


Figure 2. Components

2.6.1. List of components

1. (1x) WP-ION Power Plus 12 V/210 Ah Battery
2. (4x) M8 Bolt
3. (6x) M8 Spring washer
4. (6x) M8 Plain washer
5. (2x) M8 Nut
6. (1x) Mega Fuse 32 V/500 A
7. (1x) Phoenix plug 7
8. (2x) Terminal cover, Red
9. (2x) Terminal cover, Black
10. (1x) Terminal protection cap, Red
11. (1x) Terminal protection cap, Black

2.7. Connections, indicators and battery controls

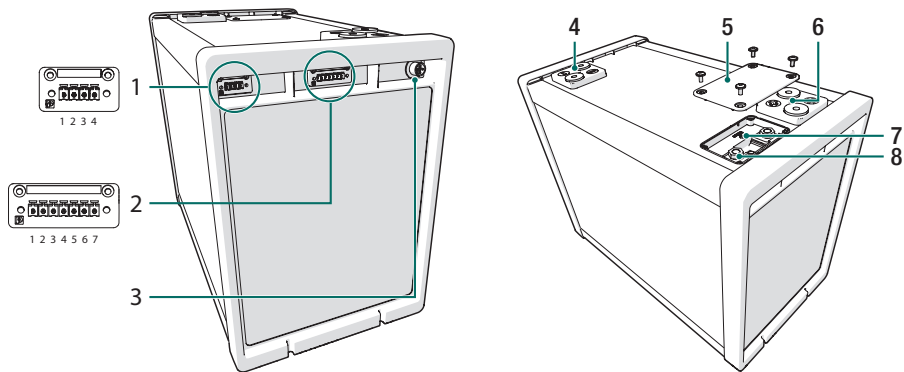


Figure 3. Connections, indicators and battery controls

- 1. Con 1 (Output for BI-Stable Relay; Phoenix FRONT-MC 1,5/4-STF-3,81 1850877)
- 2. Con 2 (I/O Connection 7; Phoenix FRONT-MC 1,5/7-STF-3,81 1850903)
- 3. Con 3 (CANopen; 5-pin “micro” style connector)
- 4. Terminal- (2x 95mm2 wire connection)
- 5. Fuse cover
- 6. Terminal + (2x 95mm2 wire connection)
- 7. Reset button
- 8. Fuse connections

2.7.1. Con1 (Output for BI-Stable Relay)

PIN #	Output range (12 V dc)	Function
1	2.7 A (continuous) 15 A (100ms pulse)	+, OFF
2	2.7 A (continuous) 15 A (100ms pulse)	-, ON
3	2.7 A (continuous) 15 A (100ms pulse)	-, OFF
4	2.7 A (continuous) 15 A (100ms pulse)	+, ON

Table 9. Con1 (Output for BI-Stable Relay) Output Functions

2.7.2. Con2 (I/O connection 7)

PIN #	Range	Function
1	max 30 V dc	+ (Plus)
2	0-10 V dc	AN_SOC (Analogue state of charge)
3	NA	Nc (Not connected)
4	5 A max 48V dc max	Rc, (Relay common contact)
5		Rnc, (Relay normally close contact)
6		Rno, (Relay normally open contact)
7		GND, (Ground)

Table 10. (I/O connection 7)

2.7.3. Con3 (CANopen; 5-pin “micro” style connector)

PIN #	Signal	Description
1	CAN_SHLD	Optional CAN Shield
2	CAN_V+	Optional CAN external positive supply (dedicated for supply of transceiver and optocouplers. if galvanic isolation of the bus node applies)
3	CAN_GND	Ground / 0V
4	CAN_H	CAN_H bus line (dominant high)
5	CAN_L	CAN_L bus line (dominant low)

Table 11. Con 3 (CANopen; 5-pin “micro” style connector)

2.8. Peripheral equipment

2.8.1. Obligatory

In order for the Lithium battery to be used safely, an external disconnect device must be installed. This should either be a relay or latching relay (bi-stable) controlled by the battery’s BMS or a relay or latching relay controlled by a remote switch (CAN controlled). If an external switch off device is not installed the warranty of the Lithium battery will be void.

2.8.2. Optional Components

The Lithium battery can be used in combination with a number of (Whisper Power) products:





Art.Number	Article name		code
50214815	WP Power Plus Whisper Interface box WIB 12 V / 600 A		C
50214817	WP Power Plus Whisper Interface box WIB 24 V / 600 A		C
50214819	WP Power Plus Whisper Interface box WIB 48 V / 600 A		C
40290253	WP Power Plus Relay 9-36 V / 500 A		C
40290254	WP Power Plus Relay 12-42 V / 190 A Bi-stabile relay + cable 1 meter		C
40290255	WP Power Plus CAN bus cable 0.6 meter		C
40290256	WP Power Plus CAN bus Power cable		C
40290257	WP Power Plus CAN bus splitter		C
40290258	WP Power Plus CAN bus terminator female		C
40290259	WP Power Plus CAN bus terminator male		C
40290340	WP Power Plus CAN bus cable to whisper connect		C
40290346	WP ION Power Plus, bracket kit 12 V 210 Ah		C

Table 12. Optional components that can be used with the Lithium battery.

3. Safety guidelines and measures

3.1. General

- Do not short-circuit the Lithium battery.
- Treat the Lithium battery as described in this manual.
- Do not dismantle, crush, puncture, open or shred the Lithium battery.
- Do not expose Lithium battery to heat or fire. Avoid exposure to direct sunlight.
- Do not remove the Lithium battery from its original packaging until required for use.
- In the event of the Lithium 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 Lithium battery.
- Observe the plus (+) and minus (–) marks on the Lithium battery and equipment and ensure correct use.
- Do not use any battery which is not designed for use with the Lithium battery.
- Do not mix batteries of different manufacture, capacity, size or type within a device.
- Keep the Lithium 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 Lithium battery on prolonged charge when not in use.
- After extended periods of storage, it may be necessary to charge and discharge the Lithium battery several times to obtain maximum performance.
- Retain the original product documentation for future reference.
- Remove the Lithium battery from the equipment when not in use.
- Do not charge the Lithium battery below 0°C



Warning! *Keep the Lithium battery away from water, dust and contamination. Place the Lithium battery in well ventilated areas.*

3.2. Disposal



Dispose of the Lithium 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.

4. Installation

4.1. General information



Warning! *Never install or use a damaged Lithium battery.*



Caution! *Do not reverse connect the Lithium battery (polarity)*

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

4.2. Unpacking

Check the Lithium battery for damage after unpacking. If the Lithium battery is damaged, contact your reseller or Whisper Power. Do not install or use the Lithium battery if it is damaged!

4.3. Preparing the battery for use



Caution! *Do not operate the Lithium battery beyond published maximum specifications.*



Caution! *In case of an under-voltage shutdown, charge immediately.*



Warning! *Always remain within the limits indicated in chapter 2 during the use of the Lithium battery.*



Caution! *This Lithium battery stores fault conditions internally, like excessive charge current or deep discharge situations. Whisper Power uses this information in the warranty process*



Warning! *Do not overcharge the Lithium battery.*

4.3.1. Placement of the battery

Before it is used, the Lithium battery must be positioned in such a way that it will not move around in its compartment during use. If necessary, the Lithium battery may be fixed in place by means of Whisper Power mounting brackets. The brackets can be screwed in place by means of bolts or screws (See Figure 4).

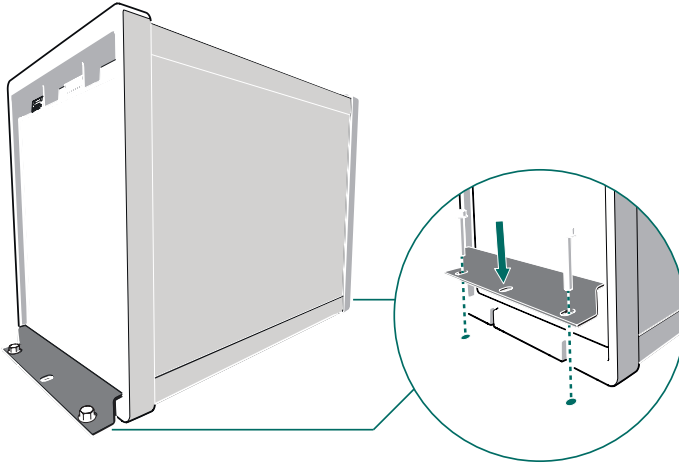


Figure 4. Installing the Lithium battery using the Whisper Power mounting brackets

4.3.2. Placement and removal of a fuse

Before the Lithium battery can be used, the internal fuse needs to be installed into it. The 32 V/500 A fuse is supplied with the Lithium battery. Other fuses may only be used in the product when they are approved by Whisper Power for this application.

Use the following steps to (re)place the fuse in the Lithium battery (Figure 5):

1. Disconnect the negative wire from the - pole of the Lithium battery (see paragraph 4.5.5. for the details).
2. Disconnect the positive wire from the + pole of the Lithium battery.
3. Unscrew the fuse cover using the fuse TORX key.
4. Unscrew the fuse contacts using a 13mm wrench.



Warning! Short circuit danger. Avoid making a short circuit with the wrench.

5. Place the (new) fuse between the contacts, place washers and spring washers and tighten the fuse contact points to 13Nm.
6. Fasten the fuse cover.
7. Proceed to the next paragraph to read the instructions on installing the Lithium battery in an electrical circuit.

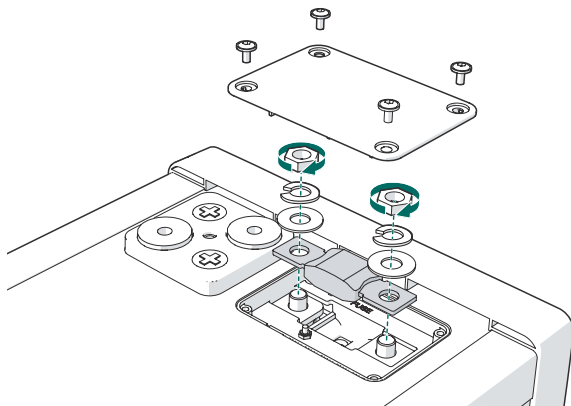


Figure 5. Install a fuse

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.

WhisperPower recommends to use at least 95 mm² conductors for short lengths and higher rating for longer distances.



Caution! *Smaller diameter wires can cause overheating or necessary losses and shall be avoided.*

4.5. Installing the mandatory Battery Disconnect device



Warning! *Always connect the relay between the + or - terminal of the battery and the load.*



Warning! *Never use the Lithium battery without a properly installed Battery Disconnect device (relay or latching relay).*

An external Battery Disconnect device must be installed between the + or - terminal of the Lithium battery and the load. The protection of the Lithium battery is possible by one of the following ways:

1. Connect a bi-stable relay to the Lithium battery's Con1 output.
2. Connect a normal relay to the Lithium battery's Con2 (I/O connection 7) output.
3. By using the WP WIB (Battery Interface Box).
4. By using the WP BCI-C1 (Battery Communication Interface) and a normal relay.

4.5.1. Connecting a bi-stable relay to the Lithium battery

1. When using a bi-stable relay connect it to Con1 output as displayed in Figure 6. The Con1 output controls both the ON coil and the OFF coil of the bi-stable relay. The output of Con1 can be found in Table 9.

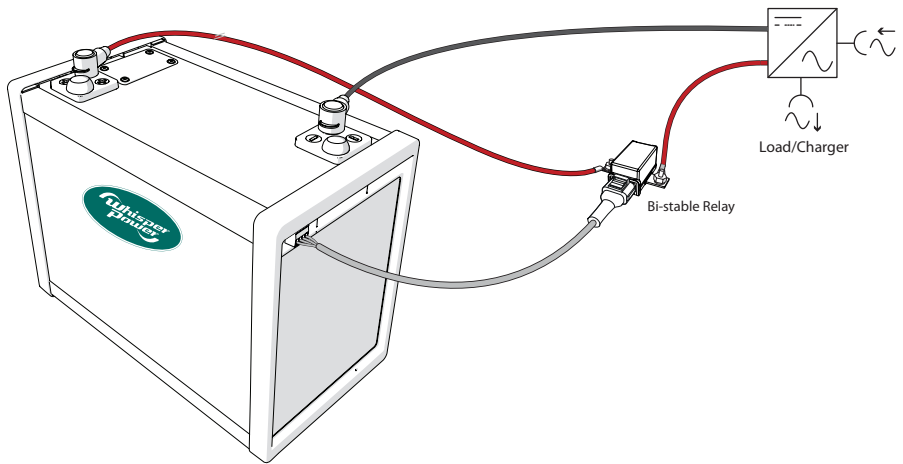


Figure 6. Connect a bi-stable relay as Battery Disconnect device

4.5.2. Connecting a normal relay as Battery Disconnect device

1. When using a normal relay, connect it to Con 2 (I/O Connection 7), Pin 4 (Rc) and Pin 5 (Rnc) as displayed in Figure 7.

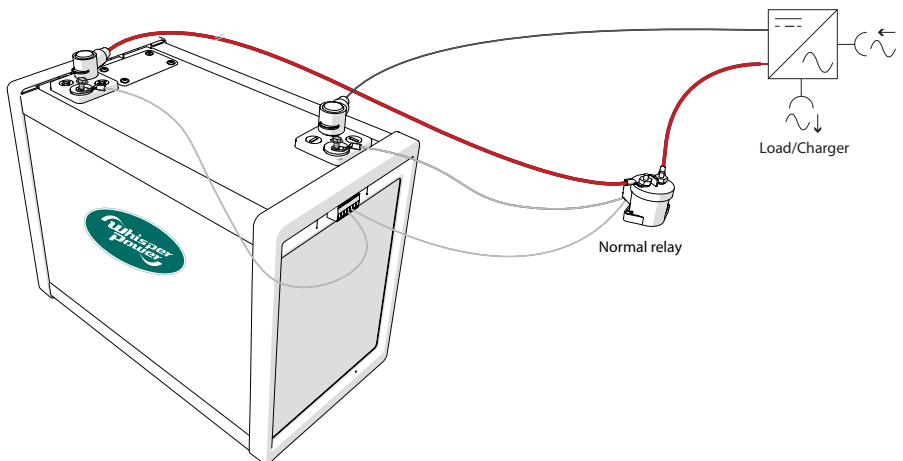


Figure 7. Connect a normal relay as Battery Disconnect device.

4.5.3. Using the WP-WIB (WhisperPower Interface Box)

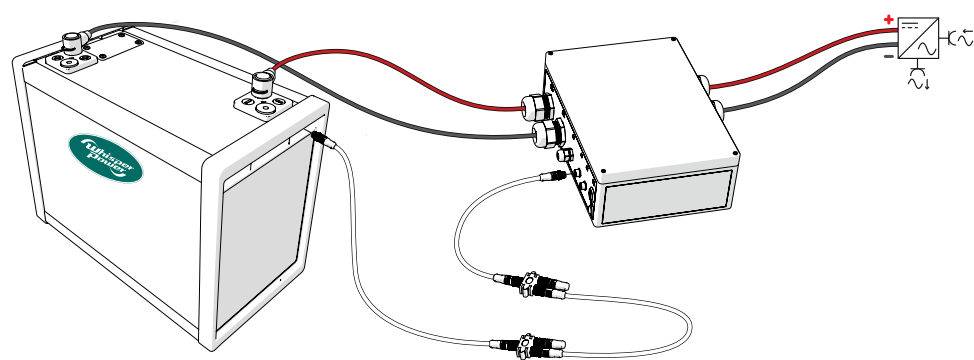


Figure 8. Connecting a Lithium battery to the WP WIB

Consult the manual of the WP WIB for installation instructions.

4.5.4. Using the WP-BCI-C1 (Battery Communication Interface) with a normal relay

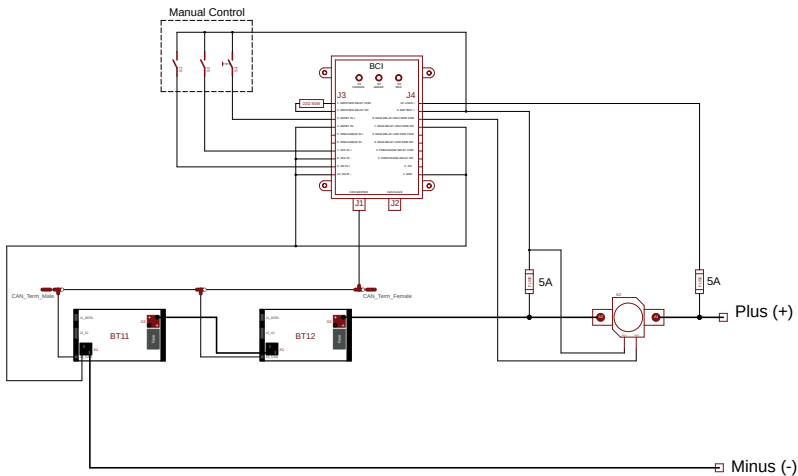


Figure 9. Connecting a Lithium battery to the WP BCI-C1

Consult the manual of the WP BCI-C1 for installation instructions.

4.6. Connecting the Lithium battery to the load/charger

4.6.1. Connecting a single Lithium battery to the load/charger with a bi-stable relay



Warning! Ensure you have completed all the previous steps described in chapter 4.5 before connecting the battery to the load/charger.

1. Slide the terminal covers over the connection wires.
2. Connect the + terminal of the battery to the - or A terminal of the relay (Figure 10).
3. Connect the load or charger to the + or B terminal of the relay.
4. Connect the - terminal of the battery. Do not connect the - terminal first as this may lead to short circuits (Figure 10).
5. Ensure both contacts are tightened to 13Nm.
6. Place the terminal covers over the terminals (Figure 11).
7. Press the reset button for 10-15 seconds after connecting the bi-stable relay to Con1 output. (the reset button is located under the fuse cover). The bi-stable relay contacts will be turned off and on, this is to make sure that the bi-stable relay is ON

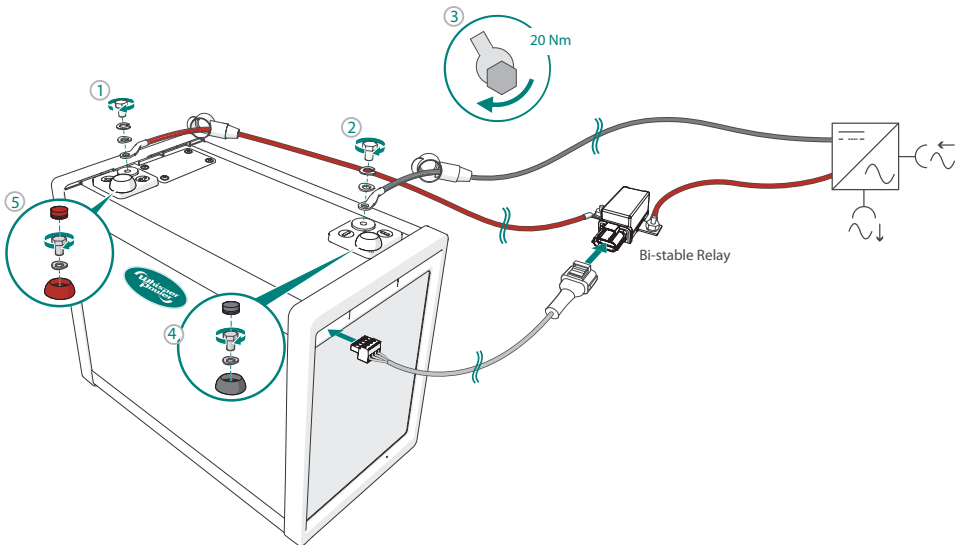


Figure 10. Connecting the battery to the load

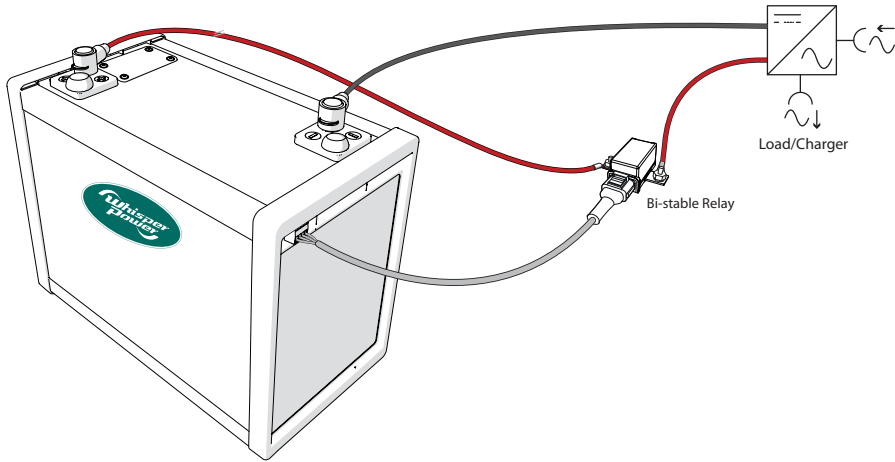


Figure 11. Securing the terminal covers

4.6.2. Connecting a single Lithium battery to the load/charger with a normal relay



Warning! *Ensure you have completed all the previous steps described in chapter 4.5 before connecting the battery to the load/charger.*

1. Slide the terminal covers over the connection wires.
2. Connect the + terminal of the battery to the - or A1 terminal of the relay (Figure 12).
3. Connect the load or charger to the + or A2 terminal of the relay.
4. Connect the - terminal of the battery. Do not connect the - terminal first as this may lead to short circuits (Figure 12).
5. Ensure both contacts are tightened to 20Nm.
6. Place the terminal covers over the terminals (Figure 13)

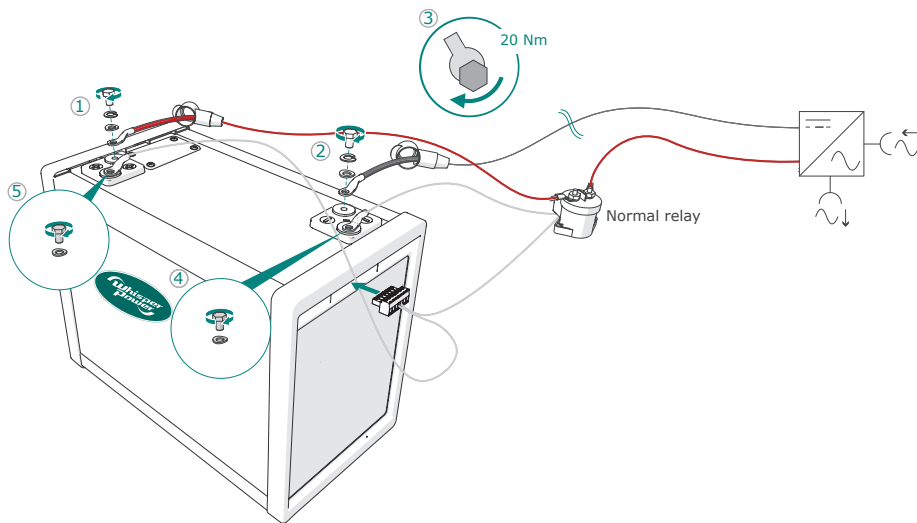


Figure 12. Securing the terminal covers.

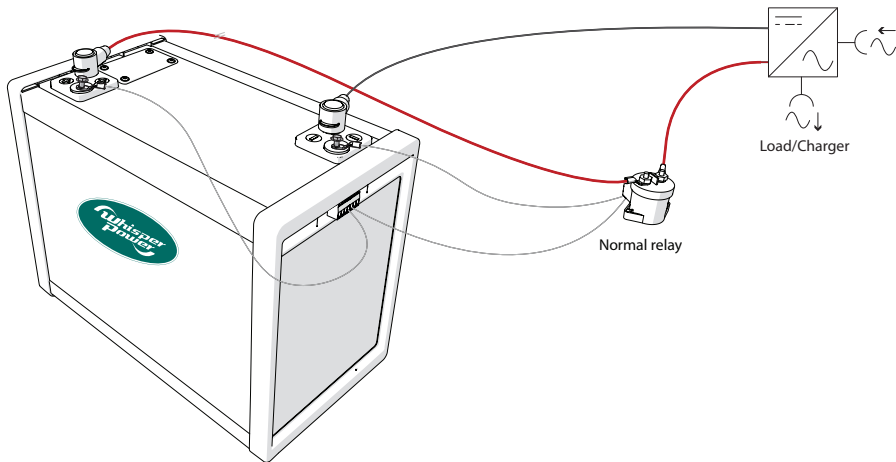





Figure 13. Connecting the battery to the load

4.6.3. Connecting Lithium batteries in series

-  **Caution!** Before connecting 2 or more Lithium batteries, the Lithium batteries must be charged to 100% SoC.
-  **Caution!** For more than 4 Lithium batteries in series connection consult Whisper Power or your dealer.
-  **Caution!** Depending on the installation a precharge circuit is needed. For further information consult Whisper Power or your dealer.

When using Lithium batteries in series configuration CAN balancing is required (see paragraph 4.7.4.).

The CAN power cable is necessary for CAN balancing.

In installations with more than 2 batteries in series the CAN power cable should be powered from an external 24V power supply. The external voltage on the CAN power cable shall not be higher than 28.8 Vdc.

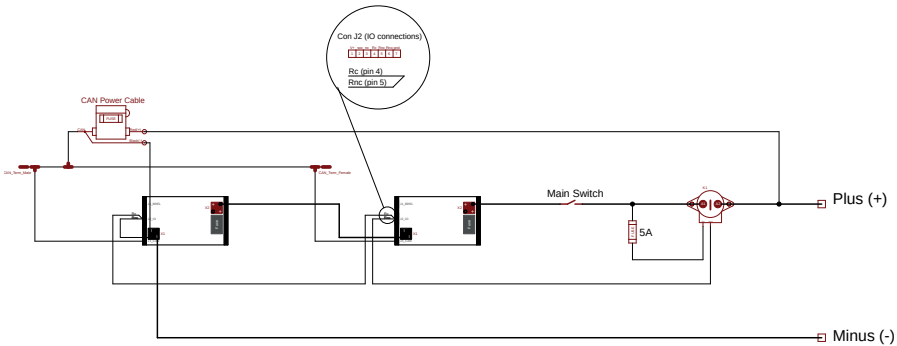






Figure 14. Batteries connected in series with CAN power cable external disconnecting device and external power supply.

4.6.4. Connecting Lithium batteries in parallel

-  **Caution!** Before connecting 2 or more Lithium batteries, the Lithium batteries must be charged to 100% SoC.
-  **Caution!** For more than 4 Lithium batteries in parallel connection consult Whisper Power or your dealer.
-  **Caution!** Depending on the installation a precharge circuit is needed. For further information consult Whisper Power or your dealer.
-  **Caution!** When batteries are placed in parallel configuration, the used relay shall be suitable for the current used by the application.

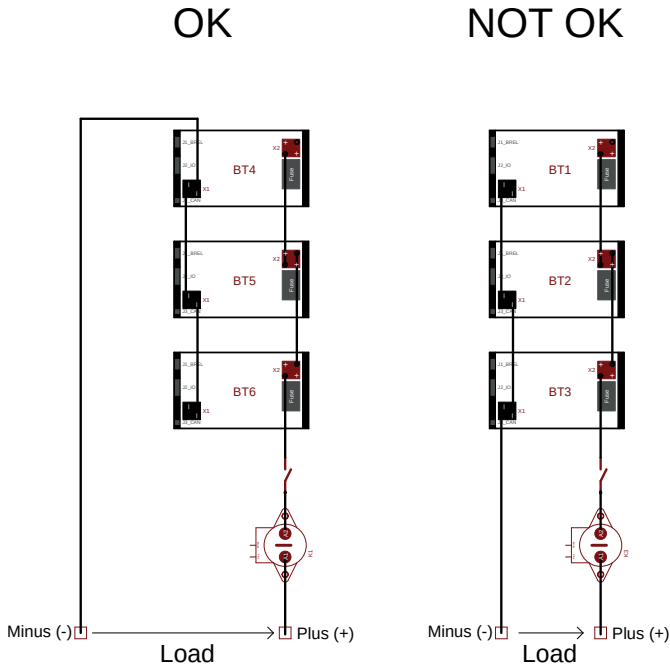


Figure 15. Three Lithium batteries in parallel with external relay

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 the load will have lesser current contribution.

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

When using Lithium batteries in parallel configuration CAN balancing is not required.

4.6.5. Connecting Lithium batteries in series and parallel

⚠ Caution! Before connecting 2 or more Lithium batteries, the Lithium batteries must be charged to 100% SoC.

⚠ Caution! For more than 4 Lithium batteries in series and parallel connection consult Whisper Power or your dealer.

⚠ Caution! Depending on the installation a precharge circuit is needed. For further information consult WhisperPower or your dealer.

When using Lithium batteries in series and parallel configuration CAN balancing is required (see paragraph 4.7.4). The CAN power cable is necessary for CAN balancing. In installations with more than 2 batteries in series the CAN power cable should be powered from an external 24V power supply.

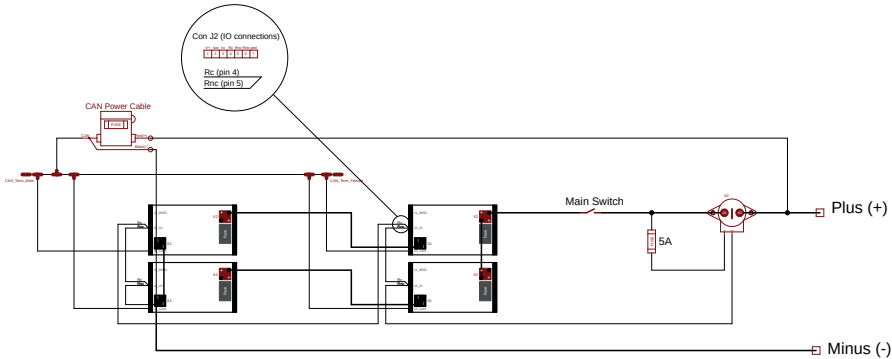


Figure 16. Four Lithium batteries in a series - parallel connection with external relay

4.7. CANopen interface

The CANopen interface of the Lithium battery must be used for CAN balancing and can be used for monitoring purposes.

The Lithium battery can be monitored using the Battery Monitor software and the Touch Display Screen.
(see paragraph 2.8.2)

To use the Battery Monitoring Software, the CAN bus of the Lithium battery (CON 3) needs to be connected by means of CAN-to-USB interface to the computer on which the monitoring software and the usb drivers are installed.

More information about the CANopen bus can be found at the CiA website:
www.can-cia.org.

4.7.1. CAN Bus network topology

The CAN Bus must be used in a bus network topology. Do not use a ring- or a star topology. The maximum CAN bus length is limited because the Lithium battery has a fixed bitrate of 250kbps.

In Table 6 is an overview of these restrictions.

Bit rate	Bus length (L)	Max. stub length (S)	Accumulated stub length
250 kbps	250 m	11 m	55 m

Table 6. CAN bus speed

4.7.2. Termination Resistors

The CAN bus requires termination at the two ends of the bus. The USB-to-CAN interface may be connected in anywhere to the CAN bus.

Use termination resistors at the end nodes to prevent reflections on the line. The value of this resistor should be +/- 120 ohms.

4.7.3. CAN bus power

Due to the galvanic separation between the BMS and the Lithium battery's CAN interface an external power supply is needed on the CAN bus.

The CAN bus can be powered through Con 2 (I/O Connection 7) (figure 17) or the CAN power cable. (figure 18)

This situation may occur when a USB-to CAN interface is directly connected to the Lithium battery (figure 17).

1. Connect Pin 1 of Con2 to the + terminal of the Lithium battery.
2. Connect Pin 7 of Con2 to the- terminal of the Lithium battery.

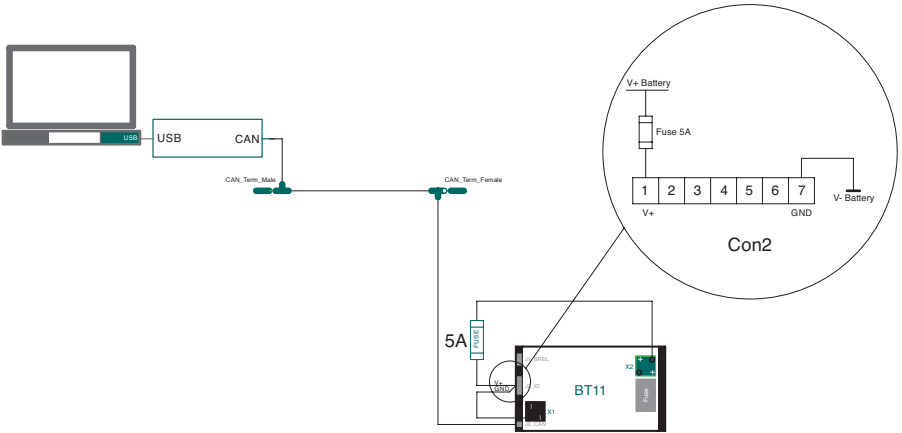


Figure 17. Use Con2 to power the CAN bus

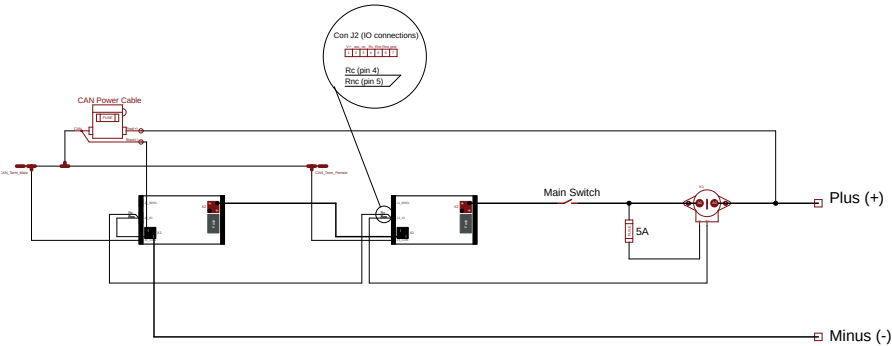


Figure 18. Use of CAN power cable to power the CAN bus

4.7.4. CAN balancing

When the Lithium battery is connected in a series configuration CAN balancing is required. CAN balancing makes sure that all batteries are balanced properly. For this it is necessary that the batteries must communicate with each other. Therefore the CAN bus is used.

CAN balancing works with WP BCI-C1/WP WIB and without WP BCI-C1/WP WIB up to 8 batteries.

4.8. Disconnecting the Lithium battery

1. Turn off any device or charger the Lithium battery is connected to.
2. Disconnect the negative wire from the - terminal of the Lithium battery.
3. Disconnect the positive wire from the + terminal of the Lithium battery.

5. Battery use

5.1. General information



Warning! Always use an external Disconnect device.

Warning! In case of an undervoltage shutdown, the charging current must be very low until a safe voltage is achieved.

Warning! Follow the safety guidelines and measures of chapter 3



Caution! Charge the Lithium battery before use.

5.2. Charging



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

Warning! Stop charging in case the Lithium battery switches into alarm mode. (the protection relay will switch off)



Caution! Charge before use

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

Caution! To preserve the lifespan of the Lithium battery, use a charger approved by Whisper Power.

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

5.2.1. Charging rate

Whisper Power Lithium battery can be charged in approximately 1 hour. Displayed in Table 7 are the charge times for the Lithium 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 (210 A) 300 A
Endurance lifecycle	3 hours	C3 (70 A) 300 A

Table 7. Charging rates at different charge currents

5.2.2. Charging method

Whisper Power recommends using the following charging method.

Charge Profile Whisper Power Batteries

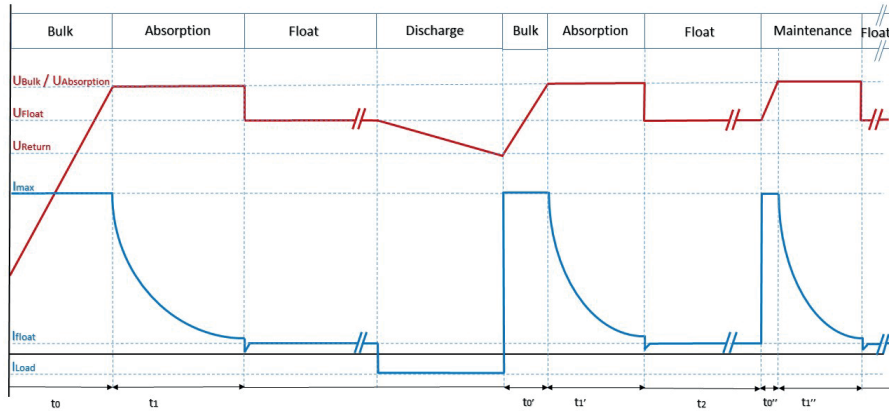


Figure 19. Charge curve

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 Whisper Power batteries is 1C, however for endurance cycle life Whisper Power 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 (t_0) can be programmed. Whisper Power suggests setting t_0 to: $t_0 = 2 * (BTcap / Chcur)$

Example: Battery capacity = 210 Ah, Charger = 100 A, Set to a maximum of $2 * (210/100) = 4.2$ hours.

Bulk Phase			
	Typical	Min	Max
I_{max}	-	-	1C (210 A) 300 A
t_0	Depends on the battery SoC	-	$2 * (BTcap / Chcur)$

Table 8. Bulk Phase

Absorption phase

In this phase the charge voltage must be maintained at $U_{absorption}$ to fully charge the Lithium battery and set the State of Charge (SoC) counter to 100%. See Table 7. This phase is finished when the SoC is indicating 100%.

Absorption Phase			
	Typical	Min	Max
UAbsorption	14.4V DC	14.3V DC	14.6V DC
t1	20 minutes	10 minutes	1 hour

Table 9. Absorption Phase

Float phase

In this phase the charge voltage is set to UFloat. The charger will supply the load, if any.

Float Phase			
	Typical	Min	Max
UFloat	13.8V DC	13.6V DC	14V DC

Table 10. Float Phase

Discharge phase

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

Discharge Phase			
	Typical	Min	Max
UReturn	13.5V DC	13.4V DC	13.6V DC

Table 11. Discharge Phase

Maintenance phase

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

Maintenance Phase		
	Typical	Max
t2	13 weeks	26 weeks

Table 12. Maintenance phase

5.2.3. Battery balancing

The Lithium battery is automatically balanced during the absorption phase (see paragraph 5.2.2). During the batteries lifespan, the cells within the Lithium battery may be unbalanced due to high discharge currents and short float charge periods. This may result in a loss of capacity and unbalanced cells. Cells may be manually equalized by means of the following procedure:

Apply a constant voltage of 14.4V and a current of between 1A and 2A to manually equalize the Lithium battery.

5.2.4. Reading out the battery's State of Charge (SoC)

The Lithium battery's State of Charge can be read out either by using an external battery monitor, Touch Display, CAN network, or by the analogue output (see further instructions below).

1. Connect Pin1 of Con2 to the Lithium battery's + pole.
2. Connect Pin 7 of Con2 to ground.
3. Determine the voltage at Pin 2 of CON2 (see Figure 20).
The analog SoC output ranges from 0 to 10 volt, in which 0V corresponds with 0% SoC and 10V corresponds with 100% SoC.
The SoC is an indication. Charging currents smaller than 100mA are not used in the SoC calculation.
4. Perform a complete charge cycle to the Lithium battery through if the SoC indication does not provide an accurate measurement. This will recalibrate the SoC.

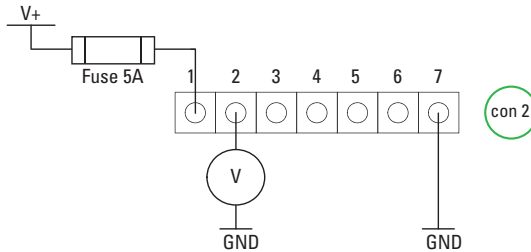


Figure 20. Determining the batteries SoC

5.3. Battery Monitoring Software

Battery monitoring software offers the possibility to continuously monitor a number of the Lithium battery properties through sensors within the Lithium battery. It also enables one to download a complete recording of the Lithium battery's properties over time.

The Battery Monitoring software and the hardware are not included with the Lithium battery. See whisperpower.com/batterymonitoring for the most recent products.

5.3.1. Battery History Recording

The battery history can be downloaded with the Battery Monitor software.

This recording can only be accessed by a reseller or Whisper Power for evaluation.

6. Inspection, cleaning and maintenance

6.1. General information



Warning! *Never attempt to open or dismantle the Lithium battery! The inside of the Lithium 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 4.7.5).
2. Remove the fuse or dummy fuse before cleaning and maintenance activities (see paragraph 4.3.2).
3. 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 Lithium battery is found, it must be replaced. Do not attempt to charge or use a damaged Lithium battery. Do not touch the liquid from a ruptured Lithium battery
2. Observe and note the run time that a new, fully-charged Lithium battery provides for powering your product. Use this new Lithium battery run time as a basis to compare run times for older batteries. The run time of the Lithium battery will vary depending on the products' configuration and the application it is used for.
3. Routinely check the Lithium battery's charge status. Lithium Iron Phosphate batteries continue to slowly self-discharge (<3% per month) when not in use or whilst in storage.
4. Carefully monitor batteries that are approaching the end of their estimated life.
5. Consider replacing the Lithium battery with a new one if you note either of the following conditions:
 - The Lithium battery run time drops below about 80% of the original run time.
 - The Lithium battery charge time increases significantly.

6.3. Cleaning

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

7. Storage

Follow the storage instructions in this manual to optimize the lifespan of the Lithium battery during storage. If these instructions are not followed and the Lithium 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 Lithium battery.

See chapter 2.4 for storage temperature conditions.

The self-discharge of the Lithium battery is <3 % per month.

1. Charge the Lithium battery to 100% of its capacity before storage.
2. Disconnect the Lithium battery from all loads and, if present, the charging device
3. Remove the fuse from the Lithium battery during storage. (See paragraph 4.3.2)
4. Place the terminal covers over the Lithium battery's terminals during storage.
5. Charge the Lithium battery to 80% of its capacity every year.

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 Lithium battery may, in certain cases, be specifically limited or prohibited.

The transport of the Lithium battery falls under hazard class UN3480, class 9. For transport over water, air and land, the Lithium battery falls within packaging group PI965 Section II.



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

Battery recycling is encouraged. Dispose of the Lithium 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 Lithium battery. Contact Rechargeable Battery Recycling Corporation (www.rbrc.org) for U.S.A. and Canada, or your local Lithium 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 reason	Solution
The capacity of the Lithium battery has decreased	The cells within the batteries are not properly balanced or the Lithium battery is worn out. .	Perform one full charge cycle to balance the cells.
The Lithium battery cannot be charged / discharged	The fuse of the Lithium battery is not installed	Install the fuse; follow the procedures described in paragraph 4.3.2
	The fuse in the Lithium battery is broken.	Disconnect all loads and chargers, check and correct for short circuits and defects. Then replace the fuse; follow the procedures described in paragraph 4.3.2
	The Lithium battery has been deeply discharged. The BMS is now in "fault condition".	Disconnect all loads and connect a charger to the Lithium battery. Then press the reset button for at least 10-15 seconds to resolve the "fault condition"(see paragraph 2.7.).
	The Lithium battery has been overcharged. The BMS is now in "fault condition".	Disconnect the charger from the Lithium battery and press the reset button for at least 10-15 seconds to resolve the "fault condition" (see paragraph 2.7.).
	The Lithium battery has overheated. The BMS is now in "fault condition".	Disconnect the charger and all loads and wait for the Lithium battery to cool down. Then press the reset button for at least 10-15 seconds to resolve the "fault condition" (see paragraph 2.7.).

Table 13. 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 Whisper Power thereof as soon as possible, in any event no later than three (3) days of delivery, by means of accurate, written statement, stating the damage and where possible a photograph. Failure to inspect the products and inform Whisper Power within the stated time or the use of the products at any time shall be conclusive evidence that Whisper Power 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, Whisper Power (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 Whisper Power 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 Whisper Power products (f) installation of the Whisper Power product by persons unskilled to work with electro-technical devices or components, (g) any other wrongful use contrary to the Whisper Power'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 Whisper Power 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 Whisper Power in writing.

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

11.6 Any liability of Whisper Power 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 Whisper Power. Whisper Power can never be held liable for (a) damage caused by any of the circumstances mentioned in clause 11.3, leading to damage to the Whisper Power 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, Whisper Power's liability for loss of property, damage to property, and bodily injury (including death) caused by the application of those particular Whisper Power products shall in any event be limited to the amount actually paid out by Whisper Power's insurance company to Whisper Power in accordance with the insurance cover of that insurance policy for that particular type of damage. Whisper Power 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 Whisper Power if, and to the extent that, the event is a covered event.

Appendix I. Declaration of Conformity



Enjoy Green Energy

EC Declaration of Conformity

Product Number/Name/Description:

**WP-POWER BATTERY PLUS (Lithium Batteries)
12V / 210Ah & 12V / 340Ah**

The object of the declaration described above is in conformity with the requirements of the following Directives and standards, as applicable:

- Council Directive 2006/66/EC, Environmental EU Compliance
- Council Directive 2014/30/EU on Electromagnetic Compatibility
- European standards used:
 - EN 61000-6-3 (2007) + A1 (2011), EN 55016-2-3 (2010) + A1 (2010) + C1 (2013), EMC (Emission) Compliance
 - EN 61000-6-2 (2005) + AC (2005), EN 61000-4-2 (2009), EN 61000-4-3 (2006) + A1 (2008) + A2 (2010), EN 61000-4-4 (2012), EN 61000-4-5 (2007), EN 61000-4-6 (2009), EMI (Immunity) Compliance
- IEC 62133, Safety IEC Compliance
- IEC 61960 (ed2.0), Performance IEC Compliance

The Technical Construction File required by this Directive is maintained at the corporate headquarters of WhisperPower BV, Kelvinlaan 82, 9207 JB Drachten, The Netherlands.

Signed by:

Ing. M. Favot

CTO, Drachten

Date: May 19, 2022

WhisperPower BV
Kelvinlaan 82
9207 JB Drachten
The Netherlands

T: +31 (0) 512 571 550
KvK: 01120025

whisperpower.com



Enjoy Green Energy

WhisperPower BV

Kelvinlaan 82,
9207 JB Drachten
The Netherlands

www.whisperpower.com
sales@whisperpower.com

