PowerBrick

12V – 24V – 48V
Lithium-Iron-Phosphate Battery Pack

USER'S MANUAL

CE

2. 3 Version – July 2020

TABLE OF CONTENTS

1. SAFETY PROTECTION 3
1.1. General Rules 3
1.2. Precaution for transportation 3
1.3. Recycling Lithium-Ion batteries 3
1.4. General safety precautions 3
1.5. Use Wisely 4
1.6. Warranty Limitations 4

2. POWERBRICK® PRODUCT OVERVIEW 5
2.1. Introduction 5
2.2. Charging/ Discharge 5
2.3. Initial balancing 6
2.4. Parallel Assembly 6
2.5. Parallel / Serial Assembly 7
2.6. Assembly in series 8
2.7. Battery installation 8
2.8. External fuse protection 8
2.9. Short circuit protection 9
2.10. In case of internal relay cut-off 9

3. MAINTENANCE 9
3.1. Battery maintenance 9
3.2. Storage / wintering 9

1. Safety Protection

1.1. General Rules

- Do not short-circuit the Li-ion battery.
- The battery should never be left completely discharged for more than 7 days, otherwise the chemistry of the cell will deteriorate and shorten its life.
- Do not disassemble, crush, puncture, open or crush the Li-ion Battery.
- Do not expose the Li-ion Battery to heat or fire. Avoid exposure to direct sunlight.
- Always use a charger specifically provided for use with a battery with Lithium Iron Phosphate (LiFePO4).
- Observe the plus (+) and minus (-) marks located on the Li-ion battery and equipment and make sure they are used properly.
- Do not mix batteries of different makes, capacities, sizes, or types.
- Store the Li-ion battery in a clean, dry place.
- Take care of the Li-ion Battery as described in this manual.
- Retain the original product documentation for future reference.

1.2. Precaution for transportation

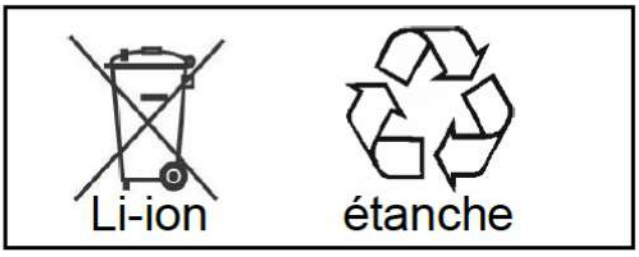


The PowerBrick® battery must be transported in its original packaging or equivalent. Once the battery is in its packaging, use straps to secure the battery.

Batteries classified as UN3480, Class 9 and must be transported in accordance with the applicable regulations.
This means that for land or sea transport (ADR, RID and IMDG) they must be packed according to instructions P903. For air transport (IATA), instructions P965 apply.

1.3. Recycling Lithium-Ion batteries

Batteries marked with the recycling symbol must be assigned to a recognized recycling agency.
Once used, PowerBrick® products can be returned to an authorized recycler, whose list of collection points is available on the site :
http://www.corepile.fr/carte-des-points-de-collecte/
Do not mix batteries with household or industrial waste.



1.4. General safety precautions

- Li-ion batteries do not require liquid leveling. Never open the battery. Never add acid or distilled water.
- Do not expose the Li-ion battery to rain, snow, splashes, moisture, excessive pollution or condensation.
- Short circuit or reverse polarity can cause serious damage to the Li-ion battery, connected equipment and wiring. Fuses between the battery and equipment do not prevent damage caused by reverse polarity and the warranty does not apply.
- The connections and protection must be carried out in accordance with local regulations.

- Do not work on the Li-ion battery or installation if powered. Do not accept modifications to your installation unless they are made by qualified electricians.
- Check the wiring at least once a year. Defects such as slack in connections, damaged cables, etc. must be corrected immediately.

1.5. Use Wisely

The Li-ion battery is manufactured in accordance with the applicable technical and safety recommendations.

Use the Li-ion battery only under the following conditions:

- Correct technical conditions
- Protected from rain, condensation and dust.
- According to instructions and specifications specified in this manual

Use of the Li-ion battery under conditions other than those described above is considered improper. PowerTech Systems cannot be held responsible for any damage that may result.



WARNING
Never use the Li-ion battery in places where there is a potential hazard of gas, dust or flammable products.

1.6. Warranty Limitations

PowerTech Systems guarantees that the Li-ion battery has been manufactured according to the standards and specifications legally in force. Operation that does not comply with the instructions in this manual may damage the battery or alter its characteristics. In these cases, the warranty becomes null and void.

The warranty is limited to repair and/or replacement of the product. It does not cover the cost of installing or shipping faulty parts. Damage to the battery caused by overcharging or undercharging is not covered by the warranty.

The use of an external fuse is recommended.

PowerTech Systems accepts no responsibility for :

- Indirect damage resulting from the use of a Li-ion battery
- Possible errors in this manual and their consequences

2. PowerBrick® Product Overview

2.1. Introduction

This chapter describes the characteristics of the Li-ion PowerBrick® battery, which is a high capacity deep discharge battery. Compared to a lead-acid battery, the Li-ion battery has a weight saving of 70% and a lower volume for three times as many charging cycles.

One of the main advantages of the Li-ion battery is the availability of constant power at any charge level. The capacity of a lead-acid battery decreases at high discharge while the Li-ion battery retains 100% of its available power.

PowerBrick® Li-ion battery strengths:

- Deep discharge without noticeable effects on life cycle life
- No gas emission, no risk of self-ignition (Lithium Ferro phosphate technology)
- No memory effect
- No energy loss at high discharge levels (loss of Peukert)
- Fast charging times compared to lead-acid batteries
- 96% energy efficiency
- Cell management system to control charges and discharges and improve safety and performance.
- Integrated solid state relay.
- Reduced dimensions compared to a lead-acid battery.

The Li-ion PowerBrick® battery comes with an integrated Battery Management System (**BMS**) that controls each cell individually and monitors the operation of the pack.

Functions of the BMS system:

- Balancing the cells composing the battery
- Monitoring of pack tension and cell tension
- Monitoring of the current stored or delivered by the battery
- Secure with solid state relay (Solid State Relay) low power consumption
- Cut-off voltage

	PowerBrick® 12V	PowerBrick® 24V	PowerBrick® 48V
Low cut-off voltage	10.0V± 0.4V	20.0V± 0.8V	40.0V± 1.6V
High cut-off voltage	14.8V ± 0.1V	29.4V ± 0.2V	59.2 V ± 0.4V

2.2. Charging/ Discharge

Batteries must be charged with a compatible charger or a stabilized power supply delivering an accurate voltage (unless different value on the specification sheet) :

	PowerBrick® 12V	PowerBrick® 24V	PowerBrick® 48V
Charge voltage	14.4V ± 0.2V	28.8V ± 0.4V	57.6 V ± 0.8V

The recommended charge rate is 1/2 C, C being the capacity of the battery.
The charging must be carried out between 0°C and 60°C.

Regarding discharge, the maximum continuous or maximum discharge rate is specified in the product specifications.

Discharge can be carried out between -20°C and 60°C.

In case of a TOTAL DISCHARGE that has caused a BMS CUT-OFF, recharge the battery IMMEDIATELY. Never store the fully discharged battery.

2.3. Initial balancing

Before using the PowerBrick® for the first time, initial balancing is essential for correct use.

In order to ensure that the State of Charge is identical between the different PowerBrick® making up the final system, it is important to first connect all battery modules in parallel (see figure in chapter 2.4) and charge them up to 100%.

Then maintain charge voltage (see specification sheet, ie : 14.4V ± 0.2V for PowerBrick® 12V) at the system terminals for several hours so that the initial balancing of the cells can be done properly.

Deployment according to the desired configuration can then be performed.

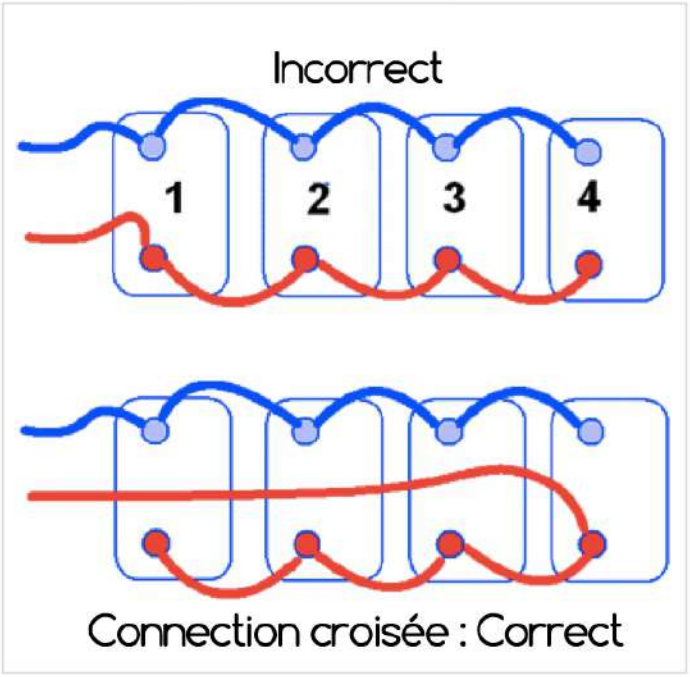
Make sure that only PowerBricks of the same capacity are connected in the same system.

2.4. Parallel Assembly

For a parallel set up, two kind of assembly are possible, according to the number of batteries to connect

- **« crossed connectivity » set-up**, This type of assembly is valid for 4 batteries in parallel maximum

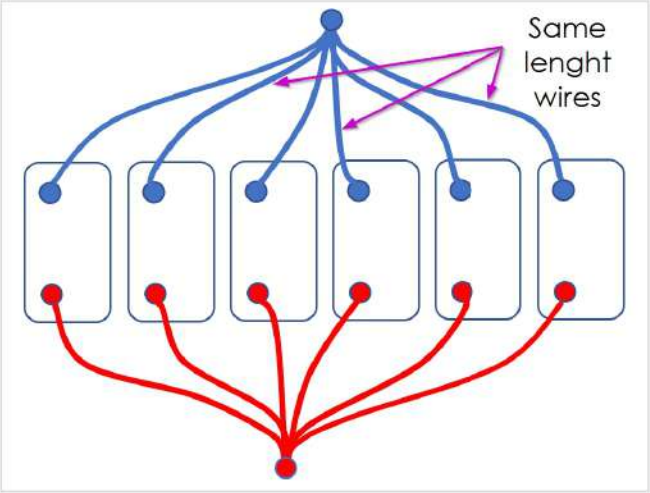
The assembly must be carried out according « Correct » schema (below), in order to make sure the batteries will be charged and discharged in a good balanced manner.



Crossed Connectivity (max 4 batteries in parallel)

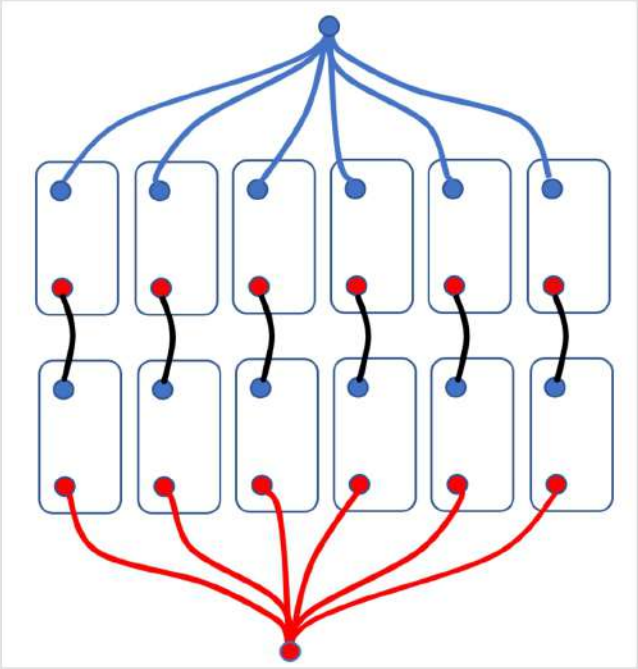
- **« Mesh assembly » assembly**, it is the **best** connection mode whatever the number of batteries to be assembled in parallel. This connection mode ensures a natural power distribution between each battery. It is all the more recommended when the charging and discharging currents of the batteries are high.

The connectors used to assemble the batteries must be of sufficient cross-section and identical length so that the ohmic resistance is identical between each connection.



Mesh Assembly

2.5. Parallel / Serial Assembly



Parallel / Serial Set-up with Mesh Assembly

2.6. Assembly in series

It is possible to assemble the batteries in series to increase the voltage of the pack. Although it is technically possible, we recommend that no more than 4 batteries be assembled in series.
Before carrying out this operation, an **initial balancing** of each battery must be carried out as detailed in chapter 2.3.

Although the batteries are balanced every charge cycle, it is possible that the batteries may become unbalanced over time. This is particularly the case if the recharging cycles are widely spaced in time or if the battery pack is used with high currents.

Imbalance of the batteries will result in a decrease in the battery pack's autonomy.

If this phenomenon is observed, there are two possible solutions to solve it:

1/ Carry out an initial balancing of the batteries making up the pack (see chapter 2.3).

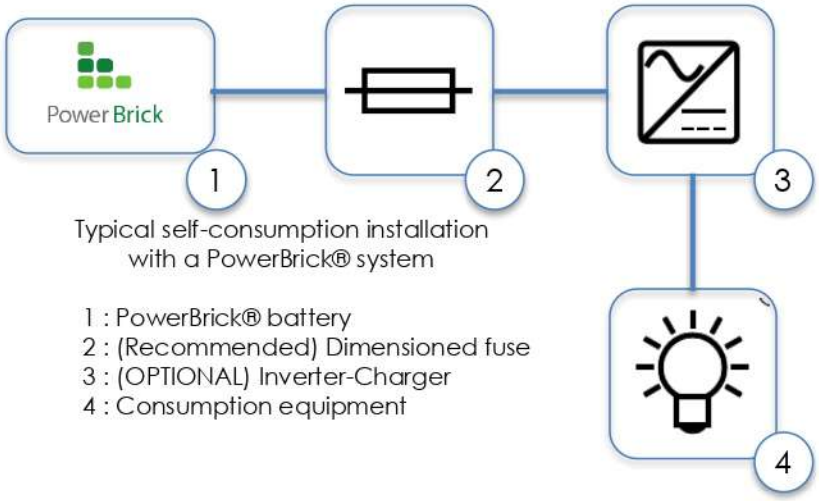
2/ Use an automatic balancing system to be added to the pack. Please contact PowerTech Systems for more information on this accessory.

2.7. Battery installation

The PowerBrick® batteries are designed around an assembly of sealed cells. There is no risk of electrolyte leak. The whole of the block cells and embarked electronics is firmly fixed in the battery casing.

All our batteries can be placed **in any positions** (tilted or lying).

2.8. External fuse protection



Typical self-consumption installation
with a PowerBrick® system

1 : PowerBrick® battery
2 : (Recommended) Dimensioned fuse
3 : (OPTIONAL) Inverter-Charger
4 : Consumption equipment

IMPORTANT
The installation of a protective fuse (2) is recommended to protect the battery..

The dimensioning of the fuse is determined in relation to the charge and discharge power of the installation (the maximum value) plus a factor of 1.5.

Example: An inverter-charger has a maximum charge current of 25A and 40A in discharge. The fuse must be dimensioned as follows :

Max(25A, 40A) = 40A
Fuse size: 40 x 1.5 = 60A.

SPECIAL NOTE: the fuse can be mounted independently on the positive or negative connector of the battery.

2.9. Short circuit protection

The integrated BMS coupled to the internal battery relay provides short-circuit protection.
This protection trips in less than 20 ms.
To reuse the battery, disconnect it completely. Check your electrical installation to remove this short circuit. Then you can reconnect it again.

2.10. In case of internal relay cut-off

The BMS integrated in the PowerBrick® battery is designed to protect it against deep discharge or overcharge voltage, cell and BMS over temperature (+70°C) or charging or discharge over current.

When the BMS detects an anomaly, the solid state relay (SSR) will cut-off and isolate the battery from the rest of the system.

To automatically reset the relay, disconnect the **(-) NEGATIVE** battery pack power connector from the system.
Before reconnecting the battery, identify the cause of the relay cut-off. Once the system is in compliance with the battery usage specification, you can reconnect it.

In case of a TOTAL DISCHARGE that has caused a BMS CUT-OFF, recharge the battery IMMEDIATELY. Never store the fully discharged battery.

3. Maintenance

3.1. Battery maintenance

The Li-ion battery requires no special maintenance. Check your electrical installation regularly, at least once a year. Defects such as slack in connections, damaged or burnt cables, etc. must be corrected immediately.

Ensure that the battery is clean and free of moisture to prevent current leakage. If necessary, clean the battery with a soft, clean and dry cloth and protect it from all liquids, acids and/or abrasive brushes.

3.2. Storage / wintering

PowerBrick® battery shall be stored in a dry place. The self-discharge rate is less than 5% per month. This rate and the natural ageing of the battery increases with the ambient temperature.

If a Lithium-Ion battery remains unused for more than one month, we recommend:

- Full charge the battery before storage.
- Check the state of charge every three months and recharge if necessary.
- The battery should **never be completely discharged for more than 7 days**, otherwise the cell chemistry will deteriorate and shorten its life.



IMPORTANT

The on-board electronics (BMS) has a residual energy consumption to ensure its operation.

NEVER STORE FOR MORE THAN ONE WEEK A FULLY DISCHARGED BATTERY.