

# LiFePO<sub>4</sub> - BLUETOOTH-BATTERY 12 V

81410



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## WARRANTY

The warranty period is 36 months. Reimo reserves the right to rectify eventual defaults. The guarantee is excluded for all damages caused by faulty use or improper handling. **Liability limitations:** In no case Reimo will be reliable for collateral-, secondary- or indirect damages, costs, expenditure, missed benefits or missed earnings. The indicated sales price of the product is representing the equivalent value of Reimo's liability limitations.

## DISPOSAL

Electronic and electrical appliances, as well as batteries, contain materials, components and substances that can be harmful to yourself and the environment in the event that the waste materials (discarded electrical and electronic devices and batteries) are not handled correctly.

Electrical and electronic appliances, as well as batteries, are labelled as depicted with a crossed out dustbin. This symbol means that electrical and electronic appliances, as well as batteries, may not be discarded with the household trash, and must be disposed of separately.

As an end consumer it is your responsibility to dispose of dead batteries at the collection points provided. This ensures that the batteries will be recycled in accordance with applicable laws, with no impact on the environment.

Cities and municipalities have set up collection points where electrical and electronic appliances, as well as batteries are accepted at no charge for recycling; alternatively, arrangements can be made to have them picked up. Please contact your municipal authorities for more information.

## USE PRECAUTIONS

In order to operate and use the battery better, extend its service life, and avoid abnormality, please read the following instructions carefully before using the battery.

- Handle with care to avoid violent vibration.
- Do not immerse the battery and its accessories in water or other liquids. When the battery is not in use, it should be placed in a cool and dry environment at room temperature.
- Do not use and retain the battery near hot and high temperature sources, such as fire, heater, etc. Do not expose the lithium battery to fire, it may explode.
- Do not remove the battery pack housing without authorization of professional maintenance staff.
- Please select a special LiFePO4 battery charger to charge the battery, do not reverse the positive and negative terminal, and do not plug the battery into the power socket directly.
- Do not use metal or wire to connect the positive and negative terminal of the battery directly for short circuit.
- Do not knock, throw, tread the battery or pierce the battery with nails or other sharp tools.
- In case of battery damage, deformation, electrolyte leakage, smell and other abnormal phenomena, do not use the battery again, please contact the manufacturer or dealer for treatment.
- Without permission of the manufacturer or dealer, do not use the battery in series and parallel.

## TRANSPORTATION PRECAUTIONS

- The battery pack is suitable for automobile, train, airplane and other modes of transportation. But the sun, rain and severe vibration shall be avoided in the process of transportation.
- The battery pack shall be packed with insulating and shockproof materials, to avoid the damage of battery pack caused by bumps on the way.
- The terminal of the battery pack shall be upward, and shall not be placed upside down or sideways.
- The battery pack must be handled carefully during transportation, loading and unloading. Do not throw, to avoid collision.
- Do not press heavy objects on the battery pack during transportation, to avoid damage the battery pack by extrusion
- Do not mix with inflammable, explosive and sharp metal articles for transportation.

## INSTALLATION

- After unpacking, visually inspect the battery appearance to see if there is any collision damage during transportation.
- The battery installation area shall be well ventilated, away from water, combustible gas, corrosion agent and other dangerous goods, the installation environment shall meet the requirements of product specifications.
- Avoid placing on the side. Do not squeeze or tread.
- When the battery charging and discharging with same line, only need connect the charger or electrical equipment with the positive and negative terminal. Do not charge and discharge at the same time.

## MAINTENANCE

- Half electric storage, long-term power shortage will affect battery life. When the battery power is insufficient, it should be charged in time, which will be beneficial to prolong the battery life.
- If the battery is not used for a long time, it is recommended to charge it every three months.
- The battery shall be installed in a dry and clean environment with air circulation. To avoid the fire source and inflammable materials approaching and disconnecting the load (turn off the electric equipment) when charging.
- The best working environment temperature of the battery is 15 – 35°C. If the temperature is outside this range, it may have an impact on the performance of the battery. The visual representation is the change of battery capacity, or the change of equipment operation time, which is a normal phenomenon.

## CONFIGURATION OPTIONS

We don't recommend to connect several modules in series or parallel, we suggest single module usage. Please do not build battery banks!

## ATTENTION!

Do not connect the modules to battery modules of other chemistries or 12 V battery modules of different capacities. For example, do not connect a 12 V 100Ah LiFePO4 battery to a lead-acid 12 V 100Ah or a LiFePO4 12 V 20/60 Ah.

## ENVIRONMENTAL REGULATIONS

The battery pack is compliant with the following environment regulations:

- EU Directive 2002/95/EC for Restriction of Hazardous Substances (RoHS)
- EU Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators
- Management Methods for Controlling Pollution Caused by Electronic Information Products Regulation (China RoHS)

## LIFEPO4 BATTERY MODULES

The batteries leverages LiFePo4 for the following key advantages over lead-acid alternatives:

- Longer life in applications requiring repeated discharge and recharge cycles
- Higher power capability, both during discharge and subsequent recharge
- More energy during applications requiring four hours of runtime or less
- Greater degree of safety due to the fact that the batteries are continually monitored by an integral microprocessor

## CONFIGURATION AND OPERATION

This chapter discusses configuring, charging and discharging the batteries in the following sections:

- Terminology
- Configuration Options
- Integrated Module Protection

## TERMINOLOGY

This chapter discusses configuring and operating 12V LiFePO4 battery modules using the following terminology:

Terminology	Definition
Cell	Refers to an individual LiFePO4 cell that is the basis for the TI 12V/110 battery module.
Module or Battery Module	LiFePO4 battery module

## RELATIONSHIP BETWEEN CHARGE LIMITS AND TEMPERATURE

Due to the chemistry of lithium ion cells, the cells cannot accept as much charge current at lower temperatures without risking permanent loss of capacity. As the cell's temperature rises during the charging process, they can gradually accept higher currents.

## CHARGE RATE BY TEMPERATURE

Temperature (°C)	Charge rate
-20~ -10	< 0,1 C
0~ 10	< 0,2 C
10~ 25	< 0,3 C

Maximum recommended continuous charge rate is 0,2 C.

## INTEGRATED MODULE PROTECTION

The LiFePO4 battery module includes integrated protection circuitry to prevent the battery module from exceeding its voltage limits. The module's circuitry interrupts either charging or discharging current if the battery is in danger of exceeding upper or lower voltage or temperature limits.

### Over Voltage and Under Voltage

The modules circuitry continuously monitors cell voltage and can interrupt either charge or discharge current in the event that a cell's voltage exceeds safe operating limits. The over voltage and under voltage protection include software/hardware protection.

#### Over voltage

MOSFET are used to control and will turn OFF and interrupt the charge current when meet over voltage protection (The protection circuitry interrupts current if the voltage on any single cell rises above 3.9V.

For hardware protection: over voltage protection threshold is 3.9V, the over voltage protection recovers when voltage drops to 3.6V.

#### Under voltage

MOSFET are used to control and will turn OFF and interrupt the discharge current when meet under voltage protection (The protection circuitry interrupts current if the voltage on any single cell falls below 2.3V or 2.0V

#### Hardware protection:

During discharging, when any cell's voltage falls below 2.0 V, the discharge MOSFET turns OFF. Interrupt discharge current and under voltage protection will recover when voltage reaches to 2.5V.

**NOTE!**

Under-voltage protection creates an open circuit, removing voltage from the terminals. With a lead-acid battery, finding no voltage at the terminals often indicates the battery has reached the end of its life. With the LifePo4 module, low voltage at the terminals typically means the cell protection circuitry has interrupted current to protect the battery module. Simply connect the module to a charger to restore voltage to the terminals.

**OVER TEMPERATURE**

A battery module has one temperature sensor to measure every cell bank's temperature and one PCBA to measure MOSFET temperature.

- The ideal hardware over temperature protection threshold of cell is around +65°C
- The ideal hardware over temperature protection threshold of MOSFET is around +85°C

During charging and discharging, when any cell banks temperature >60°C, software over temperature protection appears, charge and discharges MOSFETS turn OFF. When any cell banks temperature <55°C, over temperature protection disappear, charge and discharges MOSFETS turn ON again.

When any cell banks temperature >65°C, hardware over temperature protection appear, charge and discharge MOSFETS turn OFF. When the temperature decreases to 55°C, the charge and discharge MOSFETS turn ON again.

**BALANCING**

Over time, the cells inside a battery pack diverge in both capacity and SOC. An advantage of the module is the circuitry continuously monitors the capacity and SOC of each individual cell and balances the battery module to ensure maximum capacity.



## TROUBLESHOOTING

The LiFePO4 battery module is an extremely reliable battery module that provides greater useful life than comparable 12V lead-acid batteries. Despite the high reliability, you may encounter situations where the battery module does not operate as expected. These situations are typically the result of misuse, abuse or a non-optimal operating or storage environment. This chapter details potential issues you may encounter with and the appropriate troubleshooting procedures.

### CHARGER TRIPS USING CC & CV

#### Problem

chargers trips when charging the battery module. This is due to the low impedance of the module creating a current inrush.

#### Solution

Reset the charger and try again.

### TERMINAL VOLTAGE ABSENT OR LOW

#### Problem

Using a multi-meter to check terminal voltage shows the terminal voltage is low. Possible causes for this problem are:

- The voltage of a cell within the module dropped below 2.3V, causing the microprocessor to enable under-voltage protection.
- The module overheated, causing the microprocessor to enable over-temperature protection.

#### Solution

To resolve situations where terminal voltage is absent or low:

1. Allow the battery to cool and then recheck terminal voltage.
2. Connect the battery to a charger to wake the battery and recover terminal voltage. Depending on the module's voltage and state of balance it may take up to 48 hours to completely charge and balance the module.

## **BATTERY RAPIDLY DEPLETES ENERGY BETWEEN CHARGES**

### **Problem**

The battery module rapidly depletes its energy between charging. Possible causes for this problem are:

- The battery pack is out-of-balance.
- The battery pack has reached the end of its useful service life.

### **Solution**

To resolve situations where the battery rapidly depletes its energy between charges:

1. Use a CC & CV charger for 48 hours to balance the battery packs cells.
2. Replace the battery pack.

## **BATTERY CURRENT DISAPPEARS WHEN CHARGING**

### **Problem**

Battery current disappears when charging. Possible causes for this problem are:

- The battery overheated, enabling over-temperature protection.
- The battery pack is out-of-balance.
- Charger voltage is too high.

### **Solution**

To resolve situations where current disappears when charging:

1. Allow the battery to cool.
2. Use a CC & CV charger for 48 hours to balance the battery packs cells.
3. Reduce charger voltage to 14.6V or less.

## **VOLTAGE DROPS ABRUPTLY**

### **Problem**

Battery voltage appears constant, then drops abruptly.

### **Solution**

This is normal for this product. Constant voltage throughout the battery's SOC ensures maximum usable life. Once the voltage of a cell within the module drops below 2.3V, the module's circuitry enables under-voltage protection, which creates an open circuit at the terminals.

## **APPENDIX A**

### **GLOSSARY**

This appendix contains the following sections:

### **TERMINOLOGY TABLE**

The following table describes the terminology used in this document.

**DEFINITIONS AND ACRONYMS**

Term/Acronym	Meaning
ACR	Alternating Current Resistance
Ah	Amp- Hour is a unit of measure of charge that can be stored or delivered to/from a battery.
Batterie / Akku	One or more cells which are electrically connected together by permanent means, including case, terminals and markings
BCM	Battery Control Module – The Battery Control Module is necessary to aggregate information from modules and communicate with the system the ESS resides in.
BMS	Battery Management System – The Battery Management System refer to the collection of electronics responsible for monitoring and controlling the ESS.
C-Rate	An electrical current corresponding to that which will fill or empty a cell in one hour.
CC	Constant Current – A method to charge or discharge a battery in which the current is held constant independent of the battery's terminal voltage.
CE	Consultants Europe – Tests and Certifies safe and compliant product operation in Europe.
Cell	A single encased electrochemical unit (one positive and one negative electrode) which exhibits a voltage differential across two terminals.
CID	Current Interrupt Device – A small device integrated into a cell designed to interrupt the flow of current through its terminal when too much pressure or current exists in the cell.
CV	Constant Voltage – A method to charge a battery in which the terminal voltage is held constant and the current is determined by the power path impedance or some active current limiting
DVT	Design Verification Testing
ESS	Energy Storage System
iSOC	Current based SOC algorithm
OCV	Open Circuit Voltage – voltage reading of a battery when there is no current going in or out of it.
vSOC	Voltage based SOC algorithm

**PRODUCT SPECIFICATION 81410 100AH/12.8V**

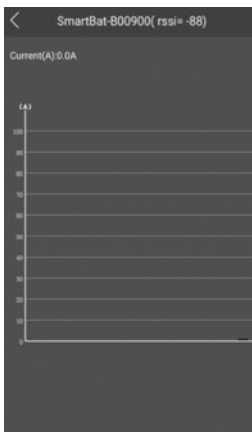
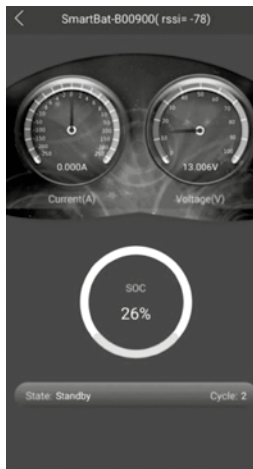
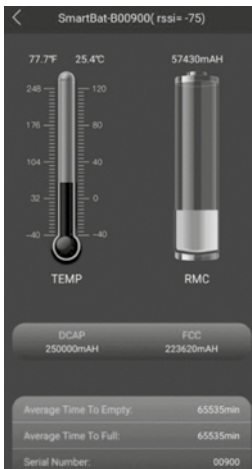
Electrical Characteristics	Nominal Voltage	12.8V
	Nominal Capacity	100Ah
	Energy	1200 Wh
	Cycle Life	2000 cycles@0.2C 100% DOD
Standard Charge	Charge current	20A
	Charge mode	0.2C5A constant current (CC) charge to 14.6V, then constant voltage (CV) 14.6V charge till charge current decline to $\leq 0.05 C5A$
	Charging cut-off voltage	14.6 $\pm$ 0.2V
Discharge	Continuous Current	80A
	Peak discharge Current	160A
	Discharge cut-off voltage	10V
Environmental	Operation Temperature Range	Charge: 0~45°C, Discharge: -20~60°C at 60 $\pm$ 25% R. H.
	Storage Temperature Range	0~45°C at 60 $\pm$ 25% R.H
	Plastic Case	ABS + PC
	Dimensions (mm/in)	307 x 168 x 211 mm
	Weight (kg/lbs)	13.5 Kg
	Terminal	M8

## BLUETOOTH FUNCTION

Before using this function, please install the app provided by our company on the mobile phone. This function can be used only after the successful installation.

Please download via app store: **“SmarTEC-BMS”**

- Turn on Bluetooth connection button of mobile phone
- Search for the corresponding Bluetooth number to the battery, and click »Connect« The Bluetooth number is marked on the battery housing.
- After successful connection, you can see the battery related information
- The Bluetooth interface is as below:



PRODUCT OUTLINE DRAWING





## SAFETY DATA SHEET

Safety Data Sheet according to Directive 1907/2006/EC, Article 31, Annex II, and TRGS 220 (Germany)

Product name: **LiFePO4 Battery 12V/100Ah**

Date of issue: 30 March, 2020

Date of last revision:

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### SECTION 1: Product and Company Identification

<i>Trade name:</i>	<b>LiFePO4 Battery 12V/100Ah</b>
<i>Product utilisation:</i>	Battery for living quarters in caravan trailers and mobile homes.
<i>Manufacturer/Supplier:</i>	<b>Reimo Reisemobil-Center GmbH</b> D-63329 Egelsbach, Boschring 10, Germany Ph.: +49 (0) 6103 4005-21 oder -22 Fax: +49 (0) 6150 8662 177 E-mail: service@reimo.com Internet: www.reimo.com
<i>Person in charge:</i>	Technical advice, ph.: +49 (0) 6103-4005-28 Fax: +49 (0) 6150 8662 177
<i>Emergency telephone code:</i>	+49 (0) 6201 989 956 (Mr. Volker Müller)

### SECTION 2: Hazards Identification

2.1 *Classification and labelling according to Regulation (EC) No 1272/2008 (Directive 1272/2008/EC)*

None.

2.2 *Information pertaining to particular dangers to man and the environment:*

No harmful effects on human health or on the environment are to be expected, if the product is used as specified and as long as the housing of the battery is tight.

Though, the product contains harmful ingredients, which are hermetically and impermeably sealed and will stay sealed upon foreseeable extraneous causes.

According to the UN 38.3 Manual of Tests and Criteria ST/SG/AC.10/11/Rev. 6, Amend 1, the product is tested for impermeability, for consistency against low pressure up to 116 hPa, for mechanical compression up to 13 kN, for temperature stability between -42°C to +72°C, for vibration stability between 7 Hz and 200 Hz, for shock stability up to 150 G (gravitational acceleration), for short circuit stability (0.1 Ω at 57°C +/- 4°C), for electrical excess charge at 22V, etc. (Test Report No. SZABB191226002-01 of Shenzhen Anbotek Compliance Laboratory Limited of 10 January, 2020).

There are considerable hazards for human health and for the environment (refer to SECTION 4, 11 and 12), if the ingredients are set free by fire, by exceptional extraneous causes, by targeted breakup of the housing (refer also to SECTION 7) or whatsoever.

Ion batteries are hazardous waste, and are to be disposed specifically (refer to SECTION 13).

Combustible, may explode when burning or overheating.

### SECTION 3: Composition / Information on Ingredients

3.1 <i>Characterization:</i>	Lithium ion battery on the basis of phosphoric acid, iron(2+) lithium salt (1:1:1) with copper and graphite as main components, electrolytes and two different polymers for the housings of the cells (polypropylene) and the battery (ABS rubber, refer also to SECTION 3.2). The battery consists of 20 cells. The ingredients are hermetically and impermeably sealed.
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**SAFETY DATA SHEET**

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**3.2 Ingredients:**

Substance	CAS No.	EINECS No.	Characterization	Mass%
Phosphoric acid, iron(2+) lithium salt (1:1:1) <sup>1)</sup> <i>Synonyms: Lithium iron(II) phosphate; ferrous lithium phosphate; Triphylite</i>	15365-14-7	604-917-2	Mixed phosphate	22.1 - 31
Aluminium, foil	7429-90-5	231-072-3	Metal	18 - 19.5
Graphite, powder	7782-42-5	231-955-3	Crystalline Carbon	13.3 - 17.7
Phosphate(1-), hexafluoro-, lithium (1:1) <i>Synonyms: Lithium hexafluorophosphate(1-); Phosphate(1-), hexafluoro-, lithium</i>	21324-40-3	244-334-7	Fluorinated lithium phosphate	8.9 - 13.3
ABS rubber housing	not applicable	not applicable	Copolymer acrylnitril/butadiene/styrene	11.8
Copper, foil	7440-50-8	231-159-6	Metal	6.2 - 11.5
Nickel plated sheet steel	not applicable	not applicable	with nickel coated steel	< 4.4
Polypropylene <i>Synonyms: 1-Propene, homopolymer; Propylene polymer</i>	9003-07-0	not existent	Polymer of propylene	< 4.4

<sup>1)</sup> Not classified according to ECHA Substance Information of 7 March, 2020 (most notifiers), <https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/91911>

This product does not contain substances of very high concern according to directive 1907/2006/EC, article 57.

**3.3 Hazardous ingredients:**

Classification of the **pure** ingredients according to Directive 1272/2008/EC (GHS), table 3

Common or chemical name:

**Phosphate(1-), hexafluoro-, lithium (1:1):**

Acute tox. (oral) 3 (Acute toxicity if ingested, Hazard Category 3): H301  
 Skin corrosion/irritation 1A, (Hazard Category 1A): H314  
 Eye Dam. 1, (Hazard Category 1): H318  
 STOT RE 1 [Specific organ toxicity (repeated exposure), Hazard Category 1]: H372



Signal word: "Danger"

H301: Toxic if swallowed.

H314: Causes severe skin burns and eye damage.

H318: Causes serious eye damage (not necessary for labelling)

H372: Causes damage to organs (bones, teeth) through prolonged or repeated exposure.



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 Classification according to ECHA Substance Information of 7 March, 2020,  
<https://echa.europa.eu/substance-information/-/substanceinfo/100.040.289>

**Nickel metal or nickel plated sheet steel are not classified.**  
**The following classification (Directive 1272/2008/EC (GHS), table 3) is only valid for nickel powder** (e. g. if the nickel is welded or grinded, refer to SECTION 8.2, Remarks):

Carc. 2 (Carcinogenicity, Category 2)



Signal word: „Danger“

H351: Suspected of causing cancer.

 STOT RE 1 [Specific target organ toxicity - (repeated exposure),  
 Category 1]

H372: Causes damage to organs through prolonged or repeated exposure.

Skin Sens. 1 (Skin Sensitization, Category 1)

H317: May cause an allergic skin reaction.

Aqu. chron. 3 (Chronic aquatic toxicity, Category 3)

H412: Harmful to aquatic life with long lasting effects (only if particle size &lt; 1 mm).

**SECTION 4: First Aid Measures**

*General information:* As long as the housing of the battery is tight no first aid measures are necessary.

If the housing of the battery is damaged and ingredients are leaking the following first aid measures are appropriate:

*Inhalation of aerosols or vapours:*

Move the affected person into fresh air. If symptoms persist give oxygen or artificial respiration and seek medical attention.

*Skin:*

Wash skin with plenty of water and soap. Change contaminated clothing. If symptoms persist seek medical attention.

*Eyes:*

Rinse with plenty of water for at least 15 minutes. If symptoms persist seek medical attention.

*Ingestion:*

If the patient is conscious have him rinse his mouth with water, spit it out and then have him drink water or milk. In case of persisting symptoms put him in a recovery position and - if the patient is conscious - let him vomit. Seek medical attention.

*Information for doctor:* None

**SECTION 5: Fire Fighting Measures**

*General information:* Most parts of the product are combustible including the housing (see also „Special hazards“ below).



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<i>Extinguishing agents:</i>	Carbon dioxide, foam, dry chemical. Use water spray only if the housing is tight and the battery is not loaded to prevent short circuit.
<i>Not suitable extinguishing agents for safety reasons:</i>	Water jet. Water in general, if the housing is damaged or the battery is loaded and is not protected against short circuit.
<i>Special hazards:</i>	In case of burning the battery might explode! In case of exposure above 80°C or in case of damage of the housing, the battery may leak or spout vaporized electrolytes or their decomposed products, such as very toxic fluorides and hydrofluoric acid, hydrocarbons, carbon monoxide and phosphorous oxides. The electrolytes are partly inflammable and may cause serious eye damage and severe skin burns by contact or by aerosols, and severe irritation of the respiratory tract by inhaling aerosols or by inhaling vapours specially when the product is burning.
<i>Special protective equipment for fire-fighters:</i>	Use self-contained breathing apparatus and protection clothes.
<i>Further notice:</i>	In case of fire in the surroundings immediately remove battery to a safe place or at least try to cool the battery, but take care of the possibility of a short circuit by water.
<b>SECTION 6: Accidental Measures after Release of Ingredients</b>	
<i>General information:</i>	Only if the battery is damaged and ingredients are set free or after a short circuit, accidental measures may be necessary.
<i>Personal precaution:</i>	Leave the endangered area immediately and warn co-workers. Ventilate the area until aerosols and vapours are gone before entering the area with protective clothing, chemical resistant gloves (refer to SECTION 8.3) and safety goggles with side shield. Otherwise use fine dust respirator (P3, identification colour: white) or a ventilated breathing hood.
<i>Environmental precaution:</i>	Do not let the ingredients enter surface water, groundwater or soil. Prevent large amounts of ingredients from entering the sewage system.
<i>Methods for cleaning up:</i>	Prevent generation of aerosols. Pack solid parts into container to be labelled. Take up liquids with liquid-adsorbent material (sand, clay, cat litter, etc.). Fill contaminated adsorbent material into container. Finally clean area with water and soap. Discharge contaminated material according to SECTION 13.
<b>SECTION 7: Handling and Storage</b>	
<i>Handling:</i>	Under no circumstances, do not open the housing, do not throw the battery into fire, prevent the battery from heating-up and from direct sunlight, do not cause short circuit. If the battery becomes hot (< 80°C), remove it to a safe place or at least try to cool the battery, but take care of the possibility of a short circuit by water, if the battery is loaded. If the battery is heated above 80°C leave the endangered area immediately and warn co-workers (refer to SECTION 5, „Special hazards“, and SECTION 6, „Personal precaution“). Prevent battery from exceeding vibrations.



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### Notes for prevention of fire and explosion:

Prevent battery from heat above 80°C, and prevent short circuit.

### Storage:

Store the battery separated from other materials at a dry, cool and well ventilated place between -20°C and 30°C and between 45% and 85% humidity. The higher the temperature of storage the sooner the loading capacity will drop. Charge the battery every 6 months to the amount specified by the manufacturer, even if the battery was not used. Prevent short circuit by covering the electrical poles with plastics. Do not store together with inflammable substances. Keep loaded and used batteries separated. German VCI-class of storage: 11 (combustible solids, TRGS 510).

## SECTION 8: Exposure Controls / Personal Protection

**8.1 Technical protection:** Opening of the housing of the battery should only be done by trained personnel. In this case use closed plant with exhaust. Otherwise use at least exhaust and monitor the occupational exposure limit. Avoid generation of aerosols.

**8.2 Ingredients with occupational exposure limit values, if ingredients of the battery are set free:**

### General Limit for Dusts

- |                           |   |
|---------------------------|---|
| - CAS No.:                | Not applicable.   |
| - Exposure limit value:   | 1.25 mg/m <sup>3</sup> alveolar dust or alveolar aerosols<br>10 mg/m <sup>3</sup> inhalable dust or aerosols  |
| - Short term limit value: | 2 (II)  |
| - Origin:                 | AGW   |
| - BLV:                    | Aluminium: 50 µg/g Creatinine in urine after long-term exposure and after working shift   |
| - Remarks:                | C (MAK-KOMMISSION, Germany)   |
| - Exposure limit value:   | 0,3 mg/m <sup>3</sup> alveolar dust or alveolar aerosols, not obligatory  |
| - Short term limit value: | 2 (II)  |
| - Origin:                 | Recommendation of the MAK-KOMMISSION, Germany   |
| - Note:                   | Employment medical examination is to be initiated, if contact of phosphate(1-), hexafluoro-, lithium (1:1) with skin cannot be excluded (GESTIS).<br>There are special exposure limit values for aerosols or dust of metallic nickel (0.006 mg/m <sup>3</sup> , TRGS 900, refer also to SECTION 3), and of metallic aluminium (1.5 mg/m <sup>3</sup> , MAK-Kommission of Germany, refer to GESTIS). This is only valid, if the metallic ingredients of nickel or aluminium are processed (e.g. welded or grinded) in a way that aerosols are generated. |
| - Year:                   | 2020  |

### Explanations:

- |        |   |
|--------|---|
| - AGW  | Exposure limit value (refer to TRGS 900, (Technical rules for hazardous substances), Germany, last revision: GMBI 2020, p. 199-200 [No. 9-10] of 13 March, 2020 |
| - BLV: | Biological Limit Value (refer to TRGS 903, Germany, last revision of 13 March, GMBI 2020, p. 200 [Nr. 9-10])  |



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*- Short term limit values:*

Exceeding factor X: Exposure may exceed the exposure limit value by the factor X for not longer than 15 minutes. 4 measurements at intervals of 1 hour.

Exceeding factor =X=: Exposure must never exceed the exposure limit value by more than the factor X (instantaneous value).

(I): Category I: substances for which the exposure limit value is based on local effects or sensitizing substances.

(II): Category II: substances effective by resorption.

H : Substances effective by resorption through skin

S = Sensitizing substance

Y, C (DFG): There is no teratogenic risk if the exposure limit value and the BLV are maintained.

*- Remarks::*

### 8.3 Personal Protection:

The following protection measures apply, if ingredients of the battery are set free:

*Respiratory protection:*

Use respiratory protection apparatus or ventilated breathing hood. If contact with hands cannot be avoided use protection gloves tested according to DIN EN 374. Seek advice from manufacturers of protection gloves. If gloves cannot be used for safety reasons (e. g. while working at rotating machines) use skin-protective barrier cream. Consult the company medical officer for the type of barrier cream to be used.

*Hand protection:*

Comment: In contrary to the European ordinance 1907/2006/EC (REACH), it is not sufficient to specify only the protective glove material. The break-through-times are dependent not only on the material but also on the manufacturing technique. It is therefore essential to consult the manufacturers of protective gloves. For the ingredients of the battery the following materials should be appropriate: for short-time contact (few minutes) rubber or plastic is sufficient, for long-time contact use gloves of nitrile/latex rubber - NBR (0.35 mm).

*Eye protection:*

Safety glasses with side shield.

*Skin protection:*

Use chemical resistant protective clothing if contamination of clothing cannot be avoided. Change contaminated clothing immediately.

*General protective measures:*

Avoid contact with eyes and skin. Do not inhale aerosols or vapours.

*Industrial hygiene:*

Wash hands or skin after contact immediately. Do not eat, drink, smoke or take snuff at work.

## SECTION 9: Physical and Chemical Properties

### 9.1 Appearance

*Physical state:* Solid.  
*Colour:* Silver.  
*Odour:* None.



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### 9.2 Relevant data for Safety and Health for the product:

Data which should be mentioned in this SECTION are not relevant for the product. Refer to SECTIONS 2, 6, 7, and 10 for safety-related information.

*Nominal Voltage:* 12 V  
*Loading capacity:* 100 Ah

### SECTION 10: Stability and Reactivity

*Thermal decomposition:* Danger of explosion above 130°C.

*Conditions to be avoided:* Heating above 70°C. Short circuit. Damage of the housing. Long-time storage under humid conditions.

*Substances to be avoided:* Strong oxidizing agents (halogenes, nitriles, hydrogen peroxide, perchloric acid, aqua regia, etc.), strong acids, strong lyes.

*Dangerous reactions:* Ingredients may form very toxic fluorides and hydrofluoric acid with strong acids.

*Hazardous decomposition products:* Very toxic fluorides and hydrofluoric acid, hydrocarbons, carbon monoxide and phosphorous oxides.

*Dangerous polymerisations:* None.

### SECTION 11: Toxicological Information

#### 11.1 Product

As long as the housing of the battery is tight and no ingredients are set free, no harmful effects on human health are to be expected.

The following information is valid for all ingredients:

*Sensitization:* Intense and repeated skin contact with nickel metall or nickel plated sheet steel may result in sensitization.

*Mutagenicity:* No mutagenic effects are known.

*Cancer:* No carcinogenic effects are known. All ingredients are not mentioned as carcinogenic in the lists of ACGIH, NIOSH, IARC or TRGS 905.

*Reproductive toxicity:* No toxic effects on reproduction are known.

*Toxic effects after repeated exposure (subacute to chronic toxicity):*

Refer to SECTION 11.2

*Practical experience:* There are no reports of symptoms of poisoning after handling the ingredients.

#### 11.2 Toxicological information on the pure ingredients:

##### 11.2.1 Phosphoric acid, iron(2+) lithium salt (1:1:1)

The toxicology of this substance is yet hardly investigated. There are no experimental animal data



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(refer to MSDS of Sigma-Aldrich Inc.). In analogy to iron (III) phosphate no noteworthy hazards to the human health are to be expected, because the substance is unsoluble and therefore is hardly resorbed in the body.

### 11.2.2 Graphite

*Toxikokinetics, metabolism and distribution:*

Resorption in the body is negligible.

*Acute toxicity:*

There are no LD<sub>50</sub>-values of animal experiments. There were no deaths of rats after injection of suspensions of graphite (HSDB).

*Practical experiences with occupational exposures of graphite (HSDB):*

*After inhalation:* Slight irritation of the respiratory tract.

*After skin contact:* No symptoms.

*After eye contact:* Physical irritation.

*After ingestion:* No experiences.

*Chronic toxicity:* Bronchitis and lung damage after repeated and prolonged inhalation.

### 11.2.3 Phosphate(1-), hexafluoro-, lithium (1:1)

*Toxikokinetics, metabolism and distribution:*

No information is available.

*Acute toxicity:*

LD<sub>50</sub> (female rat, oral): > 50 mg/kg (OECD guideline 423, Sigma-Aldrich)

*After inhalation:* Severe irritation of the respiratory tract.

*After skin contact:* Severe irritation up to chemical burn (test with artificial skin, Sigma-Aldrich).

*After eye contact:* Severe irritation, risk of serious, irreversible eye damage (rabbit, OECD guideline 405).

*After ingestion:* Toxic. Severe irritation of the oral cavity, of the oesophagus and the stomach.

*Sensitization:* No sensitizing effects were found. In-vitro-test with mouse: negative (OECD guideline 429, Sigma-Aldrich).

*Mutagenicity:* No mutagenic effects were found. Mutagenicity of germ cells: Ames-Test with salmonella typhimurium: negativ (Sigma-Aldrich).

*Cancer:* Refer to SECTION 11.1.

*Reproductive toxicity:* Refer to SECTION 11.1.

*Chronic toxicity:* After repeated and prolonged exposure hazardous to bones and teeth.

*Further information:* Fire or strong acids may set free fluorides and hydrofluoric acid, which cause severe health problems.



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### 11.2.4 All other ingredients

The toxicities of the remaining ingredients are negligible in comparison to the substances mentioned in this SECTION, specially because nickel, aluminium and copper are not powdery.

## SECTION 12: Ecological information

### 12.1 Product:

The product as delivered causes no environmental hazards in normal use. If the product is disposed into the environment the housing will leak after a long period of time or after outside impact, and the ingredients will finally end up in the environment. On behalf of the ingredients the product must be classified as highly water polluting (WGK 3) according to AwSV (Germany). But as long as the battery is in good order and is used as intended it is not water polluting (WGK 0), but must not put into water because of electrical short cut, which might destroy the battery and the ingredients are set free.

### 12.2 Information on the **pure** ingredients:

#### 12.2.1 Phosphoric acid, iron(2+) lithium salt (1:1:1)

**Ecotoxic effects:** Not biodegradable. On account of its sparing solubility in water no efficient ecotoxic effects are to be expected. Triphylin,  $\text{Li}(\text{Fe}, \text{Mn})[\text{PO}_4]$ , is a natural mineral, where the iron-II-ions of phosphoric acid, iron(2+) lithium salt (1:1:1) are partly replaced by manganese-II-ions.

**Ecotoxic data:** There are no experimental animal data.

**Biodegradation:** As an anorganic substance a potential of biodegradation is not expected.

**Abiotic degradation:** On a long term scale a transformation to lithium oxide and iron-III-phosphate is to be expected.

**WGK (Water Pollution**

**Category, Germany):** 1 (slightly water polluting) (classification by analogy to trilithium phosphate and to iron phosphite (both WGK 1).

#### 12.2.2 Aluminium

**Ecotoxic effects:** Not biodegradable. Aluminium is insoluble, but in acid soil (pH < 4.5) aluminium is slowly oxidised to soluble ions, which are toxic to water organisms.

**Ecotoxic data of dissolved aluminium ions:**

**Fish toxicity:**  $\text{LC}_{50}$ : 0.12 - 5.2 mg/l, median value: 1.55mg/l (GESTIS)

**Daphnia toxicity:** Daphnia magna: toxic above 136 mg/l (Merck)

**Algae toxicity:** Scenedesmus quadricauta: toxic above 1.5 mg/l (Merck)

**Further information:**

**WGK (Water Pollution**

**Category, Germany):** 0 (not water polluting) (BAnz. AT, identification no.: 1443)



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### 12.2.3 Graphite

**Ecotoxic effects:** Not biodegradable. As a natural substance no ecotoxic effects are to be expected.

**Ecotoxic data:** There are no experimental animal data.

**WGK (Water Pollution**

**Category,Germany):** 0 (not water polluting) (BAnz. AT, identification no.: 801)

### 12.2.4 Phosphate(1-), hexafluoro-, lithium (1:1)

**Ecotoxic effects:** No information is available.

**Ecotoxic data (Sigma-Aldrich):**

**Daphnia toxicity:** Daphnia magna: EC<sub>50</sub>: > 100 mg/l / 48 h (OECD guideline 202)

**Bacterial toxicity:** Pseudomonas putida: EC<sub>50</sub>: > 1,000 mg/l / 3 h (OECD guideline 209)

**Algae toxicity:** Pseudokirchneriella subcap.: EC<sub>50</sub>: > 100 mg/l / 76 h (OECD guideline 201)

**Further information:**

**WGK (Water Pollution**

**Category,Germany):** 2 (notedly water polluting), (BAnz. AT, identification no.: 9245)

### 12.2.5 Copper

**Ecotoxic effects:** Bioaccumulation is not to be expected. Metallic copper is mobilised below p<sub>H</sub> 2.8 by oxidation to water soluble copper ions, which are very mobile in water but not in soil, because copper ions are strongly adsorbed by solids (HSDB).

**Ecotoxic data (GESTIS, relevant for copper ions):**

**Fish toxicity:** LC<sub>50</sub>: 0.0087 - 21 mg/l / 96 h; median value: 0.665 mg/l / 96 h (114 studies)

**Crustacean toxicity:** LC<sub>50</sub>: 0.000072 - 5.36 mg/l / 48h; median value: 0.044 mg/l / 96 h (135 studies)

**Crustacean toxicity:** EC<sub>50</sub>: 0.0016 - 0.34 mg/l / 48 h; median value: 0.02 mg/l / 96 h (75 studies)

**Algae toxicity:** EC<sub>50</sub>: 0.01 -0.91 mg/l / 72 h; median value: 0.57 mg/l / 72 h (9 studies)

**Algae toxicity:** EC<sub>50</sub>: 0.04 -9.2 mg/l / 96 h; median value: 7.9 mg/l / 96 h (3 studies)

**WGK (Water Pollution**

**Category,Germany):** 0 (not water polluting) (BAnz. AT, identification no.: 1443)

### 12.2.6 All other ingredients

The remaining ingredients are polymers, which are hardly biodegradable and hardly ecotoxic because of their insolubility.

For all the remaining ingredients:

**WGK (Water Pollution**

**Category,Germany):** 0 (not water polluting) (BAnz. AT, identification no.: 766)

Do not allow the product to enter water supplies, waste water or soil (refer to SECTION 12.1 and 13.1).





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### SECTION 13: Disposal Considerations

**13.1 Product:** For disposal the product has not to be supervised. But before disposal the battery must be pretreated and the ingredients must be partly recovered (BattGDV or Directive 2006/66EG). The battery may be returned to the supplier or must be left over for a disposal company. It is not allowed to dispose the battery either as household waste nor as hazardous waste. This applies also, if the housing of the battery is damaged or/and part of the ingredients together with contaminated adsorbent and filter materials are collected in a container.

**Waste code:** 16 06 05  
**Waste name:** Other batteries and accumulators

**13.2 Batteries with damaged housing or the ingredients:**

**Waste code:** 16 06 06\*  
**Waste name:** Separately collected electrolyte from batteries and accumulators

\* : Hazardous waste must be supervised.

**13.3 Packing materials :**

- a) Packing materials made of plastics:  
**Waste code:** 15 01 02  
**Waste name:** Packing materials made of plastics
- b) Packing materials made of metal:  
**Waste code:** 15 01 04  
**Waste name:** Packing materials made of metal

Waste codes numbers and names in accordance with the European Waste Register Ordinance.

### SECTION 14: Transport Information

#### Transportation by land ADR/RID/GGVSE

ADR/RID/GGVSE Class: 9  
 UN No.: 3480  
 UN proper technical name: Lithium Ion Batteries  
 Hazard label: Class 9A Lithium Ion Batteries  
 Packaging group: II  
 Packing instruction: PI 910  
 Max. gross weight per package: 30 kg  
 Tunnel category: E  
 Classification code: M4 Lithium Battery  
 Limited quantity: LQ: 0.0

The special instructions SV 310 and SV 376 for transport of batteries with damaged housing, the special instructions SV 310 and SV 377 for the transport of batteries for disposal, and packing instructions PI 908 bzw. 909 are to be complied with.

#### Shipping by air ICAO-TI und IATA-DGR 61 edition of 7 Nov., 2019:

ICAO-TI und IATA-Class: 9  
 UN/ID No.: 3480

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IATA proper shipping name:	Lithium Ion Batteries
Marine Pollutant:	No
Hazard label:	Class 9A Lithium Battery
Packing instruction:	965 Part IA
Max. gross weight per package:	35 kg
Additional hazard label on outer case:	



Special instructions:	A88, A99, A154, A164, A182, A183, A185, A201, A206, A331
-----------------------	--

The transport with passenger aircrafts is for bidden. Batteries must not be damaged. The battery terminals must be protected against short circuit. The state of charge must not exceed 30% of each battery. The energy content (Wh) must be specified on the type plate. Note that the different airline companies request different terms for transportation (refer to Addendum 1 of IATA-DGR 61 edition 2019).

**Shipping by sea IMDG Sea:**

IMDG/GGVSee Class:	9
UN No.:	3480
Proper shipping name:	Lithium Ion Batteries
Hazard label (for packages):	Class 9A Lithium Ion Batteries
IMDG-Code:	38 - 16
EMS:	F-A, S-I
Packaging group:	II
Packing instruction:	PI 910
Max. gross weight per package:	30 kg
Marine Pollutant:	No

The special instructions SV 310 and SV 376 for transport of batteries with damaged housing and the special instructions SV 310 and SV 377 for the transport of batteries for disposal are to be complied with.

**SECTION 15: Regulatory Information**

Directive 1907/2006/EC of 18 Dec. 2006, last revision of 7 February, 2020  
 Ordinance (EC) No. 1272/2008 (GHS) of 16 Dec., 2008; last revision of 18 February, 2020

15.1.1 There are no safety reports according to 1907/2006/EC (REACH) available.

15.1.2 *Substances of very high concern (SVHC):*

This product does not contain substances of very high concern according to directive 1907/2006/EC, article 57a - 57f or annex XIV and XVII.

15.1.3 *Directive No. 850/2004/EC on (very) persistent organic pollutants and amending directive 79/117/EEC or directive 1907/2006/EC, article 57d + e or annex XIII:*

None of the ingredients are regulated.



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15.1.4	<i>Directive No. 1005/2009/EC on substances that deplete the ozone layer</i>	None of the ingredients are regulated (Last supplementation: Directive No. 2019/2079/EC of 27 Nov., 2019)
		All other relevant regulations are mentioned elsewhere in this Safety Data Sheet.
15.2	<i>Classification and Labelling:</i>	None (refer to SECTION 2)
15.3	<i>National Regulations, Germany:</i>	
15.3.1	<i>StörfallIV:</i>	Annex I, No. 1.1.2: lower threshold: 50 t; upper threshold: 200 t [applies only to Phosphate(1-), hexafluoro-, lithium (1:1)]
15.3.2	<i>TA-Luft:</i>	Clause 5.2.1 Total dust including fine dusts: max. mass concentration: 20 mg/m <sup>3</sup> or max. mass flow: 0,20 kg/h (at a max. mass concentration of 150 mg/m <sup>3</sup> ).
15.3.3	<i>VCI Storage Class:</i>	11 (combustible solids, TRGS 510)
15.3.4	<i>AwSV:</i>	Batteries with damaged housing are WGK 3 (highly water polluting, German Water Pollution Category 3), batteries in good order are WGK 0 (not water polluting, German Water Pollution Category 0), as long as damaging can be excluded, e. g. by traffic of staplers.
15.3.5	<i>Volatile components:</i>	None, VOC: 0
15.4	<i>Further regulations and restrictions:</i>	Occupational restrictions: Take note of Directive 94/33/EC on the protection of young people at work.

### SECTION 16: Other Information

#### Abbreviations:

ACGIH: American Conference of Governmental Industrial Hygienists

AwSV: Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen vom 18 April 2017 (ordinance about facilities for handling with substances hazardous to water of 18 April 2017)

BAnz. AT: Liste der wassergefährdenden Stoffe, veröffentlicht im Bundesanzeiger AT vom 10.08.2017 (list of water polluting substances, published in Bundesanzeiger AT of 8 Aug. 2017, last revision of 18 February, 2020)

BOD: Biochemical oxygen demand

ChemIDplus: Database of the United States National Library of Medicine

COD: Chemical oxygen demand

DFG: Deutsche Forschungsgemeinschaft (German Society for Research)

GMBI: Gemeinsames Ministerialblatt: Publication of all ministries of the Federal Republic of Germany  
Webb: gmbi-online.de

DNEL Derived No-Effect Level

DIN; DIN/ISO: German standard

DOC: Dissolved organic carbon

EN: European standard

EINECS: European Inventory of Existing Commercial Substances

GESTIS: Data base of Berufsgenossenschaftliches Institut für Arbeitsschutz, Germany

GMBI: Gemeinsames Ministerialblatt: Publication of all ministries of the Federal Republic of Germany  
Webb: gmbi-online.de

IARC: International Agency for Research on Cancer (World Health Organisation)

IRT: Inhalation risk test

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IUCLID: International Uniform Chemical Information Database  
LC<sub>50</sub>: Lethal Concentration for 50% of the tested animals  
LD<sub>50</sub>: Lethal Dose for 50% of the tested animals  
LOEC: Lowest Observed Effect Concentration  
MAK: Maximale Arbeitsplatzkonzentration (maximum concentration in the workplace, out of date)  
Merck, Sigma-Aldrich, etc.: Actual MSDS of Merck, Darmstadt, Germany, Sigma-Aldrich, Germany, etc.  
MITI: Ministry of International Trade and Industry, Japan  
MSDS: Material Safety Data Sheet  
NIOSH: National Institute for Occupational Safety and Health (USA)  
NOAEL: No Observed Adverse Effect Level  
NOEC: No Observed Effect Concentration  
NOEL: No Observed Effect Level  
OECD: Organisation for Economic Co-operation and Development  
OSHA: Occupational Safety and Health Administration (USA)  
PNEC: Predicted No-Effect Concentration  
RTECS: Register of Toxic Effects of Chemical Substances  
TG: Test-Guideline  
TOC: Total organic carbon  
TOD: Theoretical oxygen demand  
TRGS: Technische Regel für Gefahrstoffe (Technical rules for hazardous substances, Germany)  
TRK: Technische Richtkonzentration (technical concentration in the workplace to comply with [for cancerogenic substances], out of date)  
VCI: Verband der Chemischen Industrie e.V. (Chemical Industry Association, Germany)  
VOC: Volatile organic carbons  
WGK: Wassergefährdungsklasse (Water Pollution Category, Germany)

As of the date of issuance, we are providing available information relevant to the handling of this material in the workplace. All information contained herein is offered in good faith in the belief that it is accurate. This material safety data sheet shall not be deemed to constitute or imply any warranty of any kind. In the event of an adverse incident associated with this material, this safety data sheet is not intended as a substitute for consultation with appropriately trained personnel (refer to SECTION 1). Nor is this safety data sheet intended to be a substitute for any product literature which may accompany the finished product.





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