POWERBLOX

Swarm-enabled Solar Battery System
Installation and operating instructions

PBX-200 Pb
PBX-200 Li
PBX-200 Li/LE

EN
12-2022

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1 Introduction and General

1.1 Foreword

Thank you for choosing the PBX-200. We are sure that you will enjoy our innovative energy cube. We have spent several years developing the product to make it as easy as possible to use and to give you access to sustainable electricity even in places where there is no power outlet.

With the PBX-200 you can use solar energy in a simple, flexible and scalable way. No matter whether you use the PBX-200 as a single device, combined as a tower or even as a Power Wall of up to nine or more devices. Set no limits to your imagination and your energy projects. The swarming algorithm we have developed, on which the PBX-200 is based, makes off-grid and mini-grid energy projects easier than ever before.

Actually, no manual is needed for the "normal" use of the PBX-200. Set it up, plug in the solar module, switch it on, done. Nevertheless, the PBX-200 is an energy product that produces dangerous alternating current with a voltage of 230 V. In addition, unfavourable handling can considerably reduce its service life. To enable you to operate the PBX-200 safely for several years, we would ask you to study these instructions carefully. You can also visit our YouTube channel and watch short films about the essential steps.

Whatever you plan to do with your PBX-200: We wish you many sunny days and a high-energy time.

Best wishes,
Your

Alessandro Medici

CTO & Co-Founder

Frick, August 23, 2019

1.2 Contact details

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1.3 Explanation of symbols

Symbol	Description
⚠	Caution, Danger
⚡	Caution, risk of electric shock
ℹ	Important note
📖	Read instructions before using the product
🗑	WEEE marking Do not dispose of the product with household waste, but after valid disposal regulations for electronic waste.

1.4 General Safety Instructions

- This manual is an integral part of the PBX-200 product and is provided digitally on the Power-Blox AG website.
- Only install and use the PBX-200 after you have read and understood this document.
- Always carry out the measures described in this document in the order given.
- Keep this document for the lifetime of the PBX-200. Pass the document on to subsequent owners and users.
- Improper operation can reduce the yield of the solar system or damage system components.
- The PBX-200 must not be operated with a damaged housing.
- Put the PBX-200 out of operation immediately and disconnect it from the solar module and the mains /generator if one of the following components is damaged:
    - Device (visible damage, smoke development, infiltrated liquid, etc.)
    - Connected lines
    - Solar module
- Do not switch on the PBX-200 again before:
    - the device has been repaired by the dealer or manufacturer.

       - damaged lines or solar modules have been repaired by a qualified technician.

- Treat battery acid on skin or clothing immediately with soapy water and rinse with plenty of water. In case of injury, consult a doctor immediately.
- Battery acid in the eyes rinse immediately with plenty of water and consult a doctor.
- <u>Do not</u> open the electronics housing: **Danger to life! Warranty claim expires!**
- Never alter, remove or alter signs and markings applied by the factory.
- When using external devices that are not described in this document, the manufacturer's instructions must be read! Incorrectly connected devices can damage the PBX-200.
- The PBX-200 is not intended for:
  - Kids.
  - People with physical, sensory or mental impairments.
  - Persons who do not have sufficient experience and knowledge unless they have been instructed in the use of the device by a person responsible for their safety.
  - People with a pacemaker.
- Never operate the PBX-200 with safety-relevant devices.

2   Scope of delivery, transport and storage

2.1   Available versions

The product is available in several configurations:

1. With network and network-independent charging capability (PBX-200 Li, PBX-200 Pb)
                        OR
2. Only with mains-independent charging capability (PBX-200 Li/LE)

For details of the differences, see chapter 4.

2.2   Scope of delivery

▪   PBX-200 Pb, PBX-200 Li, or PBX-200 Li/LE
▪   Power cord
▪   Brief instructions

Optional accessories:

▪   Solar cable with MC-4 connectors and Neutrik powerCON plug
▪   Neutrik Plug powerCON
▪   Solar module
▪   Printed version «Installation and Operating Instructions» (also available online)

2.3   Storage and transport

If the PBX-200 is stored or not used for a long time, make sure that the PBX-200 is switched off via the main switch.

The PBX-200 must be stored fully charged in clean, dry, cool and frost-free rooms. Too high storage temperatures lead to increased self-discharge and premature aging. To prevent a deep discharge of the batteries and to achieve the longest possible battery life, the PBX-200 must be recharged regularly:

- PBX-200 Pb: fully recharge every 3-4 months
- PBX-200 Li: recharge to only about 50% every 6-7 months

Alternatively, a solar module can be connected to the PBX-200. When the solar module surface is exposed to sunlight, the battery of the PBX-200 charges even if the PBX-200 is switched off via the main switch.

To prevent damage to the product, a suitable transport device and the original transport packaging must be used when shipping or transporting the PBX-200. During transport, the PBX-200 must be properly secured to prevent damage and potentially dangerous malfunctions the PBX-200 and the battery.

When transporting the PBX-200 by car, truck, ship and plane, the respective applicable standards and regulations must be complied with.

3 Overview of the PBX-200

The two integrated AC sockets (1) on the top of the lid supply 230 V AC (alternating current). It is possible to connect commercially available devices directly via these sockets. The power of the PBX-200 should not be exceeded (for a single PBX-200: 200 W, short-term 400 W). Only one consumer device per socket is permitted.

Figure 1: PBX-200 front panel

Below the LED display (2) and next to the main switch (3), the PBX-200 provides two 5 V USB ports with up to 2.1 A (5). The additional 12 V car socket (4) to the left of the main switch supplies up to 3 A. Consumer devices with a total output of 36 W can be connected to (4) and (5).

Figure 2: Front connections and main switch

The extensive range of electrical connections is located on the back of the PBX-200. A solar module can be connected directly to the PBX-200 using an adapter cable (solar cable) at the solar input socket (8). If the solar module does not supply enough energy, for example on short winter days, the PBX-200 can also be connected and charged directly to a 230 V socket via the IEC socket (7). Two resettable miniature circuit breakers (13) protect the PBX-200 against overload. At the transfer sockets (6), further PBX-200s can be connected to a network via the transfer cable (9). A resettable miniature circuit breaker (12) protects the transfer lines/the swarm against overload. The transfer cable can be stowed in the cable ducts (10, 11). To prevent the PBX-200 from changing hands unintentionally, it can be chained via the anti-theft protection (15). There are additional terminal connections (16-19) under the cover (14).

Figure 3: PBX-200 rear panel

The terminal connections are another way of connecting the PBX-200 to a solar module (16) or an external 230 V power source (18). Several solar modules can be connected to the PBX-200 in parallel. The

total possible current must not exceed 8 A, otherwise the solar modules must be protected by a DC fuse. Only qualified electricians are allowed access to the terminal area. The installation flap (14) covers and protects the terminal connections. For safety reasons, the installation flap must be closed and screwed on both sides during operation.
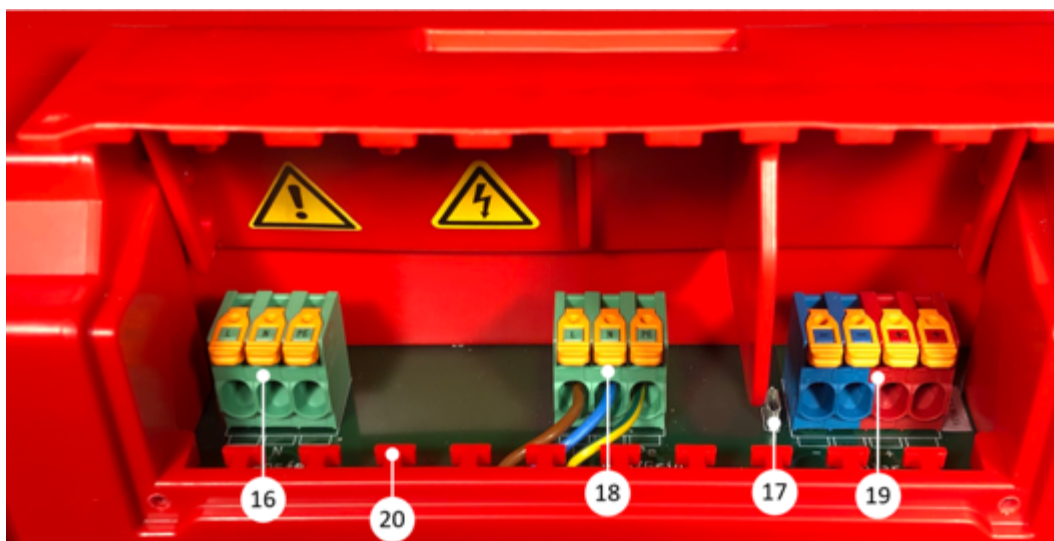
Figure 4: Terminal connections behind installation flap

Legend of components and connections

1   Alternating current socket, 230 V
2   LED display
3   Main switch
4   Cigarette lighter socket 12 V DC, 3 A
5   2 x USB connections 5V, 2.1 A
6   Sockets for transfer cable
7   Socket for mains/generator (input)
8   Solar socket for optional solar cable (input)
9   Transfer cable for connecting several PBX-200
10   Vertical cable duct
11   Horizontal cable ducts
12   Resettable circuit breaker (10 A) for transfer socket
13   Resettable circuit breaker (10 A) for mains/generator input
14   Installation flap for terminal connections
15   Anti-theft bolts
16   Terminal block Transfer connection
17   Micro-USB connection (for service work)
18   Terminal block for mains/generator input
19   Terminal block Solar connection
20   Strain relief web
21   Carrying handle

4 Properties and technical data

Input PV / Mppt (DC)	PBX-200 Pb	PBX-200 Li	PBX-200 Li/LE
Absolute maximum voltage ($V_{MAX\,PV}$)	45 V		
MPPT voltage range	30 V ... 45 V		
Maximum input DC power [1]	200 W		
Recommended input power [2]	250 W ... 500 W		
Maximum DC input current	8 A		
Maximum short current ($I_{SC\,PV}$) [2]	8 A		
Solar connection type	Neutrik powerCON TRUE1 inlet / terminals 0.2-6 mm^2		
Reverse polarity protection	Yes		

[1] Maximum power the MPPT can handle.
[2] If the solar module can generate a current higher than 8.0 A, an additional string fuse must be used.

Input Grid / Generator (AC)	PBX-200 Pb	PBX-200 Li	PBX-200 Li/LE
Input voltage range	220-240 V		–
Maximum input current	10 A		–
Grid frequency range	47 Hz ... 64 Hz		–
Grid connection	C14 socket / terminals 0.2-6 mm^2		–
Fuse	Resettable circuit breakers 10 A		–
Equipotential bonding	Screw M6 (only from the series 1707.x.xxx and higher installed)		

Input / Output Transfer (AC)	PBX-200 Pb	PBX-200 Li	PBX-200 Li/LE
Transfer voltage range	220-240 V		
Maximum transfer current	10 A		
Transfer frequency range	47 Hz ... 64 Hz		
Transfer cable	1.3 m cable with Neutrik powerCON Plug		
Transfer socket	Neutrik powerCON inlet / terminals 0.2-6 mm^2		
Fuse	Resettable circuit breakers 10 A		

Sockets output rating, mains operation (AC)	PBX-200 Pb	PBX-200 Li	PBX-200 Li/LE
Voltage range	220-240 V		–
Maximum continuous power [3]	2'125 VA		–
Maximum continuous current [4]	9.25 A		–
Frequency	47 Hz ... 64 Hz		–
Power factor range	0.1 ... 1		–
Amount	2		

[3] For each additional PBX-200 connected, the maximum continuous current decreases by 0.75 A.
[4] For each additional PBX-200 connected, the maximum continuous power decreases by 175 VA.

Sockets output ratings, standalone operation (AC)	PBX-200 Pb	PBX-200 Li	PBX-200 Li/LE
Voltage range		220-240 V	
Maximum continuous power per PBX-200 [5]		200 VA	
Maximum continuous current per PBX-200 [6]		0.87 A	
Frequency		47 Hz ... 64 Hz	
Power factor range		0.1 ... 1	
Amount		2	

[5] For each additional PBX-200 connected, the maximum continuous power increases by 200 VA.

[6] For each additional PBX-200 connected, the maximum continuous current increases by 0.87 A.

Car socket (DC)	PBX-200 Pb	PBX-200 Li	PBX-200 Li/LE
Voltage		12 V	
Maximum current		3 A	
Amount		1	
Total power (USB socket and car socket)		36 W	

USB sockets (DC)	PBX-200 Pb	PBX-200 Li	PBX-200 Li/LE
Voltage		5.0 V	
Maximum current		2 A	
Amount		2	
Total power (USB socket and car socket)		36 W	

Inverter (AC)	PBX-200 Pb	PBX-200 Li	PBX-200 Li/LE
Continuous output voltage		220-240 V	
Continuous output power		200 VA	
Maximum output power for 3 seconds		400 VA	
Output frequency range		47 Hz ... 64 Hz	
Harmonic distortion		<4%	
Power factor range		0.1 ... 1	

Mains charge controller (AC)	PBX-200 Pb	PBX-200 Li	PBX-200 Li/LE
Charging characteristic	IUoU [7]	Li BMS [7]	–
Input voltage range		220-240 V	–
Maximum input power		175 VA	–
Maximum input current		0.75 A	–
Input frequency range		47 Hz ... 64 Hz	–

[7] IUoU = Multi-stage charging process for optimum charging of batteries. BMS = Battery Management System

Battery (DC)	PBX-200 Pb	PBX-200 Li	PBX-200 Li/LE
Integrated battery	2 x Hoppecke sun power VR M, 12 V 58Ah	2 x GreenLiFE 12 V, 50 AH oder 1 x Ronda 24V, 50AH	
Battery technology	Blei / AGM [8]	Lithium / LiFePO4 [9]	
Battery capacity	1'392 Wh	1'200 Wh	
Usable capacity	80%	90%	
Internal battery voltage	24V		
Expected lifetime	3 years ... 10 years	> 10 years	

[8] AGM = Absorbent Glass Mat, Electrolyte is bound in a fleece of glass fibers
[9] LiFePo4 = Lithium iron phosphate

Swarm connector	PBX-200 Pb	PBX-200 Li	PBX-200 Li/LE
Connecting multiple PBX-200	With integrated cable		
Maximum stacking tower height	3 units		
Maximum stacking / transfer capacity	9 units / 1.8 kW		

Certifications	PBX-200 Pb	PBX-200 Li	PBX-200 Li/LE
Electromagnetic compatibility (EMC)	IEC/EN55032, IEC/EN61000		
Safety standards	EC/EN62109-1, IEC62109-2		

Environmental conditions	PBX-200 Pb	PBX-200 Li	PBX-200 Li/LE
Ingress Protection Marking	IP20		
Relative humidity	95% non condensing		
Operating temperature [10]	-10 °C ... 45 °C [11]	-0 °C ... 50 °C [12]	
Ventilation	Passive, no active cooling		
Maximum operating altitude	2'000 m.a.s.l.		
Warranty	2 years		

[10] All technical data refer to an ambient temperature of 25° C.
[11] The batteries age much faster if the operating temperature remains above 30°C.
[12] The batteries age much faster if the operating temperature remains above 45°C.

General data	PBX-200 Pb	PBX-200 Li	PBX-200 Li/LE
Weight	42 kg	22.0 kg	21.0 kg
Dimensions (W / H / D)	400 mm / 443 mm / 400 mm		

4.1 PBX-200 pictorial schematic
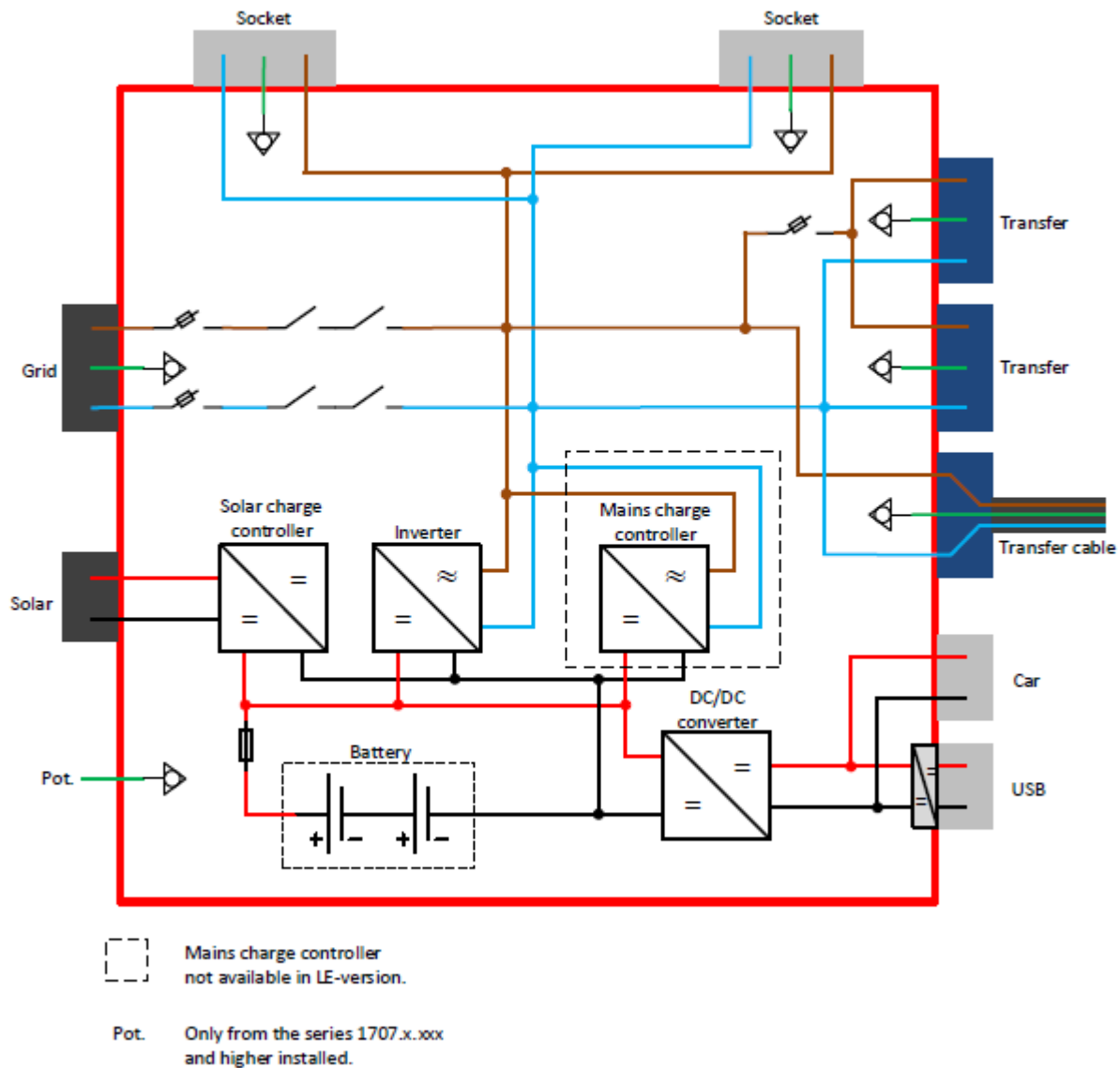
Figure 5: PBX-200 schematic diagram

5 Safety and accident prevention

5.1 Personnel

Only qualified electricians may service or repair the PBX-200.

Important note

Any installation of two or more PBX-200 units must always be performed by a qualified electrician.

A qualified electrician is a person with appropriate training and experience who can perceive risks and avoid dangers that can arise from electricity.
[IEC 60050-195:1998/AMD1:2001, 195-04/02]

5.2 Protection against electric shock

Despite the fail-safe design of the PBX-200, there are some rules that must be observed for safe operation:

Risk of electric shock

The PBX-200 may only be connected to a power supply network with at least one type A RCD of 30 mA or less.

The installation of two or more PBX-200 must be carried out by a qualified electrician. Connecting more than one device to an electrical installation consisting of more than one PBX-200 may require additional protection systems, such as insulation monitoring, which must also be installed by a qualified electrician.

Important note

Local and national laws and guidelines as well as applicable standards must be observed.

5.3 Information about the batteries

5.3.1 Approved battery types

The system may only be operated with the manufacturer's certified absorbent glass mat (AGM) or lithium-iron-phosphate-based (LiFePO4) batteries. The use of other battery models or battery types poses significant risks to human health and the environment! When used as intended and in accordance with the operating instructions, the batteries do not pose any hazard.

List of released battery types
- **Hoppecke: sun power VR M 12V, 58Ah**
- **GreenLiFE: Lithium-Ion battery 12V, 50 Ah**
- **Ronda: Lithium-Ion battery 24V, 50Ah**

Important note

Due to different charging settings, changing the battery type in the PBX-200 requires a special firmware configuration. The same battery types must always be used within the PBX-200.

Danger

NEVER use AGM or LiFePO4 batteries other than those approved by the manufacturer. The use of other battery types can lead to serious accidents with fire or even explosions and fatal injuries!

Depending on the type of battery used, the compositions and properties vary. Detailed information on physical, chemical and toxicological properties of the batteries can be found on the battery manufacturer's website and/or in the corresponding Material Safety Datasheet (MSDS).

Danger

Batteries must be used and handled with care. Do not short-circuit, damage mechanically, operate or store above or below the permitted temperature, do not burn or expose to open fire. Improper use can lead to overheating, smoke, fire and serious injury. In addition, the handling instructions and/or the safety data sheet of the battery manufacturer must be observed.

5.3.2 Protective equipment

Danger

Gases from lead-acid or lithium batteries are dangerous and/or potentially lethal. When opening the PBX-200 or working with/on the batteries, maintenance personnel must always wear the protective equipment recommended by the battery manufacturer for the specific battery type. This must be observed especially when handling damaged batteries! Detailed information can be found in the documentation and/or the safety data sheet from the battery manufacturer.

During normal operation of the PBX-200, it is not necessary to wear protective equipment.

5.3.3 Potential hazards of AGM lead-acid batteries (PBX-200 Pb)

Danger

Lead-acid batteries can release hydrogen and oxygen gases. This can result in an explosive gas mixture. The explosion of a hydrogen-oxygen gas mixture can cause fatal injuries.

Hydrogen and oxygen gases are produced during normal battery operation/charging. During overcharging, these gases leave the battery housing through a pressure relief valve.

To avoid the risk of fire or explosion, batteries must not be placed near ignition sources such as fire.

Danger

Lead-acid batteries contain sulphuric acid. Contact with leaked sulphuric acid or its gas can lead to severe skin burns, permanent damage to the eyes and/or lungs. Always wear suitable protective equipment when working with lead-acid batteries. Observe the handling instructions and the information on the battery manufacturer's safety data sheet.

5.3.4   First aid measures for AGM lead acid batteries (PBX-200 Pb)

Sulphuric acid:	Has a corrosive and tissue-destroying effect.
After skin contact	Rinse with water for at least 15 minutes, remove wetted clothing and wash.
After inhalation of acid mist [2]	Breathe fresh air.
After eye contact [2]	Rinse under running water for at least 15 minutes.
After swallowing [2]	Immediately drink plenty of water and take in activated carbon.
Leaded battery paste:	Is classified as toxic for reproduction.

[2] Consult a doctor immediately

5.3.5   Measures in case of accidental release of lead acid

Bind spilled acid with a binding agent, for example sand, and neutralize with lime, soda, or caustic soda. Then dispose of in accordance with official and local regulations.
If the spilled or escaped substance is in a closed room, ventilate the room well. Do not allow it to enter the sewerage system, soil or water. Detailed information can be found in the documentation and/or the safety data sheet provided online by the battery manufacturer.

5.3.6   Potential hazards of LiFePO4 batteries (PBX-200 Li)

LiFePO4 batteries are safe to use when properly handled under the parameters specified by the manufacturer. Incorrect handling or circumstances leading to improper operation may cause leaks and leakage of battery contents and decomposition products, resulting in severe reactions that are hazardous to health and the environment.

5.3.7   First aid measures for LiFePO4 batteries Electrolyte (PBX-200 Li)

After skin contact	Rinse with water for at least 15 minutes, remove wetted clothing and wash.
After inhalation	Breathe fresh air.
After eye contact	Rinse under running water for at least 15 minutes.
After swallowing	Rinse mouth and throat with water. Do not induce vomiting!

In all cases, consult a doctor immediately and, if necessary, contact the toxicological service.

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5.3.8 Measures in case of accidental release of LiFePO4 batteries Electrolyte

Electrolyte may leak if the battery casing is damaged. Batteries must be sealed airtight in a plastic bag. Dry sand, chalk powder (CaCO3) or vermiculite should be added if possible. Personal protective equipment adapted to the situation must be used (protective gloves, protective clothing, face protection, breathing protection). Detailed information can be found in the documentation and/or the safety data sheet provided online by the battery manufacturer.

5.4 In case of fire

5.4.1 General notes

1. Immediately contact the fire department or the local team responsible for this type of emergency.
2. The affected area must be evacuated, and it must be ensured that unauthorised persons cannot get near the fire. Elderly people or people who are otherwise unable to walk alone must be supported.
3. If possible, switch off the power supply and fight the fire.

5.4.2 Fire fighting measures for AGM lead-acid batteries (PBX-200 Pb)

Suitable extinguishing media:
For electrical fires in general, water and foam are suitable extinguishing agents. For incipient fires, extinguishing with CO2 is the most effective solution.

Unsuitable extinguishing media:
Extinguishing with powder extinguishers is not suitable, among other things because of the ineffectiveness, risk and possible collateral damage.

Special protective equipment:
For larger stationary battery systems or larger storage quantities: Eye, breathing and acid protection, as well as acid-proof clothing.

5.4.3 Fire fighting measures for LiFePO4 batteries (PBX-200 Li)

Suitable extinguishing media:
Cold water and dry powder can be used in large quantities.
Metal extinguishing powder or dry sand can be used if only a few cells are affected.

Unsuitable extinguishing media: Extinguishing media other than those specified above are ineffective.

Special protective equipment:
Wear self-contained breathing apparatus and protective suit.

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6   Installation and commissioning

Important note

Only the installation of the PBX-200 is described below. When installing external components (solar module, consumer device, cable) the relevant instructions must be followed.

6.1   General

Risk of electric shock

The electronics housing of the PBX-200 must not be opened.
The installation flap (14, chapter 3) must be closed and screwed down during operation.

Always carry out the following measures before working on the PBX-200:

1. Switch off the PBX-200 via the main switch.
2. Switch off all consumer devices and disconnect them from the PBX-200.
3. Disconnect the solar cable with solar module from the PBX-200.
4. Disconnect transfer cable connections (if any).
5. Open external fuses before the terminal inputs generator/mains and transfer and secure against reconnection.
6. Check that the sockets on the PBX-200 are voltage-free.

Danger

- The PBX-200 may only be connected to other PBX-200s via the transfer cable or the transfer terminals when it is switched off.
- Adhere to technical data, the connection values of consumer devices and solar modules.
- When selecting the solar module, make sure that its open-circuit voltage at temperatures below 25 °C is higher than that specified on the type plate.
- Maximum open circuit voltage of the solar generator must not exceed 45 V.
- Secure cables that are clamped to the PBX-200 via the terminal strips with a strain relief.
- Connect only one conductor to each terminal.
- Lay the cable so that:
    — connections cannot become loose accidentally.
    — persons cannot step on or trip over it.
    — fire protection equipment is not affected.

- Comply with all applicable installation regulations and standards, national laws and the connection values of the regional power supply company.

Important note

- The PBX-200 must be fully charged the first time it is used. This causes the charge level indicator to be calibrated.

6.2 Site conditions

Important note

- Only set up and/or operate in dry places and in no environment with water, danger of flooding, rain or splashing water. If there is a risk of flooding, move the PBX-200 to a dry place in good time.

- The PBX-200 must not be operated in a dusty place with no or too little air exchange. The PBX-200 must not be covered during operation.

- The PBX-200 must not be exposed to direct sunlight for long periods during operation.

- The PBX-200 must not be installed in animal husbandry/breeding stables or equipment cabinets.

- The PBX-200 must not be installed near open fires, stoves or other heat sources.

- The PBX-200 must not be installed near flammable gases or liquids.

- The floor and surroundings of the PBX-200 must be dry, stable, even, flame-resistant and not permanently vibrating.

- The PBX-200 must not be installed in locations with strong winds or drafts.

- It must be ensured that the installation of the PBX-200 is properly secured against tipping over.

- No more than three PBX-200s may be stacked on top of each other.

- The PBX-200 must be protected from physical impact.

- The installation location of the PBX-200 must be out of the reach of animals/pets.

- The installation location of the PBX-200 must be out of the reach of children.

- It must be ensured that there is sufficient free space around the PBX-200. (See chapter 6.5.)

- The PBX-200 must be easily accessible and the LED display must be clearly visible.

- The PBX-200 Pb weighs about 51.4 kg (Li version 20.6 kg). Therefore, the device must be moved by at least two persons.

- Personal protective equipment (protective clothing, safety shoes, gloves) must always be worn when moving PBX-200.

- For trouble-free operation and possible warranty claims / guarantee, the maintenance rules described in chapter 8 "Maintenance" must be observed.

6.3 Connecting the solar module to the PBX-200

A solar cable is optionally available for the PBX-200 in different lengths with a MC4 plug/coupling on the primary side and a solar plug (Neutrik powerCON plug) on the secondary side. This solar cable can be plugged directly into the back of the PBX-200.
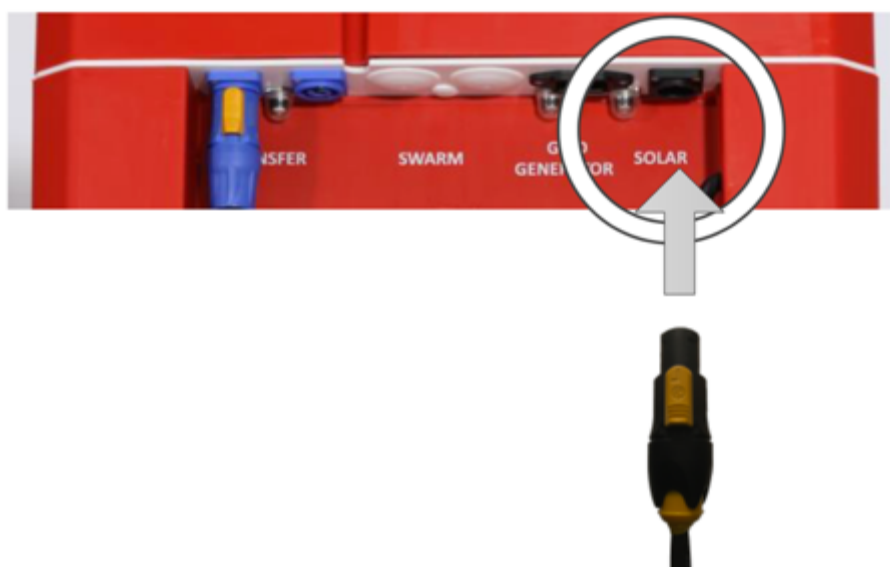

Figure 6: Connecting the solar module via solar cable on the back of the PBX-200

To connect the solar plug, it must be turned slightly to the left until it can be fully inserted into the socket. Then turn the solar plug back **until it snaps into place**.

Figure 7: Correct connection and locking of the solar connector

To release the solar plug, the yellow locking lever must be pulled down. Afterwards, the plug can be turned to the left and removed.

6.3.1   Plug mounting of the solar connection

The solar cable can also be disconnected from the plug for easier installation, e.g. to route the cable through a wall. In addition, the plug can also be purchased separately from specialist dealers. The plug is a Neutrik NAC3FX-W.

Alternatively, the solar cable can also be connected to the terminals (19) of the PBX-200. In this case the solar plug described above is not required.

If the solar plug is to be removed, proceed as follows:
1. Loosen the locking protection with a screwdriver (see Figure 8)
2. Turn the cap 360 degrees counterclockwise
3. Repeat steps one and two until the cap can be completely removed

Figure 8: Releasing the locking protection
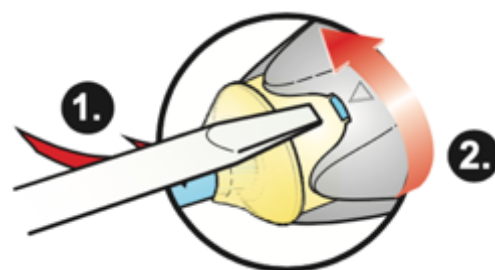
As soon as the cap is completely loosened, the connector part can be pushed back into the sleeve to make the cable terminals accessible. Using a Torx T8 screwdriver, the positive cable of the solar module at "L" as well as the negative cable at "N" can now be loosened and the connector can be separated from the cable.

Proceed as follows for reassembly after laying the cable:
1. Screw cap and sleeve together slightly (do not tighten completely)
2. Lead the cable through the yellow rubber end
3. Guide the white clamping piece over the cable
4. Insert positive solar cable into terminal "L" and tighten with Torx T8 screwdriver
5. Insert negative solar cable into terminal "N" and tighten with Torx T8 screwdriver
6. Insert plug part into sleeve and turn until nose fits into the groove. Then push it to the stop
7. Screw cap with sleeve, making sure that the white clamping part is correctly seated. If necessary, turn it until it fits completely into the sleeve
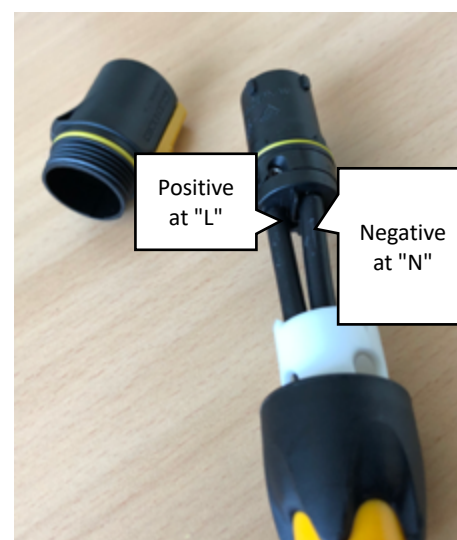
Figure 9: Polarity of the solar cable
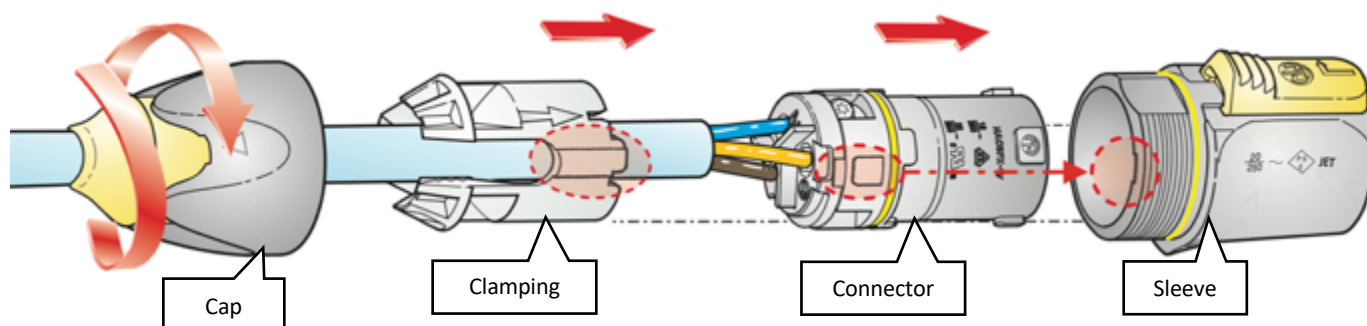
Figure 10: Mounting the solar connector

6.4 Coupling of PBX-200

The coupling of the individual PBX-200 is carried out by using the integrated transfer cable. This cable is about 1.7 m long and allows vertically stacked PBX-200s (power towers) or Power Walls (up to 3 power towers) to be connected. The blue transfer plug can be connected to any blue transfer socket of another PBX-200. The order of this connection is not important since all devices are connected in parallel. It must be ensured that the PBX-200 to be connected is switched off during the coupling process.

By coupling individual PBX-200 devices to form a complete system, several effects can be achieved:

- The performance of the overall system is increased.
- The memory of the combined system is increased.
- The daily energy yield from the sun is increased.
- The entire system can be charged by connecting a single PBX-200 to a mains/generator connection

The individual power elements can simply be added together in such a coupling:

1 PBX-200 = 200 W power, 1.2 kWh storage tank (Pb version 1'392 kWh), 200 W solar power

2 PBX-200 (coupled) = 400 W power, 2.4 kWh storage (Pb version 2'784 kWh), 400 W solar power

The adjacent figure (8) shows how two PBX-200s can be coupled together.

Before pairing the two PBX-200s, switch off at least one of the two units using the main switch. In general, always switch off the new PBX-200 to be added.

The transfer cable of the upper unit is now led through the cable duct and connected to one of the two transfer sockets of the lower unit.

After switching on the two PBX-200s, both PBX-200s synchronize and form a "swarm network". This process can take some time, but should be completed after two minutes at the latest and should not result in the entire LED display flashing. If a flashing is displayed after synchronization, switch off both PBX-200, wait ten seconds and switch them on again.

Figure 11: Two paired PBX-200s as "Power Tower

⚠️ **Danger**

No towers higher than three units may be formed. Each PBX-200 Pb weighs 51.4 kg (Li version 20.6 kg) and a high tower could fall and injure people. Higher towers are unstable and may easily tip over if they are not properly secured or if they are placed on unstable or sloping ground.

6.5 Minimum distances
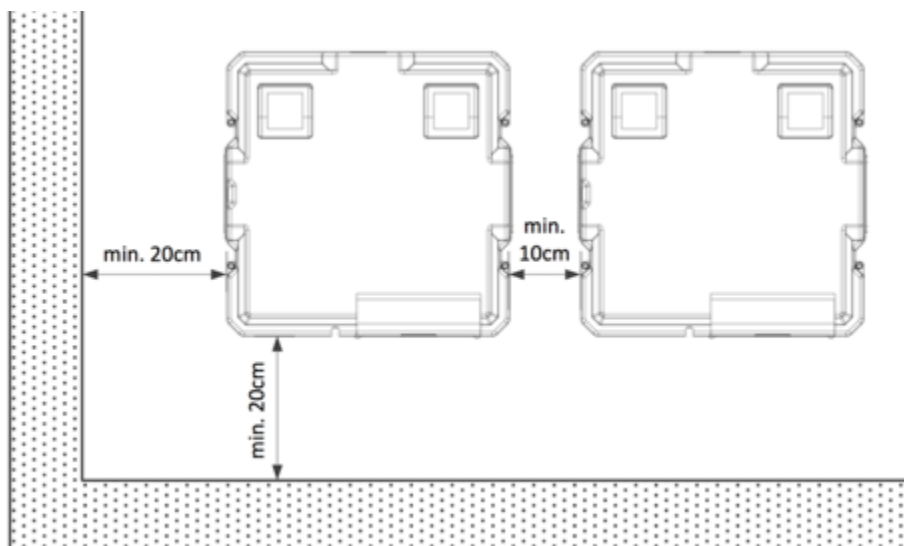
Figure 12: Recommended minimum distance between two PBX-200s and an adjacent wall

When placing multiple PBX-200 or Power towers next to each other, make sure there is a minimum distance of at least 10 cm between the units and at least 20 cm from an adjacent wall.

6.6 Interconnecting several towers to form a "Power Wall"

Several towers are connected in the same way as described in the previous chapter for coupling to a Power Wall. The transfer cable of the PBX-200 below is connected to the transfer socket of the neighbouring tower. All PBX-200s must be switched off.

Connected in this way, the system delivers the power of the entire system to one of the top sockets of a tower. In our example with nine PBX-200s, this results in 9 x 200 W = 1.8 kW power that can be tapped at the sockets. It must be noted that certain sockets are designed for a lower maximum power, depending on the national specification.

Figure 13: Connection of a "Power Wall"

6.7 Use of the connection terminals

> ⚠️ **Danger**
>
> Installations using the connection terminals may only be carried out by qualified electricians. Improper handling may result in danger to life through electric shock, destruction of individual components and/or fire!

All connections of the PBX-200 are alternatively available as terminals. In the following situations a connection to the terminals can be advantageous:
- Connection of a solar module with its own cable without a special solar plug.
- Connection of two PBX-200s or towers over a greater distance, for example between two buildings
- Connection of a generator with a self-made cable.
- Connection to the public power supply system with a self-made cable.
- Connection to a fuse box, e.g. to supply a building installation.

- Connection to a fuse box for coupling several Power-Walls to a large system.

Before installation on the terminals of the PBX-200:
- Switch off the PBX-200.
- Disconnect the power cable from the PBX-200.
- Disconnect the transfer cable from and to the PBX-200.
- Disconnect the solar cable from the PBX-200.
- Check that the sockets on the PBX-200 are voltage-free.

After these steps, the two securing screws (A) and (B) of the installation flap can be loosened with a Phillips screwdriver:

Figure 14: Locking screws of the installation flap

Now the terminal blocks for connecting external cables are visible. To keep the installation flap locked during the installation process, it can be slightly pressed down vertically when fully open (attachment point).

The flap can also be completely removed for better handling. To do this, press the left locking tab slightly to the side with your finger and unthread the flap.

After completion of the cabling, the flap must be inserted correctly, closed and secured with screws.

6.7.1   Connecting the terminal cables

The wires must be stripped 12 mm long. Then the wires can be pressed into the corresponding terminal opening as far as they will go.
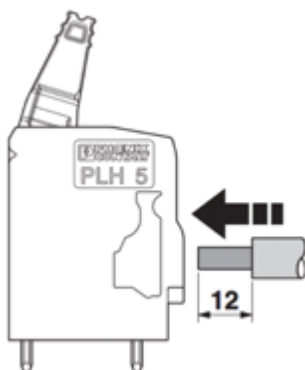
The terminals can then be closed:

When closing, make sure that the terminals are completely closed and that the clamp does not protrude:

After connection to the terminal block, the cable must be secured to the strain relief bar with a cable tie.

Figure 15: Securing the cable to the strain relief bar with a cable tie

Break-out tabs are provided in the installation cover of the PBX-200. These can be broken out at the required location using a side cutter or knife:

Figure 16: Break out the tab for the cable gland

After all installation work on the terminal blocks is completed, the installation cover must be closed and secured with the locking screws.

6.8 Interconnection types

The PBX-200 is modular and can therefore be interconnected in different ways. The types of interconnection listed in this manual are only examples. Prior to installation, it must be ensured that the relevant applicable laws and national regulations have been complied with and that all safety criteria have been observed.

6.8.1 Solar-powered PBX-200

Installing a single PBX-200 is straightforward. To do this, connect the solar module directly to the socket marked "SOLAR" (8) using the solar cable (accessory). Plug the consumer device into one of the sockets (1) and carry out the initial commissioning as described in Chapter 7.
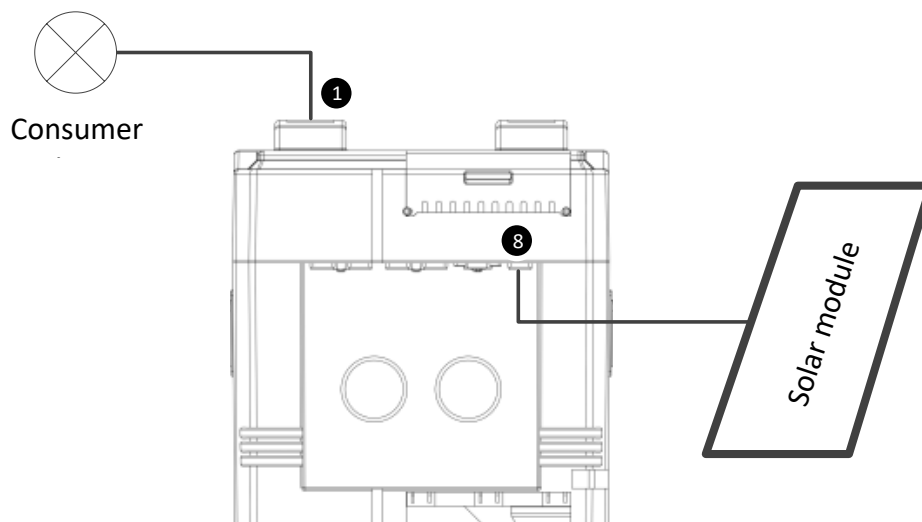

Figure 17: Solar-powered PBX-200 with consumer device

6.8.2 Solar and network operated PBX-200

It is also possible to operate a single PBX-200 with power from the solar module and from a 230 V socket. To do this the solar module cable must be connected to the rear connection (8) marked "SOLAR".
For connection to the domestic or public mains supply, the plug of the mains cable supplied must be inserted into the mains socket marked "GRID/GENERATOR" (7). Then simply connect the cable to the in-house power socket. After a few seconds, the PBX-200 will synchronise itself to the house internal network and start charging.
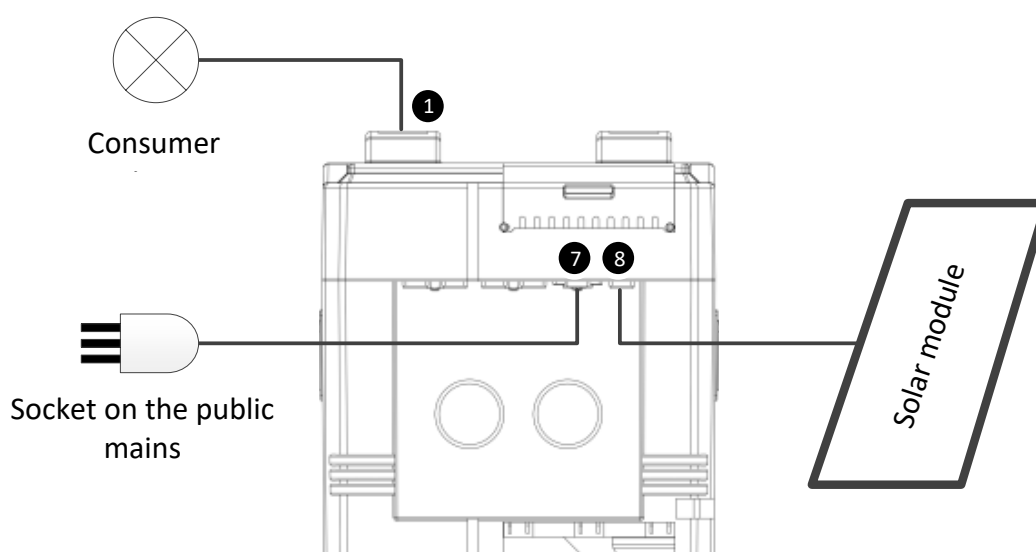

Figure 18: Solar and network operated PBX-200 with consumer device

With this type of connection it must be noted that solar power has priority over mains power. The PBX-200 will not draw power from the mains cable if there is sufficient charge.

6.8.3 Backup system

It is possible to use the PBX-200 as a battery-powered backup system in the event of a power failure. To do this, connect the supplied power cable to the rear socket (7). The sockets on the top of the PBX-200 can now be used to supply devices with power that is also available during a power failure.

The PBX-200 has no UPS (uninterruptible power supply) characteristics! In the event of a power failure, there may be a brief interruption in the power supply to the consumer devices until the PBX-200 has synchronized with the swarm network.
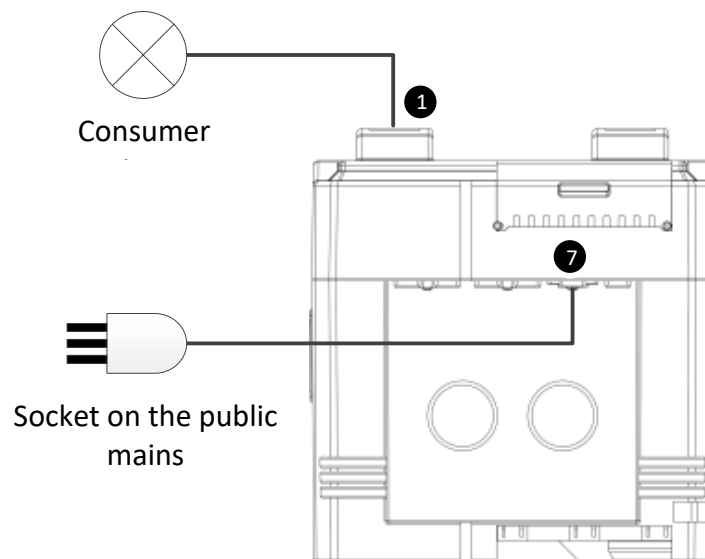
Figure 19: Backup system

6.8.4 Combined solar / grid system with connection to the terminal blocks

By using the terminal blocks, the solar system can also be set up using standard installation cables. The solar module can be connected via the terminal (19) and the public grid at the terminal (18).
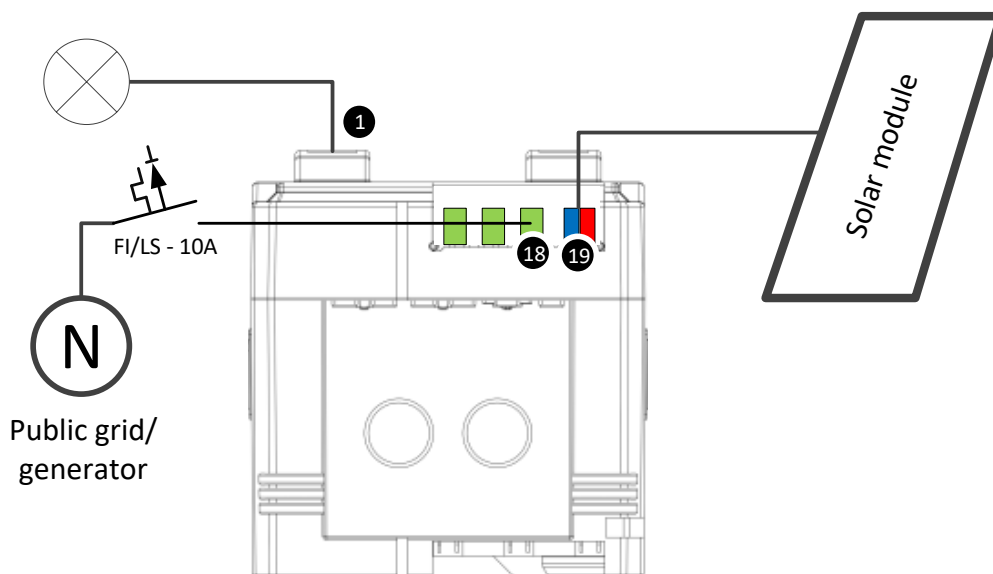
Figure 20: Individual PBX-200 with wiring via terminal blocks

> ⚠️ **Caution, risk of electric shock**
>
> Terminal (19) is connected to the network input of the PBX-200 by default. To avoid a dangerous mains voltage at the contacts of the mains socket (7), the pre-installed wires must be loosened and individually insulated with insulating tape. Only either the three wires of the power socket or an external cable may be connected to the terminals (18), but never both at the same time. No power cable may be plugged in during this work! It is not possible to feed power into the public mains either via the integrated sockets (1) or via the terminal connections.

6.9 Install PBX-200

6.9.1 Installation of a single PBX-200

1. Select the installation site in compliance with the above safety conditions as well as the necessary distances according to chapter 6.5.
2. Wipe/sweep the installation surface with a broom.
3. Set up PBX-200.
4. Mount the solar module at its destination using a suitable mounting bracket.
5. Lay the solar cable to the PBX-200 and connect it to the solar socket or terminal block.
6. If necessary, lay the transfer connection to the building distributor.

6.9.2 Installation of additional PBX-200s to a tower or Power Wall (maximum 9 units)

1. Install the first PBX-200 according to the previous chapter.
2. Set the second PBX-200 to the first PBX-200. The sockets must point in the same direction.
3. Place the third PBX-200 on the second PBX-200 and again observe the socket orientation.
4. Wire the tower according to the instructions in chapter 6.4.
5. Place the next PBX-200 next to the existing tower, again observing the minimum distances according to chapter 6.5.
6. Lead the free transfer cable from the first tower to the PBX-200 and connect it to a transfer socket.
7. Now continue with the next PBX-200 as described from step 2 until the maximum number of nine PBX-200s of the Power Wall is reached.
8. If necessary, lay the transfer connection to the building distributor.

> ℹ️ **Important note**
>
> If several PBX-200 are interconnected, each **PBX-200** must have **its own solar module.** Only in this way the PBX-200s can recharge during the day. Cross-charging via a solar module from device to device is not possible. An exception is charging via the network/generator. Here it is sufficient to connect a single PBX-200 to the network to cross-charge the remaining PBX-200s.

> ⚠️ **ATTENTION!**
>
> Any installation of two or more PBX-200s must always be carried out by a qualified electrician. An installation of two or more PBX-200s may require equipotential bonding. Whether equipotential bonding is required depends on the respective application and the standards and laws that apply in the country. The installation of equipotential bonding must be carried out by a qualified electrician.

6.9.3   Installation of power systems larger than nine PBX-200

1. Install several Power Walls according to the previous chapter.
2. Within the building distribution board, the individual Power Walls are each protected by a 10 A (type B) circuit breaker.

7 Operation

7.1 Important notes before commissioning

- The technical data of the connected devices must also be considered. The type plate of the solar module must be checked for compatibility with the PBX-200.
- When selecting the solar module, please note that its open-circuit voltage at temperatures below 25°C is higher than that specified on the type plate.

7.2 LED display

The LED display has several functions:

- Display of the battery charge status
- Showing the direction and strength of current flow
- Visualization, whether voltage is present at the output
- Display of various errors

7.2.1 Battery charge level indicator

During normal operation, the LEDs indicate the current charge level of the battery's usable energy. If the charge level falls to the safety minimum, the left LED starts flashing red and the inverter is switched off. Even if the display is orange or red, the PBX-200 still supplies energy. Only a flashing red LED indicates that the battery is completely discharged to the minimum level. This minimum level ensures that the battery is not damaged. However, it is recommended to recharge the battery as soon as possible.
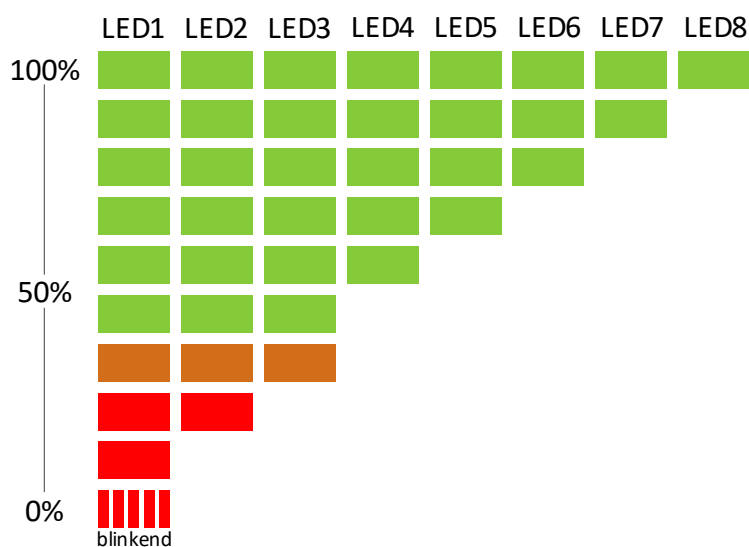
Figure 21: LED display charge level

It is preferable to always operate the PBX-200 in the green range. If you notice that the display regularly reaches the orange or red area, this indicates that the PBX-200 system is too small. If possible, add more PBX-200s to the system until the system is only operated in the green range. This guarantees you more energy security in bad weather conditions and a longer battery life.

Further information on optimum operation and battery conservation can be found in chapter 7.3.

7.2.2 Display of the battery status

During operation, the LED display shows a running light at regular intervals:

- from left to right: the battery is charging.
- from right to left: the battery is discharging.

If the charge level of the PBX-200 is indicated by two or less lit LEDs, the running light is no longer displayed.

7.2.3 Display during synchronization

When the PBX-200 synchronizes with its neighboring devices, it displays an orange chaser. This changes to green as soon as the synchronization is complete.

When synchronised to a mains or generator, the running light can remain stationary for a short time. This display behaviour is normal. Once the PBX-200 is synchronized to the grid, the battery charge status is displayed and the battery is charged if necessary.

7.2.4 Display on overheating

If the temperature of the battery or electronics rises too high during operation, the entire display flashes orange. The PBX-200 does not emit any energy in this operating mode.

The PBX-200 remains in this flashing mode for five minutes. After that it will try to return to normal operation. This is repeated continuously.

7.2.5 Display in case of fault

If an error occurs during operation, the entire display flashes red. The PBX-200 does not emit any energy in this operating mode.

The PBX-200 enters this operating mode when:
- too much load was connected.
- the inverter or the grid charge controller detects an undervoltage or overvoltage.
- the electronics are damaged. (Penetration of water, the solar module has a too high voltage, etc.)

The PBX-200 remains in this flashing mode for five minutes. After that it will try to return to normal operation. This is repeated continuously.

⚠️ **ATTENTION!**

A PBX-200 that has shut down due to an overload will automatically try to restart itself after a certain time! During repair work to rectify an overload situation, it is therefore essential to ensure that **all** PBX-200s in the system are switched off and that no unintentional automatic restart occurs!

7.3 Important aspects of handling batteries

Modern batteries are maintenance-free. However, there are some aspects to consider to ensure the longest possible and thus more ecological operation.

7.3.1 Lead-acid batteries (Type AGM)

When operating lead-acid batteries, avoid deep discharges. The PBX-200 system prevents deep discharges by switching off before a critically low level is reached. Operating the PBX-200 Pb in the green range (charge level 50%-100%) saves the battery. The lifetime of lead-acid batteries is also affected by the ambient temperature. In particular, temperatures above 35º Celsius should be avoided, as batteries age rapidly above this temperature. A good positioning of the PBX-200 Pb in a shady/cool place can significantly extend the battery life.

When wintering a Power Blox system, ensure that the batteries are maximally charged at temperatures below zero. When discharged, the electrolyte may freeze and the battery may crack. We recommend leaving the PBX-200 Pb with the solar module connected and switched off for the winter. The solar module also allows for recharging when the PBX-200 Pb is switched off, thus preventing damage to the battery in sub-zero temperatures.

It is absolutely necessary to provide adequate ventilation of the installation site of the PBX-200 Pb.

7.3.2 Li batteries (type LiFePO4)

When operating LiFePO4-based batteries, deep discharges must be avoided. This improves the battery life. The internal control of the PBX-200 Li prevents deep discharge by switching off before a critical discharge is reached.

Due to the internal charge regulator of the PBX-200 Li, the Li batteries are not charged at temperatures below 0° C. Below this temperature the Li batteries are only discharged. Detailed information on the temperature range of Li batteries can be found in chapter 4 and in the manual on the battery manufacturer's website.

To ensure the longest possible service life, it is also necessary to prevent the batteries from being operated for long periods of time at temperatures above 45 degrees. Too high temperatures reduce the service life of the batteries.

8 Maintenance

The PBX-200 is virtually maintenance-free. Nevertheless, it is recommended to keep the PBX-200 clean and to prevent clogging of the ventilation holes, for example by insects or dust and dirt. Furthermore, the solar module should be kept as clean as possible and free of dust, bird droppings and other impurities. Especially on very horizontally mounted solar modules, impurities can accumulate due to the lack of self-cleaning by rainwater run-off. In this case, the solar module must be cleaned regularly with tap or osmosis water.

All maintenance work may only be carried out by professionally trained persons and in accordance with the instructions and notes in this manual.

8.1 Cleaning the housing

Important note

Do not use harsh cleaning agents or solvents for cleaning. Clean the PBX-200 only with a damp cloth and a little soapy water. It must be ensured that no liquid enters the interior of the PBX-200 housing, especially not into the sockets, terminals, and electronics area.

For cleaning the ventilation openings of the boxes:
If possible, use a vacuum cleaner and remove the dirt cover or clogged holes. Alternatively, the surfaces and the vent holes can be cleaned with a soft brush.

Risk of electric shock

NEVER use pressurized water or a high-pressure cleaner to clean the PBX-200 housing! Penetrating water can destroy the electronics and cause a short circuit and/or electric shock. The PBX-200 must be switched off during all cleaning processes.

8.2 Battery

The batteries approved for PBX-200 operation do not require any maintenance during their lifetime. However, batteries are products of wear and tear and must be replaced from time to time. You can recognize the end of a battery's life by the fact that it charges, and discharges too quickly and thus no longer provides the capacity specified in the PBX-200 data sheet.

9 Repair and troubleshooting

In case of malfunction, please contact your local dealer.

Repair work may only be carried out by a service technician authorized by Power-Blox AG.

9.1 Troubleshooting

If the system is not working properly, you can proceed as described here.

9.1.1 General

→ Many sporadically occurring errors can be rectified by restarting the PBX-200. It is recommended to restart the PBX-200 first in case of errors:
- Switch off the PBX-200 via the main switch.
- Disconnect the solar module from the PBX-200 using the solar input connector on the PBX-200 or the solar connector on the solar module.
- After approx. 30 seconds you can switch the PBX-200 on again via the main switch.
- Connect the solar module to the PBX-200 again.

→ If these actions do not solve the problem, the PBX-200 should be checked by a certified Power-Blox service technician.

9.1.2 The LED display shows nothing

→ Check that the main switch is set to "I" (On).
- If it has just been switched on, wait 60 seconds.
- If no LED is still on after one minute, the battery charge level is probably so low, that the electronics cannot start up.
- Check that the cable between the PBX-200 and the solar module is correctly connected and that the connector is engaged.
- Make sure that the solar module:
  - is not shaded
  - no snow, leaves, etc. lie on it

→ Switch off the PBX-200 via the main switch.
- Have the PBX-200 charged via the solar module for at least one sunny day in the switched-off state.

→ If these actions do not solve the problem, the PBX-200 should be checked by a certified Power-Blox service technician.

9.1.3 No output voltage at the 230 V socket

→ Check that the main switch (3) is set to "I" (On).

→ Is the LED indicator lit?
- Only one red LED is lit or flashing.
  - The PBX-200 is discharged too deeply to be able to supply power.
  - Have the PBX-200 charged via the solar module for at least one sunny day or on the mains until at least six green LEDs light up again.
- Yes, several LEDs are lit.
  - Was there a 60 second wait after switching on the PBX-200?
  - The device requires a certain amount of time before power is available at the socket.

      o Plug the consumer appliance into the second socket and check whether the voltage is present there (switch on consumer appliance).

      o Was a too large load connected?

      o A PBX-200 delivers 200 W. If the load is too high, the output is switched off.

      o Disconnect the connected consumer device from the PBX-200.

→ If these actions do not solve the problem, the PBX-200 should be checked by a certified Power-Blox service technician.

9.1.4 The PBX-200 has a voltage at the sockets, but not full 230 V

→ At best, the attached load is too large.
- Remove the attached device and wait 60 seconds.
- Connect a device with less power to the PBX-200.

9.1.5 The PBX-200 does not charge, the battery indicator shows a falling charge level although the sun is shining

→ Check that the cable between the PBX-200 and the solar module is correctly connected and that the connector is engaged.

→ Make sure that the solar module:
- is not shaded
- no snow, leaves, etc. lie on it

→ Check the performance of the attached consumer equipment. If the load on the PBX-200 is greater than the energy from the solar module, the PBX-200 will discharge even in sunshine
- If necessary, reduce the number of attached devices to allow the PBX-200 to load.

9.1.6 The PBX-200 only supplies power in direct sunlight

→ Check whether the fuse of the battery is defective.
- How the fuse can be exposed can be read in chapter 10.1 under points 1-3.
- If the fuse is intact, the PBX-200 should be checked by a certified Power-Blox service technician.

9.1.7 The PBX-200 regularly goes into fault mode (whole display flashes red)

→ Check whether the performance of all connected consumer devices is higher than the total performance of the PBX-200.
- Many consumers (LED lamps, refrigerators, motors) have a much higher switch-on power than indicated on the type plate.

→ Disconnect all consumers from the PBX-200 and restart the PBX-200 as described in chapter 9.1.1. Note the LED display:
- The PBX-200 starts up and immediately falls back into fault mode.
- The PBX-200 should be checked by a Power-Blox service technician.

9.1.8 The PBX-200 is overheated (whole display flashes orange)

→ Check that the PBX-200 is installed in a well-ventilated and cool place.
  - Avoid direct sunlight on the PBX-200
→ Switch off the PBX-200 via the main switch and disconnect the connection to the solar module.
→ Let the PBX-200 cool down for a few minutes.
→ Switch on the PBX-200 via the main switch and connect the solar module to the PBX-200.
→ If these actions do not solve the problem, the PBX-200 should be checked by a certified Power-Blox service technician.

10 Return and disposal

10.1 Removing the battery

> ⚠️ **CAREFUL!**
>
> **Replacing batteries**
> The PBX-200 model can be operated either with lead batteries or with Li-Ion batteries. Batteries can be replaced, but only by a certified Power-Blox technician.
>
> The PBX-200 batteries may only be replaced with batteries certified and approved by Power-Blox AG. Untested third-party products may cause damage to the PBX-200 or fire.

Batteries are replaced as follows:

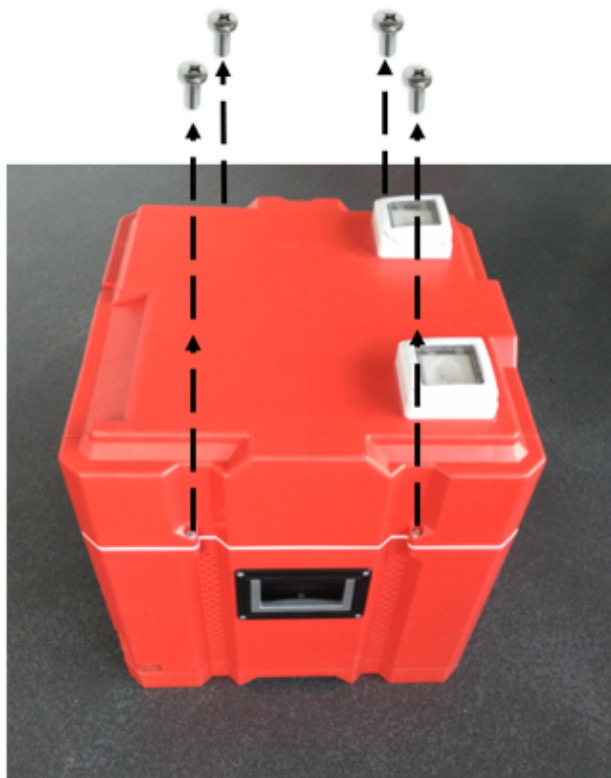1. Unscrew the four screws securing the cover with an S2 PH2 screwdriver (see illustration22).

Figure 22: Remove the cover of the PBX-200

2. Uncoil the transfer cable on the back of the PBX-200.

3. The lid can now be removed carefully. The same applies to the black damper element (see Figure 23). Please note the correct alignment of the damper element, as it is not symmetrical and prevents the assembly if inserted incorrectly.

Figure 23: Remove the buffer material

4. Remove the fuse by hand as shown in figure24.

Figure 24: Remove the fuse

5. Loosen the two screws on the battery terminals and remove the battery cable. (see Figure 25)

Figure 25: Loosening the screws from the battery cables

6. Use a screwdriver and carefully remove the temperature sensor as shown in Figure 26. Take care not to damage the battery or the battery sensor.

Figure 26: Remove the temperature sensor

7. Now the two screws of the safety cable can be loosened and the safety cable removed. (see Figure 27)

Figure 27: Disconnecting the safety cable

8. You can remove the old batteries by hand and insert the new batteries in the same place. Finally, steps 1 to 6 can be performed in reverse order to reassemble the PBX-200. Make sure that the fuse is put back in the fuse holder.

10.2 Disposal

Do not dispose of the device in household waste! Dispose of the device or used batteries at the collection point designated in your country or send the device to Power-Blox AG customer service at the end of its service life with the note "For disposal".

11 Disclaimer

Neither compliance with this manual nor the conditions and methods for installing, operating, using and maintaining the PBX-200 can be monitored by the manufacturer. Improper installation can cause damage to property and consequently endanger persons.

Therefore, the manufacturer accepts no responsibility or liability whatsoever for loss, damage or costs arising from or in any way connected with incorrect installation, incorrect performance of installation work, improper operation, and incorrect use and maintenance.

Likewise, we assume no responsibility for patent infringement or violation of other third party rights resulting from the use of the PBX-200.

The manufacturer reserves the right to make changes to the product, the technical data or the installation and operating instructions without prior notice.

12 Legal information

Please keep this documentation in a safe place so that it is available to all persons who carry out activities in connection with PBX-200. All information contained in this manual is the property of Power-Blox AG.

Copying or reproduction, in whole or in part, is only permitted with the prior written consent of Power-Blox AG.

The specifications contained in this document are subject to change without notice. All necessary precautions have been taken to ensure the accuracy of the information contained in this document. Our products are subject to continuous development. Therefore, there may be differences between the illustrations in this document and the product you have purchased.

Power-Blox AG is open to all improvement suggestions from our customers. Please send improvement suggestions to: support@power-blox.com.

For further information not contained in this manual, please visit our website (www.power-blox.com) or contact your local Power-Blox distributor.

13 EU Declaration of Conformity

POWERBLOX

EU DECLARATION OF CONFORMITY

Manufacturer's Name: **Power-Blox AG**	Certificate No.: 001-17-E
Address: Dammstrasse 3 CH-5070 Frick Switzerland	Issue No.: 1.6
Telephone: + 41 56 450 96 96 Mail: info@power-blox.ch	

EU Declaration of Conformity
Herewith we declare that the products designated below will meet the requirements of the relevant Directive(s).

Designation of Products:	Brand: POWER-BLOX Model: PBX-200 Pb… PBX-200 Li…
Relevant EC directive(s):	**2014/53/EU RADIO EQUIPMENT DIRECTIVE** 2014/35/EU LOW VOLTAGE DIRECTIVE (LVD) 2014/30/EU EMC DIRECTIVE
	2011/65/EU RoHS DIRECTIVE
Applied Standards:	EN 62109-1:2010, EN 62109-2:2011 CISPR 11 Ed. 6.0 2015, EN 55032 :2012 6.1
Serial Numbers:	1582.1.4 to 1999.9.9
CE marking date:	May 8, 2017
Name and Signature of Authorized Persons: Alessandro Medici - CEO	
Place and date of issue:	Frick, November 21, 2018

Dealers:

Street, no:

Postcode, place:

Land:

Phone:

E-mail:

website:

Notes

guy: ....

serial number   ....

MAC address: ....