# Manual

# Battery Storage Outdoor

# BSO MAX-Serie

## BSO MAX 90/188 | BSO MAX PRO 90/188


Version 1.4 (Nr. PS-20269)

January 2026

Version history

| Rev. | Date | Name | Amendment |
|---|---|---|---|
| 1.0 | 15.07.2025 | MFR | Release |
| 1.1 | 25.07.2025 | LHO | Company name, service contact |
| 1.2 | 01.09.2025 | PMO | Content and visual adjustments |
| 1.3 | 28.10.2025 | LHO | DNS-Server IP |
| 1.4 | 07.01.2026 | LHO | Revision of package insert, note on air inlet/outlet |

Note

This manual contains important safety instructions that must be observed during installation and maintenance of the device.

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Storage of the manual

The manual is included in the scope of delivery of the product and must be available at all times. The manual must always accompany the device, even if it is transferred to another user or another location.



The company PR Industrial S.r.l. reserves the right to final interpretation. This manual may be amended based on user or customer feedback. Please refer to our website at www.pramac.com about the latest version.

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Preface

Outline

Please read this manual carefully before installation, operation or maintenance. This manual contains important safety information and installation instructions that must be followed when installing and maintaining the device.

Scope of application

This manual describes the installation, electrical connections, commissioning, maintenance and troubleshooting of the outdoor battery storage system with the variants BSO MAX 90/188 and BSO MAX PRO 90/188.

Keep this manual in a place where it can be accessed at any time.

Target group

This manual is intended for qualified electrical engineers who are responsible for the installation, commissioning and maintenance of the Battery Storage Outdoor with all the necessary components, as well as for the operator of the Battery Storage Outdoor.

Symbols used

This manual contains information on safe operation and uses symbols to ensure the safety of persons and property. Please read the instructions and explanations of the symbols in the manual thoroughly before installing and operating the Battery Storage Outdoor. If you have any questions, please contact us immediately.PR Industrial S.r.l. to obtain advice and instructions.

**⚠ DANGER**

Danger indicates a warning that, if ignored, will result in immediate death or serious injury.

**⚠ WARNING**

Warning indicates a notice that, if ignored, could result in death or serious injury.

**⚠ CAUTION**

Caution indicates a dangerous situation which, if not avoided, could result in minor or moderate injury.

**NOTE**

The note indicates potential risks which, if not avoided, could result in device malfunctions or damage to property.

▶ REMARK

Remark contains tips that are valuable for optimal operation of the product.

Table of contents

# 1 Basic safety information

## 1.1 General safety instructions for handling the Battery Storage Outdoor

**⚠ DANGER**

Read the safety instructions in this manual carefully, as failure to do so may result in serious injury or death.

▶ REMARK

If you have any questions or problems, please read the following information and contact the PR Industrial S.r.l. contact.

**⚠ DANGER**

Batteries supply electricity and may explode or pose a fire hazard if short-circuited or installed incorrectly.

**⚠ DANGER**

Dangerous voltages are present at the battery terminals and cables. Contact with the cables and terminals can result in serious injury or death.

**⚠ WARNING**

Please do not open or modify the battery module.

**⚠ WARNING**

Wear suitable personal protective equipment (PPE) such as rubber gloves, steel-toe safety shoes and safety goggles when working on the battery.

**⚠ WARNING**

Temperature range for Battery Storage Outdoor BSO MAX 90/188 and BSO MAX PRO 90/188:

Permissible ambient temperature: -20 °C … +50 °C

Operate BSO MAX only within the environmental conditions described in the technical data to ensure proper long-term operation.

**⚠ CAUTION**

Improper settings or maintenance can permanently damage the battery.

**⚠ CAUTION**

Incorrect inverter parameters lead to premature ageing of the battery.

**NOTE**

Before installation and commissioning, please check the technical connection conditions with the responsible energy supply company and obtain approval.

## 1.2 Symbols

Explanation of symbols and notes (e.g. on the packaging or type plate of the BSO MAX):

| | |
|---|---|
|  | See also the external checklists, data sheets and operating instructions for the individual main components. |
|  | Danger!<br>Attention! |
|  | Caution, risk of electric shock! |
|   | There is residual voltage in the inverter!<br>Before opening the device, the operator should wait 2 minutes to ensure that the capacitors are completely discharged. |
|  | Do not place near flammable materials! |
|  | Caution, hot surface! |
|  | Beware of hand injuries! |
|  | The positive and negative terminals must not be reversed. |
|  | Do not place near open flames. |
|  | Do not place in areas accessible to children and pets. |
|  | Grounding point |

| | |
|---|---|
|  | LTE connection |
|  | This indicates the permissible temperature range. |
|  | Recycle-Etikett |
|  | Symbol for the Waste Electrical and Electronic Equipment Directive (WEEE) (2012/19/EU) |
|  | EU conformity mark (ConformitéEuropéenne) |
|  | UK conformity mark |
|   | TÜV Rheinland safety certificate |
|   | TÜV Rheinland safety certificate for the US and Canadian markets |
| + / - | Positive terminal / negative terminal of the input voltage (DC) |

The following symbols and notes are shown on the type plate of the battery inverter:

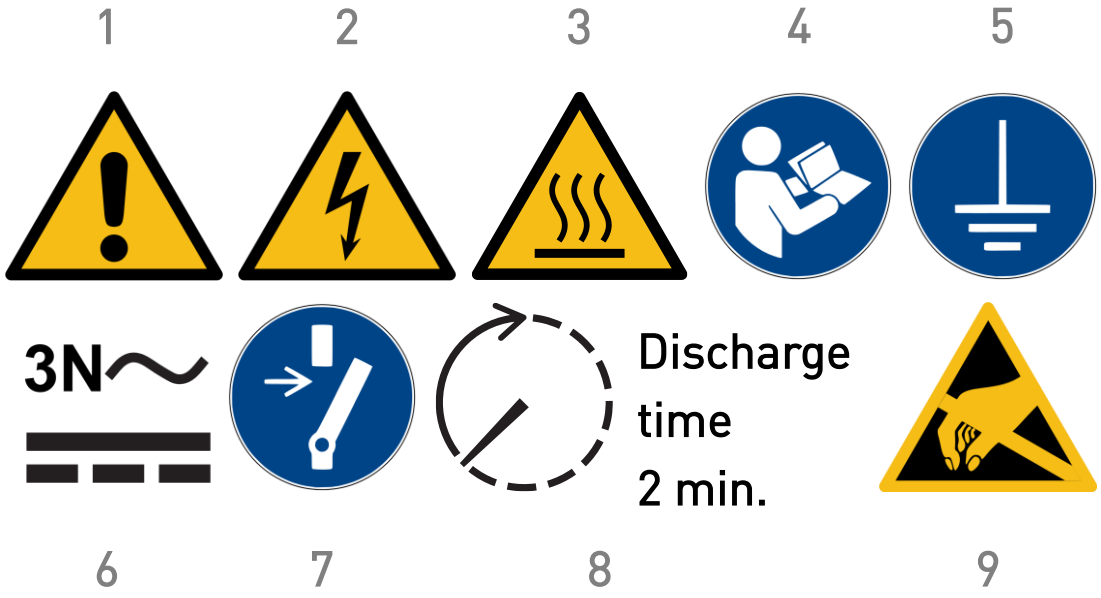



Figure 1-1: Battery inverter symbols

| Pos. | Description |
|---|---|
| 1 | General warning |
| 2 | Warning of electrical voltage |
| 3 | Warning of hot surface |
| 4 | Read the instructions before use. |
| 5 | Earthed before use |
| 6 | Warning of electrical voltage on the AC and DC sides.<br>All strands on the DC side are live. |
| 7 | Before maintenance or repair, ensure that the power supply is disconnected. |
| 8 | Discharge time two minutes |
| 9 | Warning about the device's susceptibility to electrostatic discharges |

### 1.3 Required tools

The following tools are required for the assembly, installation and repair of the BSO MAX:

| | | | |
|---|---|---|---|
|  | Side cutters |  | Cordless screwdriver with bit set |
|  | Cable ties |  | 1500 VDC insulated socket set |
|  | Screwdriver set |  | Multimeter<br>CAT III 1000 V |
| Additional equipment and tools are required to transport the BSO MAX:<br>• Crane with suitable lifting equipment<br>Alternativ:<br>• 3 t-forklift trucks including driver<br>• Forklift forks with a maximum height of 5 cm | | | |

**⚠ CAUTION**

Observe the 5 safety rules and only use properly insulated tools to avoid accidental electric shocks or short circuits.

### 1.4 Protective equipment

**⚠ WARNING**

When working with the BSO MAX, it is recommended that you follow the following Safety equipment to bear:

| | | | | | |
|---|---|---|---|---|---|
|  | Electrical insulating gloves |  | Safety goggles |  | Steel toe cap safety shoes |

**⚠ WARNING**

When installing and replacing battery modules, battery inverters or air conditioning units as a result of service and maintenance work, a second person with suitable tools must always be called in to assist.

## 1.5 Installation conditions

The Battery Storage Outdoor BSO MAX, available in the BSO MAX 90/188 and BSO MAX PRO 90/188 versions, is a lithium battery storage system with an integrated battery inverter. The components are manufactured in accordance with the latest technology and applicable product-specific standards.

The Battery Storage Outdoor BSO MAX is only approved for operation with the integrated Pramac battery inverter PBI 90K or PBI 90K-BU. Any other use must be agreed with the manufacturer and, if necessary, the local energy supplier.

**⚠ CAUTION**

- All available versions of the Battery Storage Outdoor BSO MAX may only be installed and operated outdoors.
- The operating temperature range and the Maximum permissible relative humidity can be found in the technical data.
- The BSO MAX must not be used in corrosive atmospheres (in accordance with ISO 12944). Corrosivity category C3– Urban and industrial environments with moderate sulphur dioxide pollution and not located near the sea).
- When installing the BSO MAX, ensure that the system is placed on a sufficiently dry, stable, horizontal and level surface. (inclination ≤ 0,5 %) is fastened.
- Once installed at its destination, the Battery Storage Outdoor must not be moved. The height of the installation site is max.3,000 m above sea level. Deviations from this are only permitted with the written approval of the manufacturer.
- Installation in close proximity to fire loads is prohibited.
- Furthermore, when installing in flood zones or topographical depressions, care must be taken to ensure that the outdoor battery storage unit is always raised and protected from contact with water.
- It must be ensured that no external mechanical overload can occur, e.g. vehicles driving into the structure or trees falling on it.
- The operator is obliged to include the Battery Storage Outdoor in their risk analysis in accordance with DIN EN 62305-2 in order to derive any necessary structural measures (e.g. impact protection/bollards, etc.).
- In addition, it must be ensured that the outdoor battery storage unit may only be opened by trained and instructed specialist personnel. The key may only be accessible to authorised persons. Tampering with the hardware and software is prohibited.
- It is recommended to construct solid walls or fences with a height of over 2.2 m around the energy storage area. The access points must be lockable.

**NOTE**

For the BSO MAX PRO 90/188 variant, the installation conditions for the Pramac Smart Transfer Switch (PSTS) accessory must also be observed.

**NOTE**

Proper use of the BSO MAX 90/188 and BSO MAX PRO 90/188 also includes compliance with the information in this manual.

▶ REMARK

- The built-in UPS battery must not be exposed to high ambient temperatures.
- The permissible storage and transport temperature range is between -20 °C and +40 °C.
- Latest commissioning due to the UPS battery after 6 months (at +20 °C).

**⚠ WARNING**

The use of the BSO MAX 90/188 and BSO MAX PRO 90/188 with PSTS is prohibited for the following purposes:

- Mobile deployment on land, in the air or on water
- For the use of medical devices
- As a UPS system
- Continuous operation with doors open

The battery modules must not be installed and operated in potentially explosive areas or in areas with high humidity.

**⚠ CAUTION**

In addition, the following points must be taken into account:

- Do not open, pierce or drop the battery cells or modules.
- Do not expose the battery cells or modules to high temperatures.
- Do not throw battery cells or modules into fire.
- In case of fire, use $CO_2$ fire extinguishers if the fire originates from the battery.
  In the event of a fire in the vicinity of the battery, an ABC fire extinguisher must be used.
- In the event of an accident, keep your distance; do not open the doors of the BSO MAX. These may only be opened by the local fire brigade after they have assessed the current condition of the BSO MAX. The released aerosol can result in toxic concentrations of NO, CO, $NH_3$.
- The fire brigade's fire hydrant connection must always be kept clear and must not be obstructed.
- Use of the fire hydrant is the responsibility of the local fire brigade.
- Do not use defective or damaged battery modules.

**NOTE**

The following regulations have been taken into account and must also be observed by the installer and operator:

- DGUV Regulation 3 – Electrical installations and equipment
- DIN VDE 0105-100 – Safe operation of electrical installations
- State building regulations
- VDE-AR-E 2510-50 – Stationary energy storage systems with lithium batteries – Safety requirements
- VDE-AR-E 2510-2 – Stationary electrical energy storage systems intended for connection to the low-voltage grid

**NOTE**

The following regulations and rules must be observed internationally:

- DIN EN 50110-1 – Operation of electrical installations - Part 1: General requirements
- DIN EN 50110-2 – Operation of electrical installations - Part 2: National annexes
- DIN IEC 60364-6 – Low voltage electrical installations - Part 6: Verification

Country-specific requirements for grid compatibility (e.g. VDE-AR-N 4105 (Germany)). The BSO MAX may only be connected to a supply network if the required network quality is met. In particular, compliance with the limit values for harmonic components and the maximum permissible voltage drop in the network supply line must be checked and confirmed in advance for the entire system.

**NOTE**

In installations with multiple parallel BSO MAX PRO units in backup mode, please note that there are limits to the connection cable lengths from the common AC distribution to the individual BSO MAX PRO units. To avoid AC voltage oscillations and shutdowns for self-protection and consumer protection, a maximum cable length of 50 m must be observed. We recommend sheathed cables to keep inductance as low as possible.

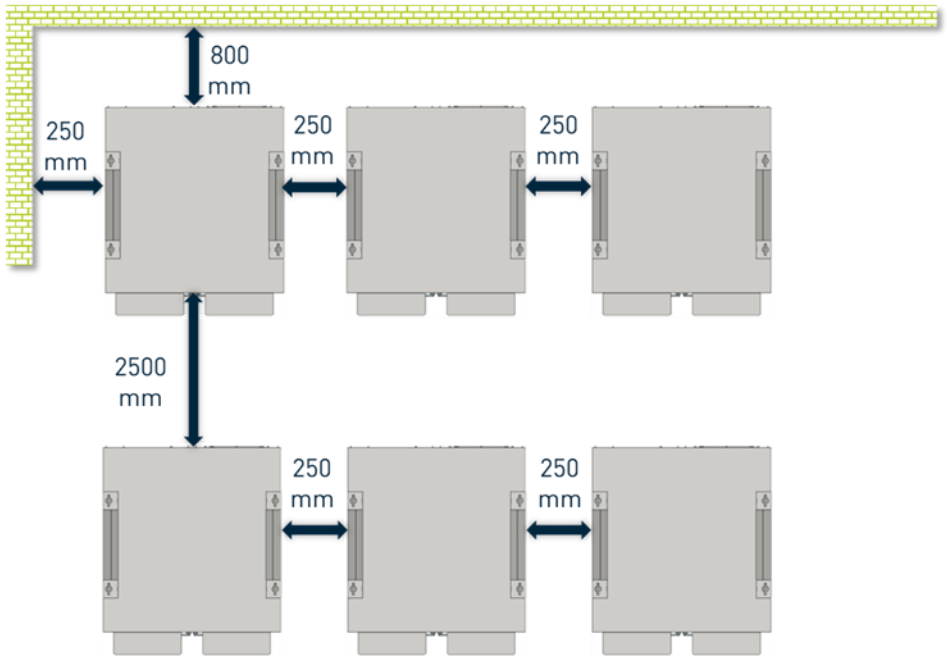



Figure 1-2: distances to be maintained

These distances are sufficient to ensure proper fresh air exchange and the necessary space for to ensure service quality.

**NOTE**

For the BSO MAX PRO 90/188 variant, the minimum distances for the Pramac Smart Transfer Switch (PSTS) accessory product must also be observed.

## 1.6 Checklist BEFORE commissioning

**NOTE**

- B2B Pre-Commissioning Checklist for BSO MAX Series
- B2B Pre-Commissioning Checklist for PSTS
- We recommend carefully reviewing the pre-commissioning checklist before commissioning. If you have any questions, please contact support.pramac.com. Items on the checklist that are not completed prior to commissioning and therefore result in additional effort during commissioning will be subsequently charged based on the time and waiting period involved.

Excerpt from B2B Pre-CommissioningCheckliste for BSO MAX series:

| ID | Examination | Description | Comment | Checked |
|---|---|---|---|---|
| 01 | Foundation constructed in accordance with current foundation plan. | | | ☐ |
| 02 | A foundation earth electrode is available for connection. | | | ☐ |
| 03 | AC main supply 3P/N/PE for TN-S network or TT network is available at the connection point. | • Maximum AC cross-section at circuit breaker: 95 mm² (e.g. NYY-J 5x95mm²); for fine-stranded wires, the maximum cross-section is70 mm².<br>• Maximum cross-section on PE and N rail: M8×95 mm² | | ☐ |
| 04 | Compliance with grid connection conditions. | The grid connection of the system was tested with regard to grid interactions (harmonics, voltage drop) by expanding the system and found to be compatible in terms of connected load and grid impedance. | | ☐ |
| 05 | Protection of the AC supply line with max. 160 A for the PBI 90K and PBI 90K-BU variants is available at the grid connection point. | | | ☐ |
| 06 | Free network connection (LAN customer) with min. 5 Mbit/s is available at the connection point. Alternatively: Router incl. data SIM card with min. 5 Mbit/s. | The Pramac Smart Energy Controller (PSEC) requires permanent internet access. | | ☐ |
| 07 | Relevant for BSO MAX PRO:<br>An Ethernet network cable to the PSTS is available at the connection point. | The Pramac Transfer Controller (PTC) requires an Ethernet connection to the Ethernet switch in the BSO MAX PRO. | | ☐ |
| 08 | An interface for integrating the meter data is available at the connection point. | Integration of the energy meter either via RS485 (2-wire) to the Link B connection of the PSEC or via Ethernet via switch | | ☐ |
| 09 | The installation site is accessible for lorries and forklifts. | Paved access roads, no kerbs, etc. | | ☐ |
| 10 | A 3-tonne forklift truck, including driver, is on standby for unloading and installation. | ▶ REMARK<br>Forklift fork thickness, see transport section of the foundation drawing. | | ☐ |
| 10a | A crane with suitable lifting equipment is available. | Installation of the BSO MAX with a crane – see foundation and crane drawing | | ☐ |

| | | | | |
|---|---|---|---|---|
| 11 | Suitable current transformers for energy meters at the connection point are available. | No power converters are included in the scope of delivery. | | ☐ |
| 12 | Suitable fastening materials (appropriate for the foundation and installation site) are available. | See foundation drawing:<br>8× mounting holes M16 | | ☐ |
| 13 | Mild weather conditions are essential for construction and commissioning! | | | ☐ |
| 14 | Check delivery for completeness. | | | ☐ |
| 15 | Check compatibility with existing generator systems. | | | ☐ |
| 16 | Provision of access authorisation for installation personnel | If necessary | | ☐ |

### 1.6.1 Requirements for the foundation

Foundation in accordance with the following foundation plan. This serves only as a reference and describes the minimum dimensions for the design of the foundation, as well as the dimensions (A) for the cable entry.

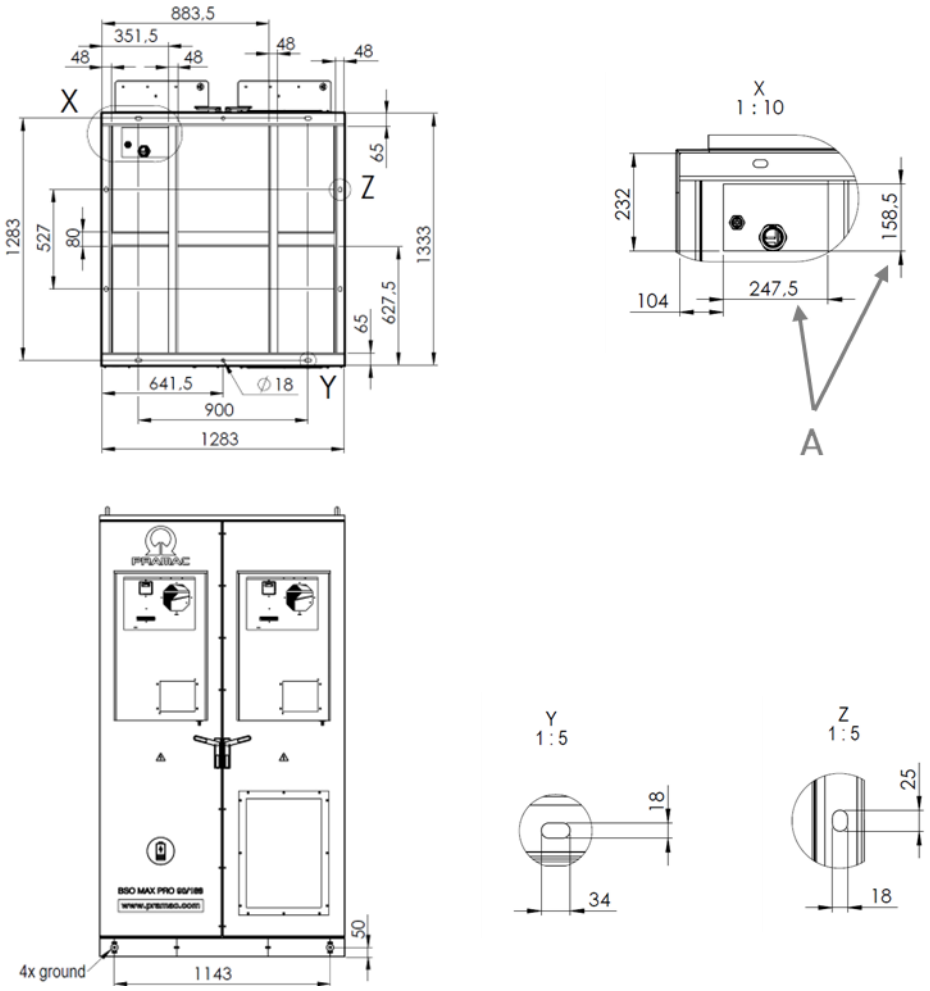



Figure 1-3: Minimum dimensions for the foundation

REMARK

- The top of the foundation is levelled. The embedded parts of the foundation, such as cable entries, etc., must be positioned precisely. The difference between the highest and lowest embedded parts of the foundation must not exceed 3 mm.
- The specific detailed drawings must be prepared by experts. The load-bearing depth of the structure must be determined in accordance with local conditions and must meet the requirements of national regulations for seismic vibrations up to a magnitude of 8.
- The total weight of the product (including cabinet) is up to 2,600 kg.
- The inlet and outlet openings at the bottom of the external cabinet must be sealed with suitable means in accordance with protection class IP54 after connecting the supply cables.
- The supply cables for the outdoor cabinet can be laid in empty conduits in the upper part of the foundation to prevent poor cable connections.

### 1.6.2 Transport requirements

If you notice any packaging issues that could lead to damage to the components, or if you notice any visible damage, please notify the relevant transport company immediately. If necessary, you can contact the distributor or the PR Industrial S.r.l. Ask for help. The proper and safe transport of the device, especially by land, must be carried out in a suitable manner and with suitable means to protect the components (especially the electronic components) from violent shocks, moisture, vibrations, etc.

REMARK

- The battery modules that are already installed must not be exposed to high ambient temperatures.
- The permissible storage temperature range is between -20 °C and +50 °C.

### 1.6.3 Unpacking the system

The BSO MAX systems are packed for transport in a sea freight crate with metal clamps around the perimeter. The system is also delivered on a wooden pallet. The system is bolted to the pallet with four M16 metal bolts.

The packaging must be completely removed before setting up and installing.

**NOTE**

Ensure that suitable personal protective equipment (PPE) is worn. Risk of cuts or splinters.

Appropriate aids:

- Angle grinder with cutting disc
- Alternatively: crowbar and hammer
- Socket wrench set with M16 socket
- Knife
- 2nd support person

To remove the packaging, follow the instructions below:

1) Use the cutting disc to cut through the metal clips on the upper wooden lid and remove the lid.
2) Use the cutting disc to cut through the metal clips at the bottom of the wooden box.
3) Use the cutting disc to cut through the vertical metal clips on the wooden box one by one and remove the wooden walls individually.
4) Remove all protective materials such as film, paper, foam or wooden strips that were used to protect the system.
5) Loosen and remove the fastening bolts between the system and the pallet using the M16 socket wrench set.

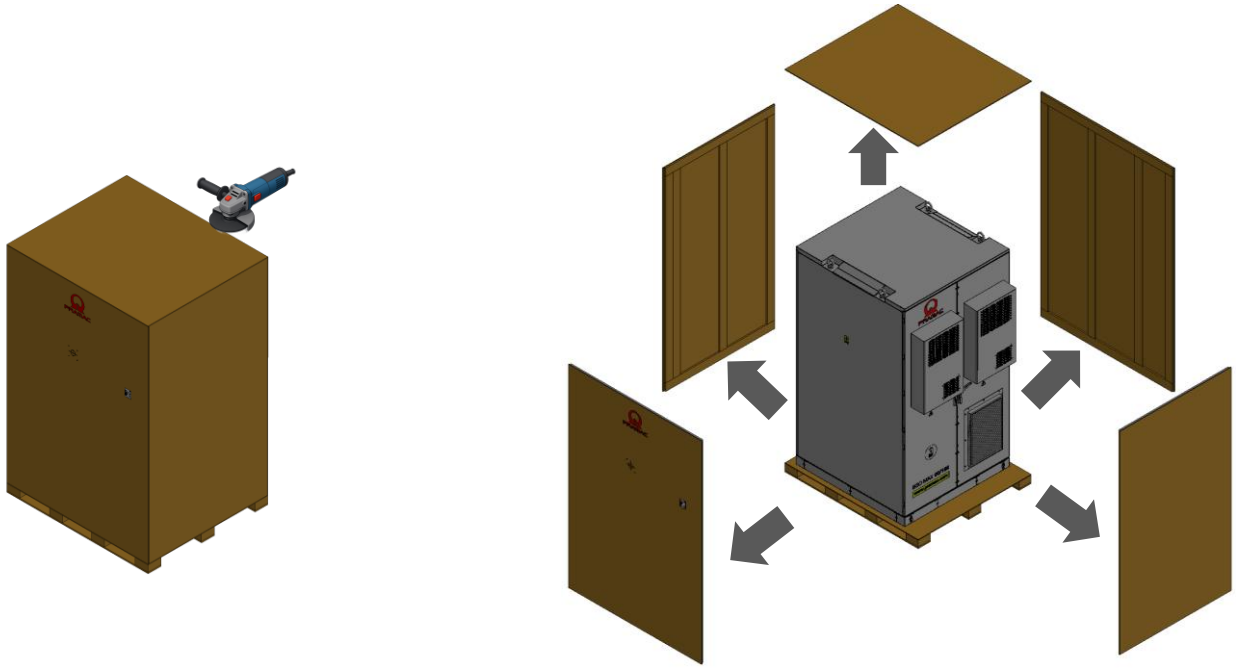


Figure 1-4: Packaging

# 2 Overview Battery Storage Outdoor

This chapter introduces the individual components of the Battery Storage Outdoor.

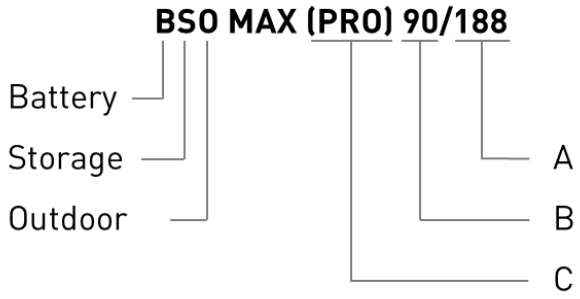



Figure 2-1Explanations of type designations

| Pos. | Description |
|---|---|
| A | 188 kWh gross capacity |
| B | 90 kW rated power |
| C | Backup capable (PRO version) |

## 2.1 Component overview

The all-in-one battery storage outdoor BSO MAX 90/188 and BSO MAX PRO 90/188 with an output of 90 kW and a capacity of 188 kWh comes fully equipped upon delivery. The BSO MAX PRO 90/188 supports backup operation in the event of a power failure with an additional external grid switchover device (PSTS).

The BSO MAX is divided into 2 areas:

- Battery compartment (top)
- AC and inverter section (below)

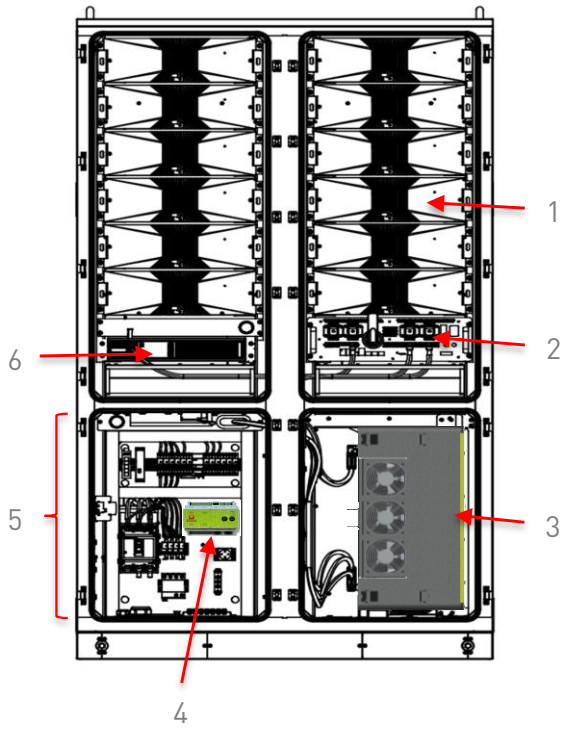



Figure 2-2: System overview

| Pos. | Description |
|---|---|
| 1 | Battery module |
| 2 | BMS |
| 3 | Inverter |
| 4 | PSEC |
| 5 | AC connection and distributor |
| 6 | UPS |

The upper battery area contains 12 battery modules, a battery management system (BMS), an uninterruptible power supply (UPS), and various safety devices (e.g., fire protection equipment).

The lower section houses the PBI 90K or PBI 90K-BU battery inverter and the spatially separated AC distribution. The AC distribution includes the AC connection terminals, the AC disconnect switch, various fuses, and the terminals for the internal consumers.

The connection of the BSO MAX is described in "Chapter**Fehler! Verweisquelle konnte nicht gefunden werden. Fehler! Verweisquelle konnte nicht gefunden werden.**" described in detail.

There is also a 230V safety socket, a power supply, an Ethernet switch, and the Pramac Smart Energy Controller (PSEC). Alternatively, an LTE router can be installed here for a standalone Internet connection. The BSO MAX PRO 90/188 also features a 24V UPS.

The configuration of the PSEC is specified in„Chapter4.7 Commissioning of Pramac Smart Energy Controller (PSEC)“ detailed described.

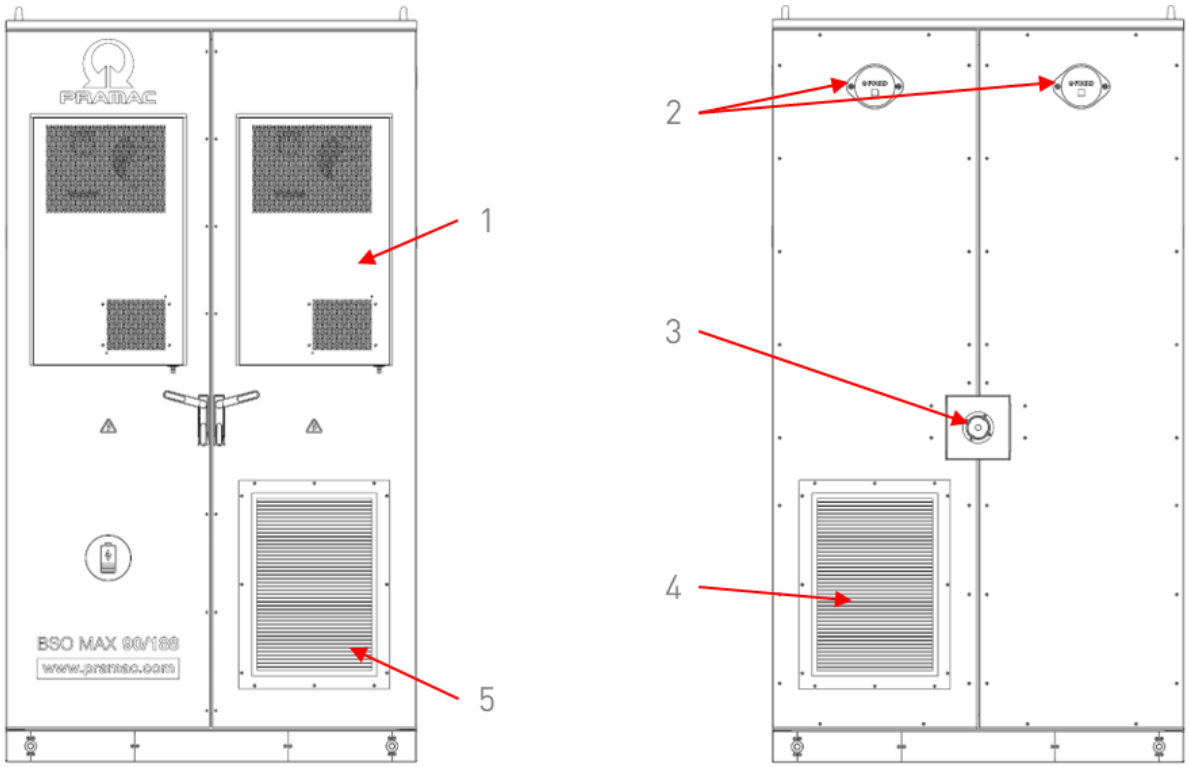



Figure 2-3: Front and Rear view BSO MAX

| Pos. | Description |
|---|---|
| 1 | Air conditioner |
| 2 | Pressure relief valve |
| 3 | Extinguishing water connection DN65 (fire brigade) |
| 4 | Air outlet inverter |
| 5 | Air inlet inverter |

The BSO MAX systems are lockable and can only be opened at the front. The universal keys included in the accessory pack fit both doors. If necessary, the door lock cylinders can be replaced with your own keys and lock cylinders.

The keys for the initial opening of the system are located at the fire water connection on the rear of the system (see „Figure 3-3“).

**NOTE**

All BSO MAX systems use the same lock cylinders with the same keys. To prevent misuse, we recommend replacing the lock cylinders and keys with at least SKG** protection. Lock cylinder design: 30/10 Half cylinder, e.g., Keso 8000 Omega² half cylinder.

**⚠ CAUTION**

After replacing the lock cylinders, ensure that the BSO MAX is clean and tight and can be locked.
New keys must be kept by the operator and protected against unauthorized access.

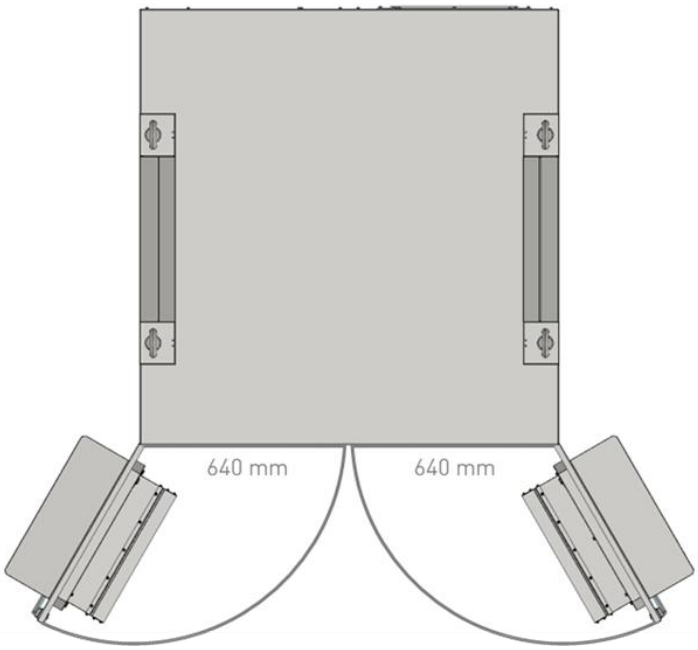



Figure 2-4: Overview of doors

Figure 2-5: Lock cylinder type 30/10 half cylinder

The doors of the BSO MAX have a locking mechanism at an opening angle of 120°. To close the door again, a bolt must be lifted via the guide rail. A mechanical stop engages when the opening angle exceeds 120°. To prevent damage to the doors and housing of the BSO MAX, the doors must not be opened more than 120°.

The accessory pack includes the following components:

- 4× Key
- 24V power supply
- Power cables/busbars
- Screws for Power cables/busbars
- Security screws (spare) for the rear panels
- Set of ring cable lug accessories for QF1 connection
- Set of accessories for direct cable connection to QF1

The document bag contains the following components:

- Manual BSO MAX Series
- Electrical schematic
- PBI Series Battery Inverter Manual
- CE-Declaration System

### 2.1.1 Safety devices

Various active and passive safety features are built into the BSO MAX.

| Active facilities | |
|---|---|
| Continuous monitoring of battery cells | The battery cells (voltage, temperature, current) are continuously monitored by the battery management system (BMS) and the higher-level energy management system (EMS). |
| Heat detector | Regardless of the BSO MAX variant, a heat detector is installed. This detects excessive temperatures exclusively on the battery side. |
| Smoke detector | Regardless of the BSO MAX variant, a smoke detector is installed. This detects any smoke development on the battery side. |
| Fire protection device with aerosol generator | The fire protection device in the form of an aerosol generator in the battery compartment can actively inhibit the spread of fire in the event of a fire and the associated excessive temperatures. The aerosol is released as soon as the temperature at the generator housing reaches < 93°C. A heat sensor triggers the aerosol generator. The extinguishing agent is produced in the aerosol generator. |
| Passive facilities | |
| Pressure relief valves | The pressure relief valves on the rear of the battery compartment are designed to allow the correct escape of sudden pressure changes caused by fire/gas development. |
| Fire hose connection | On the rear of the BSO MAX there is a DN65 fire hose connection that can be connected by the fire department if necessary. |

**⚠ WARNING**

- The release of fire extinguishing agents for firefighting can pose a potential hazard to personnel due to the natural form of the agent or the combustion products that are generated when the agent is exposed to fire or hot surfaces.
- Unnecessary exposure of personnel to the extinguishing agent or decomposition products must be avoided.

### 2.1.2 Datasheet

Table 2-1: Data sheet Battery Storage Outdoor

| TECHNICAL DATA Battery Storage Outdoor | | BSO MAX 90/188 | BSO MAX PRO 90/188 |
|---|---|---|---|
| Gross capacity | | 188 kWh | |
| Net capacity (90 % DoD) | | 169 kWh | |
| Rated voltage | | 768 VDC | |
| Max. charging/discharging current | | 155 A | |
| Cell type | | Li-Ion (LFP) Pouch | |
| Cycles(90 % DoD \| 65 % SoH \| 0,5 C/0,5 C \| 25 °C) | | 7300 cycles | |
| BATTERY CONVERTER | | | |
| Nominal apparent power On-grid operation | | 90 kVA | |
| Nominal apparent power backup operation | | - | 75 kVA |
| Max. permissible phase imbalance | | - | 20 kVA |
| rated voltage | | 400 VAC | |
| Max. AC-Strom | | 130 A | |
| Max. peak current (amplitude) | | - | 185 A |
| THDi | | < 3 % | |
| AC power factor / range | | 1 / 0i … 0c | |
| Max. efficiency | | 98,4 % | 98,1% |
| RTE | | 89,1% | |
| Topology | | Transformerless | |
| SAFETY DEVICES SYSTEM | | | |
| Safety devices | Active facilities | Continuous monitoring of battery cells | |
| | | Heat detector | |
| | | Smoke detector | |
| | | Fire protection device with aerosol generator | |
| | Passive facilities | Pressure relief valves | |
| | | Extinguishing water connection DN65 | |

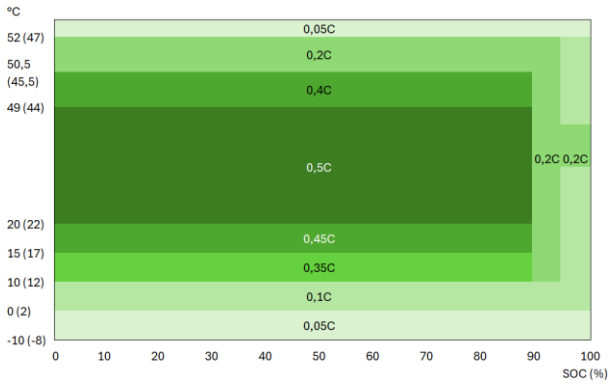
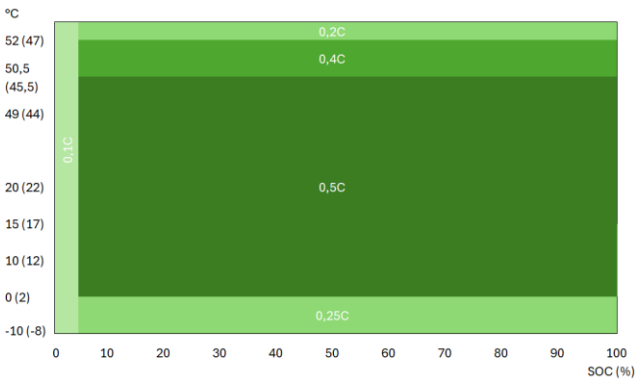
Table 2-2: General data Battery Storage Outdoor

| GENERAL DATA | | | BSO MAX 90/188 | BSO MAX PRO 90/188 |
|---|---|---|---|---|
| AC mains connection | | | 3P, N, PE / TN-C, TN-C-S, TT | |
| Rated frequency | | | 50 Hz | |
| Permissible ambient temperature | | | -20 … +50 °C | |
| Humidity,RH | | | 4 … 100 % | |
| Cooling/heating concept | Battery compartment | | Cooling capacity 2×1,5 kW / heating capacity 2×1 kW | |
| | Inverter room | | Forced air cooling | |
| Dimensions (L×W×H) | | | 1 300×1 354×2 387 mm | |
| Weight: Total including batteries and inverter | | | 2 600 kg | |
| Protection class | | | IP54 | |
| Max. permissible installation height | | | 3 000 m | |
| Corrosion resistance of the housing | | | C3H | |
| Noise emissions at a distance of 1 m | | | < 69 dB(A) | |
| Housing color | | | RAL 9016 | |
| Interfaces | | | RJ45 (Ethernet) | |
| Certificates / Approvals | Battery System | | CE / UN 38.3 / UN 3480 / IEC 62619 / IEC 63056 / UL 1973 / UL 9540A / VDE 2510-50 / EN 61000-6-2 / EN 61000-6-4 | |
| | Battery inverter | EU directives | 2014/30/EU / 2014/35/EU / 2011/65/EU / 2015/863/EU | |
| | | Product | IEC 62109-1 / IEC 62109-2 / IEC 62477-1 / IEC 61439-1 / IEC 61439-2 | |
| | | Grid connection conditions | DIN VDE V 0126-1-1 / VDE AR-N 4105:2018 / VDE AR-N 4110:2023 / TOR Stromerzeugungsanlagen Typ A/B / C10/11 / G99 / CEI 0-16, CEI 0-21 / NTS 631, UNE 217002 / EN 50549-1/-2 / AS4777.2 / EirGrid | |

### 2.1.3 Warranty terms

See Pramac "Warranty Statement – Battery Energy Storage Systems and Hybrid Solutions" at www.pramac.com

| Derating with PBI 90K(-BU) | |
|---|---|
| Battery inverter<br>PBI 90K(-BU) | A reduction in performance depends on the respective system environment conditions and the respective performance specification.<br><br>Further information can be found in the manual for the PBI 90K(-BU) battery inverter. |
| Batteriemanagementsystem (BMS) | The decisive limitation is implemented by the active cell monitoring of the battery module or battery management system (BMS). The BMS continuously monitors the maximum cell temperature. If a cell reaches the maximum cell temperature, e.g. 49 °C, the BMS limits charging to 0.4C. Discharging can still take place at 0.5C. (See the following table for reference)<br>The climate control unit in the battery area delays the heating or cooling of the cells by either cooling or heating. Depending on the operating behavior and how quickly cycles are run one after the other, the cells heat up faster or slower.<br>Verified example:<br>• Battery modules preconditioned to 20-24°C; $P_{AC}$= 90kW<br>à Multiple full cycles can be performed at 0.5C without battery inverter and BMS derating. |

| C-rates as a function of the maximum cell temperature (hysteresis values) and SOC state | |
|---|---|
| Charge | Discharge |
|  |  |
| Figure 2-6: Charge (C rates) | Figure 2-7: Discharge (C rates) |

## 2.2 Overview of external component connections

The following figure describes the structure and the components to be provided by the customer:

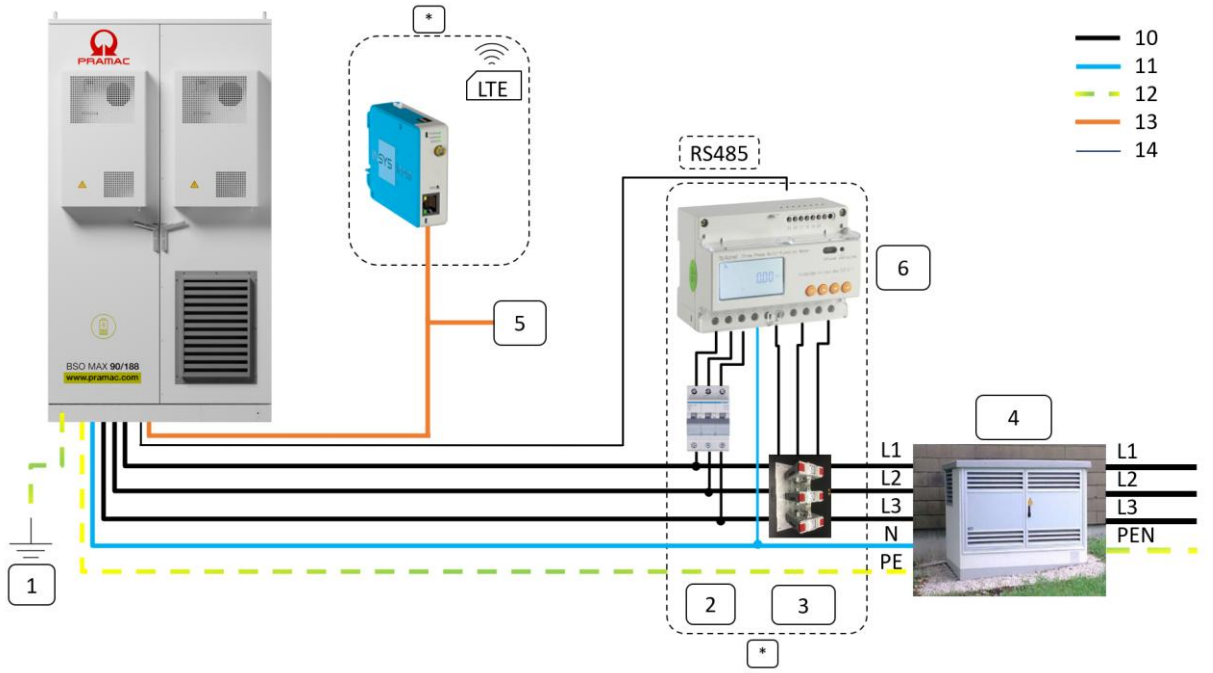



Figure 2-7: Overview plan of components BSO MAX 90/188

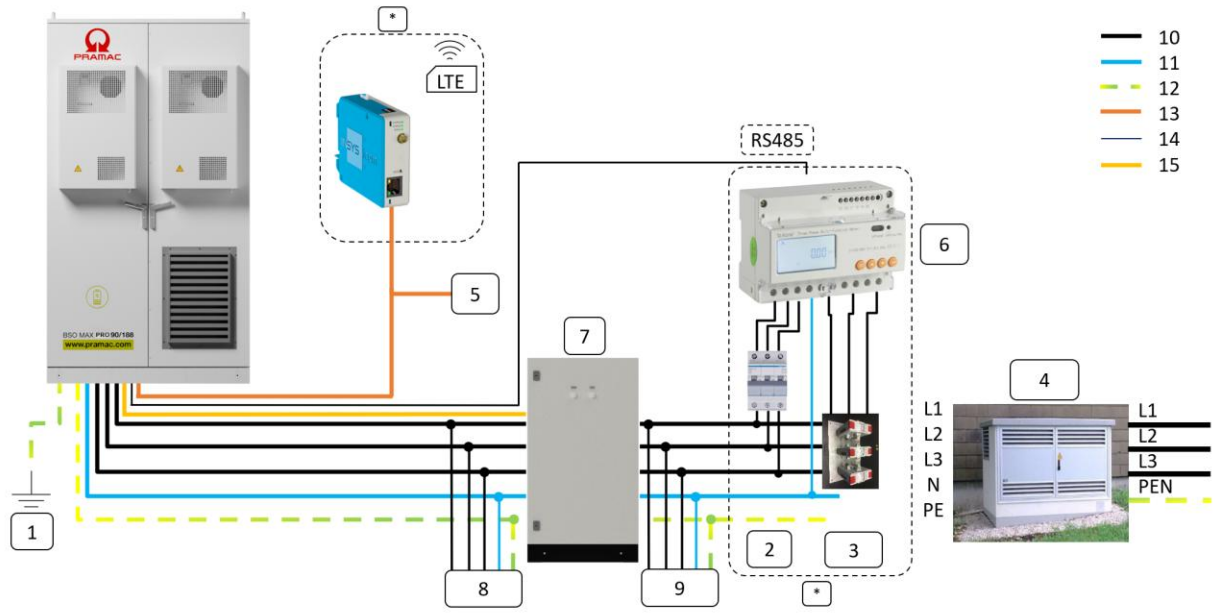



Figure 2-8: Overview diagram of components for BSO MAX PRO 90/188 with PSTS

| Pos. | Description | Pos. | Description |
|---|---|---|---|
| 1 | Foundation earth electrode | 9 | Switchable load |
| 2 | Voltage measurement | 10 | AC main supply 3P |
| 3 | Current transformer | 11 | N conductor |
| 4 | Grid 3 AC 400V | 12 | PE/PEN conductor |
| 5 | Internet customer | 13 | Internet customer |
| 6 | Energy Meter | 14 | 2-wire RS485 |
| 7 | PSTS | 15 | Ethernet |
| 8 | Critical load | * | optional |

REMARK

In order to operate the BSO MAX correctly, the customer must provide an AC connection in the TN-C-S or TN-C network. In the case of an incoming TN-C network, there is a PE-N cable bridge inside the BSO MAX, which must be removed for an incoming TN-C-S network.

A suitable Energy Meter with voltage and current measurement.

The Energy Meter is **not** included in the scope of delivery and can be ordered as an accessory. Furthermore, a suitable Internet connection must be established. The EMS (PSEC) and the battery inverter require a permanent Internet connection.

In addition to an accessible installation area, the following components and installations must be provided in advance by the customer (see section „1.6 Checklist BEFORE commissioning“).

- Foundation constructed according to foundation plan.
- AC power supply cable to the outdoor battery storage system, including suitable fuse protection, is available.
- Local IT network or LTE router for connecting the EMS (PSEC) to the portal via the internet https://portal.pramac.energy.
- Suitable measuring transformers for correct integration of the energy meter, including fuse protection for voltage measurement.

# 3 Installation of BSO MAX 90/188 and BSO MAX PRO 90/188

This chapter describes the installation of the Battery Storage Outdoor.

**NOTE**

- Powercube M5 battery rack from manufacturer Pylontech
- Battery inverters fromPR Industrial S.r.l.

## 3.1 Before installation

Before installation, check that all items on the B2B pre-commissioning checklist (see section „1.6 Checklist BEFORE commissioning") have been fully considered and completed.

REMARK

- The BSO MAX PRO 90/188 system should be put into operation after no more than 6 months due to the UPS battery (applies to an ambient temperature of +20 °C).

**⚠ WARNING**

During installation and commissioning, ensure that the weather is not damp.

## 3.2 Installation of the battery storage unit

Perform assembly as follows:

1. Place the fully unpacked BSO MAX on the prepared foundation using a 3-ton forklift (or alternatively a crane) and then mark the 8 mounting holes. The mounting holes have a diameter of 18 mm.

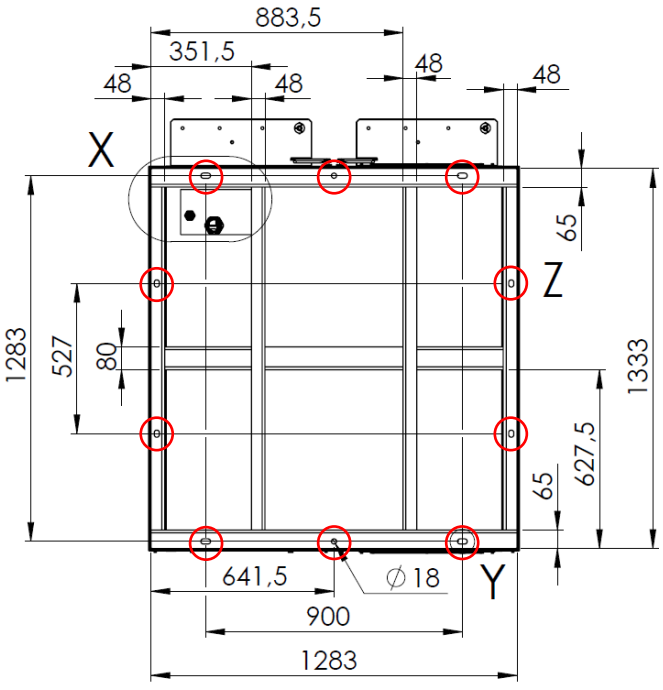
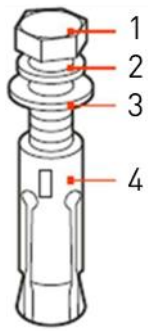



Figure 3-1: Fastening to foundation - view from below

2. The Battery Storage Outdoor can be securely fastened with ≥4 mounting bolts.
   The following illustration shows a possible mounting bolt:




| Pos. | Description |
|---|---|
| 1 | Screw |
| 2 | Rubber seal |
| 3 | Washer |
| 4 | Expansion bolt |

Figure 3-2: View of mounting bolts

3. Lift the BSO MAX off the foundation when drilling the holes.
   Insert the fastening bolts using a hammer.
   Place the BSO MAX back onto the foundation over the bolts.
4. Inserting the cable leads
   (AC power cable, network cable, communication cable to the energy meter).
5. Attaching the BSO MAX with the nuts on the bolts.

**NOTE**

Place the BSO MAX horizontally!

6. Close the recesses for the fork insertion in the base of the BSO MAX with the enclosed transport covers and screws.

**NOTE**

Ensure that the air inlet and outlet louvers (see Figure 2-3: Front and rear view of BSO MAX) are not manually pressed or lifted, as this may cause damage to the push rod and result in deformation of the louvers.

### 3.2.1 Installation PSTS (Optional)

The BSO MAX PRO 90/188 requires the Pramac Smart Transfer Switch (PSTS) mains transfer device. Its operation, installation, and commissioning are described in the PSTS manual.

**NOTE**

- Refer to the PSTS manual

## 3.3 Electrical connection of the BSO MAX (PRO)

**⚠ WARNING**

To connect to the AC power supply network, authorisation must be obtained in advance from the local energy supply company (grid provider).

**⚠ WARNING**

The assembly, installation, and initial commissioning may only be carried out by a trained electrician.

**NOTE**

Connecting DC busbars involves working with live electrical systems. Check safety equipment and authorization to perform the work in advance.

**⚠ WARNING**

Before starting work, connect the protective conductor of the AC main supply cable to the main grounding bus in the BSO MAX.
In addition, a protective equipotential bonding must be connected to the BSO MAX.

- Connect to the external grounding connection point of the BSO MAX (located on both long sides).

It is also possible to connect a foundation earth electrode to the external earthing connection points.

When connecting the BSO MAX to the power supply, the following points should be observed in accordance with the5 safety rules and, in addition, be examined and observed:

- Disconnect the power supply and ensure that the product cannot be switched on accidentally!
- Before turning on the power, use a multimeter to verify that there is no voltage and to ensure that there are no short circuits or open circuits inside the product.
- Cover and isolate adjacent parts of the equipment that may be live.
- During maintenance and repair, ensure that escape routes are not blocked.

### 3.3.1 Connection to foundation grounding

The foundation earth can be connected to the marked connection points on the BSO MAX. The connections are equipped with an M10 thread. The cable cross-section may vary depending on the customer's requirements and must be determined by a qualified electrician.

**NOTE**

After connecting the grounding, perform a documented grounding measurement.

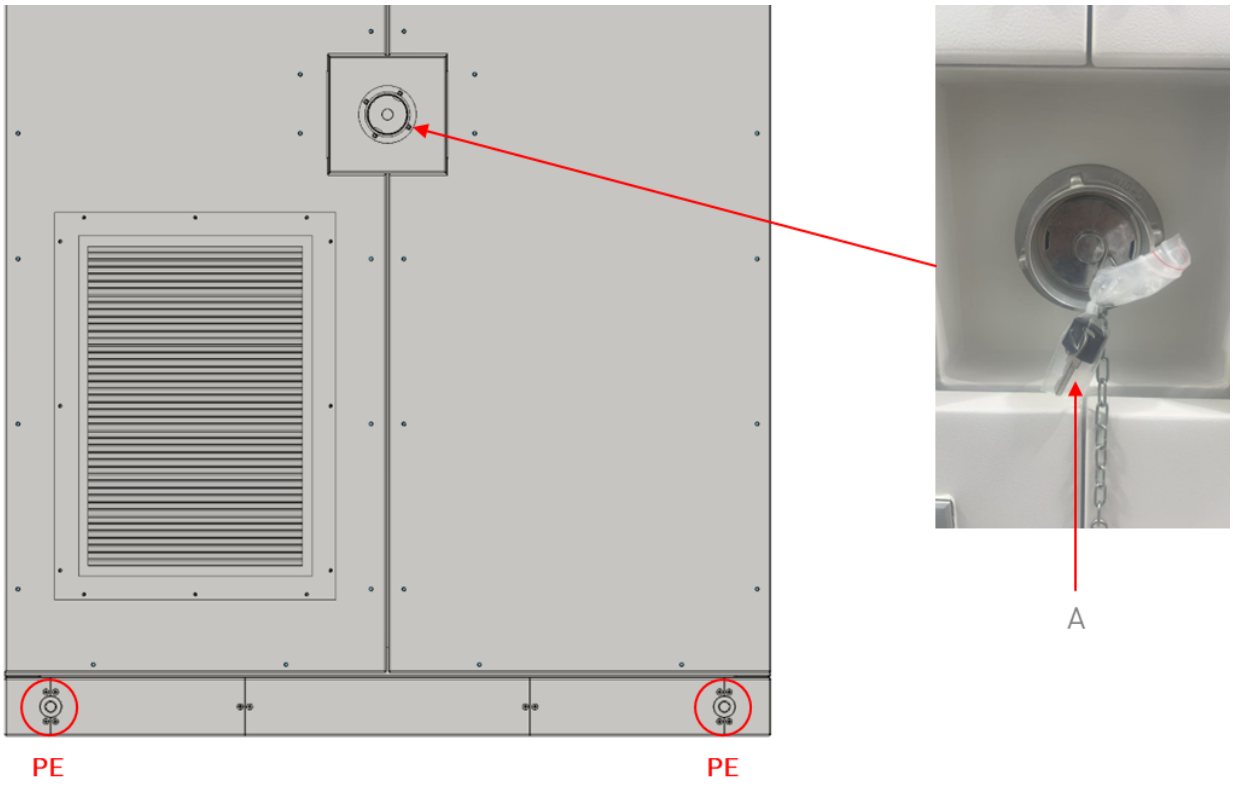



Figure 3-3: Connection foundation earthing and key (A)

### 3.3.2 Connection of the AC supply line

**⚠ WARNING**

When connecting the AC supply lines L1, L2, and L3, ensure that the phase sequence is clockwise.

The AC supply line 3P/N/PE to the BSO MAX must be provided by the customer and must be fused with a maximum of 160 A (BSO MAX 90/188 or BSO MAX PRO 90/188).

**NOTE**

The cable material must be copper (CU).

If the system is started up with a 3P/N/PE (TN-C-S) power supply cable, the black cable bridge between N and PE on the respective connection rails must be removed.

**NOTE**

In installations with multiple parallel BSO MAX PRO units in backup mode, please note that there are limits to the connection cable lengths from the common AC distribution to the individual BSO MAX PRO units. To avoid AC voltage oscillations and shutdowns for self-protection and consumer protection, a maximum cable length of 50 m must be observed. We recommend sheathed cables to keep inductance as low as possible.

The AC supply cable is fed through the cable entry at the bottom of the BSO MAX. The connection is made to the lower terminals of the QF1 circuit breaker. The maximum permissible cable cross-section at the QF1 circuit breaker is 95 mm².The maximum cable cross-section of the PE conductor on the PE rail is M8×95mm².

The following torque must be provided:

| | |
|---|---|
| ≤ 50mm²: | 7 Nm |
| > 50 mm² … 95 mm²: | 8,5 Nm |

**NOTE**

Tighten the individual conductors with an Allen key.

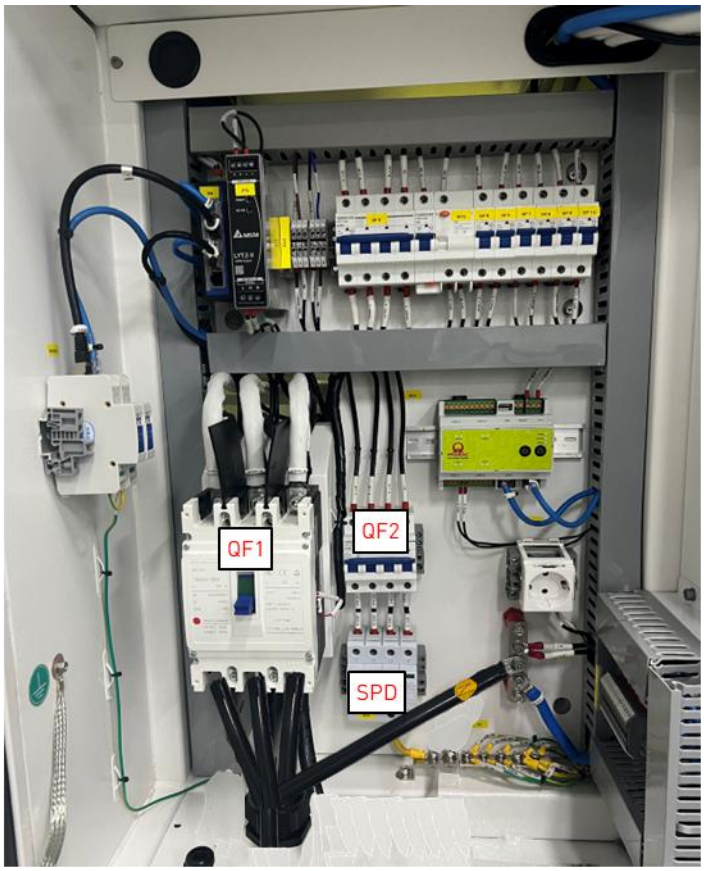



Figure 3-4: Connection AC supply line

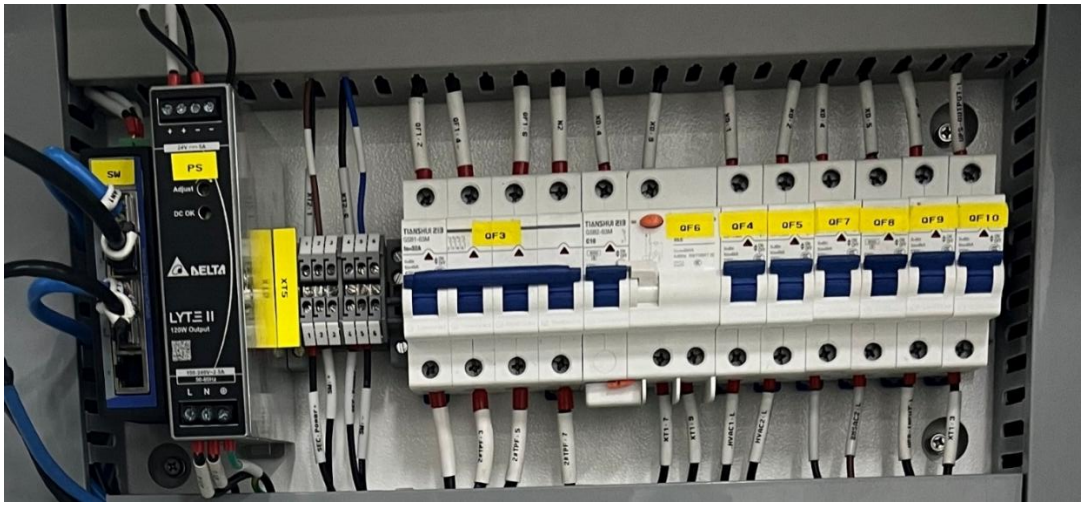



Figure 3-5: Overview of fuse block

### 3.3.3 Connection of the battery string

**DANGER**

When connecting the battery power cables (DC+ and DC-), be careful not to cause a short circuit or reverse polarity to avoid injury.

**WARNING**

Ensure that external communication cables are laid in accordance with EMC requirements.

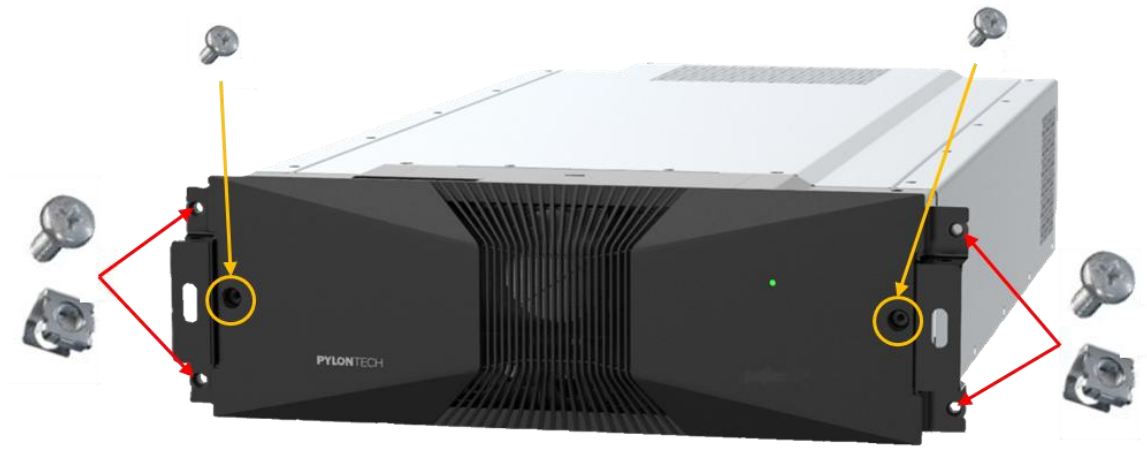



Figure 3-6: Battery module with cover

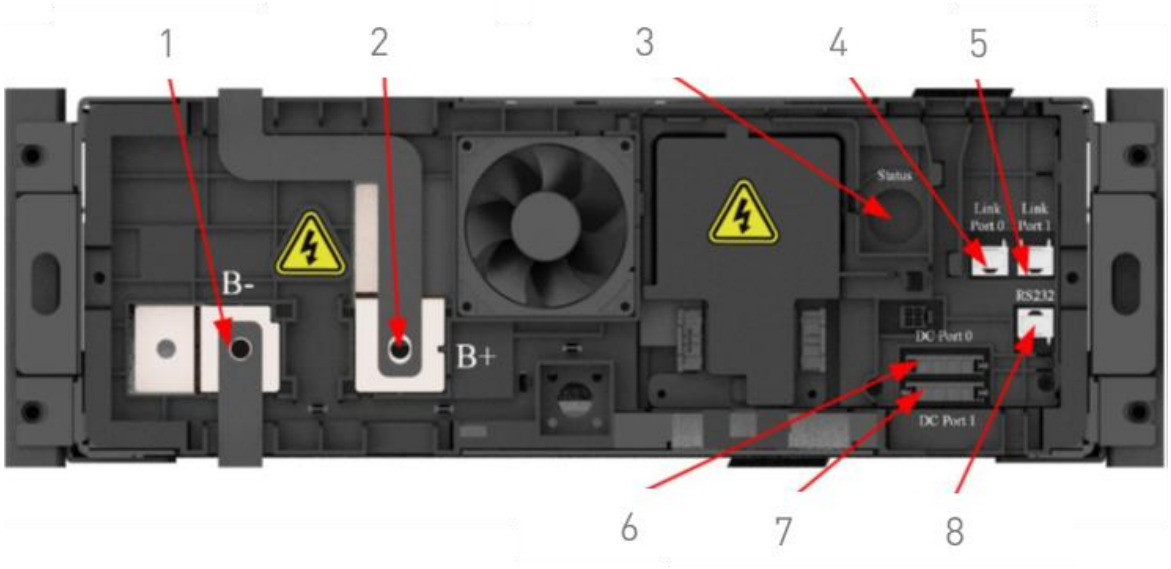



Figure 3-7: Battery module without cover

| Pos. | Description | Pos. | Description |
|---|---|---|---|
| 1 | Connection battery DC- | 5 | Link Port 1 |
| 2 | Connection battery DC+ | 6 | DC Port 0 |
| 3 | Status | 7 | DC Port 1 |
| 4 | Link Port 0 | 8 | RS232 |

**NOTE**

Ensure that the DC disconnect switch of the BMS is open (pos. OFF).

**⚠ DANGER**

When connecting the battery power cables (DC+ and DC-), be careful not to cause a short circuit or reverse polarity to avoid injury.

The battery rack in the Battery Storage Outdoor is largely pre-installed. The battery modules are professionally assembled and secured (torque of 12 Nm).

The flexible DC+ and DC- busbars for the power cabling of the battery modules must be fastened with a torque of
8 Nm.

The necessary covers for the battery modules must be fastened with 2 screws and a torque of 2 Nm.

Only the DC power connection from the BMS to the battery inverter is already fully connected.

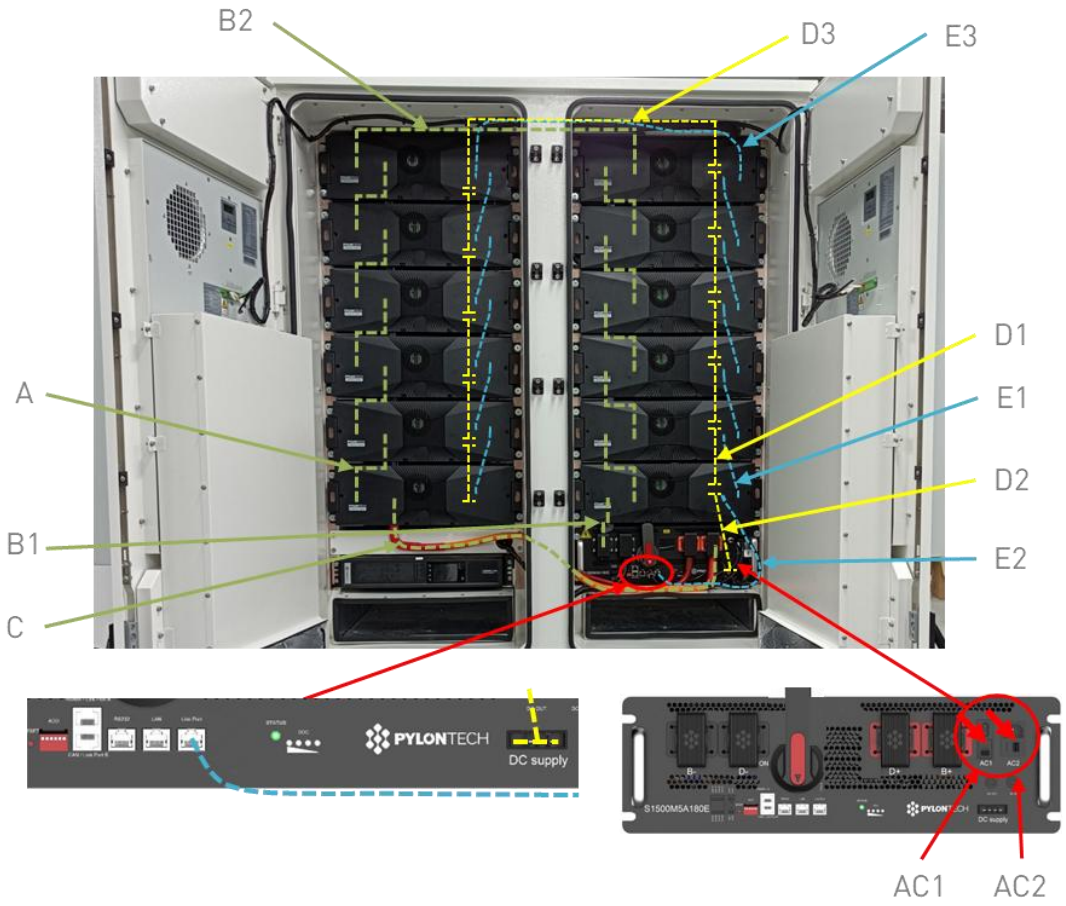



Figure 3-7: Overview of DC power cabling

| Pos. | Description | Pos. | Description |
|---|---|---|---|
| AC1 | AC supply for BMS from "AC out" of UPS | AC2 | AC supply for fan |

| ID | Components | Description | Unit | Quantity |
|---|---|---|---|---|
| A | flexible conductor rail | Busbar from battery module to battery module (195*92*20*3mm) | pcs. | 10 |

The DC connection between B- of the BMS and B- of the lowest battery module is made with the single busbar:

| ID | Components | Description | Unit | Quantity |
|---|---|---|---|---|
| B1 | flexible conductor rail | Busbar from BMS to battery module (133*40*20*3mm) | pcs. | 1 |

The DC connection between B+ of the battery module (top right) and B- of the battery module (top left) is made using a flexible busbar (red):

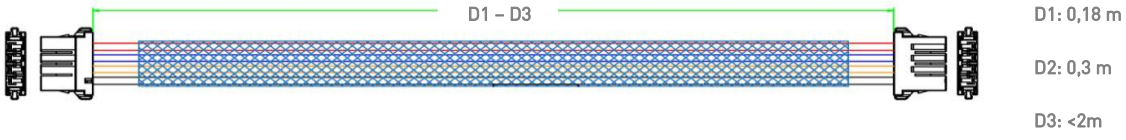
| ID | Components | Description | Unit | Quantity |
|---|---|---|---|---|
| B2 | Flexible busbar | Busbar from right to left (B+ to B-) | pcs. | 1 |

The DC connection between B+ of the battery module (bottom left) and B+ of the BMS is made using a long power cable (red):

| ID | Components | Description | Unit | Quantity |
|---|---|---|---|---|
| C | Flexible busbar | Busbar 1/0 AWG | pcs. | 1 |

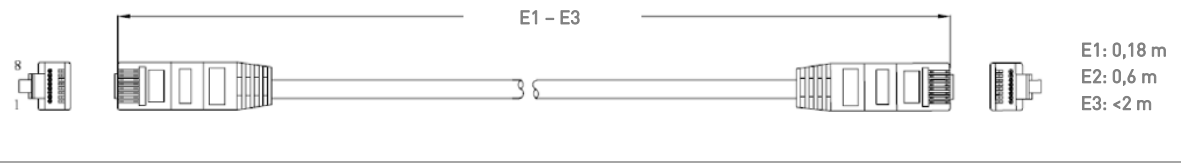
The power supply to the individual battery modules is established using the following cables:

| ID | Components | Description | Unit | Quantity |
|---|---|---|---|---|
| D1-D3 | Power cable Battery | black 10AWG/12AWRG 4-pin | pcs. | 10x D1<br>1x D2<br>1x D3 |



The communication link from the BMS to the battery module or from battery module to battery module is established as follows:

| ID | Components | Description | Unit | Quantity |
|---|---|---|---|---|
| E1-E3 | Kommunikationskabel | Schwarz RJ45 - twisted pair | pcs. | 10x E1<br>1x E2<br>1x E3 |




The DC power connection on the BMS is made to the "B+" and "B-" terminals as shown in the figure below. The power connections from the inverter are already connected (D+ and D-).

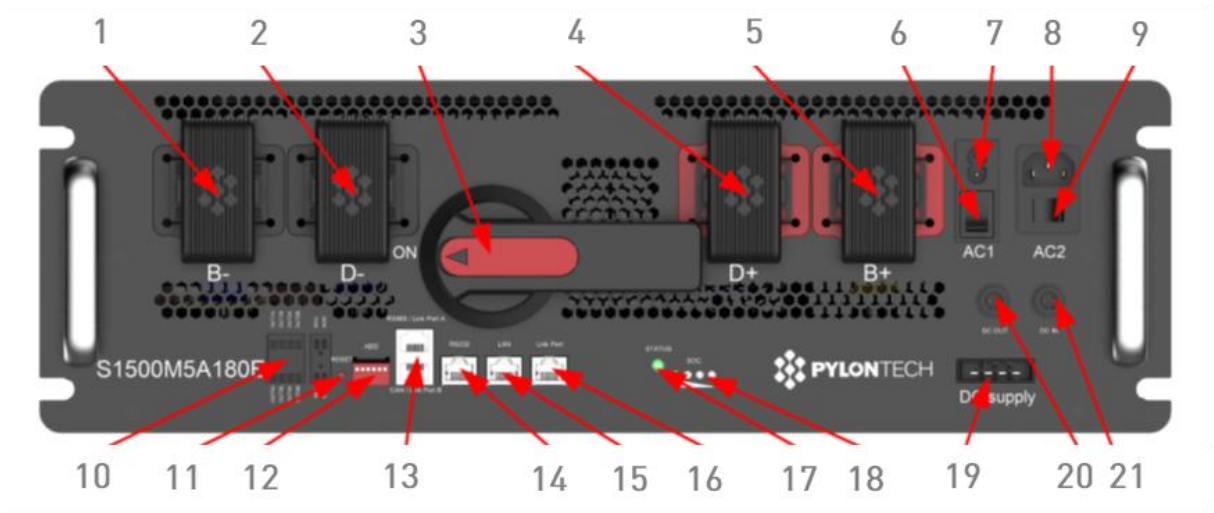
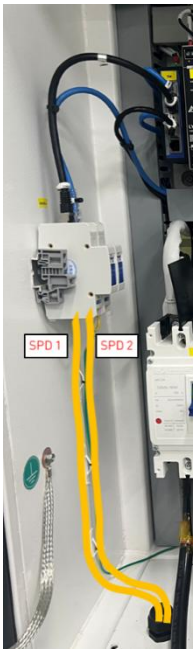



Figure 3-8: BMS - communication and power connections

| Pos. | Description | Pos. | Description |
|---|---|---|---|
| 1 | Battery DC | 12 | ADD |
| 2 | Inverter DC- | 13 | RS485 / Link Port A and CAN / Link Port B |
| 3 | Main switch | 14 | RS232 PORT |
| 4 | Inverter DC+ | 15 | LAN PORT |
| 5 | Battery DC+ | 16 | Link Port |
| 6 | BMS switch | 17 | status |
| 7 | AC for BMS | 18 | SOC |
| 8 | AC for fan | 19 | DC supply |
| 9 | Fan switch | 20 | 12VDC output |
| 10 | Floating contact | 21 | 12VDC input |
| 11 | Reset | | |

### 3.3.4 Connection of the network cable




The network cable is fed through the cable gland and connected to the surge protection device (SPD2). The LAN SPD interface is via Ethernet (RJ-45 socket). An Ethernet connection to LAN port 2 (LAN2) of the EMS (PSEC) is already provided ex works.

The BSO MAX PRO also requires a network connection to the network transfer switch (PSTS). In the PSTS, the Ethernet cable is connected to the right-hand port (LAN2) of the Pramac Transfer Controller (PTC). In the BSO MAX PRO, the Ethernet cable is connected to the surge protection device (SPD1).

Similar to an internet connection, an energy meter must also be installed at the network connection point (NAP) to measure the voltage and currents and thus calculate the applied load. The EMS (PSEC) controls the battery storage system at this network connection point (NAP). The energy meter at the NAP is connected to the BSO MAX via Ethernet and is also connected to the surge protection device (SPD1) (customer-side distribution/switch required). An Ethernet connection to the local internal switch is already provided ex works.

Connecting the Energy Meter via RS485 (see chapter„**Fehler! Verweisquelle konnte nicht gefunden werden. Fehler! Verweisquelle konnte nicht gefunden werden.**“)

Figure 3-9: LAN customer connection

### 3.3.5 Connection to Pramac Smart Energy Controller (PSEC)

The energy management system (PSEC) is already mounted on a standard DIN rail in the BSO MAX. It requires 6 TE of space on the controller's DIN rail. The integrated 24 V power supply unit is installed next to the controller and is used to supply power to the controller. The controller has 4 plug-in card slots, which have been selected specifically for this product.

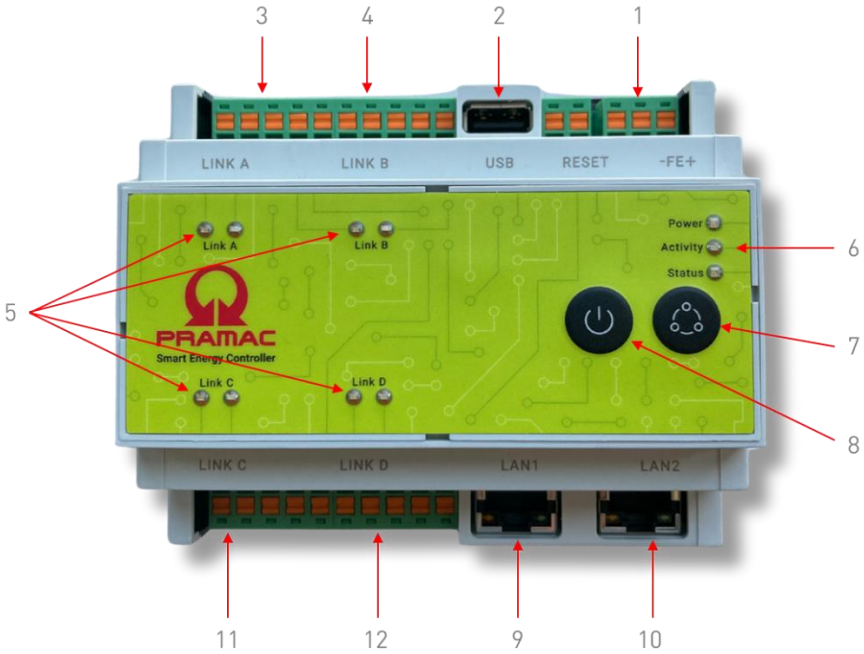



Figure 3-10: Overview PSEC (EMS)

| Pos. | Description | Pos. | Description |
|---|---|---|---|
| 1 | 10 … 24 VDC-power supply | 7 | Confirmation button |
| 2 | USB-A 2.0 | 8 | ON/OFF-Button |
| 3 | Link Port A à 4× Digital IO | 9 | Internal network |
| 4 | Link Port B à 4× Digital IO | 10 | External customer network with internet connection |
| 5 | Status-LED Link Port A / B / C / D | 11 | Link Port C à Modbus RTU (RS485) |
| 6 | Status indicator: Power / Activity / Status | 12 | Link Port D à Modbus RTU (RS485) |

### 3.3.6 Connection of energy meter via RS485

The Energy Meter is primarily connected to the grid connection point of the BSO MAX. The Energy Meter can be mounted and installed on a standard DIN rail in a control cabinet.

REMARK

The scope of delivery of the optional Energy Meter does not include current transformers. These can be ordered separately. The operating instructions are included. They describe the menu navigation and how to set the transmission ratio.

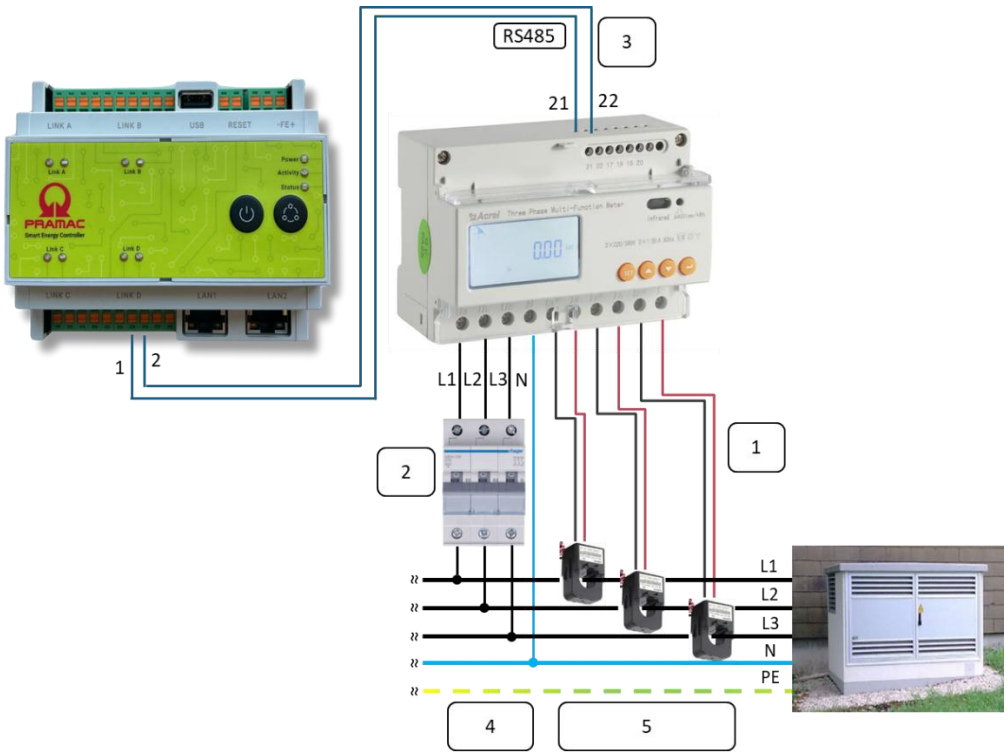



Figure 3-11: Energy Meter connection via RS485

| Pos. | Description |
|---|---|
| 1 | A transformer is required for each phase to measure the current. It is important to ensure that the current arrow direction is consistent and connected in the same direction as the arrow from the mains connection to the consumer. |
| 2 | The voltage measurement must be fused separately. For this purpose, the customer must install a 3-pole circuit breaker or a 3-pole fuse in the sub-distribution board in which the Energy Meter is also installed. |
| 3 | Connect the RS485 bus to terminals 21 and 22 on the Energy Meter. |
| 4 | Voltage measurement |
| 5 | Current measurement |

The RS485 cable is fed through the same rubber grommet as the customer's network cable. The Energy Meter is connected to Link Port D (terminals 1 and 2) on the energy management system (PSEC).

**NOTE**

- It is important that transformer 1 is connected with phase L1 to Ua (Ia, Ia* and terminal 1) and analogue to this L2 and L3 and that the direction of rotation L1, L2, L3 is maintained.
- Only use shielded and twisted cables for Ethernet cabling.
  We recommend bus cables or network cables of type CAT6/CAT7.
- The fuse is not included in the scope of delivery. The dimensioning of the fuse and the conductor cross-sections must be designed by the customer.
- Observe the counting arrow direction:
  Install the PV meter and grid meter in the correct counting direction: Supply + / Feed-in -.

### 3.3.7 Energy meter connection via RJ45

An energy meter is also integrated via Ethernet at the grid connection point to which the BSO MAX is connected.

REMARK

The scope of delivery of the Energy Meter does not include current transformers. These can be ordered as an option. The operating instructions are enclosed. It describes the menu navigation and how to set the transformation ratio.

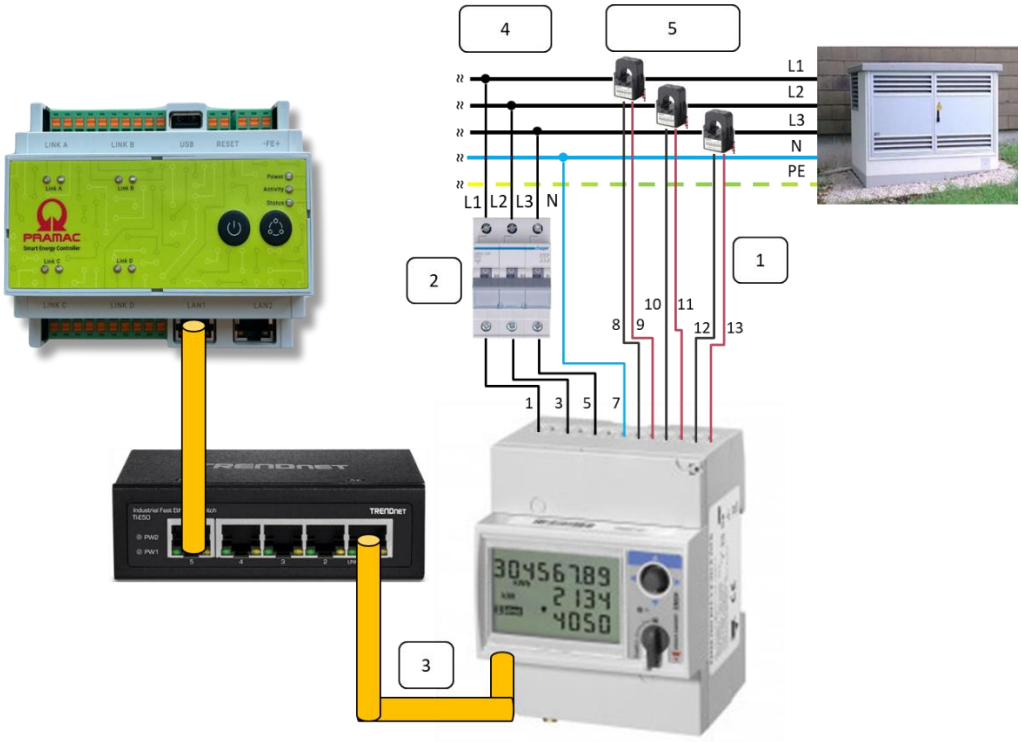



Figure 3-82: Energy meter connection via Ethernet

| Pos. | Description |
|---|---|
| 1 | A transformer is required for each phase to measure the current. It is important to ensure that the direction of the current arrow is uniform and is connected in the direction of the arrow from the mains connection to the consumer. |
| 2 | The voltage measurement must be fused separately. For this purpose, the customer must install a 3-pole circuit breaker or a 3-pole fuse in the sub-distribution board in which the Energy Meter is also installed. |
| 3 | Ethernet connection from energy meter to switch. |
| 4 | Voltage measurement |
| 5 | Current measurement |

**NOTE**

- It is important that transformer 1 is connected with phase L1 and analogue L2 and L3 and that the direction of rotation L1, L2, L3 is maintained.
- Only use shielded and twisted cables for Ethernet cabling.
  We recommend network cables of type CAT6/CAT7.
- The fuse is not included in the scope of delivery. The dimensioning of the fuse and the conductor cross-sections must be designed by the customer.
- Observe the counting arrow direction:
  Install the PV meter and grid meter in the correct counting direction: Supply + / Feed-in -.

The electrical connection of the BSO MAX or BSO MAX PRO is now complete.

# 4 First Power-On and Configuration

## 4.1 Before operation

To ensure safe operation of the BSO MAX or BSO MAX PRO, the following tests are required after installation and wiring have been completed:

1. Check that the installation environment of the device meets the requirements,
2. that the installation clearances are sufficient to ensure normal maintenance of the appliance,
3. that the appliance is firmly connected to the foundation,
4. that the DC power cables are connected correctly,
5. that the positive and negative poles are connected correctly,
6. that the phase sequence of U = L1, V = L2 and W = L3 is maintained on the AC side (clockwise rotating field).
7. that the power transfer switch (PSTS) is correctly connected on the AC and network side (only with BSO MAX PRO)

**NOTE**

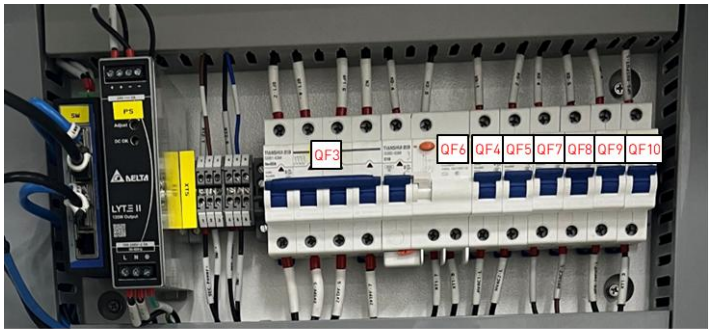
- Checklist BEFORE commissioning

## 4.2 Securing the BSO MAX Battery Storage

1. Switch on the main AC supply for the Battery Storage Outdoor at the transfer point.
2. Use a multimeter to check that voltage is present at QF1.
3. Check that a clockwise phase sequence (right-hand rotation) is present at the AC connection of the BSO MAX.

The individual steps for switching on the BSO MAX are described below:

4. Close AC isolating switch QF1.
   - All other circuit breakers are closed in the delivery condition.
   - The inverter indicators BATTERY and GRID light up and blink.
   - The air-conditioning unit starts with a slight delay.



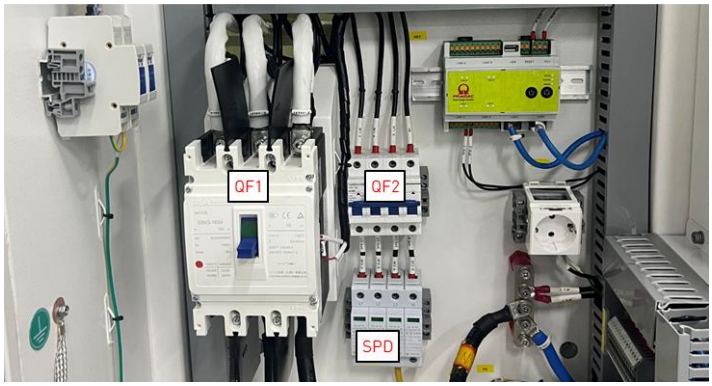




Figure 4-1: Designations Fuses

| | |
|---|---|
| QF1 | AC disconnector |
| QF2 | Fuse overvoltage protection |
| QF3 | Back-up fuse for auxiliary consumers |
| QF4 | Air conditioner 1 |
| QF5 | Air conditioner 2 |
| QF6 | Socket outlet |
| QF7 | Control fuse for QF1 (tripping) |
| QF8 | BMS fan |
| QF9 | UPS in |
| QF10 | UPS out |
| SPD | Overvoltage protection |

### 4.3 Switching on the circuit breakers of the PSTS and the BSO MAX PRO

Switching on the automatic circuit breakers (PSTS):

1. Check whether the UPS fuse is inserted in the PSTS.
2. Switch on the main AC supply for the PSTS at the transfer point.
3. Use a multimeter to check that voltage is present at the diverter switch of the PSTS.
4. Switch on all circuit breakers for voltage measurement and control
5. Check whether the UPS battery is charging. The yellow indicator light on the power supply unit (T1) should flash.

Switch on the circuit breakers of the BSO MAX PRO:

6. Switch on the main AC supply for the BSO MAX PRO in the main distribution board of the critical load.
7. Use a multimeter to check that voltage is present at QF1.
8. Check that a clockwise rotating field is present at the AC connection of the BSO MAX PRO.
9. Close AC disconnector QF1.
   - All other circuit breakers are closed in the delivery condition.
   - The inverter indicators BATTERY and GRID light up and blink.
   - The air-conditioning unit starts with a slight delay.
10. Once the Smart Energy Controller (PSEC) has been successfully configured, the diverter switch in the PSTS must be switched to automatic mode manually.

**NOTE**

- See manual for the power transfer switch (PSTS)
- Charge the UPS battery for approx. 12 hours during initial commissioning

## 4.4 Configuration of the battery inverter

The battery inverter is switched on by switching on the AC isolating switch QF1 in the main distribution board of the BSO MAX or BSO MAX PRO.

When activated, the battery inverter performs the following steps:

- Internal tests (e.g. relay test).
- Checking the connection conditions for the AC grid and the battery storage system.

The inverter will not yet switch to operating mode as the DC disconnector of the battery rack is still open and the network configuration has not yet been completed.

The network configuration of the inverter can be carried out via laptop with the PBI Connect PC software.

PBI Connect can be downloaded at www.pramac.com.

### 4.4.1 Configuration via Ethernet

With the PC software PBI Connect, firmware updates can be performed and country-specific inverter parameters can be set. The connection between the PC and the inverter can be established via Ethernet.

At the first startup of the inverter, PBI Connect displays the initial setup screen with the following settings:

- Installation country (DE/AT/CH etc.)
- Grid code (if several are available for the selected country)
  (e.g., VDE AR-N 4105/4110 / TOR Generator Type A, etc.)
- Nominal grid voltage
- Date and time
- Ensure that the DNS server IP address is the same as the standard gateway address. This address corresponds to the EMS (PSEC) IP: 192.168.42.1

Optional settings:

- Limitation of continuous power
- Remote shutdown signal
- RS485 network settings

| FUNCTIONS | |
|---|---|
| Firmware update | Frequency-dependent power reduction |
| Export of inverter data | Monitoring of instantaneous voltage (line-to-neutral voltage) |
| Feed-in conditions: voltage and frequency | Frequency monitoring |
| Ramp-up time after grid fault | Reactive power provision (cos φ, etc.) |
| Monitoring of average voltage | Switching times |
| Monitoring of line-to-line voltage | |

### 4.5 Configuration of the Energy Meter

The configuration of the energy meter via RS485 or Ethernet can be found in the respective manual.

**NOTE**

The appropriate transformer ratio still needs to be set.

Ct berechnet sich wie folgt: $C_t = \frac{\text{Transformer}_{\text{Maximum Current}}}{\text{Transformer}_{\text{Rated Current (5 A)}}}$

### 4.6 Powering On the Battery Rack

**NOTE**

Before powering on the battery rack, verify both the correct DC power cabling and the correct network cabling.

1. Turn on the voltage supply for the BMS (AC1) of the battery string.

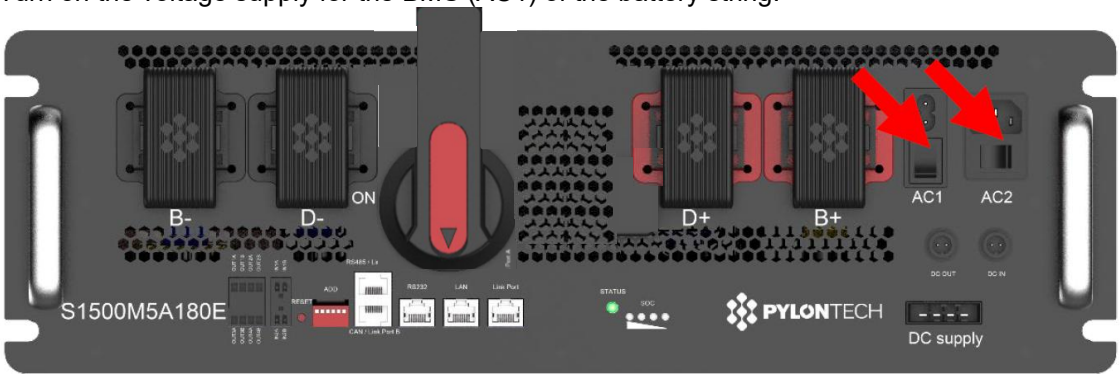



Figure: 4-3: BMS – AC1 and AC2

Once the AC1 voltage supplies are turned on, the BMS of the battery string enters self-test mode. If the battery string is functioning normally, the status LED lights green. The self-test is usually completed within 30 seconds.

However, since the BMS has not yet received any signals from the EMS, the status LED will turn red after 30 seconds. This behavior is normal.

If the status LED is red from the beginning, this indicates a fault in the battery string. Fault diagnosis must be carried out, as the power relays in the BMS cannot close.

2. Turn on the battery string by rotating the DC isolator switch to the “ON” position.

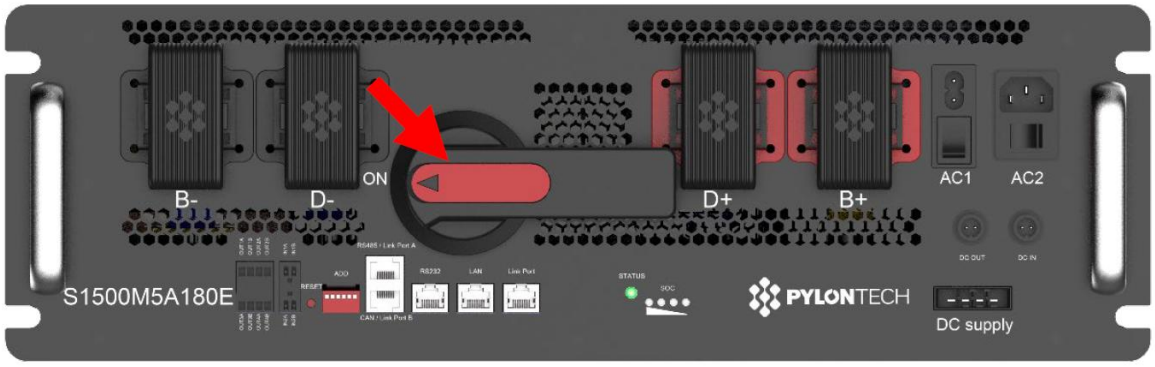



Figure 4-4: Switch on main switch DC rack

Table 4-1: LED display instructions

| BATTERY STATUS | Protection / Alarm / Normal | STATUS (green) | STATUS (red) | Capacity (SOC) | | | | Description |
|---|---|---|---|---|---|---|---|---|
| | | ● | ● | ● | ● | ● | ● | |
| Switched off | | Off | Off | Off | Off | Off | Off | Completely switched off |
| Sleep | Normal | Blink 2[1)] | Off | Off | Off | Off | Off | Indicates sleep mode to save energy |
| Idle | Normal | On | Off | Off | Off | Off | Off | Indicates energy-saving mode |
| | Alarm | On | Off | Off | Off | Off | Off | Indicates that the battery voltage or temperature is high or low |
| | Protection | Off | On | Off | Off | Off | Off | Indicates that the battery voltage or temperature is too high or too low |
| Charge | Normal | On | Off | The highest capacity indicator LED blinks (Blink 2[1)]), while the others remain steadily lit. | | | | The highest capacity indicator LED blinks (Blink 2[1)]), while the others remain lit |
| | Alarm | On | Off | | | | | |
| | Protection | Off | On | Off | Off | Off | Off | Charging stopped, STATUS (red) lit |
| Discharge | Normal | Blink 2[1)] | Off | Capacity indication (%) | | | | Capacity indication in 25% steps |
| | Alarm | Blink2[1)] | Off | >75 | ≤75 | ≤50 | ≤25 | |
| | Protection | Off | On | Off | Off | Off | Off | Discharging stopped, STATUS (red) lit |
| Faults / Alarms | Startup Fault | Off | Blink 4[2)] | Off | Off | Off | Off | Charge/discharge stopped, STATUS (red) lit |
| | Other Fault | Off | On | Off | Off | Off | Off | |
| | STL Fault | Off | Blink 2[1)] | Blink 2[1)] | | | | MCU self-test problem |

**NOTE**

Blinking Instructions

[1)] Blink 2: 0.50 s ON | 0.50 s OFF

[2)] Blink 4: 1.00 s ON | 1.00 s OFF

## 4.7 Commissioning of Pramac Smart Energy Controller (PSEC)

The PSEC features local monitoring, accessible via a LAN (Ethernet) connection at port **“LAN 1”** (OT network).

The initial login credentials are: admin / admin.

The address for browser access is: „https://192.168.42.1“ or „https://energy.controller“.

1. Connect the laptop to the internal LAN 1 network (via switch).
2. Enter the PSEC IP address in the web browser and press **ENTER**.

**NOTE**

- All further steps for commissioning the PSEC can be found in the online manual.

REMARK

The next steps are available via the link: https://docs.pramac.energy/de/installation_guide or the QR code below.


Figure 4-5: QR code for registration

## 4.8 Balancing After Commissioning

After successful commissioning, the BSO MAX battery must be calibrated. To do this, balancing must be activated in the operation interface. Depending on the state of charge (SoC/%) of the individual battery modules, balancing may take several days.

**NOTE**

Automatic balancing can also occur during operation. This happens if the SoC remains below 90% for more than 30 days.

## 4.9 Functionality of the fire extinguishing system

The mode of operation is based on 2 independent chains of action.

1) The smoke and/or heat detector emits a signal to the EMS. The detectors also emit an acoustic signal. The EMS notifies the operator of an overtemperature and/or smoke development via e-mail. An alarm is also visible in the user portal.
2) The aerosol generator has independent temperature monitoring. If the temperature on the housing of the aerosol generator is > 93°C, the extinguishing agent in the generator is activated. The aerosol flows out of the generator and prevents the flame from spreading. The quantity of aerosol is sufficient for a duration of approx. 20 minutes. When the generator is activated, a signal is sent to the EMS to alert the operator.
3) The DN65 extinguishing water connection installed at the rear allows the local fire brigade to cool the battery system if necessary.

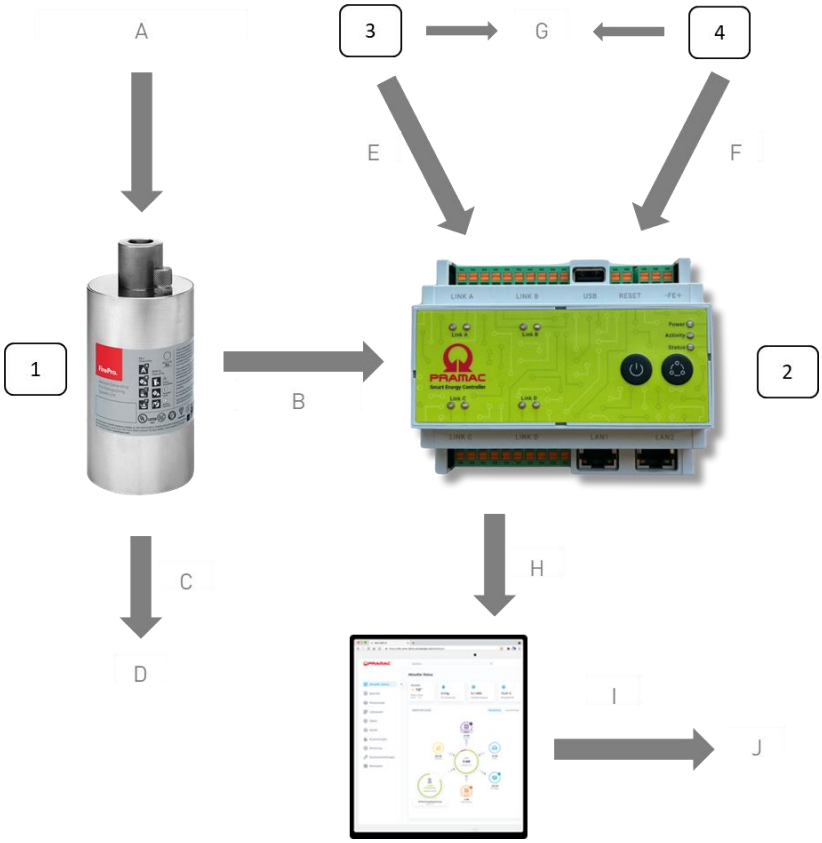


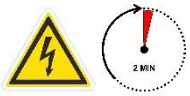

Figure 4-6: Function of the extinguishing system

| Pos. | Description | Pos. | Description |
|---|---|---|---|
| 1 | Aerosol generator | A | Aerosol generator temperature > 93°C |
| 2 | PSEC | B | "Aerosol released" Contact |
| 3 | Smoke sensor | C | Aerosol released |
| 4 | Heat sensor | D | Fire extinguishing |
| | | E | If smoke |
| | | F | If overtemperature |
| | | G | Audible alarm |
| | | H | Overtemperature status / smoke status |
| | | I | If overtemperature detected OR if smoke detected |
| | | J | EMS feedback to the customer |

# 5 Decommissioning

## 5.1 Decommissioning the BSO MAX

**⚠ WARNING**




After shutting down the BSO MAX, do not switch it on again for at least 2 minutes to ensure that the internal capacitors are completely discharged.

Only then can the product be put back into operation.

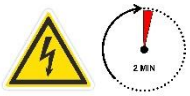
1. Check BSO MAX for current charging or discharging mode.
   Otherwise, the BSO MAX is in standby mode and the AC and DC currents are 0 A.
2. Switch off QF1.
3. Switch off the battery rack by turning the DC isolator switch on the rack BMS to the "OFF" position.

**⚠ WARNING**

Do not switch off the DC disconnector during normal operation.

## 5.2 Decommissioning the BSO MAX PRO and PSTS

**⚠ WARNING**




After shutting down the BSO MAX PRO, wait at least 2 minutes before switching it on again to ensure that the internal capacitors are fully discharged.

Only then can the product be put back into operation.

1. Check BSO MAX PRO for current charging or discharging mode or stand-alone operation.
   Otherwise, the BSO MAX PRO is in standby mode and the AC and DC currents are 0 A.
2. Switch the PSTS diverter switch from automatic mode to manual mode.
3. Switch off QF1.
4. Switch off the battery rack by turning the DC isolator switch on the rack BMS to the "OFF" position.
5. Switch off the main AC supply for the BSO MAX PRO in the main distribution board of the critical load.
6. Remove the fuses for the power supply line (PSTS)
7. Remove and store the fuse from the UPS (PSTS)

**⚠ WARNING**

Do not switch off the DC disconnector during normal operation.

**NOTE**

- Observe the manual for the PSTS automatic transfer switch.

# 6 Maintenance information

Due to the influence of ambient temperature, humidity, dust and vibration, the devices in the BSO MAX age and wear out, which can lead to potential failures in the BSO MAX. Regular maintenance is therefore necessary to ensure normal operation over the service life. All measures and methods that help to ensure that the BSO MAX remains in good operating condition fall within the scope of maintenance work.

## 6.1 Maintenance BSO MAX or BSO MAX PRO

The following tables list the recommended maintenance work and routine intervals and also serve as a maintenance checklist.

Table 6-6-1: Maintenance BSO MAX or BSO MAX PRO housing

| CONTENT | ENTRY | MINIMUM INTERVAL | NOTE | CHECKS |
|---|---|---|---|---|
| Site inspection & operating condition | • Visual inspection of the system and its installation site.<br>• Verify compliance with installation requirements and minimum clearances.<br>• Check housing for external damage, deformation, or corrosion. | 2/a | Depending on location. For areas with regular pedestrian traffic, shorter inspection intervals are recommended (vandalism). ≈ 15 min | □ OK<br>□ NOT OK |
| Safety markings on BSO MAX / BSO MAX PRO | Check warning signs and markings on the outdoor enclosure. | 1/a<br>or as needed | Depending on location. For areas with regular pedestrian traffic, shorter intervals are recommended. ≈ 5 min | □ OK<br>□ NOT OK |
| Inspection for unusual operating noises (external) | • Acoustic inspection to detect unusual noises and identify potential faults early.<br>• Inspect device for damage or deformation. | 1/a | Normal operational sounds are described in the maintenance manual. ≈ 8 min | □ OK<br>□ NOT OK |
| Inverter area air outlet (louver) | Visual inspection of the Louver and filter mat. If heavily soiled, clean using compressed air. Replace filter mat if necessary. | 2/a<br>or as needed | Depending on location. Heavy dirt may reduce cooling efficiency and prevent full inverter performance. ≈ 5 min | □ OK<br>□ NOT OK |

Table 6-6-2: Maintenance battery area

| CONTENT | ENTRY | MINIMUM INTERVAL | NOTE | CHECKS |
|---|---|---|---|---|
| Operating condition & environment | • Visual inspection of the battery area.<br>• Check components for damage, moisture, and deposits. Clean with compressed air if necessary. | 1/a | | □ OK<br>□ NOT OK |
| Electrical connections / terminals & cables | • Visual inspection of power cables and busbars on the battery rack.<br>• Check all connections (e.g., torque check – follow safety instructions and wear protective equipment; Battery is energised).<br>• Check contacts (e.g., thermographic inspection during operation – follow safety instructions and wear PPE; Battery is energised). | 1/a | Check cable connections between battery modules and BMS. Replace damaged, corroded, or suspicious connections. Ensure busbars are secure. Remove battery module covers. Electric shock hazard – use PPE. ≈ 20 min | □ OK<br>□ NOT OK |
| Communication & power cables (fans) | • Visual inspection of communication cables.<br>• Check all plug connections.<br>• Verify contact. | 1/a | Ethernet cables between battery modules and BMS. Ethernet cables between BMS / inverter / energy meter / Ethernet switch. Power cables between BMS and modules. Reinstall module covers. ≈ 15 min | □ OK<br>□ NOT OK |
| Surge protection (SPD) | • Check trigger indication. | | Replace SPD elements after activation. | □ OK<br>□ NOT OK |
| Tripping and testing of residual current device (RCD) | • Routinely test the QF6 residual current device (RCD) | 2/a | Press the release button on the QF6 and check functionality | □ OK<br>□ NOT OK |
| Pressure relief valves | • Visual inspection. | 1/a | | □ OK<br>□ NOT OK |
| Battery rack & modules | • Visual inspection of the battery rack and components.<br>• Check status LEDs of battery modules and BMS.<br>• Check for moisture and dust in and around the battery storage rack. | 1/a | Inspect for damage, moisture, deposits, and dirt. Clean using compressed air or a dry, soft cloth. ≈ 5 min | □ OK<br>□ NOT OK |
| Inspection for unusual operating noises (battery area) | • Inspect BSO for damage or deformation.<br>• Acoustic inspection to detect unusual noises and identify potential faults early. | 1/a | Normal operational sounds are described in the maintenance manual. ≈ 5 min | □ OK<br>□ NOT OK |

Table 6-6-3: Maintenance of inverter area

| CONTENT | ENTRY | MINIMUM INTERVAL | NOTE | CHECKS |
|---|---|---|---|---|
| Operating condition & environment | • Visual inspection of the inverter area.<br>• Check components for damage, moisture, and deposits. Clean with compressed air if necessary.<br>• Check for dust and moisture around the inverter. | 1/a | Depending on location. Clean with compressed air or dry, soft cloth. ≈ 10 min | □ OK<br>□ NOT OK |
| Electrical connections / terminals & cables | • Visual inspection of power cables.<br>• Check all connections.<br>• Verify contacts and torque. | 1/a | Visible cable connections from AC supply through line choke to inverter. Replace damaged, corroded, or suspicious connections. Check additional connections (e.g., PSEC, Ethernet switch, air-conditioning). ≈ 10 min | □ OK<br>□ NOT OK |
| Air inlet & outlet at front/rear of BSO MAX / BSO MAX PRO | • Remove louvers.<br>• Visual inspection of louvers; clean with compressed air if heavily soiled.<br>• Inspect inlet filter mats; clean with compressed air or replace if heavily soiled. | 1/a | Check for damage, dirt, or deposits. Perform functional test. ≈ 5 min | □ OK<br>□ NOT OK |
| Fans (in inverter room) | Check fan function and unusually loud operating noises. | 1/a | | □ OK<br>□ NOT OK |
| Inspection for unusual operating noises (inverter area) | Acoustic inspection to detect unusual noises and identify potential faults early. | 1/a | Normal operational sounds are described in the maintenance manual. ≈ 5 min | □ OK<br>□ NOT OK |

## 6.2 Maintenance of Battery Inverters PBI 90K and PBI 90K-BU

The table below lists the required maintenance tasks and intervals for the battery inverter and also serves as a maintenance checklist.

Table 6-6-4: Inverter maintenance PBI 90K / 90K-BU

| CONTENT | ENTRY | MINIMUM INTERVAL | NOTE | CHECKS |
|---|---|---|---|---|
| Inverter fan inspection | • Visual inspection of the inverter fan.<br>• Check functionality and unusually loud operating noises. | 1/a | Check for damage, deposits, and dirt. Perform a functional test at the end of maintenance. The inverter will automatically run a fan test after recommissioning. ≈ 10 min | □ OK<br>□ NOT OK |
| Heatsink | Visual inspection of the heatsink and, if necessary, cleaning with compressed air. | 1/a<br>or as needed | Depending on the installation location. For better access, remove the air outlet plate. ≈ 5 min | □ OK<br>□ NOT OK |
| Air outlet plate | • Visual inspection | 1/a<br>or as needed | Check for dirt, blockages, or damage. Clean with compressed air or a dry, soft cloth. | □ OK<br>□ NOT OK |

| | | | | |
|---|---|---|---|---|
| | | | Replace if heavily soiled. ≈ 3 min | |

**NOTE**

Shorter maintenance intervals may be required depending on location and environmental conditions.

### 6.3 Maintenance of Air-Conditioning Unit

To ensure normal operation of the air-conditioning unit, regular maintenance must be performed.
The table below serves as a maintenance checklist.

**⚠ WARNING**

All maintenance work should be carried out by qualified personnel.
Before performing any maintenance, disconnect the power supply, communication, and alarm output cables of the air-conditioning unit, and only reconnect them prior to performing the functional test.

Table 6-6-5: Maintenance air conditioner / fan

| CONTENT | ENTRY | MINIMUM INTERVAL | NOTE | CHECKS |
|---|---|---|---|---|
| Inspection of electrical connections / terminals and cables | • Visual inspection of cable connections and terminal clamps.<br>• Check that all cable connections are secure | 1/a | Damaged, corroded, or suspicious cable connections must be replaced. ≈ 5 min | □ OK<br>□ NOT OK |
| Capacitor and filter | Perform visual inspection. | 1/a | Depending on the installation location, check for deposits and dirt. If heavily soiled, clean using compressed air or water. ≈ 5 min | □ OK<br>□ NOT OK |
| Fans (internal / external) | • Perform visual inspection.<br>• If blocked, clear the airflow path and clean thoroughly.<br>• Check for moisture and dust in and around the battery storage kit. | 1/a | ≈ 3 min | □ OK<br>□ NOT OK |
| Condensate drain | • Perform visual inspection.<br>• If blocked, clear the drain and clean thoroughly. | 1/a | ≈ 3 min | □ OK<br>□ NOT OK |
| Functional test | • Reconnect wiring and switch on the air-conditioning units.<br>• Check the setpoints (see right).<br>• Run the unit's self-test programme.<br>• Check all components for correct operation. | 1/a | Setpoints:<br>Cool SP: 20 °C<br>Cool sensitivity: 4 °C<br>Heat SP: 14 °C<br>Heat sensitivity: 4 °C<br>≈ 15 min | □ OK<br>□ NOT OK |

### 6.4 Maintenance of Fire Protection System

The fire protection systems on the rear of the battery system must be maintained regularly.

Table 6-6-6: Maintenance of fire protection equipment

| CONTENT | ENTRY | MINIMUM INTERVAL | NOTE | CHECKS |
|---|---|---|---|---|
| Visual inspection | Visual inspection of the aerosol generator | 1/a | Check for damage, corrosion, leaks, and contamination. Replace immediately if any issues | □ OK<br>□ NOT OK |

| | | | | |
|---|---|---|---|---|
| | | | are found. Screws on the covers must be secured with Loctite 2400 threadlocker. ≈ 5 min | |
| Visual & functional inspection | Visual and, if necessary, functional inspection of smoke and temperature detectors | 1/a | Smoke and temperature detectors must be subjected regularly to an on-site smoke or heat test in accordance with applicable local regulations to ensure alarms are triggered correctly. Check the supply voltage, the condition of connections, and the wiring. The plastic surface of the bases may be cleaned with a damp cloth. | □ OK<br>□ NOT OK |

### 6.5 Maintenance of the UPS

The 230 V UPS including battery, integrated in the BSO MAX and BSO MAX PRO, must be serviced at regular intervals.

Table 6-6-7: UPS maintenance

| CONTENT | ENTRY | MINIMUM INTERVAL | NOTE | CHECKS |
|---|---|---|---|---|
| Operating condition and environment | • Visual inspection of the UPS battery.<br>• Check components for damage, moisture and deposits.<br>If necessary, clean with compressed air. | 1/a | | □ OK<br>□ NOT OK |
| Charging after extended downtime | Charge the UPS battery for approx. 12 hours if the UPS has been switched off for more than 3 months. | | | |

## 6.6 Maintenance of the Energy Management System

Table 6-8: Maintenance of energy management system

| CONTENT | ENTRY | MINIMUM INTERVAL | NOTE | CHECKS |
|---|---|---|---|---|
| Serial number & firmware version | Read out the serial number of the PRAMAC Smart Energy Controller, as well as the currently used firmware version. | 1/a | Available under “System settings” in the “Controller detail view”. ≈ 5 min | □ OK<br>□ NOT OK<br>Serial number:<br>…<br>FW version:<br>… |
| Operating data and battery parameters | Check the current operating data and battery storage parameters. | 1/a | Check the status under “Storage” in “Details”. Parameters can be read out under “BMS”. Verify all Inverter Battery Units (IBU). ≈ 8 min | □ OK<br>□ NOT OK<br>Ucell,max:<br>Ucell,min:<br>Tcell,max:<br>Tcell,min:<br>SoC real:<br>SoH: |
| Current error messages | Read out & document current error messages. | 1/a | Error messages can be found under the “Notification” tab. Documentation of error messages via screenshot. ≈ 5 min | □ OK<br>□ NOT OK |

Once the individual maintenance steps have been successfully completed, the BSO MAX Outdoor can be put back into operation as follows:

- The recommissioning of the battery storage system is fully described in the maintenance manual.
- System operation must be reactivated within the user interface of the energy management system.
- By switching off the BMS, recalibration (balancing) of the battery is required.
- Depending on the settings, recalibration is initiated either by the BMS itself or according to the defined schedule.

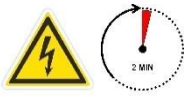
# 7 Dismantling and recycling

## 7.1 Dismantling

The BSO MAX or BSO MAX PRO is dismantled as described below:

1. Switch off the BSO MAX (see chapter „5 Decommissioning
2. Decommissioning the BSO “) or BSO MAX PRO (see chapter „5.2 Decommissioning the BSO MAX PRO and “).

**⚠ CAUTION**




There is residual voltage in the inverter!

Before opening the device, the operator should wait 2 minutes to ensure that the capacitor is completely discharged.

3. Unplug and remove the communication cable from the PSEC / switch / router.
4. If necessary, dismantle and remove the energy meter including transformer at the grid transfer point.
5. Disconnect and remove the AC supply in the connection area of the BSO MAX or BSO MAX PRO.
6. Loosen the earthing connection on the housing.

Loosen the fixing screws of the BSO MAX or BSO MAX PRO and lift the BSO MAX off the foundation using a crane / forklift and remove it.

## 7.2 Recycling

### 7.2.1 Recycling Battery Racks

Disposal of Damaged, Defective, or End-of-Life Batteries

- Dispose of damaged or defective batteries in accordance with local laws and regulations, based on Regulation (EC) No. 1013/2006 of the European Union. Do not dispose of defective or damaged batteries in household waste or publicly accessible recycling bins, as this may cause environmental pollution or explosions.
- Contact a battery recycling company to properly dispose of the battery. Alternatively, Pramac GmbH offers its customers in Germany free take-back for the proper disposal of end-of-life devices in Germany from the company headquarters in 70736 Fellbach, in accordance with the German Battery Act (BattG). For this, please contact the service team at service.pramac.com.
- Keep damaged or used batteries away from high temperatures and direct sunlight.
- Ensure that damaged or used batteries are not exposed to high humidity or corrosive environments.
- Do not attempt to reuse damaged or used batteries. Contact a battery recycling company immediately for proper disposal to prevent environmental contamination.

### 7.2.2 Recycling Battery Inverters

**NOTE**

Packaging and replaced parts must be disposed of in accordance with the regulations of the country where the product is installed.

The battery inverter PBI 90K and PBI 90K-BU must not be disposed of with normal household waste.

PR Industrial S.r.l. offers its customers free take-back for the proper disposal of old equipment in Germany, starting from the company’s headquarters in 70736 Fellbach.

The battery inverter PBI 90K and PBI 90K-BU is RoHS-compliant. For complete take-back, please contact our service department.

Registration in accordance with ElektroG

According to the law, every manufacturer and distributor of electrical equipment is obliged to register and to maintain a corresponding WEEE number.

# 8 Quality Assurance

WARRANTY

The current warranty conditions can be downloaded from the Internet at www.pramac.com.

Disclaimer

If a fault occurs in the BSO MAX or BSO MAX PRO during the warranty period, please contact your installer or supplier. For defects that are the responsibility of the manufacturer, PR Industrial S.r.l. will provide free replacement or repair within the warranty period.

Any defect caused by the following circumstances is not covered by the manufacturer's warranty. Dealers or distributors are responsible for, and authorised by PR Industrial S.r.l. to carry out, the following assessment:

- Product modified, design changed, or parts replaced without approval from PR Industrial S.r.l.
- Alterations or repair attempts, and deletion of the serial number or seals by a technician not employed by PR Industrial S.r.l.
- Failure to comply with the user manual, installation instructions, and maintenance requirements; improper use or misuse of the equipment.
- Non-compliance with local safety regulations (e.g. VDE standards in Germany).
- Non-compliance with local grid connection requirements (e.g. VDE application rules in Germany) in the case of incompatible grid connection.
- Improper storage of the product and damage during storage by the dealer or end user.
- Transport damage (including paint scratches caused by movement within the packaging during transport). A claim must be submitted directly to the insurance company once the packaging has been unloaded and such damage has been detected.
- Operation of the system outside the specified temperature range, or inadequate ventilation of the system.
- Failure to follow prescribed maintenance procedures for the product.
- Damage caused by external factors or force majeure (violent or stormy weather, lightning, overvoltage, fire, etc.).

# 9 Technical Support

If you have followed the troubleshooting steps and were unable to resolve your issue, you can contact the PR Industrial S.r.l. service team as follows:

Websites: support.pramac.com
www.pramacparts.com
www.pramac.com

PR Industrial S.r.l.
Loc. Il Piano
53031 Casole d'Elsa (SI)
ITALIA

Version 1.4 (Nr. PS-20269)

January 2026