Freen-BSL

Energy storage unit user's manual

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

For the latest documentation, technical updates and warranty information, visit:

www.freen.com

Product Scope

This manual applies to the following products:

Energy Storage Unit FREEN-BSL

All specifications and descriptions in this manual are verified to be accurate at the time of publication.
Due to continuous product improvement, Freen OÜ reserves the right to make changes to the product, documentation, or specifications without prior notice.

Images used in this document are for illustration purposes only. Depending on product revision and regional configuration, the appearance may differ slightly.

Copyright and Legal Notice

Additional technical information may be available upon request.

The following names and logos are trademarks or registered trademarks of Freen OÜ in applicable countries:

Freen OÜ Energy Storage Unit Freen-BSL

All other trademarks mentioned herein are the property of their respective owners.
Use of their names does not imply endorsement or affiliation.

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

Table of Contents

1. ***Product overview*** 4
2. ***Safety information*** 5
3. ***System Description*** 8
4. ***System installation*** 14
5. ***System Operation*** 18
6. ***Maintenance*** 20
7. ***Storage and Transport*** 21
8. ***Datasheet*** 22
9. ***Warranty Information*** 23

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

1. Product overview

The Freen-BSL series offers scalable, low-voltage rechargeable sodium-ion battery modules ideal for residential and small commercial energy storage systems. With excellent cycle life, high round-trip efficiency, and robust operating temperature range, these floor-mounted units are designed for performance and reliability — even in extreme climates.

With a nominal voltage of 48 V and modular configurations, Freen-BSL systems are compatible with most inverters, providing high power output, extended cycle life, and dependable operation.

High Efficiency

Over 97% round-trip energy efficiency ensures minimal energy loss during storage and retrieval.

Long Lifetime

Delivers over 5,000 full charge-discharge cycles with >80% of end capacity for long-term performance and reliability.

Sodium-ion Technology

A fire-safe, and sustainable alternative with stable performance across various conditions.

Modular Design

Scalable architecture allows flexible system sizing to meet different energy storage needs.

Broad Temperature Tolerance

Consistent performance even in the harshest environmental conditions. Capable of discharging between -40°C and +65°C.

Low Upkeep Requirements

Natural convection cooling, robust safety engineering, and smart CAN/RS485 communication.

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

2. Safety information

(Compliant with EU Regulation 2023/1542 - general user-level requirements)

2.1. General Safety

- Do not open, disassemble, or modify the battery enclosure.
- Keep the product away from water, moisture, and chemically aggressive environments.
- Do not expose the system to direct sunlight, open flames, sparks, or heat sources.
- Do not stack heavy objects on top of the unit or apply mechanical shock (impact, dropping, crushing).
- Ensure that the unit is positioned on a level, stable surface before operation.
- Do not allow children or unauthorized people to operate or interact with the system.
- The system must be used only with compatible inverters and electrical equipment (see actual list on freen.com).

2.2. Electrical Safety

- Always **turn off** the inverter and isolate the DC circuit before connecting or disconnecting the battery.
- Ensure correct polarity:

Red = Positive (+), **Black = Negative (–)**.

- Never short-circuit the DC terminals.
- Use only approved cables with appropriate current ratings and insulation.

Recommended minimum DC cable cross-section: 25 mm^2 copper

- Avoid loose connections - improperly tightened terminals can cause overheating or arcing.

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

- Do not touch exposed conductors with wet hands or conductive tools.
- Ensure that the system is properly grounded according to local electrical regulations.
- Avoid placing metal objects near the terminals.

2.3. Temperature and Environmental Requirements

Operating Temperature

- **Charging:** 0°C to +60°C
- **Discharging:** –40°C to +65°C

Storage Temperature

- Recommended: **-10°C to +25°C**
- Long-term storage should be at **20–85% state of charge (SoC)**.

Environmental Conditions

- Indoor installation only
- Keep the system away from humidity, dust, and corrosive agents.
- Maintain at least **5 cm** clearance around the enclosure for airflow.
- Prevent condensation - allow the battery to acclimate to room temperature before powering on if previously stored in a cold environment for not less than 24 hours.

2.4. Emergency Procedures

Overheat, Smoke, Abnormal Noise or Smell

If one mentioned above observed:

- Immediately turn off the inverter and disconnect the DC power circuit.
- Move away from the product and ensure ventilation of the room.
- Do not attempt to open the enclosure.

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

- Contact technical support.

Liquid Exposure

If exposed to water or other liquids:

- Disconnect the unit from all power sources
- Do not turn it back on
- Allow professional inspection before reuse

Physical Damage

If the unit has been dropped, severely shaken, or damaged:

- Do not operate the system
- Contact the manufacturer for inspection

Fire Safety

- Use only **Class D** or **appropriate metal-fire extinguishers** for battery-related incidents.
- **Do NOT use water.**
- Evacuate personnel if smoke becomes dense or the unit becomes abnormally hot.

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

3. System Description

The Energy Storage Unit FREEN-BSL uses Sodium-Ion (Na-ion) battery cells. Sodium-ion chemistry provides high cycle life, enhances thermal stability and does not rely on lithium-based components.

The resulting system voltage is compatible with most 48 V-class inverters and energy storage applications.

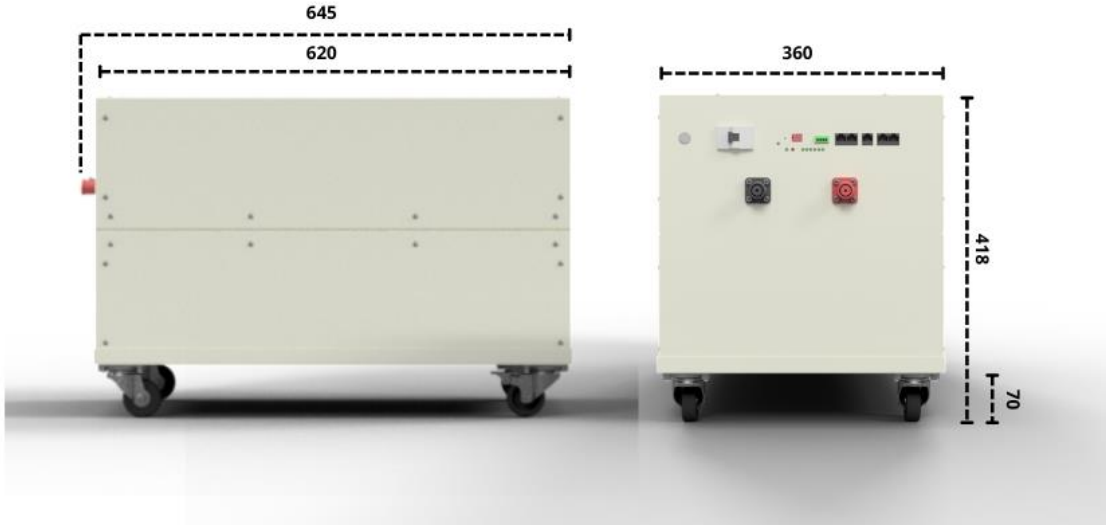
3.1. Mechanical Features

The Energy Storage Unit is built using reinforced metal housing designed for indoor stationary installations. The enclosure provides structural rigidity, thermal stability and mechanical protection for the internal sodium-ion battery modules and the integrated BMS.

Key housing features:

- Powder-coated metal enclosure, corrosion-resistant
- Protection degree: **IP20** (indoor use only – no exposure to water, dust ingress limited)
- Side ventilation openings for natural air cooling
- Dedicated internal compartment for the **Battery Management System (BMS)**
- Front control panel with indicators, communication ports and main power terminals
- Lower structural frame for stable floor mounting

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54



Picture 1. Dimensions of Energy Storage Unit

The actual design of the unit may be different and changed by manufacturer.

3.2. Integrated BMS Functions

The system uses **Battery Management System** optimized for sodium-ion modules. The BMS continuously monitors the battery state and ensures protection under all operating conditions.

Main BMS functions:

Monitoring

- Cell voltage monitoring (individual series cells)
- Pack voltage and current measurement
- Dual temperature sensing (internal NTC sensors)
- State of Charge (SOC) calculation
- Remaining life cycle estimation

Protection Features

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

- Overcharge protection
- Over-discharge protection
- Over-current protection (charge and discharge)
- Short-circuit protection
- Over-temperature protection for charge/discharge
- Low-temperature charge restriction
- Automatic shutdown under critical conditions

Balancing

- Active balancing between cells for optimal lifetime and improved cycle stability
- Balancing during charge and float modes

Communication

- CAN bus (for inverter/EMS connection)
- RS485 (Modbus-type communication for monitoring)

Compatibility of this function must be verified for the specific inverter model.

Automatic Modes

- Auto wake-up after power connection
- Sleep mode during long inactivity
- Fault memory storage for service diagnostics

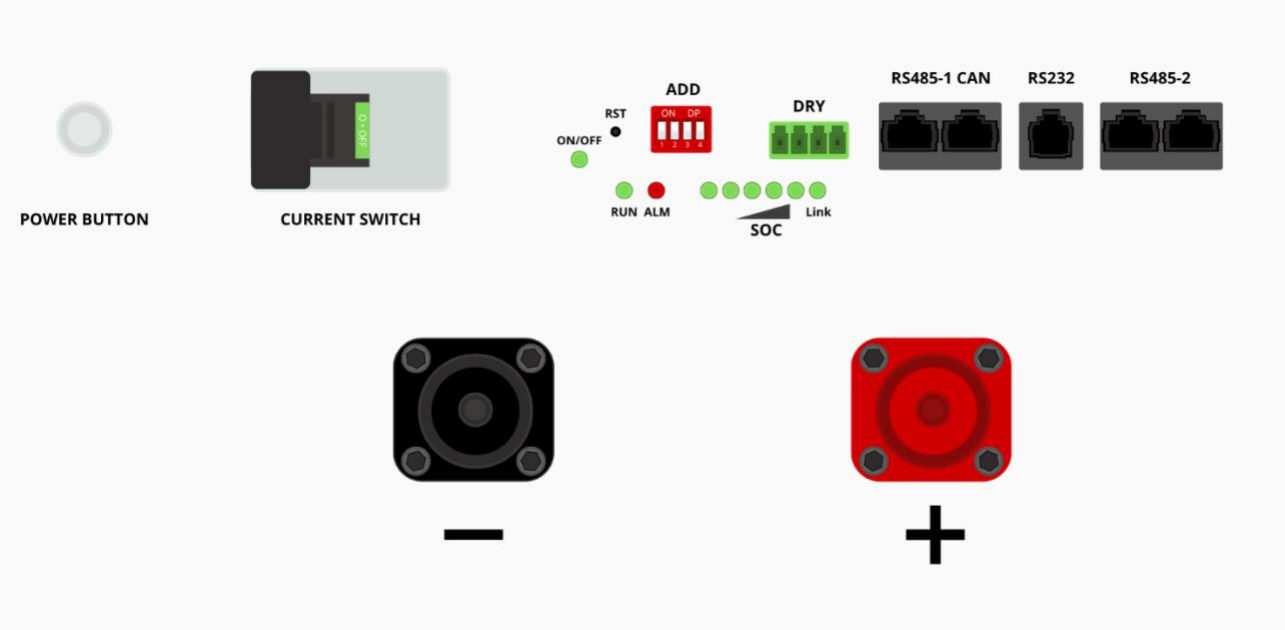
3.3. Ports, Interfaces and Terminals/ Indicators and Controls

The front panel (see picture 2) includes all user-accessible elements.

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

Name	Function / Purpose
Power Button	Turns the BMS system ON or OFF. Used to power-up after connection or shut down safely.
Current Switch (ON/OFF breaker)	Main current isolation switch. Cuts battery output/input current. Must be ON for the BMS to operate.
RST Button (Reset)	Resets the BMS controller. Used after wiring changes, errors, or configuration updates.
ADD – Address DIP Switches (1–4)	Sets the CAN/RS485 communication address when multiple BMS units are used in parallel.
RUN LED	Blinks when BMS is running normally.
ALM LED	Lights when an alarm is active (overvoltage, undervoltage, overcurrent, temp error, etc.).
SOC LEDs	Battery State of Charge indicator (more LEDs = higher charge level).
Link LED	Indicates active communication link (RS485/CAN).
DRY Contact (Dry Relay)	Relay output used for controlling external devices (contactors, alarms, chargers). No internal voltage.
RS485-1 / CAN	Communication port for CANBus or RS485 to inverter, computer, or another BMS.
RS232	Serial port for configuration or monitoring.
RS485-2	Additional RS485 port for daisy-chain communication.
Negative terminal (–)	Battery pack negative connection.
Positive terminal (+)	Battery pack positive connection.

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54



Picture 2. Energy Storage Unit Front Panel

3.4. System Scalability and Parallel Expansion

Our energy storage solution is designed to be modular and scalable. You can combine up to **16 individual energy storage units** to create a larger battery system tailored to your power and capacity needs.

Each single unit has the following specifications:

- Rated capacity: 158 Ah
- Nominal energy: 7.6 kWh
- Nominal voltage: 48 V
- Maximum continuous current: 100 A
- Maximum power: 4.8 kW

When multiple units are combined in parallel, the overall capacity and power increase accordingly:

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

- Total usable energy equals the sum of all connected units (for example, 16 units provide up to 121.6 kWh).
- The system voltage remains the same (48 V nominal).
- Maximum current and power scale roughly by the number of units connected.

Important user notes:

- All combined units must be the same model and have similar state-of-charge to ensure safe and efficient operation.
- The system's Battery Management System (BMS) manages communication and balancing between modules, helping maintain system stability.
- Installation and commissioning by **qualified personnel** is required to ensure correct parallel operation.
- Expansion can be done gradually, but adding modules later requires system configuration and verification.
- This modular approach offers flexibility and allows your energy storage to grow with your energy needs, making it ideal for both residential and commercial applications.

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

4. System installation

This section describes the required steps to install and commission the Energy Storage Unit FREEN-BSL. All installation work must be performed by qualified personnel.

4.1. Electrical Connection Procedure

Before you start

- Ensure the inverter is powered OFF.
- Lock the unit's caster brakes.
- Verify correct cable size for DC current **(Recommended minimum DC cable cross-section: 25 mm^2 copper. Ensure the same cable cross-section is used on both sides of the DC connection)**
- Confirm correct polarity on DC terminals.

Connection Steps (see picture 3)

1. **Connect the Ground**

Attach the grounding cable to the designated grounding point of the battery enclosure.

2. **Connect the Negative (–) Terminal**

Connect the black DC cable to the negative terminal. Tighten using an insulated tool. Ensure correct torque and firm contact

3. **Connect the Positive (+) Terminal**

Connect the red DC cable to the positive terminal. Tighten using an insulated tool Ensure correct torque and firm contact.

4. **Secure all connections**

Check for proper crimping, tightening, and insulation.

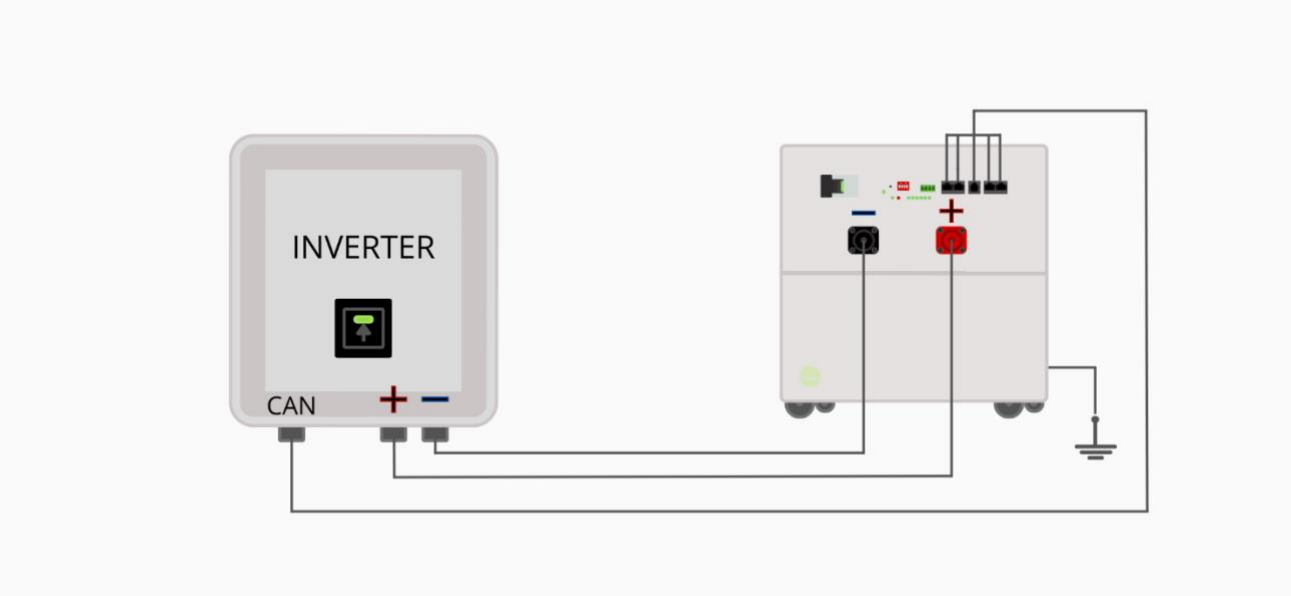
5. **Connect communication cables (if used)**

Install CAN or RS485 cables between the battery and the inverter/energy controller.

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

6. **Recheck all wiring**

Verify that no cables are under tension or touching sharp edges.



Picture 3. Simple connection diagram

4.2. Communication Wiring (CAN / RS485)

The Energy Storage Unit supports optional communication protocols for closed-loop control.

General Guidelines

- Use shielded twisted-pair cables (max. recommended cable length: 20–25m indoors)
- Avoid routing communication cables next to high-current DC lines.
- Follow the inverter manufacturer's wiring diagram for pin assignments.
- Only connect **one** communication protocol at a time (CAN *or* RS485).

- **For CAN**: follow device-specific CAN mapping (termination resistor if needed).
- **For RS485**: verify Modbus device ID and baud rate if applicable.

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

- Ensure connectors are fully seated and secured.

Typical Functions

- SoC/SoH reporting
- Charge/discharge control
- Error signaling
- Voltage/current telemetry

4.3. Initial Power-On Procedure

1. Verify that the housing is not damaged.
2. Ensure the unit is placed on a level floor surface.
3. Check ambient temperature: **+10 °C to +35 °C recommended**.
4. Connect protective earth (PE).
5. Connect DC cables to the inverter observing polarity.
6. Connect CAN or RS485 communication cable if required.
7. **Turn on** the inverter or system controller.
8. The BMS will automatically wake up; Power LED should illuminate.
9. Check that no Fault indication is active.

4.4. Mobile Application Monitoring

The BMS supports real-time monitoring through mobile applications - **Freen BMS app** - for iOS and Android devices.

After installing the application, enable Bluetooth on your mobile device and open the **Freen BMS app**. Once connected, the interface will display real-time battery information.

The application allows to monitor key operating parameters of the battery system, including:

- Individual cell voltages

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

- Total pack voltage
- Charge/discharge current
- Temperature sensor readings
- Balancing status
- Active protection indicators

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

5. System Operation

The Unit operates automatically under normal conditions. The BMS and inverter coordinate charging and discharging.

5.1. Normal Power Modes

- **Standby:** BMS active, inverter idle, no current flow.
- **Charge Mode:** Pack voltage rising, active thermal monitoring.
- **Discharge Mode:** Inverter supplies connected loads.
- **Protection Mode:** System isolates battery until safe recovery conditions are met.

5.2. Charge/Discharge Behavior

- Operating voltage: 40–60 V
- Max charge/discharge current: 100 A
- Max power: 4.8 kW

Temperature limits:

- Charge: 0 °C to +55 °C
- Discharge: –40 °C to +60 °C
- Storage: –10 °C to +35 °C

The BMS automatically reduces or stops charging if:

- temperature is below 0 °C or above +55 °C
- current exceeds permitted limits
- voltage reaches maximum

5.3. LED Indicators and Status Codes

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

Indicator	State	Meaning
Power LED	Solid green	System ON / normal operation
	Off	Unit in sleep mode or no power
SOC LEDs	1–4 green bars	Battery state of charge (25–100%)
Fault LED	Red blinking	Protection active (over-voltage, over-temp, etc.)
	Red solid	Critical fault – system locked, service required

Notes:

- Fault LED behavior is controlled by BMS event priority.
- Detailed diagnostics available via CAN/RS485 reading.

5.4. Standby and Sleep Modes

- The unit enters Sleep Mode after long inactivity without communication or current flow.
- Wake-up occurs automatically when:
  - Inverter requests current
  - Communication becomes active
  - DC voltage applied

Sleep mode minimizes internal consumption and protects the battery during long idle periods.

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

6. Maintenance

6.1. Visual Inspection (Every Month)

- Check for damage to housing or connectors
- Ensure ventilation slots are not blocked
- Confirm no signs of overheating or smell
- Verify LEDs for normal operation
- Check cabling for wear, corrosion or loose connections

6.2. Recommended Service Intervals

Every 2-3 months:

- Check and restore tightening terminal connections
- Clean ventilation zones

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

7. Storage and Transport

Storage Requirements

- Store at **40–60% State of Charge (SoC)** for long-term storage.
- Storage temperature: -**10°C to 35°C** recommended.
- Avoid direct sunlight and high humidity.
- Recharge the battery every **3 months** if stored idle.

Transport

- Transport upright and secure in the original packaging.
- Do not expose to excessive shock, vibration, or dropping.
- Ensure power is turned off before transport.
- Follow regional battery transport regulations.

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

8. Datasheet

Technical specifications	
Cell type	Sodium-ion
Rated capacity	158 Ah
Nominal/Usable Energy	7.6 kWh
Nominal voltage	48 V
Operating voltage	40-60 V
Max. charging/discharging current	100 A
Max. charging/discharging power	4.8 kW
Dimensions, mm（W / D / H）	680 x 360 x 418
Weight	120 kg
Mounting method	Floor Mounted
Installation location	Indoor
Storage temperature range	-10 ºC to +35 ºC
Operating temperature range	Charge 0 ºC to +55 ºC Discharge -40 ºC to +60 ºC
Degree of protection	IP20
Cooling concept	Natural Cooling
Communication	CAN, RS485
Relative humidity	< 70%
Round-trip efficiency	> 97%
Life cycle	> 5000 times

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54

9. Warranty Information

Warranty Period
The product is covered by a **5-year limited warranty** from the date of purchase.

Warranty Coverage
This warranty covers **manufacturing defects and material defects only**, under normal use and operating conditions.

Warranty Exclusions
The warranty does **not** cover damage or failure resulting from:

- misuse or improper operation,
- incorrect or non-compliant installation,
- mechanical damage,
- fire, flooding, or water exposure,
- acts of God or force majeure events.

Additional Conditions
The warranty is valid only if the product is installed, operated, and maintained in accordance with the user manual and applicable standards.

Customer Support
For warranty claims, technical assistance, or product-related questions, please contact our support team:

Email: support@freen.com

Response time: within 1–2 business days

FREEN OÜ
Registration number 14541774
VAT number EE102096378
Arenduse tn 6, Kohtla-Järve, 30328 Ida-Viru maakond, Estonia
freenindustries.com | freenwind.com | freensolar.com | freen.com
contact@freen.com
+372 5374 17 54