Greenrich Suncore HV Series

High-Voltage Battery Energy Storage System

HVCB125-P / HVCB200-P
HVB50096-P / HVB50156-P / HVB235-P

Installation Manual



Document: GR-SUNHV
Version: 0.13
Audience: Licensed electrical installers and commissioning engineers only

1. Introduction

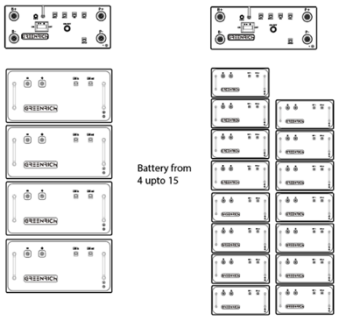
1.1 About This Manual

This document is the controlled installation, commissioning, and maintenance reference for the Greenrich Suncore HV Series High-Voltage Battery Energy Storage System (BESS). The system family comprises the HVCB125-P and HVCB200-P high-voltage control boxes paired with the HVB50096-P and HVB50156-P lithium-iron-phosphate ($LiFePO_4$) battery modules.
It is intended for licensed electrical installers, commissioning engineers, and field service technicians authorized to deploy, energies, and maintain medium-to-high-voltage DC battery systems. End-user operation, mobile-app pairing, and routine monitoring are addressed separately in the accompanying *User Manual*, which shall be handed over to the site operator upon completion of commissioning.

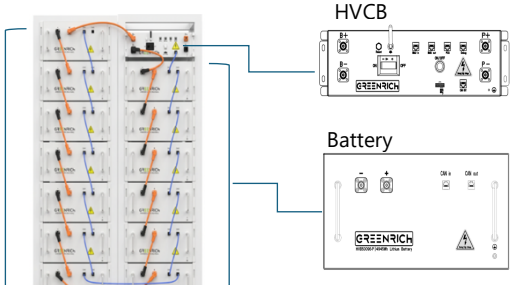
- **! NOTICE** This manual must be available on site throughout installation and commissioning. Mark up the document with as-built notes and retain it with the system commissioning record.
- ⚠ **WARNING** Do not deviate from the procedures described in this manual. Any modification of the wiring topology, protective settings, or sequence of operations may compromise system safety and will void the manufacturer's warranty.

1.2 System Overview

The Suncore HV Series is configured as a series-connected DC string formed of one HVCB (High-Voltage Control Box) and four to fifteen battery modules. Multiple strings — up to ten — may be connected in parallel through a common DC bus to the Power Conversion System (PCS).



String Topology – One HVCB (High Voltage Control Box) +



1 Single string topology

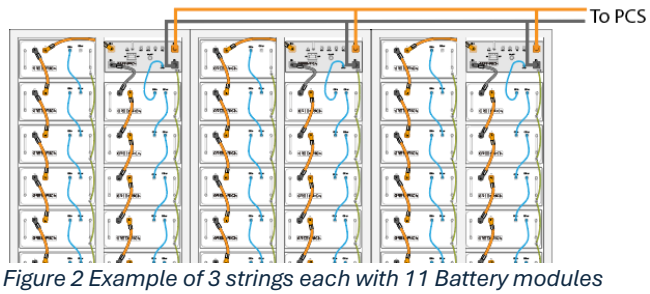


Figure 2 Example of 3 strings each with 11 Battery modules

Configuration rules:

- One HVCB plus 4–15 battery modules per string.
- Up to 10 strings may be connected in parallel.
- All parallel strings shall contain an identical number of battery modules.
- All battery modules across all strings shall be of the same model.
- All modules in a single deployment shall originate from the same shipment / production batch (SOC- and impedance-matched).

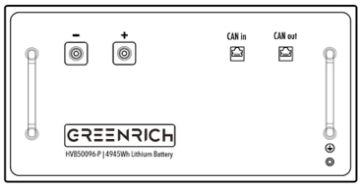
1.3 Specification

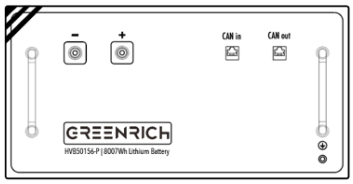
SPECIFICATION

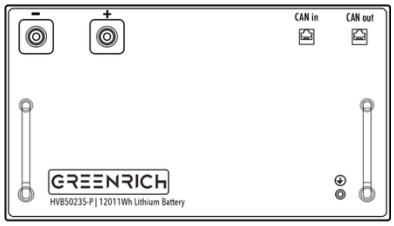
System

	SUNCORE HV 50-30	SUNCORE HV 50-60	SUNCORE HV 80-120
Rated Voltage (V)	307.2	614.4	768
System Capacity (kWh)	29.67	59.35	120.1
Rated Charge Current (A)	80	80	125
Rated Discharge Current (A)	120	120	190
Battery Module Qty in Series	6	12	15
Parallelizable	Up to 10, 296.7kWh	Up to 10, 493.5kWh	Up to 10, 1201kWh
Communication	RS485, CAN		
Cooling Mode	Natural air cooling		
IP Rate	IP20		
Operating Temperature (℃)	Charge: -10-55 / Discharge: -20-60		
Humidity	5~95% RH		
Storage Temperature (℃)	-10~45		
Installation	Rack Mounting		

Battery Module

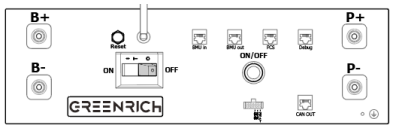


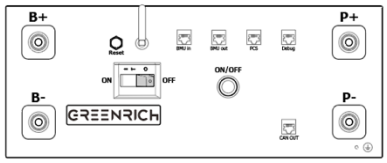




	HVB50096-P	HVB50156-P	HVB50235-P
Cell Chemistry	$LiFePO_4$ Cylindrical cells		
Module Energy (kWh)	4.945	8.007	12.011
Module Nominal Voltage (V)	51.2		
Module Capacity (Ah)	96.6	156.4	234.6
Max. Battery Module Qty in Series	15		
Weight per Module (kg)	47	69	110
Pack Dimension (WDH) (mm)	438*536*221	438*536*221	438*695*255

High Voltage Control Box (HVCB)





	HVCB125-P	HVCB200-P
Operating Voltage (Vdc)	80~1000	
Nominal Current (A)	125A continuous	200A continuous
Working Temperature (°C)	-40~85	
Communication Interface	3 ways CAN & 3 ways RJ45	
Temperature Detection	5 ways	
Dry Contact	2 ways	
DI Detection	2 ways	
Dimension (W+D*H) (mm)	438*478*133	438*478*177
Weight (kg)	15.5	18

! CAUTION The IP20 rating restricts deployment to clean, dry, indoor environments. Outdoor or dust-laden installations require an additional enclosure rated for the site conditions.

2. Safety

The Suncore HV Series is a high-voltage DC system in which lethal potentials may be present at the battery terminations even when the HVCB is in the OFF state. All work shall be carried out by competent personnel holding the qualifications required by local regulation for high-voltage DC and battery systems. Read this section in full prior to opening any packaging.

2.1 Hazard Summary

Safety symbols used throughout this manual.

Symbol	Meaning
⚠ **DANGER**	Will cause death or serious injury.
⚠ **WARNING**	Could cause death or serious injury.
! CAUTION	Could cause minor injury or damage.
! NOTICE	Equipment damage risk.
[NOTE]	Useful information.

⚠ **DANGER** Lethal DC voltages are present at the battery terminations and across closed power connectors. Contact may be fatal. Always assume terminals are live until proven dead with a suitable, calibrated DC voltmeter.
⚠ **DANGER** The series voltage of a fully populated string may exceed 800 V DC. Do not bridge, short, or ground any live conductor. Maintain insulation integrity at all times.
⚠ **WARNING** Lithium-ion batteries can release flammable and toxic gases under fault conditions. Do not work on a module showing bulging, leakage, charring, or unusual odor — isolate the area, ventilate, and contact Greenrich service.

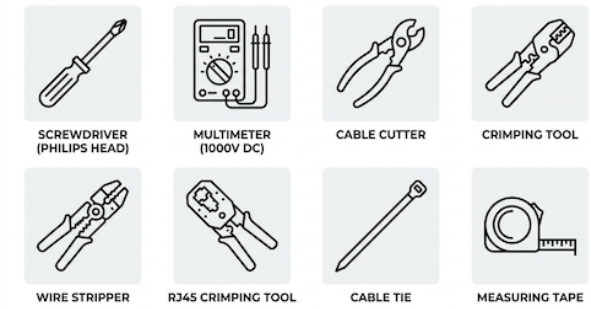
The following requirements apply without exception:

- Read this manual and the project-specific design documents in full before commencing work.
- Personnel performing installation, operation, or maintenance shall hold the local and national qualifications required for high-voltage DC and battery operations.
- Verify the integrity of all equipment before connecting any cables. Do not energize damaged equipment.
- Apply Lockout/Tagout (LOTO) procedures to the PCS, all HVCB actuators, and any upstream isolation device prior to any intrusive work.
- Wear the prescribed Personal Protective Equipment (PPE) at all times when working on or near the system.
- Treat short-circuits, reverse-polarity, and over-tightened connections as principal causes of fire and burn injury.

! NOTICE All commissioning, fault, and intervention events shall be recorded in the site logbook and counter-signed by the responsible engineer.

2.2 PPE & Tooling

Essential Tool



Safety Gear



3. Receiving & Handling

3.1 Pre-Unpacking Inspection

The packaging is engineered to protect the modules during transport. On receipt and prior to unpacking, conduct a visual inspection of the outer packaging.

! NOTICE Inspect the outer packaging for holes, cracks, water staining, impact damage, and the integrity of the shock/tilt indicators where fitted. If damage is found, do **not** unpack — photograph the packaging, retain all transport documentation, and contact the supplier.

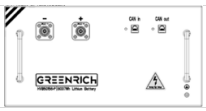
After unpacking, verify that the contents match the bill of materials and that no item is mechanically damaged. Retain the original packaging for the duration of the warranty period for safe return shipment.

3.2 Material List

HVB50096-P (5kWh Battery Module)

Ref		Qty	Battery module
B5-1		1	HVB50096-P battery module
B5-2		1	25mm2, 180mm orange inter-module power cable
B5-3		1	Cat6 Ethernet communication cable, 310mm
B5-4		1	RNB2-6, 14AWG, 300mm PE bonding lead

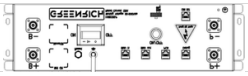
HVB50156-P (8kWh Battery Module)

Ref		Qty	Battery Module.
B8-1		1	HVB50156-P battery module
B8-2		1	70mm2 (CCA), 235mm orange inter-module power cable
B8-3		1	Cat6 Ethernet communication cable, 310mm
B8-4		1	RNB5-6 PE bonding lead

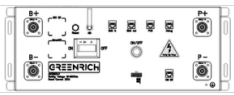
HVB50235-P (12kWh Battery Module)

Ref		Qty	Battery Module.
B8-1		1	HVB50235-P battery module
B8-2		1	2 AWG (35 mm^2) Power Cable, UL3820, 200mm
B8-3		1	Cat6 Ethernet Communciation Cable, 310mm
B8-4		1	Grounding Cable, 6 mm^2 (M6, 300mm)

HVCB125-P (HVCB High Voltage Control Box)

Ref		Qty	Battery Module.
C1-1		1	HVCB125-P control box
C1-2		1	+ve Power cable, 900mm 3AWG (Bat B+ to HVCB B+)
C1-3		1	-ve Power cable 500mm 3AWG (Bat B- to HVCB B-)
C1-4		1	Power cable 700mm 3AWG (Bat+ to Bat-)
C1-5		1	Power Connector Orange (P+)
C1-6		1	Power Connector Black (P-)
C1-7		2	SC50-10 Copper ring terminal (Connector to PCS)
C1-8		1	PE bonding wire, 6mm², 700mm
C1-9		1	CAT5e STP cable, 500 mm – Bat to HVCB comm. Cable. Labelled BAT-CAN IN / HVCB-CAN OUT
C1-10		1	CAT5e STP cable, 800 mm - labelled CAN IN / CAN OUT (cross-rack battery CAN port connection)
C1-11		2	120ohm RJ45 Termination plug

HVCB200-P (HVCB High Voltage Control Box)

		Qty	Battery Module.
C2-1		1	HVCB200-P control box
C2-2		1	+ve power cable, 900mm, Black (Bat B+ to HVCB B+)
C2-3		1	-ve power cable, 500mm, Black (Bat B- to HVCB B-)
C2-4		1	Power cable 700mm (Bat+ to Bat-)
C2-5		1	Power connector, orange (P+)
C2-6		1	Power connector, black (P-)
C2-7		2	SC50-10 Copper ring terminal (Connector to PCS)
C2-8		1	Ground wire 6mm² 700mm
C2-9		1	CAT5e STP cable 500mm - labeled BAT-Input / HVCB-BSU)
C2-10		1	CAT5e STP cable 700mm - labelled Input / Output. Cross rack
C2-11		2	120ohm RJ45 termination plug

! NOTICE Modules ship SOC-matched within a production batch. Do not mix modules from different shipments or batches in a single string.

! CAUTION Store unused modules in a clean, dry, temperature-controlled area (refer to storage temperature in §1.4) and on a horizontal surface. Do not stack beyond the limit indicated on the packaging.

4. Mechanical Installation

4.1 Installation Workflow

The mechanical and electrical installation shall proceed in the following order:

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Mechanical → Battery DC → Battery CAN → HVCB DC → HVCB CAN → Verification
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⚠️ **WARNING** Indoor installation only. Reserve sufficient clearance around the equipment for installation, ventilation, and service access. Allocate at least two competent persons for module handling — a single HVB50096-P module is approximately 47 kg and a single HVB50156-P module is approximately 69 kg.

4.2 Site & Rack Preparation

The system is supplied without racks. The installer is responsible for providing racks that satisfy the local structural and seismic code, are level within manufacturer tolerance, and are mechanically rated for the total populated weight (system, modules, HVCB, and cabling).
Prior to mechanical installation, plan and position the HVCBs and batteries in the racks per the configuration below. Each string chains one HVCB with batteries in series, with all HVCBs wired to the bus bar for power and data connections.

Thinking...

I will rewrite the section in a simple, general format. The battery string placement and front access requirements apply to all models.

The rewrite will omit explanations and show only the suggested layout. Battery strings can sit side by side or back to back without separate ventilation rules; all clearance points will merge into one. Front space must allow easy battery insertion and removal.

The front aisle dimension will be a single conservative value covering the 695 mm deepest module plus handling space. This replaces the previous model-specific measurements.

4.2.1 Installation and Service Clearance

Provide a clear space in front of each rack so that every HVCB and battery module can be slid fully in and fully out on its rails.

This applies to all models.

Item	Requirement
Front clearance	Not less than 700 mm from the front face of the installed module to the nearest obstruction (wall, door, column, cable tray, or facing rack).
Side-by-side racks	Permitted. No additional gap is required between racks for ventilation.
Back-to-back racks	Permitted. No additional gap is required at the rear for ventilation.
Ventilation	Keep the front ventilation slots clear. Do not cover them with panels, trunking, or cable bundles.

The front clearance shall remain available after installation. Do not use it for storage.

Where a rack door or outer enclosure is fitted, the 700 mm clearance shall exist with the door or panel fully open, and the module shall pass through the opening on its rails.

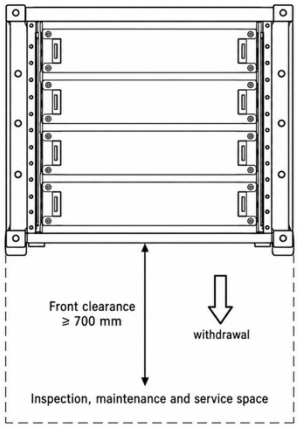


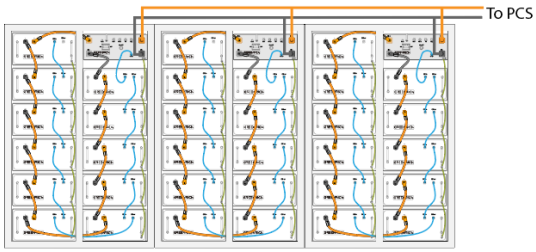
Figure 4-1. Front clearance for module insertion and withdrawal.

4.3 Positioning

Each string consists of one HVCB chained with its battery modules. The cross-rack and inter-module cables provided in the HVCB packaging are cut to specific lengths matched to the standard rack layout — installation outside that layout will require pre-approved alternative cabling.

! NOTICE Position modules so that the front face (terminals and CAN ports) is accessible without obstruction. Confirm that the supplied inter-module cables reach their target ports before final mechanical fixing.

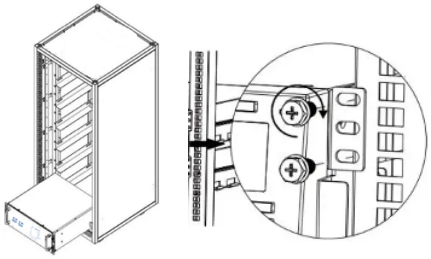
4.4 Loading Modules into the Rack



1. Verify the rack is anchored and grounded.
2. Lift the HVCB into the topmost position. Slide it fully home onto the rack rails.
3. Lift each battery module in sequence and slide it onto its rails. Confirm the module is flush with the rack face.

⚠ **WARNING** Use a mechanical lifting aid where available. Manual lifting of a 69 kg module is a recognized manual-handling hazard and shall comply with the site lifting plan.
! CAUTION Do not use module handles to drag modules across rough surfaces. The handles are intended for short-distance lifting only.

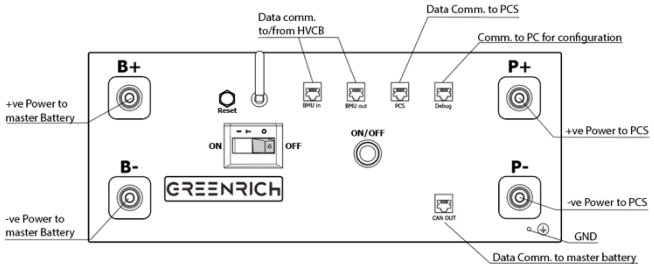
4.5 Securing Modules



Each module and the HVCB shall be secured to the rack.
! NOTICE Tighten screws to the rack manufacturer's specified torque. Cross-tighten in a diagonal pattern to ensure even load distribution on the mounting flange.

5. Electrical Installation

The electrical installation establishes the protective earth bonding, the high-current DC power path, and the CAN-based monitoring and control communication. All work shall be performed with the HVCB actuator in the **OFF** position.
HVCB cable connections:



⚠ **DANGER** The HVCB actuator does not isolate the battery string from itself. The series voltage is present at the open battery terminals at all times. Treat all orange and black power connectors as live.

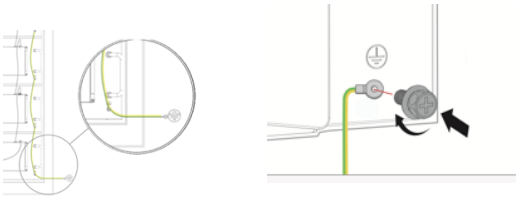
⚠ **DANGER** The series voltage of a fully populated string may exceed 800 V DC. Confirm the actuator is OFF and the PCS is locked out before any electrical work.

5.1 Protective Earth (PE) Bonding

 **Items used:** B5-4, B8-4 (battery PE leads), C1-8, C2-8 (HVCB PE leads)

Procedure:

1. Locate the PE terminal at the bottom-right of the HVCB and of each battery module.
2. Land the supplied PE lead onto the equipment terminal and to the rack PE bar.
3. Tighten the PE screw and confirm the lock washer has compressed.



PE terminal on bottom right of HVCB and batter module.

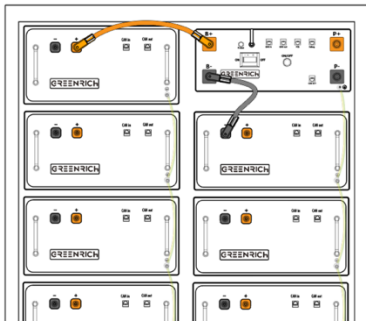
! NOTICE Verify electrical continuity from each module enclosure and the HVCB enclosure to the building earth bar with a low-resistance ohmmeter prior to applying any DC connection.

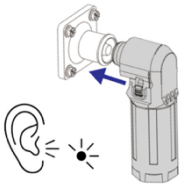
5.2 HVCB B+ / B− Terminations

The B+ and B− power leads bond the HVCB to the high and low ends of the series-connected battery string. Use cable:

 C1-2 / C2-2 for B+

 C1-3 / C2-3 for B-





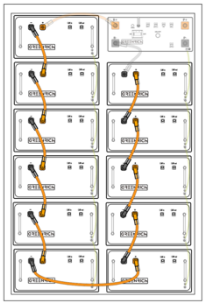
⚠ **WARNING** Do not force-mate a connector. If the connector does not seat smoothly, withdraw, inspect for foreign material or pin damage, and re-attempt.
! NOTICE Polarity is keyed by connector colour and shape. Do not modify, cut, or re-terminate the supplied power leads.

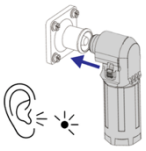
5.3 Inter-Module DC Connections

The battery modules are connected in series using the supplied inter-module power cables

 B5-2 for HVB50096 / B8-2 for HVB50156-P

Daisy-chain power cables between modules.





Procedure:

1. Working from the top module downwards, connect the (+) terminal of the lower module to the (−) terminal of the upper module via the inter-module cable.
2. Repeat through every module in the string.
3. Confirm the audible click on each connector.

⚠ **DANGER** As each inter-module cable is mated, the partial string voltage rises. After only a few modules are linked, the open-circuit voltage at the string ends is sufficient to cause severe injury or death. Maintain insulated tooling and PPE throughout.

! CAUTION Verify cable routing does not impose tension on the connectors and does not obstruct ventilation slots on the module front face.

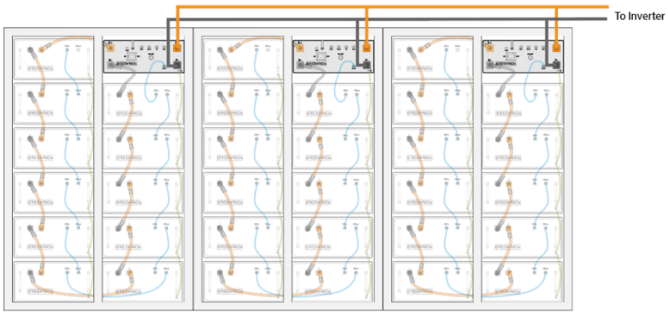
5.4 HVCB P+ / P− to PCS

Items used: C1-5 / C2-5 (orange P+ connectors), C1-6 / C2-6 (black P− connectors),
C1-7 / C2-7 (SC50-10 copper ring terminals at the PCS end).
The P+ and P− ports of the HVCB are the system DC power outputs to the PCS DC input. The cable between the HVCB and the PCS is **not supplied** with the system and shall be selected by the installer to match the system current rating, the run length, and local code.

⚠ **DANGER** High voltage is present. The HVCB actuator shall be in the **OFF** position and the PCS DC input shall be locked out before connecting the P+ / P− cabling.

Procedure:

1. Crimp the supplied SC50-10 copper ring terminals to the PCS end of the field-supplied cable using a calibrated, full-cycle hydraulic or mechanical crimp tool.
2. Assemble the orange (P+) and black (P−) connectors to the HVCB end of the field-supplied cable.
3. Mate the P+ and P− connectors to the HVCB.
4. Land the ring terminals at the PCS DC bus, observing polarity and torque specification of the PCS manufacturer.

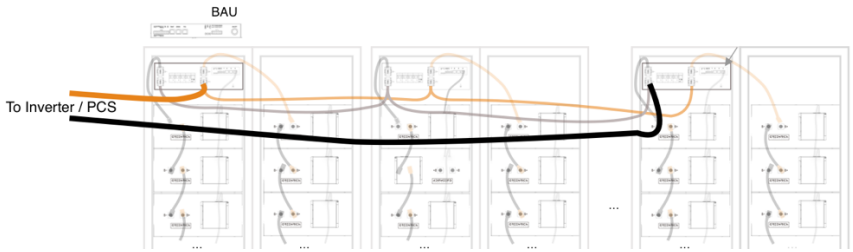


Power output: HVCB P+/P− to PCS DC inputs.

5.4.1 Multi-String Power Bus Topology

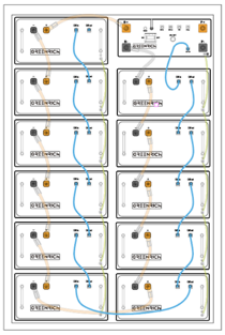
Where two or more strings are paralleled, **all** strings shall contain the same number of battery modules. Voltage equalisation between strings is mandatory before the parallel path is closed.

[NOTE] For installations of two or more strings, distribute the bus connection points across the first and last HVCB rather than terminating both PCS bus cables on a single HVCB. This reduces conductor IR imbalance and improves SOC tracking across the parallel array.



! NOTICE Measure and record the open-circuit voltage of each string immediately prior to closing the parallel bus. The voltage difference between any two strings shall be within the tolerance specified by Greenrich Service before the actuators are closed.

5.5 CAN Daisy-Chain (Communication)

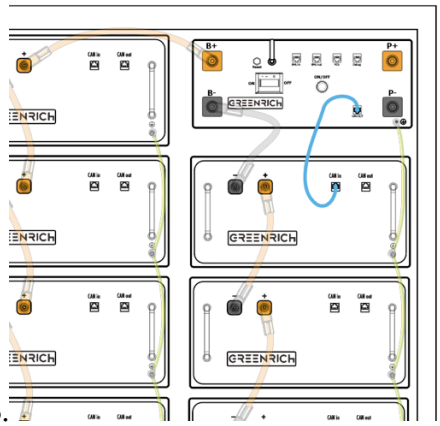


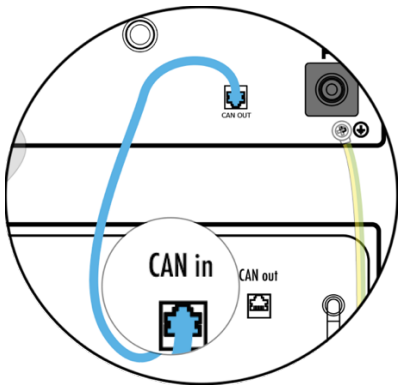
The CAN bus carries cell voltage, temperature, and protection telemetry from every BMU to the HVCB. The chain runs **HVCB CAN OUT → Module 1 CAN IN → Module 1 CAN OUT → Module 2 CAN IN → … → last Module CAN OUT (terminator)**.

Items used: C1-9 / C2-9 (HVCB-to-Module 1), B5-3 / B8-3 (inter-module), C1-10 / C2-10 (cross-cabinet/cross-rack), C1-11 / C2-11 (120 Ω termination plug).

5.5.1 CAN Communication – HVCB to Battery Module

Connect the **HVCB CAN OUT** port to the **CAN IN** port of Module 1 using cable C1-9 / C2-8.





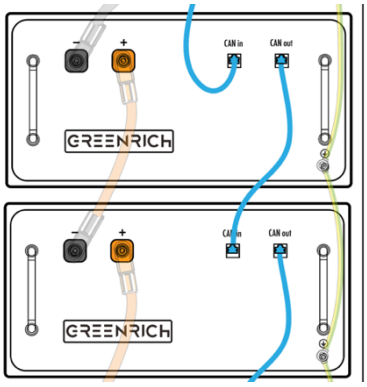
► Connect HVCB CAN OUT to Module 1 CAN IN.

! NOTICE Connecting this cable to **CAN OUT** of Module 1 will not function. The CAN protocol direction is enforced by the BMU firmware.

5.5.2 Inter-Module Daisy-Chain

 B5-3 or B8-3

For every subsequent module, connect **CAN OUT** of the upstream module to **CAN IN** of the downstream module using cable B5-3 / B8-3.

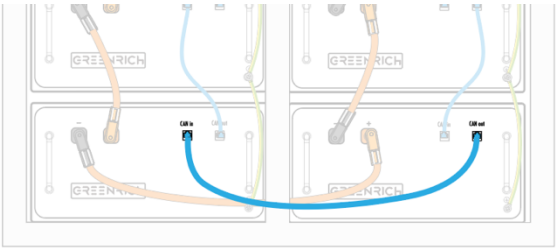


3 CAN cable between module

5.5.3 Cross-Rack/Cross-Cabinet Communication

 C1-10 / C2-10

Where a string spans two columns of a rack or two adjacent racks, use the inter-module cable with the longer cable C1-10 / C2-9 supplied in the HVCB packaging.



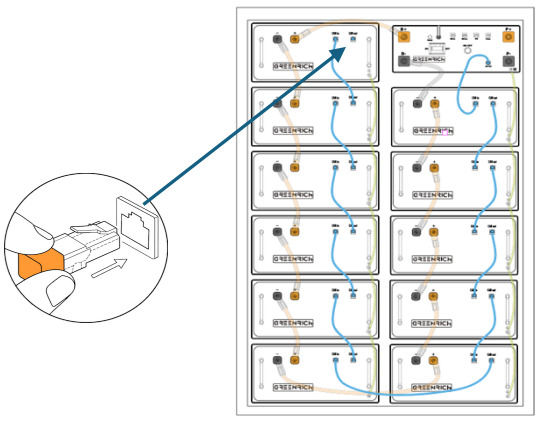
4 cross rack CAN cable between modules

! NOTICE Use only the supplied STP cabling for cross-rack runs. Substitute UTP cabling exposes the bus to common-mode noise and may cause intermittent communication faults.

5.5.4 CAN Termination

 C1-11 or C2-11

Fit the 120 Ω termination plug onto the **CAN OUT** port of the **last** battery module in the string.



⚠ **WARNING** A missing or misplaced termination plug will cause CAN reflections and intermittent BMU communication faults. The system will not energise without a correctly terminated CAN bus.

Termination Plug included 120hm resistor. Pin definition:

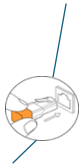


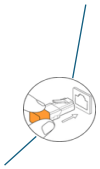
5.6 Multi-String HVCB CAN Connection

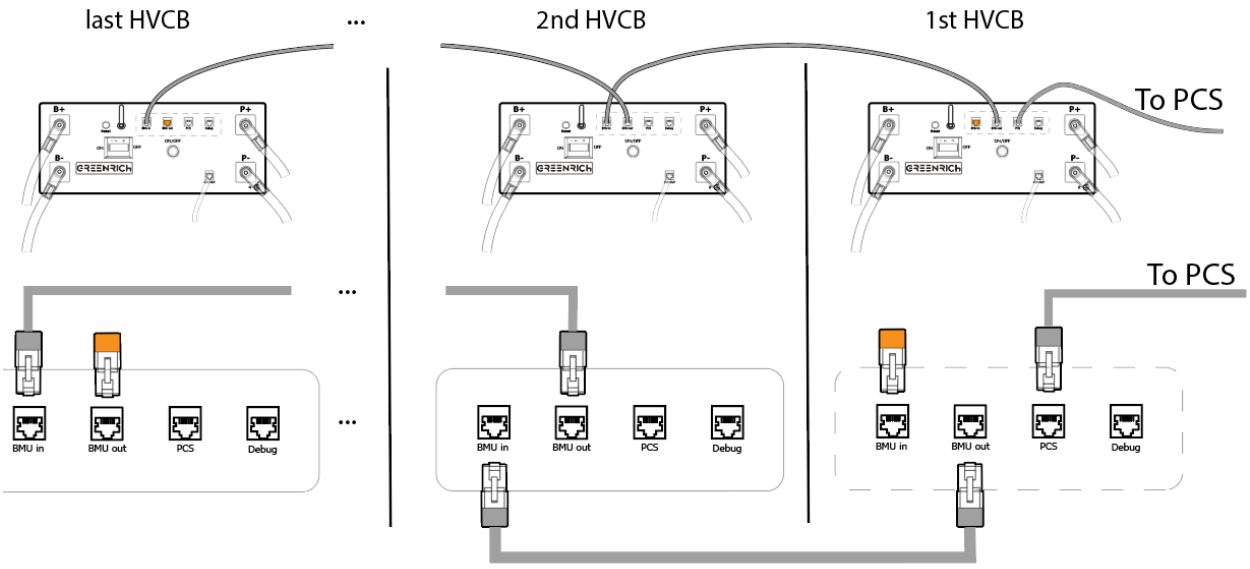
Where two or more strings are paralleled, the HVCBs are chained on a separate inter-HVCB CAN bus that uses the **BMU IN** and **BMU OUT** ports on each HVCB front panel.

[Note] Master HVCB - The first HVCB in the chain — the one whose **PCS** port is connected to the inverter — is the **Master HVCB**.

Cable for inter-HVCB CAN is not supplied. Use installer-provided STP Ethernet cable cut to length. Each individual CAN communication cable must not exceed **5 meters**, and the total combined length of all CAN cables in the chain must not exceed **30 meters**.







5.6.1 Chaining HVCBs

Connect **BMU OUT** of the Master HVCB to **BMU IN** of the second HVCB. Continue the chain through all subsequent HVCBs.

5.6.2 BMU Bus Termination

 C1-11 or C2-11

Fit a 120 Ω termination plug to:

1. The **BMU IN** port of the **Master** HVCB.
2. The **BMU OUT** port of the **last** HVCB in the chain.

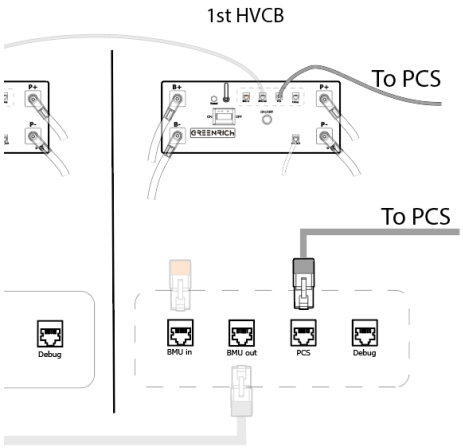
⚠ **WARNING** A termination plug fitted to the wrong port will not function. Verify port labels carefully — they are silk-screened on the front panel.

Termination Plug included 120hm resistor. Pin definition:

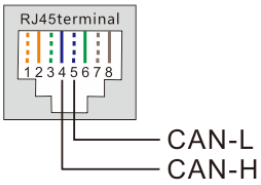


5.7 CAN Communication - PCS to Master HVCB

The CAN cable from the PCS shall be terminated at the **PCS** port of the Master HVCB.
! CAUTION Plugging the PCS cable into the **BMU IN** port of the Master HVCB will not function. The PCS port is dedicated to inverter dialogue and uses a different message map.
! NOTICE Confirm with the PCS manufacturer that the inverter is configured for the Greenrich BMS protocol prior to commissioning.



Pin definition of the PCS CAN Port is following EIA/TIA 568B.
CAN-H on Pin 4: Blue
CAN-L on Pin 5: Blue/White



6. Pre-Energisation Checks

Energisation shall not proceed until the system has passed every item in the checklist below. The checks are performed with the HVCB actuator in the **OFF** position and the PCS DC input locked out.

⚠ **WARNING** Failure to complete pre-energisation checks is the single most common cause of commissioning faults and equipment damage. Do not skip steps.

Pre-Energisation Checklist:

- All power cables securely mated and verified by audible click and gentle axial tug.
- Polarity verified at every battery-to-battery interface and at the HVCB B+ / B− terminations.
- All CAN cables connected in the correct direction (OUT → IN).
- 120 Ω termination plugs fitted on:
- Last battery module CAN OUT (per string),
- Master HVCB BMU IN (multi-string only),
- Last HVCB BMU OUT (multi-string only).
- All strings contain an identical number of battery modules.
- Open-circuit voltage measured at each HVCB B+/B−; recorded; and within tolerance of the calculated value.
- String-to-string voltage difference within tolerance (multi-string).
- Insulation resistance test performed and recorded (≥ 1 MΩ recommended between live conductors and PE).
- Continuity test on PE bonding from each module and HVCB to the building earth bar.
- No visible cable damage, kinks, or trapped conductors.
- All M6 mounting screws torqued.
- Site logbook completed and signed.

7. First Power-Up & Commissioning

First power-up is the controlled sequence by which each HVCB is energised and the system performs its self-test, insulation check, and pre-charge. The order of operations is mandatory.

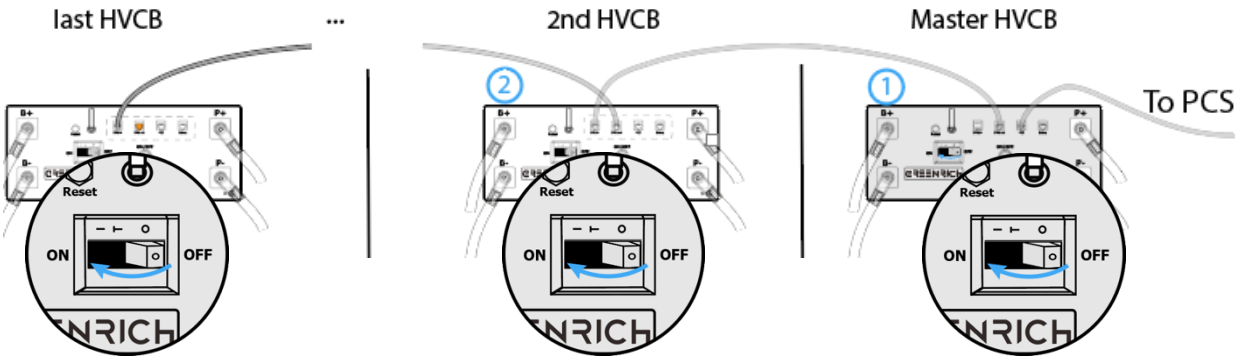
7.1 Startup Sequence

1. Confirm the PCS is OFF and its DC input remains isolated.

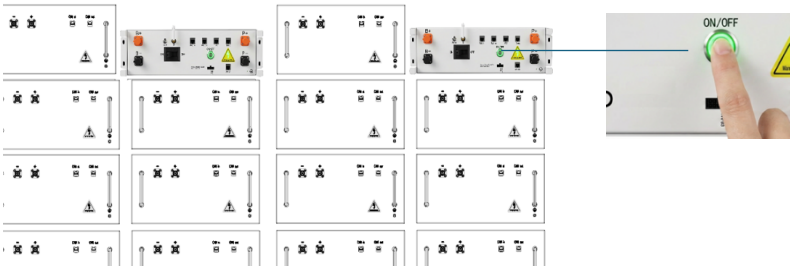
2. Move the actuator switch on **String 1 (Master HVCB)** from OFF to ON. The On/Off LED begins to flash, indicating the unit is armed and ready for initiation.
3. Move the actuator switch on String 2, then String 3, and so on, through to the last string. The On/Off LED on each unit begins to flash. Transitions through red → yellow → green
4. **Press and hold** the **Master HVCB On/Off button** until the status LED remains steady green.
5. Confirm steady-green status on every HVCB in the chain.

Turn on HVCB actuators starting from String 1 (Master HVCB), then String 2, and so on.

⚠ **WARNING** Activate HVCB actuators **in sequence** — Master first, then the next string, and so on. Out-of-sequence activation may cause string-detection errors and trigger insulation-fault protection.

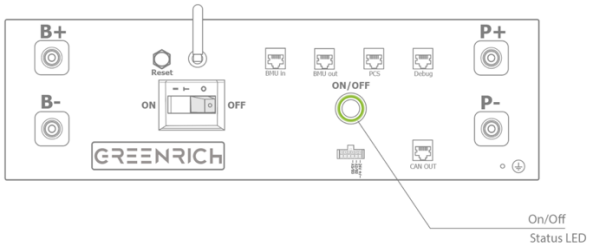


Status LED will flash red → **yellow** → green (initiation),
Press and hold the **Master** HVCB On/Off button until the LED shows steady green.
Press and hold only the **Master HVCB (nearest inverter)** on/off button to start system initiation, hold the button until LED shows steady green.



! NOTICE Data Stabilization During Startup
When multiple battery strings are connected, allow 1–2 minutes after startup for internal aggregation to complete and data transmitted to the PCS to stabilize. During this period, reported values may fluctuate slightly and may not accurately reflect actual operating conditions. Wait until the data stabilizes before assessing system status.

7.2 LED Status Reference



Indication	State
Flash red → yellow → green	System ready to initialize
Steady green	Normal operation, SOC displayed
Red flash	Fault — refer to HV_ESS app for code



System initiated: Display SOC

SOC Display (Steady):

SOC	LED Pattern
15% < SOC	Steady Red
15% <= SOC < 25%	Steady Yellow
25% <= SOC <=100%	Steady Green

Charging:

SOC	Pattern	Flash Rate
15%< SOC	Red Flash2	Flash2 (0.5s on/0.5s off)
15% <= SOC < 25%	Yellow Flash2	Flash2 (0.5s on/0.5s off)
25% < SOC <= 95%	Green Flash2	Flash2 (0.5s on/0.5s off)
95% < SOC <= 10%	Green steady	-

Fault: Red **Flash3 (0.5s on/1.5s off)** when the discharge relay is disconnected.

7.3 App / Wi-Fi Pairing

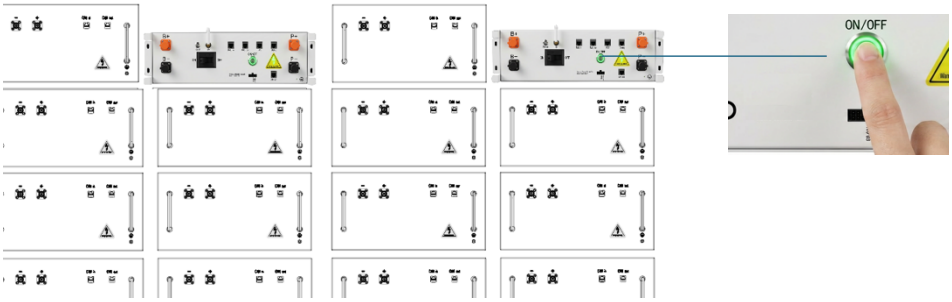
Monitor remotely via smartphone/tablet. View-only: SOC, energy flow, alarms, history.

- See *User Manual* for app pairing.
- Wi-Fi antenna port is on HVCB top row.

8. Shutdown

8.1 Normal Shutdown

Long-press the On/Off button on the Master HVCB until its status LED extinguishes. All actuators in the parallel chain disarm automatically.
⚠ **DANGER** Shutdown does **not** dissipate the series voltage at the battery terminations. The string remains live internally. All subsequent work shall apply LOTO and PPE as for live working.



---

9. System Configuration and Verification

9.1 HV_ESS Windows Application

The HV_ESS Windows application is the primary commissioning, diagnostic, and verification tool.
Tools required:



- USB-to-RS485 (RJ45) adapter (use the Greenrich-supplied unit).
- HV-EnergyStorageSystems application.
- FTDI driver (some host PCs require manual installation).

Use the application to verify:

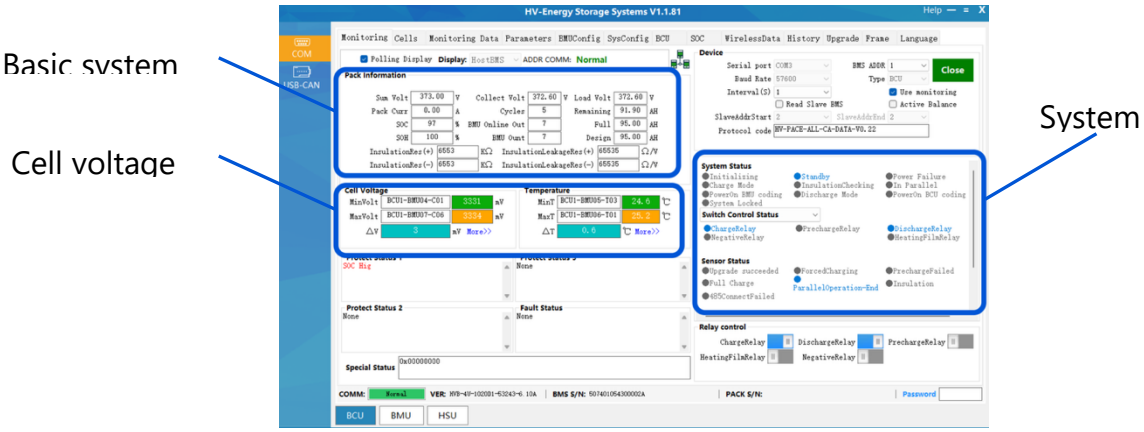
- Correct number of HVCBs and battery modules detected.
- Cell voltage delta within limits.
- All temperature sensors reporting valid data.
- No active faults.

! NOTICE Refer to Appendix A for installation, language selection, and operating procedure of the HV_ESS application.

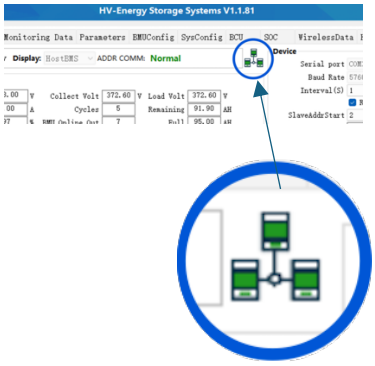
9.2 Configuration Verification

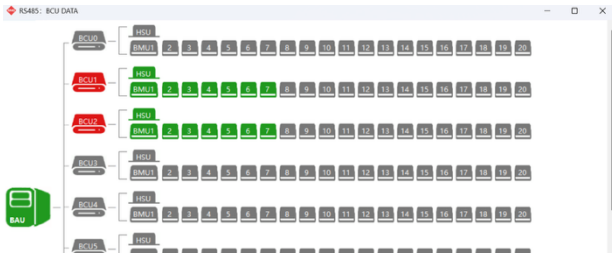
1. Open the **Monitoring** tab and confirm the displayed system summary (Sum Volt, SOC, cell count) matches the as-built configuration.

Installation and first time set up please refer to Appendix B



2. Click the topology icon to display the discovered HVCB and battery module map. Every commissioned unit shall appear green; any red or missing unit indicates a communication or addressing fault.





9.3 Set up System for Wifi connection to platform

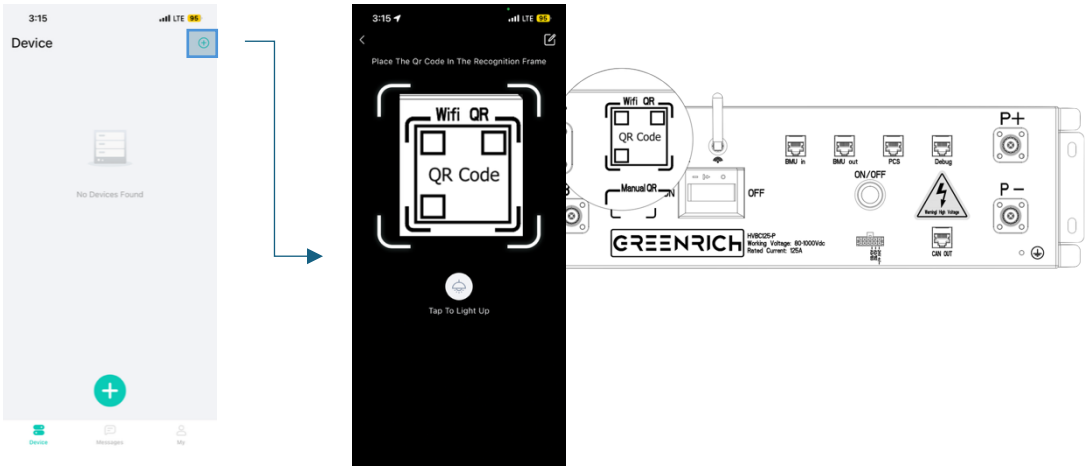
Use Mobile App to add device and set the BESS wifi to connect to platform.
Refer to Appendix B to download and sign up/Sign in through mobile app.

Step: Add Device

1. Go to Device List.

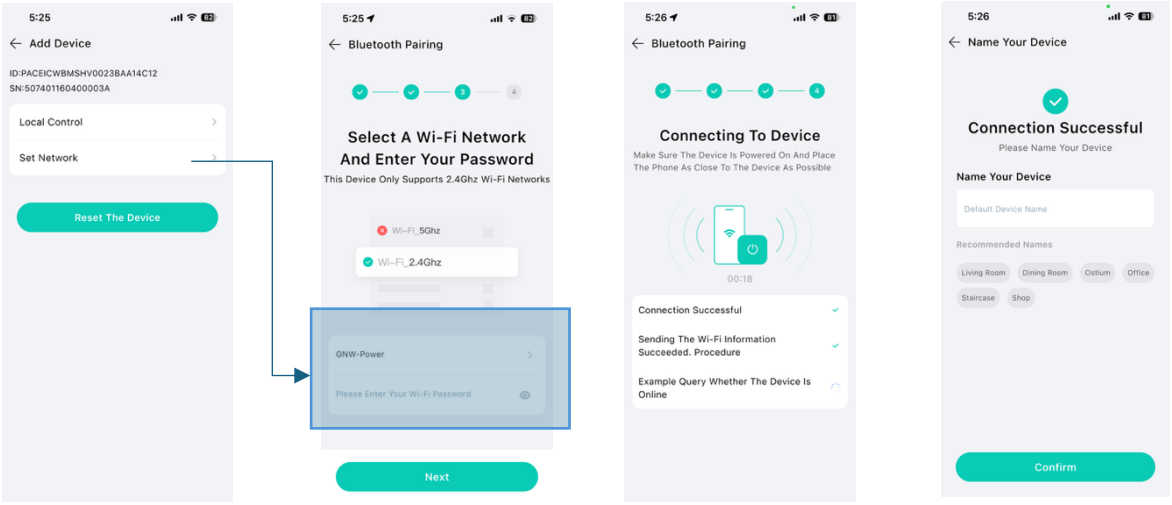
Note: Enable Bluetooth for Wuya app, grant permissions if required.

2. Scan Wifi QR code on HVCB to pair.



3. Choose:
    - **Set Network:** for remote monitor through Wi-Fi. Set Network → Enter SSID/password → Connect (~1min). Name device (e.g., "Rack 1").

- **Local Control:** Bluetooth only for on-site.



9.4 Post-Commissioning Handover Test

☐ Confirm all HVCB connects to internet and online.
☐ Perform one full charge–discharge cycle to validate end-to-end operation:

1. Charge at 0.1C for 1 hour, then ramp to ≤ 0.3C and continue to 100 % SOC. Hold at 100 % for 1 hour.
2. Discharge at ≤ 0.3C to 30 % SOC.
3. Confirm cell voltage difference ≤ 15 mV at 30 % SOC.

Record the results, the BMS calibration diff, and any alarms on the commissioning form. Counter-sign and file with the project documentation.

Appendix A — HV_ESS Windows App

Install HV-ESS application on Windows to commission and verify the status on the battery system after installation.

Tools will be provided Greenrich after sales services.

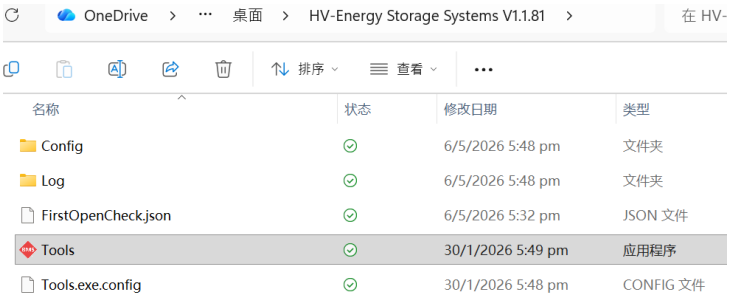
Prerequisites:

1. USB-to-RS485 cable (Greenrich supplied).
2. `HV-EnergyStorageSystems` application folder.

3. FTDI driver — some host PCs require manual driver installation for the USB-to-RS485 adapter to enumerate.

Procedure:

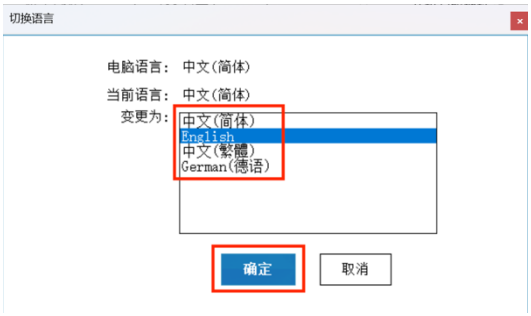
1. Expand the application folder and run `Tools.exe`.



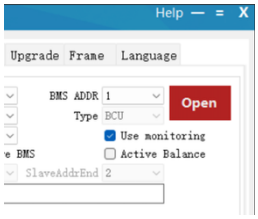
- On first launch the user interface may default to Chinese. Click the right-most tab on the menu bar (language selector).

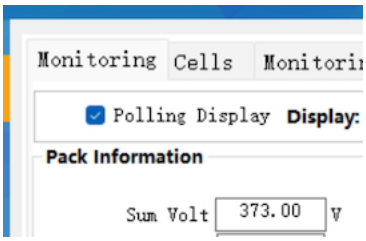


- Select the target language and click **Confirm**.

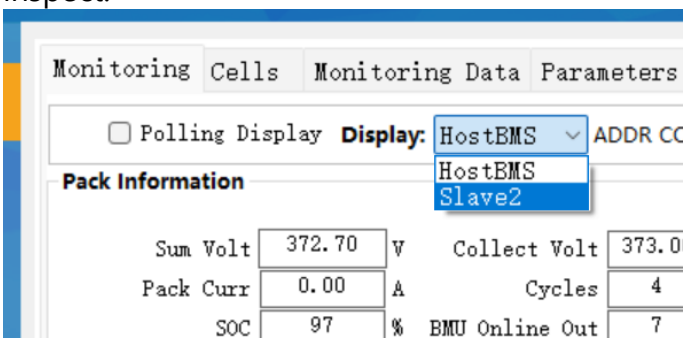


On the **Monitoring** tab, click **Open** to connect to the HVCB.
If connection fails: verify the cable seating, confirm the COM port, and confirm the FTDI driver is installed.
On success, the button turns green and the **ADDR COMM** indicator displays *Normal* in green. Telemetry begins streaming immediately.
Deselect **Polling Display** to view all BMUs simultaneously.





For multi-HVCB installations, use the **Display** drop-down to select the HVCB (BMS) to inspect.



Appendix B — Mobile App Installation

Monitor remotely via smartphone/tablet. View-only: SOC, energy flow, alarms, history.

Supported: Android (Google Play), iOS (App Store).

Figure 6 iOS (App Store)

Figure 5 Android (Google Play)

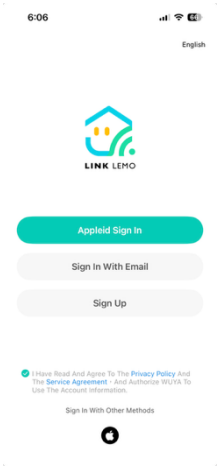
Step 1: Download/Install

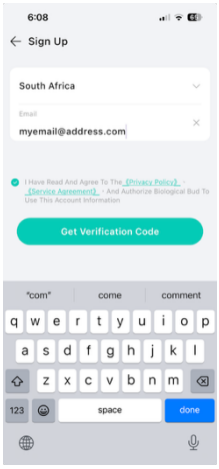


1. Open store, search "Wuya" or scan QR.
2. Install.

Step 2: Sign Up/In

1. Launch app.
2. Sign up (email/phone) or sign in.





Appendix C — BESS Charge and Discharge Maintenance

1 Daily Charging and Discharging Range Control

1.1 Optimal Operating Range

For LFP storage battery systems, the daily operating SOC should be strictly controlled within the **20%-80%** range:

1. Charging Upper Limit: Stop charging at 80%-95% under normal operating conditions, avoiding long-term full charge (100%);
2. Discharging Lower Limit: Start charging when the remaining capacity is ≥20%, and strictly prohibit discharging to SOC ≤10% (except in emergency situations).
3. SOC Correction: It is recommended to fully charge the battery every 1 – 2 weeks to calibrate the SOC.

2 Full Charge-Discharge Cycle and Operation Requirements

2.1 Mandatory Calibration Cycle

Perform full charge-discharge 1-2 times a week. Due to the flat voltage platform of this type of battery, full charge is required to activate the BMS calibration function and prevent power display distortion.

2.2 Full Charge-Discharge Operation Process

1. Select a period with an ambient temperature of 15℃-25℃ and use slow charging mode (charging rate ≤0.3C);
2. After charging to 100%, maintain the charging state for 1-2 hours (BMS calibration time) and avoid immediate power-off;
3. Control the discharge rate ≤0.5C during discharging to avoid high-current discharge;
4. After completion, restore the daily 20%-80% operating range and record the SOC display difference before and after BMS calibration.

3 Charging Method and Rate Control

1. Prioritize slow charging (charging rate 0.2C-0.3C)；
2. Fast charging is only used for emergency energy supplementation. Avoid long-term pure fast charging (high current will cause battery heating and accelerate degradation; the degradation rate of long-term pure fast charging is 1.5-2 times that of slow charging);
3. Prohibit fast charging when the battery temperature is ＞45℃ or ＜0℃. Preheat the battery to above 5℃ before charging in low-temperature environments.

Appendix C — Environment and Equipment Status Monitoring

1 Environmental Temperature Control

1. Operating Temperature: 10℃-35℃ (optimal 15℃-25℃). For every 10℃ increase in temperature, the battery life may be reduced by 25%;
2. Summer Protection: Avoid exposure of the battery compartment to sunlight. Start forced heat dissipation when the ambient temperature is ＞35℃ to ensure the battery surface temperature ≤45℃; allow 10-20 minutes of heat dissipation after exposure before charging;

3. Winter Protection: Start the preheating system when the ambient temperature is ＜0℃. Heat the battery to above 5℃ before charging to avoid internal pressure increase caused by rapid charging at low temperatures.

2 Daily Monitoring Items

Monitoring items including cell voltage, cell temperature, SOC value ,charge current and so on.

3 Equipment Status Inspection

1. Daily check for abnormalities such as leakage, bulging, or peculiar odors in the battery compartment;
2. Weekly inspect battery connection harnesses for looseness or oxidation. Wipe and clean terminal rust with alcohol;
3. Monthly check the accuracy of BMS data collection and the normal operation of PCS charging and discharging control logic to ensure matching with battery status.

Appendix D — Regular Maintenance and Fault Handling

1 Regular Maintenance Items and Cycles

Maintenance Level	Core Content
Daily Maintenance	Environmental temperature inspection, equipment operation status monitoring, SOC range control
Weekly Maintenance	Harness connection inspection, heat dissipation/thermal insulation system function test, full charge-discharge calibration for lithium iron phosphate batteries
Monthly Maintenance	Full charge-discharge calibration for ternary lithium batteries, single cell voltage balance detection, BMS software version update
Quarterly Maintenance	Battery capacity test (discharge test), electrolyte status inspection (professional equipment), PCS efficiency test
Annual Maintenance	Battery pack health assessment, faulty cell replacement, comprehensive overall performance testing

2 Common Fault Handling Processes

2.1 Abnormal SOC Display (Sudden Jump, Large Deviation)

1. Phenomenon: SOC drops sharply from 40% to 20%, or the displayed power is seriously inconsistent with actual endurance;
2. Handling: Immediately perform full charge-discharge calibration (according to the process recommended) and observe for 3 days after calibration; if the abnormality persists, check BMS sensors or cell consistency and replace faulty cells if necessary.

2.2 Excessively Large Temperature Difference in Battery Pack (＞5℃)

1. Troubleshoot whether the heat dissipation system is faulty (fans, air conditioners);
2. Check if the battery pack arrangement blocks the heat dissipation channel and adjust the cell spacing;
3. If the temperature of a single cell rises abnormally, isolate the cell and test its internal resistance to determine the risk of short circuit.

2.3 Excessively Fast Capacity Degradation (＞5% Degradation in 6 Months)

1. Review charging and discharging records to check for long-term full charge, over-discharge, or high-temperature operation;
2. Test the balance of single cells and replace cells with severe degradation;
3. Adjust the charging and discharging strategy, strictly implement the 20%-80% range control, and avoid excessive fast charging ratio.

Appendix E — Glossary

Term	Definition
BESS	Battery Energy Storage System
BMU	Battery Management Unit
HVCB	High-Voltage Control Box
LOTO	Lockout / Tagout
OCV	Open-Circuit Voltage
PCS	Power Conversion System (inverter)
PE	Protective Earth
SOC	State of Charge