# BLUE NOVA energy

# USER MANUAL

## RacPower BN52V-100-5.2k SP



Doc. version : v1.0
Compiled by : C. Delport
Approved by : A. Swart
Release date : 26 October 2023

BLUE NOVA energy

# Product User Manual
# RacPower BN52V-100-5.2k SP

Congratulations on purchasing a high quality BlueNova® product.

This document contains information on the structural specifics, installation, troubleshooting, safety & maintenance procedures, storage guidelines as well as emergency/first aid procedures relevant to the following product(s):

**BlueNova® RacPower BN52V-100-5.2k SP**

If you are unsure whether this document is applicable to your battery, or if you have any questions or comments, kindly contact BlueNova® Technical Support:

Office: +27 21 205 2000 E-mail: support@bluenova.co.za

## Table of Contents

# 01 SAFETY FIRST

Please read this product manual carefully before commencing with product installation & use. Apart from potentially incurring irreversible damage to components and voiding associated product warranties, failure to adhere to the safety and operational guidelines in this document may also result in electrical shock, serious personal injury, or even death.

## 1.1 Summary of safety requirements

- Batteries stored for extended periods should be recharged at least once every 3 (three) months. In such cases, a calibrated product-compatible charger should be used to recharge each battery individually to ±40~60% SoC.
- Do not connect battery terminals in reverse polarity to any inverter, charger, load, or other peripheral device.
- Do not connect batteries to AC power source(s) directly.
- Do not connect batteries to PV panels and/or -configurations directly. Always install the appropriate fusing & compatible supplier pre-approved MPPT module(s) between batteries and PV panel configurations.
- All conductive wiring & connection points in battery-integrated systems should be electrically insulated. Do not install batteries in systems where any of the conductive cabling and/or connection points remain non-insulated.
- Batteries should be switched off before being connected to inverters, chargers and/or other compatible devices.
- Do not connect batteries to inverters, chargers or other peripheral devices while such devices are connected to the grid and/or any load(s). Disconnect all external connections from such devices before connecting to batteries.
- Do not connect batteries in series. Failure to do so will result in immediate irreparable damage to the integrated BMS of each subjected battery & void the associated product warranties.
- Do not connect batteries to incompatible and/or faulty inverters, chargers or other peripheral devices.
- Do not open batteries to attempt fault finding or repair procedures, or for any other purposes. Do not physically modify battery enclosures and/or battery-integrated components in any way, unless such modifications are explicitly allowed & described in this document (such as the installation methods detailed in chapter 4).
- Do not store batteries without protective packaging. Batteries should be enclosed in the packaging material originally supplied by the manufacturer (including original padding) and sealed accordingly before being stored.
- Do not install batteries in outdoor environments, or in locations where the environmental temperatures and/or humidity will exceed the operational ranges specified in the product's data sheet.
- Do not install or store batteries near external heat sources and/or in locations exposed to direct sunlight.
- Do not install or store batteries in environments where contact with water and/or other fluid may occur.
- Batteries should be stored in cool, dry locations & in accordance with any other relevant requirements potentially listed in additional supporting documentation & official publications.
- Do not install batteries to power life support devices or in any other application(s) where over-discharge and/or battery failure might cause personal injury or death.

**IMPORTANT:** Some of the above requirements are specific only to the batteries covered in this document. Apart from the requirements above, the minimum industry standard requirements associated with electrical installations (especially those including DC power sources such as batteries) are not covered in this document but should also be adhered to, as well as those imposed by any duly authorised local governing authorities of the region in question. Additionally, further requirements might also be listed in the associated product warranty & other official supporting documents.

# 02 ABOUT THIS DOCUMENT

## 2.1 Terminology

The following table lists industry-specific terminology, units of measurement & abbreviations used in this document as well as in other official product-supporting documentation:

| Term / abbr. | Meaning |
|---|---|
| A | **Ampere.** The unit of measurement of electrical current. |
| AC | **Alternating current**. Electrical current that changes direction several times per second, such as supplied by utility grids, inverter output to loads & other devices. Incompatible with batteries directly. |
| Ah | **Ampere-hour**. The unit of measurement of cell capacity. Battery capacity is not specified in Ah as a rule, but instead in Wh / kWh / MWh. |
| BMS | **Battery management system**. Battery-integrated electronic circuitry that adds functionality to batteries such as cell balancing, protection against adverse operation, serial communication & others. |
| C(n) | Battery **rate of charge** and/or discharge (where n = the number of hours required to hypothetically recharge the battery in question from 0-100% SoC at constant current). |
| CAN | **Controller Area Network** serial communication protocol. |
| DC | **Direct current**. Electrical current that flows in one direction only, such as supplied by batteries and solar PV panels/-arrays. |
| EoL | **End-of-life.** Battery cycle life is specified as a certain number of cycles at a certain maximum percentage depth of discharge per cycle. A battery reaches EoL either as soon as the specified number of cycles have been reached (provided that it has not been discharged on average to beyond the associated max. DoD% specified, installed correctly, operated within recommendations etc.) or when it has been installed/used for the entirety of its product warranty period – whichever comes first. Please refer to the relevant product warranty document for more exact specifics. |
| IP(xy) | **Ingress protection** rating. Indicates how well an electrical device's enclosure protects the device from contamination / damage by foreign matter (where x = numerical rating for solids, and y = for liquids). |
| LiFePO4 | **Lithium iron phosphate**. Part of the lithium-ion family of battery chemistries. Unlike almost all other lithium battery chemistries, LiFePO4 (sometimes also: LFP) is inherently safe. |
| MOS | **Metal oxide semiconductor.** Refers to the transistor assembly integrated in each battery. |
| Ω | **Ohm**. The unit of measurement of electrical resistance. |
| RH | **Relative humidity.** |
| RS485 | **Recommended Standard #485.** A serial communication protocol standard for multi-node systems. |
| SoC | Battery **state of charge.** Expressed as a percentage. |
| SoH | Battery **state of health**. Expressed as a percentage of the maximum remaining usable capacity in comparison to the original capacity of each battery |
| V | **Voltage**. The unit of measurement of an electrical source's potential to deliver energy. |
| VAC | The **voltage** of an electrical component / source with **alternating current.** |
| VDC | The **voltage** of an electrical component / source with **direct current.** |
| Wh | **Watt-hour**. The unit of measurement of energy (and by extension, also battery capacity). |

# 03 PRODUCT OVERVIEW

## 3.1 Introduction

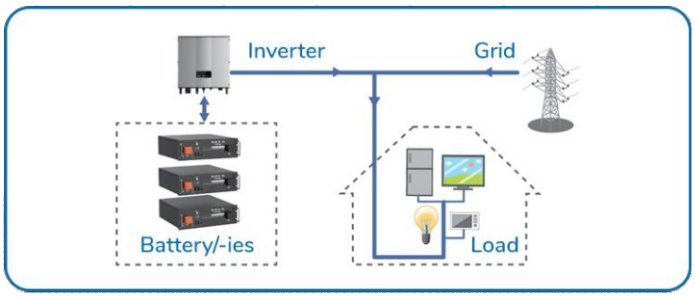
RacPower BN52V-100-5.2k SP batteries have been developed primarily for installation in residential and small commercial scale applications. Structurally, RacPower SP batteries are compatible with industry-standard 19-inch server cabinets and can therefore also be deployed in data centres & server rooms in the telecommunications industry.

The 5.2kWh capacity of each battery is established by interconnecting 16 x 100Ah high performance LiFePO4 cells in configuration 16S1P. Each battery also includes an integrated BMS with voltage, current & temperature measurement capability, communication compatibility with select inverters/chargers, and passive cell balancing ("equalisation").

A total of 6 x RacPower SP batteries can be connected in parallel for maximum capacity of 31.2kWh per battery bank. For larger capacity requirements, several 6P battery configurations can be installed to meet demands.

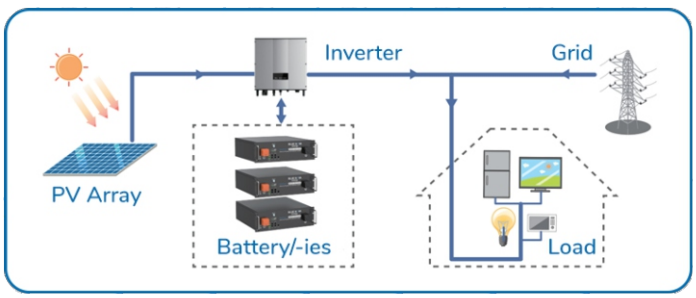
## 3.2 Applications

RacPower SP batteries are suitable for installation in the following applications:



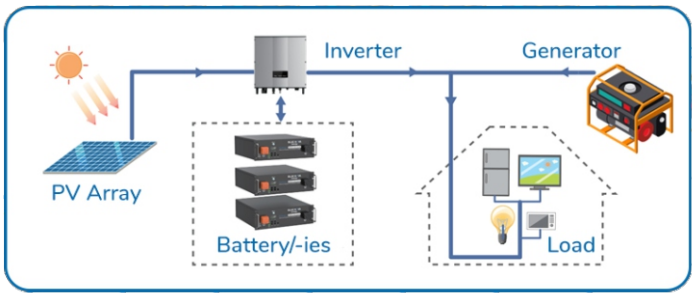

**Backup / standby applications:**

Batteries are installed with a grid-connected inverter to provide uninterrupted power to a dedicated load in the event of grid power failures / interruptions Once grid power is restored, the inverter switches seamlessly to supply the dedicated load from grid-supplied power and also recharges the batteries.




**Daily cycling applications (self-consumption):**

Batteries are installed with a grid-connected inverter and at least one renewable energy source such as a solar PV array. The PV array supplies the load with power during sunny days & is assisted by the grid when necessary, while the batteries provide power to the load after sunset & then recharged the next day.

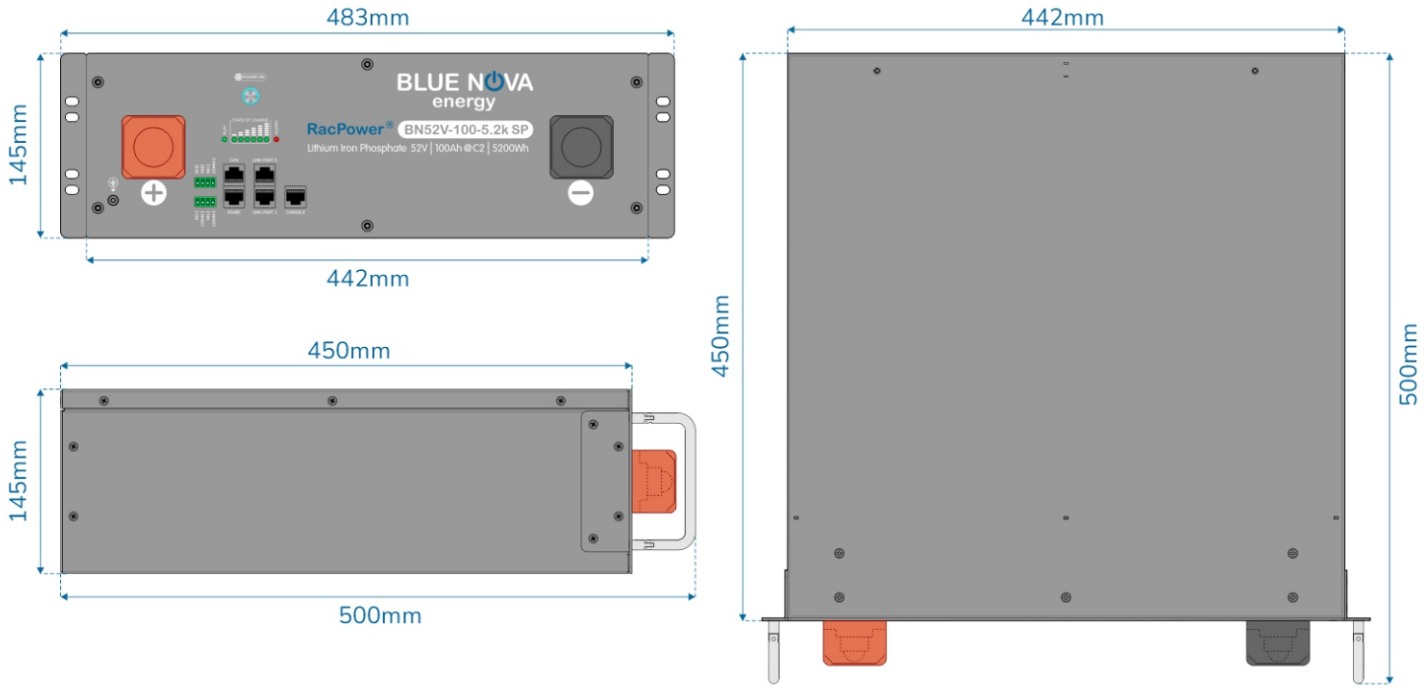



**Off-grid applications:**

Batteries are installed with an inverter and at least one renewable energy source such as a solar PV array. The PV array supplies power to the load during sunny days as far as possible & is assisted by the batteries when necessary. In the absence of a grid connection, a backup generator is typically installed.

## 3.3 External dimensions

The diagrams below illustrate the outer dimensions of a single RacPower SP battery in standard format (i.e. with server cabinet mounting extrusions fitted onto the sides of the front panel, as shipped) from a front, side and top-down perspective in each case:



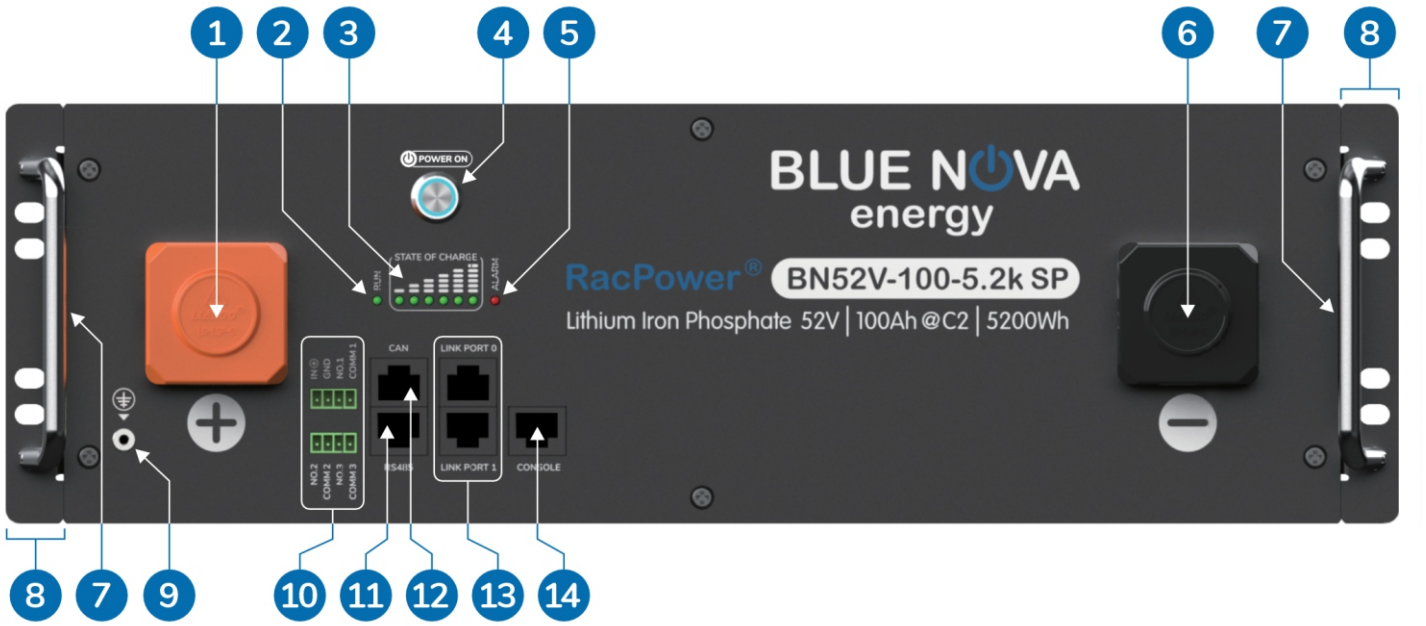

## 3.4 Technical Specifications

The table below contains a summary of the most important technical specifications of RacPower SP batteries. For a more complete list of technical product specifications, please refer to the relevant product datasheet.

| Specification | Value |
|---|---|
| Nominal voltage | 52VDC |
| Cell configuration | 16S1P |
| Ah capacity @C5 | Nominal: 100Ah \| Minimum: 97Ah |
| Internal resistance | ≤25mΩ (measured at 1kHz AC, following charge @C2) |
| Charge voltage range | 54.4 ~ 57.6V |
| Low voltage | 43.2V |
| Charge current | Normal: 51A (C2) \| Recommended: 20.4A (C5) \| Maximum: 102A (C1) |
| Discharge current | Normal: 51A (C2) \| Recommended: 20.4A (C5) \| Maximum: 102A (C1) \| Peak: 200A (2C) for ＜3000ms |
| Operating Temperature | Charge: (0°C) ~ (+45°C) \| Discharge: (-10°C) ~ (+45°C) |
| Operating Humidity | 5% ~ 85% relative humidity |
| Ingress protection rating | IP20 |
| Required Ambient Cooling | Natural convection |
| Dimensions | 442 x 450 x 145mm (W x D x H) |
| Net Weight | 43.5kg ± 1.0kg (battery only / excl. packaging) |

## 3.5 Front panel components

The diagram below illustrates the battery's front panel component layout:




The designation & function of each numbered component in the diagram above is explained in the table below:

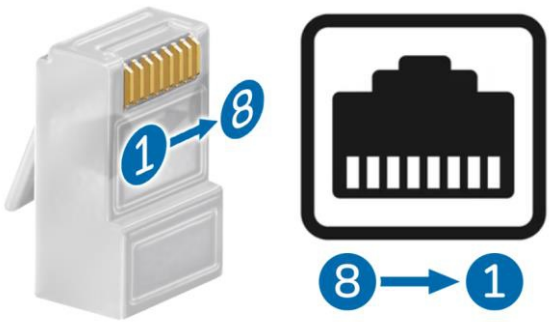
| No. | Label / Description | Note(s) |
|---|---|---|
| 1 | Positive terminal | The positive terminal of the battery. |
| 2 | Run LED | Indicates whether the battery is currently in operation. |
| 3 | SoC LED array | Indicates the battery's estimated state-of-charge. |
| 4 | On/off switch | Switch the battery on/off from here. |
| 5 | Alarm LED | Indicates performance warnings, malfunctions & configuration errors. |
| 6 | Negative terminal | The negative terminal of the battery. |
| 7 | Handles | Fold-away / collapsible type. |
| 8 | Mounting extrusions | For securing batteries to the frame of 19" server racks / other compatible mounting brackets. Mounting extrusions can also be removed if necessary. See section 4.3 in this document for instructions. |
| 9 | Earth connection point | For connecting battery enclosures to earth. |
| 10 | Dry contact point array | Compatible devices may be connected here to receive battery data output. |
| 11 | RS485 port | Connect a single battery (or the master battery in a parallel bank) to an RS485 communication-compatible inverter / peripheral device from here. |
| 12 | CAN port | Connect a single battery (or the master battery in a parallel bank) to a CAN communication-compatible inverter / peripheral device from here. |
| 13 | Link ports 0 & 1 | Used to interconnect the BMS of all batteries in a parallel configuration. |
| 14 | Console port | For maintenance / debugging. Do not connect anything to this port. |

## 3.6 Serial communication

RacPower SP batteries can communicate via CAN and RS485 protocols with compatible inverters & other peripheral devices. The pin configuration of each protocol is detailed below:

| Pin # | CAN Protocol |
|---|---|
| 1 | – |
| 2 | – |
| 3 | GND |
| 4 | CAN-H |
| 5 | CAN-L |
| 6 | GND |
| 7 | – |
| 8 | – |

| Pin # | RS485 Protocol |
|---|---|
| 1 | RS485-B |
| 2 | RS485-A |
| 3 | GND |
| 4 | – |
| 5 | – |
| 6 | GND |
| 7 | RS485-A |
| 8 | RS485-B |




## 3.7 Management functions

RacPower SP batteries include the following automatically & manually activated operational modes:

a. Sleep mode
- (Automatic) Batteries will enter sleep mode whenever over-discharged to a certain point.
- (Manual) Sleep mode can be activated by pressing the “Power On” button.

b. Wake from sleep (active mode)
- (Automatic) Batteries in sleep mode will reactivate automatically upon being charged/discharged.
- (Manual) Sleep mode can be cancelled by pressing the “Power On” button on any battery.

Additionally, the table below lists the various alarms & auto-protective countermeasures that can be triggered by the integrated BMS in each RacPower SP battery, along with the associated recovery procedures of each:

| No. | Alarm condition | Auto-triggered protection | Recovery procedure |
|---|---|---|---|
| 1 | Cell over-voltage | Over-voltage cutout | Over-voltage cutout recovery |
| 2 | Cell under-voltage | Under-voltage cutout | Under-voltage cutout recovery |
| 3 | Battery over-voltage | Over-voltage cutout | Over-voltage cutout recovery |
| 4 | Battery under-voltage | Under-voltage cutout | Under-voltage cutout recovery |
| 5 | High cell temperature | High temperature cutout | High temperature recovery |
| 6 | Low cell temperature | Low temperature cutout | Low temperature recovery |
| 7 | Current over-charge | Over-current cutout | Charge over-current recovery |
| 8 | Current over-discharge | Over-current cutout | Discharge over-current recovery |
| 9 | High SoC | *(none / see 1 & 3 above)* | *(none / see 1 & 3 above)* |
| 10 | Low SoC | *(none / see 2 & 4 above)* | *(none / see 2 & 4 above)* |
| 11 | Cell voltage imbalance | *(none / see 1 – 4 above)* | *(none / see 1 – 4 above)* |
| 12 | Cell temperature imbalance | *(none / see 5 & 6 above)* | *(none / see 5 & 6 above)* |
| 13 | High MOS temperature | MOS over-temperature cutout | MOS over-temperature recovery |
| 14 | *(no alarm)* | Secondary discharge over-current cutout | Secondary discharge over-current cutout recovery |
| 15 | *(no alarm)* | Short circuit protection | Short circuit recovery |

## 3.8 Multi-battery configurations

### 3.8.1 Series configurations

RacPower SP batteries are NOT designed to be connected in series. The integrated BMS & other electronics in RacPower SP batteries are rated for voltage ranges typical to 48V systems. Connecting RacPower SP batteries in series is a product warranty void condition and should be avoided at all costs.

### 3.8.2 Parallel configurations

The following characteristics & features are applicable to RacPower SP parallel configurations (and in some cases, single RacPower SP battery installations as well):

- Up to 6 x RacPower SP batteries can be interconnected in a single parallel configuration (for 31.2kWh total installed capacity). Several parallel configurations can be installed in applications with capacity requirements larger than 31.2kWh.
- The standard charge current applicable to RacPower SP parallel configurations is 52.5A (±C2), and the maximum charge current is 105A (±C1).
- The standard discharge current applicable to RacPower SP parallel configurations is 52.5A (±C2), and the maximum discharge current is 105A (±C1).
- Voltage-specific BMS functionalities include cell voltage measurement & reporting, cell over-voltage alarm notifications & -protection, and cell under-voltage alarm notifications & -protection.
- Temperature-specific BMS functionalities include cell temperature measurement & reporting, cell over-temperature alarm notifications & -protection, cell under-temperature alarm notifications & -protection, MOS tube temperature measurement, MOS tube temperature alarm notifications & -protection.
- Cells are intelligently balanced via fine-tuned algorithms for optimised performance & prolonged service life.
- Potential gradual loss of accuracy in calculated SoC values (“SoC drift”) is automatically corrected (if present) whenever a RacPower SP battery is charged to the recommended bulk voltage setpoint.
- Includes external CAN communication functionality with leading inverters & associated peripheral devices.
- Includes internal (battery-to-battery) CAN communication functionality to allow CAN data for parallel battery configurations to be calculated & transmitted to compatible peripheral devices as if from a single battery.
- Isolated CAN functionality simplifies development activities to allow developers to establish compatibility with additional CAN-compatible devices much easier.
- RacPower SP batteries include dry contact points from which battery status information (normal / alarm / protection triggered) may be obtained & used by compatible third-party devices.
- RacPower SP battery firmware can be updated in the field if necessary.
- Hibernation mode allow RacPower SP batteries to be set to ultra-low self-consumption to minimise the frequency of having to perform maintenance on batteries stored for prolonged periods.
- RacPower SP batteries in sleep mode will reactivate automatically as soon as charge current at the required voltage is applied over the terminals. Sleep mode can also be manually cancelled by pressing the on/off button.
- Intelligent power-on procedure includes voltage, current, temperature & other checks to eliminate potentially inflicting damage to battery-connected peripherals and/or personal injury to operators.

### 3.8.3 Battery-to-inverter ratios

The table below lists the minimum number of RacPower SP batteries that must be connected in parallel in order to meet power requirements, based on the max. collective power rating of the inverter(s) in each case:

| Inverter max. continuous power output @25°C | No. of batteries | Battery configuration: Total discharge power | | Battery config. total weight (kg) |
|---|---|---|---|---|
| | | Calculation | Result (W) | |
| ≤2000 | 1 | 1 x 52V x 50A | 2560 | 43.5 |
| ≤4000 | 2 | 2 x 52V x (50A-5A) | 4608 | 87 |
| ≤5000 | 2 | 3 x 52V x (50A-10A) | 6144 | 87 |
| ≤6000 | 3 | 4 x 52V x (50A-15A) | 7168 | 130.5 |
| ≤7000 | 4 | 5 x 52V x (50A-15A) | 8960 | 174 |
| ≤8000 | 6 | 6 x 52V x (50A-20A) | 9216 | 261 |

**Note:** Installing less than the minimum required number of parallel-connected RacPower SP batteries with an inverter/charger or parallel inverter/charger configuration as per the above requirements, will lead to erratic system performance whenever battery limitations are exceeded and battery auto-disconnection is triggered. Apart from this, subjecting RacPower SP batteries to potentially out-of-range input/output from over-sized peripheral devices connected in the same system, is a warranty void condition and should be avoided.

Please also take note of the following important installation requirements:

- When connecting RacPower SP batteries in parallel, the terminals should be connected first, followed by the serial communication / CAN connections.
- When disconnecting RacPower SP parallel configurations, the serial communication / CAN connections should be disconnected first, followed by the terminal connections.
- All batteries should be switched OFF when parallel configurations are either assembled or disassembled.
- Parallel battery configurations should be switched OFF when either connecting or disconnecting to inverters, chargers and/or other compatible peripheral devices.
- Single- and bus bar parallel connections should be connected to inverters / parallel inverter configurations from the positive terminal of the first (master) battery and negative terminal of the last (slave) battery, or vice versa.

# 04 INSTALLATION

## 4.1 Site requirements

In the interest of personal safety & prolonged system performance, please ensure that the location at which RacPower SP batteries are installed meet the following requirements:

- There are no flammable or explosive materials in proximity.
- The surface (or structures, such as wall mount brackets) on which each battery is installed is solid & level.
- There are no heat sources, either permanent or occasional, within at least 2 meters of the battery.
- The building/room is completely waterproof.
- Temperature and humidity levels are maintained in accordance with battery datasheet specifications.
- The area is dust- and dirt-free as far as possible.
- The ambient temperature in the location is expected to remain between 0ºC ~ 50ºC.
- Humidity levels at the location are expected to remain between 5% ~ 95% relative humidity.
- Natural ventilation is present & all materials which might compromise ventilation to/from the battery is absent.
- All inverter outlets are located at least 50cm or more from any part of the battery.
- The area is not exposed to direct sunlight, even occasionally.
- The area is not exposed to high salinity and/or other metal oxidation accelerants.

## 4.2 Installation requirements

- RacPower SP batteries should only be installed by suitably qualified BlueNova® approved installers. RacPower SP batteries which have been installed incorrectly by unqualified individuals will not be covered by the associated product warranty.
- Industry-standard as well as product-specific safety requirements must be met during battery installation and maintenance procedures.
- The correct PPE must be worn when installing and/or performing maintenance on RacPower SP batteries.
- Further requirements which may be imposed by one or more duly authorised regional governing bodies (if any) should also be adhered to. In South Africa, obtaining a certificate of compliance for newly installed (or modified existing) electrical systems is required by law.

## 4.3 Installation procedures

### 4.3.1 Server cabinet installation

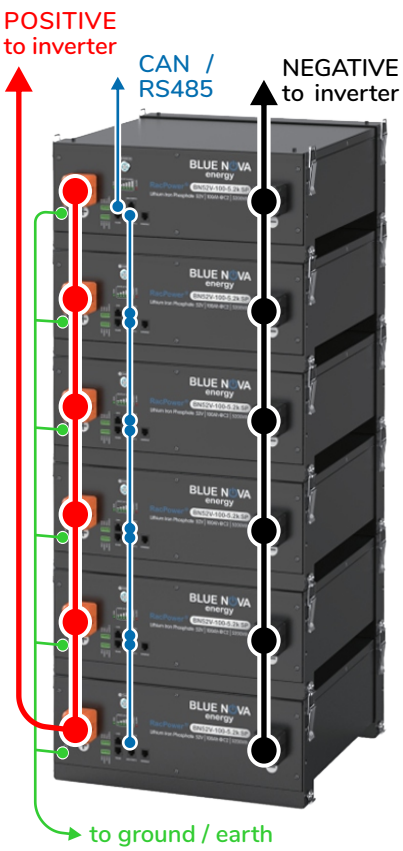
RacPower SP batteries are size-compatible with industry-standard 19-inch server cabinets. Batteries should be mounted on the inner mounting structure of such cabinets, as illustrated below:


Secure RacPower batteries to the inner mounting structure with M6 screws (at least 2 x per side):

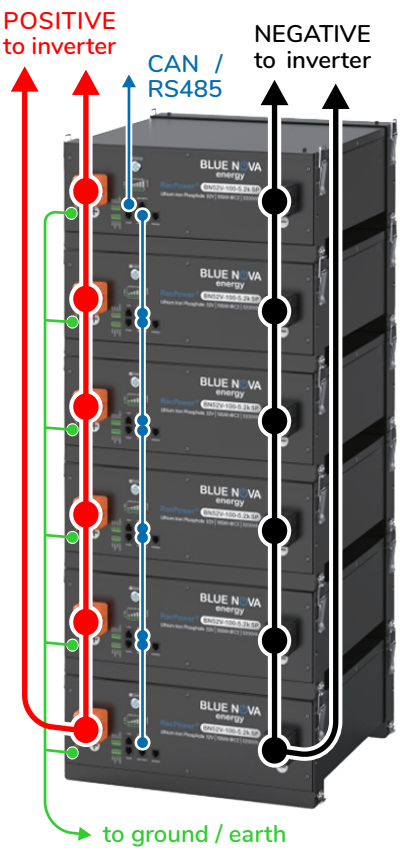

The height of each RacPower SP battery (in terms of industry-standard server cabinet units of measurement) is 5U. Up to 6 x RacPower SP batteries can be connected in parallel per cluster, as illustrated in the image on the next page.

Please take note of the wiring requirements determined by the collective power rating of the connected inverter(s) in each illustrated case:

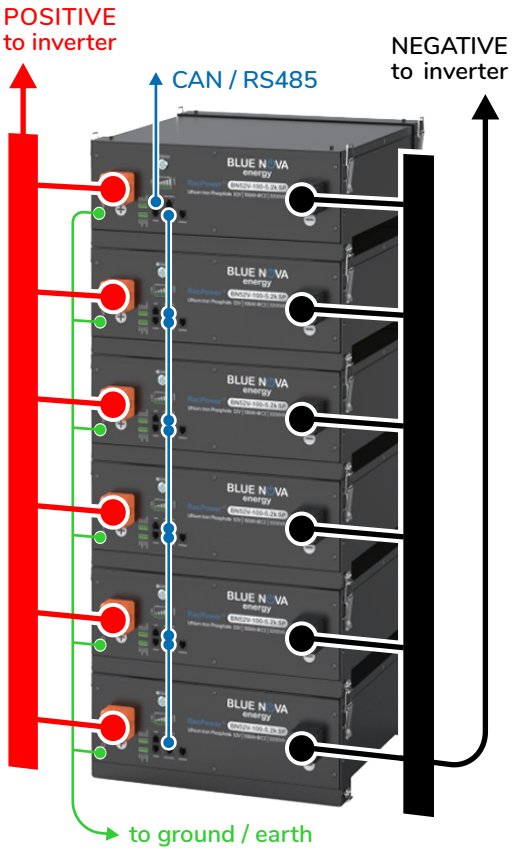
**Single parallel connection**
for batteries connected to inverters with total rated power of **< 5kW:**




**Double parallel connection**
for batteries connected to inverters with total rated power of **5 ~ 8kW:**




**Bus bar parallel connection method**
for batteries connected to inverters with total rated power of **8 ~ 12kW:**




- RacPower SP parallel configurations installed in systems where the collective continuous power rating of the system's inverter(s) is **less than 5000W** may be interconnected from terminal to terminal with **1 x wire** in each case (i.e. 1 x wire for each (+) to (+) terminal connection, and 1 x wire for each (-) to (-) terminal connection).
- RacPower SP parallel configurations installed in systems where the collective continuous power rating of the system's inverter(s) is **5000~8000W** should be interconnected from terminal to terminal with **2 x wires** in each case (i.e. 2 x wires for each (+) to (+) terminal connection, and 2 x wires for each (-) to (-) terminal connection).
- RacPower SP parallel configurations installed in systems where collective inverter output power could occasionally/potentially peak to between **8000~12000W** should be interconnected via **(+) and (-) bus bars**.
- RacPower SP battery banks cannot be installed in systems (even in 6P max. configuration) if the collective inverter power output could potentially peak to **>12000W** at any given time, regardless of output duration.

### 4.3.2 Stacked installation

RacPower SP batteries can also be installed in stacked formation by fitting the 2 x stack mount brackets included in the product packaging to each battery's enclosure. Stack mount brackets have been developed & tested to support the collective weight of maximum 6 x RacPower batteries per stacked structure, to correspond to the maximum number of RacPower SP batteries that can be interconnected in parallel.

Before fitting stack mount brackets to RacPower SP batteries, the 2 x server cabinet mounting extrusions (incl. handles) that each RacPower SP battery is fitted- and shipped with by default, should be removed first.


Next, fit the 2 x specialised stack mount brackets to the front and back of each RacPower SP battery allocated to be included in the stacked formation, as shown below:


<< Take note of the correct orientation when fitting RacPower SP stack mount brackets. The 2 x silver latches / clamps on each bracket should be positioned at the top of the battery & bracket assembly.

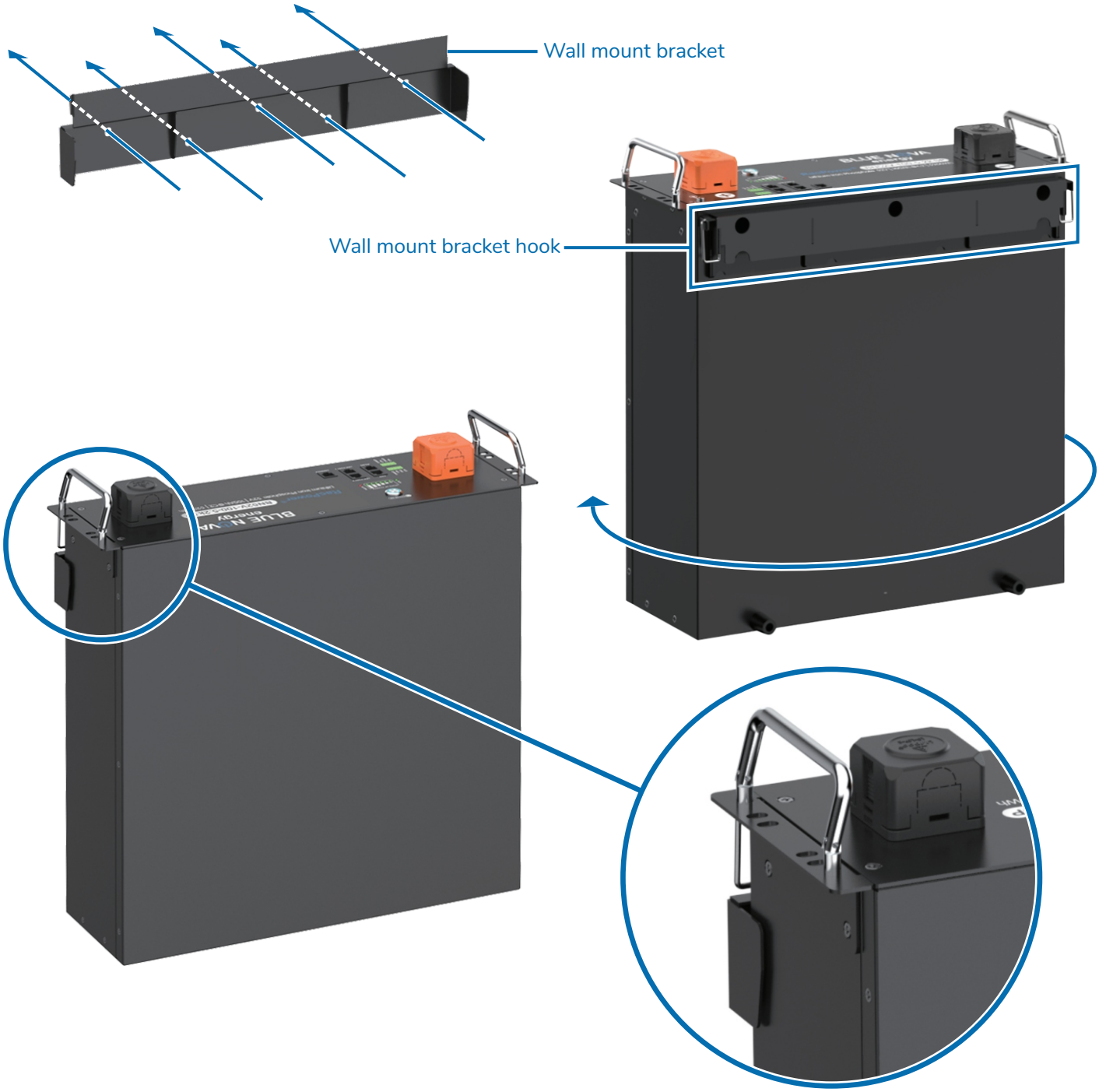
**Note:** Stack mount brackets fit tightly around RacPower SP battery enclosures by design & should be fitted flush with the front- and rear panel of each battery respectively. When correctly positioned, the cutouts on the sides of each bracket will line up perfectly with the threaded holes on the battery's enclosure. Brackets should always be secured to battery enclosures from all 4 x of these points.

Once the required number of RacPower SP batteries have been fitted securely & correctly with 2 x stack mount brackets each, assembly of the stacked battery formation can commence:


Secure the 4 x latches for each RacPower SP battery added to the stack before stacking the next battery (if any):

### 4.3.3 Wall mount installation

RacPower SP batteries can also be wall mounted by fitting the wall mount bracket components included in the packaging of each battery. The 2 x server rack mounting extrusions (with handles) on the left and right of the front panel do not need to be removed from RacPower SP batteries during wall mounting.




a. Affix the wall mount bracket onto a sturdy wall in a horizontally level position. Use wall plugs of the correct type & size to anchor the bracket to the wall. RacPower SP batteries should not be mounted onto drywall type walls.
b. Install the wall mount bracket hook on the battery in the position indicated above.
c. Mount the battery onto the wall by hooking the wall mount bracket hook onto the wall mount bracket.

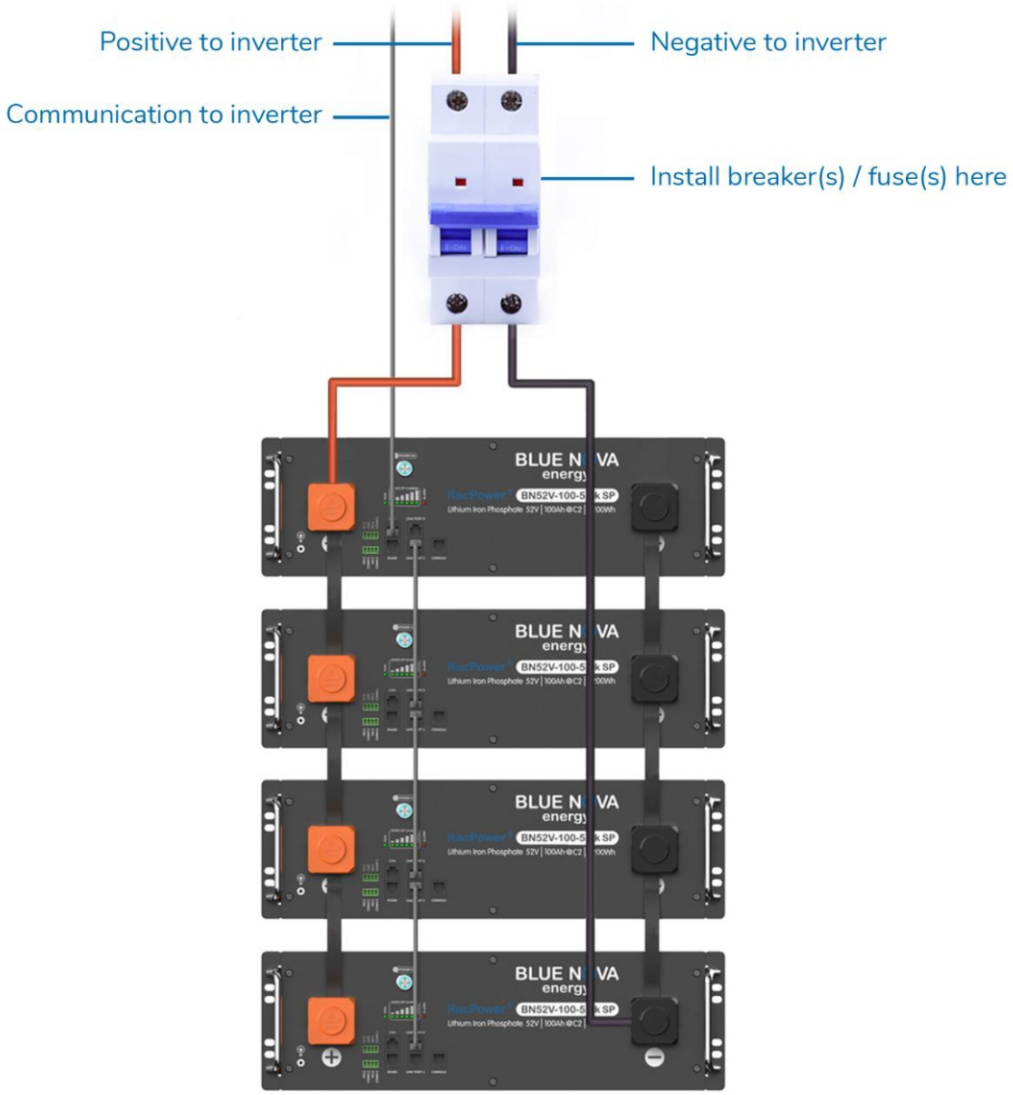
# 05 OPERATION

## 5.1 Commissioning

Upon completing installation, batteries/parallel battery configurations must be tested to verify that the installation was successful. To switch on single batteries, press the **Power On** button. To switch on parallel battery configurations, press the **Power On** button of the master (top) battery only. If the configuration is installed correctly, all slave batteries connected to the master battery should switch on automatically:

**IMPORTANT:**

- For batteries/parallel battery configurations connected to an inverter/inverter configuration which is also connected to an active grid power supply, the inverter(s) should be switched on first to prevent inverter pulse current from being added to the battery/parallel battery configuration's startup current.
- An appropriately sized fuse or circuit breaker should be installed between the battery/parallel battery configuration and the inverter(s) in accordance with international industry standards.



## 06 TROUBLESHOOTING

The following table lists the most common issues which may be experienced with RacPower SP installations in cases where the **red alarm LED** is **OFF** on all batteries, alongside the corresponding potential causes and remedial steps:

| Main issue: | Potential causes of issue: | Remedial steps: |
|---|---|---|
| Charge / discharge | The connected inverter(s) are not connected to the grid and/or other active power source. | Check whether inverter-to-grid connections are correctly connected and active. |
| | Inverter-to-battery connections are disconnected or damaged. | Test inverter-to-battery connections for continuity and check all connection points. |
| | Battery auto-protection activated. | Check the following:<br><br>- Battery-to-inverter connections.<br>- Ambient environment variables.<br>- Inverter charge voltage / -configuration.<br>- Load power demand. |
| | BMS damaged / malfunctioning. | Contact BlueNova® Technical Support to arrange replacement of the BMS electronics. |
| Serial communication | Inverter serial communication circuitry is damaged. | Replace installed inverter with another inverter known to have working serial communication to verify whether the original inverter's serial communication is operational & replace if necessary. |
| | Incorrect serial communication wiring. | Verify that the pinout configuration(s) of all installed RJ45 cables correspond to the required pinout configuration(s) in this manual. |
| | Inverter serial communication port(s) and/or -circuitry is damaged. | Check inverter serial communication ports for visible damage (such as bent contact points, water ingress etc) & replace if necessary. |
| | BMS damaged / malfunctioning. | Contact BlueNova® Technical Support to arrange replacement of the BMS electronics. |

The following table lists the most common issues which may be experienced with RacPower SP installations in cases where the **red alarm LED** is **ON** on any battery, alongside the corresponding potential causes and remedial steps:

| Main issue: | Potential causes of issue: | Remedial steps: |
|---|---|---|
| Temperature | Ambient temperature out-of-range | • Ensure that the site of installation meets all requirements listed in section 4.1 of this document.<br>• Install the necessary HVAC equipment if required & configure the equipment to maintain ideal ambient conditions at the site (25°C) on an ongoing basis.<br>• Ensure that any newly installed HVAC equipment is serviced on a regular basis in accordance with requirements listed in the OEM documentation. |
| Over-voltage | The inverter's charge voltage is higher than 54V. Battery auto-disconnection is triggered by the BMS in such cases. | • Check the voltage setpoint configuration of the inverter to verify that it has been configured correctly.<br>• Measure the actual output voltage at the end of the inverter-to-battery connectors (i.e. at the point where each will be connected to the relevant battery terminal) with a calibrated voltmeter. |
| Under-voltage | One or more connected batteries have been over-discharged to below 40.5VDC. Battery auto-disconnection is triggered by the BMS in such cases. | • Check energy input sources & connections to the inverter to ensure that it is receiving adequate input power in order to recharge connected battery/-ies sufficiently.<br>• Switch the system off, disconnect any load(s) from the inverter, switch the inverter(s) on, then switch the battery / parallel battery configuration on.<br>• Verify that inverter-to-battery recharge has recommenced. Recharge all batteries to 100% SoC before reconnecting load(s). |
| Over-current | Inverter-to-battery charge current has exceeded 110A for 60 seconds, or 200A for 10ms. Battery auto-disconnection is triggered by the BMS in such cases. | • Check the current output configuration of the inverter to verify that it has been configured correctly. |

# 07 MAINTENANCE

## 7.1 Product storage & transportation

The following environment variables and battery parameters should be maintained for all RacPower SP batteries stored for the durations indicated:

| Variable | Stored period | Required variable range: |
|---|---|---|
| Ambient temperature | < 1 month | -10°C ~ 45°C |
| | 1-3 months | -10°C ~ 35°C |
| | > 3 months | 0°C ~ 30°C |
| Humidity | Any period | ≤ 75% RH |
| State-of-charge | Any period | 40 – 60% SoC |

## 7.2 General maintenance requirements

Please also take note of the following requirements relevant to the storage & transportation of RacPower SP batteries:

- RacPower SP batteries stored for prolonged periods should be recharged individually at least once every 3 months to 40-60% SoC each. A calibrated inverter/charger should be used for such procedures. Inverter charge current output should be set to ±50A to ensure that the recharge period for each battery amounts to 0.5~1 hour.
- Installed RacPower SP batteries due to remain non-operational for prolonged periods should be disconnected from the inverter(s)/load(s), regardless of whether the inverter(s)/load(s) will remain inactive as well. The same maintenance requirements applicable to stored batteries are applicable to installed disconnected batteries.
- RacPower SP batteries which are transported for any reason and/or distance should be packaged in their original packaging (incl. original shock absorbent padding materials). Should the original packaging not be available for any batteries due to be transported, suitable replacement packaging must be provided to minimise potential physical damage during transportation to the minimum extent provided by the original packaging.
- Batteries should not be subjected to severe/continued vibration, direct sunlight or rain during transportation.

# 08 EMERGENCY & FIRST AID

| Emergency condition: | Procedure to follow: |
|---|---|
| Ruptured / leaking components | • **Inhalation:** Evacuate the area. Seek medical attention immediately.<br>• **Eye contact:** Rinse eyes with clean water continuously for 15 minutes. Seek medical attention immediately afterwards.<br>• **Skin contact:** Wash the affected area thoroughly with soap and water. Seek medical attention immediately afterwards if irritation persists.<br>• **Ingestion:** Induce manual (non-medicinal) vomiting if possible. Seek medical attention immediately afterwards. |
| Thermal event (fire) | • Evacuate the area immediately. Inform local firefighting authorities.<br>• Extinguish any fires with $CO_2$ fire extinguishers if it is safe to do so. |
| Water contact / damage | • Avoid making direct physical contact with batteries damaged by water/other fluid as well as the fluid itself.<br>• Disconnect such batteries with non-conductive tools only if deemed safe enough to do so & while wearing suitably insulated PPE.<br>• Place water-damaged batteries in original packaging & contact BlueNova® Technical Support for further instructions. |