PowerPlus Energy

ESCAPE20 BESS

Installation, Operation and Maintenance Manual

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1 Documentation Control

Printed copy is Uncontrolled.
The currency of this document and the equipment it describes can be obtained by contacting PowerPlus Energy on:
Telephone: +61 3 8797 5557
PowerPlus Energy Website: www.powerplus-energy.com.au
Email: bess.support@powerplus-energy.com.au

2 Introduction

The purpose of this document is to describe the Escape20 series battery energy storage system (BESS) technical specifications and provide required information to perform system installation, commissioning and maintenance.
PowerPlus Energy BESS and batteries should be installed, commissioned, operated and maintained by qualified personnel only.
This manual should be made available to each person concerned with commissioning, maintenance and operation of the system as well as the handover documentation for future work. The end-user is responsible to take the necessary actions for the prevention of damage to personnel and material.

3 Acronyms and Definitions

ACRONYMS	DEFINITIONS
AC	Alternating Current
A/C	Air Condition
Ah	Ampere Hour
AS/NZS	Australian/New Zealand Standard.
BESS	Battery Energy Storage System
BMS	Battery Management System
BOM	Bill of Material
CAN	Controller Area Network
CAT5	Category 5
CB	Circuit Breaker
Comms	Communications
DC	Direct Current
ELV	Extra Low Voltage
EMC	Electromagnetic Compatibility
EMS	Energy Management System
ETH	Ethernet
FAT	Factory Acceptance Test
GA	General Arrangement
GFD	Ground Fault Detection
GND	Ground
Hz	Hertz
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IO	Input/Output
IP	Internet Protocol
IP	Ingress Protection

kg	Kilogram
kW	Kilowatt
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
mA	Milli Ampere
MBB	Measure Box Battery
MCB	Mains Circuit Breaker
MCCB	Molded Case Circuit Breaker
MPPT	Maximum Power Point Tracking
mm	Millimetres
N	Neutral
NC	Normally Closed
NO	Normally Open
OVP	Over voltage protection
PCE	Power Conversion Equipment
PDF	Portable Document Format
PE	Protective Earth
PEK	Power Extension Kit
PPE	Personal Protection Equipment
PV	Photovoltaic
PWR	Power
RU	Rack Unit (1.75”)
SCH	Schematic
SLD	Single Line Diagram
SOC	State of Charge
SOH	State of Health
SPD	Surge Protection Device
TCP/IP	Transmission Control Protocol/Internet Protocol
THD	Total Harmonic Distortion
USB	Universal Serial Bus
V	Volts
VAC	Volts AC
VDC	Volts DC
WAN	Wide Area Network
Web UI	Web User Interface

4 Safety Requirements

Installation shall be carried out by a suitably qualified and experienced person who can specify the correct cables, DC bus arrangement, external circuit protection, polarity checking and suitability of the design for the installation according to all necessary local, national, and international standards, best practice guides and requirements within this manual.

- ***It is required that all activities associated with this operations manual are performed in a safe manner as required under Occupational Health and Safety duty of care and laws.***
- ***All operators are to be trained to perform the emergency shut-down procedure as described in Section 11.***
- ***The manufacturer is not responsible if equipment is not installed, used, or operated according to the instructions herein by skilled technicians according to local regulations.***
- ***Hazardous Voltage. The system internally carries hazardous voltages while in operation. Direct contact or indirect contact with moist objects with these components will result in fatal injury. Ensure that the power (mains and battery) to the system is turned off before any maintenance can be carried out within the system cabinet.***
- ***Insulated tools must be used at all times when working with live systems.***
- ***Follow torque settings as recommended by the manufacturer.***
- ***Read the safety precautions for battery carefully before installing them. Please refer to Safety data sheet for environment safety requirement.***
- ***Personal protective equipment (PPE) must be worn in accordance with site regulations.***
- ***Always wear safety glasses with side shields (and prescription lenses if necessary) during installation.***
- ***Remove all metallic jewellery, e.g., watches, rings, metal rimmed glasses, necklaces.***

5 Warranty

PowerPlus Energy will protect this product under warranty when it is installed as written in this manual and used as set out in the warranty documents. Any product not being used or installed as outlined will be in violation of the terms and will render the product void of any warranty.

PowerPlus Energy does not cover warranty or any liability for damages or defects caused or from the following:

- Incorrect storage or transportation.
- Incorrect installation and wiring.
- Installed not according to this manual.
- Incorrect operation.
- Inappropriate environmental conditions when operating the system.
- Failure to follow safety requirements.

- Unauthorised repairs or modifications.
- External influences such as physical damage.
- Used outside of warranty terms and conditions.

6 Reference Documents

The following referenced documents are essential for the application of this document:

- Power Conversion Equipment (PCE) Installation & Operation Manual
- Battery Datasheet
- Battery Operation Manual

7 Overview

7.1 System Composition and Configuration

The PowerPlus Escape20 series BESS is designed with versatility and scalability in mind.
Key features:

- Modular
- Hot-swappable converter modules
- Secure AC & DC loads
- Inbuilt redundancy
- Highly efficient
- Low Maintenance
- High power and energy density
- Extended AC input range 400V +/- 25%

The Escape 20 BESS consists of AC input/output circuit breakers, surge protection device, converter modules, system controller, energy management systems, industrial router, antennas, temperature & humidity sensors, battery trays, fans (ESCA2028-X1X only) and air-condition unit (ESCA2028-X2X only).

The Escape 20 BESS utilises world's first fully bidirectional power converters providing an uninterrupted power supply. The three ports (two AC and one DC) built into each module can all function as input and output. This means that you can use it to secure AC & DC loads and charge batteries at the same time. In addition to a range of standard features, the converters have a re-enforced coating for harsh environment conditions.

The Escape 20 is equipped with advanced monitoring and control. It allows the user to easily view, access, configure the system information through an LCD screen graphic display and web interface. The home screen of both LCD and web interface provides a summary of system power, converter modules, batteries, and events information. This information ranges from simple monitoring and threshold alarms for temperature, voltage and current, to advanced battery charging and diagnostic features.

The Escape 20 offers a web-based user interface (responsive and user-friendly), email alerts & notifications, real-time monitoring, digital input, mapping to log the events, is easily integrated into 3rd party devices (via Modbus, SNMP and HTTP), built-in battery management and advanced cybersecurity features among others.

The Escape 20 standard configuration is three phase and this manual refers to three phase configurations. Single phase configuration is available when specified at time of ordering.

Table 7-1 – AC Output Specifications (Escape 20)

Item	Description
Output Phase Configuration	3-Phase
AC Output Voltage	400V
AC Output Frequency	50Hz
MAX Continuous AC Output Power	28.8kW
MAX Surge AC Output Power	36.0kW (15 seconds)
MAX Apparent AC Output Power	36.0kVA
Fault Current <20ms	124A
Fault Current <15s	90A
Power Factor Range	0.8 Lagging to 0.8 Leading
UPS Mode	0ms
Total Harmonic Distortion	<3%

Table 7-2 – AC Input Specifications

Item	Description
AC Input Type	Grid or Genset
Nominal AC Input Voltage	400V
AC Input Voltage Range	400V +/- 25%
Input Phase Configuration	3-Phase
Nominal AC Input Frequency	50Hz
AC Input Frequency Range	47Hz to 53Hz
MAX Continuous AC Input Power	32.4kW
MAX Apparent AC Input Power	36kVA
Surge Protection	Type II

Table 7-3 – Battery Storage Specifications

Item	Description
Escape 20 Maximum Total Energy	65.8kWh (14 x PowerPlus Energy Eco 4847P Modules)
Escape 20 Useable Energy 80% DOD	52.64kWh
Escape 20 Minimum Total Energy	56.4kWh (12 x PowerPlus Energy Eco 4847P Modules)
Escape 20 Useable Energy 80% DOD	45.12kWh
Nominal DC Voltage	51.2V
Battery Chemistry	LFP
Battery Cell Type	Cylindrical

Table 7-4 – Efficiency Specifications

Item	Description
AC to AC	96.00%
DC to AC	93.70%
AC to DC	93.70%
Standby / Operational Power Consumption Per Escape 20 BESS Cabinet (12 x Converters)	
Inverters Only (Natural Cooling)	360W
Converters + Fan Cooling	360W + x W Per Fan
Converters + Air Conditioning Unit	360W + Air Conditioning Specified Input Watts

Table 7-5 – Environmental Requirements

Item	Description		
Operating Ambient Temperature Range	-6 to 56°C		
Nominal Ambient Temperature Range	15 to 30°C		
Max. Output Power Ambient Temperature Range	10 to 40°C		
Storage Temperature with Battery	0 to 35°C		
Storage Temperature without Battery	-10 to 60°C		
Humidity	95% Non-Condensation		
Max. Elevation	1500m		
Location	Indoor	Outdoor	Outdoor
IP Rating	IP21	IP54	IP54
Noise Level @1m	61dB	TBC	70dB
Cooling	Natural	Fans Only	HVAC

Table 7-6 – Mechanical Specifications

Item	Description		
Dimensions (H x W x D)	2050 x 600 x 800mm	2100 x 600 x 800mm	2160 x 800 x 925mm

Mounting Options	Floor		
Weight with Batteries (Approx.)	1000kg	1050kg	1100kg
Weight without Batteries (Approx.)	398kg	448kg	498kg
Lifting Options	Caster Wheels	Forklift/Crane	Forklift/Crane

Figure 1 – ESCAPE20 Front View

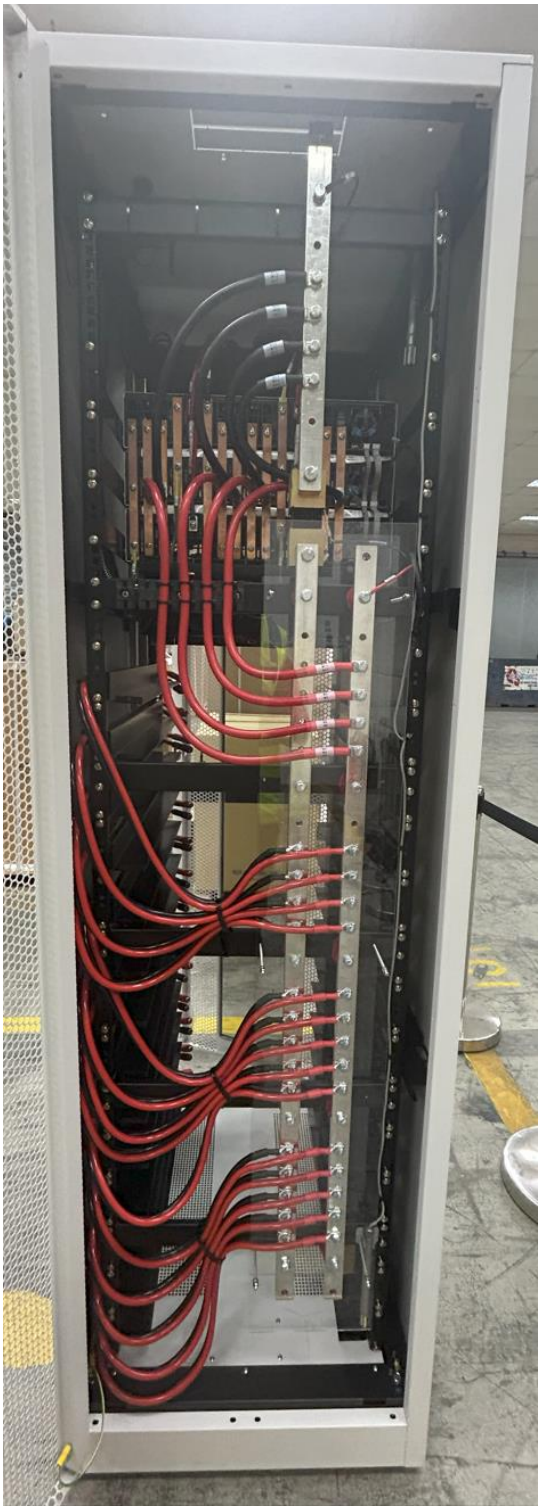


Figure 2 – ESCAPE20 Rear View

7.2 Single Line Diagram

The Single Line Diagram of the system is shown in Figure 3 –System Single Line Diagram.

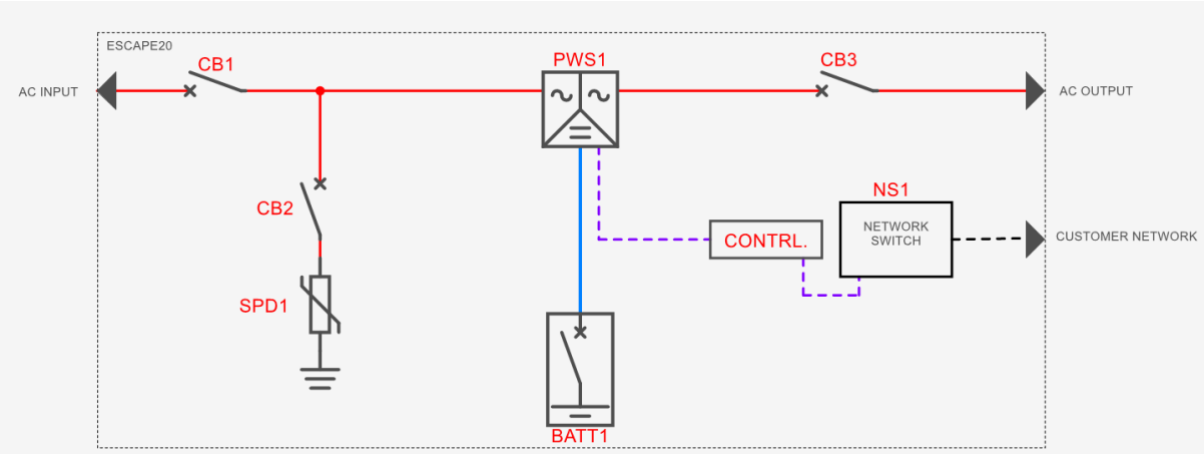


Figure 3 –System Single Line Diagram

8 Installation Instructions

This section provides step by step guidance to prepare, install, and commission BESS on site. Please read all user documentations carefully before installation.

- Pay attention to the module position, make sure that converter modules are repositioned in the same slot please follow number guide below.
- In three phase systems, the modules are configured as per phase 1 (A, R), phase 2 (B, S) and phase 3 (C, T). Each converters module has a label on the top. As long as the system is not in operation, make sure that modules from one phase are not mixed with modules from another phase. When the system is running, modules can be moved from one phase to another without issue.

L1	L1	L1	L1
L2	L2	L2	L2
L3	L3	L3	L3

Figure 4 – Converter Module Position

- The Indoor system is designed for installation within a clean environment.
- When installed in a dusty and/or corrosive environment, it is important to install an appropriate filter on the room's ventilation system or air conditioning system.

8.1 Site Preparations

Site should be ready for the installation of the systems and the recommended clearances shall be observed for correct operation and access to the system. The installation site shall be in a non-explosive atmosphere and suitably ventilated.
It is important that the installation surface must be able to support the total weight of the system including the batteries.
The incoming AC supply shall be checked to verify the correct type and rating.

8.2 Receipt Inspection & Unpacking

An inspection of the BESS is required to confirm that the mechanical and electrical requirements and parameters are within specification.
A packing slip is always attached to the delivery which indicates list and quantity of the items included in a shipment. Verify that the quantity and serial numbers of delivered goods and documents are in accordance with the packing slip and record the receipt date and inspection date.
Upon receipt, and during unloading, each package should be inspected for damage to ensure they are in good condition. If damage is evident a more detailed inspection of the entire shipment should be carried out. If any part is damaged, report immediately and do not proceed without any confirmation.

- Handle the battery with care when installing or transporting. The battery is heavy and correct lifting techniques or equipment should be utilised.
- Do not use the battery if it appears damaged or broken.
- Do not use chemicals to clean the battery.
- Do not touch the DC terminals of the battery.
- Do not touch the DC busbar.
- Do not touch the AC busbar.

8.3 Storage

The BESS shall be stored indoors in a clean, dry area at any temperature between -10°C and 60°C. PowerPlus batteries are supplied at a storage voltage. During storage batteries lose capacity through self-discharge. It is recommended that the batteries are charged to 100% within the first 24 hours of installation.

- The battery must be stored horizontally, and there must be no more than 6 batteries stacked on top of each other without additional mechanical support.
- The battery must be kept in a dry environment away from heat and moisture.
- The battery must be stored away from incompatible substances, like liquid, chemical materials.
- The battery should be stored between 0 to 35°C, however, temperatures close to 25°C should be considered for long term storage.
- After 6 months of storage all batteries will need a periodic recharge.
- Any issues with charging after long term storage should be discussed with PowerPlus Energy.

Refer to battery installation manual for more details about handling, storage and periodic recharging instructions.

8.4 Mechanical Installation

- ***Do not install the batteries unless the cabinet is securely fixed on the floor.***
- ***Do not step on any part of the cabinet.***
- ***Do not move cabinet while batteries are installed.***

8.4.1 Mounting the Cabinet

The cabinet must be placed on a level floor.

Choose cable entry position to suit your application. Determine the installation position of the cabinet in the room and wheel cabinet into position. Ensure cabinet is placed in the correct location before loading batteries into the cabinet.

Note: The castor wheels are not designed to take the weight of the cabinet and batteries. The adjustable support legs supplied must be used. Failure to use the support legs may result in failure of the castor wheels and cause physical harm or damage to the BESS.

8.4.1.1 ESCA2028-0XX Cabinet (Black Cabinet)

Secure locking feet and wind down adjustable support legs pictured below until firm against the ground, transferring the cabinet weight from the castor wheels and ensuring cabinet is level.

Figure 5- ESCA2028-0XX Cabinet Adjustable Legs and Castor Wheels

8.4.1.2 ESCA2028-1XX Cabinet (White Cabinet)

To secure the locking feet first undo the 13mm bolt pictured below. Once the bolt has been removed this will reveal a hole. Use a number 2 flathead screwdriver to either raise or lower the feet. Once desired height is achieved screw the 13mm bolt back into position.

Figure 6 – ESCA2028-1XX Cabinet Adjustable Legs and Castor Wheels

Check the minimum clearances.

Table 7 – Minimum Clearances

Item	Minimum Distance		
	ESCA2028-X0X (Natural Cooling)	**ESCA2028-X1X (Fan Cooling)**	**ESCA2028-X2X (Airconditioning)**
Left	0	0	0
Right	0	0	0
Front	60 cm	60 cm	80 cm
Rear	10 cm	10 cm	80 cm
Top	40 cm	30 cm	30 cm

8.4.2 Cable Entry

The indoor systems have top cable entry, and the outdoor system has bottom cable entry for all external cables; AC Input/Output cables, Genset control cables, etc. An un-drilled gland plate is fitted to facilitate termination of cabling.

- ***Do not drill holes on cabinet roof.***

Glands are not supplied and should be of the same or higher IP rating than the cabinet.
For details on gland plate refer to Figure 7 – Top Cable Entry Details.

Figure 7 – Top Cable Entry Details

8.4.3 Batteries

- ***Refer to battery data sheet and installation manual for health and safety information.***
- ***When installing any electrical parts, ensure that the power supply circuit breaker is in OFF position.***
- ***Do not move cabinet while batteries are installed.***

- Ensure that battery have not been damaged during transport and are in good condition. Care should be taken before placing the batteries into the shelves.
- Dust and dirt should be removed with a clean disposable wiper moistened with water.
- Do not use solvents or scouring powders to clean the battery.
- Ensure proper lifting practices are used to lift the batteries into the shelfs.
- Using equipment or at least 2 people to lift, slide the batteries into the cabinet starting from the bottom and working your way to the top.

***Notice*:** In multi cabinet installations, if the systems are not fully populated with the batteries, start installing the batteries from the bottom of the cabinet and distribute them evenly across all cabinets.

Figure 8 – Typical Battery Assembling

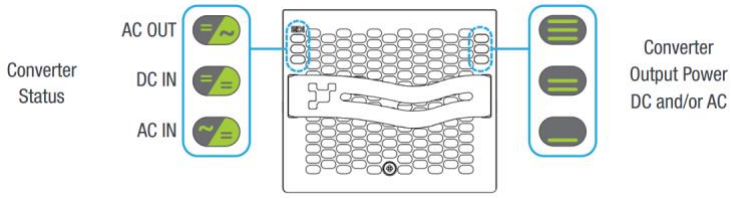
8.4.4 Converters / Inverters

- ***Refer to attached installation & operation manual of the converter for health and safety information.***
- ***When installing any electrical parts, ensure that all circuit breakers are in OFF position.***

Prior to unpacking the converters, note any damage to the shipping container. Unpack the product and inspect the exterior for damage. If any part is damaged, report immediately and do not proceed without any confirmation.

Figure 9 – Converter Module

8.4.5 Operation



Converter Status LED	Description	Remedial Action
OFF	No input power or forced stop	Refer to section 16 Troubleshooting
Permanent green	Operation	
Blinking green	Converter OK but working conditions are not fulfilled to operate properly. For instance; AC in is present but a peak shaving of 0W is set so no power is taken from AC-in.	
Blinking green/orange alternatively	Recovery mode after boost (10 In short circuit condition)	
Permanent orange	Starting mode; means the module is going through its self-checks. This only lasts a few seconds. It also stays in orange when a new firmware is being downloaded.	
Blinking orange	Modules cannot start. It means a Warning is active.	Refer to section 16 Troubleshooting
Blinking red	Recoverable fault	These are faults that the module can recover from if the fault condition disappears.
Permanent red	Non recoverable fault	Send module back for repair. Try power cycling and turning module ON/OFF via InView first. Some non-recoverable faults require a manual interaction to be cleared.

Output Power (redundancy not counted)						
<5%	5% to 40%	40 to 70%	80 to 95%	100%	100% = overload	Output Power (redundancy not counted)
×	×	×	≡	≡	≡	Status output power LED
×	×	=	=	=	=	
—	—	—	×	—	—	
1B	1P	2P	2P	3P	3B	Behaviour (B = Blinking, P = Permanent)

Figure 10- Converter Operation

8.4.6 Inserting Converter Modules

The converter modules are hot swappable meaning they can be inserted or removed from the shelf without cutting power to or from the system or the load. When a new module is inserted in a live system it automatically takes the working set of parameters.

1- Verify module compatibility (i.e. DC Voltage, model, etc.)
2- Place the module in the shelf and slide in.
3- Using the module handle, push firmly until the unit is properly connected.
4- Rotate the screw in clockwise by using cross head screwdriver to lock the latch.
5- The module will start up and take the first address available on the bus.

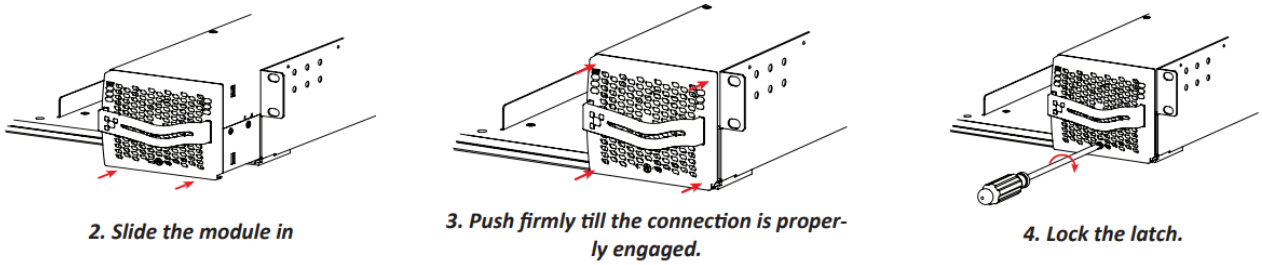


Figure 11- Inserting Converter Modules

8.4.7 Removing Converter Modules

Notice: When one or several converter modules is/are removed access to live parts becomes necessary. Replace module(s) with dummy cover immediately. Available from PowerPlus Energy.

1- Rotate the screw in anticlockwise by using cross head screwdriver to unlock the latch.
2- Hold the front handle and pull the module out.
3- Replace with a new module or a dummy module.

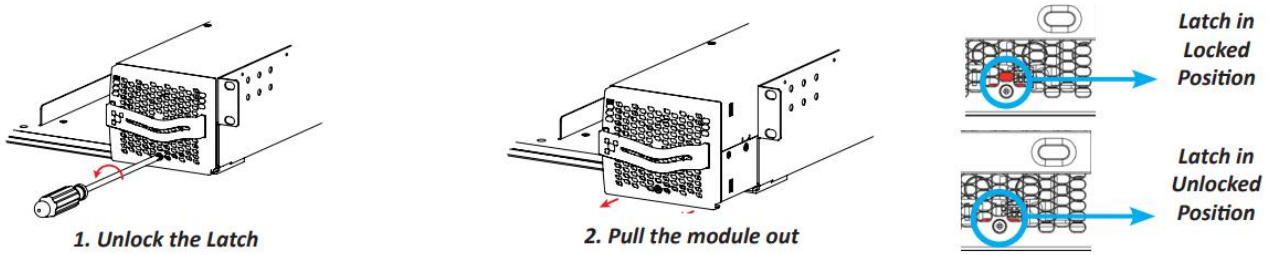


Figure 12- Removing Converter Modules

Notice: Do not force a module into position if it does not seat properly.
Notice: The external metal case of the converter module may become hot during operation. Care should be taken when handling unplugged converter modules.
Notice: Do NOT touch connectors on the module rear side, there is risk of electric shock because of
accumulated energy inside.

8.5 Electrical Installation

- ***When installing any electrical parts, ensure that all breakers are in OFF position.***
- ***Ensure all power supply from the main distribution board are turned OFF and tested de-energised before terminating the rack's AC input/output power supply.***
- ***Remove jewellery and other conductive objects before performing installation.***
- ***Use insulated tools when installing links, sensors, cables and other accessories.***
- ***Use appropriate PPE***

Although the routine tests are carried out in the workshop of the manufacturer, the installer is not exempt from checking that after transport and installation the assembly has not undergone such damages or modifications that it no longer meets the requirements already verified by these tests.

All critical connections, especially screwed and bolted connections, shall be checked for the correct tightness after transport and installation.

Each Escape 20 system is designed to accommodate 1 x 3PH mains supply and 1 x 3PH AC output.

The following colour codes are used as standard in BESS.

It is recommended to follow this rule when selecting the incoming/outgoing cables to keep the consistency in design.

AC CABLE COLOR:

- L1: RED
- L2: WHITE
- L3: BLUE
- N: BLACK
- PE: GREEN/YELLOW

48VDC CABLE COLOR:

- Positive (+): RED
- Negative (-): BLACK

8.5.1 Earth Cable

A dedicated Earth terminal is provided inside the cabinet where all exposed conductive parts are connected to.

Main Earthing cable (not supplied) must be selected and installed according to latest version of the Australian Standards.

1- Ensure all internal breakers and power supply from the main distribution board are in OFF position before terminating the earth cable.
2- Remove the front cover of the switchgear sub-rack, locate the Main Earth terminal (PE) in the cabinet and run the cable through the cable entry and gland plate while making sure the cable is long enough.
3- Connect the Main Earthing cable to earth terminal block (TB.1:4) before connecting the active conductors.
4- Tighten all screws firmly to the recommended torque values as per Annex A- Recommended Tightening Torques.

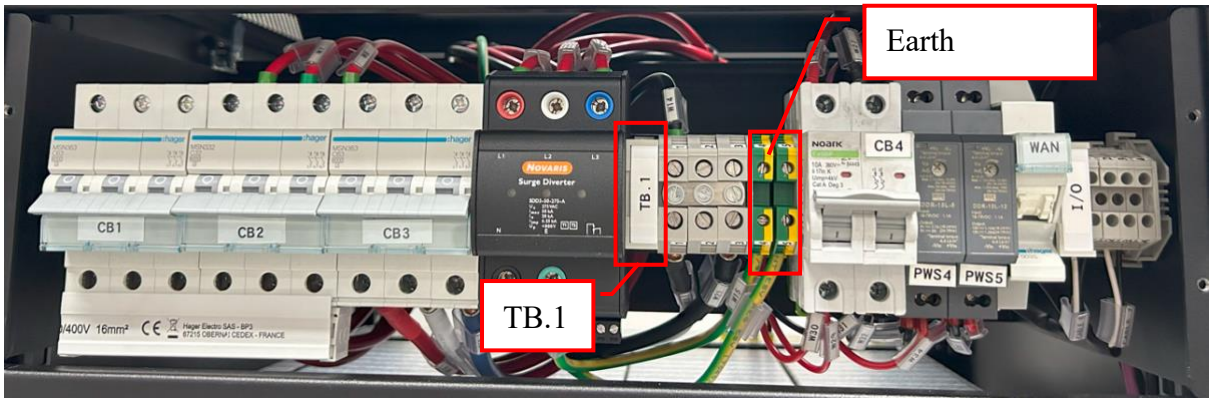


Figure 13 – Earth Terminal Inside the Switchgear Sub-rack

8.5.2 AC Input Cables

The BESS is supplied at 230/400VAC, 50Hz input. AC Input cables (not supplied) must be selected and installed according to latest version of the Australian Standards.

1- Ensure all internal breakers and power supply from the main distribution board are in OFF position before terminating the AC Input cables.
2- Remove the front cover of the switchgear sub-rack, locate the Main Isolator AC Input and Neutral terminal blocks in the cabinet and run the cables through the cable entry and gland plate while making sure the cables are long enough.
3- Connect the Neutral cable to neutral terminal block (TB.1:2) then connect the AC active cables to Main Isolator AC Input (-CB.1).
4- Tighten all screws firmly to the recommended torque values as per Annex A Recommended Tightening Torques.

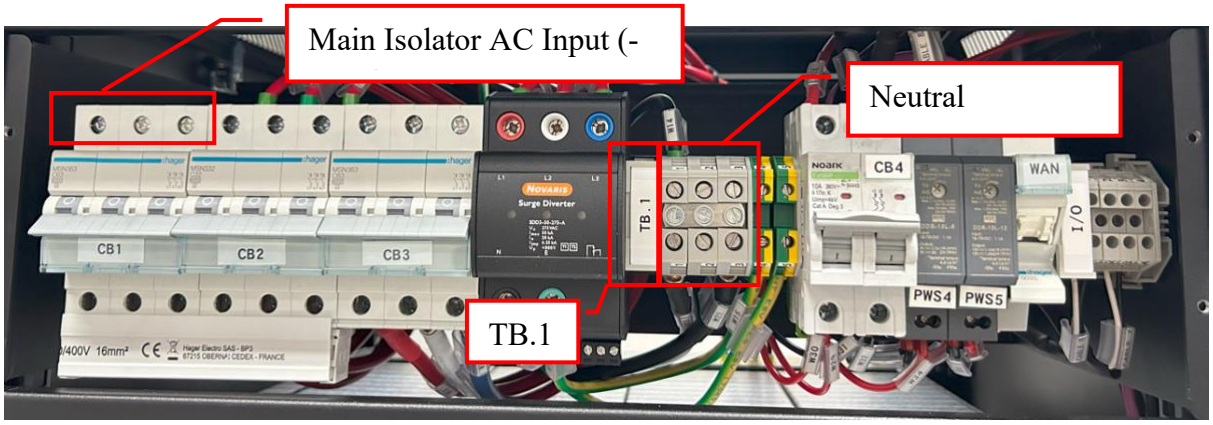


Figure 14 – Main Isolator AC Input (-CB.1) and Neutral Terminal Blocks Inside

8.5.3 AC Output Cables

AC Outputs cables (Not supplied) must be selected and installed according to latest version of the Australian Standards.

1- Ensure all internal breakers and power supply from the main distribution board are in OFF position before terminating the AC Outputs cables.
2- Remove the front cover of the switchgear sub-rack, locate the Main Isolator AC Output and Neutral terminal blocks in the cabinet and run the cables through the cable entry and gland plate while making sure the cables are long enough.
3- Connect the Neutral cable to neutral terminal block (N) then connect the AC active cables to AC Output MCB (-CB.3).
4- Tighten all screws firmly to the recommended torque values as per Annex A Recommended Tightening Torques.

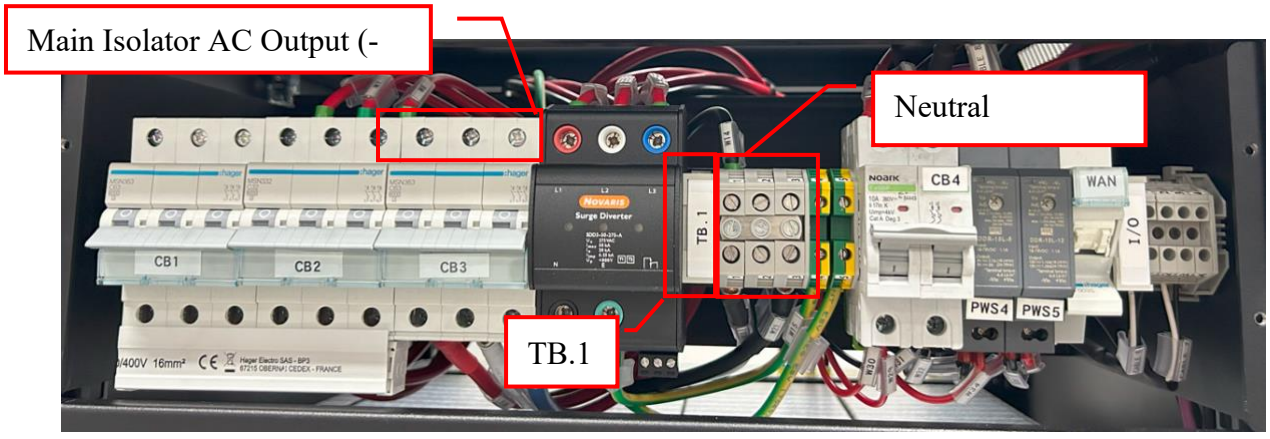


Figure 15 – Main Isolator AC Output (-CB.3) and Neutral Terminal Blocks Inside

8.5.4 Generator Start/Stop Cables

Generator Start/Stop cables (Not supplied) must be selected and installed according to latest version of the Australian Standards.

1- Ensure all internal breakers and power supply from the main distribution board are in OFF position before terminating the Genset Start/Stop cables.
2- Remove the front cover of the switchgear sub-rack, locate the Genset Start/Stop terminal blocks in the cabinet and run the cables through the cable entry and gland plate while making sure the cables are long enough.
3- Connect the Generator Start/Stop cables to -TB I/O: 3&4.
4- Tighten all screws firmly to the recommended torque values as per Annex A Recommended Tightening Torques.

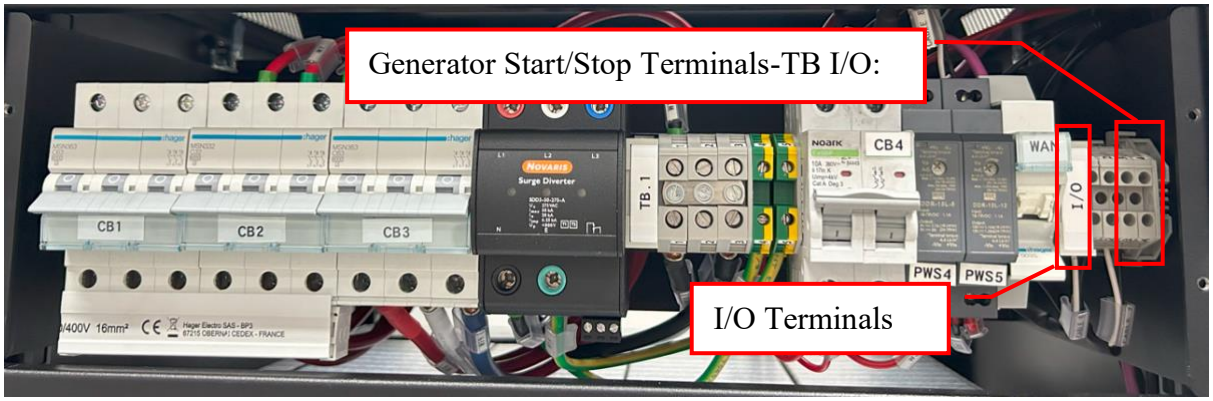


Figure 16 – Genset Start/Stop Terminals -TBI/O: 3&4

8.5.5 Battery Cables

- ***WARNING: Care should be taken to ensure the batteries are not short-circuited during this procedure***
- ***Batteries must be installed after completion of all above step.***

Each battery has a positive and negative Amphenol SurLok (non-keyed) connector for easy snap on connection. Before connecting the DC cable to the battery, you will need to remove the safety insulating cap on the battery DC connectors and dispose of appropriately.

Ensure that the positive and negative cables are connected correctly. Connect corresponding Amphenol cables to batteries and ensure terminals are seated correctly by listening for a "click" when Amphenol SurLok is pushed on.

- ***Do not connect the main DC cable with reversed polarity. It will cause severe damage to the battery.***

Figure 17 – Battery Cables Connection

8.5.6 WAN Port Connection

As part of the installation, a hard-wired internet connection is highly recommended from the network switch to the customer's modem or router. Users may be required to install a data switch if there are no spare ethernet ports available on the switch.

1- Locate the WAN Port in the cabinet and run the Ethernet cable through a cable entry and gland plate while making sure the cable is long enough.
2- Connect the Ethernet cable to Cat 6 Data patch module.

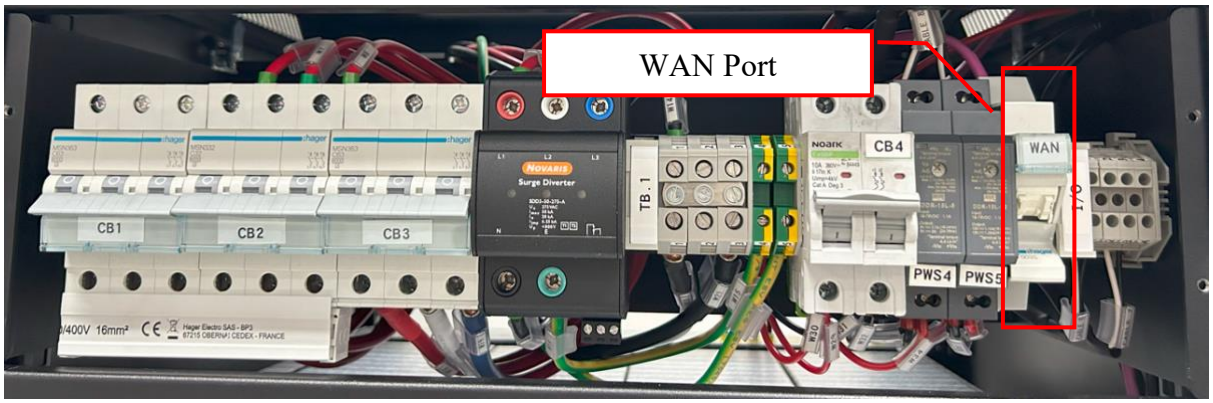


Figure 18 – WAN Port Connection

8.5.7 Multiple Cabinet Connections

For multiple cabinet installations, mechanical, electrical and communication connections between the cabinets are required. The following steps must be completed prior to placing the cabinets in the final position as rear access will be required.

***Notice*:** In multiple cabinet installations, if the systems are not fully populated with the batteries, start installing the batteries from the bottom of the cabinet and distribute them evenly across all cabinets.

8.5.8 Mechanical Connection

When installing multiple cabinets, the cabinets should be mechanically joined on the front and back. Each cabinet comes with predrilled holes in the frame. Using one supplied baying up kit for each two cabinets.

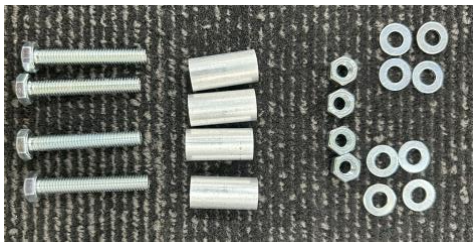


Figure 19- Baying Up Kit

1. Place the spacers in-between the cabinets prior to tightening the bolts.
2. Install the bolts with flat washers in the top and bottom holes on the front and rear of the cabinets.
3. Tighten the bolts.

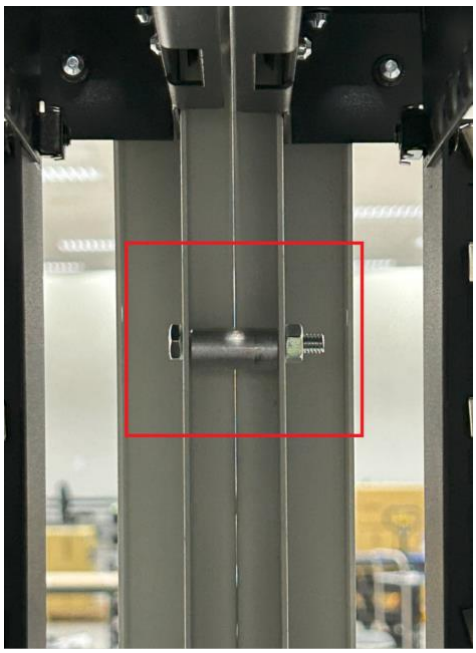


Figure 20- Baying the Cabinets

8.5.9 Power Connections

Depending on the number of cabinets to be connected battery bus bars need to be joined using an additional Cabinet Expansion DC Parallel Kit (PN: ESCA0005) before loading the batteries.

1- Using the flexible bus bars provided, connect the Positive battery busbars together at the **top** as pictured below and tighten the bolts with a torque wrench, without lubrication. Use 60 N.m clamping torque for M10 bolts.

2- Connect the Negative battery busbars together at the **bottom** as pictured below and tighten the bolts with a torque wrench, without lubrication. Use 60 N.m clamping torque for M10 bolts.

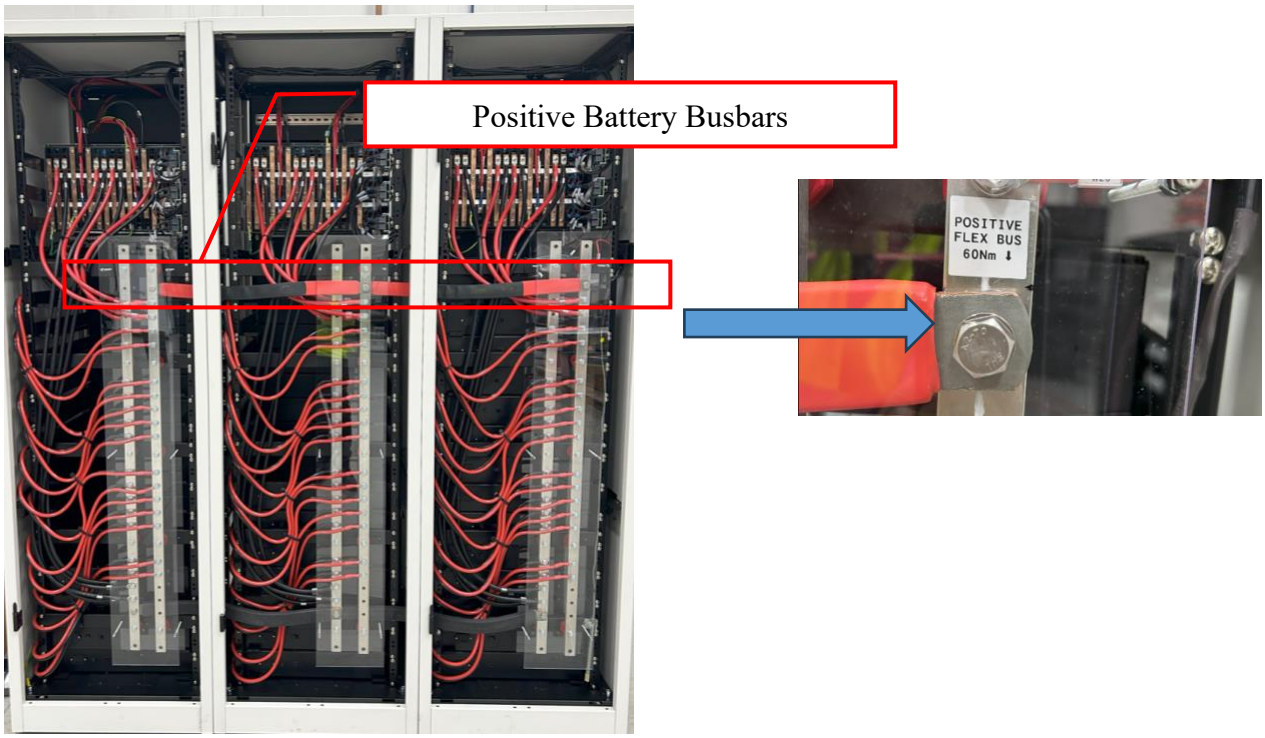


Figure 21- Positive Battery Busbars Interconnection

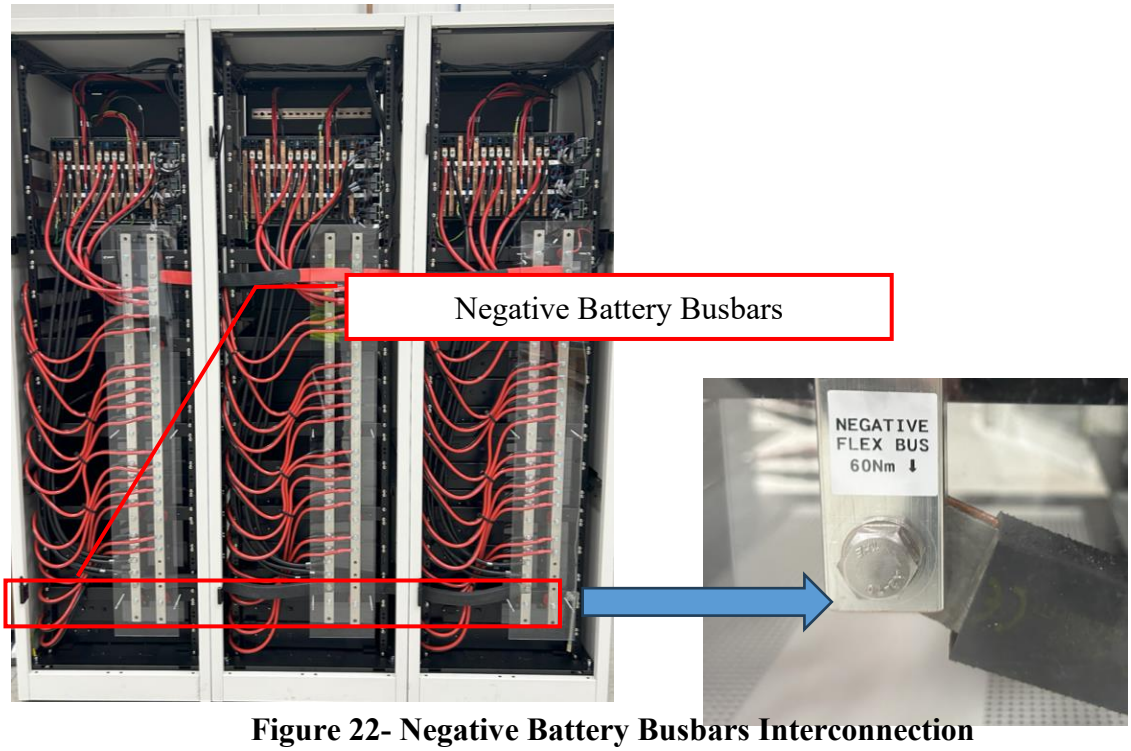


Figure 22- Negative Battery Busbars Interconnection

8.5.10 Communication Connection

Power extension kit is used to extend the capacity of a converter system. It enables synchronization and active load sharing between different group of power converter systems installed. This kit consists of three ports:

• TRI Gateway
• SYNC 1
• SYNC 2

The SYNC 1 and SYNC 2 modules are used to synchronize the group of converter modules. The TRI Gateway acts as an interface that communicates between Sync modules, converter modules and the controller.

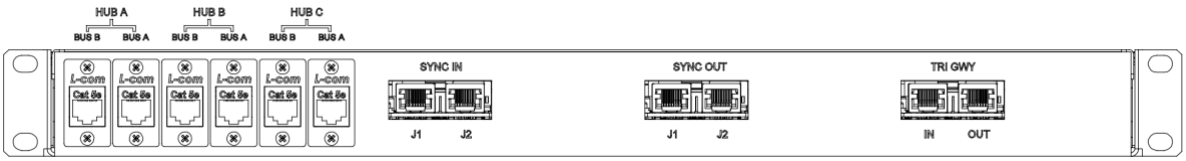


Figure 23- Power Extension Kit Rear View

There are pre-installed HUB boards inside the system. They have connectors BUS A (8 pin) and Bus B (6 pin). Make sure not to mismatch the connectors at power extension kit end.

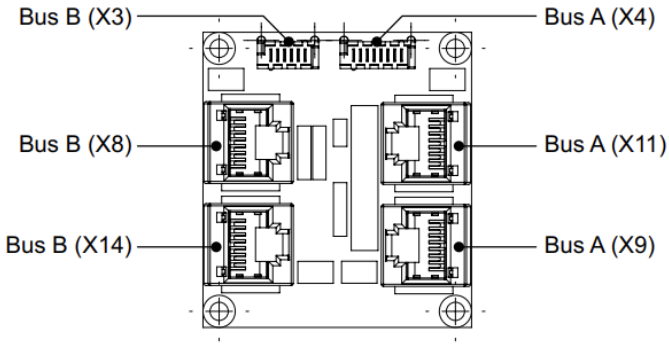


Figure 24- HUB Board Connectors

The cabling procedure for a system that has 1 power extension kit is given below. Please refer to the illustrations provided after the procedure for more clarity.

Note: Make sure not to mismatch the Bus A and Bus B connectors.
Note: Do not remove the termination plugs.
Note: Bus A and Bus B connectors of each shelf are connected to the Bus A and Bus B connectors of the respective Hub boards in each cabinet in the factory using flat cables.

1- Daisy chain Bus A and Bus B connectors of HUB boards in the Primary, Secondary and Tertiary cabinets together using Ethernet cable as shown in Figure 25- Comms Cabling for 3 ESCPAE20 System with 1 .
2- Connect the Bus A and Bus B connectors of the L1 Tertiary cabinet Hub board (HUB 1), to the ‘Hub A’ connectors (J5 and J4) on the power extension kit.

3- Connect the Bus A and Bus B connectors of the L2 Tertiary cabinet Hub board (HUB 2), to the ‘Hub B’ connectors (J5 and J4) on the power extension kit.
4- Connect the Bus A and Bus B connectors of the L3 Tertiary cabinet Hub board (HUB 3), to the ‘Hub C’ connectors (J5 and J4) on the power extension kit.
5- Connect J1 of INV GW installed on the Primary cabinet to **ETH2** port of controller.

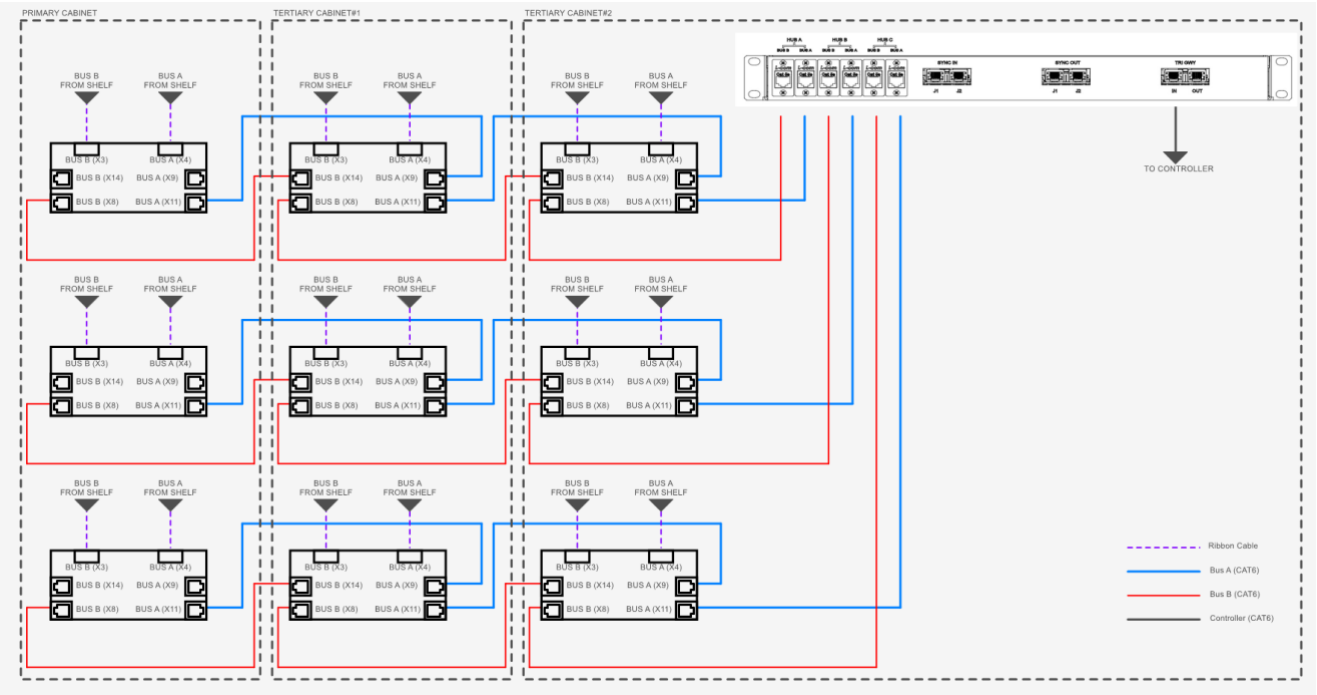


Figure 25- Comms Cabling for 3 ESCPAE20 System with 1 Power Extension Kit

8.5.11 Connecting AC Coupled Solar PV

The Escape 20 BESS can be installed with specific models of PV inverters to 'AC Couple' – i.e. supply PV generated AC directly to AC loads and recharge batteries with any excess. Only the following models of approved PV inverters can be AC Coupled to Escape 20 BESSs:

Fronius – Primo, GEN24, Symo, Tauro

SMA - TBC

AC coupled solar must be installed on the load side of the BESS and therefore will never export to grid If grid connected). The Escape 20 BESS will control the PV inverter to ramp down once the batteries are approaching full charge.

DIAGRAM TBC

8.5.12 Connecting Communications for AC Coupled Solar PV

All AC Coupled PV inverters must run individual hardwired LAN cables to Escape 20 BESS. 1 LAN cable per inverter. If multiple PV inverters are being used, a network switch must be installed at the BESS. Installers must supply their own network switch. (Does it need to be at the BESS or can it be combined further away and run a single cable to the BESS?).

Steps for setting up AC Coupled Inverters

1. Set up the inverters on their own static IP's (10.250.250.8 will be the first address, 10.250.250.9 will be the second so on and so forth).
2. Enable Modbus TCP on the inverters and change the modbus port to 502.
3. Allow Modbus Control on the inverters.

DIAGRAM TBC

The native monitoring platform of the PV inverter is no longer used and is replaced by the BESS monitoring system.

8.5.13 Connecting DC Coupled Solar PV

The Escape 20 BESS can be installed with specific models of DC MPPTs to 'DC Couple' – i.e. charge batteries directly via the DC bus.

Only the following models of approved DC MPPTs can be DC Coupled to Escape 20 BESSs:

Victron - SmartSolar MPPT 48V, SmartSolar MPPT RS

AERL – Coolmax SRX48 (Additional components and cost required)

DIAGRAM TBC

8.5.14 Connecting Communications for DC Coupled Solar PV

Setting up communications for DC Coupled Solar PV varies depending on the product used.

Communications for Victron DC MPPTs can be connected directly between VE Connect Port to the USB port of the Arvio monitoring device.

Monitoring for other DC Coupled Solar PV requires a shunt at additional cost. Contact PowerPlus Energy BESS team for more information.

9 Startup Procedure

1- Ensure ALL MAIN ISOLATOR AC OUTPUTs (-CB.3) are in the off position.
2- Ensure ALL converter modules are in the correct and secure position.
3- Switch ALL the batteries ON. Ensure the indicator LEDs are glowing steady BLUE.
4- Switch on the DC CONTROL ISOLATOR (-CB.4).
5- The controller should boot up and display will be On. Wait for controller to go through its start up.
6- Once all converter modules are on and showing Green LEDs then check output voltage on the MAIN ISOLATOR AC OUTPUT (-CB.3).
7- Switch ALL the MAIN ISOLATOR AC OUTPUT (-CB.3) On if the output voltage is within the range.
8- Switch ALL the SURGE DIVERTER ISOLATOR (-CB.2).
9- Switch ALL the MAIN ISOLATOR AC INPUT (-CB.1).
10- If in any case the module does not show any sign of life, please stop and remove the module and contact PowerPlus Energy.
11- Replace that module with a different one and continue.

10 Shutdown Procedure

1- Switch off ALL the MAIN ISOLATOR AC INPUTs (-CB.1), SURGE DIVERTER ISOLATOR (-CB.2) and the MAIN ISOLATOR AC OUTPUTs (-CB.3).

2- Once ALL the isolators have been switched off, begin switching off ALL the Batteries.
3- Once ALL the lights on the batteries are off and the lights on the converter modules are off pull the converter modules out.
4- Switch off the DC CONTROL ISOLATOR (-CB.4).

11 Emergency Shutdown Procedure

1. Switch off ALL MAIN ISOLATOR AC INPUTs (-CB.1).
2. Switch off ALL Battery Circuit Breakers.
3. Switch off ALL MAIN ISOLATOR AC OUTPUTs (-CB.3).
4. Pull out ALL Converter Modules.

12 Controller Programming

The system is pre-configured however depending on system requirements the system has multiple functions that can be configured.

Please note all system programming should be done after contact with PowerPlus Energy. Changing settings incorrectly may cause irreversible damage to equipment and void warranty.

12.1 Login

Logging into the system can be accomplished by either connecting to the local network or directly to the front Ethernet port via a LAN cable. Contact PowerPlus Energy for log in credentials.

- Open the web browser and type the IP address: 10.250.250.2 or https://inview.local in the address field and press enter.

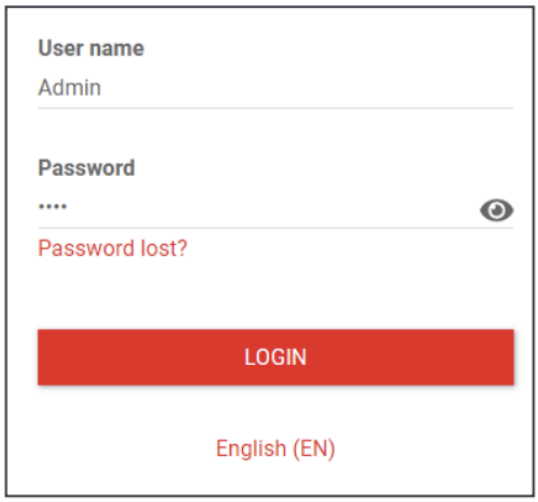


Figure 26- Login Page

Once logged in you should see the screen below. Clicking on "Advanced View" up the top will take you to the settings that can be adjusted as needed.

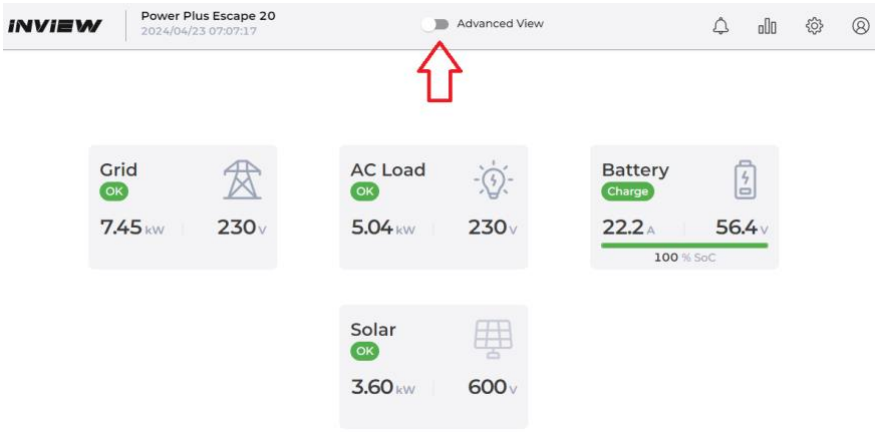


Figure 27- Advanced View

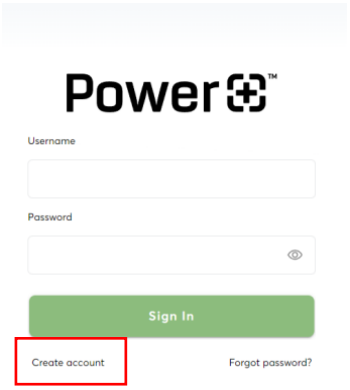
13 Arvio Energy Monitoring System

PowerPlus Energy BESS utilises Arvio for user interface and fleet visualisation for system integrators. Arvio is a smart energy monitoring & management system that can provide monitoring for multiple devices.

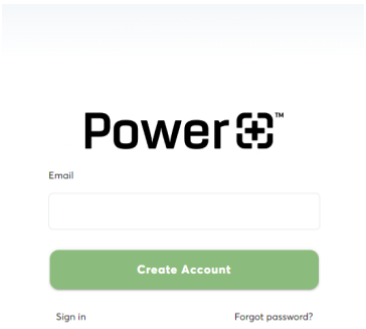
13.1 How to create your user account

1- Download and install the Stormcloud app available from Google Play and Apple App Store (search 'Stormcloud by SwitchDin').

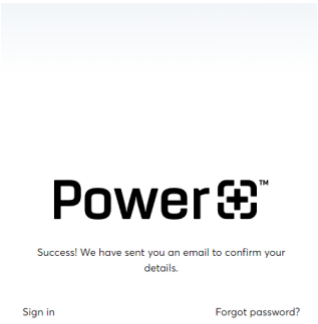
2- Users should create an account to gain access to the data from our Escapes. Click on **Create account:**



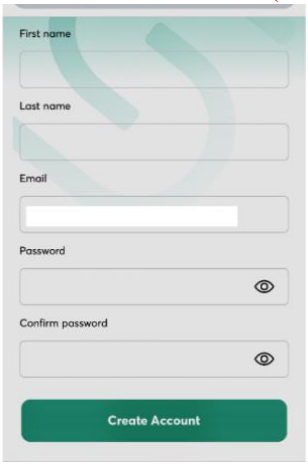
3- Provide an email that will become your application username and click on **Create Account.**



4- You will receive instructions in your email inbox within seconds.



5- Check your email inbox and click on the link provided in the email to verify your account. Time to add a password and confirm it (12 characters minimum).



6- Then you will need to provide to us the email address you used to create the account, and we will be able to give you access to the data.

14 Commissioning

Installation and commissioning must be done and conducted by trained people fully authorized to act on installation.

1. Make sure that the cabinet is properly fixed to the floor.
2. Make sure that the cabinet is connected to Ground.
3. Make sure that all breakers are switched OFF.
4. Make sure that all cables are according to recommendations and local regulations.
5. Make sure that all cables are strain relieved.
6. Make sure that all upstream and downstream circuit protection and isolation points are sized correctly.
7. Ensure all electrical terminations have been adequately torqued.
8. Make sure that no converter positions are left open and cover empty converter positions with dummy cover.
9. For special applications outside of this scope, please contact BESS project team.

14.1 Commissioning Check List

Data	
Date	
Performed by	
Site	
System serial number	

☐ Ensure converters are installed in the correct shelf and phase rotation

☐ Ensure all the battery connections are firmly seated and polarity is correct

☐ Turn the batteries ON and check the LED is solid blue

☐ Switch ON the DC CONTROL ISOLATOR

☐ Verify the controller starts up and display is On

☐ Check the AC output voltage on the MAIN ISOLATOR AC OUTPUT (-CB.3) and then turn it on if the voltage is within the range

☐ Commission the AC coupled solar

☐ Short the Generator Start/Stop terminals (-TB I/O: 3&4) and verify the genset starts (if applicable)

☐ Once genset is started or grid is present, check the AC input voltage on the MAIN ISOLATOR AC INPUT (-CB.1) and then turn it on if the voltage is within the range

☐ Ensure generator or grid connects and loads up correctly

☐ Check if converters are working fine (Green LEDs)

☐ Check if system has no alarm (Disable the alarm if any)

☐ Switch OFF MAIN ISOLATOR AC INPUT and check if system is working on DC

☐ Switch ON MAIN ISOLATOR AC INPUT and check if system correctly transferred load on AC

☐ Check if display working properly (Controller)

☐ Check if comms is working properly (if this option is present)

☐ Batteries are delivered and shipped in a partial state of charge. Prior to discharging the battery, it must be fully charged to the float stage. Refer to battery installation and operation manual for more details.

15 Inspection and Maintenance

Although very little maintenance is required with the BESS, routine checks and adjustments are recommended to ensure optimum system performance.
This schedule must be tailored to match the local site conditions. However, PowerPlus Energy recommends general maintenance annually.
Below are a few basic points for general consideration. Please do not limit your total evaluation to the below points.

- ***Only qualified service personnel should do the inspection and maintenance.***
- ***Prior to any work on AC or DC busbars, make sure that AC input voltage and DC input voltage are disconnected.***
- ***Prior to accessing the system or converter modules, make sure all source of supply is disconnected.***
- ***Risk of electric shock. Capacitors store hazardous energy. Do not remove cover until 5 minutes after disconnecting all sources of supply.***
- ***Appropriate PPE shall be worn.***

15.1 Enclosure

- ***WARNING: HIGH VOLTAGE AND SHOCK HAZARD.***
- ***Use extreme care when working inside the cabinet. The system must be de-energized to avoid any contact with live components or parts.***

The following table lists a few maintenance procedures for the enclosure. These procedures should be performed at least annually.

Table 15-1 –Maintenance Log- Enclosure

Procedure	Date Completed
Check for any external visible damage (dents or scratches)	
Touch-up any scratches on painted surfaces	
Check for abnormal traces of dust or water inside the enclosure and vacuum if required	
Check that support legs are firm on the ground	
Check that gland plates (bottom and/or top) are sealed	
Lubricate the hinges of the door as required	
Remove any debris/obstructions that blocks the airflow	
Check that the fans/HVAC are running without any abnormal noise (IP54 systems only)	
Replace the filters or clean as necessary (IP54 systems only)	
Take a photo of the cabinet and site condition	

15.2 Cables and Connections

- ***WARNING: HIGH VOLTAGE AND SHOCK HAZARD.***
- ***Use extreme care when working inside the cabinet. The system must be de-energized to avoid any contact with live components or parts.***

The following table lists a few maintenance procedures for cales and connections. These procedures should be performed at least annually.
All wirings and connections, especially critical connections shall be checked for the correct tightness as per Annex A- Recommended Tightening Torques. Critical connections include:

- Terminal blocks
- All circuit breakers
- PCE DC in
- PCE DC out
- PCE AC in
- PCE AC out
- Main Busbars
- Comb Bus Bar
- Shunt (if Any)

Table 15-2 –Maintenance Log- Cables and Connections

Procedure	Date Completed
Check for any visible damage or corrosion	
Inspect all system connections (re-torque as necessary)	
Check the resistance between main earth terminal and exposed conductive parts (< 0.5 Ω)	
Check voltages of AC input, DC input, AC output and DC output using the multi-meter.	
With an infrared camera check termination hot spots	

15.3 Converter

- ***WARNING: HIGH VOLTAGE AND SHOCK HAZARD.***
- ***Use extreme care when working inside the shelf while the system is energized. Do not make contact with live components or parts.***

The following table lists a few maintenance procedures for converters. These procedures should be performed at least annually.

Table 15-3 – Maintenance Log- Converter

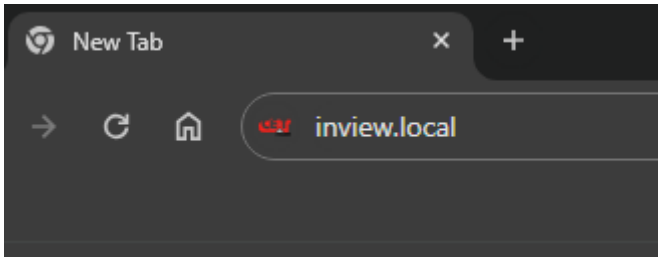
Procedure	Date Completed
Clean ventilation openings	
Inspect all system connections (re-torque as necessary)	
Check module internal temperature for deviation between converter modules	
Check module/system load	
Check/Correct converter mapping (DC group/AC group/ Address)	

NOTE: Converters are not maintainable except the inbuilt fan.

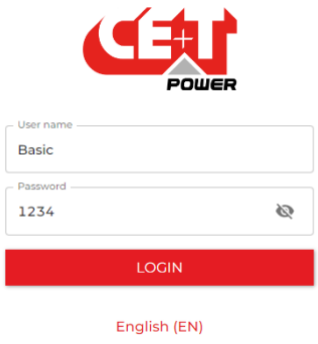
15.3.1 Checking module internal temperature

To check the module temperature a laptop or device with Wi-Fi is needed.

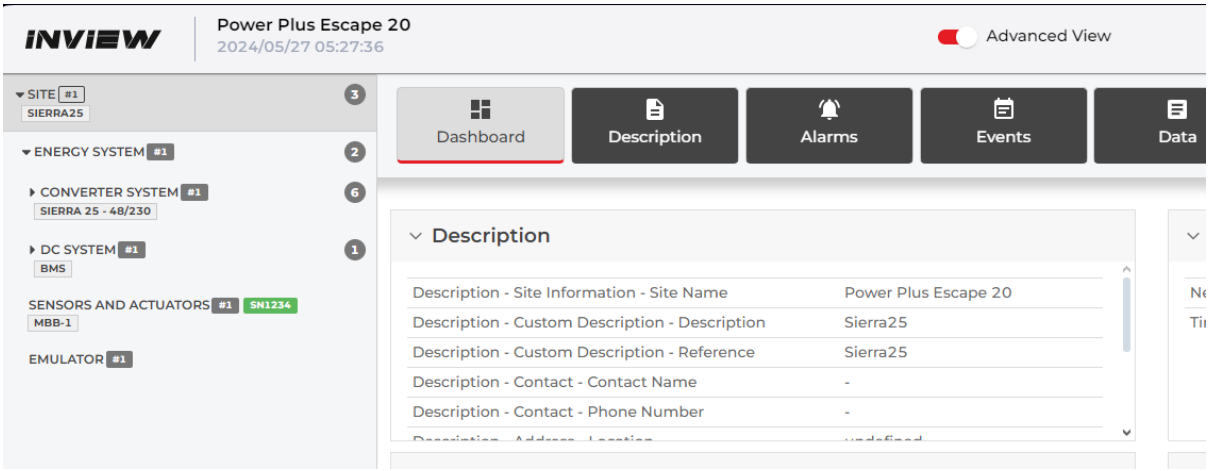
1. If using a laptop with a LAN port connect to the empty port on the left-hand side of the controller screen. Once connected open a web browser and type in the following web address: Inview.local



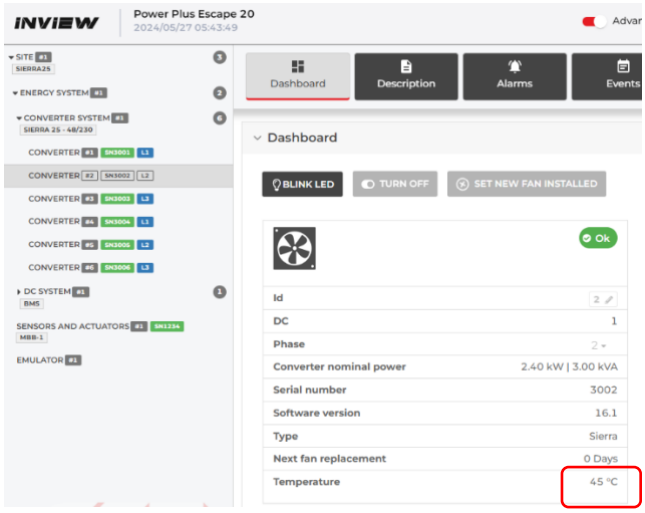
2. You will be greeted by the following log in screen. Use the following Credentials to log in.
   Username: Basic
   Password: 1234



3. Click on “Advanced” in the top middle. Once Advanced View has been selected you will have access to the following menu structure.



4. Click on the small arrow next to “CONVERTER SYSTEM” this will open a drop-down menu with all the converters currently installed on the system. Then click on each individual Converter to check the temperature data.



15.3.2 Fan Replacement

The FAN life is approximately 60,000 (sixty thousand) hours.

The converter modules have fan runtime meters and fan failure alarms. Fan failure alarm can result from a failing fan, driver circuit or polluted environment. Contact PowerPlus Energy for spare parts.

1- Pull out the converter module and ensure the lights have faded.
2- Wait 5 minutes for the module capacitors to discharge and then slide the converter out of the shelf.
3- The converter front cover must be removed. Use a screwdriver and remove the screws on both side of the module.
4- Free up the fan. (Note the fan connector and wires position).
5- Disconnect the supply cord and remove the fan.
6- Replace with new fan and connect supply cord.
7- Place the front cover and tighten the screws on both sides of the module.
8- Re-insert module to its original position

9- Check fan for operation.
10- Access Inview and reset the fan run time alarm from within the action menu.


Remove the screws


Remove the front cover


Disconnect the fan


Take the new fan


Make sure the fan is in the right position

15.4 Controller

The following table lists a few maintenance procedures for Controller. These procedures should be performed at least annually.

Table 15-4 – Maintenance Log- Controller

Procedure	Date Completed
Download and analyse system log file and ensure it is free of unexpected alerts.	

15.5 Battery

- ***WARNING: HIGH VOLTAGE AND SHOCK HAZARD.***
- ***Use extreme care when working inside the cabinet. The system must be de-energized to avoid any contact with live components or parts.***

PowerPlus batteries are designed to require no regular maintenance from users. However, as part of your overall system maintenance, some checks can be carried out at least annually.

Table 15-5 –Inspection Log- Battery (Yearly)

Procedure	Date Completed
Check Status LED	
Check battery DC Circuit Breaker by turning it off and on again	
Check battery connections and cables for secure fitting or damage	
Check for any obstruction placed around the battery or battery enclosure	
Check for animals, insects or creatures nesting in or around the battery enclosure	
Check for build-up of any foreign objects in or around the cabinet	
Measure the ambient temperature in the immediate battery environment	

16 Troubleshooting

16.1 Converter module does not power up (LEDs are off):

- Check AC input present and in range (AC breakers)
- Check DC input present and in range (DC breakers)
- Check that the converter is properly inserted.
- Remove converter to verify that slot is not damaged, check connectors.
- Check that module(s) is (are) in OFF state.
- Check for loose terminations.

16.2 Converter system does not start (LEDs are blinking orange):

- Check that Inview is present and properly connected.
- Check remote ON/OFF terminal.
- Check the configuration and setting.
- Check threshold level.

16.3 Converter only run on AC or DC:

- Check AC input present and in range (AC breakers)
- Check DC input present and in range (DC breakers)
- Check the configuration and setting Check threshold level(s)

16.4 No output power

- Check output breaker.

16.5 All OK but I have alarm

- Check the type of event and log file in the controller. Refer to controller manual for more details on check the alarms.

16.6 No alarm:

- Check relay delay time of alarms in the controller.
- Check configuration file.

Annex A- Recommended Tightening Torques

I. PCE Shelf

Manufacturer	Product Series	Tightening Torque (N.m)
CE+T	Sierra 25 - 48/277 shelf	5

II. Circuit Breaker:

Manufacturer	Product Series	Tightening Torque (N.m)
Hager	MSN1xx, MSN2xx, MSN3xx	2.8
Noark	Ex9BP	3.5
	Ex9BD125	3.5

III. Surge Protection Device (SPD):

Manufacturer	Product Series	Tightening Torque (N.m)
NOVARIS	SDD	2 (Power) 0.5 (Alarm)

IV. Terminal Blocks:

Manufacturer	Product Series	Tightening Torque (N.m)
Sprecher + Schuh	V7-W3	0.6
	V7-W4	0.6
	V7-WG6	0.7
	V7-W16S	2.1

V. Critical Connections

The correct tightening torque of bolts and nuts depends on type and the material. Typical torque settings are given in below tables. These values should be used as a guide only and shall be followed in cases where no other specification is prepared.

SCREW - steel grades according to DIN 898/1-8,8

Size	Tightening Torque (N.m)
M3	1.2
M4	2.9
M5	5.7
M6	9.8
M8	24
M10	47
M12	81
M14	128
M16	197

Brass nuts and bolts(HEX)

Size	Tightening Torque (N.m)
M2.5	0.5
M3	1.0
M4	2.0
M5	4.0
M6	6.0
M8	10.0
M10	16.0

Copper parts with self-clinching screws

Size	Tightening Torque (N.m)
M5	2.9
M6	5.7
M8	13.5
M10	24

Sheet metal parts with self-clinching screws

Size	Tightening Torque (N.m)
M3	0.75

M4	1.7
M5	3.5
M6	5.9

Rev.	Date	Description	Prepared by	Reviewed by	Approved by
1	26/04/2024	Issued for Installation	T.D	M.A	S.C
2	18/09/2024				

Revision History